US Army Corps of Engineers ®
Huntington District

Draft Environmental Assessment
Tom Jenkins Dam / Burr Oak Lake Interim Operating Plan

Athens and Morgan Counties, Ohio

June 2012

FINDING OF NO SIGNIFICANT IMPACT
TOM JENKINS DAM / BURR OAK LAKE INTERIM OPERATING PLAN
ATHENS AND MORGAN COUNTIES, OHIO

1. Members of my staff have conducted an environmental assessment, in the overall public interest, concerning the implementation of the Tom Jenkins Dam Interim Operating Plan. The purpose of this action is to assure that Tom Jenkins Dam is operated in a manner to reduce the likelihood of an uncontrolled release of the Burr Oak Lake pool into a recently developed underground coal mine "corridor" situated shallowly beneath the reservoir basin/valley floor and within the Burr Oak Lake flowage easement. The "corridor", as defined by the Ohio Department of Natural Resources, is a system of four (4) parallel entries with cross-cuts less than 60 feet beneath the reservoir basin/valley floor within the Burr Oak Lake flowage easement. An uncontrolled release of the pool into the mine could subsequently allow reservoir water to exit at some point within or outside of the East Branch of Sunday Creek drainage basin, potentially resulting in loss of life, as well as economic and environmental damages.

2. The possible consequences of implementing the Interim Operating Plan (Proposed Action Alternative) have been studied for environmental, cultural and social well-being impacts.

3. The Proposed Project Action Alternative (PAA) and the No Action Alternative (NAA) were the only alternatives carried forward for detailed evaluation.

4. An evaluation of the PAA and the NAA produced the following pertinent conclusions:

a. Environmental Considerations. The Huntington District has taken reasonable measures to assemble and present the known or foreseeable environmental impacts of the PAA and the NAA in the Draft Environmental Assessment (DEA).

b. Social Well-Being Considerations. With the NAA, there is an increased potential risk to the public and to the integrity of the reservoir basin when water is stored above an existing underground coal mine "corridor". The underground mine "corridor" is located within the flowage easement of the Tom Jenkins Dam / Burr Oak Lake project. Lake levels exceeding an elevation of 725 feet places reservoir waters above the "corridor". The concern is that an uncontrolled release of the Burr Oak Lake pool into the mine could occur if there is subsidence of the mine "corridor" either prior to, or as a result of, flooding or there is breakthrough of the reservoir into the mine "corridor" during flooding, subsequently allowing reservoir water to exit at some point outside the East Branch of Sunday Creek drainage basin. To reduce the risk of an uncontrolled release of water from the reservoir into the mine, the PAA would conduct dam operations to minimize storage of water above the elevation of 725 feet.

c. Coordination with Resource Agencies. Coordination with the U.S. Fish and Wildlife Service (FWS), Natural Resource Conservation Service (NRCS), the Ohio Historic Preservation Office (OHPO) and Ohio Department of Natural Resources (ODNR) is being completed through the issuance of the DEA for public and agency review. Appropriate measures and best management practices have been identified and incorporated into the PAA. Also, in accordance with the Endangered Species Act, as amended, the recommended plan should not impact listed species.

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d. Other Pertinent Compliance. The PAA is in compliance with the National Historic Preservation Act (NHPA Section 106, 36 CFR 800), Executive Order (EO) 11988 (Floodplain Management), and EO 11990 (Protection of Wetlands).

e. Other Public Interest Considerations. Comments received during the public review period will be included in the Final Environmental Assessment (FEA).

5. I find the Tom Jenkins Dam Interim Operating Plan has been planned in accordance with current authorization as described in the DEA. The PAA is consistent with national policy, statutes and administrative directives. This determination is based on thorough analysis and evaluation of the PAA and NAA. In conclusion, I find the proposed Tom Jenkins Interim Operating Plan will have No Significant Adverse Impact on the quality of the human environment.

Date

Robert D. Peterson
Colonel, Corps of Engineers
District Engineer

DRAFT

Abstract

In March 2010, the Ohio Department of Natural Resources (ODNR) granted Buckingham Coal Company (BCC) a permit (Application Number D-2223-3) to mine coal within the Burr Oak Lake State Park near Glouster, Ohio. In order to access coal reserves on the eastern side of East Branch of Sunday Creek, Buckingham Coal was permitted to mine a system of four (4) parallel entries with cross-cuts less than 60 feet beneath the reservoir basin/valley floor within the Burr Oak Lake flowage easement. This system of entries and cross-cuts is termed a mine "corridor" by the ODNR. The "corridor" was mined following additional permit approval from the Mine Safety and Health Administration (MSHA).

The mine "corridor" poses potential safety issues related to floodwater retention within the Burr Oak Lake flowage easement. The U.S. Army Corps of Engineers, Huntington District (USACE) proposes an Interim Operating Plan (IOP) to account for the safety issues. The IOP assures that Tom Jenkins Dam / Burr Oak Lake is operated in a manner to reduce the likelihood of an uncontrolled release of stored floodwater resulting in potential loss of life and damage downstream, while minimizing downstream flooding and the potential for major environmental impacts. Uncontrolled release would be related to potential subsidence of the mine "corridor" either prior to, or as a result of, flooding in the drainage basin, or potential breakthrough of the reservoir into the mine "corridor" during flooding in the drainage basin.

Currently, the risks associated with retaining floodwater above the mine "corridor" are not fully understood. The USACE proposes the following scientific studies: 1) perform a subsurface investigation program in proximity to the mine "corridor" to increase understanding of the existing geologic and hydrogeologic conditions and 2) allow mine subsidence experts to review all available documents associated with the "corridor" and make a mine inspection/evaluation of the "corridor". The USACE also proposes to update the draft Potential Failure Modes and Effects Analysis/Risk Assessment (PFMEA/RA) study based upon the results of the two scientific studies listed above. Based upon funding availability, scientific studies could be completed in as little as two years and as many as 20 years. Once scientific studies and updates are completed, the IOP may be established as the new operating plan, or operation of Tom Jenkins Dam / Burr Oak Lake will revert to the current operating plan.

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1.0. INTRODUCTION

Tom Jenkins Dam / Burr Oak Lake is situated 0.3 miles above the mouth of East Branch of Sunday Creek and approximately 4.5 miles north of Glouster, Ohio. The project was authorized by the Flood Control Act of 1944 (Public Law 78-534) as a multi-purpose project which includes flood control, recreation, water supply, and fish and wildlife enhancement.

The project controls a 33 square mile drainage area. The drainage area is comprised of East Branch of Sunday Creek and its main tributaries which include Eels Run, Cedar Run and San Toy Creek. Total Reservoir capacity is about 26,900 acre feet at the maximum flood control pool of elevation 740 feet, which is equivalent to approximately 15.4 inches of runoff.

Burr Oak Lake was created in 1950 with the completion of Tom Jenkins Dam. Two years after completion, Burr Oak Lake State Park was dedicated. The U.S. Army Corps of Engineers (USACE) manages and administers 100 acres of federal land surrounding Tom Jenkins Dam including a portion of Burr Oak Lake, and the Ohio Department of Natural Resources (ODNR) administers the 664 acre lake. The USACE also has the rights to flood a portion of the land around Burr Oak Lake up to an elevation of 750 feet. This area is known as the flowage easement. The USACE, in cooperation with local floodplain management agencies, monitor flowage easements to inhibit development that could later be subject to flooding.

Given the risks associated with retaining a pool above an active mine corridor within the flowage easement described in detail below, the USACE proposes a deviation from the existing Water Control Manual via implementation of an Interim Operating Plan (IOP). Implementation of the IOP assures that Tom Jenkins Dam / Burr Oak Lake is operated in a manner to reduce the likelihood of an uncontrolled release of stored floodwater while minimizing downstream flooding and the potential for major environmental impacts. This Environmental Assessment (EA) considers the potential environmental impacts of the proposed Tom Jenkins Dam / Burr Oak Lake Interim Operating Plan.

1.1 DEFINITIONS

Abutment – The foundation along the sides of the valley or gorge against which a dam is constructed.
Bulkhead - A structure or partition to retain or prevent sliding of the land. A secondary purpose is to protect the upland against damage from reservoir wave action.
CFS - Cubic feet per second
Crest Length - The length of a wave along a crest. The crest is the highest point on a beach face, breakwater, seawall, dam, dike, spillway or weir.
Dam tender – Person who regulates water flow and water level in reservoirs.
Flowage Easement – A real estate interest that the Government acquires entitling the Government to store water on private property.
Freeboard - The vertical distance between the water level and the top of a dam.
Intake Structure - The entrance structure, such as a conduit or tunnel, to any water transporting facility.

Interim Operating Plan (IOP) – Details the temporary operational guidance for the Tom Jenkins Dam. It supersedes the Water Control Manual until such time that scientific studies necessary to evaluate the risk to the project and the public imposed by an underground coal mining "corridor" are completed and the risks are fully understood. At that time, the plan may be revised.
Ohio River Control - Ohio River Control is the act of closing a flood control project to effect a reduction of the crest on the Ohio River. There may or may not be local flooding in the vicinity of the project.
Probable Maximum Flood (PMF) – Component of hydraulic design of dam components for which virtually complete security from flood induced failure is desired.
National Geodetic Vertical Datum (NGVD). Used by surveyors and engineers as the basis for relating ground and flood elevations. Elevations in this report are all NGVD.
Spillway - A feature in a dam allowing excess water to pass without overtopping the dam.
Stilling Basin - A basin to dissipate the energy in the water discharged from the spillway or outlet structure.
Water Control Manual (WCM) – Documents water control plans developed for specific projects and reservoir systems. Water control plans will include appropriate consideration for efficient water management in conformance with the emphasis on water conservation as a national priority.
Uncontrolled Water Release – Sudden release of water without a controlling mechanism such as a dam.

1.2 BACKGROUND

In March 2010, the ODNR granted Buckingham Coal Company (BCC) a permit (Application Number D-2223-3) to mine coal within the Burr Oak Lake State Park near Glouster, Ohio. The D-2223-3 permit map with the overall permitted area is included as Appendix A. Part of the overall permit included a mine area connecting BCC's active mine workings west of East Branch of Sunday Creek to BCC's coal reserves on the eastern side of East Branch of Sunday Creek. This portion of the permit crosses through the Tom Jenkins Dam/Burr Oak Lake flowage easement, where the elevation of the valley floor is approximately 725 feet. The permitted area within the flowage easement is termed a mine "corridor" by ODNR. Figure 1 on the following page illustrates the mine "corridor's" location related to Tom Jenkins Dam and Burr Oak Lake at normal pool elevation 721 feet. The area permitted by ODNR for the "corridor" with the highlighted flowage easement boundary is illustrated in Figure 2.

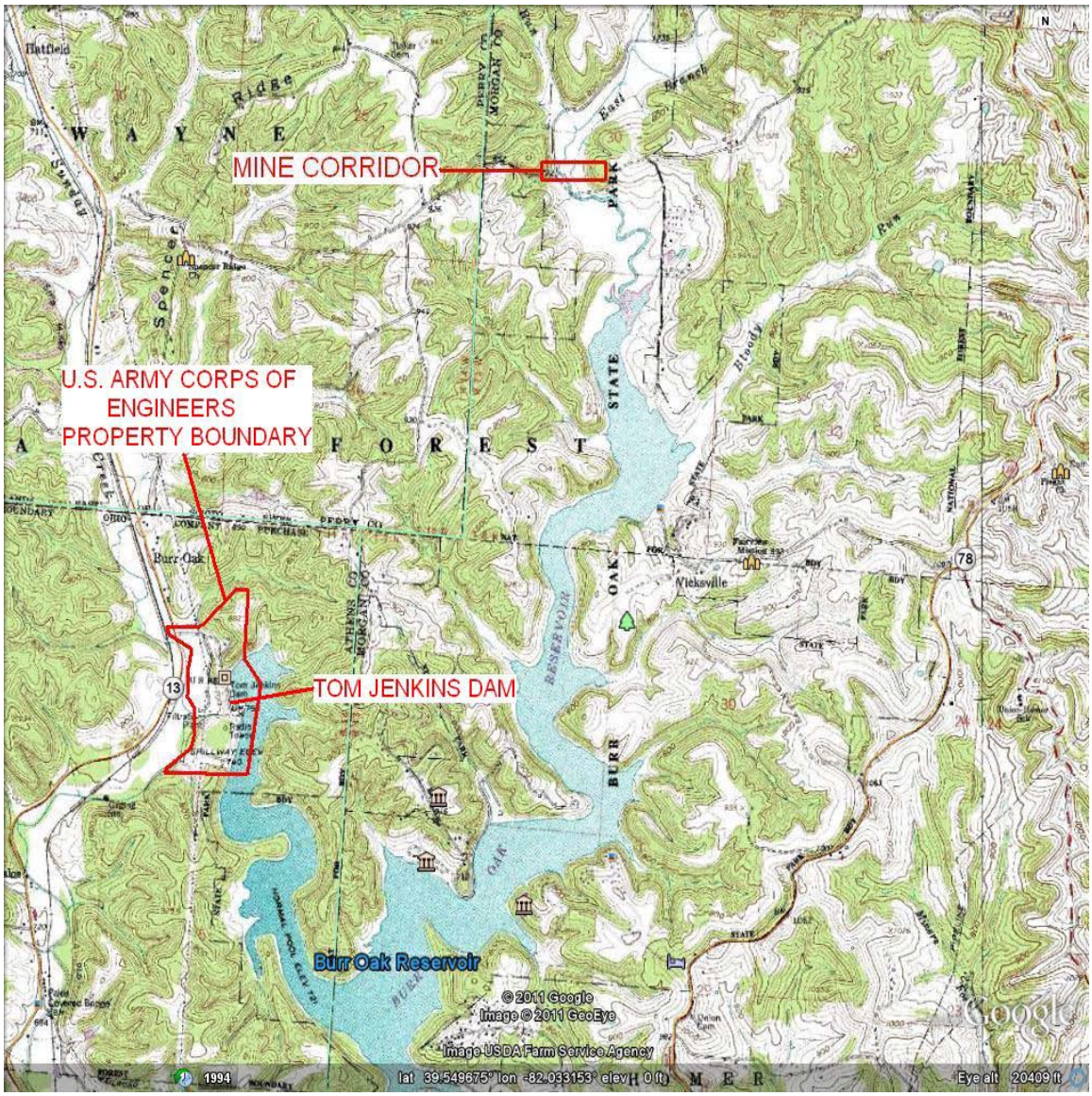


Figure 1: Tom Jenkins Dam / Burr Oak Lake Project Area on USGS 7.5' Corning Quadrangle

BCC subsequently sought and obtained a permit from the Mine Safety and Health Administration (MSHA) to "conduct mining operations under the East Branch of Sunday Creek". MSHA terminated the permit in December 2010, but reissued the permit in March 2011. Upon permit issuance, BCC mined a "corridor" less than 60 feet beneath the reservoir basin/valley floor and within the Burr Oak Lake flowage easement in order to access coal reserves on the eastern side of East Branch of Sunday Creek. MSHA permit data indicates the mine "corridor" is comprised of four (4), seventeen (17) foot wide parallel entries with cross-cuts. A copy of ODNR and MSHA permitting activities is included in Appendices B and C, respectively.

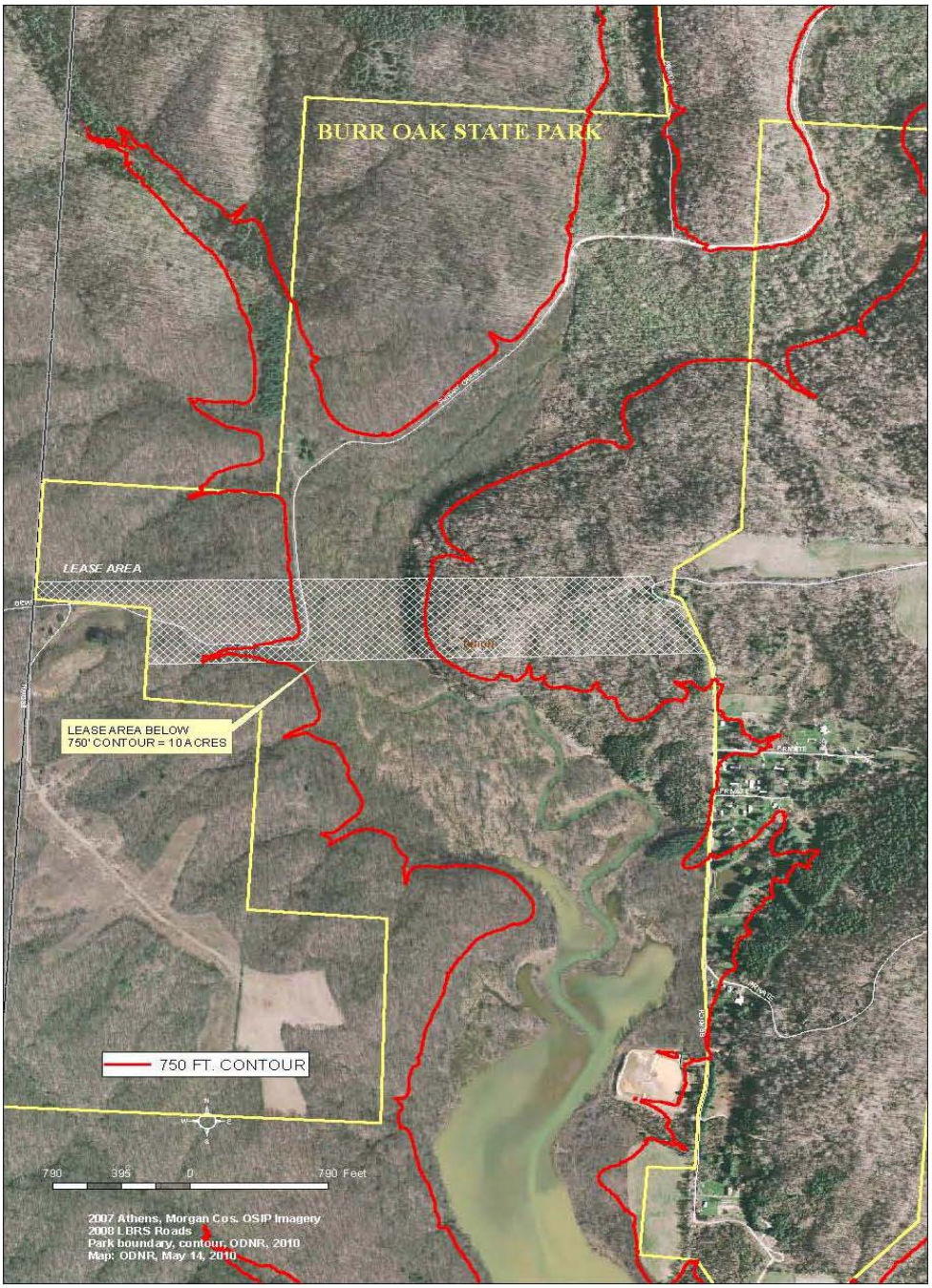


Figure 2: Plan view of the area leased by the ODNR for the "mine corridor". The flowage easement (750 Foot Contour) is illustrated in red.

ODNR and MSHA permit files provided to the USACE indicate limited site-specific geologic data collected for the "corridor" location. Furthermore, the drill hole information reviewed by the USACE, does not provide any indication of the bedrock's geologic condition or its capacity to function as a safe barrier between the mine and the reservoir basin, which are key factors in making geotechnical and engineering evaluations regarding subsidence and breakthrough potential.

Drill logs were not contained in ODNR Permit D-2223-3 specific to the "corridor" area. The June 2010 MSHA permit includes logs of two (2) drill holes (BOA-690-C and BOA-691-C) to represent the mine "corridor" area (see Appendix C, Buckingham Engineering Sheet S1 dated 06/21/2010). These logs indicate that between the roof of the then proposed mine (approximately at elevation 667 feet) and the valley floor/ground surface there is about 60 feet of overburden (i.e. unconsolidated (soil) and consolidated (bedrock) material) present. Approximately 20-22 feet of the overburden is possibly unconsolidated material leaving about 40 feet or less consolidated material.

The MSHA permit drill logs indicate the immediate "corridor" roof along the west side of East Branch of Sunday Creek consists of several feet of sandy shale overlain by alternating layers of shale and sandstone. The thickest reported sandstone interval is approximately 22 feet. Both drill logs indicate the floor consists of 1.00 to 1.88 feet of sandy shale; however, a number of other drill hole logs contained within the ODNR permit for the overall mine permit area indicate fireclay, a highly pliable clay in raw form, as a prominent strata at the base of the No. 7 Coal. Besides the general descriptions and thicknesses shown on the logs, there is no indication of the bedrock's geologic condition or the bedrock's capacity to function as a safe barrier between the mine and the reservoir.

The approved ODNR mine permit (D-2223-3), includes information on "prior unplanned subsidence" that has occurred in a different mine (ODNR Permit D-1163), but within the Sunday Creek watershed. Specifically, the subsidence area is located north of the Glouster, Ohio city limits. According to an ODNR Coal Inspection Report dated April 29, 2006 for D-1163, possible subsidence was reported by a landowner above abandoned portions of an active underground room-and-pillar mine. Surface impacts included approximately 800 feet of surface cracking which crossed Waterworks Road, a broken and repaired waterline, subsidence of fill materials within an old well/cistern, and residential structural issues (e.g. doors and windows not functioning correctly). This subsidence location, in relation to the mine "corridor", is depicted in figure 3 on the following page.

A BCC response letter to DNR dated May 9, 2006 pertaining to the D-1163 subsidence event indicated that abandoned portions of the active underground room-and-pillar mine were beneath the reported subsidence area. The letter states that the mine is a wet mine that contains pumps throughout the underground workings to keep the mine dewatered. Once mine sections are abandoned, the pumps are removed and groundwater is allowed to accumulate. The coal company assumes that the cause of subsidence could be the result of roof flaking and pillars pushing into the wet fireclay floor (Department of Natural Resources Permit, 2010).

Figure 3: Location of Mine "Corridor" and Reported Potential Subsidence

The 2006 BCC letter also states that within the reported subsidence area, the mine has an overburden thickness of approximately 335 feet. The mine roof is comprised of several feet of shale immediately above the coal with a 62 foot layer of white sandstone above the shale. The roof is supported by 7 foot long, 7/8" diameter, fully grouted steel roof bolts in a four (4) foot pattern. Pillar sizes average 32 feet by 25 feet and the average entry widths and crosscuts are 18.5 feet. Maximum coal extraction within subsidence area is 66.1 percent of the total coal volume (Department of Natural Resources Permit, 2010).

The mine "corridor" is situated shallowly (approximately 60 feet) beneath the valley floor of the East Branch of Sunday Creek, which is a perennial stream, and within the Burr Oak Lake flowage easement. The ODNR D-2223-3 permit indicates that the strata immediately above and inclusive of the No. 7 Coal seam (i.e. the coal seam being mined via this permit) comprise a bedrock aquifer (i.e. a ground water zone). MSHA approval related to mining beneath the East Branch of Sunday Creek, directed particular attention to the pillars and mine floor with respect to their potential detrimental effects due to water entering the mine.

Both the June 2010 and March 2011 MSHA permits identify safety measures the coal company proposed to employ within the "corridor". Such measures generally include installing crossbars or beams within specified entries and crosscuts, supporting king beams with 50 ton roof jacks, installing screen, installing 6 foot tension rebar bolts on 4 foot by 4 foot spacing, and using a chevron layout (v or fishbone pattern) of the coal pillars under areas with less than 100 feet of overburden. Entries would be narrowed to 17 feet widths. Entry centers would be a minimum of 80 feet with cross-cut centers at a minimum of 80 feet and up to a maximum of 105 feet. Specific pillar dimensions analyzed within the June 2010 MSHA permit indicated pillars having a minimum dimension of 43.62 feet and a maximum dimension of 61.20 feet with 70 feet entry centers.

The risks associated with floodwater retention within the flowage easement above the mine "corridor" are not yet fully understood. Safety concerns are related to potential subsidence of the mine "corridor" either prior to, or as a result of, flooding in the drainage basin, or potential breakthrough of the reservoir into the mine "corridor" during flooding in the drainage basin which may result in uncontrolled release of the Burr Oak Lake pool into the mine potentially allowing reservoir water to exit at some point outside the East Branch of Sunday Creek drainage basin.

Given the potential life safety risks, flood damages, and environmental damage which may result from an uncontrolled release of the pool, the USACE proposes a deviation from the existing Water Control Manual via implementation of an Interim Operating Plan (IOP). Implementation of the IOP assures that Tom Jenkins Dam / Burr Oak Lake is operated in a manner to reduce the likelihood of an uncontrolled release of stored floodwater while minimizing downstream flooding and the potential for major environmental impacts. A copy of the existing Water Control Manual is included in Appendix D and a copy of the draft IOP is included as Appendix E.

Additionally, the USACE proposes the following scientific studies: 1) perform a subsurface investigation program in proximity to the mine "corridor" to increase understanding of the existing geologic and hydrogeologic conditions and 2) allow mine subsidence experts to review all available documents associated with the "corridor" and make a mine inspection/evaluation of the "corridor". The USACE also proposes to update the draft Potential Failure Modes and Effects Analysis/Risk Assessment (PFMEA/RA) study based upon the results of the two scientific studies listed above. Based upon funding availability, scientific studies could be completed in as little as two years and as many as 20 years. Once scientific studies and updates are completed, the IOP may be established as the new operating plan, or operation of Tom Jenkins Dam / Burr Oak Lake will revert to the current operating plan.

1.3 PROJECT LOCATION AND DESCRIPTION

Tom Jenkins Dam / Burr Oak Lake is part of a comprehensive flood control plan to reduce flooding on the Ohio River. The project area is located in Athens and Morgan Counties, Ohio (figure 4), on East Branch of Sunday Creek, which is a tributary of Sunday Creek of the Hocking River. The project is situated 0.3 miles above the mouth of East Branch and approximately 4.5 miles north of Glouster, Ohio. Completed in February 1950, the project controls a 33 square mile drainage area. Total reservoir capacity is about 26,900 acre feet at the maximum flood control pool elevation of 740 feet, which is equivalent to approximately 15.4 inches of runoff.

Figure 4: Project General Location Map

Tom Jenkins Dam is a rolled earth and rock fill impervious structure with a maximum height of 84 feet. The dam consists of a rolled impervious zone and two small upstream and downstream rock fill zones for increased stability. The crest length is 944 feet at elevation 765 feet with a 20 foot spillway design flood surcharge plus 5 feet freeboard above the spillway elevation of 740.0 feet (figure 3).

The outlet works is located in the south left abutment, and consists of an approach channel, an intake structure with 3 gated rectangular 3.5-foot by 7.0 foot intake tunnels leading to the outlet tunnel, three service and three emergency screw stem operated gates each 4.0 feet by 7.0 feet, one 3.5-feet by 12.17-feet emergency bulkhead, and two low-flow control and water supply intakes which are now sealed, the machinery for operating the gates and bulkhead, and an 8.0 foot horseshoe tunnel discharging through the left abutment into a stilling basin 25 feet wide by 89 feet long into an outlet channel.

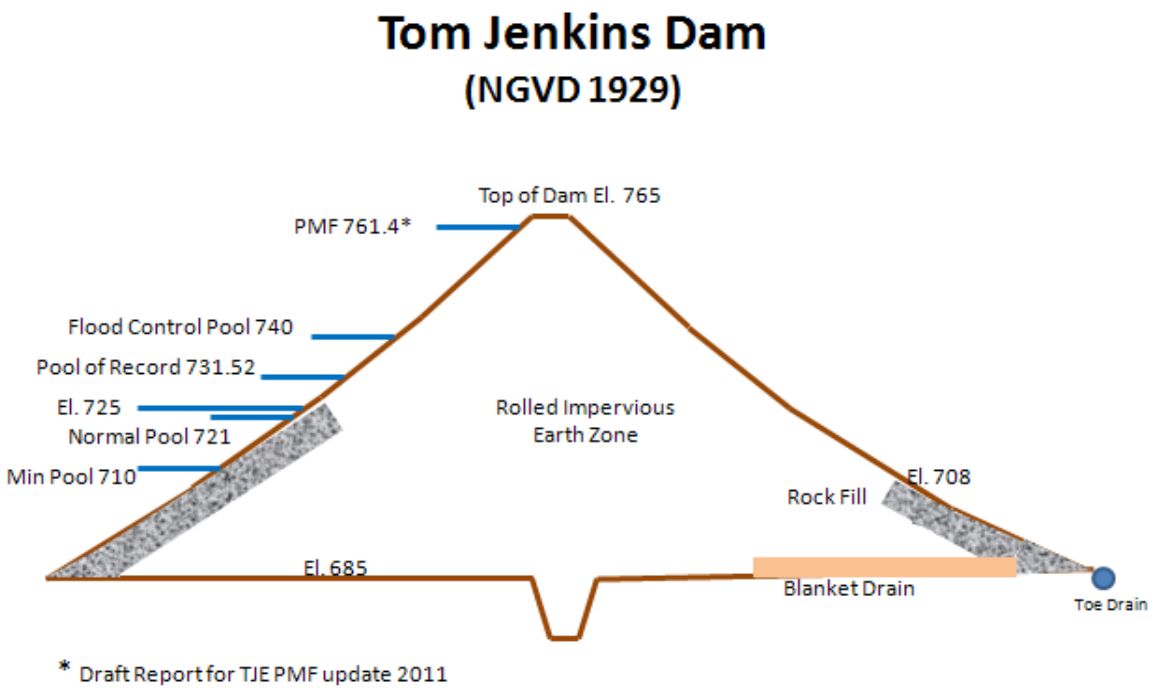


Figure 5: Tom Jenkins Dam Profile

2.0. PURPOSE AND NEED

The purpose of this action is to implement an IOP to assure that Tom Jenkins Dam is operated in a manner to reduce the likelihood of uncontrolled release of stored floodwater due to potential subsidence of the mine "corridor" or breakthrough of the reservoir into the mine "corridor". Should mine "corridor" subsidence or reservoir breakthrough occur, potential loss of life and damages due to flooding may result within the mine and at some point outside of the East Branch of Sunday Creek drainage basin. Mine "corridor" subsidence or reservoir breakthrough may also potentially result in major environmental impacts within or outside of the Basin.

3.0. DESCRIPTION OF ALTERNATIVES

The Proposed Action Alternative (PAA) and No Action Alternatives (NAA) are the only alternatives carried forward in this EA for detailed evaluation.

3.1 PROPOSED ACTION ALTERNATIVE (PAA)

Under the existing water control plan, Tom Jenkins Dam is designed to reduce flooding locally in the Sunday Creek and Hocking River Basin as well as the Ohio River Basin. Tom Jenkins Dam maintains a year-round lake elevation between 721 and 721.5 feet. The flood control pool elevation is 740 feet with a maximum flood elevation of 761.4* feet. The flowage easement extends to the 750 foot contour.

*Proposed flood elevation in the Tom Jenkins Probable Maximum Flood 2011draft report

Three gages are utilized to control water elevations on Sunday Creek and Hocking River. The control at the "A" gage, which is located on Sunday Creek at Red Rock Road, is not to exceed 14.5 feet in summer and 15.5 feet in winter under normal conditions. The control at the Glouster Gage is not to exceed 12.5 feet in summer and 14.0 feet in winter. The control at the Athens Gage is not to exceed 22.0 feet year round. An "A" Gage elevation not to exceed 14.5 feet in summer and 15.5 feet in winter can be maintained during light to medium rainfall without any damage downstream. However, since the Tom Jenkins Dam is located on a tributary of Sunday Creek rather than Sunday Creek itself, during significant rainfall, the drainage area on Sunday Creek not controlled by Tom Jenkins Dam could still cause stream elevations to exceed control stages.

The project has a negligible effect on water levels in the Ohio River. The approximate control flow at the next Ohio River downstream dam, Belleville Locks and Dam, is 317,000 cfs with a stage of 45 feet. The maximum physical discharge from Tom Jenkins ranges from 1550 – 1850 cfs, depending on pool elevation. This is approximately 0.5 % of Belleville's total flow and a change in stage would not be measureable. Historical records indicate that the project has operated for Ohio River controls three times. Of these times, only one event shows the Ohio River exceeding a stage of 45 feet at Belleville.

- September 19, 2004 – Bellville 45.8 feet
- January 1, 1991 – Belleville 41.5 feet (forecasted to exceed 45 feet)
- March 6, 1955 – Belleville 41.3 feet (forecasted to exceed 45 feet)

The IOP will provide guidance for project operation until such time that the risk associated with the mine "corridor" is fully understood. The main goal of this IOP is to decrease the likelihood of mine "corridor" subsidence and reservoir breakthrough into the "corridor" while minimizing downstream flooding. Tom Jenkins Dam / Burr Oak Lake will no longer operate for 'Ohio River Control', but will continue to operate to minimize local flooding in the Sunday Creek and Hocking River basins, in order to meet these goals.

In the event that downstream flood control prohibits the release of water from the reservoir and water elevations within the reservoir exceed 725 feet, the project will operate to lower the pool elevation to 725 feet as quickly as possible while not exceeding downstream controls. A rain event sizeable enough to increase the lake elevation to 725 feet has a statistical occurrence of once every 1.75 years. Figure 5 on the following page illustrates Tom Jenkins Dam water retention levels.

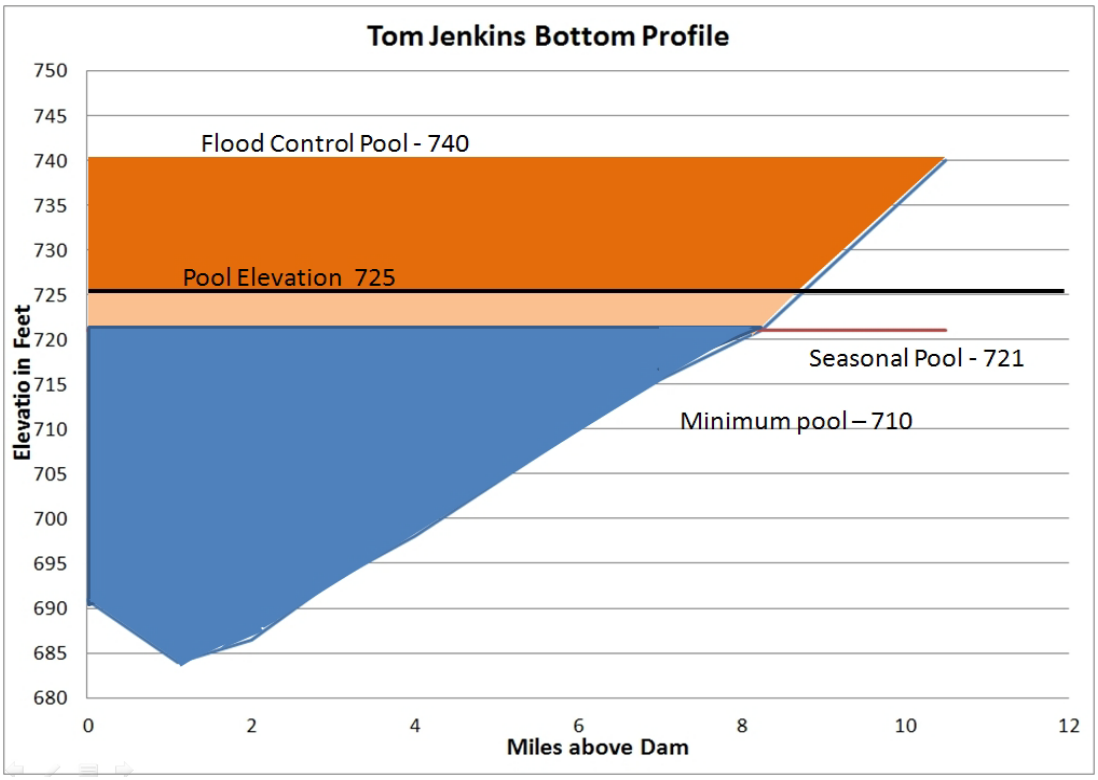


Figure 6: Tom Jenkins Dam retains water to elevation 721 year round with a flood control pool of 740.

IOP guidance for project operation will include close contact with forecasting agencies during normal communications. When a large rain event is projected, or has occurred, enhanced communications will be necessary. The protocol for enhanced communications is addressed in detail in Section III of the draft IOP in Appendix E. Enhanced communications include notification protocols between staff at Tom Jenkins Dam, the Scioto Area Office, the Huntington District Office, forecasting and emergency agencies, as well as public dissemination to mitigate risk to the local population.

In emergency situations that indicate the reservoir's integrity is in question, such as observed subsidence above the mine "corridor", or water exiting from the mine portal, the Commander may declare a Dam Safety Emergency. If a Dam Safety Emergency is declared, the Commander may exercise his emergency authority to increase the outflow in order to reduce water levels below 725 feet. This emergency outflow may result in damage downstream of the project in order to reduce the potential of mine corridor failure. In the event that all communication is disrupted, either between the Huntington District office and / or the Scioto Area Office and the Tom Jenkins Dam Project Office, the Scioto Area Office Manager will assume responsibility for regulating the dam as long as communication exists between the Scioto Area Office and the Dam Project Office. Otherwise the Project Office Dam tender will assume regulation of the dam.

The PAA is the alternative that best meets the purpose and need of the project. This alternative reduces the likelihood of uncontrolled release of stored floodwater due to potential subsidence of the mine "corridor" or breakthrough of the reservoir into the mine "corridor" while still operating to reduce risk associated with additional downstream flooding impacts.

3.2 NO ACTION ALTERNATIVE (NAA)

The No Action Alternative (NAA) would result if no federal action were taken. Under the NAA, Tom Jenkins Dam / Burr Oak Lake Reservoir will continue operating under the current Water Control plan. No actions will be taken to lower the pool elevation to 725 feet as quickly as possible to reduce potential for an uncontrolled water release into the mine. The existing plan will continue to operate in a manner which takes into account "Ohio River Control".

4.0. AFFECTED ENVIRONMENT AND CONSEQUENCES OF ALTERNATIVES

As previously stated, the risk associated with retaining floodwater above the mine "corridor" is not fully understood. The IOP will be utilized to minimize risks associated with retaining floodwater above the mine "corridor" until scientific studies and updates to the draft Potential Failure Modes and Effects Analysis/Risk Assessment (PFMEA/RA) are completed. Without the IOP, there is an unknown risk of an uncontrolled release of stored floodwater due to potential mine "corridor" subsidence and reservoir breakthrough into the "corridor" resulting in potential loss of life, as well as damage downstream. Without a complete understanding of all the potential risks associated with the existence of the mine "corridor" within the Tom Jenkins Dam/Burr Oak Lake flowage easement, it is assumed for this environmental assessment that potential risks are confined to health and safety, socioeconomics, aquatic resources, recreation, and aesthetics. Other resources that may be affected may include, but are not limited to: wetlands, terrestrial resources, threatened and endangered species prime farmland, hazardous, toxic and radioactive waste (HTRW), floodplains, cultural resources and historic properties. As information is not available to describe the effects on these resources, description of the effects on these resources is excluded from this document as per Council of Environmental Quality guidance as it relates to NEPA guidance in instances when information is unavailable (40 CFR 1502.22). Environmental justice, air quality, and noise are not anticipated to sustain impacts under either the NAA of PAA based upon an initial screening of potential impacts.

4.1 HEALTH AND SAFETY

The MSHA permit files indicate that between the mine "corridor" roof and valley floor/ground surface, there is approximately 20-22 feet of possibly unconsolidated (i.e. bedrock) material leaving about 40 feet or less consisting of consolidated material. The USACE has concerns related to the mostly unknown nature/geologic conditions and the limited thickness of the bedrock with regard to the potential for subsidence and breakthrough within the reservoir basin, in both the short-term and long-term.

Health and safety impacts are not anticipated under the PAA since the IOP will make every effort to avoid storing water above the 725 foot contour, therefore reducing the potential for subsidence and breakthrough. In events where flood storage is necessary, waters retained above 725 feet will be lowered to the 725 foot pool elevation as quickly as possible, while not exceeding the three downstream control points.

Under the NAA, there is a potential for health and safety impacts. Subsidence or breakthrough at the mine "corridor" could impact miner safety while the mine is operational. Subsidence or breakthrough at the mine "corridor", while the mine is in operation, or when the mine is abandoned, could also potentially have significant adverse effects on the health and safety of downstream communities if water exits at some unknown point that cannot be controlled by Tom Jenkins Dam.

4.2 SOCIOECONOMICS

The mine "corridor" is located beneath (or within) East Branch of Sunday Creek in Athens and Morgan Counties 0.3 miles above the mouth of East Branch and approximately 4.5 miles north of Glouster, Ohio (figure 4). Athens and Morgan Counties are characterized by single-family residences with moderate incomes. The population within the Athens County Ohio is approximately 64,757. Seventy percent of the population is between the ages of 18 and 65. The population is predominantly Caucasian (91.8 percent). Eight-five percent of the population 25 years and older have at least a high school education (U. S. Census Bureau, 2010). The population within Morgan County is approximately 15,054. Fifty-three percent of the population is between the ages of 18 and 65. The population is predominantly Caucasian (93.2 percent). Eighty-four percent of the population 25 years and older have at least a high school education (U. S. Census Bureau, 2010). On a state level, 56 percent of the population is between the ages of 18 and 65, 82.7 percent of the population is Caucasian and 86.8 percent of the population 25 years and older having at least a high school education (U. S. Census Bureau, 2010).

The median household income in Athens County is $30,823 and the median household income in Morgan County is $33,083. The median household income in Ohio is listed as $45,467. Fifty-eight percent of Athens County and 79 percent of Morgan County residents own their home. The median home values are $110,500 in Athens County and $86,100 in Morgan County. Median home values in Ohio are listed as $134,500 (U. S. Census Bureau, 2010).

Tom Jenkins Dam is the only water control project in the Sunday Creek Basin. Burr Oak Lake provides water supply for the city of Glouster in Athens County, Ohio. The Public Health Service determined that there will be a strong future need for industrial water supply as well as municipal water supply. To meet this need, Tom Jenkins Dam / Burr Oak Lake maintains a water supply pool that could provide up to five million gallons a day during any summer month (USACE Water Control Manual, 1999). Currently, this pool is used by a municipal water treatment plant located downstream of the dam.

The PAA will not alter the existing water supply storage. The PAA Tom Jenkins Dam / Burr Oak Lake will continue to be operated under its current authorization as a multi-purpose project which includes flood control, recreation, water supply, and fish and wildlife enhancement. Therefore, under the PAA Burr Oak Lake will continue to supply water for downstream communities for industrial and municipal purposes.

As the PAA will reduce risk of subsidence or reservoir breakthrough into the mine corridor, this reduction of risk will benefit the general public on equal terms, the action will not result in a disproportionately adverse impact to low-income or minority populations. This action is therefore considered compliant with Executive Order 12898 which directs federal agencies to identify and address the disproportionately high and adverse effects on minority and low-income populations.

While the impacts associated with the NAA are not fully understood, storing water within the flowage easement above the 725 foot contour may increase risk of subsidence or reservoir breakthrough into the mine corridor potentially resulting in temporary or permanent loss of East Branch of Sunday Creek. East Branch of Sunday Creek, along with its main tributaries (Eels Run, Cedar Run, and San Toy Creek) are all located upstream of the mine "corridor".

Subsidence, and the possible inability to recapture East Branch of Sunday Creek, would mean the loss of the only creek and its tributaries which feed Burr Oak Lake. This loss could potentially prohibit Burr Oak Lake from maintaining the existing 2 cfs minimum outflow and therefore inhibit the reservoir from serving as a water supply for downstream communities.

4.3 AQUATIC RESOURCES

The Federal Water Pollution Control Amendments of 1972 and the Clean Water Act of 1977 (CWA) collectively set regulatory standards on the discharge of various pollutants into surface water resources. These discharges include acid mine drainage (AMD) into streams and rivers which can contribute to poor water quality and degrade aquatic resources in a variety of ways. In addition, the CWA also regulates the discharge of material into navigable waterways and tributaries of navigable waters or waters of the United States.

The 2005 Ohio EPA Division of Surface Water Report: *Total Maximum Daily Loads for the Sunday Creek Watershed* evaluated the 138 square mile watershed noting that much of the northwest portion has been mined. Sinkholes are surface manifestations of subsidence. Sinkholes in the valleys send streams into underground mines and emerge elsewhere polluted with AMD. The main impairments within the watershed are metals, ph, siltation, and flow alteration (Ohio EPA, 2005).

The report examined the water quality of 19.6 linear stream miles along East Branch of Sunday Creek and its three named tributaries (Eels Run, Cedar Run and San Toy Creek). Twelve monitoring stations were utilized to evaluate the stream and its tributaries. 7.6 miles (38.8 percent) were in full attainment of water quality standards, 8.2 miles (41.8 percent) in partial attainment, and 3.8 miles (19.4 percent) were in non-attainment. Upstream of Burr Oak Lake, cattle access and stream intermittence were the main aquatic life impairments. Downstream of Burr Oak Lake impairment is mainly anoxic (low levels of dissolved oxygen in water), and hypolimnetic (noncirculating perpetually cold water) releases from the reservoir. AMD is considered only a tertiary source of water quality problems within East Branch of Sunday Creek (Ohio EPA, 2005). The results for the Sunday Creek mainstem, as well as East Branch of Sunday Creek and its tributaries are summarized below in the Table 1.

Waterbody	***Impairments***	***Total Maximum Daily Loads***		
		Acidity	***Bacteria***	***Sediment***
Sunday Creek Mainstem	1.) Acid Mine Drainage 2.) Upper site interstitial (subsurface flow between the water table and surface water flow).	X		X
East Branch Sunday Creek	1.) Reservoir (flow and bottom release) lower 0.1 miles. 2.) Livestock access (upstream reservoir). 3.) Intermittent flow (uppermost site). 4.) Modest AMD (up from reservoir).			X
Eels Run	None			
Cedar Run	None			

San Toy Run	1.) Naturally low gradient swamp/ beaver affected stream.			X

Table 1: Impairments and Total Maximum Daily Load summary from the 2005 Ohio EPA Division of Surface Water Report: *Total Maximum Daily Loads for the Sunday Creek Watershed*.

Under the PAA, the project purpose of flood reduction to the local downstream communities of Glouster, Trimble, Chauncey, and Athens along Sunday Creek and the Hocking River will continue as described in the water control manual. As the lake elevation approaches elevation 725 feet, project staff will continue to follow guidance in the water control manual for Sunday Creek and the Hocking River. At the same time, project staff will make every effort to lower the lake elevation below 725 feet if possible, thus minimizing the duration the pool is above the mine "corridor". A rain event sizeable enough to increase the lake elevation to 725 feet has a statistical occurrence of once every 1.75 years. Therefore, chances of subsidence within the mine "corridor" or breakthrough of the reservoir into the mine "corridor" will be reduced and affects to aquatic resources are not expected to occur.

The NAA increases the risk of mine subsidence and reservoir breakthrough by allowing flood water retention above the 725 contour, as well as unknown groundwater effects after the mine ceases operation and groundwater potentially accumulates in the abandoned mine and mine "corridor". Potential subsidence or reservoir breakthrough and temporary or permanent loss of East Branch of Sunday Creek into the mine "corridor" could result in AMD escaping at some unknown point within or outside of the drainage basin. This could either introduce acid mine drainage into streams and tributaries that currently do not have attainment issues related to AMD, or could add to the quantities of AMD in drainages already in non-attainment for AMD.

4.4 RECREATION

Tom Jenkins Dam / Burr Oak Lake provide numerous recreational activities. The state park currently offers 30 family cottages, 17 electric and 78 non-electric camping sites, two (2) camper cabin rentals, boating, fishing, swimming, seven (7) hiking trails, three (3) bridle trails, picnicking, hunting, and winter recreation opportunities which includes sledding, ice skating, and ice fishing (Department of Natural Resources, 2012). Presently, there is uncertainty surrounding the future operation of the lodge.

Under the PAA there are no anticipated impacts to recreation. The NAA may increase the risk of loss of the primary recreational activities associated with the 664 acre lake. If subsidence breakthrough were to occur, and result in a temporary or permanent loss of East Branch of Sunday Creek, the ability to maintain water levels within the reservoir could be compromised. Loss of recreation could impact the economic benefits Athens and Morgan Counties generate through tourism. These impacts could either be temporary or permanent based upon the ability to recapture East Branch of Sunday Creek on the surface.

4.5 AESTHETICS

Tom Jenkins Dam / Burr Oak Lake is located in a rural setting. The area includes the 664 acre lake, Sunday Creek, and a portion of East Branch of Sunday Creek south of the mine "corridor". A portion of East Branch of Sunday Creek and its main tributaries are located north of the mine "corridor". The area is surrounded by hardwood forests, agricultural lands, small communities, and underground coal mining.

Under the PAA there are no anticipated impacts to aesthetics. The NAA could result in aesthetic impacts related to potential alterations in the drainage basin south of the mine "corridor". Potential alterations are associated with the temporary or permanent inability to recapture East Branch of Sunday Creek on the surface. Alterations could prevent Burr Oak Lake from functioning in its current authorized reservoir capacity providing flood control, recreation, water supply, and fish and wildlife enhancement. The NAA could also result in AMD contamination which would alter the existing characteristics within or outside of the drainage basin.

5.0. CUMULATIVE EFFECTS

Cumulative effects are defined by the Council on Environmental Quality as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The geographical boundary for the purposes of this analysis is considered the Sunday Creek watershed. Appropriate temporal boundaries are considered from the date the reservoir became operational in 1950 to 75 years beyond that date to 2025.

Analysis of the potential impacts, both direct and indirect associated with the NAA and PAA, has been performed for resources within the Project Area. The PAA would result in overall beneficial effects as it is intended to minimize the probability of incurring risks associated with the NAA. As described previously, resources which would likely be adversely affected by the NAA would include: socioeconomic, aquatic, recreation, aesthetics, and health and safety. Given the overall beneficial effect implementation of the PAA through reduction of these risks, the PAA has no adverse effects which would contribute cumulatively to past present and reasonably foreseeable actions.

6.0. CONCLUSION

The IOP proposes a change to the water control manual to account for potential safety issues associated with a mine "corridor" under East Branch of Sunday Creek and within the flowage easement of Burr Oak Lake. Until scientific studies are completed, the IOP assures that Tom Jenkins Dam / Burr Oak Lake is operated in a manner to reduce the likelihood of an uncontrolled release of stored floodwater due to potential subsidence of the mine "corridor" or a reservoir breakthrough into the "corridor" resulting in potential loss of life and damage downstream, while minimizing downstream flooding and the potential for major environmental impacts. Two alternatives, the PAA (implementation of the IOP) and the NAA (continued operation under existing guidelines), were considered to address the purpose and need of the project. The PAA has been chosen because it is the least environmentally damaging alternative that best meets the project's purpose and need.

Therefore, the conclusion of this assessment is that the PAA will avoid significant long or short-term adverse impacts to evaluated resources until such time as scientific studies can be completed.

7.0. COORDINATION

Coordination with federal, state, and local agencies will be conducted through the issuance of the EA.

8.0. REFERENCES

Ohio Department of Natural Resources. 2012. Burr Oak State Park. Accessed online at http://www.dnr.state.oh.us/parks/parks/burroak/tabid/719/Default.aspx.

Ohio Department of Natural Resources Mineral Resources Management. 2010. Coal Mining and Reclamation Permit # D-2223-3 issued to Buckingham Coal Company, Inc.

State of Ohio Environmental Protection Agency Division of Surface Water. 2005. Total Maximum Daily Loads for the Sunday Creek Watershed.

State of Ohio Environmental Protection Agency Division of Surface Water. 2010. Integrated Water Quality Monitoring and Assessment Report.

United States Army Corps of Engineers, Huntington District. 2012. Draft Interim Operation Plan.

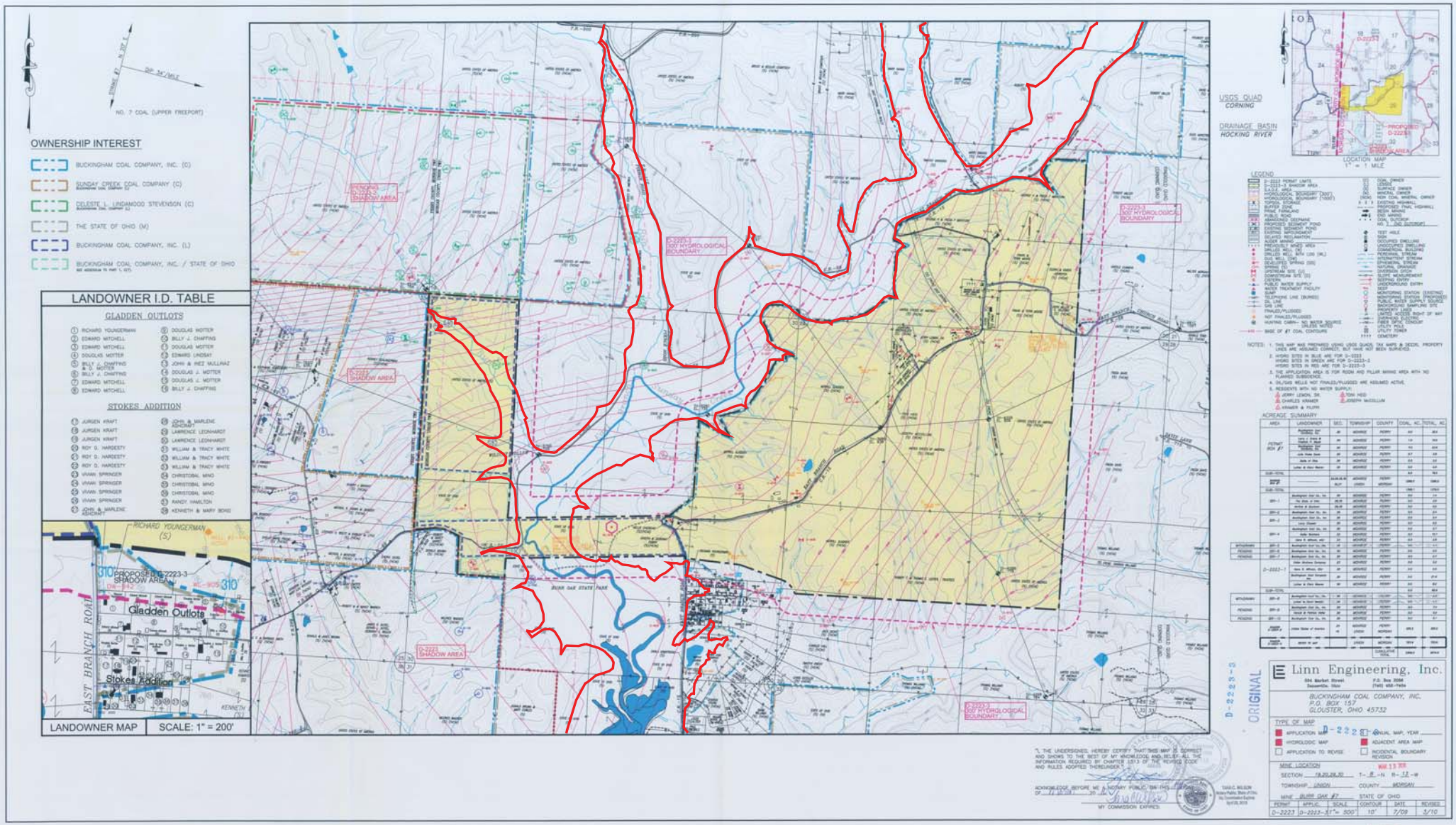
United States Army Corps of Engineers, Huntington District. 1999. Hocking River Basin, Ohio: Water Control Manual for Tom Jenkins Dam (Burr Oak) Lake – East Branch Sunday Creek.

United States Census Bureau. 2010. United States Year 2010 Census Data. Accessed online at http://www.quickfacts.census.gov/qfd/.

United States Department of Labor Mine Safety and Health Administration. 2010. Coal Mining Permit Approval No. 33-04520 issued to Buckingham Coal Company, Inc.

Appendix A

Ohio Department of Natural Resources Map of the Mine Permit Area (D-2223-3) with the 750” Elevation Highlighted by the USACE


OWNERSHIP INTEREST
BUCKINGHAM COAL COMPANY, INC. (C)
SUNDAY CREEK COAL COMPANY (C)
CELESTE L. LINDAMOOD STEVENSON (C)
THE STATE OF OHIO (M)
BUCKINGHAM COAL COMPANY, INC. (L)
BUCKINGHAM COAL COMPANY, INC. / STATE OF OHIO
NO. 7 COAL (UPPER FREEPORT)
LANDOWNER I.D. TABLE
GLADDEN OUTLOTS
STOKES ADDITION
LANDOWNER MAP
SCALE: 1" = 200'
D-2223-3 1000' HYDROLOGICAL BOUNDARY
D-2223 SHADOW AREA
D-2223-3 SHADOW AREA
D-2223-3 500' HYDROLOGICAL BOUNDARY
BURR OAK STATE PARK
EAST BRANCH ROAD
USGS QUAD
CORNING
DRAINAGE BASIN
HOCKING RIVER
LOCATION MAP
1" = 1 MILE
LEGEND
ACREAGE SUMMARY
Linn Engineering, Inc.
BUCKINGHAM COAL COMPANY, INC.
P.O. BOX 157
GLOUSTER, OHIO 45732
TYPE OF MAP
MINE LOCATION
SECTION
TOWNSHIP
COUNTY
MINE
STATE OF OHIO
D-2223
ORIGINAL

Appendix B

Ohio Department of Natural Resources - Mineral Resources Management Permit Number D-2223, Application Number D-2223-3, Buckingham Coal Company

COAL MINING AND RECLAMATION PERMIT

Issued To: BUCKINGHAM COAL CO INC
PO Box 157
21525 SR 13
GLOUSTER, OH 45732-0157

Telephone: 614-394-2644

Permit Number: D-2223
Application Number: D-2223-3
Acreage: 0
Underground Acreage: 723.6

Effective: 03/12/2010
Expires: 11/21/2014

Type of Operation: Underground (Room and Pillar)

CONDITIONS

CONDITION TYPE	DESCRIPTION
Archeology	An archaeology clearance from the Division is necessary prior the permittee's or operator's repair of ground surface or historic structures where the repair is associated with mining related damage.

LOCATION IS NOT AVAILIABLE

The issuance of this permit means only that the application to conduct a coal mining operation meets the requirements of Chapter 1513 of the Revised Code, and as such DOES NOT RELIEVE the operator of any obligation to meet other federal, state or local requirements.

This permit is issued in accordance with and subject to the provisions, conditions, and limitations of Chapter 1513 of the Revised Code and Chapters 1501:13-1, 1501:13-3 through 1501:13-14 of the Administrative Code.

The water monitoring plan for this permit shall be:

Quality: ~~See Page 26, F3 of the Permit Application~~ NA
Quantity: ~~See Page 26, F3 of the Permit Application~~ NA

Note: These monitoring requirements are separate from NPDES monitoring requirements.

Signature: John F Hunter BH **Date:** 03/12/2010
Chief, Mineral Resources Management

D-2223-3

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F46 Rev: 07/01/2001

H. **FOR REVISION REVIEW ONLY:** This item is to be completed after revisions, if any, have been made to the permit application.

I, the undersigned, a responsible official of the applicant, do hereby verify and acknowledge the revisions made during the permit review process as true and correct to the best of my information and belief.

Printed Name **TIMOTHY H. LINN** Title **CONSULTANT**

Signature _____ Date 3/8/10

Sworn before me and subscribed in my presence this 7 day of March 20 10.

Tara C. Wilson

Notary Public

NOTARY SEAL STATE OF OHIO

TARA C. WILSON
Notary Public, State of Ohio
My Commission Expires
April 22, 2013

MAR 0 8 2010

APPROVED UNDERGROUND COAL MINING PERMIT APPLICATION

Applicant:

Name: BUCKINGHAM COAL CO INC
Address: PO Box 157
21525 SR 13
GLOUSTER, OH 45732-0157

Application Number: D-2223-3

Number of acres in underground workings: 723.6

Number of surface acres to be affected: 0

The water monitoring plan for this permit shall be:

Quality: ~~See Page 26, F3 of the Permit Application~~ NA
Quantity: ~~See Page 26, F3 of the Permit Application~~ NA

Note: These monitoring requirements are separate from NPDES monitoring requirements.

This application is APPROVED since it demonstrates and the Division has found that the criteria in paragraph (E) of rule 1501: 13-5-01 of the Administrative Code have been met.

Signature: John F Hunter BH **Date:** MAR 12 2010

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PERMIT SUMMARY SHEET
Division of Mineral Resources Management

Permit Number: D-2223

Application Number: D-2223-3

See permit cover sheet for specific conditions and hydrologic monitoring requirements.

Inspector's Note:
This summary is designed only to advise you of important provisions of a permit that require your attention and monitoring. Your familiarity with requirements and permitted activities will insure that mining and reclamation occurs as was intended and approved at the time of permit issuance. Please take the time to review relevant provisions of the permit carefully and thoroughly. Should you have questions about this or any permit, please do not hesitate to contact the application manager within the Permitting Section.

Items marked are applicable to this permit:

- ☐ Auger Mining/Highwall Mining
- ☐ Alternate Resoiling Material
- ☐ Blasting Plans
- ☐ Buffer Zone Variance Request (BZVR)
- ☐ Coal Waste Disposal
- ☐ Delay in Contemporaneous Reclamation
- ☐ Excess Spoil Disposal
- ☐ Experimental Mining Practices
- ☐ Federal Lands
- ☐ Mountain Top Removal
- ☐ MSHA Impoundment
- ☐ AML No-Cost Area
- ☐ Prime Farmlands
- ☐ Remining (Reduced Maintenance)
- ☐ Remining (Modified effluent)
- ☐ Remining BMP only Permit
- ☐ Special handling of acid-forming/toxic materials.
- ☐ Beneficial Use of CCB's
- ☐ Public Road Permit
- ☐ Small Area Drainage Exemption (SADE)
- ☐ Steep Slope Mining
- ☐ Slurry Impoundment
- ☐ Test Hole Variance
- ☐ Variance from AOC
- ☐ Wetlands Affectment/Avoidance
- ☑ Within 500' of active UG mine
- ☐ Within 500' of abandoned UG mine
- ☐ Within 100' of a cemetery
- ☐ Within 300' of occupied dwelling
- ☐ Within 300' of public building, church, school, community or institutional building or public
- ☐ Within 1000' of wild, scenic or recreational river
- ☐ OEPA 401/COE 404 permits needed for wetlands or stream affectment and/or reconstruction
- ☐ Tree Planting in Reclamation Plans

Application Manager: Jeff Emmons, Environmental Specialist **Date:** MAR 12 2010

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F103 Rev: 07/01/2001

OHIO DEPARTMENT OF NATURAL RESOURCES
Division of Mineral Resources Management

Written Findings

(Underground Workings Only)

Applicant: **Buckingham Coal Co., Inc.**

Application Number: **D-2223-3**

The Division of Mineral Resources Management completed a regulatory review of this application on March 12, 2010. As required in provisions of 1501:13-5-01(E) of the Ohio Administrative Code (OAC), the Division's comprehensive review of this application resulted in finding the following:

1. The permit area is not within an area designated as unsuitable for mining pursuant to 1501:13-3-07 of the Ohio Administrative Code. As of this date, three areas within the state have been designated as unsuitable: Guernsey County, Valley Township Sections 7 & 8 (for all coal mining operations); Carroll County, Harrison Township Sections 4 and 5, Center Township Sections 27 and 33, Washington Township Sections 28, 29, 30, 34, 35, and 36 (for full coal recovery underground mining operations); and Belmont County, Smith Township Sections 27, 28, 33, 34 (for surface operations), and Sections 27, 33, 34 (for underground operations above the Meigs Creek No. 9 coal seamand for limited extraction in the Meigs Creek No. 9 and Pittsburgh No. 8 seams).

2. The permit area is not within an area under study for designation as unsuitable for mining. This finding was determined following a review of lands unsuitable petitions on file with the Division as of March 12, 2010.

3. Coal mining operations proposed in this permit application will not affect the continued existence of threatened or endangered species or result in the destruction or adverse modification of their critical habitat as determined under the Endangered Species Act of 1973 (16 U.S.C. 1513 et seq.).

   There are several species on the federal list that are found in the coal-mining region of Ohio. Sightings of the Indiana bat, American burying beetle, fanshell and the pink mucket pearly mussel have been recorded in Morgan County. Review of the permit application; consultation with the U.S. Department of the Interior, Fish and Wildlife Service dated August 18, 2009; and information dated September 9, 2009 provided by the Natural Heritage Program administered by the Division of Natural Areas & Preserves; and/or consideration of the endangered and threatened species from the U.S. Fish & Wildlife Service November 2009 offer no indication of listed species

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having been sighted or critical habitat on or in the vicinity of the application area.

4. The applicant and/or any affiliated company has corrected or is in the process of correcting, to the satisfaction of the issuing agencies, all notices of violations/IHCO's and has no unpaid final demand(s) for civil penalty assessments. This finding is based on verification of Division-issued NOV's, IHCO's, and CPA's and review of information through the AVS on March 11, 2010. See documentation in the administrative file verifying this information.

5. The applicant is not delinquent in payment of the Federal reclamation fee required by Section 402 of Public Law 95-87 based on review of the AVS on March 11, 2010. See documentation in the administrative file verifying this information.

6. The applicant (and the operator, if applicable) does not control and has not controlled mining operations with a demonstrated pattern of willful violations of Chapter 1513. of the Revised Code and rules adopted thereunder of such nature, duration, and with such resulting irreparable damage to the environment as to indicate an intent not to comply with such provisions. The Division bases this finding on a records search.

7. Coal mining and reclamation to be performed under this permit will be consistent with other operations to be performed during the same permit term in areas adjacent to the permit area. This finding is based upon the Division's review of the permit application and adjacent proposed or existing permit areas, including those listed on the Permit List and Pending Application List included in the permit application.

8. Based on our hydrologist's review of Part 2, B, C, D, E, and Part 3, A(7), C, D, and E of the permit application as documented in the Cumulative Hydrologic Impact Assessment (CHIA), we find that the proposed operations have been designed to prevent damage to the hydrologic balance outside the permit area.

9. The probable cumulative hydrologic impact for this mining operation area and adjacent areas on the hydrologic regime and water availability is: Insofar as the proposed operation involves no planned subsidence, being a room and pillar mining operation in its entirety, and the fact that the ground water supplies are developed more than one hundred feet above the horizon of mining, which is the #7 Upper Freeport Coal, there are no anticipated adverse impacts to the hydrologic balance. This finding is based upon the Division hydrologist's comprehensive review of the permit application, Hydrologic Inventory, analysis of existing ground water data maintained by the Division of Water, and other available hydrological and geological data which is part of the permit application. These findings are

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summarized in the (CHIA) completed by the Division's hydrologist on January 26, 2010.

10. Based upon the Division's review of the permit application; use of reasonable mining and reclamation practices proposed in the application; technical review by the Division's engineer, hydrologist, environmental specialist, soils resource specialist, and other technical experts; consultation with other agencies; and the Division's previous experience with the applicant (if applicable), the chief of the Division has found that the mining and reclamation plans contained in Parts 2, 3, and 4 of the application can be feasibly and responsibly accomplished.

11. To protect against possible adverse effects of the proposed mining operations on properties included on the National Register of Historic Places, the Chief of the Division has placed the following condition on this permit:

    An archaeology clearance from the Division is necessary prior the permittee's or operator's repair of ground surface or historic structures where the repair is associated with mining related damage.

12. The Division of Mineral Resources Management has determined that permit application number D-2223-2 submitted on August 11, 2009 is accurate, complete, and complies with the requirements of Chapter 1513 of the Ohio Revised Code and all rules adopted thereunder.

Chief, Division of Mineral Resources Management _____

Date: MAR 12 2010

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Cumulative Hydrologic Impact Assessment
Buckingham Coal Co., Inc., application D-2223-3

Geologist: George Mychkovsky **Date**: January 26, 2010

Background

Location: The proposed shadow area is located in Sections 19, 20, 29, and 30 of Union Township, Morgan County, in the middle portion of the Hocking River Drainage Basin (O-02). The proposed site is located immediately to the north and east of previously permitted areas of D-2223, and is located entirely within the watershed of south-flowing perennial East Branch of Sunday Creek.

Proposed operation: The #7 Upper Freeport Coal seam of the Pennsylvanian Allegheny Group will be room and pillar-mined beneath 723.6 acres, with no planned subsidence. The planned recovery rate is 59%.

Relief: The maximum cover of approximately 435 feet is located on a ridge on the central portion of the eastern boundary of the proposed shadow area, where the top of the #7 Coal is 645' msl and the surface elevation is 1080' msl (1080 – 645 = 435). The minimum cover of approximately 55 feet is located along Eels Creek in the northwest corner of the proposed shadow area, where the top of the #7 Coal is 695' msl and the surface elevation is 750' msl (750–695 = 55).

Geology: Bedrock throughout the entire shadow area consists of sandstone and shale of the Pennsylvanian Monongahela Group. The #7 Coal is about 4-feet thick moderate total and pyritic sulfur contents of approximately 3% and 2%, respectively. Over the shadow area taken as a whole, the #7 Coal seam dips to the southeast at approximately 34 feet per mile, which is consistent with the regional dip. Detailed mapping reveals a noticeable east-plunging syncline in the southwestern portion of the proposed shadow area, with a more subtle east-plunging syncline in the northwest corner of the proposed shadow area.

The bottom of the #7 Coal seam ranges in elevation from 695 ft. msl in the northwest corner of the proposed shadow area to 628 ft. msl in the southeast corner of the proposed shadow area. Therefore, the highest potential head elevation is 700' msl (695 + 5 = 700), which is approximately 30 feet below the lowest land surface (730 – 700 = 30). Furthermore, the highest potential head elevation is 40 feet below the box cut elevation of 740' msl on the original permit. In addition, the elevation of the drainage nearest the portal on the original permit area is 722' msl. Therefore, the highest coal elevation within the mine is still 22 feet below stream level. It should be noted that the proposed shadow area is adding negligible, if any, head to the deep mine, as it is effectively along strike to slightly down-dip of the previously permitted shadow areas of Permit D-2223. In light of the above, gravity discharge at the surface is not possible as a result of the proposed operation.

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Moderately to weakly toxic fireclay or shale underlie the #7 Coal. The roof consists of shale from 2 to 9-feet thick, which varies from moderately nontoxic to moderately toxic.

Ground Water Hydrology: The Division of Water's Analysis of Existing Ground Water File Data, prepared on October 9, 2002 and submitted with the original permit, indicated that yields of less than 3 gallons per minute are obtained wells developed in sandstone, limestone, and shale aquifers at depths of up to 320 feet. This report concludes by stating that the proposed mining operation recommended water well monitoring. This concern was addressed by the monitoring plan submitted by the applicant.

The applicant indicated that there are no new aquifers within the hydrology review area, and referred to the original permit for information regarding aquifers. The original permit identified four bedrock aquifers, labeled A through D, with aquifer D formed in and above the #7 Coal seam. Alluvial aquifer E is located within the floodplain of Sunday Creek. Ground water supplies consist of five drilled wells, dug wells DW-940, DW-945, and DW-1006, and developed spring DS-929. Wells WL-900, WL-928, and W-935, and developed spring DS-929 serve as domestic supplies. DW-1006 is a domestic supply, primarily when the residence is occupied on weekends. Dug wells DW-940 and DW-945 were formerly used as domestic supplies, but are currently unused. Wells WL-936 and WL-941, which are located on State of Ohio property, are also unused.

It should be noted that the boundary of the proposed shadow area has been designed so that the residences and water wells of the Gladden Outlots to the south are just beyond the hydrology review area. Furthermore, the majority of residences within the proposed hydrology review area are supplied by public water. Finally, there are five residences that have no public or ground water supply and depend on portable water.

The Ohio EPA's Division of Drinking and Ground Waters report does not identify any public water sources or supplies within one mile of the proposed shadow area. It should be noted, however, that the corridor management zone for the Burr Oak Regional Water District public water system's Burr Oak Lake intake, which is approximately 6.0 river miles downstream of the proposed shadow area, intake extends into the proposed shadow area.

Surface Water Hydrology: The drainage is dendritic, as geologic structure does not appear to have played a leading role in stream drainage patterns. South-flowing perennials Eels Run, Cedar Run, and San Toy Creek flow across portions of the proposed shadow area, from west to east, respectively, before discharging into the East Branch of Sunday Creek within the proposed shadow area. The Ohio EPA's Division of Surface Water has designated Eels Run, Cedar Run, San Toy Creek, and the East Branch of Sunday Creek as warmwater aquatic life habitats that are agricultural and industrial supplies, and which serve as primary contact recreational waters. The remaining streams within the hydrology review area are intermittent.

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Without exception, ground water and stream quality is very good, as it that of pond P-934, the only pond within the hydrology review area. It should be noted that there was a lack of flow in many streams during the time of sampling, which was confirmed by the hydrologist's field review in November 2009.

Consequences

Aquifers and groundwater supplies impacts: Insofar as the operation proposes only room and pillar deep mining, no subsidence damage to any aquifer is anticipated. Only Aquifer D, formed in and above the #7 Coal seam, will be affected, due to removal of this coal. It is possible that ground water initially accumulating in these voids may be characterized by acid mine drainage (AMD) initially due to the moderate sulfur content of the #7 Coal. However, over time the oxygen levels within the deep mine voids will decrease due to complete inundation, as the coal is located below perennial the East Branch of Sunday Creek. Consequently, water quality levels should improve to the point that AMD will no longer be present. As a result the proposed mining operation should not significantly affect ground water quality with respect to pH, total iron, manganese, acidity, and dissolved solids on a long-term basis.

All of the used wells are at least 30 feet above the #7 Coal, and no well bottom is closer than 20 vertical feet above the #7 Coal. Consequently, the potential for well diminution as a result of its source being intercepted is minimal. The used wells and DS-929 shall be monitored for quality per the procedures addressed in the original permit. Due to access problems, quantity monitoring is not practical and/or possible of wells and springs, with the exception of unused WL-936, which shall be monitored for quantity and quality. The monitoring of this well will help to assess the impact of the proposed operation on the two deepest bedrock aquifers, C and D.

There are six producing oil and gas wells and three that are plugged and abandoned. The applicant proposes to avoid all the oil and gas wells within the proposed shadow area. In the event an oil and gas well is inadvertently intercepted, regardless of whether there is a record for this well, it will be properly plugged.

Streamflow loss to deep mine potential: For the same reasons provided in the preceding discussion regarding impacts to the ground water system, no impacts are anticipated to either the quantity or quality of streams within the hydrology review area. Specifically, the proposed mining operation should not significantly affect stream quality with respect to pH, total iron, manganese, acidity, and dissolved solids. Consequently, the proposed operation should not jeopardize the previously-mentioned designations for Eels Run, Cedar Run, San Toy Creek, and the East Branch of Sunday Creek. Streams within the proposed shadow area will be monitored as addressed in the original permit. Finally, the proposed operation will have no impact on the corridor management zone for the Burr Oak Lake intake of the Burr Oak Regional Water District public water system.

In conclusion, the proposed operation will not result in material damage to the hydrologic balance of the hydrology review area.

ORIGINAL

Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR | SEAN LOGAN DIRECTOR

Division of Mineral Resources Management
John F. Husted, Chief
2050 E. Wheeling Avenue
Cambridge, OH 43725-2159
Phone: (740)439-9079 Fax: (740)432-7711

Date: 03/12/2010

To: Appropriate Governmental Agencies

From: John Husted, Chief
Division of Mineral Resources Management

Re: Coal Mine Application Number: D-2223-3
Coal Mine Permit Number: D-2223
Mine Name: Burr Oak #7
Date Issued: 03/12/2010

Applicant: BUCKINGHAM COAL CO INC
PO Box 157
21525 SR 13
GLOUSTER, OH 45732-0157

Telephone: 614-394-2644

Permit Location:

COUNTY	TOWNSHIP	SECTION	LOTS	T	R	Quad
MORGAN	UNION	19		8	13	CORNING
MORGAN	UNION	20		8	13	CORNING
MORGAN	UNION	29		8	13	CORNING
MORGAN	UNION	30		8	13	CORNING

Surface Acres: 0

Underground Acres: 723.6

The Division of Mineral Resources Management has issued a coal mining and reclamation permit Adjacent Area Application/Amendment (AAA) to the above named applicant. The permit number and date of issuance is shown above.

The approved water monitoring plan for this permit's AAA is:

ORIGINAL

Distribution List:

Office of Surface Mining
4605 Morse Road
Room 102
Columbus, OH 43230

Ohio Historical Preservation Office
567 East Hudson Street
Columbus, OH 43211-1030

MSHA
50985 National Road
St. Clairsville, OH 43950

Michael Eggert
Ohio EPA, Division of Drinking & Groundwater
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, OH 43216-1049

Debbie Woischke
Division of Natural Areas & Preserves
2045 Morse Road, Bldg. F-1
Columbus, OH 43229-6693

Linn Engineering, Inc.
534 Market Street
Zanesville, OH 43701

Lanny Erdos
Division of Mineral Resources Management
2050 East Wheeling Avenue
Cambridge, OH 43725

Bruce Goff
Ohio EPA, Southeast District Office
2195 Front Street
Logan, OH 43138

Morgan County Commissioners
155 East Main ST., RM 216
McConnelsville, OH 43756

Morgan County Planning Commission
c/o County Commissioners
155 E Main St., RM 216
McConnelsville, OH 43756

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

UNDERGROUND COAL MINING AND RECLAMATION PERMIT APPLICATION
(UNDERGROUND WORKINGS ONLY)

A. Applicant's Name **BUCKINGHAM COAL CO., INC.**

Address **P.O. BOX 157**

City **GLOUSTER** State **OHIO** Zip **45732**

Telephone **740-767-9902**

Employer Identification No. (EIN)

Social Security No. (last 4 digits) XXX-XX-

B. Type of Operation (check appropriate space(s)):

☒ Room and Pillar, ☐ Pillar Extraction, ☐ Longwall, ☐ Other

C. Name of mine **Burr Oak #7**

D. List below the MSHA identification numbers for the mine and for all mine-associated structures requiring MSHA approval on this application area.

33-04025

E. Indicate the exploration permit number(s) or notice of intent (NOI) number(s) that were obtained for this application area.

NOI 08-JAC-14

F. Did a person other than an employee of the applicant prepare this application?

Yes ☒ No ☐ If "yes," provide:

Preparer's Name **LINN ENGINEERING, INC.**
Address **534 MARKET STREET**
City **ZANESVILLE** State **OHIO** Zip **43701** Telephone **740-452-7434**

ORIGINAL

PART 1: LEGAL, FINANCIAL, COMPLIANCE, AND RELATED INFORMATION

A. IDENTIFICATION OF INTERESTS

(1) Is the applicant a single proprietorship? Yes ☐ No ☒ If "yes," provide the following:

Owner's Name

Address

City State Zip Telephone

EIN , or SSN (last 4 digits) XXX-XX-

Beginning date of ownership

If "no," indicate business structure of applicant.

☐ Partnership (registration no. and date obtained)
☒ Corporation (charter no. and date incorporated) **887368 12/07/94**
☐ Association
☐ Other, specify

Provide the following for the applicant's statutory agent and submit Owners and Controllers

Agent's Name **JAMES F. GRAHAM**

Address **3570 SOUTH RIVER ROAD**

City **ZANESVILLE** State **OHIO** Zip **43701** Telephone **740-453-0721**

EIN , or SSN

(2) Will there be a mine operator other than the applicant?

Yes ☐ No ☒ If "yes" provide the operator's name and submit Operator Ownership and Control (Note: if more than one operator, indicate operator's name and submit a separate form for each).

Operator's Name

(3) Provide the following for the person or entity who will pay the abandoned mine land reclamation fee for the applicant.

Name **BUCKINGHAM COAL COMPANY, INC.**

Address **P.O. BOX 157**

City **GLOUSTER** State **OHIO** Zip **45732** Telephone **740-767-9902**

or SSN (last 4 digits - optional) XXX-XX-

ORIGINAL

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

OWNERS AND CONTROLLERS

Applicant's Name **BUCKINGHAM COAL CO., INC.**

This attachment is to be completed and submitted with the permit application if the applicant is other than a single proprietorship. Provide the following for all partners, officers, directors, and stockholders owning ten percent or more of any class of voting stock or other instruments of ownership, and any other person performing a function similar to a director. Persons holding or who have held multiple positions must be listed separately for each position. If any owner or controller listed is a business entity and not an individual, also complete an Owners and Controllers for that business entity.

Name of business entity **BUCKINGHAM COAL CO., INC.**

Name **JAMES F. GRAHAM**

Street address **3570 SOUTH RIVER ROAD, PO BOX 3373**

City **ZANESVILLE** State **OHIO** Zip **43701**

EIN , or SSN (last 4 digits)

Title of position within entity **CHIEF EXECUTIVE OFFICER**

Date position assumed/ended (if applicable) **12/07/1994/**

Percent of ownership **80%** Date of ownership **12/07/1994**

Name **NICHOLAS LITTLE**

Street address **3570 SOUTH RIVER ROAD, PO BOX 3373**

City **ZANESVILLE** State **OHIO** Zip **43701**

EIN , or SSN (last 4 digits)

Title of position within entity **PRESIDENT**

Date position assumed/ended (if applicable) **06/01/2007/**

Percent of ownership **0%** Date of ownership **N/A**

Name **CLAY P. GRAHAM**

Street address **3570 SOUTH RIVER ROAD, PO BOX 3373**

City **ZANESVILLE** State **OHIO** Zip **43701**

EIN , or SSN (last 4 digits)

Title of position within entity **ASSISTANT SECRETARY**

Date position assumed/ended (if applicable) **12/07/1994/**

Percent of ownership **10%** Date of ownership **12/07/1994**

Submit and identify additional pages necessary to complete response.

Part 1: Section A

ORIGINAL

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

OWNERS AND CONTROLLERS

Applicant's Name **BUCKINGHAM COAL CO., INC.**

This attachment is to be completed and submitted with the permit application if the applicant is other than a single proprietorship. Provide the following for all partners, officers, directors, and stockholders owning ten percent or more of any class of voting stock or other instruments of ownership, and any other person performing a function similar to a director. Persons holding or who have held multiple positions must be listed separately for each position. If any owner or controller listed is a business entity and not an individual, also complete an Owners and Controllers for that business entity.

Name of business entity **BUCKINGHAM COAL CO., INC.**

Name **BRYAN H. GRAHAM**

Street address **3570 SOUTH RIVER ROAD, PO BOX 3373**

City **ZANESVILLE** State **OHIO** Zip **43701**

EIN , or SSN (last 4 digits)

Title of position within entity **TREASURER**

Date position assumed/ended (if applicable) **12/07/1994/**

Percent of ownership **10%** Date of ownership **12/07/1994**

Name **RONALD K. BIRD**

Street address **21525 STATE ROUTE 13, PO BOX 157**

City **GLOUSTER** State **OHIO** Zip **45732**

EIN , or SSN (last 4 digits)

Title of position within entity **EXECUTIVE VICE PRESIDENT**

Date position assumed/ended (if applicable) **04/01/2007/**

Percent of ownership **0%** Date of ownership **N/A**

Name

Street address

City State Zip

EIN , or SSN (last 4 digits) xxx-xx-

Title of position within entity

Date position assumed/ended (if applicable) /

Percent of ownership Date of ownership

Submit and identify additional pages necessary to complete response.

Part 1: Section A

ORIGINAL

(4) Provide the following for all persons having the authority or ability to commit the financial, real property assets, or working resources of the applicant who are not otherwise identified as officers, directors or owners of the applicant. If none, check box: ☒. If any person listed is a business entity and not an individual, also complete Owners and Controllers for that person.

Name

Address

City State Zip Telephone

EIN , or SSN (last 4 digits) XXX-XX-

O & C relationship to entity

Date O & C relationship began/ended (if applicable) /

If necessary, submit additional pages to complete response.

(5) Provide the following for all persons owning or controlling the coal to be mined by another person under a lease, sublease, or other contract and (a) having the right to receive the coal after mining, or (b) having the authority to determine the manner in which another person conducts coal mining operations. If none, check box: ☒. If any person listed is a business entity and not an individual, also complete Owners and Controllers for that person.

Name

Address

City State Zip Telephone

EIN , or SSN (last 4 digits) XXX-XX-

O & C relationship to entity

Date O & C relationship began/ended (if applicable) /

If necessary, submit additional pages to complete response.

(6) List below the person or persons primarily responsible for ensuring that the applicant will comply with Chapter 1513 of the Revised Code and the rules adopted pursuant thereto while mining and reclaiming the area for which this permit is requested.

RONALD K. BIRD and / or MARK BARTKOSKI

(7) Has the applicant, any person or entity listed under items A (4) and (5), or any person or entity listed on the Owners and Controllers who "owned or controlled" or "owns or controls" held a coal mining permit in the United States within the five years preceding the date of this application?

Yes ☒ No ☐ If "yes," submit Permit List.

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

PERMIT LIST

Applicant's Name **BUCKINGHAM COAL CO., INC.**

Submit the following information for each coal mining operation owned or controlled by either the applicant or by any person who owns or controls the applicant.

Name of Business Entity **BUCKINGHAM COAL CO., INC.**
Address **P.O. BOX 157**
City **GLOUSTER** State **OHIO** Zip **45732**
Telephone **740-767-9902**
EIN or SSN (last 4 digits) XXX-XX-

Permit Number	State	Regulatory Authority	MSHA Number and Date Issued
D-1163	**OHIO**	**ODNR**	**33-04389, 01/01/1997**
D-1182	**OHIO**	**ODNR**	**33-04025, 04/01/1994**
D-2223	**OHIO**	**ODNR**	**33-04025, 04/01/1994**
D-2269	**OHIO**	**ODNR**	**33-04025, 04/01/1994**
D-2331	**OHIO**	**ODNR**	**33-04025, 04/01/1994**

If not previously provided, indicate the ownership or control relationship of the business entity with the applicant, including percent of ownership and location in organizational structure:

Part 1: Section A

(8) Does the applicant, any person or entity listed under items A (4) and (5), or any person or entity listed on Owners and Controllers have a pending coal mining application in any state of the United States?

Yes ☒ No ☐ If "yes," submit Pending Application List.

(9) Submit Certificate of Insurance.

B. COMPLIANCE INFORMATION

(1) Has the applicant, any subsidiary, affiliate or persons controlled by or under common control with the applicant:

(a) Had a federal or state coal mining permit suspended or revoked in the five years preceding the data of submission of this application?

Yes ☐ No ☒ If "yes," submit Suspension, Revocation & Forfeiture List.

(b) Forfeited a mining bond or similar security deposited in lieu of bond?

Yes ☐ No ☒ If "yes," submit Suspension, Revocation & Forfeiture List.

(2) Has the applicant been issued notices of violation (NOVs) in connection with any coal mining and reclamation operation during the three years preceding the date of submission of this application for violations of Chapter 1513 of the Revised Code or the Administrative Code, or of any federal or state law, rule, or regulation pertaining to air or water environmental protection?

Yes ☒ No ☐ If "yes," submit NOV List.

(3) Have any unabated federal or state cessation orders (COs) and unabated air and water quality notices of violations (NOVs) been received prior to the submission date of this application by any coal mining and reclamation operation owned or controlled by either the applicant or by any person who owns or controls the applicant?

Yes ☐ No ☒ If "yes," submit Unabated Violations.

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

PENDING APPLICATION LIST

Applicant's Name **BUCKINGHAM COAL CO., INC.**

Provide the following information for each pending coal mining application for either the applicant or any person who owns or controls the applicant.

Indicate the business entity for which this listing has been completed **BUCKINGHAM COAL CO., INC.**

Application No.	Name of Regulatory Authority	State
D-2269-2	**ODNR, DMRM**	**OHIO**
D-2269-3	**ODNR, DMRM**	**OHIO**
D-2223-2	**ODNR, DMRM**	**OHIO**

Part 1: Section A

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

CERTIFICATE OF INSURANCE

Name of Insured **Buckingham Coal Company, Inc., 21525 St Rt 13, Glouster, OH 45732-0157**

This is to certify that the policy of insurance listed below has been issued to the above named insured and is in force at this time. The policy provides bodily injury and property damage insurance for all coal mining and reclamation operations of the insured in the state of Ohio as required by 1501:13-7-07 of the Administrative Code stated below.

Name of Insurer **Lexington Insurance Company**

Policy Number **054197886**

Policy Period **05-01-09 - 05-01-10**

Name of Underwriting Agent **Dawson Insurance, Inc.**

Address of Underwriting Agent **1340 Depot Street, Cleveland, Ohio 44116**

Telephone No. of Underwriting Agent **(440) 333-9000 (ext. 386)**

In the event of cancellation or non-renewal of this policy, including non-payment of policy premiums, the insurer agrees to promptly notify: The Division of Mineral Resources Management, 2045 Morse Road, Building H-3, Columbus, Ohio 43229-6693.

5/21/09
Date

Signature of Underwriting Agent

This certificate is issued as a matter of information only and confers no rights upon the Division of Mineral Resources Management. This certificate does not amend, extend or alter the coverage afforded by the policy listed above.

1501:13-7-07(B) THE PUBLIC LIABILITY INSURANCE POLICY SHALL:

(1) BE IN EFFECT DURING THE TERM OF THE PERMIT OR ANY RENEWAL, INCLUDING THE LENGTH OF ALL RECLAMATION OPERATIONS;

(2) PROVIDE FOR PERSONAL INJURY AND PROPERTY DAMAGE PROTECTION IN AMOUNTS ADEQUATE TO COMPENSATE ANY PERSONS INJURED OR PROPERTY DAMAGED AS A RESULT OF COAL MINING AND RECLAMATION OPERATIONS, INCLUDING THE USE OF EXPLOSIVES. THE MINIMUM INSURANCE COVERAGE FOR BODILY INJURY AND PROPERTY DAMAGE SHALL BE THREE HUNDRED THOUSAND DOLLARS FOR EACH OCCURRENCE AND FIVE HUNDRED THOUSAND DOLLARS IN THE AGGREGATE; AND

(3) INCLUDE A RIDER REQUIRING THAT THE INSURER NOTIFY THE CHIEF WHENEVER SUBSTANTIVE CHANGES ARE MADE IN THE POLICY, INCLUDING ANY TERMINATION OR FAILURE TO RENEW.

Part 1: Section A

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

NOV LIST

Applicant's Name **BUCKINGHAM COAL CO., INC.**

Permit Number	Violation Number	Date of Issuance	Issuing Agency	State	Brief Description of NOV	Action Taken to Abate NOV	Current Status of NOV (*)
D-1163	21084	08/23/07	ODNR	OHIO	FAILURE TO SUBMIT YR 8 ANNUAL REPORT	COMPLETED AND SUBMITTED ANNUAL REPORT	TERMINATED
D-2269	21086	10/03/07	ODNR	OHIO	FAILURE TO SUBMIT QTR HOLLOW FILL CERTS	SUBMITTED HOLLOW FILL CERTIFICATIONS	NON-REMEDIAL
D-2223	21087	10/03/07	ODNR	OHIO	FAILURE TO SUBMIT QTR HOLLOW FILL CERTS	SUBMITTED HOLLOW FILL CERTIFICATIONS	NON-REMEDIAL
D-2269	21088	10/23/07	ODNR	OHIO	FAILURE TO NOTIFY LANDOWNERS OF MINING SURFACE PROPERTY	NOTIFIED LANDOWNERS OF SURFACE MINING	NON-REMEDIAL
D-2269	21089	10/23/07	ODNR	OHIO	FAILURE TO COMPLETE HAULROAD DRAINAGE SYSTEM	COMPLETED HAULROAD DRAINAGE SYSTEMS	TERMINATED
D-2223	21090	10/23/07	ODNR	OHIO	FAILURE TO NOTIFY LANDOWNERS OF MINING SURFACE PROPERTY	NOTIFIED LANDOWNERS OF SURFACE MINING	NON-REMEDIAL
D-1163	21092	11/15/07	ODNR	OHIO	FAILURE TO SUBMIT QTR HOLLOW FILL CERTS	SUBMITTED HOLL FILL CERTIFICATIONS	NON-REMEDIAL
D-2269	21768	12/10/07	ODNR	OHIO	DISCHARGE FROM POND 107 CONTAINED 7.1 MG OF IRON	TREATED POND DISCHARGE	TERMINATED

(*) If administrative or judicial proceedings have been initiated concerning any of the violations, identify the violation and provide an

Revised 02/06
DNR-744-9016

addendum indicating the date, location, type of proceeding, and current status.

C. RIGHT OF ENTRY INFORMATION

(1) Provide the following information for every legal or equitable owner of record of the property affected by operations within the underground (UG) workings area, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	DEED PARCEL NO.	T-	R-
OWNER NAME: **Buckingham Coal Company, Inc.** ADDRESS: **P.O. Box 157** CITY, STATE, ZIP: **Glouster, Ohio, 45732** TELEPHONE: **740/767-9902**	☐ Surface – UG workings area ☒ Coal ☐ Non-coal mineral	Morgan	Union	19,20,29,30	N/A	D-2223-3	8	13
OWNER NAME: **The State of Ohio** ADDRESS: **2045 Morse road, Bldg C-4** CITY, STATE, ZIP: **Columbus, Ohio, 43229-6693** TELEPHONE: **614/265-6395**	☒ Surface – UG workings area ☒ Coal ☒ Non-coal mineral	Morgan	Union	19,30	N/A	D-2223-3	8	13
OWNER NAME: ADDRESS: CITY, STATE, ZIP: TELEPHONE:	☐ Surface – UG workings area ☐ Coal ☐ Non-coal mineral						8	13
OWNER NAME: **United States of America c/o Wayne National Forest** ADDRESS: **13700 U.S. Route 33** CITY, STATE, ZIP: **Nelsonville, Ohio, 45764** TELEPHONE: **740/753-0101**	☒ Surface – UG workings area ☐ Coal ☒ Non-coal mineral	Morgan	Union	19,20,29,30	N/A	D-2223-3	8	13

RIGHT OF INFORMATION (Supplemental Information - Underground Only - Part 1, Section C) REV 3

Provide the following information for every legal or equitable owner of record, surface and mineral, of the property to be mined or affected by surface operations and facilities, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	T-	R-
OWNER NAME: **East Central Ohio Realty** ADDRESS: **no current address refer to addendum to pat 1 C(4)** CITY, STATE, ZIP: TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13
OWNER NAME: ADDRESS: CITY, STATE, ZIP: TELEPHONE:	☐ Surface - UG Workings area ☐ COAL ☐ NON-COAL MINERAL						
OWNER NAME: CITY, STATE, ZIP: TELEPHONE:	☐ Surface - UG Workings area ☐ COAL ☐ NON-COAL MINERAL						
OWNER NAME: CITY, STATE, ZIP: TELEPHONE:	☐ Surface - UG Workings area ☐ COAL ☐ NON-COAL MINERAL						

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RIGHT OF INFORMATION (Supplemental Information - Underground Only - Part 1, Section C)

Provide the following information for every legal or equitable owner of record, surface and mineral, of the property to be mined or affected by surface operations and facilities, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	T-	R-
OWNER NAME: **George H. & Freda F. Makatura** ADDRESS: **9500 Sunday Creek Rd.** CITY, STATE, ZIP: **Malta, Ohio 43758** TELEPHONE: **740/962-6925**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13
OWNER NAME: **Frank & Terri Moore** ADDRESS: **1 Wood Eden Lane** CITY, STATE, ZIP: **Bluffton, South Carolina 29910** TELEPHONE: **843/757-3717**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13
OWNER NAME: **John Miller & Elizabeth Dillehay** ADDRESS: **P.O. Box 14506** CITY, STATE, ZIP: **Des Moines, Iowa 50306** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13
OWNER NAME: **Floyd Chappelear** ADDRESS: **1940 SE Branch Road SW** CITY, STATE, ZIP: **Malta, Ohio 43758** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13

RIGHT OF INFORMATION (Supplemental Information - Underground Only - Part 1, Section C)

Provide the following information for every legal or equitable owner of record, surface and mineral, of the property to be mined or affected by surface operations and facilities, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	T-	R-
OWNER NAME: **Eldon & Karen Johnston** ADDRESS: **5241 Hawthorne Valley Drive** CITY, STATE, ZIP: **Westerville, Ohio 43082** TELEPHONE: **614/895-2932**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13
OWNER NAME: **Trustees of East Branch Cemetery** ADDRESS: **no mailing address listed** CITY, STATE, ZIP: **McConnelsville, Ohio 43756** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	20	N/A	8	13
OWNER NAME: **Sharon Williams** ADDRESS: **3399 State Route 78** CITY, STATE, ZIP: **Glouster, Ohio 45732** TELEPHONE: **740/962-2148**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **Robert F. & Thomas E. Leeper, Trustees** ADDRESS: **3980 N Dugan Road** CITY, STATE, ZIP: **McConnelsville, Ohio 43756** TELEPHONE: **740/962-2665**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13

RIGHT OF INFORMATION (Supplemental Information - Underground Only - Part 1, Section C)

Provide the following information for every legal or equitable owner of record, surface and mineral, of the property to be mined or affected by surface operations and facilities, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	T-	R-
OWNER NAME: **Jerry Lemon, SR.** ADDRESS: **2029 East Branch Road** CITY, STATE, ZIP: **Malta, Ohio 43758** TELEPHONE: **740/962-5758**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **Jonathan Oberholser** ADDRESS: **1305 North State Route 201** CITY, STATE, ZIP: **Casstown, Ohio 45312** TELEPHONE: **937/339-0333**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **Charles Kramer** ADDRESS: **1415 Eastwood Avenue** CITY, STATE, ZIP: **Columbus, Ohio 43203** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **David Jenkins** ADDRESS: **7248 Daughtery drive** CITY, STATE, ZIP: **Reynoldsburg, Ohio 43068** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13

RIGHT OF INFORMATION (Supplemental Information - Underground Only - Part 1, Section C)

REV. 1

Provide the following information for every legal or equitable owner of record, surface and mineral, of the property to be mined or affected by surface operations and facilities, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	T-	R-
OWNER NAME: **Toni Heid** ADDRESS: **306 Browns Lane** CITY, STATE, ZIP: **Louisville, Kentucky 40207** TELEPHONE: **502/899-7499**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **Joseph McCollum** ADDRESS: **474 Fairview Street** CITY, STATE, ZIP: **Nelsonville, Ohio 45764** TELEPHONE: **740/753-3147**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **William Kramer & Victioria Filippi** ADDRESS: **1762 Ford Road** CITY, STATE, ZIP: **Delaware, Ohio 43015** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29	N/A	8	13
OWNER NAME: **Merrill Gladden** ADDRESS: **643 N State Route 78 NW** CITY, STATE, ZIP: **Malta, OH 43758** TELEPHONE: **740/962-3101**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	29,30	N/A	8	13

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RIGHT OF INFORMATION (Supplemental Information - Underground Only - Part 1, Section C)

Provide the following information for every legal or equitable owner of record, surface and mineral, of the property to be mined or affected by surface operations and facilities, indicating whether the ownership is of surface, coal or non-coal mineral.

LAND OWNER INFORMATION	OWNERSHIP INFORMATION	COUNTY	TOWNSHIP	SECTION	LOT	T-	R-
OWNER NAME: **Nellie Cherevas** ADDRESS: **8480 Imlay Road** CITY, STATE, ZIP: **Blue Rock, Ohio 43720** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	30	N/A	8	13
OWNER NAME: **Joseph & Deborah Fabiny** ADDRESS: **106 W 3rd Street** CITY, STATE, ZIP: **The Plains, Ohio 45780** TELEPHONE: **not listed**	☑ Surface - UG Workings area ☐ COAL ☑ NON-COAL MINERAL	Morgan	Union	30	N/A	8	13
OWNER NAME: CITY, STATE, ZIP: TELEPHONE:	☐ Surface - UG Workings area ☐ COAL ☐ NON-COAL MINERAL						
OWNER NAME: CITY, STATE, ZIP: TELEPHONE:	☐ Surface - UG Workings area ☐ COAL ☐ NON-COAL MINERAL						

(2) Provide the following information for the holders of record of any leasehold interest in the coal to be mined.

Leaseholder Name **BUCKINGHAM COAL CO., INC.**

Address **P.O. BOX 157**

City **GLOUSTER** State **OHIO** Zip **45732** Telephone **740/767-9902**

Leaseholder Name **See Supplemental Leaseholder Information**

Address

City State Zip Telephone

Submit and identify additional pages necessary to complete response.

(3) Are there purchasers of record under a real estate contract of the coal to be mined?

Yes ☐ No ☒ If "yes," submit Purchasers of Record.

(4) Is any owner, holder or purchaser listed in items C (1) or (2), a business entity other than a single proprietorship?

Yes ☒ No ☐ If "yes," submit Other Business Entities.

(5) Does the applicant hold lands, interests in lands, options or pending bids on interests for lands that are contiguous to this application area?

Yes ☒ No ☐ If "yes," list those that are contiguous to this application area.

Refer to Application/Hydrology Map.

(6) Is it anticipated that mining permits would be sought for any of those lands described in item C (5) above?

Yes ☒ No ☐ If "yes," describe contiguous properties for which permits may be sought, to include the size, sequence and timing of future mining permits.

THE DESCRIPTION CANNOT BE PROVIDED BECAUSE THE SIZE, SEQUENCE AND TIMING OF FUTURE PERMITS DEPENDS ON VARIOUS FACTORS, SUCH AS, THE STRENGTH OF COAL MARKET, ENVIRONMENTAL REGULATIONS AND OBTAINING APPROPRIATE RIGHT OF ENTRY.

(7) Identify the right of entry documentation that is being provided that allows for coal mining operations within the underground workings:

☒ A copy of the right-of-entry documents attached as addenda, or
☒ A Right-of-Entry Affidavit

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Leaseholder Name **Petrox, Inc.**

Address **67 Poland Manor**

City **Youngstown** State **Ohio** Zip **44514** Telephone **330 / 757-3303**

Surface ☐, Coal ☐, Non-Coal Mineral ☒

Leaseholder Name **Broad Street Energy Company**

Address **37 W. Broad Street, Suite 1100**

City **Columbus** State **Ohio** Zip **43215** Telephone **614 / 228-0326**

Surface ☐, Coal ☐, Non-Coal Mineral ☒

Leaseholder Name **Enervest Operating, LLC**

Address **300 Capitol Street, Stuite 200**

City **Charleston** State **W.V.** Zip **25301** Telephone **304 / 343-5505**

Surface ☐, Coal ☐, Non-Coal Mineral ☒

Leaseholder Name

Address

City State Zip Telephone

Surface ☐, Coal ☐, Non-Coal Mineral ☐

Leaseholder Name

Address

City State Zip Telephone

Surface ☐, Coal ☐, Non-Coal Mineral ☐

Leaseholder Name

Address

City State Zip Telephone

Surface ☐, Coal ☐, Non-Coal Mineral ☐

Part 1: Section C

DEC 1 1

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

OTHER BUSINESS ENTITIES

Applicant's Name **Buckingham Coal Company, Inc.**

A separate attachment is to be submitted for each business entity.

Name of business entity **East Central Ohio Realty**

Statutory agent **Edward E. Zinkon**

Street Address **2040 Luka Ave**

City **Columbus** State **Ohio** Zip **43201**

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Part 1: Section C

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

OTHER BUSINESS ENTITIES

Applicant's Name **Buckingham Coal Company, Inc.**

A separate attachment is to be submitted for each business entity.

Name of business entity **Petrox, Inc.**

Statutory agent **Benjamin W. Cart**

Street Address **67 Poland Manor**

City **Poland** State **Ohio** Zip **44514**

Person's name **Benjamin W. Cart** Position **President**

Street Address **67 Poland Manor**

City **Poland** State **Ohio** Zip **44514**

Person's name **Mark G. Depew** Position **Secretary**

Street Address **2610 E Streetsboro Rd**

City **Hudson** State **Ohio** Zip **44236**

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Part 1: Section C

Revised 02/06
DNR-744-9012

DEC 1 1 2009

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

OTHER BUSINESS ENTITIES

Applicant's Name **Buckingham Coal Company, Inc.**

A separate attachment is to be submitted for each business entity.

Name of business entity **Broad Street Energy Company**

Statutory agent **Acme Agent, Inc.**

Street Address **41 S. High Street, Suite 2800**

City **Columbus** State **Ohio** Zip **43215**

Person's name **William E. Arthur** Position **President**

Street Address **37 W. Broad Street, Suite 1100**

City **Columbus** State **Ohio** Zip **43215**

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Part 1: Section C

Revised 02/06
DNR-744-9012

DEC 11 2009

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

OTHER BUSINESS ENTITIES

Applicant's Name **Buckingham Coal Company, Inc.**

A separate attachment is to be submitted for each business entity.

Name of business entity **Enervest Operating, LLC**

Statutory agent **Statutory Agent Corporation**

Street Address **52 East Gay Street**

City **Columbus** State **Ohio** Zip **43215**

Person's name **John B. Walker** Position **President**

Street Address **1001 Fannin Street**

City **Houston** State **Texas** Zip **77002**

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Person's name Position

Street Address

City State Zip

Part 1: Section C

Revised 02/06
DNR-744-9012

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Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Part 1, C(4)

Other Business Entities (formerly Attachment 3) for Buckingham Coal Company, Inc. and USA, Wayne National Forest were submitted with the original permit application.

Other Business Entities for East Central Ohio Realty is submitted with only the Statutory Agents name and address. Research from the Morgan County Auditor and Treasures offices has shown that East Central Ohio Realty owns land within the permit area, however, East Central Ohio Realty has no current mailing address with the Morgan County offices. Furthermore, the Secretary of State cancelled the articles of corporation/certificate of authority for East Central Ohio Realty on January 4, 2007.

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

RIGHT-OF-ENTRY AFFIDAVIT

Applicant's Name **Buckingham Coal Co., Inc.**

RIGHT-OF-ENTRY AFFIDAVIT

State of **Ohio**, **Muskingum** County, ss. **Timothy H. Linn** being first duly sworn, says that the following described documents convey to the applicant the legal right explained below and is a subject of litigation as shown below.

Type of document **Corporation Special Warranty Deed**

Execution Date **December 31, 2001**

Expiration Date **none**

Parties: From **Peabody Development** to **Buckingham Coal Co., Inc.**

Description of land: Number of Acres **+/- 22,538 "A-2"**

County **Morgan** Township **Union, Homer**

Section **Union 3,5,6,7,8,14,15,16,18,19,20,22,27,29,30,31,32,33,34** Lot **N/A**
Homer 1,7,13,16,17,18,19,23,24,26,29,30,31,32,36

Explanation of legal rights claimed **To enter in, on or under the premises for exploration, research, mining (by any means), removal of all coal and to construct, operate, and maintain any facilities necessary to the mining operation.**

Pending litigation Yes ☐ No ☒

[signature]	7/17/09	consultant
Signature of Affiant	Date	Position

Sworn to before me and subscribed in my presence this 17 day of, July, 2009

[signature]
Notary Public

NOTARIAL SEAL STATE OF OHIO

MICHELLE HAMPTON
Notary Public, State of Ohio
My Commission Expires
June 12, 2012

Part 1: Section C

02/06
DNR-744-9060

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

RIGHT-OF-ENTRY AFFIDAVIT

Applicant's Name **Buckingham Coal Co., Inc.**

RIGHT-OF-ENTRY AFFIDAVIT

State of **Ohio**, **Perry** County, ss. **Ronald K. Bird** being first duly sworn, says that the following described documents convey to the applicant the legal right explained below and is a subject of litigation as shown below.

Type of document **Coal Mining Lease**

Execution Date **March 9, 2010**

Expiration Date **5 years with an option to extend for four 5 year terms or until mining operations cease**

Parties: From **State Of Ohio, Ohio Department of Natural Resources** to **Buckingham Coal Co., Inc.**

Description of land: Number of Acres **+/- 41.14**

County **Morgan** Township **Union**

Section **30** Lot **N/A**

Explanation of legal rights claimed **To enter under the premises for mining, removal of all coal and to operate, and maintain any facilities necessary to the mining operation. The property is know as the "corridor".**

Pending litigation Yes ☐ No ☒

Ronald K Bird 3/9/10 EVP

Signature of Affiant Date Position

Sworn to before me and subscribed in my presence this 9 day of, March, 20 10

Tia N Tysinger

Notary Public

NOTARIAL SEAL STATE OF OHIO

TIA N. TYSINGER
Notary Public, State of Ohio
My Commission Expires
August 18, 2013

Part 1: Section C

02/06
DNR-744-9060

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

RIGHT-OF-ENTRY AFFIDAVIT

Applicant's Name **Buckingham Coal Co., Inc.**

RIGHT-OF-ENTRY AFFIDAVIT

State of **Ohio**, **Perry** County, ss. **Ronald K. Bird** being first duly sworn, says that the following described documents convey to the applicant the legal right explained below and is a subject of litigation as shown below.

Type of document **Coal Mining Lease**

Execution Date **January 11, 2010**

Expiration Date **5 years with an option to extend for four 5 year terms or until mining operations cease**

Parties: From **State Of Ohio, Ohio Department of Natural Resources** to **Buckingham Coal Co., Inc.**

Description of land: Number of Acres **+/- 76**

County **Morgan** Township **Union**

Section **30** Lot **N/A**

Explanation of legal rights claimed **To enter under the premises for mining, removal of all coal and to operate, and maintain any facilities necessary to the mining operation. The property is described as the West half of the Northwest quarter of Section 30. Excepting 4 acres off the South half.**

Pending litigation Yes ☐ No ☒

Ronald K Bird 3/5/2010 EVP

Signature of Affiant Date Position

Sworn to before me and subscribed in my presence this 5 day of, March, 20 10

Tia N. Tysinger

Notary Public

NOTARIAL SEAL STATE OF OHIO

TIA N. TYSINGER
Notary Public, State of Ohio
My Commission Expires
August 18, 2013

02/06
DNR-744-9060

MAR 0 8 2010

The following four pages and Exhibits A and B are an addendum to Part 1, C(7).

Tim Linn

From: Loucas, Cathryn [Cathryn.Loucas@dnr.state.oh.us]
Sent: Wednesday, March 10, 2010 4:40 PM
To: Heavilin, Brent; Emmons, Jeff
Cc: Erdos, Lanny; Milleson, Rich
Subject: Buckingham Coal Transfers
Importance: High
Attachments: Buckingham_Exchange 131.40.pdf

Gentlemen: Attached please find a document entitled "Agreement for Exchange of Coal Rights." This document expresses the intention of the parties to prepare and execute all necessary documents to effectuate the transfer of mineral rights as identified in the Agreement. The Agreement has been signed by all relevant parties with interest in the identified parcels, including Buckingham Coal, Division of Parks, the Department of Natural Resources, the Governor and the Attorney General. No other party has an interest in the lands or parcels identified in the Agreement. Despite such intent, all relevant deeds have not been finalized. Since it is the intent of the parties to transfer the interest in said properties, thereby giving Buckingham legal access to the area for the purpose of carrying out underground mining activities as described in the Agreement and other related documents, the Department agrees to grant Buckingham permission to enter the described properties for said purpose until such time as the Deeds are finalized. When the Deeds are finalized there should be no question regarding Buckingham's right to access the reserves, as well as, the properties in question.

Please let me know if you need anything else from the Director or the Department.

Cathryn N. Loucas
Chief Legal Counsel
Deputy Director, Resource Conservation
Ohio Department of Natural Resources
2045 Morse Road, Columbus, Ohio 43229
(614) 265-6882

AGREEMENT FOR EXCHANGE OF COAL RIGHTS

This **AGREEMENT** is made and entered into by and between the State of Ohio, Department of Natural Resources, acting by and through the Chief of the Division of Parks and Recreation pursuant to Section 1541.083 of the Ohio Revised Code, hereinafter known as "The State," and the Buckingham Coal Company, an Ohio corporation, with an office at 21525 State Route 13, P.O. Box 157, Glouster, Ohio, 45732 , hereinafter known as "Buckingham Coal Company."

WITNESSETH,

WHEREAS, The State and Buckingham Coal Company shall enter into the attached "Coal Mining Lease" on or before January 1, 2011 for the extraction of coal from beneath the surface of Burr Oak State Park, to wit: a 41.14 acre tract located in Section 30, Union Township, Morgan County, Ohio; and

WHEREAS, The State does hereby agree to exchange, give and grant over unto said Buckingham Coal Company its equity and interest in certain coal rights located in Burr Oak State Park and consisting of 131.4 acres of land, more or less, as described in attached Exhibit A; and

WHEREAS, Buckingham Coal Company does hereby agree to exchange, give and grant over unto the State its equity and interest in certain coal rights located in Burr Oak State Park and consisting of 131.4 acres of land, more or less, as described in attached Exhibit B; and

WHEREAS, both parties by acknowledgment are mutually desirous of the above exchange and conveyance unto each other of said lands and premises, as described in the attached Exhibits; and

WHEREAS, the Chief of the Division of Parks and Recreation has deemed the above exchange beneficial to the citizens of the State of Ohio; and

WHEREAS, this exchange is in the public interest and advantageous to the management of Burr Oak State Park;

MAR 0 8 2010

NOW THEREFORE, IN CONSIDERATION OF the above exchange and mutual conveyance of said lands as described above in attached Exhibits A and B the parties hereto agree unto each other to give good and sufficient deeds and clear title, for the coal rights, to said premises. Buckingham Coal Company shall, at closing tender a general warranty deed for the premises described in Exhibit B. The State shall tender a Governor's Deed for the premises described in attached Exhibit A.

FURTHERMORE, Buckingham Coal Company hereby agrees to pay all taxes and assessments on the premises described in Exhibit B to the date of closing. Also each party agrees to pay its own conveyance, transfer and recording expenses. Obligations of the State are subject to the provisions of Section 126.07 of the Ohio Revised Code.

IN TESTIMONY WHEREOF, both said parties have hereunto set their names on this __ day of _____, 2010.

Buckingham Coal Company

Ronald K Bird

Ronald K. Bird, Executive Vice President

STATE OF OHIO

COUNTY OF Perry

Before me a notary public in and for said County and State personally appeared the above named Ronald K. Bird, Executive Vice President who acknowledges that he did sign the foregoing instrument, and that the same is his free act and deed

In Testimony whereof I have hereunto set my hand and official seal at, Corning Ohio, this 22 day of January, 2010.

Tia N. Tysinger

Notary

My Commission Expires: Aug. 18, 2013

NOTARIAL SEAL STATE OF OHIO

TIA N. TYSINGER
Notary Public, State of Ohio
My Commission Expires
August 18, 2013

MAR 0 8 2010

FOR THE STATE OF OHIO:

John H Hunter

JOHN H. HUNTER, Chief
Division of Parks and Recreation

2-5-2010
Date

APPROVED:

Sean D Logan

SEAN D. LOGAN, DIRECTOR
Department of Natural Resources

February 9, 2010
Date

Ted Strickland

Ted Strickland, Governor
State of Ohio

March 1, 2010
Date

Richard H. Gw AAG for

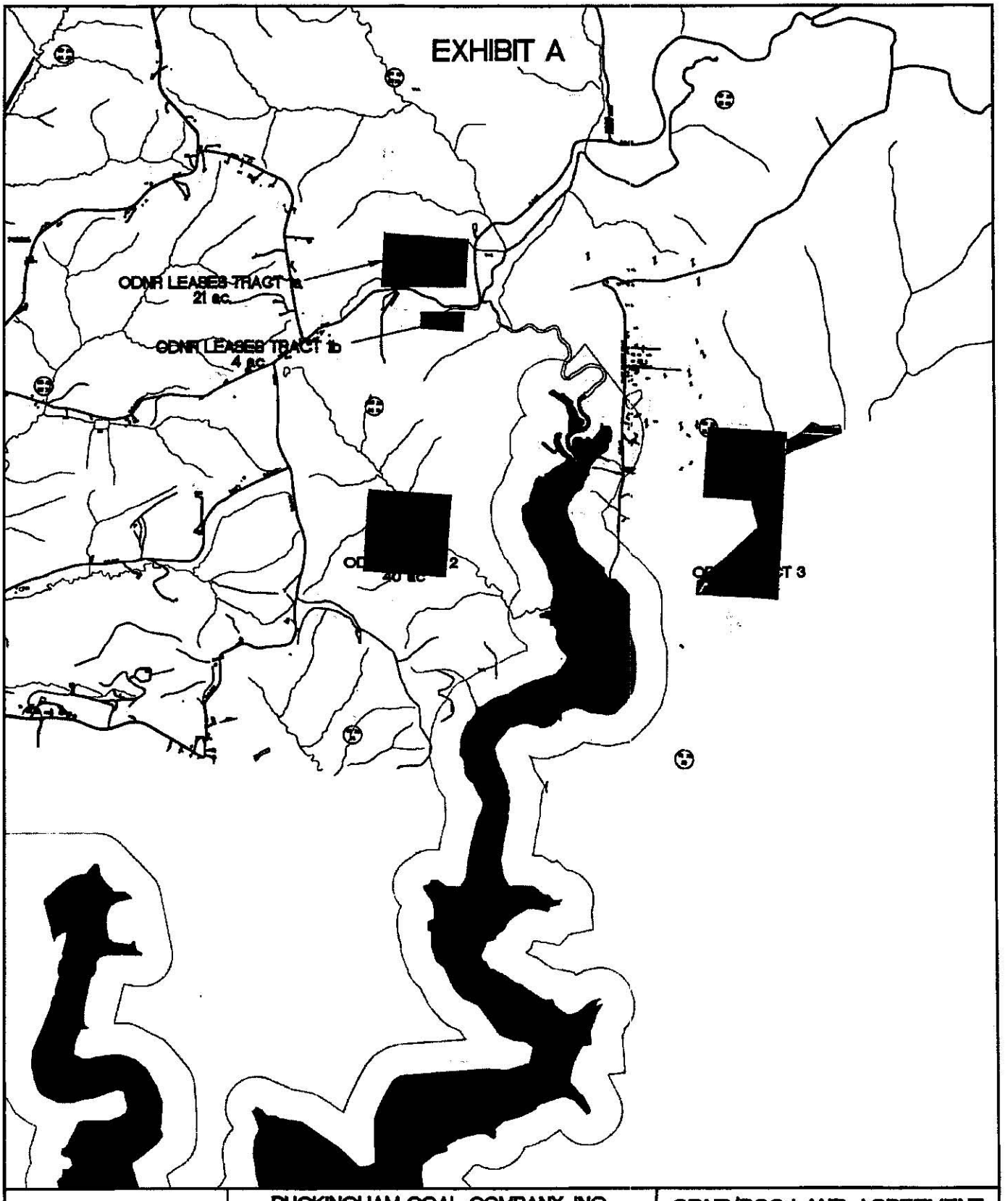
Richard Cordray
Attorney General of Ohio

2. 5. 10
Date

This instrument prepared by: Rachel Stelzer, Assistant Attorney General

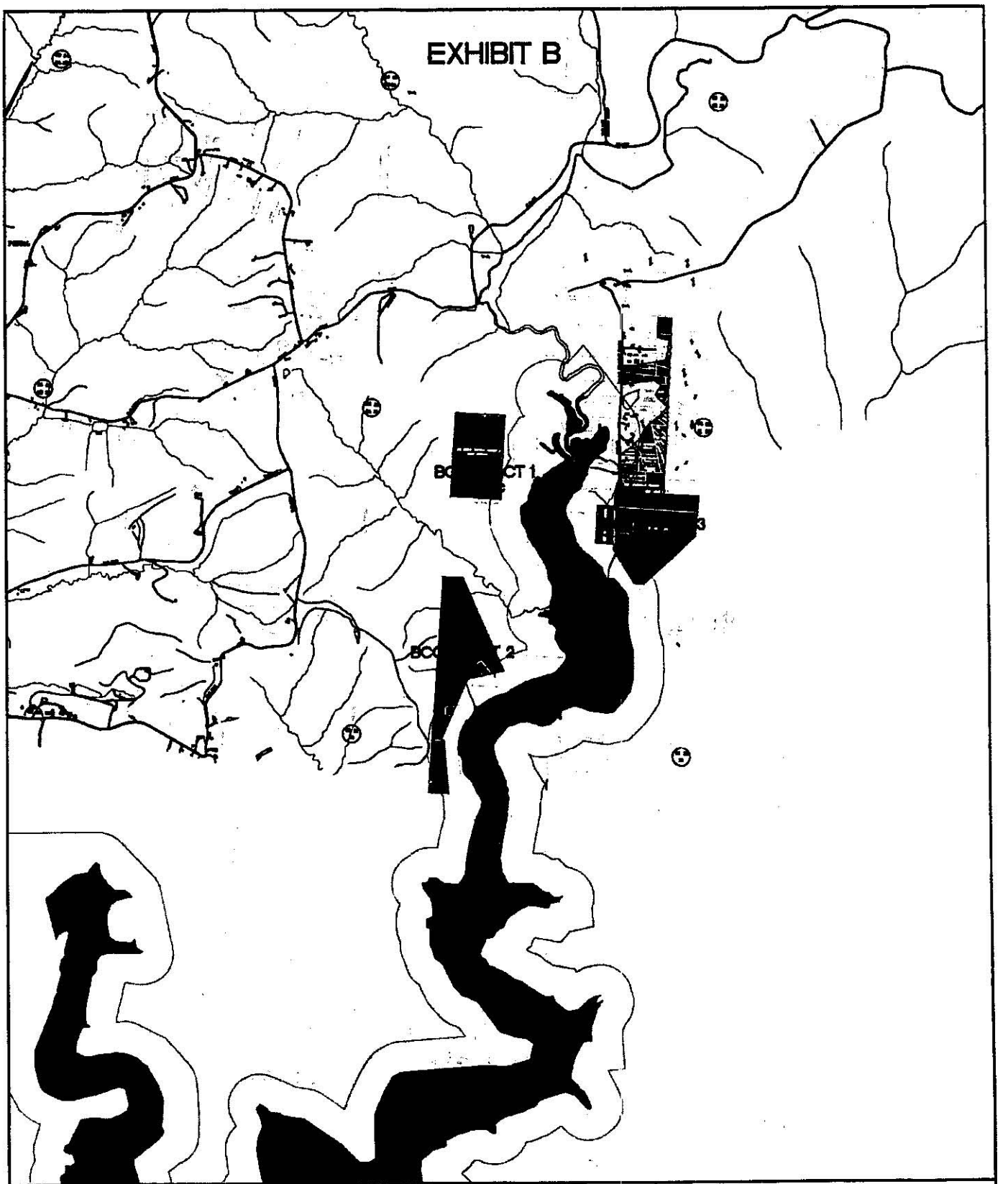
EXEMPT 12/87
M:\Common\realest\Land Exchange\1. Land Exchange Form.rtf

MAR 0 8 2010



ODNR PROPERTIES TO BUCKINGHAM COAL	BUCKINGHAM COAL COMPANY, INC. Buckingham Mine No.7 (Monroe Township, Perry County, Ohio) 9950 State Route 13 Glouster, OH 45732 State ID No. D-2223 MSHA ID No. 33-04520	ODNR/BCC LAND AGREEMENT FOR MINE #7 1" = 2000' 01/22/2010

MAR 0 8 2010



BUCKINGHAM COAL PROPERTIES TO ODNR	BUCKINGHAM COAL COMPANY, INC. Buckingham Mine No.7 (Monroe Township, Perry County, Ohio) 9980 State Route 13 Glouster, OH 45732 State ID No. D-2223 MSHA ID No. 33-04520	ODNR/BCC LAND AGREEMENT FOR MINE #7 1" = 2000' 01/22/2010

MAR 0 8 2010

D. AREAS WHERE MINING IS PROHIBITED OR LIMITED

(1) Is this application area within an area designated unsuitable for coal mining operations or under study for designation in an administrative proceeding?

Yes ☐ No ☒

If "yes," did the applicant make substantial legal and financial commitments in this application area prior to January 4, 1977? Yes ☐ No ☐ If "yes," provide documentation supporting the assertion that the commitments were made prior to January 4, 1977.

E. PERMIT TERM AND RELATED INFORMATION

(1) Anticipated/actual date for:

(a) Starting mining operations **3/2010**

(b) Terminating mining operations **11/21/2014**

(2) Does the applicant propose a permit term in excess of five (5) years?

Yes ☐ No ☒ If "yes," submit an addendum with the information required by 1501:13-4-03(E)(3), Ohio Administrative Code.

(3) Horizontal extent of shadow area over life of permit in acres:

(a) Full Coal Recovery/Longwall Mining Acreage **-0-**

(b) Room and Pillar Acreage **723.6**

(c) Total Acres **723.6** (Shadow Area)

F. PUBLIC NOTICE

(1) In the space below, provide the name and address of the public office where a complete copy of this permit application is to be filed.

MORGAN CO. RECORDER'S OFFICE
155 E MAIN STREET, ROOM 160
McCONNELSVILLE, OHIO 43756

MAR 0 8 2010

(2) In the space below, list the name and address of the newspaper and provide the text of the advertisement that is to be published in a newspaper of general circulation in the locality of this application area. Provide proof of publication.

The Morgan Co. Herald
89 West Main Street
P.O. Box 268
McConnelsville, Ohio 43756

Buckingham Coal Company, Inc., P.O. Box 157, Glouster, Ohio 45732-0157 has submitted an underground coal mining and reclamation application numbered D-2223-3 to the Ohio Department of Natural Resources, Division of Mineral Resources Management. The application area is located in Morgan County, Union Township, Sections 19, 20, 29 and 30, T-8N; R-13W. The application contains 1248.2 undergound acres and is located on the Corning 7-1/2 minute USGS quadrangle map, approximately 3 miles south and east of Corning, Ohio. The underground area will remove coal by room and pillar method.

The application is on file at the the Morgan County Recorder's Office, 155 E. Main Street, Room 160, McConnelsville, Ohio 43756, for public viewing. Written comments or requests for informal conference may be sent to the Division of Mineral Resources Management, 2050 E Wheeling Avenue, Cambridge, Ohio 43725-2159 within thirty (30) days after the last date of publication of this notice.

BUCKINGHAM COAL CO., INC.
APPLICATION NO. D-2223-3
ADDENDUM TO PT 1, ITEM F(2)

Buckingham Coal Company, Inc., P.O. Box 157, Glouster, Ohio 45732-0157 has submitted an underground coal mining and reclamation application numbered D-2223-3 to the Ohio Department of Natural Resources, Division of Mineral Resources Management. The application area is located in Morgan County, Union Township, Sections 19, 20, 29 and 30, T-8N; R-13W. The application contains 1248.2 underground acres and is located on the Corning 7-1/2 minute USGS quadrangle map, approximately 3 miles south and east of Corning, Ohio. The underground area will remove coal by room and pillar method.

The application is on file at the Morgan County Recorder's Office, 155 E. Main Street, Room 160, McConnelsville, Ohio 43756, for public viewing. Written comments or requests for informal conference may be sent to the Division of Mineral Resources Management, 2050 E. Wheeling Avenue, Cambridge, Ohio 43725-2159 within thirty (30) days after the last date of publication of this notice.

33-4

I, THE UNDERSIGNED, HEREBY VERIFY THAT THIS IS A TRUE COPY OF THE ORIGINAL.

Tara C. Wilson 10/14/2009

NOTARIAL SEAL STATE OF OHIO

TARA C. WILSON
Notary Public, State of Ohio
My Commission Expires
April 22, 2013

DEC 11

PROOF OF PUBLICATION

STATE OF OHIO, MORGAN COUNTY, ss:

Helen Bickley, being first duly sworn, says: that she is the agent of the Morgan County Publishing Co., an Ohio corporation of McConnelsville, Ohio, the publisher of the Morgan County Herald, a newspaper of general circulation printed in McConnelsville, Morgan County, Ohio; that a notice of advertisement, of which the attached is a true copy, was published in said newspaper once a week on Wednesday for **4** consecutive week(s) on and next after the **19th** day of **August**, **2009**.

Helen Bickley

Sworn to and subscribed before me this 11th day of September 2009.

Sara Lee Hurst

Sara Lee Hurst
Notary Public, Morgan County, Ohio

SARA LEE HURST
Notary Public, State of Ohio
My Commission Expires March 13, 2011

Advertising Cost:	$ 139.96
Notary Fee:	$ 1.50
TOTAL:	**$ 141.46**

Buckingham Coal Company

Underground Coal Mining Application #D-2223

PART 2: ENVIRONMENTAL RESOURCES INFORMATION

A. CULTURAL, HISTORIC, AND ARCHEOLOGICAL INFORMATION

(1) In order to address the nature of cultural, historic and archeological resources in planned subsidence operations, submit Archeology - Underground.

(2) Submit an addendum indicating the method to be used to identify historic properties on planned subsidence areas as mining progresses.

B. GEOLOGY DESCRIPTION

(1) Submit an addendum describing the geology within the proposed shadow and adjacent areas and down to and including the deeper of either the first stratum below the lowest coal seam to be mined or any aquifer below the lowest coal seam to be mined which may be adversely affected by mining. The description shall also include information on the areal and structural geology of the shadow and adjacent areas and any other geologic parameters, which may influence the probable hydrologic consequences and protection of the hydrologic balance from material damage outside of the permit area, and which may influence the required reclamation.

(2) Submit an addendum describing how the areal and structural geology may affect the occurrence, availability, movement, quantity, and quality of potentially affected surface and ground waters.

(3) For those areas within the shadow area where the stratum above the coal seam to be mined will not be removed, submit Drilling Report - Underground. Submit approved test hole variance request, if applicable.

C. GROUND WATER INFORMATION

(1) Submit Ground Water Description that describes the ground water hydrology of the proposed shadow area and adjacent area. The Ground Water Description is to include information on each water-bearing stratum or zone, including the first water-bearing stratum below the coal to be mined.

(2) Are there any wells on the proposed shadow area and adjacent area? Yes ☒ No ☐ If "yes," submit Ground Water Inventory.

(3) Are there any developed springs on the shadow area and adjacent area? Yes ☒ No ☐ If "yes," submit Ground Water Inventory, and show location on the hydrology map. Also, show location of undeveloped springs on the hydrology map.

(4) Are there any public water supply sources on the proposed shadow area and adjacent area? Yes ☐ No ☒ If "yes," submit Ground Water Inventory, and show location on the hydrology map.

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Part 2, A(1) and A(2)
This application does not propose planned subsidence.

Addendum to Part 2, B(1) and B(2) **REV. 1**
In addition to the response in the original application. The proposed adjacent area is a moderately sized area adjoining the east side of the original shadow area. As applicable to the proposed area, mining on D-2223 has not produced any areas of subsidence or any adverse impact to surface or ground waters.

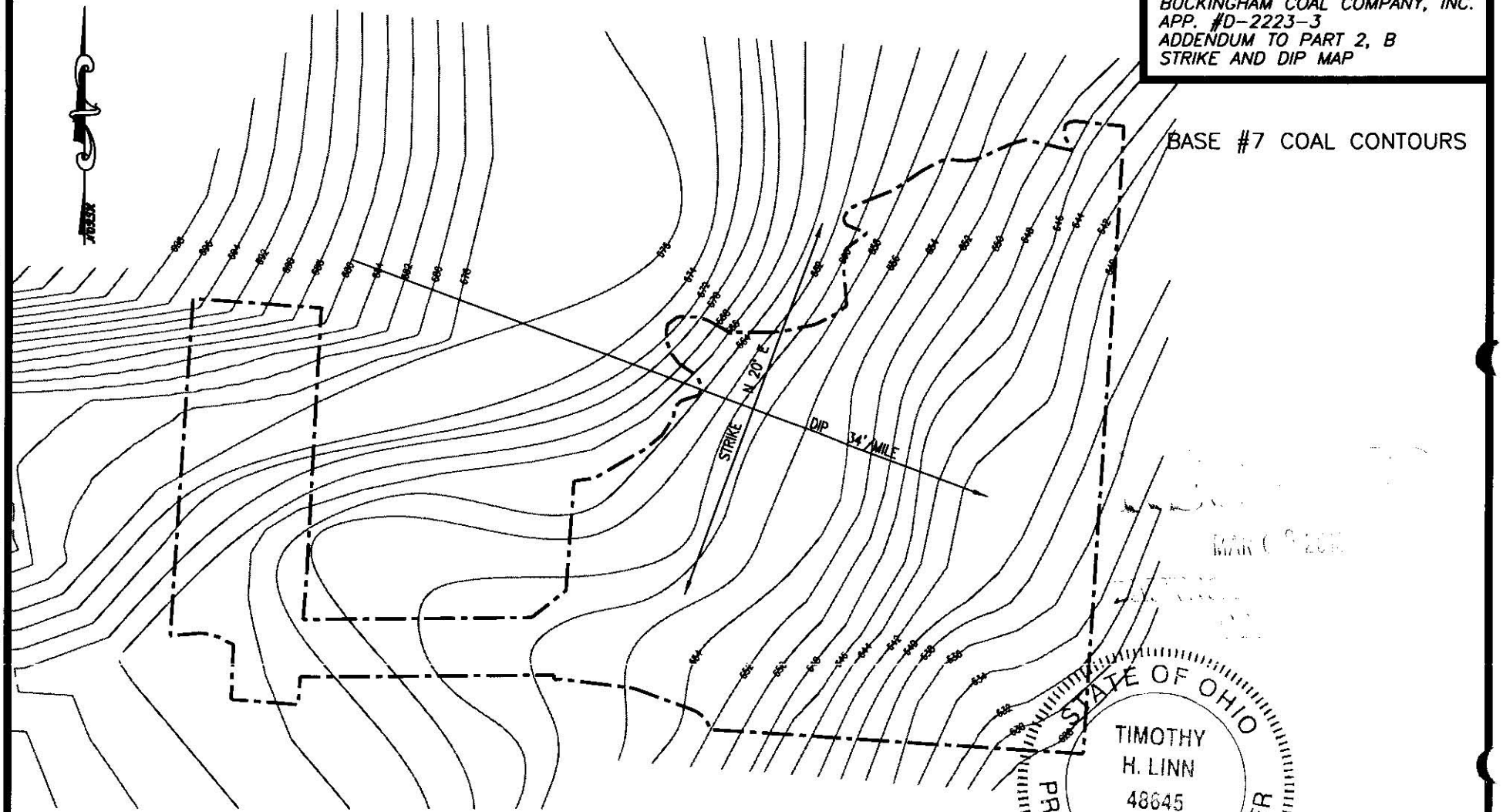
THE UPPER FREEPORT (NO.7) COAL WILL BE MINED BY ROOM AND PILLAR METHOD THROUGHOUT THE SHADOW AREA. THERE IS NO PLANNED SUBSIDENCE IN THIS AREA. THE AVERAGE COAL THICKNESS OF THE NO. 7 COAL WITHIN THE SHADOW AREA IS 42 INCHES. ACCORDING TO DRILL LOGS ANALYSES THE AVERAGE TOTAL SULFUR OF THE NO. 7 COAL IN THE SHADOW AREA IS 2.7 %. THE BASE OF COAL RANGES IN ELEVATIONS FROM 694 TO 628. INSIDE THE SHADOW AREA THE COAL GENERALLY DIPS TO THE SOUTH AND EAST AT AN AVERAGE RATE OF 34'/MILE.

DRILL REPORT UNDERGROUND SHOWS THE STRATIGRAPHY WITHIN THE SHADOW AREA, WHICH IS GENERALLY VARYING SHALE AND SANDSTONE STRATA. THE ROOF IS A PERSISTENT GRAY SHALE AND THE FLOOR IS DESCRIBED FROM DRILL LOGS AS EITHER A FIRE CLAY OR GRAY SHALE. THIS IS GENERALLY THE SAME AS THE ORIGINAL D-2223 AREA.

THE BASE OF NO. 7 IS SHOWN ON THE STRIKE AND DIP MAP SUBMITTED AS AN ADDENDUM TO THIS ITEM. THE CONTOURS SHOW A SOUTHEAST-PLUNGING SYNCLINE UNDERLING THE SOUTHWESTERN PORTION OF THE DEEP MINE AND A SOUTHEAST-PLUNGING ANTICLINE UNDERLING THE NORTHWEST PORTION OF THE PROPOSED DEEP MINE.

F:\COAL\CAD\BUCK\Burr Oak\D-2223\D-2223-3 (Bishopville)\D-2223-3 App-Hyd-REV2.dwg, 3/5/2010 1:41:49 PM, KHK

BUCKINGHAM COAL COMPANY, INC.
APP. #D-2223-3
ADDENDUM TO PART 2, B
STRIKE AND DIP MAP



GRAPHIC SCALE

1500 0 750 1500 3000

(IN FEET)
1 inch = 1500 ft.

MAR 0 8 2010

STATE OF OHIO
TIMOTHY H. LINN
48645
REGISTERED
PROFESSIONAL ENGINEER

Timothy H. Linn, P.E., P.S.

3/8/10
Date

Linn Engineering, Inc. 740-452-7434
Civil Engineering Consultants
P.O. Box 2086 Zanesville, Ohio 43702-2086

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **398B**

State Plane Coordinates: X **2105407** Y **573636** Surface Elevation **937.7**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		2	
Subsoil		4	clay
Shale		6.2	gray
Sandstone		3.7	
Shale		15.9	gray
Sandstone		6.5	
Shale		30.1	gray, sandstone bands
Sandstone		11.0	shale bands
Shale		96.1	hard, gray
Sandstone		2.0	
Shale		9.5	gray
Sandstone		5.0	
Shale		23.2	gray
Sandstone		3.6	

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **398B**

State Plane Coordinates: X **2105407** Y **573636** Surface Elevation **937.7**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil			
Subsoil			
Shale		**11.2**	**gray**
Sandstone		**44.9**	
Shale		**1.8**	
Coal #7		**4.5**	
Fire Clay		**1.4**	

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Shale	**1.57**	**1.27**	**49.06**	**38.74**	**10.32**
Coal #7	**2.39**	**1.32**	**74.69**	**-45.83**	**120.52**
Fire Clay	**1.96**	**0.85**	**61.25**	**52.18**	**9.07**

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **428B**

State Plane Coordinates: X **2107101** Y **571527** Surface Elevation **778.3**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		2.9	
Subsoil		10	clay
Shale		61.1	gray
Sandstone		65.2	gray
Shale		2.2	gray
Coal #7		4.7	
Fire Clay		1.9	

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Gray Shale	0.96	0.63	30	31.22	-1.22
Coal #7	2.35	1.95	73.44	-28.28	101.72
Fire Clay	1.22	0.98	38.13	26.66	11.47

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **483B**

State Plane Coordinates: X **2101783** Y **577692** Surface Elevation **747.0**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		3.2	
Subsoil		6.0	
Shale		18.7	gray
Sandstone		18.0	shale streaks
Shale		3.5	gray
Sandstone		14.8	
Shale		3.7	dark
Coal #7		2.6	
Shale		3.6	gray

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Dark Shale	1.74	1.24	54.38	46.14	8.24
Coal #7	3.02	1.94	94.38	-4.03	98.41
Fire Clay	1.61	1.12	50.31	20.09	30.22

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **575B**

State Plane Coordinates: X **2100511** Y **573256** Surface Elevation **729.4**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		2.2	
Subsoil		14.0	clay, shale bands
Sandstone		39.7	
Shale		9.1	gray
Coal #7		4.2	
Shale		4.8	gray

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Gray Shale	1.29	1.02	40.31	40.83	-0.52
Coal #7	2.91	2.32	90.94	-14.27	105.21
Gray Shale	1.32	1.11	41.25	9.17	32.08

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **607C**

State Plane Coordinates: X **2103538** Y **576257** Surface Elevation **747.2**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		2.0	
Subsoil		10.0	clay
Shale		14.8	gray
Sandstone		38.6	
Shale		3.8	gray
Coal #7		1.0	
Shale		9.8	gray

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Gray Shale	1.33	1.07	41.56	26.31	15.25
Coal #7	3.05	2.74	95.31	-21.16	116.47
Gray Shale	1.62	1.21	50.63	23.54	27.09

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **626C**

State Plane Coordinates: X **2102933** Y **573825** Surface Elevation **735.4**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		2.0	
Subsoil		12.2	dark clay
Shale		24.8	gray
Sandstone		21.2	gray
Shale		5.9	gray
Coal #7		3.9	
Fire Clay		2.0	

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Gray Shale	0.97	0.83	30.31	31.23	-0.92
Coal #7	2.32	1.19	72.5	-26.04	98.54
Fire Clay	1.02	0.77	31.88	25.81	6.07

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

DRILLING REPORT - UNDERGROUND

Applicant's Name **Buckingham Coal Company, Inc.** Drill Hole # **632B**

State Plane Coordinates: X **2106966** Y **573753** Surface Elevation **829.3**

Lithology	H_2O*	Thickness	Physical Properties
Topsoil		2.5	
Subsoil		5.1	clay
Shale		58.8	gray with red bands
Sandstone		37.1	shale band
Shale		15.3	gray
Sandstone		59.9	
Shale		6.4	gray
Coal #7		4.1	
Fire Clay		1.8	

Submit the following information for the stratum above the coal seam, the coal seam, and the stratum below the coal seam.

Stratum	Total Sulfur %	Pyrite Sulfur %	Potential Acidity Mg/l as $CaCO_3$	Neutralization Potential (1000 Tons)	$CaCO_3$ Deficiency (1000 Tons)
Gray Shale	1.24	0.89	38.75	40.04	-1.29
Coal #7	2.64	2.11	82.5	-34.71	117.21
Fire Clay	1.27	0.63	39.69	14.66	25.03

* Indicate waterbearing stratum with an asterisk (*) under column labeled H_2O

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Part 2, B(3) **REV. 2**

Area	Coal Acres	Number of Drill Reports
Shadow area D-2223	1306.1	9
Shadow area D-2223-1	-0-	1
Shadow area D-2223-2	320.2	1
Shadow area D-2223-3	~~1248.2~~ 723.6	7
Total	~~2874.5~~ 2349.9	18

Nine Drilling Report-Underground(s) (formerly Attachment 13) were submitted with the original permit application, one Drilling Report-Underground was submitted for D-2223-1 and one Drilling Report-Underground was submitted for D-2223-2. These previously submitted reports would cover 11 reports x 160 acres/report =1760 acres. With this AAPA, a grand total of ~~2874.5~~ 2349.9 coal acres will be permitted, which requires ~~18~~ 15 drill reports. DURING THE PROCESSING OF THIS APPLICATION THE ACREAGE WAS REDUCED TO 723.6 ACRES DUE TO CHANGES IN THE MINING PLAN. Therefore, seven additional Drilling Report-Underground(s), are submitted for this Adjacent Area Application.

TYPICALLY DRILL HOLES LOCATED IN THE FLOODPLAINS OF PERENNIAL STREAMS TEND TO BE SATURATED WITH WATER. HOLES 575B, 607C, 626C AND 483B ARE LOCATED WITHIN FLOODPLAINS. THE DRILL LOGS FOR THESE HOLES SHOWED NO WATER PRESENT. IT'S POSSIBLE THE DRILLER FAILED TO NOTE WHERE WATER WAS ENCOUNTERED WHILE LOGGING THE HOLE. THE LOGS FOR THE HOLES ARE AS RECEIVED AND IT IS IMPOSSIBLE TO IDENTIFY WHERE WATER LIES WITHIN THE STRATA OF THE FLOODPLAIN IF NOT NOTED.

Hydrogeologic section E-E terminates at hole #426B and hydrogeologic section F-F terminates at hole #681C. The logs for these holes are submitted for reference.

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Buckingham Coal Company, Inc.
App. #D-2223-3
Addendum to Part 2, B(3) REV. 1

Drillhole	Northing	Easting	Surf.Elev.	Density	Type	Quality
426B	569749.90	2107783.65	784.50	80.00	0	1 1

Descript.: STATE=OH
MINE=0116
CNTY=115
DRILLER=JH
DRILL_EQUIP=ROT

Strata	Bed	Depth	Elevation	Thick.	Key	Attributes
OB_7C_UNC	OB_7C_	15.50	769.00	15.50	N	DESC1=CL DESC2=SH
OB_7C_SH4	OB_7C_	66.30	718.20	50.80	N	DESC1=HRD DESC2=SS DESC3=GRY
OB_7C_SS3	OB_7C_	76.40	708.10	10.10	N	
OB_7C_SH3	OB_7C_	101.40	683.10	25.00	N	DESC1=HRD DESC2=SS DESC3=GRY
FC2	FC2	110.00	674.50	8.60	N	DESC1=LGT DESC2=SH
OB_7C_SS2	OB_7C_	116.00	668.50	6.00	N	
OB_7C_SH2	OB_7C_	127.40	657.10	11.40	N	DESC1=RED DESC2=GRY
OB_7C_SS1	OB_7C_	164.40	620.10	37.00	N	DESC1=HRD
OB_7C_SH1	OB_7C_	166.40	618.10	2.00	N	DESC1=HRD DESC2=SS DESC3=GRY
7C	7C	169.90	614.60	3.50	Y	
FC1	FC1	171.00	613.50	1.10	N	

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Buckingham Coal Company, Inc.
App. #D-2223-3
Addendum to Part 2, B(3) REV. 1

Drillhole	Northing	Easting	Surf.Elev.	Density	Type	Quality
681C	575041.36	2109705.19	1096.60	80.00	1	1 1

Descript.: STATE=OH
MINE=0116
CNTY=115
DRILLER=APW
DRILL_EQUIP=ROT

Strata	Bed	Depth	Elevation	Thick.	Key	Attributes
OB_7C_UNC	OB_7C_	5.50	1091.10	5.50	N	DESC1=CL
OB_7C_SH5	OB_7C_	93.00	1003.60	87.50	N	DESC1=RED
OB_7C_SS4	OB_7C_	102.50	994.10	9.50	N	DESC1=SH
						DESC2=BND
OB_7C_SH4	OB_7C_	105.30	991.30	2.80	N	DESC1=GRY
OB_7C_SS3	OB_7C_	134.80	961.80	29.50	N	DESC1=SH
						DESC2=BND
OB_7C_SH3	OB_7C_	198.30	898.30	63.50	N	DESC1=GRY
OB_7C_SS2	OB_7C_	314.80	781.80	116.50	N	DESC1=LS
						DESC2=BND
OB_7C_SH2	OB_7C_	365.80	730.80	51.00	N	DESC1=RED
						DESC2=GRY
						DESC3=STK
OB_7C_SS1	OB_7C_	461.80	634.80	96.00	N	DESC1=SH
						DESC2=BND
OB_7C_SH1	OB_7C_	467.30	629.30	5.50	N	DESC1=GRY
7C	7C	469.30	627.30	2.00	Y	
FC	FC	470.50	626.10	1.20	N	

DEC 1 1

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Part 2, C(1)

The additional shadow area proposed in this AAPA does not encounter any new groundwater conditions or conditions that substantially differ from those addressed in the original permit application. Refer to the groundwater hydrology described in the original permit application as Attachments 14B and 14C, which serves as Groundwater Description.

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Hydrologic Analyses **REV. 1**

There are numerous stream hydro sites and springs for which sampling was not possible due to no flow. The dates on which sampling was attempted are shown on the Hydrologic Analyses form. In addition, streams shown as intermittent on the map with no hydro sampling site have no surface flow. These streams have a defined bed and bank and are mainly composed of cobble, sand and alluvium materials. Several attempts during each flow period were made to capture samples on these streams, but flow was apparently subsurface. According to area residents, these streams only have surface flow during and shortly after rain.

ON HYDROLOGIC ANALYSES FORM, ROW 7, THE UNITS OF FLOW ARE 'GPM'.

Addendum to Surface Water Inventory and Ground Water Inventory

X and Y coordinates are based on State Plane NAD83 south zone.

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

GROUND WATER INVENTORY

APPLICANT'S NAME: Buckingham Coal Company, Inc. REV. 2

FEB 0 2 2010

ID No. Of Sampling Site from Hydrology Map	State Plane X-Y Coordinates	Surface Elevation (ft msl)	Depth of Well Below Land Surface (feet)*	SWL of Well Below Land Surface (ft)*	Discharge for Spring, Under-ground Mine, etc. (gpm or cfs)*	Date Measured	Aquifer/ Water-bearing Zone ID*	Known Uses, including public water	Name of Owner
WL-900	X 2,102,391 Y 572,307	835	90 (L)	40 (L)	n/a	see Hydro Analyses	C,D	domestic	Nellie Cherevas
WL-928	X 2,108,298 Y 575,049	1,085	118 (L)	89 (L)	n/a	see Hydro Analyses	B	domestic	John Miller / Elizabeth Dilleha
W-935	X 2,106,698 Y 574,993	915	200 (R)	200 (R)	n/a	see Hydro Analyses	C,D	domestic	Sharon Williams
WL-936	X 2,101,555 Y 572,207	820	134 (M)	74 (M)	n/a	see Hydro Analyses	C,D	not used	State of Ohio
WL-941	X 2,099,450 Y 572,525	820	125 (L)	47 (L)	n/a	*	C,D	*	State of Ohio
DS-929	X 2,107,074 Y 576,980	765	n/a	n/a	n/a	see Hydro Analyses	C	domestic	George H. & Freda F. Makatura
DW-940	X 2,104,260 Y 572,631	948	*	*	n/a	*	C	not used formerly domestic	Merrill Gladden
DW-945	X 2,106,518 Y 574,929	935	50	*	n/a	*	A	not used formerly domestic	Jerry Lemon, Sr.
DW-1006	X 2,106,816 Y 577,324	737	UNKNOWN (R)	14 (R)	n/a	see Hydro Analyses	E	domestic	Mark Simkins
	X Y								

*NOTE: If well depth, static water level, or aquifer/water-bearing zone information is unobtainable, submit as an addendum to GROUND WATER INVENTORY a statement giving the reasons why the information is unobtainable. Do not include SWL and discharge value

05/08

DNR-744-9083

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Part 2, C(5)
Seasonal variations of groundwater quality and quantity are addressed in the original permit application.

Addendum to Part 2, D(3)
Seasonal variations of surface water quality and quantity are addressed in the original permit application, as well as Addendum to Hydrologic Analysis and Addendum to Part 3, C(2) submitted with this permit application.

(5) Submit required analyses on the Hydrologic Analyses for representative wells and developed springs. Based on the data on the Ground Water Inventory and Hydrologic Analyses, identify the seasonal variations of ground water quality and quantity.

(6) Submit Analysis of Existing Ground Water File Data from the Division of Water. **REFER TO RESPONSE IN ORIGINAL PERMIT APPLICATION**

D. SURFACE WATER INFORMATION

(1) List the name of the watershed that will receive water discharges from the proposed shadow and adjacent areas as listed in the "Gazetteer of Ohio Streams" published by the Ohio Department of Natural Resources.

EAST BRANCH OF SUNDAY CREEK TO HOCKING RIVER

(2) Are there any perennial or intermittent streams or other surface water bodies, including public water supply sources, on the proposed shadow area and adjacent area?

Yes ☒ No ☐ If "yes," submit Surface Water Inventory and Hydrologic Analyses.

(3) Based on the quality and quantity measurements listed on Surface Water Inventory and Hydrologic Analyses, and from other information available to the applicant and submitted with this application, identify the seasonal variations in water quality and quantity for the surface water sources on this application area and adjacent areas.

REFER TO ADDENDUM TO PART 2, D(3) AND THE RESPONSE IN THE ORIGINAL PERMIT APPLICATION.

E. CLIMATOLOGICAL INFORMATION

If requested by the chief, subsequent to the filing of the permit application, provide the climatological information.

N/A

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	D-907	D-907	D-907	D-912	D-912	D-912
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/06/09 03/24/09	08/25/08 10/28/08	03/06/09 03/24/09	12/31/08 06/16/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	H	I
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09	08/05/08 10/25/08	03/01/09 03/19/09	12/28/08 06/11/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0	0	0	0
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	D-913	D-913	D-913	D-920	D-920	D-920
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/06/09 03/24/09	08/25/08 10/28/08	12/31/08 06/16/09	03/06/09 03/24/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09	08/05/08 10/25/08	12/28/08	03/01/09 03/19/09
6	Static Water Level of Well below Land Surface (feet)*		---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0	0	0	0
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	D-924	D-924	D-924	D-926	D-926	D-926
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/04/09 03/24/09	08/25/08 10/28/08	12/31/08 06/16/09	03/04/09 03/24/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0	0	0	0
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	U-908	U-908	U-908	U-910	U-910	U-910
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/06/09 03/24/09	08/25/08 10/28/08	12/31/08 06/16/09	03/04/09 03/24/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0	0	0	0
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.** **REV. 1**

1	ID No. of Sampling Site From Hydrology Map	U-916	U-916	U-916			
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/04/09 03/24/09			
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H			
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09			
6	Static Water Level of Well below Land Surface (feet)*	---	---	---			
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0			
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	U-921	U-921	U-921	U-923	U-923	U-923
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/04/09 03/24/09	08/25/08 10/28/08	12/31/08 06/16/09	03/06/09 03/24/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0	0	0	0
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	D-906	D-906	D-906	D-925	D-925	D-925
2	Lab ID No.	0825-07	1231-03	0324-01		0306-05	0616-04
3	Date Measured/Sampled	08/25/08	12/31/08	03/24/09	08/25/08 10/28/08	03/06/09	06/16/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	H	I
5	Date Last Precipitation Event (if applicable)	08/05/08	12/28/08	03/19/09	08/05/08 10/25/08	03/01/09	06/11/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	85	250	300	0	1	1
8	pH (Standard Units)	7.1	7.0	7.3		7.1	7.4
9	Total Acidity (mg/l $CaCO_3$)	0	0	0		0	0
10	Total Alkalinity (mg/l $CaCO_3$)	106	84	70		131	119
11	Total Iron (mg/l)	0.77	0.27	0.88		0.03	0.08
12	Total Manganese (mg/l)	0.9	0.1	0.5		0	0
13	Total Aluminum (mg/l)	0.023	0	0.011		0	0
14	Total Suspended Solids (mg/l)	36	9	7		8	4
15	Total Hardness (mg/l as $CaCO_3$)	133	109	147		123	136
16	Total Sulfates (mg/l)	30	30	40		35	20
17	Specific Conductivity (umhos/cm at 25°C)**	230	185	260		230	210
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	D-927	D-927	D-927	D-932	D-932	D-932
2	Lab ID No.		0306-07	0616-06	0825-10	1231-13	0324-10
3	Date Measured/Sampled	08/25/08 10/28/08	03/06/09	06/16/09	08/25/08	12/31/08	03/24/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	H	I	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	03/01/09	06/11/09	08/05/08	12/28/08	03/19/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	1.5	1	10	20	20
8	pH (Standard Units)		7.2	7.4	7.1	7.4	7.1
9	Total Acidity (mg/l $CaCO_3$)		0	0	0	0	0
10	Total Alkalinity (mg/l $CaCO_3$)		145	123	50	60	40
11	Total Iron (mg/l)		0.02	0.03	0.01	0.06	0.03
12	Total Manganese (mg/l)		0.1	0.1	0.1	0.1	0.1
13	Total Aluminum (mg/l)		0	0.009	0	0	0
14	Total Suspended Solids (mg/l)		4	4	3	1	1
15	Total Hardness (mg/l as $CaCO_3$)		125	155	145	85	65
16	Total Sulfates (mg/l)		60	35	70	40	35
17	Specific Conductivity (umhos/cm at 25°C)**		220	260	160	110	70
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	D-933	D-933	D-933			
2	Lab ID No.		1231-04	0324-05			
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08	03/24/09			
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H			
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08	03/19/09			
6	Static Water Level of Well below Land Surface (feet)*	---	---	---			
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	10	15			
8	pH (Standard Units)		6.9	7.1			
9	Total Acidity (mg/l $CaCO_3$)		0	0			
10	Total Alkalinity (mg/l $CaCO_3$)		66	72			
11	Total Iron (mg/l)		0.04	0.01			
12	Total Manganese (mg/l)		0.2	0.2			
13	Total Aluminum (mg/l)		0	0			
14	Total Suspended Solids (mg/l)		1	0			
15	Total Hardness (mg/l as $CaCO_3$)		86	78			
16	Total Sulfates (mg/l)		25	35			
17	Specific Conductivity (umhos/cm at 25°C)**		150	120			
18	Total Dissolved Solids (mg/l)**	---	---	---			

Laboratory Name: **Linn Engineering, Inc.**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	P-934	P-934	P-934			
2	Lab ID No.	1028-01	0306-09	0630-02			
3	Date Measured/Sampled	10/28/08	03/06/09	06/30/09			
4	High (H), Low (L), Intermediate(I) (if applicable)	L	H	I			
5	Date Last Precipitation Event (if applicable)	10/25/08	03/01/09	06/25/09			
6	Static Water Level of Well below Land Surface (feet)*	---	---	---			
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0			
8	pH (Standard Units)	7.1	7.2	7.2			
9	Total Acidity (mg/l $CaCO_3$)	0	0	0			
10	Total Alkalinity (mg/l $CaCO_3$)	125	158	113			
11	Total Iron (mg/l)	0.08	0.15	0.14			
12	Total Manganese (mg/l)	0.1	0.1	0.1			
13	Total Aluminum (mg/l)	0.029	0.003	0.015			
14	Total Suspended Solids (mg/l)	8	34	8			
15	Total Hardness (mg/l as $CaCO_3$)	60	110	91			
16	Total Sulfates (mg/l)	0	0	0			
17	Specific Conductivity (umhos/cm at 25°C)**	190	90	125			
18	Total Dissolved Solids (mg/l)**	---	---	---			

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.** **REV. 1**

1	ID No. of Sampling Site From Hydrology Map	U-915	U-915	U-915	U-919	U-919	U-919
2	Lab ID No.		1231-19	0324-06		1231-20	0304-06
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08	03/24/09	08/25/08 10/28/08	12/31/08	03/04/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08	03/19/09	08/05/08 10/25/08	12/28/08	03/01/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0.5	0.5	0	1	3
8	pH (Standard Units)		7.4	7.1		7.4	7.5
9	Total Acidity (mg/l $CaCO_3$)		0	0		0	0
10	Total Alkalinity (mg/l $CaCO_3$)		68	64		59	44
11	Total Iron (mg/l)		0.03	0.02		0.05	0.02
12	Total Manganese (mg/l)		0.1	0.2		0.3	0.2
13	Total Aluminum (mg/l)		0	0		0	0
14	Total Suspended Solids (mg/l)		0	1		0	0
15	Total Hardness (mg/l as $CaCO_3$)		90	82		80	40
16	Total Sulfates (mg/l)		45	55		35	45
17	Specific Conductivity (umhos/cm at 25°C)**		135	150		115	145
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	U-909	U-909	U-909	U-911	U-911	U-911
2	Lab ID No.		1231-16	0306-08		1231-18	0304-09
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08	03/06/09	08/25/08 10/28/08	12/31/08	03/04/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H	L	I	H
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08	03/01/09	08/05/08 10/25/08	12/28/08	03/01/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0.5	1	0	0.5	1
8	pH (Standard Units)		7.4	7.0		7.5	7.1
9	Total Acidity (mg/l $CaCO_3$)		0	0		0	0
10	Total Alkalinity (mg/l $CaCO_3$)		53	40		130	92
11	Total Iron (mg/l)		0.29	0.15		0.04	0.01
12	Total Manganese (mg/l)		0.1	0		0.1	0
13	Total Aluminum (mg/l)		0	0		0	0
14	Total Suspended Solids (mg/l)		16	10		11	15
15	Total Hardness (mg/l as $CaCO_3$)		74	50		155	95
16	Total Sulfates (mg/l)		45	22		40	25
17	Specific Conductivity (umhos/cm at 25°C)**		95	80		185	110
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	U-930	U-930	U-930	U-931	U-931	U-931
2	Lab ID No.	0825-11	03/24-08	0616-09	1028-03	0306-11	0630-03
3	Date Measured/Sampled	08/25/08	03/24/09	06/16/09	10/28/08	03/06/09	06/30/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	H	I	L	H	I
5	Date Last Precipitation Event (if applicable)	08/05/08	03/19/09	06/11/09	10/25/08	03/01/09	06/25/09
6	Static Water Level of Well below Land Surface (feet)*	---	---	---	---	---	---
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	8	25	15	10	15	15
8	pH (Standard Units)	7.5	7.1	7.1	7.7	7.5	7.1
9	Total Acidity (mg/l $CaCO_3$)	0	0	0	0	0	0
10	Total Alkalinity (mg/l $CaCO_3$)	210	170	108	124	112	88
11	Total Iron (mg/l)	0.24	0.11	0.35	0.95	0.32	0.55
12	Total Manganese (mg/l)	0.1	0.2	0.1	0.8	0.8	0.1
13	Total Aluminum (mg/l)	0.088	0	0	0	0.23	0.10
14	Total Suspended Solids (mg/l)	13	45	34	6	38	12
15	Total Hardness (mg/l as $CaCO_3$)	185	110	138	123	195	155
16	Total Sulfates (mg/l)	90	60	30	60	90	90
17	Specific Conductivity (umhos/cm at 25°C)**	170	210	180	165	220	280
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	U-943	U-943	U-943			
2	Lab ID No.						
3	Date Measured/Sampled	08/25/08 10/28/08	12/31/08 06/16/09	03/04/09 03/24/09			
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H			
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	12/28/08 06/11/09	03/01/09 03/19/09			
6	Static Water Level of Well below Land Surface (feet)*	---	---	---			
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	0	0	0			
8	pH (Standard Units)						
9	Total Acidity (mg/l $CaCO_3$)						
10	Total Alkalinity (mg/l $CaCO_3$)						
11	Total Iron (mg/l)						
12	Total Manganese (mg/l)						
13	Total Aluminum (mg/l)						
14	Total Suspended Solids (mg/l)						
15	Total Hardness (mg/l as $CaCO_3$)						
16	Total Sulfates (mg/l)						
17	Specific Conductivity (umhos/cm at 25°C)**						
18	Total Dissolved Solids (mg/l)**	---	---	---			

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	WL-904	WL-904	WL-904	WL-905	WL-905	W-905
2	Lab ID No.	0825-05	0304-01	0616-01	0825-06	0304-02	0616-02
3	Date Measured/Sampled	08/25/08	03/04/09	6/16/09	08/25/08	03/04/09	6/16/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	H	I	L	H	I
5	Date Last Precipitation Event (if applicable)	08/05/08	03/01/09	06/11/09	08/05/08	03/01/09	6/11/09
6	Static Water Level of Well below Land Surface (feet)*	*	*	*	*	*	*
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	---	---	---	---	---	---
8	pH (Standard Units)	7.3	6.9	6.7	7.0	7.2	7.0
9	Total Acidity (mg/l $CaCO_3$)	0	0	0	0	0	0
10	Total Alkalinity (mg/l $CaCO_3$)	260	223	248	346	402	368
11	Total Iron (mg/l)	0.05	0.42	0.52	1.88	1.78	1.94
12	Total Manganese (mg/l)	0.1	0.1	0.3	0.6	0.4	0.5
13	Total Aluminum (mg/l)	0.015	0.029	0.023	0.008	0.008	0.010
14	Total Suspended Solids (mg/l)	2	6	4	22	36	26
15	Total Hardness (mg/l as $CaCO_3$)	120	140	276	325	294	307
16	Total Sulfates (mg/l)	40	64	125	105	88	90
17	Specific Conductivity (umhos/cm at 25°C)**	475	620	530	670	750	640
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

AUG 03 2009

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	W-935	W-935	W-935			
2	Lab ID No.		0630-05				
3	Date Measured/Sampled	08/25/08 10/28/08	06/30/09	03/04/09 03/24/09			
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H			
5	Date Last Precipitation Event (if applicable)	08/05/08 10/25/08	06/25/09	08/05/08 10/25/08			
6	Static Water Level of Well below Land Surface (feet)*		*				
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)		---				
8	pH (Standard Units)		8.0				
9	Total Acidity (mg/l $CaCO_3$)		0				
10	Total Alkalinity (mg/l $CaCO_3$)		516				
11	Total Iron (mg/l)		0.03				
12	Total Manganese (mg/l)		0.3				
13	Total Aluminum (mg/l)		0.003				
14	Total Suspended Solids (mg/l)		2				
15	Total Hardness (mg/l as $CaCO_3$)		20				
16	Total Sulfates (mg/l)		0				
17	Specific Conductivity (umhos/cm at 25°C)**		2300				
18	Total Dissolved Solids (mg/l)**		---				

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

AUG 03 2009

05/08
DNR-744-9024

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.** **REV. 2**

1	ID No. of Sampling Site From Hydrology Map	WL-936					
2	Lab ID No.	1228-01					
3	Date Measured/Sampled	12/24/09					
4	High (H), Low (L), Intermediate(I) (if applicable)	one time					
5	Date Last Precipitation Event (if applicable)	12/19/09					
6	Static Water Level of Well below Land Surface (feet)*	*					
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	---					
8	pH (Standard Units)	7.4					
9	Total Acidity (mg/l $CaCO_3$)	0					
10	Total Alkalinity (mg/l $CaCO_3$)	289					
11	Total Iron (mg/l)	0.13					
12	Total Manganese (mg/l)	0					
13	Total Aluminum (mg/l)	0					
14	Total Suspended Solids (mg/l)	25					
15	Total Hardness (mg/l as $CaCO_3$)	271					
16	Total Sulfates (mg/l)	50					
17	Specific Conductivity (umhos/cm at 25°C)**	410					
18	Total Dissolved Solids (mg/l)**	---					

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

05/08
DNR-744-9024

FEB 0 2 2010 ✓

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.** **REV. 2**

1	ID No. of Sampling Site From Hydrology Map	WL-900	WL-900	WL-900			
2	Lab ID No.	0825-01	1231-01	0324-07			
3	Date Measured/Sampled	08/25/08	12/31/08	03/24/09			
4	High (H), Low (L), Intermediate(I) (if applicable)	L	I	H			
5	Date Last Precipitation Event (if applicable)	08/05/08	12/28/08	03/19/09			
6	Static Water Level of Well below Land Surface (feet)*	*	*	*			
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	---	---	---			
8	pH (Standard Units)	7.3	7.4	7.3			
9	Total Acidity (mg/l $CaCO_3$)	0	0	0			
10	Total Alkalinity (mg/l $CaCO_3$)	506	350	420			
11	Total Iron (mg/l)	0.53	0.16	0.27			
12	Total Manganese (mg/l)	0	0	0			
13	Total Aluminum (mg/l)	0.007	0.029	0.010			
14	Total Suspended Solids (mg/l)	51	90	70			
15	Total Hardness (mg/l as $CaCO_3$)	334	148	153			
16	Total Sulfates (mg/l)	800	175	250			
17	Specific Conductivity (umhos/cm at 25°C)**	1300	570	650			
18	Total Dissolved Solids (mg/l)**	---	---	---			

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

FEB 0 2 2010 ✓

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	WL-928	WL-928	WL-928	DS-929	DS-929	DS-929
2	Lab ID No.	0825-12	0304-01	0616-01	0825-13	0304-02	0616-02
3	Date Measured/Sampled	08/25/08	03/04/09	6/16/09	08/25/08	03/04/09	6/16/09
4	High (H), Low (L), Intermediate(I) (if applicable)	L	H	I	L	H	I
5	Date Last Precipitation Event (if applicable)	08/05/08	03/01/09	06/11/09	08/05/08	03/01/09	6/11/09
6	Static Water Level of Well below Land Surface (feet)*	*	*	*	*	*	*
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	---	---	---	---	---	---
8	pH (Standard Units)	7.3	7.0	7.1	7.0	7.1	7.0
9	Total Acidity (mg/l $CaCO_3$)	0	0	0	0	0	0
10	Total Alkalinity (mg/l $CaCO_3$)	311	193	292	216	95	141
11	Total Iron (mg/l)	0.08	0.01	0.03	0.09	0.05	0.08
12	Total Manganese (mg/l)	0.1	0.1	0.1	0.1	0.1	0.1
13	Total Aluminum (mg/l)	0.015	0	0	0.01	0.008	0
14	Total Suspended Solids (mg/l)	8	4	2	12	2	4
15	Total Hardness (mg/l as $CaCO_3$)	423	160	316	311	120	198
16	Total Sulfates (mg/l)	60	20	15	131	63	57
17	Specific Conductivity (umhos/cm at 25°C)**	570	350	460	420	250	270
18	Total Dissolved Solids (mg/l)**	---	---	---	---	---	---

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

HYDROLOGIC ANALYSES

Applicant's Name: **Buckingham Coal Company, Inc.**

1	ID No. of Sampling Site From Hydrology Map	DW-1006					
2	Lab ID No.	0902-01					
3	Date Measured/Sampled	9/2/09					
4	High (H), Low (L), Intermediate(I) (if applicable)	ONE TIME					
5	Date Last Precipitation Event (if applicable)	8/28/09					
6	Static Water Level of Well below Land Surface (feet)*	14'					
7	Discharge for Spring, Stream, Pond, Mine, etc. (gpm or cfs)	N/A					
8	pH (Standard Units)	7.3					
9	Total Acidity (mg/l $CaCO_3$)	0					
10	Total Alkalinity (mg/l $CaCO_3$)	262					
11	Total Iron (mg/l)	0.05					
12	Total Manganese (mg/l)	0					
13	Total Aluminum (mg/l)	0					
14	Total Suspended Solids (mg/l)	1					
15	Total Hardness (mg/l as $CaCO_3$)	424					
16	Total Sulfates (mg/l)	220					
17	Specific Conductivity (umhos/cm at 25°C)**	600					
18	Total Dissolved Solids (mg/l)**	N/A					

Laboratory Name: **Linn Engineering, Inc.**

Address: **534 Market Street** City: **Zanesville**

State: **Ohio** Zip: **43701**

* NOTE: If information required by item 6 is unobtainable, submit as an addendum to Hydrologic Analyses a statement giving the reasons why the information is unobtainable.

** NOTE: For each sample provide data for either item 17 or item 18.

05/08
DNR-744-9024

FEB 0 2 2010

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Ground Water Inventory **REV. 2**

THE DEPTH OF WELL BELOW SURFACE AND STATIC WATER LEVELS FOR EACH WELL ARE INDICATED BY THE FOLLOWING NOTATION; (M) MEASURED, (R) REPORTED BY LANDOWNER AND (L) TAKEN FROM THE WELL LOG.

Wells label WL have well log files. These files were used to calculate depth of well and static water level when unable to access the well in the field. Below are a list of wells where sampling or access for measuring was impossible.

W-901 was sampled during each flow period, but the property owner would not allow field crews to open the well for measuring depths and water levels.

WL-936 WAS LOCATED DURING THE FIELD REVIEW. THE WELL WAS SAMPLED AND MEASURED FOR TOTAL DEPTH AND STATIC WATER LEVELS. THE WELL IS NOT USED.

WL-941 COULD NOT BE LOCATED IN THE FIELD. THE WELL IS PLACED ON THE MAP USING THE COORDINATES PROVIDED FROM THE WELL LOG FILE.

DW-940 located on the property of Merrell Gladden was inaccessible. DW-940 is capped and the pump is broken. The resident has a cistern and is on public water. During each sampling period the property was vacant making the wells inaccessible.

Several wells located within the hydro boundary were difficult to sample and measure. WL-900 and WL-928 were sampled during each flow period. The property owners would not allow field crews to open the wells for measuring depths and water levels.

W-935 WAS SAMPLED ONE TIME DUE TO OWNER AVAILABILITY. THE PROPERTY OWNER WOULD NOT ALLOW FIELD CREWS TO OPEN THE WELL FOR MEASURING DEPTHS. THE OWNER REPORTED THE WELL DEPTH AND STATIC WATER LEVEL THE SAMPLE WAS TAKEN FROM AN OUTSIDE TAP.

DS-929 WAS SAMPLED FROM A TAP LOCATED ON THE OUTSIDE OF THE HOUSE. THE WATER IS COLLECTED IN THE DEVELOPED SPRING AND PUMPED TO THE HOUSE. THE SPRING ITSELF HAS A CONCRETE LID AND DISCHARGE FROM THE SPRING WAS NOT ENCOUNTERED DURING HYDRO COLLECTION PERIODS.

DW-945 IS LOCATED ON THE PROPERTY OF JERRY LEMON, SR. HE REPORTED THE PUMP AS BEING BROKEN. THEREFORE, SAMPLES AND DEPTHS WERE NEVER COLLECTED. CURRENTLY DW-945 IS NOT IN USE. THE LANDOWNER IS SUPPLIED BY W-935.

DW-1006 ON THE PROPERTY OF MARK SIMKINS WAS SAMPLED ONE TIME DUE TO

FEB 0 2 2010

Buckingham Coal Company, Inc.
App. #D-2223-3

Addendum to Ground Water Inventory cont'd **REV. 2**

OWNER AVAILABILITY. ACCORDING TO MR. SIMKINS THE HOME IS MAINLY USED ON WEEKENDS AND IS NOT OCCUPIED THROUGH THE WEEK. THE WELL HAS A LOCKED COVER ON IT WHICH MADE MEASURING OF THE WELL IMPOSSIBLE. THE OWNER REPORTED THE STATIC WATER LEVEL AS 14' AND IS NOT SURE OF THE TOTAL DEPTH. THE SAMPLE WAS TAKEN FROM THE WELL BY MR. SIMKINS. NO SAMPLE IS TO BE TAKE WITHOUT THE OWNER PRESENT.

FEB 0 2 2010

WL-900

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 675427

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *BRIAN MILLER*

County: *MORGAN* **Township:** *UNION* **Section Number:** *30*

Address: *2576 BRANCH RD E* **Lot Number:**

City: **State:** *OH* **Zip Code:**

Location Number: **Location Map Year:** **Location Area:**

Latitude: **Longitude:**

CONSTRUCTION DETAILS

Borehole Diameter: 1: **Borehole Depth:** 1: *90 ft.* **Depth to Bedrock:**
2: 2:

Casing Diameter: 1: *6 in.* **Casing Length:** 1: *35 ft.* **Casing Thickness:** 1:
2: 2: 2:

Casing Height Above Ground: **Aquifer Type:** *UNDIFFERENTIATED*

Date of Completion: *2/14/1999* **Total Depth:** *90 ft.* **Well Use:** *DOMESTIC*

Driller's Name:

Screen Diameter: **Slot Size:** **Screen Length:**

Type: **Material:**

Set Between:

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *40 ft.* **Test Rate:** *6 gpm* **Associated Reports**

Drawdown: **Test Duration:** *NONE*

COMMENTS: *NONE*

WELL LOG

Formations	From	To
UNDIFFERENTIATED	0	58
GRAY SHALE	58	63
SAND	63	78
GRAY SHALE	78	90
UNDIFFERENTIATED	90	90

Printing Tips (opens in new window)

Print This Page | Close

Well log questions - Web site questions - Web policies

WELL LOG AND DRILLING REPORT

675427

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

) CARBON PAPER NECESSARY - ELF-TRANSCRIBING

ALTERATION

Permit Number 51

Y MORGAN TOWNSHIP UNION SECTION OF TOWNSHIP 30

BRIAN MILLER ADDRESS 2576 EAST BRANCH Rd

TION OF PROPERTY SAME

CONSTRUCTION DETAILS

meter 6" Length of casing 35"

reen Length of screen

mp SUBMERSIBLE

of pump 7 gpm

ump setting 85'

mpletion 2-14-2000
or Cable

BAILING OR PUMPING TEST
(specify one by circling)

Test rate 6 gpm gpm. Duration of test hrs

Drawdown ft Date 12-28-1999

Static level (depth to water) 40 ft

Quality (clear) cloudy, taste, odor)

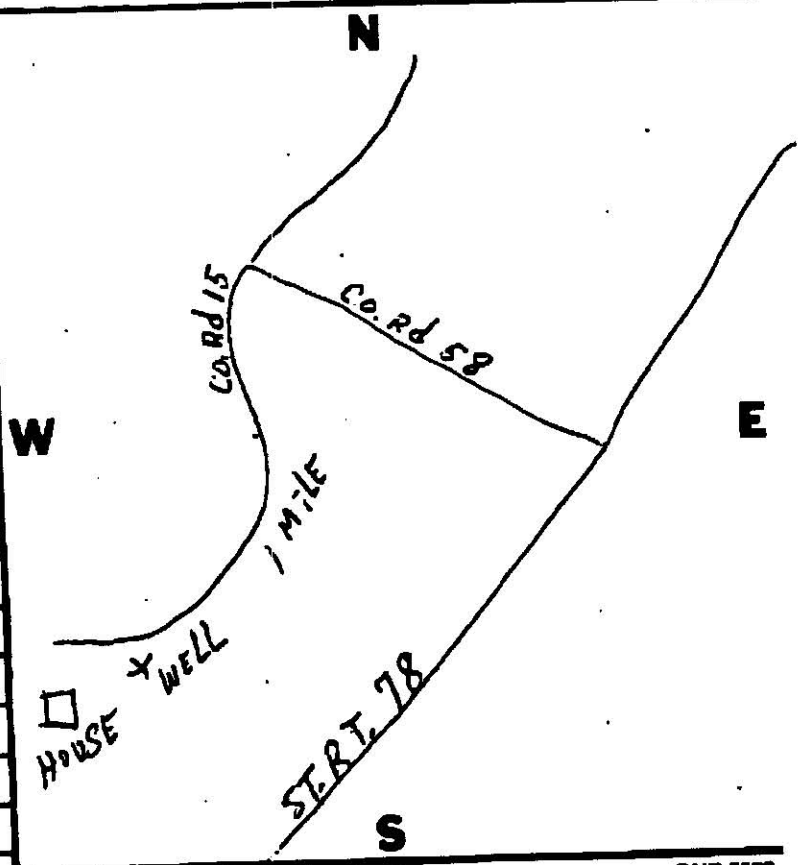
Pump installed by R+C DRILLING Co.

WELL LOG

nations: sandstone, shale, limestone, gravel, clay	From	To
ady DRILLED	0 ft	58 ft
y SHALE	58	63
d	63	78
SHALE	78	90
T.D.	90	

SKETCH SHOWING LOCATION

Locate in reference to numbered state highways, street intersections, county roads, etc.



DNR 7502

tional space is needed to complete well log, use next consecutively numbered form.

NG FIRM R+C DRILLING Co. REGISTRATION NUMBER 1400 DATE 12-28-1999

ISS CORNING, Ohio SIGNED Roger Blosser

tion of this form is required by 1521.05, Ohio Revised Code - file within 30 days after completion.

ORIGINAL COPY - ODNR, DIVISION OF WATER, FOUNTAIN SQ., COLS., OHIO 43224 / Blue - Customer's Copy / Pink - Driller's Copy / Green - Local Health Dept. Copy

WL-928

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740 Fax: 614-265-6767

[redacted]

Well Log Number: 212993

ORIGINAL OWNER AND LOCATION

Original Owner Name: *HARRY MARTIN*
County: *MORGAN*
Township: *UNION*
Section Number: *20*
Address: *SR 78*
Lot Number:
City:
State: *OH*
Zip Code:
Location Number: *13*
Location Map Year: *1981*
Location Area:
Latitude: *39.577973*
Longitude: *-82.003659*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *118 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *6.25 in.*
2:
Casing Length: 1: *44 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *SHALE*
Date of Completion: *5/17/1962*
Total Depth: *118 ft.*
Well Use:
Driller's Name: *BENJAMIN CLELL B*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *89 ft.*
Test Rate: *1 gpm*
Drawdown:
Test Duration:

Associated Reports
NONE

COMMENTS: *NONE*

WELL LOG

Formations	From	To
CLAY	0	5
TOP SOIL	5	5
YELLOW SAND	5	50
GRAY SHALE	50	60
GRAY SAND	60	67
GRAY SHALE	67	70
GRAY SAND	70	72
GRAY SHALE	72	80
GRAY SAND	80	90
SANDY SHELL	90	110
RED SHALE	110	118
WATER AT		65
WATER AT		89

Printing Tips (opens in new window)

[redacted]

WL-948 ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1500 Dublin Road
Columbus, Ohio

Q (6)

No. 212993

County Morgan Township Union Section of Township 20

Owner Harry Martin Address Columbus Ohio

Location of property Cap 2 miles west of Ringold O. then 1/2 mile on Rd

CONSTRUCTION DETAILS

Casing diameter 6 1/4 Length of casing 44'

Type of screen ..... Length of screen .....

Type of pump .....

Capacity of pump .....

Depth of pump setting .....

Date of completion .....

BAILING OR PUMPING TEST

Pumping rate ..... G.P.M. Duration of test ..... hrs.

Drawdown ..... ft. Date .....

Developed capacity 30 gal hr.

Static level—depth to water 89 ft.

Pump installed by .....

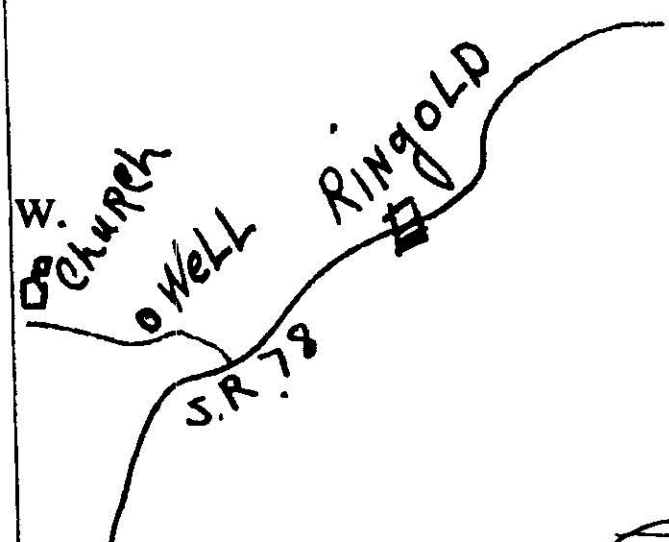
WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
clay	0 Feet	5 Ft.
sand yellow	5	50
grey shale	50	60
sand grey	60	67
grey shale	67	70
grey sand	70	72
grey shale	72	80
grey sandy	80	90
shells sandy	90	110
red shale	110	118

water 65
water 89

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

13

Drilling Firm Lelell Benjamin Date May 17/62

Address Malta Ohio 172 Signed Lelell Benjamin

Water Well Log and Drilling Report

WL-936

Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740 Fax: 614-265-6767

[redacted]

Well Log Number: 400107

ORIGINAL OWNER AND LOCATION

Original Owner Name: *STATE OF OHIO*
County: *MORGAN*
Township: *UNION*
Section Number: *30*
Address: *SR 78*
Lot Number:
City:
State: *OH*
Zip Code:
Location Number: *17*
Location Map Year: *1981*
Location Area:
Latitude: *39.570476*
Longitude: *-82.027222*

CONSTRUCTION DETAILS

Borehole Diameter: 1:
2:
Borehole Depth: 1: *134 ft.*
2:
Depth to Bedrock:
Casing Diameter: 1: *6 in.*
2:
Casing Length: 1: *34 ft.*
2:
Casing Thickness: 1:
2:
Casing Height Above Ground:
Aquifer Type: *SANDSTONE*
Date of Completion: *6/24/1970*
Total Depth: *134 ft.*
Well Use:
Driller's Name: *FOUTS DRILLING*
Screen Diameter:
Slot Size:
Screen Length:
Type:
Material:
Set Between:
Gravel Pack Material/Size:
Vol/Wt Used:
Method of Installation:
Placed:
Grout Material/Size:
Vol/Wt Used:
Method of Installation:
Placed

WELL TEST DETAILS

Static Water Level: *70 ft.*
Test Rate: *1 gpm*
Drawdown: *999 ft.*
Test Duration: *8 hrs.*

Associated Reports
NONE

COMMENTS: *NONE*

WELL LOG

Formations	From	To
YELLOW CLAY	0	19
BLUE CLAY	19	33
BLUE GRIT	33	47
BLUE CLAY	47	69
SANDSTONE	69	70
BLUE CLAY	70	80
LIMESTONE	80	81
BLUE CLAY	81	87
SANDSTONE	87	93
GRAY CLAY	93	99
SANDSTONE	99	114
BLUE CLAY	114	122
SANDSTONE	122	134

Printing Tips (opens in new window)

[redacted]

WELL LOG AND DRILLING REPORT

ORIGINAL

NO CARBON PAPER NECESSARY— SELF-TRANSCRIBING

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
65 S. Front St., Rm. 815 Phone (614) 469-2646
Columbus, Ohio 43215

No. 400107

County [redacted] Morgan Township Union Twp. Section of Township 30

Owner State of Ohio Address

Location of property Upper end of Burr Oak Lake, East Branch on Rt 78

CONSTRUCTION DETAILS

Casing diameter 6" Length of casing 34 ft
4" 134 ft Liner
Type of screen Length of screen
Type of pump
Capacity of pump
Depth of pump setting
Date of completion 6-24-70

BAILING OR PUMPING TEST
(Specify one by circling)

Test Rate 35 G.P.M. Duration of test 8 hrs.
Drawdown Dry ft. Date 6-24-70
Static level-depth to water 70 ft.
Quality (clear, cloudy, taste, odor)

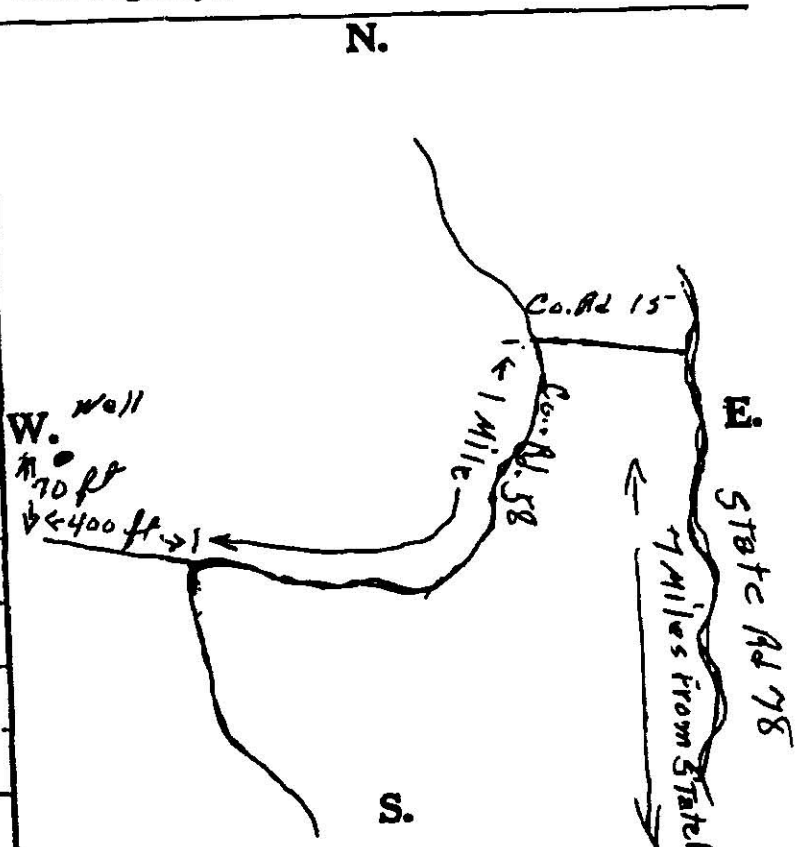
Pump installed by

WELL LOG*

Formations Sandstone, shale, limestone, gravel and clay	From	To
Yellow Clay	0 Feet	19 Ft.
Blue Clay	19	33
Blue Grit	33	47
Blue Clay	47	69
Sand Stone	69	70
Blue Clay	70	80
Lime	80	81
Blue Clay	81	87
Sand Stone	87	93
Gray Clay	93	99
Sand Stone	99	114
Blue Clay	114	122
Sand Stone	122	134

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



Drilling Firm Foots Drilling
Address Glouster, Ohio

Date 6-24-70
Signed Carl E Foots

17

*If additional space is needed to complete well log, use next consecutive numbered form.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER

58 12

Co. Morgan Twp. Union Sec. 30

Owner Eva Brooks
Address R. 2, Glouster, O.
Well location ½ mi. W. of Fairview Church

Construction Details	Pumping Test
Casing: Diam. 5 5/8 length 120	Rate: —
Screen:	Hrs.:
Type of pump:	D.D.
Capacity:	S.L. 47'
Depth of setting:	Date

Owner's Well No.
Driller Dwight Price
Located by JJs Date

Remarks

Office No.
Log form No. 39569
Quad. Morgan

STRATA	Depth From	Depth To
Elevation		
Red clay	0	10
Yellow shale		20
Blue shale		34
Clay		36
Fossil rock		37
Clay		49
Blue shale		50
Sandstone		55
Gray shale		79
Marl		85
Red		89
1st cow run sand 2		100
Lime shell		101
Gray brown shale		120
Blue shale		125

X= 2,131,000
Y= 572,800 S

*Approximate Location

WL-941

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 37569 [redacted]

ORIGINAL OWNER AND LOCATION

Original Owner Name: *EVA BROOKS*
County: *MORGAN* **Township:** *UNION* **Section Number:** *30*
Address: **Lot Number:**
City: **State:** *OH* **Zip Code:**
Location Number: *126* **Location Map Year:** *1945* **Location Area:**
Latitude: *39.570936* **Longitude:** *-82.035589*

CONSTRUCTION DETAILS

Borehole Diameter: 1: **Borehole Depth:** 1: *125 ft.* **Depth to Bedrock:**
2: 2:
Casing Diameter: 1: *5.63 in.* **Casing Length:** 1: *120 ft.* **Casing Thickness:** 1:
2: 2: 2:
Casing Height Above Ground: **Aquifer Type:** *SHALE*
Date of Completion: **Total Depth:** *125 ft.* **Well Use:**
Driller's Name: *PRICE DWIGHT E*
Screen Diameter: **Slot Size:** **Screen Length:**
Type: **Material:**
Set Between:
Gravel Pack Material/Size: **Vol/Wt Used:**
Method of Installation: **Placed:**
Grout Material/Size: **Vol/Wt Used:**
Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *47 ft.* **Test Rate:** **Associated Reports**
Drawdown: **Test Duration:** *NONE*
COMMENTS: *NONE*

WELL LOG

Formations	From	To
RED CLAY	0	10
YELLOW SHALE	10	20
BLUE SHALE	20	34
CLAY	34	36
ROCK	36	37
CLAY	37	49
BLUE SHALE	49	50
SANDSTONE	50	55
GRAY SHALE	55	79
MARL	79	85
RED SAND	85	89
SAND	89	100
LIME SHALE	100	120
BLUE SHALE	120	125

Printing Tips (opens in new window)

[redacted]

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

SURFACE WATER INVENTORY

APPLICANT'S NAME: Buckingham Coal Company, Inc. REV. 1

ID No. Of Sampling Site from Hydrology Map	State Plane X-Y Coordinates	Surface Elevation (ft msl)	Discharge* (gpm or cfs)	Date Measured	Known Uses, including public water	Type of Supply (pond, perennial or intermittent stream, etc.)	Name of Owner
D-906	X 2,102,262 Y 570,865	727	See Hydro Analyses	See Hydro Analyses	Wildlife	perennial (East Branch of Sunday Creek)	Refer to Map
D-907	X 2,103,523 Y 576,157	737	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-912	X 2,107,160 Y 570,893	767	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-913	X 2,103,017 Y 573,691	737	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-920	X 2,107,636 Y 577,217	747	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-924	X 2,104,689 Y 570,857	785	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-925	X 2,102,292 Y 573,242	760	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-926	X 2,106,014 Y 570,766	775	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-927	X 2,103,804 Y 574,798	740	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
D-932	X 2,106,159 Y 577,147	735	See Hydro Analyses	See Hydro Analyses	Wildlife	perennial (San Toy Creek)	Refer to Map

* Do not include discharge values if such measurements are reported on the Hydrologic Analyses.

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

SURFACE WATER INVENTORY

APPLICANT'S NAME: Buckingham Coal Company, Inc. **REV. 1**

ID No. Of Sampling Site from Hydrology Map	State Plane X-Y Coordinates	Surface Elevation (ft msl)	Discharge* (gpm or cfs)	Date Measured	Known Uses, including public water	Type of Supply (pond, perennial or intermittent stream, etc.)	Name of Owner
D-933	X 2,100,595 Y 573,046	728	See Hydro Analyses	See Hydro Analyses	Wildlife	perennial (Eels Run)	Refer to Map
U-908	X 2,104,271 Y 572,018	860	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
U-909	X 2,099,552 Y 571,687	770	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map
U-910	X 2,107,095 Y 574,804	868	See Hydro Analyses	See Hydro Analyses	Wildlife	intermittent	Refer to Map
U-911	X 2,104,947 Y 574,057	820	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map
U-915	X 2,103,390 Y 572,784	860	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map
U-916	X 2,103,914 Y 572,904	860	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map
U-919	X 2,098,678 Y 575,813	755	See Hydro Analyses	See Hydro Analyses	wildlife	perennial (Eels Run)	Refer to Map
U-921	X 2,108,517 Y 573,257	835	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map
U-923	X 2,102,992 Y 577,666	898	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map

* Do not include discharge values if such measurements are reported on the Hydrologic Analyses.

DEC 11 2

05/08
DNR-744-9084

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERAL RESOURCES MANAGEMENT

SURFACE WATER INVENTORY

APPLICANT'S NAME: Buckingham Coal Company, Inc. REV. 1

ID No. Of Sampling Site from Hydrology Map	State Plane X-Y Coordinates	Surface Elevation (ft msl)	Discharge* (gpm or cfs)	Date Measured	Known Uses, including public water	Type of Supply (pond, perennial or intermittent stream, etc.)	Name of Owner
U-930	X 2,105,667 Y 578,164	735	See Hydro Analyses	See Hydro Analyses	wildlife	perennial (San Toy Creek)	Refer to Map
U-931	X 2,107,854 Y 578,089	735	See Hydro Analyses	See Hydro Analyses	wildlife	perennial (East Branch of Sunday Creek)	Refer to Map
U-943	X 2,108,422 Y 576,319	805	See Hydro Analyses	See Hydro Analyses	wildlife	intermittent	Refer to Map
P-934	X 2,104,324 Y 573,081	945	See Hydro Analyses	See Hydro Analyses	Wildlife	pond	Refer to Map

* Do not include discharge values if such measurements are reported on the Hydrologic Analyses.

DEC 11 2009

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DNR-744-9084

PART 3: RECLAMATION AND OPERATIONS PLAN

A. GENERAL REQUIREMENTS

(1) Describe the type and method of coal mining procedures.

REFER TO ADDENDUM TO PART 3, A(1).

(2) Describe the proposed engineering techniques to be used in this mining operation.

REFER TO ADDENDUM TO PART 3, A(2).

(3) Anticipated annual production of coal: **520,000** tons
Anticipated total production of coal: **2,600,000** tons

(4) List the major pieces of equipment to be used for all aspects of the operation.

CONTINUOUS MINERS, NARKO JOY SHUTTLE CARS, FLETCHER DUAL HEAD PINNERS, IMCO AND FAIRCHILD SCOOPS

(5) Submit Performance Security Estimate providing an estimate of the reclamation cost on the proposed operation.

(6) Will the proposed mining operations be within 25 feet of any known oil or gas well?

☒ Yes ☐ No If yes, submit a variance request as an addendum to this item.

(7) Will the proposed operation include return of slurry or other mine waste or material into the abandoned underground workings?

Yes ☐ No ☒ If "yes," comply with provisions contained in paragraph (N) of rule 1501:13-4-14 and paragraph (Q) of 1501:13-9-04 of the Administrative Code, and submit copies of the required MSHA approvals as an addendum.

B. RECLAMATION PLAN – GENERAL REQUIREMENTS

(1) Describe the plan for minimizing to the extent possible and using the best technology currently available disturbances and adverse impacts of the operation on fish and wildlife and related environmental values, including compliance with the Endangered Species Act, and achieving enhancement of such resources where practical.

ADDITIONAL SURFACE AFFECTMENT IS NOT PROPOSED, THIS AAPA IS ONLY FOR AN EXTENSION OF UNDERGROUND MINING AREA.

MAR 0 8 2010

Buckingham Coal Company, Inc.
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Addendum to Part 3, A(1) **REV. 1**

Deep mining is typically done in areas where the cover is too great to economically strip mine and where the coal is of sufficient height to justify deep mine development. This geologic condition exists for this proposed mining operation. REFER TO PART 3, C(1) FOR THE PROPOSED MINING METHOD. SUBSIDENCE IS NOT PLANNED.

Addendum to Part 3, A(2) **REV. 1**

The proposed underground area will be mined utilizing room and pillar method of mining with a proposed 59% recovery rate. This procedure will allow the coal seam to be depleted to the extent that future mining of the seam would not be practical, thereby maximizing the use and conservation of the coal resource. CAREFUL PLANNING WILL BE USED TO DEVELOP THE MINE. ENGINEERING WILL FOCUS ON THE SAFETY OF THE MINERS AND CONSIDER IMPORTANT DETAILS SUCH AS VENTILATION, ELECTRICITY AND ROOF SUPPORT. THE MINE WILL BE INSPECTED AND REGULATED UNDER MSHA STANDARDS.

Addendum to Part 3, A(5)

The proposed operation is for an extension of the underground workings. There will be no additional surface affectment. The estimate of reclamation cost that is already in place remains valid.

Addendum to Part 3, A(6) **REV. 2**

A DETAILED RECORDS SEARCH HAS IDENTIFIED SEVERAL OIL AND GAS WELLS. THESE WELLS ARE ~~2-0063~~, 6-2545, 2-4265, 2-4271,2-4403, 2-4404, 2-4407, 2-4408 AND 2-4409. THE LOCATION OF THESE WELLS HAVE BEEN PLACED ON THE APPLICATION MAP USING COORDINATES RECORDED IN THEIR LOG FILES. A FIELD SEARCH WILL BE DONE TO LOCATE EACH WELL AS MINING ADVANCES INTO THE AREA. IF FOUND THE WELL WILL BE SURVEYED FOR EXACT COORDINATES. BUCKINGHAM SHALL ESTABLISH AND MAINTAIN BARRIERS AROUND EACH WELL IN ACCORDANCE WITH MSHA AND FOLLOW PROCEDURES DIRECTED IN 30 CFR 75.1700. IF A WELL IS ENCOUNTERED OR INTERCEPTED, THE WELL WOULD BE PLUGGED AND VENTED BY MEANS APPROVED BY THE CHIEF. THESE MEASURES ENSURE PROTECTION OF THE WELL AND HYDROLOGIC BALANCE, AS WELL AS THE SAFETY OF THE MINERS.

MAR 0 8 2010

C. RECLAMATION PLAN-PROTECTION OF HYDROLOGIC BALANCE

(1) Based on the baseline data submitted in response to Part 2, items B, C, D and other submitted information in this application, describe the probable hydrologic consequences of this proposed underground mining operation on the hydrologic regime of the proposed shadow area and adjacent areas. The description shall include findings on each of the following items:

(a) The consequences of the proposed operation on the contents of dissolved and total suspended solids, total iron, total manganese and pH;
(b) Whether adverse impacts may occur to the hydrologic balance;
(c) The impact the proposed operation will have on:
  i) Sediment yield from the disturbed area,
  ii) Acidity, total suspended and dissolved solids and other important water quality parameters of local impact,
  iii) Flooding or stream-flow alteration, ground water and surface water availability.

REFER TO ADDENDUM TO PART 3, C(1).

(2) Identify the extent to which the proposed underground mining operations, including subsidence impacts, may proximately result in contamination, diminution or interruption of an underground or surface supply of water within the proposed shadow area and adjacent areas which is used for domestic, agricultural, industrial or other legitimate use. If contamination, diminution or interruption may result, provide a description of alternative sources of water which could be developed to replace existing sources including information on water availability and suitability of alternative water sources for existing pre-mining uses and approved post-mining land uses. Furthermore, address the protection of the rights of present users of surface and ground water.

REFER TO ADDENDUM TO PART 3, C(2).

(3) Is the application within 1,000 feet of an Ohio Source Water Protection Area?
Yes ☐ No ☒ If "yes," indicate the name of the protection area. Describe activities that are potentially harmful to public water supplies and address mitigation of, and alternatives, to such activities. Identify the protection area on the Hydrology Map.

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Addendum to Part 3, Item C(1) **REV. 1**

Proposed Mining Operation

The proposed mining operation is for an extension of the underground mining area in the #7 Upper Freeport coal seam on Permit D-2223. Coal recovery will be by a conventional mining machine using the room and pillar method of mining, as approved in the original permit application. There will be no additional surface affectment, and subsidence is not anticipated. As such there will not be consequences on the contents of dissolved and total suspended solids, total iron, total manganese and pH. Furthermore, sediment yields will not increase because additional surface affectment is not proposed. Anomalous qualities for coal, floor and roof strata have not been encountered which could adversely impact acidity, total suspended and dissolved solids or other important water quality parameters. As addressed below, the occurrence of an event such as subsidence, fracturing of the overburden or hydrologic discharge from or intrusion into the mine is remote thus minimizing the potential for flooding or stream flow alteration. Similarly, the availability of ground and surface waters should remain unimpacted.

THERE ARE NO GROUND MONITORING SITES IN PLACE FOR D-2223 OR D-2223-1. QUARTERLY MONITORING SITES HAVE BEEN LIMITED TO SURFACE WATER ON THE ORIGINAL SURFACE PERMIT. THESE MONITORING SITES ARE LOCATED APPROXIMATELY 2 MILES AWAY FROM THE PROPOSED ADJACENT AREA. THERE ARE NO VIOLATIONS ASSOCIATED WITH THESE QMR SITES.

Addendum to Part 3, Item C(2) **REV. 1**

Surface Water - Shadow Area

Surface water affectment resulting from underground mining activities would typically occur by subsidence or fracturing of the roof rock and overburden. Another surface water impact could result from a gravity discharge of mine water.

Coal will be mined using a conventional miner without use of underground explosives; therefore, the potential to fracture the roof and overburden is minimal. Also, the room and pillar method of mining, which will result in an estimated 59% recovery rate, will have a factor of safety against subsidence that is greater than 2. (Refer to Addendum to Part 4, B(4)(b) for calculations.)

ACCESS TO THE MAJORITY OF THE COAL ON THE PROPOSED AREA REQUIRES MINING AND CROSSING UNDER EAST BRANCH OF SUNDAY CREEK. THE LOCATION OF MINIMUM COVER IS NEAR THIS STREAM IN THE SOUTHERN PORTION OF THE PROPOSED SHADOW AREA. AT THIS LOCATION THE VERTICAL SEPARATION BETWEEN THE STREAM AND #7 COAL IS ABOUT 58'. THE SUBSIDENCE CONTROL PLAN SUBMITTED AS PART 4, B(4)(B) DEMONSTRATES ADEQUATE SAFETY FACTORS FOR SUBSIDENCE UNDER THE WORST CASE SCENARIO OF MAXIMUM PILLAR LOADING (I.E. MAXIMUM OVERBURDEN HEIGHT AND MAXIMUM PILLAR HEIGHT). SINCE PILLAR LOADING WILL BE THE LEAST WITHIN THE FLOODPLAIN, SAFETY FACTORS FOR SUBSIDENCE DUE TO PILLAR LOADING WILL ALSO BE ADEQUATE. ALTHOUGH THE DRILL LOGS INDICATE SHALE AS PREDOMINATE ROOF FORMATION WHICH TYPICALLY PROVIDES A

Buckingham Coal Company, Inc.
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Addendum to Part 3, Item C(2) cont'd **REV. 2**

SOUND ROOF, ADDITIONAL MEASURES TO BOLSTER ROOF SUPPORT INCLUDE USING LONGER BOLTS (E.G. 8' TO 10' BOLTS), TRUSS BOLTING, NARROWING ENTRY WIDTH AND/OR INCREASING SPACING BETWEEN ENTRIES WILL BE USED AS NEEDED.

Surface water bodies within the hydrologic study area include numerous intermittent and ephemeral streams. Flow rates for these waters are generally low, and at times there is no flow at all. As discuss earlier, steam flow is evidently subsurface.

Consequently, the risk of adverse impact is minimal. A gravity discharge of mine water from the portal area/box cut following reclamation will not occur. The base of coal elevations within the proposed shadow area fall between El. 684 to 628. The mine portal is at El. 700 and the top of the box cut is at El. 740. The maximum hydraulic head, which was addressed in the original permit application, will not be increased by this mining operation. Exploratory drilling indicates that within the proposed shadow area the coal generally dips to the southeast at an average rate of 34'/mile.

Groundwater - Shadow Area

In addition to the response in the original application. The proposed adjacent area is a moderately sized area adjoining the east side of the original shadow area. As applicable to the proposed area, mining on D-2223 has not produced any areas of subsidence or any adverse impact to surface or ground waters.

UNDERGROUND MINING OF THE NO. 7 COAL WILL LIKELY CAUSE A DIMINUTION OF SATURATED ZONE D, WHICH INCLUDES THE COAL AND STRATA IMMEDIATELY ABOVE IT. WELLS LOCATED IN THIS ZONE ARE WL-900, W-935, W-936 AND WL-941. EACH WELL IS ADDRESS BELOW.

W-935 HAS A SURFACE ELEVATION OF 915 MSL AND IS REPORTED BY THE LANDOWNER AS BEING 300' DEEP AND 200' TO THE STATIC WATER LEVEL. THIS PLACES THE BOTTOM OF THE WELL AT 615 MSL AND THE STATIC WATER LEVEL AT 715 MSL. THE NO. 7 COAL IS THIS VICINITY IS ABOUT EL. 648, PLACING THE BOTTOM OF THE WELL ROUGHLY 33' BELOW THE COAL. THE STATIC WATER LEVEL IS APPROXIMATELY 67' ABOVE THE COAL PLACING IT IN ZONE D. CONSEQUENTLY, THE WELL MAY BE SUPPLIED BY ZONE C OR D OR BOTH. SINCE THE WELL PENETRATES THE MINE, A DIMINUTION IN QUALITY AND QUANTITY ARE LIKELY TO OCCUR. HOWEVER, AFTER MINING, WHEN THE MINE VOID FILLS WITH WATER, QUALITY AND QUANTITY ARE EXPECTED TO RETURN TO PRE-MINING LEVELS.

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Addendum to Part 3, Item C(2) cont'd **REV. 2**

WL-900 IS LOCATED IN ZONES C AND D ACCORDING TO THE WELL LOG FILE. THE BOTTOM OF THE WELL IS AT ABOUT EL. 745 AND THE NO. 7 COAL IS AT ABOUT EL.664 , PLACING THE BOTTOM OF THE WELL ABOUT 81' ABOVE THE COAL SEAM. THE VERTICAL SEPARATION BETWEEN THE BOTTOM OF THE WELL AND THE MINING AREA SHOULD PREVENT ITS ADVERSE AFFECTMENT.

WL-936 IS LOCATED IN ZONES C AND D ACCORDING TO THE WELL LOG FILE. THE BOTTOM OF THE WELL IS AT ABOUT EL. 691 AND THE NO. 7 COAL IS AT ABOUT EL.664 , PLACING THE BOTTOM OF THE WELL ABOUT 27' ABOVE THE COAL SEAM. THE VERTICAL SEPARATION BETWEEN THE BOTTOM OF THE WELL AND THE MINING AREA SHOULD PREVENT ITS ADVERSE AFFECTMENT.

WL-941 WAS NEVER LOCATED IN THE FIELD. IT IS PLACED ON THE MAP AND INVENTORIED USING INFORMATION GATHERED FROM THE LOG FILE.

DW-1006 LOCATED IN ZONE E IS NOT EXPECTED TO BE IMPACTED BY MINING. THE WELL IS CAPPED AND LOCKED ALTHOUGH THE BOTTOM OF THE WELL WAS NOT ABLE TO BE MEASURED, AS A DUG WELL THE DEPTH SHOULD BE LESS THAN 50 FEET. USING THIS RATIONALE THE BOTTOM ELEVATION WOULD BE APPROXIMATELY 687 AND THE NO. 7 IN THIS VICINITY IS AT ELEV. 655. THIS 32 FOOT VERTICAL SEPARATION SHOULD PREVENT ADVERSE AFFECTMENT.

Nevertheless, all groundwater supplies are at some risk. Although not anticipated, diminution of water levels in the bedrock material during deep mining may lead to lowering of water levels in overlying or adjacent alluvial materials, especially where fracture zones are encountered

No geologic anomalies such caves, faults, or sink holes have been identified within the AAA hydrologic study area. Consequently, the hydrogeologic conditions addressed in the original permit application are considered representative of conditions for this AAA.

THERE ARE NO WELLS MONITORED WITHIN THE ORIGINAL PERMIT AREA FROM WHICH TO DETERMINE IMPACTS. RESIDENTS ARE SUPPLIED BY PUBLIC WATER.

Conclusion

The mining plan as a whole addresses protection of the environment and health and safety of the public and Buckingham's employees. Changes in ground and surface water regimes are not expected to be significant and as such there should be no material damage beyond the proposed shadow area.

FEB 0 2 2010

D. GROUND WATER AND SURFACE WATER MONITORING PLAN

Based upon the probable hydrologic consequences determination and analysis of all baseline hydrologic, geologic and other information submitted in this application, describe the plan for collection, recording and reporting of all surface and ground water quality and quantity monitoring data, including data collected for the NPDES program.

REFER TO THE RESPONSE IN THE ORIGINAL PERMIT APPLICATION AND TO THE ADDENDUM TO PART 3, D.

E. COAL MINING NEAR UNDERGROUND MINES

(1) Will mining operations within this application area be conducted within five hundred feet of an active underground mine or known abandoned underground mine?
Yes ☐ No ☒ If "yes", MSHA approval is required.

(2) If "yes" to item E (1), will the mining operations result in improved resource recovery, abatement of water pollution or elimination of hazards to the health and safety of the public?
Yes ☐ No ☐ If "yes," check appropriate blank.

☐ Resource recovery
☐ Abatement of water pollution
☐ Elimination of hazards

(3) Provide documentation that the remaining barrier will be sufficient to prevent failure with respect to the level of flooding in the adjacent underground mine.

N/A

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Buckingham Coal Company, Inc.
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Addendum to Part 3, D **REV. 2**

QUALITATIVE MONITORING WILL BE FOR THE PARAMETERS LISTED ON HYDROLOGIC ANALYSES.

MONITORING WILL BE DONE FOR THE LIFE OF THE PERMIT.

QUALITATIVE AND QUANTITATIVE MONITORING IS PROPOSED AT WL-936.

DW-1006 WILL NOT BE MONITORED. THE WELL IS LOCATED ON THE PROPERTY OF MR. SIMKINS. HE STATED THAT THE HOME IS MAINLY USED ON WEEKENDS AND IS NOT OCCUPIED THROUGH THE WEEK. THE WELL HAS A LOCKED COVER. THE OWNER MUST BE PRESENT IN ORDER TO OBTAIN A SAMPLE.

FEB 0 2 2010

PART 4: UNDERGROUND MINING PLAN

A. SUBSIDENCE CONTROL SURVEY

(1) Is this a full coal recovery operation?

Yes ☐ No ☒ If "yes," complete Pre-Subsidence Inventory and items B (2) and (3).

(2) Does the shadow area contain any of the structures or facilities listed in 1501:13-12-03(J)(1-3)?

Yes ☐ No ☒ If "yes," complete Subsidence Control - Protection of Specific Structures, and specifically identify the structures or facilities on the application map.

(3) Are any aquifers or bodies of water that serve as a significant water source for any public water supply system present in the shadow area?

Yes ☐ No ☒ If "yes," complete Subsidence Control - Protection of Specific Structures, and specifically identify the areas on the application map.

B. SUBSIDENCE CONTROL PLAN

(1) Describe the method of coal removal, and indicates the size, sequence, and timing of the development of the underground workings.

REFER TO ADDENDUM TO PART 4, B(1).

(2) Utilizing the application map, specifically indicate areas where planned subsidence mining methods (i.e. longwall or pillar extraction) will be used.

(3) Utilizing the application map, specifically indicate room-and-pillar mining areas where subsidence will be prevented or minimized.

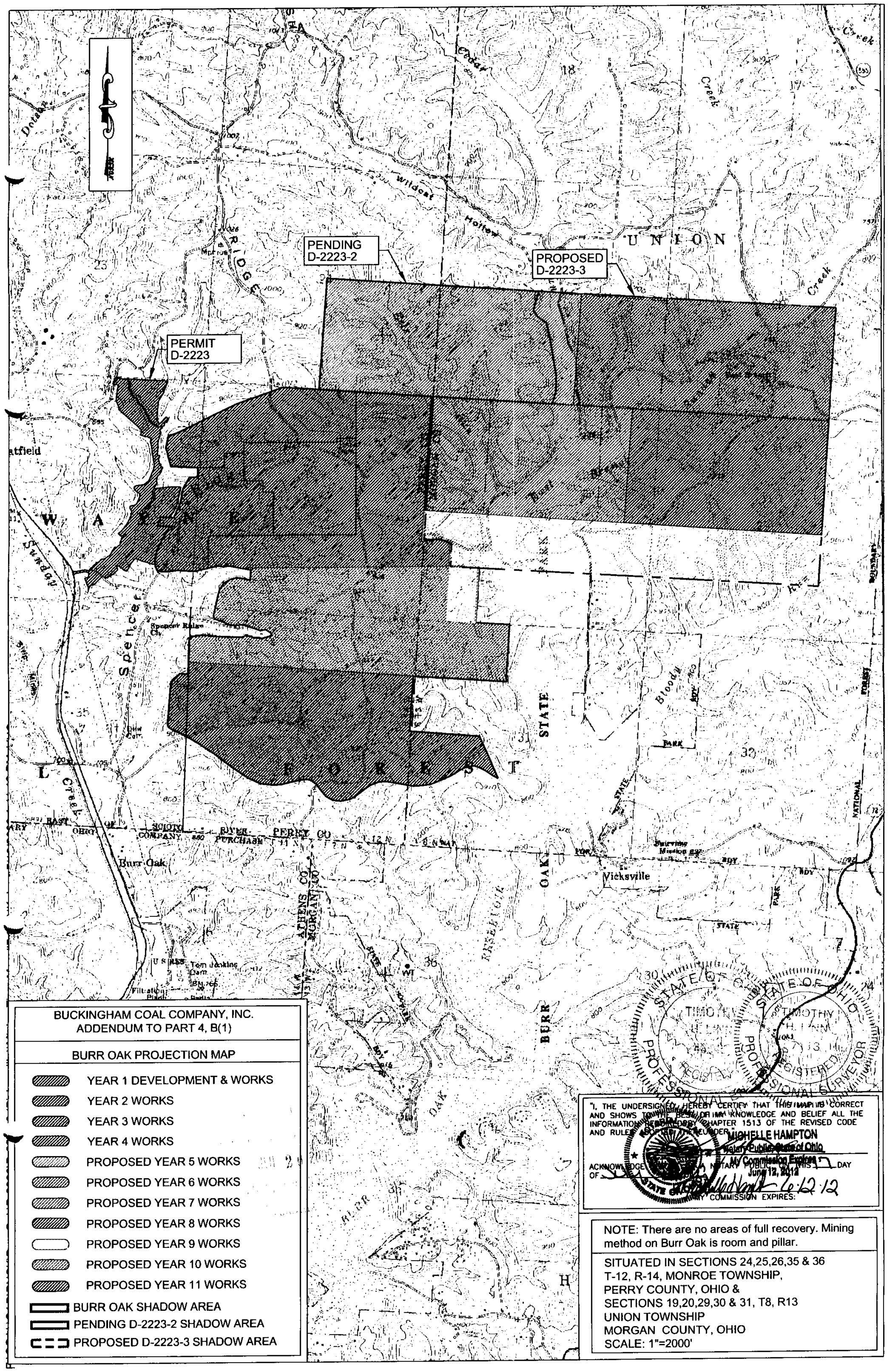
(4) For those areas mapped as room-and-pillar mining, provide the following information:

(a) The maximum and average overburden thickness.

REFER TO ADDENDUM TO PART 4, B(4).

(b) The projected maximum extraction ratios for mains, submains, and butt sections, as well as the existing ranges of values for the same areas.

REFER TO ADDENDUM TO PART 4, B(4).


PENDING
D-2223-2
PROPOSED
D-2223-3
PERMIT
D-2223
UNION
WAYNE
FOREST
STATE
BURR OAK
Vicksville
Burr Oak
Spencer
Wildcat Hollow
Cedar
Creek
Sunday Creek
Bloody
Fairview Mission
ATHENS CO
MORGAN CO
PERRY CO
EAST OHIO COMPANY SCIOTO RIVER PURCHASE
NATIONAL FOREST BOUNDARY
Tom Jenkins Dam
Filtation Plant
BUCKINGHAM COAL COMPANY, INC.
ADDENDUM TO PART 4, B(1)
BURR OAK PROJECTION MAP
YEAR 1 DEVELOPMENT & WORKS
YEAR 2 WORKS
YEAR 3 WORKS
YEAR 4 WORKS
PROPOSED YEAR 5 WORKS
PROPOSED YEAR 6 WORKS
PROPOSED YEAR 7 WORKS
PROPOSED YEAR 8 WORKS
PROPOSED YEAR 9 WORKS
PROPOSED YEAR 10 WORKS
PROPOSED YEAR 11 WORKS
BURR OAK SHADOW AREA
PENDING D-2223-2 SHADOW AREA
PROPOSED D-2223-3 SHADOW AREA
STATE OF OHIO
TIMOTHY H. LINN
REGISTERED
PROFESSIONAL SURVEYOR
"I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY CHAPTER 1513 OF THE REVISED CODE AND RULES ADOPTED THEREUNDER."
MICHELLE HAMPTON
Notary Public, State of Ohio
My Commission Expires
June 12, 2012
ACKNOWLEDGED BEFORE ME, A NOTARY PUBLIC, ON THIS ___ DAY OF ___
6.12.12
MY COMMISSION EXPIRES:
NOTE: There are no areas of full recovery. Mining method on Burr Oak is room and pillar.
SITUATED IN SECTIONS 24,25,26,35 & 36
T-12, R-14, MONROE TOWNSHIP,
PERRY COUNTY, OHIO &
SECTIONS 19,20,29,30 & 31, T8, R13
UNION TOWNSHIP
MORGAN COUNTY, OHIO
SCALE: 1"=2000'

Buckingham Coal Company, Inc.
D-2223-3

Addendum to Part 4, Item B(1)
Deep mining is typically done in areas where the cover is too great to economically strip mining and where the coal is of sufficient height to justify deep mine development. This geologic condition exists for this proposed mining operation.

The proposed underground area will be mined utilizing room and pillar method of mining with a proposed 59% recovery rate. This procedure will allow the coal seam to be depleted to the extent that future mining of the seam would not be practical thereby, maximizing the use and conservation of the coal resource.

Addendum to Part 4, Item B(2)
Planned Subsidence is not proposed.

Addendum to Part 4, Item B(3)
The entire shadow area as shown on the Adjacent Area Application Map will be mined using the room and pillar method. Subsidence is not anticipated within the proposed area.

Addendum to Part 4, Item B(4)
(a) Data from test holes were used to generate base of coal contours and coal thicknesses, which then provides a roof elevation. Comparing the roof elevations to existing ground contours yields the maximum and minimum overburden thicknesses.

Maximum cover occurs at:
N= 575,198
E= 2,108,144
Ground elevation = 1080
Roof elevation = 640.6
Max. Cover = 439.4'
Coal thickness = 3.3'
For ARMPS: Max. cover = 438.4'
Entry height = 4.3'

Minimum cover occurs at:
N= 571,602
E= 2,100,951
Ground elevation = 725
Roof elevation = 667.0
Min. Cover = 58'
Coal thickness = 4.0'
For ARMPS: Min. cover = 57.0'
Entry height = 5.0'

Average cover = (MIN+3MAX)/4 = [57.0+(3*438.4)]/4 = 343'
Equation typically used in underground coal mining pillar design.

Buckingham Coal Company, Inc.
D-2223-3

(b) Before an extraction ratio can be determined, the pillar sizes must first be calculated. The pillar design analysis was performed using the National Institute for Health and Safety (NIOSH) computer program ARMPS 5.1.22.

Analyses are performed for the two scenarios listed in Part 4, B(4)(a) above. For each scenario the entry height = coal thickness plus 1'. For the Minimum Cover scenario the coal strength = 900 psi which is the conservative default value provided by NIOSH. For the Maximum Cover scenario the coal strength is reduced by 10% to 810 psi, which is a highly unlikely value given that the 900 psi is the conservative default value provided by NIOSH.

The maximum extraction ratio is calculated by ARMPS and is shown on the print out, which is submitted as Addendum to Part 4, B(4)(b).

Buckingham Coal Co., Inc.
App. #D-2223-3
Addendum to Part 4, B(4)(b)

ARMPS module build: 5.1.23
Project File: F:\COAL\WP\BUCK\Burr Oak\D-2223-3 (Bishopville)\PERMIT\D-2223-3-Min.ARM
Input Units: (ft) (psi)

[PROJECT DESCRIPTION]
Scenario Minimum Cover

[DEVELOPMENT GEOMETRY PARAMETERS]
Entry Height.....5 (ft)
Depth of Cover.....57 (ft)
Crosscut Angle.....90 (deg)
Entry Width.....18 (ft)
Number of Entries.....8
Crosscut Spacing.....50 (ft)
Center to Center Distance #1.....50 (ft)
Center to Center Distance #2.....50 (ft)
Center to Center Distance #3.....50 (ft)
Center to Center Distance #4.....50 (ft)
Center to Center Distance #5.....50 (ft)
Center to Center Distance #6.....50 (ft)
Center to Center Distance #7.....50 (ft)

[DEFAULT PARAMETERS]
In Situ Coal Strength.....900 (psi)
Unit Weight of Overburden.....162 (pcf)
Breadth of AMZ.....37 (ft)
AMZ set automatically

[RETREAT MINING PARAMETERS]
Loading Condition.....DEVELOPMENT

[ARMPS STABILITY FACTORS]
DEVELOPMENT.....16.92

[DATA ABOUT THE ACTIVE MINING ZONE (AMZ)]

AMZ Width.....350.0 (ft)
AMZ Breadth.....37.0 (ft)
AMZ Area.....12950.0 (ft)*(ft)
Extraction Ratio Within AMZ.....0.59
Development Load on AMZ.....5.98E+04 (tons)

TOTAL LOADINGS ON AMZ, INCLUDING TRANSFER FROM BARRIERS

LOAD CONDITION	ABUTMENT LOAD (tons)	LTRANSBAR (tons)	LTRANSREM (tons)	TOTAL (tons)
DEVELOPMENT	0.00E+00	0.00E+00	0.00E+00	5.98E+04

R-Factor for front abutment is the percent of the total front abutment load that is applied to the AMZ.

R-Factor for side abutment is the percent of the total side abutment load that is applied to the barrier pillar (the remainder is applied to the AMZ).

LTRANSBAR is the load transferred to the AMZ from the barrier pillar between the side and active gob if the barrier's SF is less than 1.5.

LTRANSREM is the load transferred to the AMZ from the remnant barrier between the side and active gob if the remnant's SF is less than 1.5.

[PILLAR PARAMETERS]

PILLAR	ENTRY CENTER (ft)	MINIMUM DIMENSION (ft)	MAXIMUM DIMENSION (ft)
1	50.00	32.00	32.00
2	50.00	32.00	32.00
3	50.00	32.00	32.00
4	50.00	32.00	32.00
5	50.00	32.00	32.00
6	50.00	32.00	32.00
7	50.00	32.00	32.00

PILLAR	AREA (ft)*(ft)	STRENGTH (psi)	LOAD-BEARING CAPACITY (tons)
1	1.02E+03	2.65E+03	1.95E+05
2	1.02E+03	2.65E+03	1.95E+05
3	1.02E+03	2.65E+03	1.95E+05
4	1.02E+03	2.65E+03	1.95E+05
5	1.02E+03	2.65E+03	1.95E+05
6	1.02E+03	2.65E+03	1.95E+05
7	1.02E+03	2.65E+03	1.95E+05

TOTAL LOAD-BEARING CAPACITY OF PILLARS WITHIN AMZ: 1.01E+06 (tons)

To view the distribution of Pillar Load Bearing Capacity
select 'View Plots->Settings->Pillar Load Bearing Capacity'

[BARRIER PILLAR PARAMETERS]

none

ARMPS module build: 5.1.23
Project File: F:\COAL\WP\BUCK\Burr Oak\D-2223-3 (Bishopville)\PERMIT\D-2223-3-Max.ARM
Input Units: (ft) (psi)

[PROJECT DESCRIPTION]
Scenario Maximum Cover

Entry Height.....4.3 (ft)
Depth of Cover.....438.4 (ft)
Crosscut Angle.....90 (deg)
Entry Width.....18 (ft)
Number of Entries.....8
Crosscut Spacing.....50 (ft)
Center to Center Distance #1.....50 (ft)
Center to Center Distance #2.....50 (ft)
Center to Center Distance #3.....50 (ft)
Center to Center Distance #4.....50 (ft)
Center to Center Distance #5.....50 (ft)
Center to Center Distance #6.....50 (ft)
Center to Center Distance #7.....50 (ft)

[DEFAULT PARAMETERS]
In Situ Coal Strength.....810 (psi)
Unit Weight of Overburden.....162 (pcf)
Breadth of AMZ.....104 (ft)
AMZ set automatically

[RETREAT MINING PARAMETERS]
Loading Condition.....DEVELOPMENT

[ARMPS STABILITY FACTORS]
DEVELOPMENT.....2.23

[DATA ABOUT THE ACTIVE MINING ZONE (AMZ)]

AMZ Width.....350.0 (ft)
AMZ Breadth.....104.0 (ft)
AMZ Area.....36400.0 (ft)*(ft)
Extraction Ratio Within AMZ.....0.59
Development Load on AMZ.....1.29E+06 (tons)

TOTAL LOADINGS ON AMZ, INCLUDING TRANSFER FROM BARRIERS

LOAD CONDITION	ABUTMENT LOAD (tons)	LTRANSBAR (tons)	LTRANSREM (tons)	TOTAL (tons)
DEVELOPMENT	0.00E+00	0.00E+00	0.00E+00	1.29E+06

R-Factor for front abutment is the percent of the total front abutment load that is applied to the AMZ.

R-Factor for side abutment is the percent of the total side abutment load that is applied to the barrier pillar (the remainder is applied to the AMZ).

LTRANSBAR is the load transferred to the AMZ from the barrier pillar between the side and active gob if the barrier's SF is less than 1.5.

LTRANSREM is the load transferred to the AMZ from the remnant barrier between the side and active gob if the remnant's SF is less than 1.5.

[PILLAR PARAMETERS]

PILLAR	ENTRY CENTER (ft)	MINIMUM DIMENSION (ft)	MAXIMUM DIMENSION (ft)
1	50.00	32.00	32.00
2	50.00	32.00	32.00
3	50.00	32.00	32.00
4	50.00	32.00	32.00
5	50.00	32.00	32.00
6	50.00	32.00	32.00
7	50.00	32.00	32.00

PILLAR	AREA (ft)*(ft)	STRENGTH (psi)	LOAD-BEARING CAPACITY (tons)
1	1.02E+03	2.99E+03	2.20E+05
2	1.02E+03	2.99E+03	2.20E+05
3	1.02E+03	2.99E+03	2.20E+05
4	1.02E+03	2.99E+03	2.20E+05
5	1.02E+03	2.99E+03	2.20E+05
6	1.02E+03	2.99E+03	2.20E+05
7	1.02E+03	2.99E+03	2.20E+05

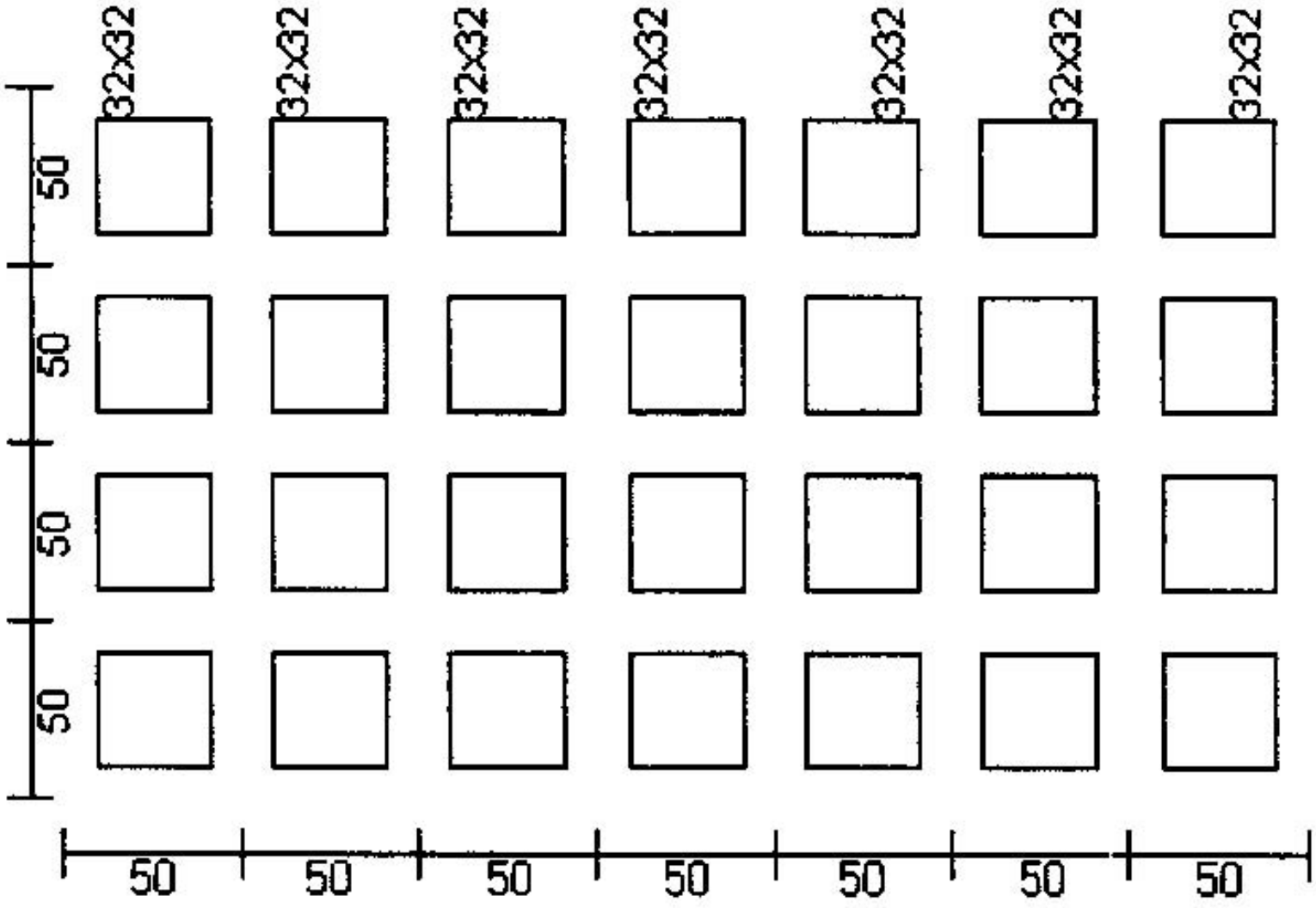
TOTAL LOAD-BEARING CAPACITY OF PILLARS WITHIN AMZ: 3.21E+06 (tons)

To view the distribution of Pillar Load Bearing Capacity select 'View Plots->Settings->Pillar Load Bearing Capacity'

[BARRIER PILLAR PARAMETERS]

none

ARMPS: Actual Pillar Dimensions (width*length, ft). Entries shown from left to right.



(c) Projected maximum width of entries and cross cuts throughout the mine, as well as the existing ranges of values for the same areas.

The projected maximum width of entries and cross cuts are shown on the AMPS print out. Widths will be adjusted depending on depth of cover and mining height to provide at least a factor of safety against pillar failure of 2.0. THE MAXIMUM WIDTH OF ENTRIES AND CROSS CUTS WILL NOT EXCEED THE VALUES SHOWN IN THE ARMPS PRINTOUT. AS A RESULT PILLAR SIZE WILL INCREASE THUS PROVIDING GREATER ROOF SUPPORT.

(d) The center spacing for entries and cross cuts.

The projected minimum center spacing is shown on the ARMPS print out. Center spacing will be adjusted depending on depth of cover and mining height to provide at least a factor of safety against pillar failure of 2.0. THE SPACING FOR ENTRIES AND/OR CROSS CUTS WILL NOT BE LESS THAN THE VALUES SHOWN IN ARMPS PRINTOUT. AS A RESULT PILLAR SIZE WILL INCREASE THUS PROVIDING GREATER ROOF SUPPORT.

(e) Minimum pillar dimensions for mains, submains, and butt sections, as well as the existing ranges of values for these areas.

The projected minimum pillar dimensions are shown on the ARMPS print out.

(f) The barrier pillar width between butt sections, as well as the existing ranges of values for the same areas.

The proposed barrier pillar width at all locations is 50'

(g) The engineering properties of the clay/shale, or other soft rock material in the roof and floor of the mine under both saturated and natural moisture conditions.

The geologic structure the same as that addressed in the original permit application. Refer to the response to this item in the original permit application

(h) Measures to be taken on the surface to prevent damage or lessening of the value or reasonably foreseeable use of the surface, if any.

Without performing any measures on the surface, this new mining area will not cause damage or lessen the value or reasonably foreseeable use of the surface.

(i) The minimum pillar safety factor, for protected structures, based upon coal strength and load.

There are no protected structures

(j) Methods and calculations used to determine the long-term safety factor.

Bieniawski (1968) has shown that the compressive strength of coal cubes (short term strength) decreases with an increase in size and reaches an asymptotic value at a cube size of about 1.5m which, according to him, is the critical size for coal. The reduction in strength with increase in size is attributed to the presence of joints and weakness planes in coal specimens of large volume and the exclusion of such flaws in small specimens. If this is the case, the long term strength of small specimens may differ considerably from that of the larger ones, and of mine pillars, although according to Bieniawski the long term strength should remain unaffected by specimen size as it is a material property. According to Sheorey (1980) the long term strength is generally between 61% and 80% of the uniaxial compressive strength.

(k) Provide the minimum long-term subsidence control safety factor recommended by the method's author or the literature supporting this method.

MAXIMUM AND MINIMUM COVER SCENARIOS HAVE BEEN SUBMITTED. THE WORST CASE SCENARIO IS THE MAXIMUM COVER. AT MAXIMUM COVER THE ARMPS STABILITY FACTOR IS 2.23.

(l) Indicate how coal strength was determined if the assumed coal compressive strength exceeds 900 psi.

The ARMPS analyses coal strengths do not exceed 900 psi.

(m) Describe any prior unplanned subsidence events, pillar or floor failure experienced by the applicant. Indicate the seam mined and relevant facts.

A portion of Buckingham's D-1163 mine experienced unplanned subsidence. Refer to the following pages for the DMRM inspection report and Buckingham's response to the subsequent Cessation Order, which has since been terminated.

(5) For those areas mapped as full coal recovery mining, provide the following information:

(a) For each method to be employed (i.e. longwall or pillar extraction), provide the following:

i) Rate and direction of dip for the coal seam.

N/A.

ii) Dimensions of panels or butt sections.

N/A.

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Buckingham Coal Company, Inc.
D-2223-3

State of Ohio
Department of Natural Resources
Division of Mineral Resources Management

Coal Inspection Report

Permit Information

Permit: D-1163	Company: Buckingham Coal Co., Inc.	Permit Issued: 04/03/1998
Status: Active	Operation Type: SEUM	Final Report:
		BFO Issued:

Inspection Date: 04/29/2006
Last Inspection: 04/05/2006
Type of Inspection: Administrative

Commentary

1. Did a complaint inspection for possible subsidence on the property/residence of Robert and Gannet Cinquepalmi at 21380 Waterworks Hill Road, Glouster, Ohio. I was accompanied on the inspection by Robert Cinquepalmi. The following conditions were observed. From Waterworks Road, the cracking runs Northwest approximately 100 feet, then across Waterworks Road and to the Southeast approximately 700 feet. An old well/cistern had been filled with material in the past, but the material had dropped about 3-4 feet. I observed, on the Cinquepalmi property, where the house's waterline had broken and been repaired. Mr. Cinquepalmi also complained of cracking and popping noises in the home, as well as doors and windows not working properly. After the on site inspection, I talked with George Evans and Claude Imler of Buckingham Coal Co. about the possible subsidence. They had been contacted by Gannet Cinquepalmi and was aware of the problem and had even been on site. The company was at this time, asking questions of what the next step should be.
2. The plan and schedule for the repairs of the structures and surface lands may need to include drilling and grouting to provide for long-term stability. This plan should also include a detailed discussion of the temporary measures that will be implemented to prevent damage to all structures, utilities, roads, etc... that may be affected by continued subsidence. Please consider this carefully as you prepare your plans. Submit your written plans and time-schedules to my attention in the Jackson Office.
3. The analysis of the cause of the subsidence should include at a minimum:
a. A review of the overburden strength, thickness, and type at the affected location.
b. A detailed analysis of the pillar size and strength beneath the property.
c. A report as to the mining practices used in that section of the mine.
d. A discussion as to the reason that portion of the mine is now flooded.
e. Your explanation as to the cause of the subsidence.
f. A listing of the necessary adjustments that will be made to prevent further subsidence.
g. This report should be prepared and/or reviewed by a qualified mining engineer prior to submission to the Division.

Inspector: Gary L. Green
Gary Green

Personnel Contacted C. Imler/S. Ray

Copies to: Operator Inspector

Buckingham Coal Company, Inc.
D-2223-3

BUCKINGHAM
COAL COMPANY

21525 State Route 13
P.O. Box 157
Glouster, Ohio 45732-0157

General Office 740-767-9902
Fax 740-767-4774

Mine Office 740-767-4361
Fax 740-767-4019

Shop 740-767-4035

May 9, 2006

Attention: Gary Green
Mineral Resources Inspector
Ohio Department of Natural Resources
Division of Mineral Resources Management
34 Portsmouth Street
Jackson, Ohio 45640

RE: Response to Cessation Order I 13177 of May 2, 2006 D-1163

OVERVIEW

The area of the mine beneath the affected location is in the Southwest B and Southwest C Panels, both off of the South Mains.
Southwest B Panel was mined in 2003/2004 and Southwest C was mined 2004.
These panels are now partially sealed and ventilated by moving air from the South Mains intake entries, through the panels and on to the ventilation boreholes located at the western end of the Southwest A Panel. This method of partial sealing and ventilating is utilized for safety reasons, primarily to avoid having a fireboss regularly travel these abandoned areas. The air quality and quantity moving through these abandoned areas are checked weekly, from the surface, at the ventilation boreholes.

This mine is generally considered a "wet" mine and a system of some 50 pumps, deployed throughout the underground workings, are used to keep the mine dewatered. In abandoned areas, such as the Southwest A, B and C Panels, pumping is normally discontinued after the panels are mined, so that men are not at risk by having to travel into these abandoned areas to maintain the pumps and pipelines. Water accumulating in these areas will gradually make its way to the active areas in the mine where it is then pumped out of the mine.

Buckingham Coal Company, Inc.
D-2223-3

ANALYSIS OF THE POSSIBLE CAUSES OF AFFECTMENT

a. The overburden thickness at the affected location is approximately 335'. Drill Hole G-119C, located approximately 500' from the cracks and at the same surface elevation, reveals the coal is overlain by several feet of shale in the immediate roof with a 62' thick layer of white sandstone comprising the main roof. The remaining stratum to the surface is composed of various layers of shale and massive sandstone.

b Pillar sizes beneath the affected area average 32' x 25' and the coal has an estimated minimum compressive strength of 900 psi. Located between the SW B and SW C Panels is a coal barrier pillar approximately 50' wide by 2,500' long.

c. The area of the mine beneath the affected location is in the rooms of the SW B and SW C Panels (sometimes referred to as 'butt sections). The average width of entries and crosscuts is 18.5'. The roof is supported by 7' long, 7/8" diameter, fully-grouted steel roof bolts. The bolts are installed on a 4' pattern.

d. A portion of the SW C Panel is flooded because pumping has been discontinued in that area for some time. It appears that the water in that area is that which is normally produced from mining and is not the result of inflow from the surface. There is some water accumulated in the SW B Panel and again, this is a result of the discontinuation of pumping and it is water normally produced from mining.

e. It appears that the cause of affectment could be the result of roof flaking and some pillars pushing into the wet fireclay floor in the rooms of SW B Panel. The 50' barrier pillar between SW B and SW C Panels is intact. The SW C Panel has been investigated and shows no signs of roof, floor or pillar deterioration. In addition, this area of the mine has the greatest amount of overburden.

f. The approved permit allows for mining the rooms in butt sections with a maximum extraction of 66.1%. The rooms mined beneath the affected area have an average extraction of 65.2%. In order to prevent subsidence, we are utilizing a mining plan of no less than 50' x 50' entry and crosscut spacing. Our average mining width is 19'. This results in an extraction of 61.5%. This lower extraction percentage along with less overburden should prevent subsidence. It should be pointed out that since mining was completed in the SW C Panel, Buckingham has been mining the butt section rooms utilizing the 50' x 50' spacing almost exclusively.

Buckingham Coal is working with the affected landowner (Cinquepalmi) to repair the surface and to monitor and keep their modular home level in order to minimize structural damage. Additionally, Buckingham Coal has had the affectment surveyed and 2 monitoring stations installed. The monitoring stations will be checked regularly in order to provide an ongoing assessment of the situation.

Sincerely,

George J. Evans, P.E.
Mine Engineer
Buckingham Coal Company

iii) Thickness of coal to be extracted (mining height).

N/A.

iv) Maximum angle of draw.

N/A.

v) Maximum anticipated subsidence.

N/A.

vi) Width of barrier pillars or chain pillars between sections or panels.

N/A.

vii) The maximum extraction ratio within a pillaring section.

N/A.

(b) The anticipated effects of planned subsidence upon the land and water resources identified in the subsidence control survey and survey of ground and surface water resources.

N/A.

(c) The measures to be taken to mitigate the anticipated effects of planned subsidence to the land and water resources.

N/A.

(d) The anticipated effects of planned subsidence upon the structures identified in the subsidence control survey.

N/A.

(e) The proposed measures to be taken to mitigate anticipated effects to structures.

N/A.

(f) The proposed measures to determine the extent of mining related damages including a pre-subsidence survey with an indication of the timing of the survey.

N/A.

(g) The provisions for repair and/or compensation for damages to structures.

N/A.

(h) Describe the monitoring, if any, needed to determine the commencement

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and degree of subsidence so that, when appropriate, other measures can be taken to prevent, reduce, or correct material damage in accordance with rule 1501:13-12-03 of the Administrative Code.

N/A.

(6) Will planned subsidence operations be conducted within the angle of draw of urbanized areas, cities, towns, communities, industrial or commercial buildings, major impoundments, or perennial streams?

Yes ☐ No ☒ If "yes," describe any measures or activities that will prevent a condition or practice that could result in an imminent danger to the health or safety of the public.

(7) Will planned subsidence operations be conducted within the angle of draw of transmission pipelines?

Yes ☐ No ☒ If "yes," describe the procedural plan to avoid the creation of a situation of imminent danger to the health and safety of the public.

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PART 5: FORMAT AND CONTENT

A. FILING OF ADDENDA

If an addendum is needed to present the information required by the items in the permit application, the addendum is to be submitted with the permit application and each page, map, plan or other document in the addendum should include the applicant's name and indicate to what item the addendum applies. For example, "Addendum to Part 3, item A (11)(c)Zebco Coal Company."

B. Provide the information requested below for all technical data submitted in the application.

Identification of Technical Data *	Person/Organization that Collected Data and Date	Methodology for Collecting Data	Person/Organization that Collected Data and Date	Methodology Used to Analyze Data
HYDROLOGIC ANALYSES	**LINN ENGINEERING 2008-2009**	**GRAB SAMPLE**	**LINN ENGINEERING 2008-2009**	**STANDARD METHODS**

* The technical data is to be identified by referencing the particular item in the application for which the data was used in preparing the response (e.g. Part 2, B (1); Hydrologic Analyses; Part 4, A.

C. Provide the following information for each private or academic research organization or governmental agency contacted in the preparation of the application for information on land uses, soils, geology, vegetation, fish and wildlife, water quantity and quality, air quality, and archeological, cultural, and historic features.

Name and Address of Agency/Organization	Name, Position and Phone Number of Contact Person	Type of Information (e.g. Geology)
PREVIOUSLY SUBMITTED INFORMATION WAS SUFFICE.		

Appendix C

Mine Safety and Health Administration Permits, Buckingham Coal Company

U.S. Department of Labor

Mine Safety and Health Administration
604 Cheat Road
Morgantown, West Virginia 26508

UNDERGROUND MINE FILE	
DATE FWD:	6-30-10
INITIALS	DR

JUN 30 2010

SENT TO AND/OR DISCUSSED WITH FIELD OFFICE:

SURNAME	DATE

	REVIEWED BY	DATE
Specialist	JX	6-29-10
Spec. Supv	Evanto	6/29/10
Proofread		6/29/10
Tech ADM	Mosley	6-29-10
Roof	BLAKE	6/29/10

Mr. Michael D. Brooks
Loss Prevention Manager
Buckingham Coal Company
P. O. Box 400
Corning, Ohio 43730

Dear Mr. Brooks:

A review has been conducted of your submittal received June 28, 2010, for the Buckingham Mine No. 7, MSHA I.D. No. 33-04520. The plan proposes to conduct mining operations under the East Branch of Sunday Creek. A permit to mine under a body of water per the requirements of 30 CFR 75.1716 is hereby issued contingent upon the following conditions:

(1) All mining will be in accordance with the submitted mine projections.

(2) During and after mining, any significant inflow of water or the encountering of adverse roof conditions shall be reported to this office. Miners on the sections shall be made aware that they are mining under a body of water prior to mining in this area.

(3) After the area is mined, particular attention shall be directed to the pillars and mine floor for any detrimental effects due to water entering the mine.

If you have any questions, please contact the Impoundment Group at 304-225-6855.

Sincerely,

Bob E. Cornett

Bob E. Cornett
District Manager

JGutta:dr

bcc: St. Clairsville Field Office
Ventilation Section
Roof Control Section
Main File
Impoundments File

BUCKINGHAM COAL COMPANY
Corning, Ohio
PHONE: 740-347-4565 FAX: 740-347-4003
BILLING: P.O. Box 400, Corning, OH 43730
DELIVERY: 14755 Twp. Rd. 295, SE, Glouster, OH 45732

RECEIVED
JUN 28 2010
DR 6-28-10 T2
CM

June 28, 2010

Mr. Bob Cornett, District Manager
Mine Safety and Health Administration
604 Cheat Road
Morgantown, WV 26508

Dear Mr. Cornett:

Buckingham Coal Company Mine #7, MSHA I.D. #33-04520, is requesting permission to mine under The East Branch of Sunday Creek Tributary.
The following measures will be taken as shown on the map provided.

If you have any questions regarding this matter please contact me at
740-347-4000

Sincerely,

Michael D. Brooks
Loss Prevention Manager
Buckingham Coal Company

LOG OF DRILLING

AREA Burr Oak #7 No. BOA-690-C
LAND TITLE ODNR
County Morgan State Ohio
SEC ____ TWP ____ RG ____ LOC ____
Driller T. Sowers Date Drilled 1-22-10
Est. Elev. ____ Act. Elev. ____

TOTAL FT. & 10ths		STRATA	THICKNESS FT & 10ths	
Surface		Gravel	2.	00
2.	00	Soft Brown Clay	2.	00
4.	00	Gray drift (water)	18.	00
22.	00	Sandstone	12.	00
34.	00	Gray Shale	10.	00
44.	00	Sandstone	9.	60
53.	60	Gray Sandy Shale	6.	90
60.	50	Coal #7	2.	30
62.	80	Pyrite	0.	01
62.	81	Coal #7	0.	37
63.	81	Pyrite	0	01
63.	19	Coal #7	1.	61
64.	80	Sandy Shale	1.	00
65.	80	Depth		
		Cement		

TOTAL FT. & 10ths	STRATA	THICKNESS FT & 10ths
	WATER 9'	
	Cement	

STRATA	AMOUNT CORED	AMOUNT RECOVERED
ROOF	2.00	2.00
COAL #7	4.30	4.30
FLOOR	1.50	1.00

LOG OF DRILLING

AREA BURR OAK #7 No. BOA-69C-C
LAND TITLE ODNR
County MORGAN State OHIO
SEC ____ TWP ____ RG ____ LOC ____
Driller T. SOWERS Date Drilled 1-26-10
Est. Elev. ____ Act. Elev. ____

TOTAL FT. & 10ths		STRATA	THICKNESS FT & 10ths	
SURF		GRAVEL	2.	00
2.	00	GRAY DRIFT	18.	00
20.	00	GRAY SHALE	4.	00
24.	00	WHITE SANDSTONE	22.	05
46.	05	GRAY SANDY SHALE	0.	60
46.	65	WHITE SANDSTONE	1.	90
48.	55	GRAY SANDY SHALE ROOFRBALL	11.	07
59.	62	COAL #7	1.	50
61.	42	SHALE	0	20
61.	62	COAL #7	2	30
63.	92	SANDY GRAY SHALE	1.	88
65.	80	WHITE SANDSTONE	28.	20
94.	00	GRAY SANDY SHALE	8.	00
102.	00	DARK SHALE	1.	50
103.	50	GRAY SANDY SHALE ROOFRBALL	5.	50

TOTAL FT. & 10ths	STRATA	THICKNESS FT & 10ths
109.00	WHITE SANDSTONE	12.00
121.00	GRAY SANDSTONE W/ SHALE	19.00
140.00	GRAY SANDSTONE SHALE BANDS	5.75
145.75	GRAY SANDSTONE W/ SHALE	10.85
156.60	COAL #6 BOTTOM SLATY	0.80
157.40	COAL #6 PYRITE STRIKES	2.80
160.20	FIRE CLAY	0.40
160.60	SANDY GRAY SHALE	5.20
165.80	DEPTH	
	CEMENT	
	WATER 7'	

STRATA	AMOUNT CORED	AMOUNT RECOVERED
ROOF	19.00	19.00
COAL #7	4.30	4.30
FLOOR	1.88	1.88
ROOF #6	10.00	10.00
COAL #6	3.60	3.60
FLOOR	5.20	5.20

ARMPS module build: 5.1.23
Project File: F:\COAL\WP\BUCK\Burr Oak\D-2223-3 (Bishopville)\ARMPS FOR ALBERT\burroak 6-24-2010
Input Units: (ft) (psi)

[PROJECT TITLE]

[PROJECT DESCRIPTION]

[DEVELOPMENT GEOMETRY PARAMETERS]
Entry Height.....5.5 (ft)
Depth of Cover.....56 (ft)
Crosscut Angle.....60 (deg)
Entry Width.....17 (ft)
Number of Entries.....7
Crosscut Spacing.....70 (ft)
Center to Center Distance #1.....70 (ft)
Center to Center Distance #2.....70 (ft)
Center to Center Distance #3.....70 (ft)
Center to Center Distance #4.....70 (ft)
Center to Center Distance #5.....70 (ft)
Center to Center Distance #6.....70 (ft)

[DEFAULT PARAMETERS]
In Situ Coal Strength.....900 (psi)
Unit Weight of Overburden.....162 (pcf)
Breadth of AMZ.....37 (ft)
AMZ set automatically

[RETREAT MINING PARAMETERS]
Loading Condition.....DEVELOPMENT

[ARMPS STABILITY FACTORS]

DEVELOPMENT.....30.40

[DATA ABOUT THE ACTIVE MINING ZONE (AMZ)]

AMZ Width.....420.0 (ft)
AMZ Breadth.....37.0 (ft)
AMZ Area.....15540.0 (ft)*(ft)
Extraction Ratio Within AMZ.....0.46
Development Load on AMZ.....7.05E+04 (tons)

TOTAL LOADINGS ON AMZ, INCLUDING TRANSFER FROM BARRIERS

LOAD CONDITION	ABUTMENT LOAD (tons)	LTRANSBAR (tons)	LTRANSREM (tons)	TOTAL (tons)
DEVELOPMENT	0.00E+00	0.00E+00	0.00E+00	7.05E+04

R-Factor for front abutment is the percent of the total front abutment load that is applied to the AMZ.

R-Factor for side abutment is the percent of the total side abutment load that is applied to the barrier pillar (the remainder is applied to the AMZ).

LTRANSBAR is the load transferred to the AMZ from the barrier pillar between the side and active gob if the barrier's SF is less than 1.5.

LTRANSREM is the load transferred to the AMZ from the remnant barrier between the side and active gob if the remnant's SF is less than 1.5.

[PILLAR PARAMETERS]

PILLAR	ENTRY CENTER (ft)	MINIMUM DIMENSION (ft)	MAXIMUM DIMENSION (ft)
1	70.00	43.62	61.20
2	70.00	43.62	61.20
3	70.00	43.62	61.20
4	70.00	43.62	61.20
5	70.00	43.62	61.20
6	70.00	43.62	61.20

PILLAR	AREA (ft)*(ft)	STRENGTH (psi)	LOAD-BEARING CAPACITY (tons)
1	2.67E+03	3.51E+03	6.76E+05
2	2.67E+03	3.51E+03	6.76E+05
3	2.67E+03	3.51E+03	6.76E+05
4	2.67E+03	3.51E+03	6.76E+05
5	2.67E+03	3.51E+03	6.76E+05
6	2.67E+03	3.51E+03	6.76E+05

TOTAL LOAD-BEARING CAPACITY OF PILLARS WITHIN AMZ: 2.14E+06 (tons)

To view the distribution of Pillar Load Bearing Capacity
select 'View Plots->Settings->Pillar Load Bearing Capacity'

[BARRIER PILLAR PARAMETERS]
none

U.S. Department of Labor

Mine Safety and Health Administration
604 Cheat Road
Morgantown, West Virginia 26508

UNDERGROUND MINE FILE
DATE FWD: 6-18-10
INITIALS DR

JUN 18 2010

SENT TO AND/OR DISCUSSED WITH FIELD OFFICE:

SURNAME	DATE

	REVIEWED BY	DATE
Specialist	IAI	6-16-10
Spec. Supv	Evanto	6/16/10
Proofread	Woek	6-16-10
Tech ADM	Mosley	6-16-10

Mr. Michael D. Brooks
Loss Prevention Manager
Buckingham Coal Company
P. O. Box 400
Corning, Ohio 43730

Dear Mr. Brooks:

This notification is in response to your e-mail dated June 7, 2010, alerting the MSHA District 3 Office that Buckingham Coal Company's Buckingham Mine No. 7, MSHA I.D. No. 33-04520, is projected to mine under the East Branch of the Sunday Creek. It has been determined that mining under the East Branch of the Sunday Creek constitutes a hazard to miners in Buckingham Mine No. 7 and you are hereby notified that a permit is required. Please submit an application for a permit that meets the criteria set forth in 30 CFR 75.1716-3.

If you have any questions, please contact the Impoundment Group at 304-225-6855.

Sincerely,

Bob E. Cornett

Bob E. Cornett
District Manager

TTamasco:dr

bcc: St. Clairsville Field Office
Ventilation Section
Roof Control Section
Main File
Impoundments File ✓

BUCKINGHAM COAL COMPANY

Corning, Ohio

PHONE: 740-347-4565 FAX: 740-347-4003
BILLING: P.O. Box 400, Corning, OH 43730
DELIVERY: 14755 Twp. Rd. 295, SE, Glouster, OH 45732

RECEIVED
JUN 7 2010
DR 6-15-10 TI

June 7, 2010

Mr. Bob Cornett, District Manager
Mine Safety and Health Administration
604 Cheat Road
Morgantown, WV 26508

Dear Mr. Cornett:

Buckingham Coal Company, MSHA I.D. number 33-04520, Mine #7 is giving notice of planning to mine under the East Branch of Sunday Creek in July of 2010. The East Mains will cross under this area where the main mine reserves are located.

If you have any questions regarding this matter please contact me at 740-347-4000.

Sincerely,

Michael D. Brooks
Loss Prevention Manager
Buckingham Coal Company

Tamasco, Thomas - MSHA

From: Evanto, Michael A - MSHA
Sent: Monday, June 07, 2010 2:21 PM
To: Tamasco, Thomas - MSHA
Cc: Blake, Nelson T - MSHA
Subject: FW: Sunday creek

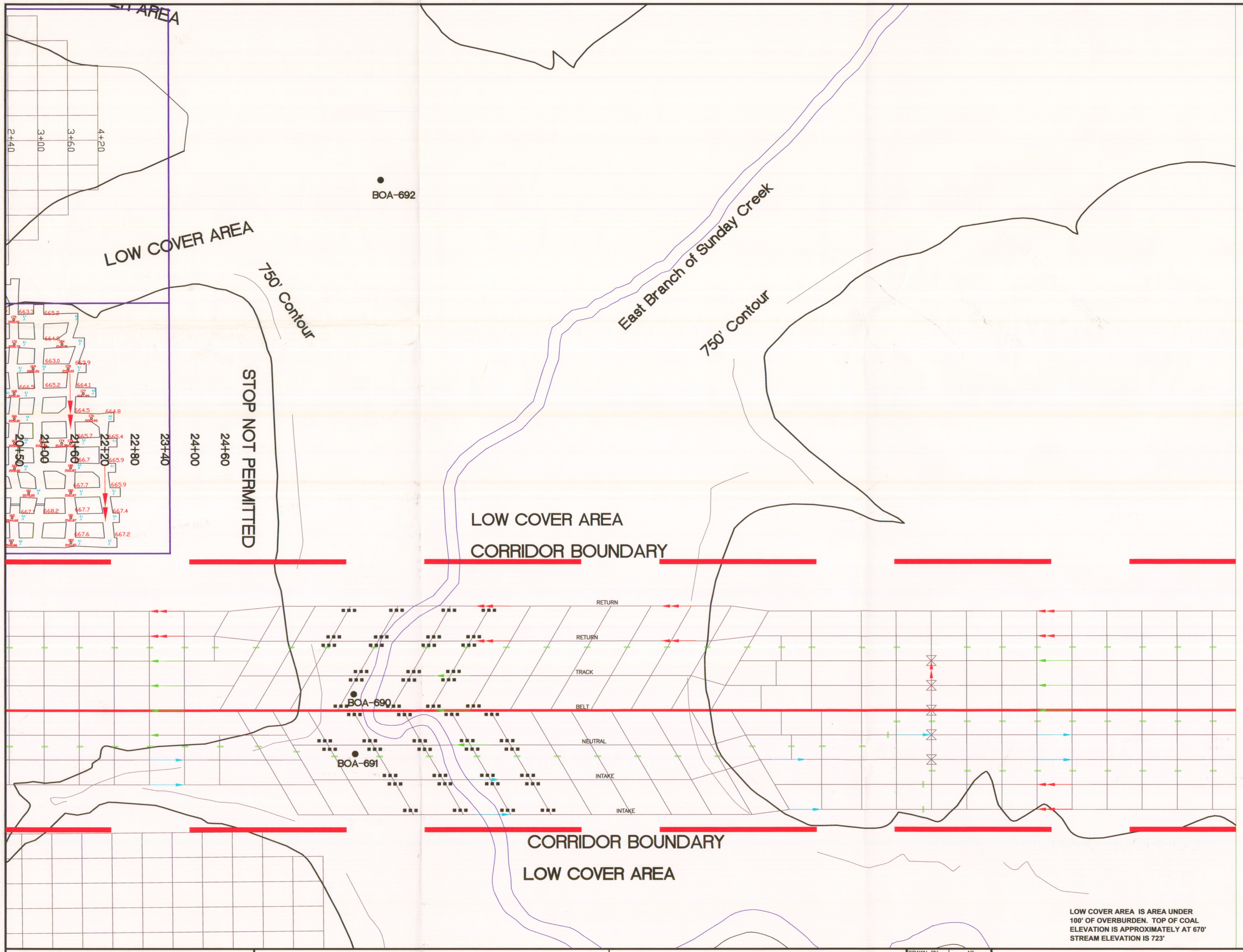
Tom,
I will forward the notification letter from Buckingham coal, please put together a letter to the operator informing him that a permit is needed.
Thanks

Michael A. Evanto
MSHA - District 3
Chief, Impoundment Section
Work - (304)225-6815
Fax - (304)225-2254

From: Evanto, Michael A - MSHA
Sent: Monday, June 07, 2010 2:18 PM
To: 'm.brooks@shellyandsands.com'
Subject: Sunday creek

Mike,
Thanks for notification of mining under a body of water. It has been determined from previous submittals that Sunday Creek has been determined to constitute a hazard to miners and you are being notified that a permit is required. I will have the official letter drafted and signed by the district manager, once you receive the letter please apply for an application with the general information from 75.1716-3.
Thanks

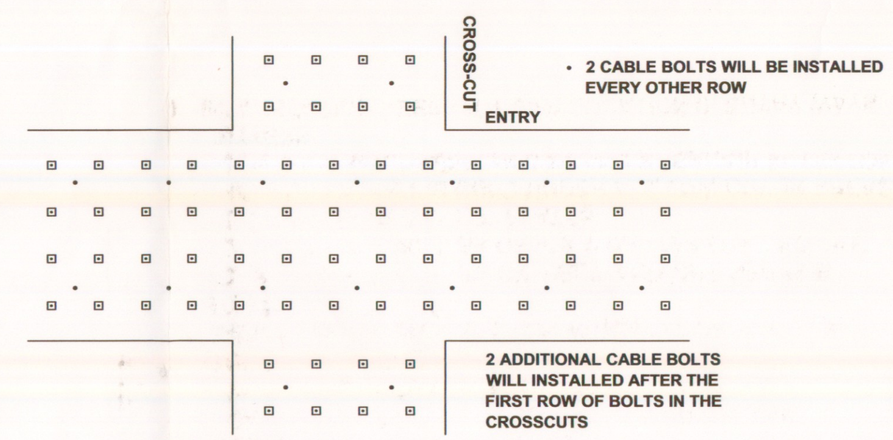
Michael A. Evanto
MSHA - District 3
Chief, Impoundment Section
Work - (304)225-6815
Fax - (304)225-2254



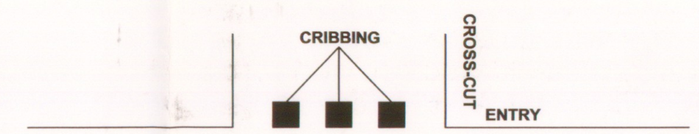
LOW COVER AREA IS AREA UNDER 100' OF OVERBURDEN. TOP OF COAL ELEVATION IS APPROXIMATELY AT 670' STREAM ELEVATION IS 723'

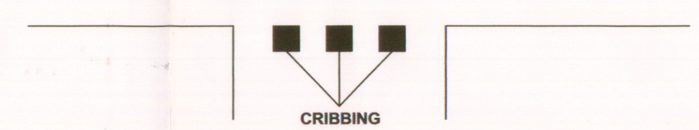
EAST BRANCH OF SUNDAY CREEK CROSSING

1. NOTIFY MSHA AND ODNR BEFORE CROSSING
2. NARROW ENTRIES TO 17 FOOT WIDTHS (NORMALLY 18')
3. EXTEND ENTRIES CENTERS TO A MINIMUM OF 80' (NORMALLY 50')
4. EXTEND CROSS-CUT CENTERS TO MINIMUM OF 80' TO A MAXIMUM OF 105' (NORMALLY 60')
5. 2 CABLE BOLTS EVERY OTHER ROWS IN ENTRIES AND 2 CARRIERS PER INTERSECTIONS, SEE DETAIL (MINIMUM OF 12' CABLE TO BE USED
6. CRIBBING IN ALL INTERSECTION WITHIN 100' OF SURFACE STREAM
7. SCREEN ONE INTAKE, TRACK, BELT, AND ONE RETURNS
8. ROOF SUPPORT WILL BE ON 4' x 4' CENTER SPACING W/ 8' TENSION REBAR & 8" x 8" PLATES
9. CHEVRON LAYOUT IS USED UNDER ALL LOW COVER AREAS TO REDUCE INTERSECTION SIZE AND BREAK-UP POTENTIAL CUTTERS
10. INTERSECTION KEEPS STREAM LOCATION IN ENTRY WAYS

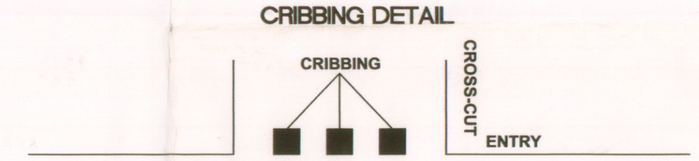


ROOF CONTROL DETAIL





CRIBBING DETAIL



CRIBBING DETAIL FOR BELT AND OUTSIDE ENTRIES

BUCKINGHAM OPERATIONS

MINE SUPERINTENDENT: Mike Griggs
CHIEF ELECTRICIAN: Chris Ray

BUCKINGHAM COAL COMPANY, INC.

Buckingham Mine No.7 (Monroe Township, Perry County, Ohio)
9950 State Route 13
Glouster, OH 45732

State ID No. D-2223
MSHA ID No. 33-04520

BUCKINGHAM ENGINEERING

ENGINEER: Albert F. Siemer, P.E.
SURVEYORS: Mike Densmore Ryan Riley

DRAWN BY	AS
CHECKED BY	MB
DATE	06/21/2010
COMM. NO.	D-2223

SHEET

S1

RETURN AIR
NEUTRAL AIR
INTAKE AIR
BELT
OVERCAST
PROJECTIONS
PROPOSED STOPPING

1" = 100'

U.S. Department of Labor

Mine Safety and Health Administration
604 Cheat Road
Morgantown, West Virginia 26508

DEC 2 1 2010

Mr. Michael D. Brooks
Loss Prevention Manager
Buckingham Coal Company
P. O. Box 400
Corning, Ohio 43730

Dear Mr. Brooks:

Your request received on December 16, 2010, to change the roof control support requirements for mining under the East Branch of Sunday Creek at the Buckingham Mine No. 7, MSHA I.D. No. 33-04520, has been reviewed and cannot be approved.

The previously issued permit to mine under this body of water was issued contingent upon the mining plan information you provided, and was not presented as mining beneath the flow easement and design flood area of Burr Oak Lake. Therefore, the prior permit dated June 30, 2010, to mine under the East Branch of Sunday Creek from the Buckingham Mine No. 7 has been terminated. A new permit to mine under a body of water per the requirements of 30 CFR 75.1716 cannot be issued until the following information is provided:

(1) A copy of your current ODNR mining permit and approval to mine beneath the flow easement and design flood area of Burr Oak Lake.

(2) A copy of US Army Corps of Engineers approval to mine beneath the flow easement and design flood area of Burr Oak Lake.

(3) Terms, conditions and precautions to be taken and the establishment of a safety zone to protect the safety of miners working or passing through the mined area beneath and adjacent to the inundation areas of the East Branch of Sunday Creek in addition to the design flood area of Burr Oak Lake.

(4) Justification to change supplemental roof control support to a truss system every other row in entries and one minimum carries per intersection from the cable bolt system.

(5) Justification to change primary roof control support from 8-foot tension rebar to 6-foot tension rebar.

If you have any questions, please contact the Impoundment Group at 304-225-6855.

Sincerely,

Bob E. Cornett

Bob E. Cornett
District Manager

U.S. Department of Labor

Mine Safety and Health Administration
604 Cheat Road
Morgantown, West Virginia 26508

MAR 14 2011

Mr. Michael D. Brooks
Loss Prevention Manager
Buckingham Coal Company
P. O. Box 400
Corning, Ohio 43730

Dear Mr. Brooks:

A review has been conducted of your submittal received on March 8, 2011, for the Buckingham Mine No. 7, MSHA I.D. No. 33-04520. The plan proposes to conduct mining operations under the East Branch of Sunday Creek. A permit to mine under a body of water per the requirements of 30 CFR 75.1716 is hereby issued contingent upon the following conditions:

(1) All mining will be in accordance with the submitted mine projections.

(2) During and after mining, any significant inflow of water or the encountering of adverse roof conditions shall be reported to this office. Miners on the sections shall be made aware that they are mining under a body of water prior to mining in this area.

(3) After the area is mined, particular attention shall be directed to the pillars and mine floor for any detrimental effects due to water entering the mine.

If you have any questions, please contact the Impoundment Group at 304-225-6855.

Sincerely,

Bob E. Cornett

Bob E. Cornett
District Manager

BUCKINGHAM COAL COMPANY
Corning, Ohio
PHONE: 740-347-4565 FAX: 740-347-4003
BILLING: P.O. Box 400, Corning, OH 43730
DELIVERY: 14755 Twp. Rd. 295, SE, Glouster, OH 45732

RECEIVED
MAR 8 2011
TG - KVC 3-8-2011

MARCH 8, 2011

Mr. Bob Cornett, District Manager
Mine Safety and Health Administration
604 Cheat Road
Morgantown, WV 26508

Dear Mr. Cornett:

Buckingham Coal Company Mine #7, MSHA I.D. number 33-04520, pursuant to the advice of MSHA is resubmitting for permission to mine under the East Branch of Sunday Creek Tributary.
The following safety measures to be taken are shown in the attached mining plan for the East Branch of Sunday creek flood zone.

If you have any questions regarding this matter please contact me at
740-347-4000.

Sincerely,

Chris Cosgrave

Chris Cosgrave
Safety Manager
Buckingham Coal Company

MINING PLAN FOR EAST BRANCH OF SUNDAY CREEK-FLOOD ZONE AREA

BUCKINGHAM COAL MINE #7 ID # 33-04520 WILL:

1. NOTIFY MSHA BEFORE CROSSING.

2. NARROW ENTRIES TO 17 FEET WIDTHS (NORMALLY 18').

3. EXTEND ENTRY CENTERS TO A MINIMUM OF 80' (NORMALLY 50').

4. EXTEND CROSS-CUT CENTERS TO A MINIMUM OF 80' AND UP TO A MAXIMUM OF 105' (NORMALLY 60').

5. INSTALL CROSSBARS (W4 x 13 OR EQUIVALENT) IN THE INTAKE, BELT, RETURN AND CROSSCUTS, WITH SUCH BEING INSTALLED ON NOT MORE THAN FOUR (4) FOOT CENTERS, SET ON PIN RAILS INSTALLED IN THE RIB AND SUPPORTED BY 1 7/8 INCH PINS DRIVEN THREE (3) FEET IN THE PILLAR. THE PINS ARE ON FOUR (4) FOOT CENTERS. METAL POSTS (LEGS) MAY BE USED IN LIEU OF PINS. IF LEGS ARE USED, BOLTS SHALL BE INSTALLED THROUGH AND NEAR THE END OF EACH CROSSBAR.

6. SUPPORT ALL KINGBEAMS WITH THREE (3) FIFTY (50) TON ROOF JACKS WITH A SUFFICIENT BASE PLATE ON THE BOTTOM TO PREVENT PUNCTURING OF THE FLOOR AND A CHANNEL ON TOP FOR THE BEAM TO SET IN.

7. SUPPORT THE TRACK ENTRY WITH (HEINTZMAN GI-120 FRENCH FRY BEAMS OR EQUIVALENT) WITH SUCH BEING INSTALLED ON NO MORE THAN FOUR (4) FOOT CENTERS, SET ON PIN RAILS INSTALLED IN THE RIB AND SUPPORTED BY 1 7/8 INCH PINS DRIVEN THREE (3) FEET IN THE PILLAR. THE PINS ARE ON FOUR (4) FOOT CENTERS. METAL POSTS (LEGS) MAY BE USED IN LIEU OF PINS. IF LEGS ARE USED, BOLTS SHALL BE INSTALLED THROUGH AND NEAR THE END OF EACH CROSSBAR. ALL KING BEAMS IN THE TRACK ENTRY WILL BE (HEINTZMANN GI-120 FRENCH FRY BEAMS OR EQUIVALENT), AND BE SET WITH THREE (3) FIFTY (50) TON ROOF JACKS WITH A SUFFICIENT BASE PLATE ON THE BOTTOM TO PREVENT PUNCTURING OF THE FLOOR AND A CHANNEL ON TOP FOR THE BEAM TO SET ON.

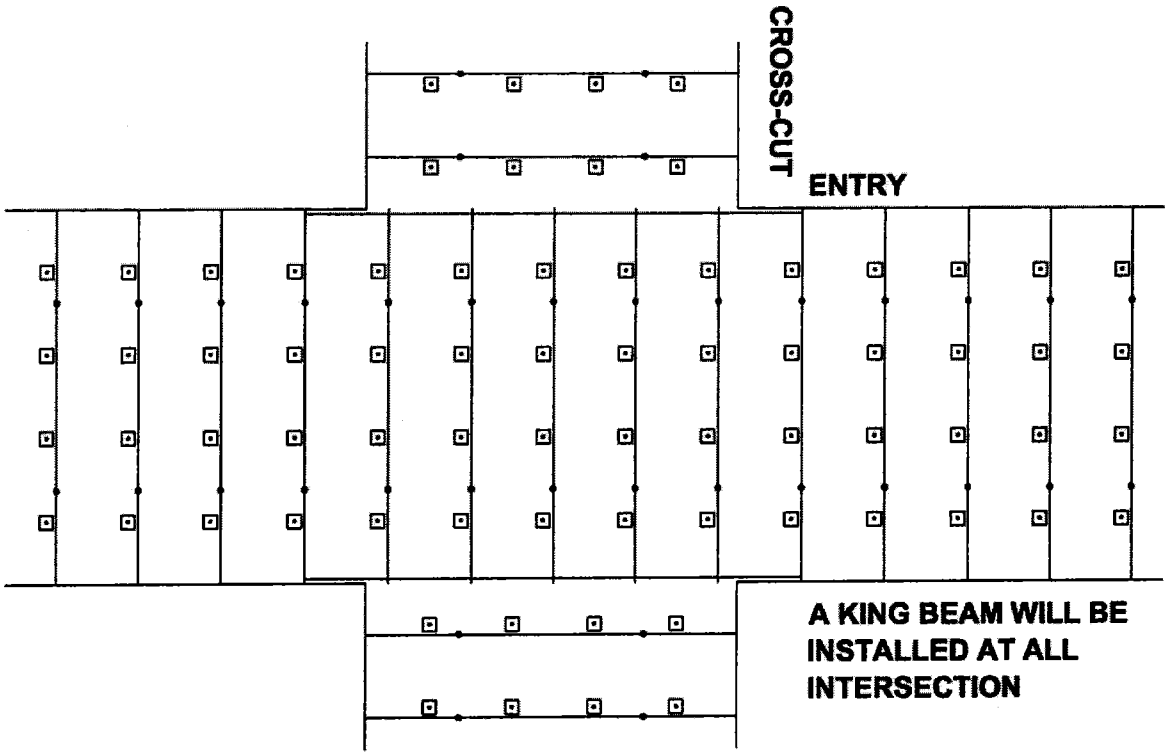
8. SCREEN INTAKE, TRACK, BELT AND RETURN.

9. SUPPORT ROOF ON 4' X 4' CENTER SPACING USING 6' TENSION REBAR BOLTS WITH 8" X 8" PLATES.

10. USE THE CHEVRON LAYOUT UNDER ALL LOW COVER AREAS TO REDUCE INTERSECTION SIZE AND BREAK-UP POTENTIAL CUTTERS.

11. KEEP INTER SECTION STREAM LOCATIONS IN ENTRY WAYS.

12. MAINTAIN ALL CROSSBARS TO THE LAST OPEN BREAK, UNLESS THE ENTRIES ARE NEEDED FOR HAULAGE, HAULAGE ENTRIES WILL BE SUPPORTED TO THE PLAN AS SOON AS POSSIBLE.



ROOF CONTROL DETAIL

PREVENTATIVE SAFETY MEASURES

1. BEFORE MINING COMMENCES UNDER THE CORRIDOR WE WILL HOLD A MEETING WITH ALL PERSONNEL EXPLAINING PROPER MINING PROCEDURES AND SAFETY PRECAUTIONS.

2. WE WILL PLACE SIGNS THAT STATE "EAST BRANCH OF SUNDAY CREEK TRIBUTARY" AT THE APROPRIATE UNDERGOUND LOCATIONS, UNDER THE EAST BRANCH OF SUNDAY CREEK TRIBUTARY.

3. WE WILL KEEP A SEPERATE WEEKLY BOOK FOR MONITORING THE CORRIDOR. WE WILL CHECK FOR SIGNS OF DEFLECTION AND AN INCREASE OF WATER FLOW. IF AT ANY TIME SIGNS OF DEFLECTION ARE FOUND, WE WILL INSTALL EXTRA ROOF JACKS WITH AN ADEQUATE BASE ON THE TOP AND BOTTOM, AND RECORD THE ACTION TAKEN IN THE WEEKLY BOOK.

4. WE WILL INSPECT BOTH THE SURFACE AND UNDERGROUND AREAS IN THE CORRIDOR, AFTER THE FIRST FLOOD AS REQUIRED BY MSHA. WE WILL NOTIFY MSHA WITH THE FINDINGS OF THE FIRST FLOOD AND RECORD THE CONDITIONS THAT WERE FOUND IN THE WEEKLY BOOK.

5. IF AT ANY TIME THE WATER LEVEL REACHES THE 725.5 FOOT ELEVATION MARK WE WILL CONTACT ALL MINERS AT AND INBY THE AFFECTED AREA SO THEY WILL BE AWARE OF THE CONDITIONS AND TAKE EXTRA SAFETY PRECAUTIONS.

6. WE WILL EVACUATE ALL PERSONNEL IMEDIATELY, IF WE HAVE AN UNCONTROLLABLE INUNDATION OF WATER.

Appendix D

Tom Jenkins Dam (Burr Oak Lake) Water Control Manual

CELRH-EC-WM

05 Jan 2010
Schray/5604

Memorandum for Resource Managers and Water Control Manual holders

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Reference CELRH-EC-WM Memorandum to Kent Browning, dated 20 January 2004, Subject: Modification of Huntington District Water Control Reporting Procedures.

2. The referenced memorandum modifies certain reporting procedures. Since that memorandum was issued, improvements in technology have resulted in the National Weather Service providing detailed snow analyses data in graphical maps via the internet. This data satisfies Water Managements needs, and therefore an additional modification is necessary.

3. Modify Instructions to Dam Tender, Section 2 – Precipitation at Project, sub-section: Snow Depth and Moisture Content:

Replace the section in its entirety with the following:

"Report snow data to Water Management only when directed to do so. Measure and record the water content of the snow at least as often as indicated below.

(1) Each day when rain falls on existing snow cover

(2) Twice a week on Mondays and Thursdays when there is snow cover on the ground if condition (1) does not require more frequent measurement.

4. This change in reporting instructions does not modify the Project's requirement to store this data on site.

5. This memorandum shall be placed in the front of the Water Control Manual to document the change.

Timothy W. Curran, P.E.
Chief, Water Management Section

CELRH-EC-WM

11 June 2007
Schray/5604

Memorandum for Resource Managers and Water Control Manual holders

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Reference CELRH-EC-WM Memorandum to Kent Browning, dated 20 January 2004, Subject: Modification of Huntington District Water Control Reporting Procedures.

2. The referenced memorandum modifies certain reporting procedures, and this memorandum makes an additional change. Some Water Control Manuals have been revised with the new procedures the "Instructions to Resource Manager" or "Instructions to Dam Tender" section. Manuals that have not been revised should have the referenced memorandum placed in the front of the manual. Make handwritten changes to the memorandum or the Water Control Manual, as appropriate. This memorandum shall be placed in the front of the Water Control Manual to document the change.

3. Modify Instructions to Dam Tender, Section 4 – Regular Reports, sub-section: Weekly Precipitation Report, second and third sentences:

Replace the text "This report must be filled out and transmitted every Monday morning by 0800 hours. If Monday is a holiday, it shall be filled out on the next work day by 0800 hrs." with "This report is no longer required to be completed on a weekly basis. It shall only be filled out and submitted if required by special directive."

Timothy W. Curran, P.E.
Chief, Water Management Section

3/16/04
Ellc

CELRH-EC-WM

20 January 2004
Schray/5604

Memorandum for Kent Browning, OR Water Management POC.

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Please distribute this memorandum to all Huntington District Flood Control Project Managers, direct them to place this memorandum in the front of the Water Control Manual, and make notes in the text which has been superseded.

2. As directed by the QC, EC-WM is implementing the recommendations of the Reservoir Reporting Process Action Team. As such, the following changes shall be made to the water control manuals and the associated processes:

The following sections are modified as noted.

Instructions to Dam Tender, Section 2 - Precipitation at Project, sub-section: Snow Depth and Moisture Content

Measure and report to EC-WM by 0900 hours the water content of the snow at least as often as indicated below.

(1) Each day when rain falls on existing snow cover

(2) Twice a week, on Mondays and Thursdays, when there is snow cover on the ground if condition (1) does not require more frequent measurements.

Instructions to Dam Tender, Section 2 - Precipitation at Ohio River Network Stations

Reports to the National Weather Service are carried out by agreement between the Project and the Weather Service and at their direction. The project is not required to gather or submit any additional data to Water Management beyond what is described previously in section 2 and what is detailed in section 4.

Sub-Sections a, b, and c are therefore no longer relevant except as to describe how to gather and provide data to the National Weather Service.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Weekly Report, ORH 14

This section is rescinded in its entirety and is replaced by sub-section: Historical Files.

Projects are required to maintain a permanent hard copy at the project of all water control data required for daily operation. This data shall be comprised of the information the project has historically gathered using the ORH 14 and 13 reports and shall be gathered at 0730 on days when the project is staffed, at other times as directed by the Schedule for Reading Gages and the Project Manager and when data is requested by Water Management Section. It shall include but not be limited to: Precipitation, Current Weather conditions, Lake Stage Levels, Outflow Stage Levels, Gate Settings, Gate Operations and time performed, Snowfall, Snow on the Ground, Total Moisture Content as directed in Section 2, and all Upstream and Downstream gauge readings which are utilized by project personnel for gate operation decision making.

This information may be maintained either on the historical reports or a new project developed format.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Daily Morning Report

This sub-section is modified to note that: Generation and transmission of the daily morning report (also call the intranet report which replaced the ORH-13 Daily report) is only required when requested by the Water Management Section. Automatic daily transmissions are no longer necessary.

Note: Atwood, Bolivar, Clendening, Piedmont, Tappan, and Tom Jenkins are still required to report all gate operations to EC-WM by phone. Extra emphasis will be placed on these phone calls as Water Management will no longer be able to look up the previous day's gate operations every morning.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Gate Operations Report

This sub-section is modified to note that: Generation and transmission of the gate operations report is only required when requested by the Water Management Section. Neither daily transmissions nor transmissions after every gate operation are necessary any longer.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Weekly Precipitation Report

This sub-section shall be added after the Water Quality Report sub-section.

A fourth report available from the Index Page is the Weekly Precipitation Report. This report must be filled out and transmitted every Monday morning by 0800 hours. If Monday is a holiday, it shall be filled out on the next work day by

0800 hours.

Upon accessing the Weekly Precip Report link on the Index Page, fill in the daily precipitation for the past week. When all data for the week is filled in, save the spread sheet and exit. This record will be saved for the entire year and can be viewed through the link used to modify it.

On days when the project is not staffed, place a "NS" in that day's field and report the combined day's precipitation in the next day when the project is staffed. I.e. If the project does not staff the weekend, place a "NS" in the field for Saturday and Sunday and report the 72 hour precipitation record on Monday morning.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Additional Comments

This sub-section shall be added after the Weekly Precipitation Report sub-section.

A fifth link available on the Index Page is the Additional Comments link. It shall be used when ever the Project has special information or questions that it wants to bring to the immediate attention of the Water Management team. Snow Moisture shall be reported using this link.

Upon accessing the Additional Comments link on the Index page, a blank email to the Water Management Team will be generated. Please note in the subject line, the nature of the issue and then provide supplemental data in the text block of the message. After the email has been completed click on the submit/send button to send the message.

Instructions to Dam Tender, Schedule for Reading Gages

The last sentence of the top paragraph "Stream gages and the precipitation gage (all gages) shall be read at least as often as shown in the table below", shall be replaced with: "Reading and recording of gages shall be carried out as defined under Schedule A except when gage levels/precipitation are such that the Resource Manager or their Acting anticipates that problems may result, at which point the relevant schedule B, C, or D shall be followed for reading and recording of all required gages. Transmission of project gage data will be at the request of EC-WM.

Modify the chart as follows:

SL, SO, and DCO shall be read in all schedules monthly as a check

Modify the footnotes as follows:

(1) When any one of the conditions listed under schedule A, B, C is exceeded and problems are anticipated, place the next higher schedule into effect. When conditions are such that would place schedules C or D into effect, notify by phone one of the Water Control personnel.

Timothy W. Curran, P.E.
Chief, Water Management Section

CF:EC-WH

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO
ATTENTION OF:

Engineering & Construction Division
Water Resources Engineering Branch

3 June 2003

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Updates for the Tom Jenkins Water Control Manual

1. EC-WM has made the following changes in the references Water Control Manual. Chapter 7 (main text), Instruction to Damtender (Exhibit B), Schedule for reading gages (Exhibit B), Outflow "A" gage Rating Table, Exhibit A (fact Sheet).

2. Changes to the Web page as requested. http://cwms.lrh.usace.army.mil/dbases/briefing/tje.htm.

3. The schedule for reading gages was modified to require an additional reading of the "A" gage when necessary to reflect that at low flows the travel time to the "A" gage is longer than one hour.

4. Replace existing sheets with the attached sheets.

5. Any questions should be directed to Mr. James Schray at (304) 529-5604.

6. Place this page in the front of the manual.

Encls

ALFRED L. BRANCH, JR., P.E.
Chief, Engineering & Construction Division

CELRD-ET-W (2)
CELRH-OR
CELRH-OR-TJE (2)
CELRH-OR-SAO
CELRH-EC-WM (2)
CELRH-EC-WH

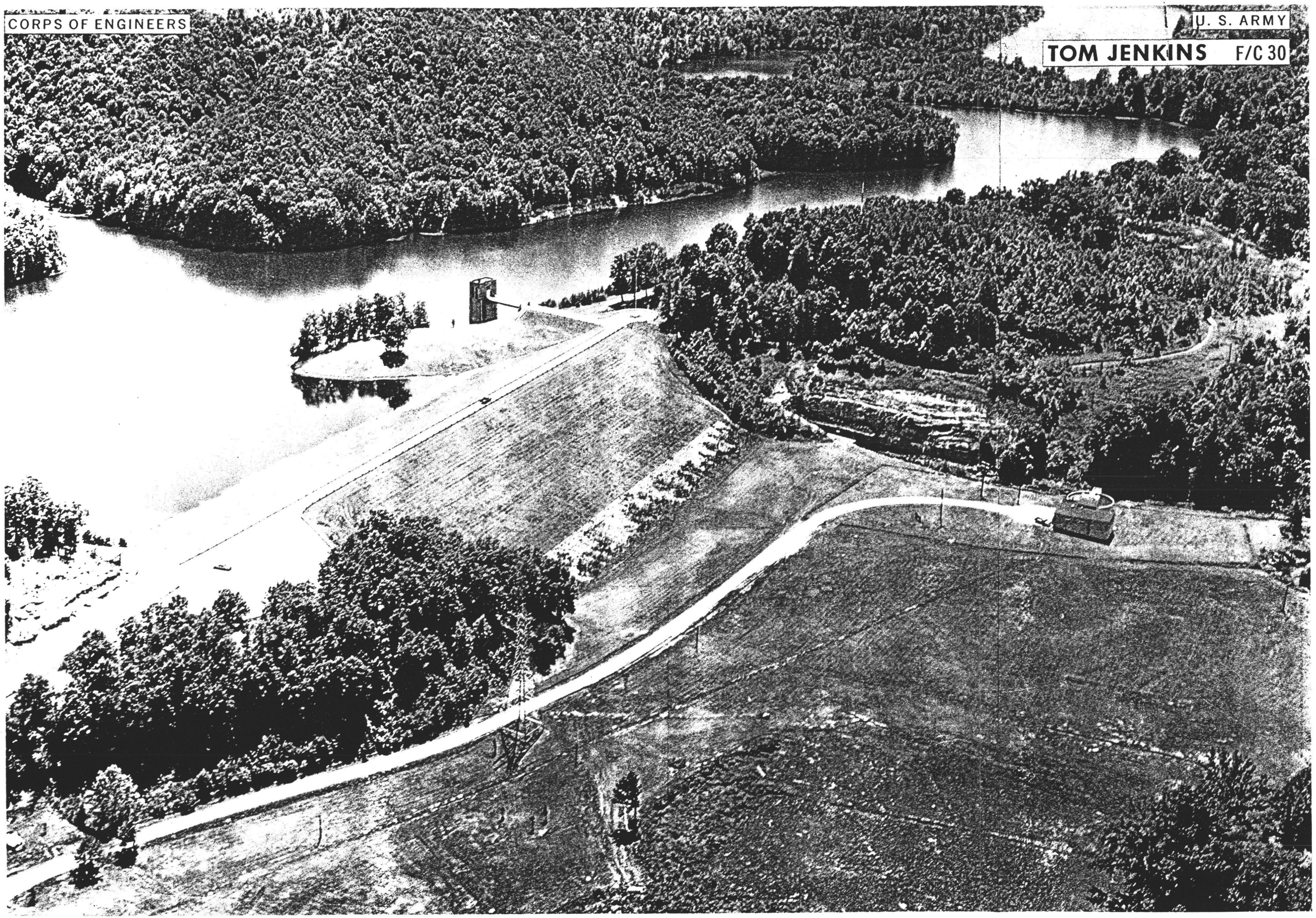
U.S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, WEST VIRGINIA

HOCKING RIVER BASIN
OHIO

WATER CONTROL MANUAL
FOR
TOM JENKINS DAM (BURR OAK) LAKE - EAST BRANCH SUNDAY CREEK

PREPARED BY
U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON, WEST VIRGINIA

MARCH 1999


CORPS OF ENGINEERS
U. S. ARMY
TOM JENKINS F/C 30

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TOM JENKINS DAM

PERTINENT DATA

LOCATION OF DAM: IN ATHENS COUNTY OHIO. ON EAST BRANCH OF SUNDAY CREEK, A TRIBUTARY OF HOCKING RIVER: 0.3 MILES ABOVE THE MOUTH OF EAST BRANCH AND 57.2 MILES ABOVE THE MOUTH OF THE HOCKING.

DRAINAGE AREA ABOVE DAM: 32.8 SQUARE MILES

LAND ACQUIRED: 99.28 ACRES
EASEMENT – 1,638.92 ACRES (INCLUDES FLOWAGE RIGHTS BY USE PERMIT FROM THE DEPARTMENT OF AGRICULTURE.

RESERVOIR DATA: STREAMBED ELEVATION AT DAM: 682’.

HOCKING RIVER BASIN
OHIO

PROJECT MANUAL
FOR
WATER CONTROL MANAGEMENT
TOM JENKINS (BURR OAK) LAKE-EAST BRANCH SUNDAY CREEK

SECTION 1 - INTRODUCTION

1-01 PROJECT AUTHORIZATION

Tom Jenkins Dam Project, formerly called Burr Oak Dam but changed to "Tom Jenkins Dam, Burr Oak Reservoir" by Public Law 504, 82nd Congress, approved 11 July 1952, is part of the comprehensive plan for flood control in the Ohio River Basin. Burr Oak Reservoir was one of the reservoirs authorized by the Flood Control Act of 1944, H. R. 4485, Public Law 534, Seventy-eighth Congress, second session, approved 22 December 1944. The project was authorized as a multi-purpose project constructed for flood control, recreation, water supply, and fish and wildlife enhancement. A boundary map of the Huntington District showing the Tom Jenkins project location is shown as Plate No. 1-1.

1-02 AUTHORITY, PURPOSE AND SCOPE OF WATER CONTROL MANUAL

This manual is prepared in accordance with ER 1110-2-8156, dated 31 August 1995, ER 1110-2-240, dated 8 October 1982, and ETL 1110-2-251, dated 14 March 1980, all providing for the submission of reservoir regulation manuals in accordance with instructions contained in "Guide for Preparing Water Control Manuals", as prepared by SWD, dated October 1977.

The purpose of this manual is to present the general plan of regulation for Tom Jenkins Dam in the Hocking River Basin. The manual serves as documentation of the plan for water control, and also as a reference source for higher authority and for personnel responsible for water control management during the life of the project. The manual also contains information pertinent to objectives and applications of water management schedules, as well as results of project operation simulations for specific purposes and conditions. The guidelines in EM 1110-2-3600 provide for submission of water control manuals that contain regulation schemes in sufficient detail to establish the basic plan of reservoir operation to be followed under current conditions. This manual supplements the report, subject, "Master Manual for Reservoir Regulation-Hocking River Basin," in which information required for the coordinated operation of all reservoirs in the Hocking River Basin (Burr Oak Lake) is presented.

1-03 RELATED MANUALS AND REPORTS

The following manuals and reports concerning Tom Jenkins Dam (Burr Oak Lake) or the Hocking River projects have been previously completed.

	TITLE	DATE
1.	Report on main river in vicinity of mouth to Coolville (Navigation)	1888
2.	Unpublished report on Hocking River, authorized by the River and Harbor Act of 1930, concluded that further navigation improvements on the Hocking River were not justified.	1931

3. Hocking River 308 Report, House Document No. 82, 73rd Congress, 1st Session, concluded that flood control improvements were not justified. 1932

4. Preliminary report on Hocking River in Athens County, authorized by the Flood Control Act of 1931, concluded that flood control improvements were not justified. 1932

5. House Document No. 306, 74th Congress, 1st Session, comprehensive Ohio River 308 Report, recommended no flood control or navigation projects in the Hocking River Basin. 1935

6. A preliminary examination of the Hocking River and Athens County Ohio, recommended a detailed survey be made for local protection for Athens and a flood control reservoir on East Branch of Sunday Creek. 1938

7. A report on Hocking River and Athens County, Ohio, House Document No. 762, 77th Congress, 2nd session, justified Burr Oak Reservoir on East Branch of Sunday Creek. 26 June 1941

8. The Flood Control Act of 1944. H.R.4485, PL 534, 78th, 2nd. session, approved 22 December 1944, authorizing construction of the Burr Oak Dam and Reservoir project. 1944

9. Report on Preliminary Examination of Hocking River in Athens County, Ohio, concluded that Burr Oak Reservoir was the only fully justified project in the basin. 1945

10. Analysis of Design - Tom Jenkins D am Revised 1947

11. Analysis of Design - Addenda to build project 1948

12. Master Manual for Reservoir Regulation and Instructions to Project Supervisor, Tom Jenkins Lake (Burr Oak) Lake. June 1952

13. By Congressional act, Public Law 504, 82nd Congress, approved 11 July 1952, the dam and related structures were named the Tom Jenkins Dam, Ohio," in honor of the late congressman who represented the Ohio 10th district. July 1952

14. Survey Report on the Hocking River Basin - Text, Vol. II, and Vol. III. justifying Athens Local Protection and Logan Reservoir. January 1965

15. History and Development of the Hocking Conservancy District Project. June 1965

16. Water Inventory of the Muskingum River Basin and Adjacent Ohio River Tributary Area. 1968

17. Periodic Inspection, Tom Jenkins Dam (Burr Oak Lake)

Report No. 1	June 1969
Report No. 2	April 1975
Report No. 3	April 1980
Report No. 4	June 1985
Report No. 5	June 1990

	Report No. 6	June 1995
18.	Sedimentation Survey Tom Jenkins Dam and Lake	February 1973
19.	Sedimentation Survey Tom Jenkins Dam and Lake	October 1976
20.	Sedimentation Survey Tom Jenkins Dam and Lake	October 1980
21.	Sedimentation Survey Tom Jenkins Dam and Lake	January 1987
22.	Operations and Maintenance Manual Tom Jenkins (Burr Oak) Lake	January 1973
23.	Southeast Ohio Water Plan	September 1978
24.	Dam Failure Study Report Flood Emergency Plan - Tom Jenkins	March 1982
25.	Dam Safety Training Program Manual, Tom Jenkins Dam (Burr Oak) Lake	1993

1-04 PROJECT OWNER.

The United States Government has full title, ownership, and fee control of Tom Jenkins Dam, the operations building, machinery and equipment, approximately 99.3 acres of land surrounding Tom Jenkins Dam, and a small plot of ground below the dam out granted to the state of Ohio for a water plant. The U.S. Government reimbursed the private land owners for the 99.3 acres adjacent to the dam. The remainder of the project area, the lake and state park is owned by the state of Ohio.

1-05 OPERATING AGENCY.

Tom Jenkins Dam is staffed and operated by the Huntington District, Corps of Engineers.

The mailing address is:
Tom Jenkins Dam
23560 Jenkins Dam Road
Glouster, Ohio 45732
Telephone No. 740 767-3527

The Project Supervisor is:
Mr. Robert Sullivan
22510 State Route 13
Glouster, Ohio 45732

1-06 OPERATING AND REGULATING RESPONSIBILITY

The Huntington District Water Resources Engineering Branch has various responsibilities as specified in Ohio River Division Regulation 1110-2-27, dated 12 January 1976. These responsibilities include the primary overall water control management of all District projects, technical evaluations of performance of these projects, and developing plans and manuals for the reservoir systems within the District, such as the Tom Jenkins (Burr Oak) Lake Project. The locations of the reservoir systems within the District are shown on Plate No. 1-1.

Guidelines for routine operations under identified conditions are included in standard operation instructions. Special Directives issued and signed by the Chief of the Water Control Section for operations needed for all other situations, low flow control, or flood regulation. Any operations which might

deviate from the approved water control plan as presented in this manual are coordinated with the Great Lakes and Ohio River Water Management Division.

The operating and regulating responsibility is exercised under the following regulations:

(l) EM 1110-2-3600, 30 November 1987, Subject: Management of Water Control Systems.

(2) ER 1110-2-1400, DAEN-CWE-Y, 24 April 1970, Subject: Reservoir Control Centers.

(3) ER 1110-2-240, DAEN-CWE-Y, 8 October 1982, Subject: Reservoir Control Centers.

(4) ORDR 1110-2-27, 12 January 1976, Subject: Water Control Management Activities.

(5) ER 1130-2-415, DAEN-CWE-Y, 28 October 1976, Subject: Water Quality Data Collection, Interpretation and Application Activities.

(6) ORDR 1110-2-26, 5 February 1979, ORDED-W, Subject: Water Quality Investigations and Control Activities.

(7) ER 1110-2-208, DAEN-CWE-Y, 30 July 1979, Subject: Water Control Management.

SECTION II - DESCRIPTION OF PROJECT

2-01 LOCATION

Tom Jenkins Dam is located in Athens County, Ohio on East Branch of Sunday Creek, a tributary of Sunday Creek of the Hocking River, 0.3 miles above the mouth of East Branch, approximately 4.5 miles north of Glouster, Ohio. The damsite is located 57.2 miles above the mouth of the Hocking River in Trimble Township, 0.4 miles southeast of Burr Oak, Ohio, and approximately 16.5 miles above the village of Chauncey, Ohio, on the Hocking River, and about 25.5 miles above Athens, Ohio. The general location of the Sunday Creek Basin is shown on Plate 2-1.

Although the village of Burr Oak and Tom Jenkins Dam lie in the northeast corner or edge of Athens County, most of the drainage area above the dam lies in Morgan County with a small portion or section in Perry County. The drainage basin is generally rectangular in shape and lies in a north-south direction. The drainage area and reservoir layout are shown on Plate Nos. 2-1 and 2-2, respectively.

2-02 PROJECT PURPOSES

a. General. Tom Jenkins (Burr Oak) Lake is authorized for flood control, water supply, recreation and fish and wildlife enhancement in a comprehensive plan for the Hocking and Ohio River Basins. The various land uses in the Burr Oak Lake Project area are shown on Plate No. 2-3. Benefits from flood control and water conservation serve not only local interests in the Sunday Creek and Hocking River Basin, but also the overall Ohio River Basin.

b. Flood Control. Prior to the construction of Tom Jenkins Dam and the adjacent Scioto and Muskingum River Basin projects, flooding was due primarily to the inadequate capacity of the stream channels and the extent of development in the overbank areas. Flood losses were experienced in cities and towns along the streams, in areas of floodplain development, and in agricultural areas.

Major flooding in southeastern Ohio can occur at any time of the year. Summer rains are often generated by thunderstorm activity, which typically occurs over small areas and produces high intensity rainfalls over a short period of time. Precipitation from late fall to early spring is generally associated with the passage of a low pressure system over the basin. If these systems become stationary or move very slowly, prolonged precipitation is possible. These types of systems can produce flooding conditions over large areas. The principal flood control benefits of Tom Jenkins Dam are to agricultural areas and urban communities downstream of the dam within the Sunday Creek, Hocking and Ohio River Basins.

c. Conservation and Water Supply. Reservoir storage below minimum pool elevation 710 has been provided for siltation reserve and general conservation purposes while storage between elevation 710 and 721 feet NGVD has been provided for water quality control, water supply, recreation, minimum releases, and emergency malaria control requirements.

Due to anticipated increased industrial activity in this general area, the Public Health Service believed it advisable to estimate the water needs to develop the economic potential of the Hocking River Basin during the next 50 years. Studies of water needs included municipal and industrial water supply under provisions of the Water Supply Act, Public Law 85-500 and flow regulation for water quality control under Public Law 87-88. For the evaluation of water supply control needs it is assumed that secondary sewage treatment or its equivalent will be provided by all municipalities and industries in the basin.

Since Tom Jenkins Dam was the only justified water project in the Sunday Creek Basin, it was decided to include additional storage in this reservoir to provide an adequate supply of water for the city of Glouster, Ohio. Tom Jenkins Dam, by releasing a minimum flow of 2 cfs at all times, will improve the minimum flow conditions downstream from the dam on East Branch of Sunday Creek and on Sunday Creek. The Public Health Service also concluded that there would be at some future time a strong need for a dependable amount of water available for municipal and industrial water supply. To guarantee this needed flow a water supply pool is included that could provide up to 5 MGD during any summer month. This pool is now used by the recently built municipal water treatment plant below the dam and it is used to increase the quality of the water downstream of the dam by a year-round minimum release of about 2 cfs.

Preliminary reservoir operation for design purposes was based on hindsight operation, however, after construction of the dam, it became necessary to forecast streamflows in order to operate the reservoir. In order to successfully operate Tom Jenkins Dam for water supply, it becomes necessary to forecast flows at downstream control stations. Until more refined forecast procedures can be developed from extended actual reservoir operation, it is proposed to operate Tom Jenkins Dam for water supply based on the control stations 0.6 mile below the water treatment plant or "A" gage and the USGS gage at Glouster.

Although the malaria vector, Anopheles quadrimaculatus, is present, the reported incidence of malaria is low as the Hocking River Sunday Creek areas are considered to be outside the endemic malaria zone. The topography and aquatic plant life in the area are such that little opportunity for significant Anopheles quadrimaculatus breeding is likely to occur, if normal precautions are taken. The narrow flood plains are generally well drained and it is unlikely that ponding of water will result from pool drawdown. Should operation of the reservoir reveal any stagnant pools, proper drainage will prevent mosquito breeding. The reservoir has been cleared above the water supply pool level, and proposed maintenance thereof should be beneficial in prevention of mosquito breeding along the reservoir shores. The reservoir regulation program for malaria control follows:

1. The normal operation for minor rises will result in lake levels high enough to strand driftwood, trash and other debris during the spring. This spring flood and drawdown will clear the flood control pool of many breeding spots and accumulated trash.

2. Since mosquito breeding is considered unlikely to occur to any great degree, it can be controlled by larviciding, if necessary.

3. During seasons in which there are no rises in stream flow, operation under the schedule for low-flow regulation will result in a slight recession from the year round water supply pool elevation 721 feet NGVD. Based on the above procedures, it is not necessary to provide a regulation program specifically for malaria control.

d. Recreation. Prior to the construction of Burr Oak Lake, Athens County did not have a sizeable body of water available for public recreational use. The need and possibilities for lake recreational facilities were recognized during the original design and construction of the nearby Muskingum System, and were finally realized in 1937 when the Conservancy Act was amended to allow recreational operations. Recreation as a project purpose at Tom Jenkins Dam (Burr Oak) Lake was authorized by the Flood Control Act of 1944 (P.L. 78-534).

In January 1948, the Federal Government negotiated an agreement with the State of Ohio to provide the local interests requirements for acquisition of land for Burr Oak Lake, and a state recreational park adjacent to the lake. The State of Ohio also agreed to manage and supervise the waters of Burr Oak Lake for recreation, fishing, hunting, boating, and game. As a result of the agreements

the state obtained hunting and fishing access rights on the lake for a fraction of the cost of constructing comparable facilities. However, the U.S. Government retained fee title to a 99.3 acre tract for the dam itself, and small tract below the dam which is out granted to the state of Ohio for a local water supply plant.

The recreation plan for Burr Oak Lake is one of the better recreational areas, due to the Burr Oak Lake State Park and the adjoining Wayne National Forest, and is shown on Plate No. 2-3. Burr Oak Lake was developed and designed to provide recreational facilities, as well as flood control and water conservation benefits. Many visitors travel each year through Wayne National Forest to Burr Oak Lake and State Park by Ohio State Route 13, which connects with U.S. Route 33 at Athens and Chauncey, goes by the dam, and on to Zanesville. State Route 78 connects with State Route 13, passes on the east side of the lake for several miles, and goes on to McConnelsville. A township road crosses the upper end of the lake and connects the two previously mentioned main highways.

The Corps of Engineers has the responsibility for maintaining and managing the fee owned 99.3 acres of Federal land at the Tom Jenkins Project, including the picnic and overlook areas under Title 36, Code of Federal Regulation. The waters of Burr Oak Lake are the responsibility of the Ohio Department of Natural Resources/Division of Wildlife, who administers fish and game propagation and management. The Ohio Department of Natural Resourses also administers state boating, fishing, and hunting regulations on the project water and land areas. The recreation facilities of Burr Oak State Park are managed by the State of Ohio. The Corps of Engineers at the damsite has no control or connection with the adjoining Wayne National Forest, however, the Corps of Engineers does fully cooperate with both parks on many matters and areas.

e. Fish and Wildlife Conservation. The Fish and Wildlife Coordination Act of 1958 (PL 85-624) provided that fish and wildlife conservation should also be considered as a viable project purpose. The Forest Conservation Act of 1960 (PL 86-717) required protection and sustained yield of the forest resources at reservoir areas. The U.S. Fish and Wildlife Service, in a report on low-flow stagnation requirements, requested that enough storage be provided to maintain minimum downstream flows of about 2 cfs during any month of the year. As long as the pool elevation is above the lower limiting rule curve a minimum release of 2 cfs will be provided at all times.

The Ohio Department of Natural Resources/Division of Wildlife is a descendent of the Ohio Fish Commission, which was created in 1873. The duties of the original Commission included dealing with declining fish populations in Ohio's inland lakes and streams. The Division's responsibilities have broadened over the years, and now include fish and wildlife management, law enforcement, research, propagation, stream improvement, enforcement of Ohio's stream litter law, and the monitoring of all endangered species in Ohio.

The Ohio Department of Natural Resources/Division of Wildlife manages fish and wildlife areas at Tom Jenkins Lake as a result of the June 1950 agreement with the Corps of Engineers. The Ohio Division of Wildlife's management programs include hunter and wildlife species management, habitat manipulation and research. Habitat management maintains diverse ecological types and provides for many wildlife oriented recreational uses. The Cooperative Hunting Program helps to control hunting pressure and trespass problems on private lands. Wildlife research projects are conducted on upland, forest and wetland wildlife to assist the Division in improving wildlife populations. The Division's primary objectives regarding non-game fish and wildlife species are inventories, formulation of management guidelines, and the restoration of selected species of endangered wildlife.

Licensing, harvest regulations and land acquisition are the fundamental tools in the management of Ohio's wildlife resources. The Division of Wildlife

issues harvest regulations to protect wildlife and allow wise resource use based on biological data, public input and long-term statutory laws. Sportsmen are licensed by the Division to provide control of consumptive wildlife use. Fees collected from Ohio sportsmen provide approximately 95 percent of the operating budget for the Division of Wildlife.

Tom Jenkins is one of many Corps of Engineers reservoirs open to public fishing. The Division of Wildlife manages the water areas, propagates fish, conducts research, and communicates with the public. Water area management at Burr Oak Lake includes stocking, construction of fish attractors, population monitoring with nets, seines, and creel census, and conducting general physical and chemical water quality analyses. The Division operates seven hatcheries in Ohio to maintain a variety of fishing in Burr Oak Lake and other fishing streams and lakes in Ohio.

Burr Oak Lake contains a variety of sportfish, including walleyes, yellow perch, largemouth bass, crappies, bluegill, channel catfish, pumpkinseed, white bass, flathead catfish, gizzard shad, carp, and brown bullhead. The best fishing sites at Burr Oak Lake are along shoreline areas and around stumps and brush during the spring and fall seasons.

The Hocking River Basin contains a diversity of wildlife species. In the Burr Oak Lake Basin, the main varieties of wildlife include large quantities of deer, beavers and turkey; smaller quantities of grouse, squirrels, opossum, skunks, muskrats, ducks, cottontail rabbits, mink, and some limited quantities of quail.

f. Special Purposes. A wide range of people needs involving water flow or stage within the sphere of project influence become special purposes which are evaluated for translation into regulation. The expressed need may be for a low stage downstream to allow fording, construction work or search for a drowning victim; a medium stage downstream for a sporting event such as canoeing; a high stage downstream to answer an emergency in the lake area; reservoir drawdown to meet an important construction need; or any of a multitude of other situations generating a request for special operation. Emergency needs are met as quickly as possible; however, requests for deviation from normal regulation must be evaluated with respect to the hydrometeorological outlook and with respect to the impact on other project purposes. Requests for deviation at Tom Jenkins Dam are coordinated with the Scioto Area office and the Water Management Division in the Great Lakes and Ohio River Division Office. After evaluation and coordination, if the request is granted, the Chief of the Water Control Section directs the regulation to the Damtender. A record of each approved request is contained on Form ORD 1018R, Record of Deviation from Approved Plan.

2-03 PHYSICAL COMPONENTS

a. General. Flood control structures at Tom Jenkins Dam include a rolled earth and rock fill dam with an impervious core, with an uncontrolled saddle-type spillway located about 1000 feet south of the left (south) abutment of the dam and the outlet works located in the left abutment. The spillway, about 80 feet wide and 660 feet long, is provided with a broad crested concrete control weir, with a crest elevation of 740 feet NGVD. General details of the dam, spillway, intake, and outlet works are shown on Plate No. 2-4.

b. Embankment. Tom Jenkins Dam is a rolled earth and rock fill impervious structure with a maximum height of 84 feet. The crest length is 944 feet at elevation 765 NGVD with a 20 foot spillway design flood surcharge plus 5 feet free board above the spillway elevation of 740.0 feet NGVD. The dam consists of a rolled impervious zone and two small upstream and downstream rockfill zones for increased stability. The embankment slopes steepen progressively from 4.5 (horizontal) to 1 (vertical) near the downstream toe and 4.5:1 near the upstream toe to 2.5:1 near the centerline of the dam. A 10' by

10' exploration trench, a 6-foot sand and gravel drain under the downstream embankment, and a 3 foot layer of protective stone are provided on both the downstream and upstream slopes to prevent erosion, and a left abutment keywall and grout curtain are design features that help control seepage. Both the upstream and down stream faces are dressed with topsoil and seeded on the areas where the stone protection is not provided. The top of the dam is covered with a 16 foot access road way connecting the state highway and dam headquarters on the right side with the intake structure and outlet works on the left side. The general project layout plans are given in Plate No. 2-2 and the embankment details for the original design are shown on Plate No. 2-4.

c. Spillway. The spillway is located approximately 1000 feet south of the left (south) abutment of the dam, discharging directly into Sunday Creek, consists of an uncontrolled but partially lined saddle having a crest width of 80 feet, about 660 feet long and is provided with a broad crested concrete control weir with a crest elevation of 740 feet NGVD. The side walls are faced with concrete to protect the indurated clay from water action and weathering. Details of the original design spillway are shown on Plate No. 2-5.

d. Outlet Works. The outlet works is located in the south left abutment, and consists of an approach channel, an intake structure with 3 gated rectangular 3.5-foot by 7.0-foot intake tunnels leading to the outlet tunnel, three service and three emergency screw stem operated gates each 4.0 feet by 7.0 feet, one 3.5-feet by 12.17-feet emergency bulkhead, and two low-flow control and water supply intakes which are now sealed, the machinery for operating the gates and bulkhead, and an 8'-0" horseshoe tunnel discharging through the left abutment discharging into a stilling basin 25 feet wide by 89 feet long and on to an outlet channel. Plan and profile of the outlet works; and general section and masonry details of the intake structure, transition section, tunnel, and stilling basin are on Plate Nos. 2-6 through 2-15.

The intake structure consists of a reinforced concrete substructure and brick and stone superstructure which houses the gates and operating machinery. Access to the intake structure is by means of a steel and reinforced concrete service bridge from the left abutment. The intake structure contains three 4'-0" x 7'-0" slide-type service gates and three emergency gates of the same size and type which discharge through a 8'-0" horseshoe tunnel at elevation 688.5 feet NGVD. Details of the operating house and intake are shown on Plate Nos. 2-6 through 2-9. The horseshoe tunnel upstream sill elevation 688.5 feet is 477 feet long sloping to elevation 687.0 feet. The tunnel is joined to the intake structure by a 20 foot transition section immediately downstream of the gates, and is fully concrete lined to prevent cavitation at high velocities due to partial gate operations. Details of the tunnel are shown on Plate No. 2-12, and 2-13.

The stilling basin is a reinforced concrete structure of conventional jump design with 18'-6" high gravity walls, and has an end sill and two rows of intermediate baffles. The water supply inlets consist of two 4.0-foot by 3-foot rectangular deep-wells located in the two outer walls of the intake structure, just upstream from the service and emergency gates' guides, and two 12-inch cast iron pipes, one from each well, buried in the base of the intake structure, the tunnel, and the stilling basin. The floor slab is anchored to rock. Drain holes 4 feet in rock are provided to relieve uplift pressure. Baffle piers and an end sill were constructed for energy dissipation. A 7 foot rising invert is located between the tunnel portal and the stepped portion of the apron. Details of the stilling basin are given in Plate Nos. 2-14 and 2-15. Two rectangular water supply ports are provided in each deep well at elevation 703.5 and 713.5 feet NGVD. Each water supply port is provided with a self contained sluice gate or hand valve. Several years later the water supply ports were connected to the 12-inch pipes at the end of the stilling basin. Each well and pipe will discharge a peak flow of 5.0 MGD or 11.5 cfs with the pool at elevation 721 feet NGVD, minimum water supply pool. Until such time as the ultimate water supply demand is reached, the water supply intake wells and pipes are used for semi-automatic maintenance of the pool at elevation 721 feet NGVD. This was first accomplished by blocking the inlet ports and providing

overflow weirs into the wells at elevation 720.5 feet and discharging the 12 inch pipes into the stilling basin through a branch connection. The development of the water supply function was finalized many years after the construction of the dam by the building of a water treatment plant for the area just below the dam. When the water supply plant was built the overflow weirs were sealed, the ports unblocked and the water supply pipes were connected to the plant and the lake is now maintained by the sluice gates.

e. Operating Machinery. The three 4'-0" x 7'-0" sluice gates and three matching emergency gates are raised and lowered by means of a motor driven, rising stem, screw hoist floor stand located on the operating floor over the gate well. The floor stands consist of an electric motor, speed reduction gears, reversing magnetic control panel with push button stations, handwheel, limit switch and position indicator. The motor is a 7.5 horsepower, 220 volt a.c., 3 phase, 60 Hertz electric motor, slow speed, vertical type, that drives the gate yoke nut through a train of spur gears to raise and lower the gate stem. The hoist is controlled by a magnetic reversing controller which is energized by the RAISE-STOP-LOWER push button control assembly mounted on the hoist. A gate position indicator is located on the gate stem extension cover, visible from the operator position at the controls. Each hoist circuit is energized by a fused knife-switch, mounted on the switch board. In the event of a power failure, including the standby generator, the sluice gates can be operated by the use of a handwheel above the motor. A throw out lever is used to select either motor or manual operation.

The emergency bulkhead is lowered into place and removed by means of a 1-ton Roeper Hoist suspended from a trolley that travels along a beam supported on the upstream face of the intake structure and extending over the bulkhead space and the three sluices. Both the hoist and the trolley are operated by means of endless chains suspended from chain wheels.

The standby emergency generator is located in the operating house. The a.c. generator is driven by a 6 cylinder gasoline engine and is rated at 31 KVA. It provides emergency power at 220/120 volts, 3 phase, 60 Hertz. The maximum current rating is 82 amperes. The power is sufficient for conceivable emergency needs.

2-04 RESERVOIR DESCRIPTION

Tom Jenkins Dam lies in Athens County, with Burr Oak Lake extending upstream into Morgan and Perry Counties. Virtually all or 32.8 square miles of the East Branch of Sunday Creek drainage basin is controlled by the dam. The Burr Oak basin is located near the north eastern edge of the Hocking River Basin watershed. The conservation pool is at elevation 710 feet NGVD, and has a surface area of 394 acres. The year-round total storage at elevation 721 feet NGVD has a surface area of 664 acres and has 9,300 acre-feet, or a total of 5.3 inches of runoff from the watershed. Table No. 2-1 displays pool area and storage information, while an aerial view of the lake is shown on Plate No. 2-1. The flood control pool is at elevation 740 feet NGVD, adding 17,600 acre-feet of flood control storage to the lake, or an additional 10.1 inches of runoff from the watershed. At the maximum flood control pool, backwater extends 10.5 miles upstream from the dam site and will have a surface area of 1192 acres. The drainage area above Tom Jenkins Dam is 32.8 square miles, with a Hocking River Basin map shown on Plate No. 2-1. Burr Oak Lake has a shoreline length of 47 miles, and is accessible by automobile from U.S. and State Routes 13 and 78, County Roads 14, 15, and 58 and Township Road 280.

During DEMIA (December to mid-April), the water supply pool is maintained at the same level through the winter and is not drawndown or lowered as at many other projects in the nearby Scioto and Muskingum Basin. The year-round water supply pool is normally at or very near elevation 721 feet NGVD. Regulation of the storage capacity at Burr Oak Lake provides flood protection for agricultural areas downstream of the lake along Sunday Creek and Hocking River,

as well as for the cities of Glouster, Chauncey, and Athens, Ohio.

TABLE NO. 2-1

RESERVOIR POOL DATA
BURR OAK LAKE
SUNDAY CREEK BASIN

Surface Pool	Surface Elevation (NGVD)	Backwater Area (Acres)	Capacity Main Stream (miles)	Runoff Net (1000 A.F.)	Runoff Gross (1000 A.F.)	Runoff Net (Inches)	Runoff Gross (Inches)
All-Year Minimum	710	394	4.3	3.5	3.5	2.0	2.0
Water Supply Storage	721	664	7.8	5.8	9.3	3.3	5.3
All-Year Flood Control	740	1,192	10.5	17.6	26.9	10.1	15.4
Total	740			26.9	26.9	15.4	15.4

2-05 REAL ESTATE ACQUISITION

Real estate purchases for the Burr Oak Lake project were initiated by the State of Ohio and the Federal Government in 1948. Lands needed for construction were purchased initially, followed by those lands that would be damaged most quickly by operation of the dams for flood control. The money for these land purchases came from combined funds appropriated by both the state and U.S. Government. The State of Ohio spent about $354,500 dollars for land acquisition. In general, land purchased in fee title included all lands within the limits of the conservation pool level, all lands to be used for construction purposes, those lands adjacent to the conservation pool on which the directors wished to control development, and lands which would be subject to frequent flooding due to the operations of the dams. In cases where a large portion of a farm unit was subject to the conservation pool or frequent flooding, the whole farm unit was purchased in fee title. Flowage easements were generally acquired on lands that were outside the limits of the conservation pools.

The taking line for acquisition of lands within Burr Oak Reservoir was predicated on the inclusion of all land upstream from the dam and below elevation 750 feet NGVD. Additional lands were acquired above elevation 750 feet NGVD in lieu of heavy severance damages and/or construction of comparatively expensive access roads. All lands below elevation 730 feet NGVD were acquired in fee. Tracts between elevations 730 and 750 feet NGVD were acquired by easement instead of fee title, where significant savings could be realized. This involved acquiring approximately 1,450 acres above elevation 740 feet NGVD and an estimated 1,150 acres below elevation 740 feet NGVD, a total of 2,600 acres. This land purchasing involved displacing or moving about 20 rural families or 100 people.

In the Burr Oak Lake area, the State of Ohio owns approximately 1150 acres in fee title for the pool area, and the Corps of Engineers owns approximately 99.3 acres at the damsite in fee title. The State of Ohio contributed $354,500 dollars for land acquisition at Burr Oak Lake. Figures for the acreage acquired for easements by the State of Ohio are not available, but the Corps of Engineers has acquired easements for approximately 1639 acres at Burr Oak Lake. The limits of acquired lands at Burr Oak Lake are shown on Plate No. 2-3.

2-06 RECREATION AND PUBLIC USE FACILITIES

Recreational activities available at Tom Jenkins Lake include camping, swimming, picnicking, boating, fishing, hiking, hunting, and trapping. The Corps of Engineers picnic area at the damsite has space for 24 tables under a shelter roof. The overlook platform has 3 tables under a 24' x 24' roof.

Wayne National Forest is an adjacent fully developed outdoor recreation center which includes a park nature center, activity center, group shelter, park naturalist and nature programs. The Wayne National Forest area was designated in 1934 as part of the Hocking Valley purchase unit and by 1944, 76,768 acres was purchased, with a large section surrounding the Corps of Engineers damsite. The park has more than 500 campsites, many of which are nestled in scenic wooded valleys, hot showers, flush toilets and electric hookups. Two bedroom vacation cabins are located on the lake shoreline with a beautiful view of the lake. The cabins sleep 6 people and include eating and cooking facilities, utilities and some bedding supplies.

Burr Oak Lake State Park is also a full facility outdoor recreation center which includes a park nature center, activity center, group shelter, park naturalist and nature programs. The state park is adjacent to the other side of the Corps of Engineers damsite area and has many of the same facilities as Wayne National Forest including a sandy swimming beach, a concession stand, changing rooms, pedal boats and miles of scenic hiking trails. Tables and charcoal grills are available for picnicking.

Boating activities at Burr Oak Lake include motorboating, sailboating, canoeing, pontooning, and waterskiing. Burr Oak Lake has a full service marina with boat and motor sales, service and rental services, as well as boating and fishing supplies, fishermen cabins, and a restaurant overlooking the lake. The marina also offers boat docking and free public launching ramps. Additional free public launching is available along State Route 13.

Ohio State lands at Burr Oak Lake are open to State hunting seasons between Labor Day and Memorial Day. No hunting is permitted at highly developed areas such as parks and cottage areas. A strip of HRCD land, 100-feet wide adjacent to the shoreline and all islands are perpetually dedicated to public use. The hunting and water recreational facilities at Burr Oak Lake are administered by the Ohio State Conservation Department.

SECTION III - GENERAL HISTORY OF BASIN AND PROJECT

3-01 AUTHORIZATION

Tom Jenkins Dam (Burr Oak Lake)is a multi-purpose flood control project built by the Corps of Engineers under the authority of the Flood Control Act of 1944. The project is an element of the comprehensive flood control plan for the Ohio River Basin. Existing project purposes include flood control, recreation, water supply, and fish and wildlife enhancement as authorized by the Flood Control Act of 1944 (P.L. 78-534), the Fish and Wildlife Coordination Act of 1958 (P.L. 85-624), the Federal Water Project Recreation Act of 1965 (P.L. 89-72), and the Forest Conservation Act of 1960 (P.L. 86-717).

3-02 GENERAL BACKGROUND HISTORY

The Hocking River-Sunday Creek Basin was settled very early in the general development of the Northwest Territory following the Revolutionary War. The first area inhabitants were the mound builders and later the Wyandot, Delaware, and Tuscarawas Indian tribes. Most of the Indian villages and trails in the basin were near the main water supply called the “Hock-Hocking”. Indian relics and souvenirs have been recovered from the Oldtown, Graham, and Loomis Davis sites in the Logan area left during the Indian period. Following the Indians came the occasional explorer and trapper and then the rare soldiers during the French and Indian War and the American Revolution. The first non-Indian settlement within the state of Ohio was the Moravian Missionaries in 1761, at nearby Schoenbrunn. This first village was later destroyed by white marauders. Nearby at Ganadenhutten 96 Christian Indians were massacred by Pennsylvania militia.

The first permanent white settlement in the “Ohio Country” was the landing of the armed galley “Mayflower” at the mouth of the Muskingum River, now the city of Marietta, on 7 April, 1788, twenty-five years after the founding of Pittsburgh, 19 years after the founding of Wheeling, and one year before George Washington was inaugurated as President. This was a small corporate colony, mostly war veterans, backed by the Ohio River Associates Company, and led by General Rufus Putnam, former Chief Engineer of the Continental - United States Army, Surveyor General of The United States, now Judge of The Northwest Territory. The new colony's mission was to establish a village; organize, develop, and govern the territory; and help recruit more settlers from the east. Campus Martius, a fort for protection from the Indians was built, and directly across the Muskingum River from Marietta on the point, Fort Harmar was built, and 100 miles downstream became the “Free French” village, Gallipolis. Marietta College was started, the first advanced school in the Northwest Territory. During the Revolutionary War the Ohio Country had been a total wilderness with many more Indians than white explorers and soldiers. In the first spring following the settlement (1788) reportedly 300 crude flatboats came downriver past Fort Harmar and by 1790 there was an estimated 125,000 settlers in the new Territory. As the small communities extended from Marietta the strong need for food, security, protection, transportation, and good access to eastern cities for markets and imports became apparent. This led to the first trail marking and clearing, wagon paths, haul road building, wharfs, levees, wells, forts, and new villages.

The two major Ohio water based cities were soon founded at present day Cincinnati and Cleveland. Losantiville was founded downriver opposite the mouth of the Licking River in 1788, Fort Washington was built in 1789, and changed to Cincinnati in 1790 and the first big floods of record followed in 1792 and 1793. Cleveland was platted on Lake Erie at the mouth of the Cuyahoga River by Moses Cleveland in 1796, and Lorenso Carter started a colony for the Connecticut Land Company in 1799.

With the founding of the new colony at Marietta, the westward pioneer movement

extended to the Hocking-Sunday Creek valley about 1797 when, encouraged by General Rufus Putnam, a number of emigrants made their way by large canoes 28 miles down the Ohio River and up the Hocking Valley. Having ascended as far as the present site of the city of Athens they landed and founded a small settlement on “college lands” chartered by the territorial government and afterward on February 18, 1804 by the state legislature. Ohio University, subsequently established on these “college lands”, is, with the exception of Marietta College, the oldest educational institution in the Northwest Territory. This small college that grew into a mighty university “opened for business or students” in 1809 with one man, Jacob Lindley, as sole faculty and president. While Athens was getting started, Ebenezer Zane blazed a trail from Wheeling across central Ohio and on down to Cincinnati. The trail crossed the Muskingum River and here was founded Zanesville in 1799, from there it went on to cross the Hocking River. The development of the upper valley began here, about 1797, when a very small settlement sprang up near Lancaster, Ohio. Much later this trail was widened and became a road and then became part of the Federal highway U.S. Route 40 and 22.

The first industrial pursuit in the valley began in 1799 when a log and grist mill was erected at the upper falls of the Hocking near Lancaster. The early activities of the settlers were confined largely to clearing their lands and establishing homes, making lumbering, hunting and agriculture the principle pursuits of the valley for several years. Salt mining was one of the first industries of the basin and coal was discovered at an early date. The early settlement on Sunday Creek, just below the forks of the stream became the village of Glouster. Many of the new settlers to the Hocking Basin came along the old Braddocks and Forbes Roads from western Pennsylvania and these were the Pennsylvania Germans, “Deutsche or Dutch”. From Brownsville, Pittsburgh, or Wheeling the settlers came down the Ohio by boat to Marietta and then on down to the Hocking River. The German, Scottish, Swiss and Amish farmers brought with them the careful farming, home, and road building practices still found today in the Hocking Basin. By 1805 Athens County was formed from Washington County and in the 1810 census the new county had an estimated population of 2,791 people.

By 1803 Ohio was the first state of the new Northwest Territory with a Capitol at Chillicothe. A few miles further north near the junction of the Scioto and Olentangy River a village of Franklinton began in 1797. This village later became Franklin County and Columbus. From this early settlement, expansion, and growth came the dependence and use of the surface waterways for personal, farm, and city consumption and heavy transportation, and primitive water power. The early narrow dirt trails or logged haul roads were only passable for a light horse wagon in warm dry weather, and needed steady maintenance and protection for public travel. Therefore, the early leaders quickly saw the obvious need for safe water access and supply, flood protection or control, and water resource development along all the rivers and floodplains of Ohio as the communities grew from a wilderness. Today there are some historical sites in the Hocking River-Sunday Creek Basin that are recognized by the Department of Interior in the National Register of Historic Places as published in the federal Register of 1974.

Most of the first projects in the Hocking River-Sunday Creek Basin were for security, survival, protection, and then water development such as wells, gristmills, wharfs, boat building and salt mining. The latest two-way boat for western rivers was now called a keelboat and by 1800 there were some 500 keelboats on the Ohio River system drifting downstream and poling upstream.

Meanwhile, the first steamboat west of the mountains the “New Orleans” was built by Nicholas J. Roosevelt at Pittsburgh in 1811 and steamed downstream, just four years after Robert Fulton's major invention on the Hudson River. Four years later Henry Shreve powered upriver from New Orleans to Wheeling in the 45-ton steamboat “Enterprise”, and built the first light draft steamboat the “Washington” in 1816. In 1819 Stephen Long then built the “Western Engineer” with a full flat bottom on a very thin 19 inch draft and the rest is history.

The new flat bottomed full powered steam boat soon plowed up and down the Ohio River system, just like the modern diesel powered tugs on todays inland waterways, the poled keelboat was left on side streams like the Hocking River.

The development of water resources in the Hocking River - Sunday Creek Basin came in four distinct overlapping phases. The first phase following settlement and the digging of individual water wells and irrigation ditches was the building of water powered grist mills which led to the construction and then quick decline of the inland barge canal system. The first excavation of the Ohio-Erie canal began on July 1, 1825 at the Licking summit level, 3 miles west of Newark, Ohio. The Ohio-Erie canal was modeled after the Erie Canal and went from Cleveland to Akron on the Cuyahoga River, through Summit and a series of ten Portage Lakes to Massillon, down along the Tuscarawas River to Coshocton, on down the Muskingum to Dresden, through a cut to Nashport, up the Licking River to Newark, through Buckeye Lake, down Little and Big Walnut Creek, and on along the Scioto River to Portsmouth. It was opened on December 1, 1832, about ten months after the record February 1832 flood, and was considered a great project for that day rivaling the mighty Erie Canal from Albany to Buffalo. Impressed with prosperity resulting from improved markets, the state began spending heavily for additional and unnecessary canal construction. The Walhonding branch was completed next and going from the main branch near Coshocton extending northwest to Walhonding and nowhere in particular. The Hocking connection was made in 1840-43 with a feeder canal going from Carroll and the Ohio Canal down to Logan in 1840, then to Nelsonville, and on to Athens in 1843. The Canal never reached Glouster. Remnants of the time, traces of the locks and the original buildings and taverns, tunnels, towpaths, aqueducts and canals abound and have been restored in many places of the Ohio Canal, but today there is very little trace of the Hocking Canal. Numerous small towns and taverns sprang up along the Ohio Canal system and were so named like Canal Winchester, Canal Dover, Canal Fulton, Port Clinton, Port Washington, Port of Massillon, Lockborne, Lockville, and Nashport. The original method of power on the canals was a team of horses walking on the towpath, usually ridden by a small canal boy. Later the development of small shallow draft steamboats lead to small steamboats on the canals. Just as young boys on the east coast left home and went to sea as cabin boys, many young boys along the canal route like John Sherman, from Lancaster, later Congressman, U.S. Senator, Secretary of Treasury, Secretary of State, and brother of General W.T. Sherman had their first real money job riding the horses or loading the barges on the Ohio Canal.

The Ohio-Erie Canal was a great success for a few years and helped in the early development of the state. However, many of the later canals were not so successful and were obsolete by the time they were opened. The biggest failure in canals was the Sandy-Beaver fiasco. Construction began in 1834 but was not completed until 1846, when railroads were already invading Ohio. The first boat reached Akron in 1840 and during the spring of 1850, an average of 10 boats a day were passing the big tunnel. Two years later the mighty railroad era began. The canal was quickly abandoned, river navigation declined, and the barge canal period ended just as quickly as it started.

The great railroad era began at this time by the building of the road connecting Lake Erie with the Ohio River in 1851 and marked the beginning of the network of railroads that now criss-cross the Hocking Basin and the state of Ohio. The first railroads in Europe had been very slow, horse drawn in daylight, but now they were steam powered, much faster and more efficient, ran in cold or bad weather, and were much more direct than the canal boat. Many times the rails and ties for the new railroad were hauled by the canal boats and the tracks were often laid on the old towpath of the canal it was replacing. The first railroad connecting the Ohio River and Lake Erie was in operation by 1851 and finally reached the Hocking Valley in 1870, terminating the canal. The Hocking-Athens Canal began closing in 1874 and 10 years later the canal was all gone. The Hocking Valley R.R. increased the industrial activity and water use in coal mining, quarrying, and ceramic operations which then formed the basis for the livelihood of a larger number of the basins inhabitants. Beginning in the 1890's, coal production increased significantly

until about 1920, after which the coal mining industry declined, except for a period of small increase in the 1940"s.

The new settlers of the Hocking Basin did not create or cause the annual spring floods. The damaging floods were there long before settlement, but little record was made of these events. The need for flood control and water management along all the Ohio-Hocking system was soon realized as communities grew and the development of floodplains increased. The first major Ohio River recorded floods were at Fort Pitt or Pittsburgh in 1762 and 1763, and Cincinnati in 1773, 1792, and 1793. The terrible Hocking Basin floods of the previous century are recorded in old Athens newspaper stories and were all very destructive at Lancaster, Athens, and Glouster and to agriculture and farm lands all along the valley. The damaging floods of the previous century were most severe at Athens, particularly around Ohio University, the second oldest advanced school in the Northwest Territory. The major floods of the previous century occurred at Athens in 1832, 1847, 1852, 1858, 1859, and 1873. The 1907 flood was the highest of record and nearly devastated the Hocking River Basin. After the 1913 flood, which resulted in nearly $200 million in flood losses and the loss of 415 lives in the Ohio River Basin, the state legislature on 18 February 1914 passed the Conservancy Act of Ohio (Vol. 104-1914, Laws of Ohio). This Act authorized the creation of conservancy districts, which would have the power to plan, construct and administer flood control and conservation projects, issue bonds, purchase land, levy assessments and enter into cooperative contracts with the state and Federal Government for any necessary work. This was the beginning of modern flood control and planning.

Subsequently, various organizations such as the Miami Conservancy District, the Muskingum-Tuscarawas Improvement Association, and the Scioto Conservancy District were formed which promoted a water management program for the entire basin. As a result of these efforts, a study of the control and use of the waters of the major Ohio rivers was financed by the Ohio Department of Public Works. The study concluded that benefits from a comprehensive program of flood control and water conservation would accrue not only to individual property owners and cities, but also to the state and nation. It was also determined that the pooling of resources within cities, towns and counties within the river basin would not be adequate to finance a major project, and that state or Federal aid would be necessary. It was concluded that a conservancy district would be the most promising agency for developing and executing the needed program. The first area to plan and complete any basinwide flood control program and project was the Miami Conservancy District, organized in 1915. This conservancy district planned and built five flood control reservoirs or retarding basins by 1922.

Although the potential for severe flooding in the Hocking, Scioto, Muskingum, Ohio, and Mississippi River Basins had long been recognized, federal investigations made prior to the 1930's were generally concerned with improvements for commercial navigation. In the 1920's and 30's, it became even more apparent that major flooding events were basin-wide problems that could not be controlled by structures built primarily for navigation purposes. In the meantime the country found itself in the midst of a very severe stock market crash and worldwide economic depression. Because of the depressed economy at the time, it did not appear that extensive Federal aid for flood control, other than on the Mississippi River would be possible; however, the election of a president, political party, and congress who were more receptive to proposals for public works programs and water resources development opened the door for the needed assistance. The severe droughts of 1930,31, and 1934; the 1926, 27, 29, 30, and 1933 floods; coupled with the national economic and financial recovery crisis; and the 1932 and 1934 elections culminated in a broader public support for Federal Public Works program, which included the adoption of a national flood control policy independent of the policy of navigation improvement.

Following the announcement of President Roosevelt's proposed Public Works Administration, the Muskingum Watershed Conservancy District was officially

organized on June 3, 1933. This was accomplished under provision of the Conservancy Act by a special common pleas court, which included a judge from each of the 18 counties in the District. The MWCD District provided the legal process required to secure the necessary financial cooperation between the State of Ohio, the Federal Government, and communities and property owners of the District and lead to the construction of 14 flood control reservoirs of various sizes in the Muskingum Basin.

While the Muskingum Conservancy District was coordinating and building the original 14 reservoirs of the Muskingum Basin, the Scioto and Hocking River Basins were reviewed several times by the Corps of Engineers comprehensive 308 reports; with each report concluding that no flood control reservoir or navigation project could be presently justified in the Hocking Basin.

While the spring floods were damaging, the record summer droughts of 1930, 1931, and 1936 were so severe that Glouster, Ohio, was spending about $10,000 dollars each summer to haul drinking water. This, and the very damaging floods of January 1937 and May 1938 led to the formation of the Sunday Creek Watershed Association and the Burr Oak Dam Association, and resulted in further flood control studies. The Sunday Creek Watershed Association attempted to function as a sanitary district and secure Federal support for a flood control project under the sponsorship of the Works Progress Administration similar to the Muskingum Conservancy District. The Sunday Creek Watershed Association and the Burr Oak Dam Association were partially successful for they supported and promoted another Corps of Engineers study published after the next damaging flood of April 1940. A Survey report on Hocking River, Ohio, and in the vicinity of Athens, Ohio, dated 26 June 1941 was published as (House Document No. 762, Seventy-seventh Congress, second session, which recommended the best and only possible plan for the basin was a combined effort by the Federal, State, and Local interests in a multi-purpose water conservation project for Sunday Creek, at an estimated cost of $400,000 dollars. This was the start of the Tom Jenkins Project as we know it today and many years later the Watershed Association evolved into the formation of the Hocking River Conservancy District. The outbreak and intervention of Pearl Harbor and World War II postponed any further action for the duration of the war. The Flood Control Act of 1944. H.R. 4485, Public Law 534, Seventy-eighth Congress, second session, was approved 22 December 1944, authorizing construction of the multi-purpose Burr Oak Dam and Reservoir project as recommended in House Document No. 762 at an estimated cost of $695,000 dollars. Due to World War II, construction of the project was again deferred until peace time. A $2 million cost sharing agreement for the Burr Oak Project was reached by the State of Ohio and the Federal Government on 22 January 1948. The Chief of Engineers approved this agreement on 13 February 1948 and it was approved by the Attorney General, State of Ohio, 15 March 1948. Work began 3 days later on 18 March 1948, closure was effected in November 1948 and construction of the dam was completed 3 February 1950.

By Congressional act, Public Law 504, 82nd Congress, approved 11 July 1952, the dam and related structures were named the “Tom Jenkins Dam, Ohio,” in honor of the late congressman who represented the Ohio 10th district and conducted the legislation through congress. In many reports the original name of Burr Oak is still used for this lake and the state park is so named. The dam is located about 0.3 miles above the mouth of East Branch of Sunday Creek, a tributary of the Hocking River, 4.5 miles northeast of Glouster, in Trimble Township of Athens county, Ohio, 0.4 southeast of Burr Oak, Ohio. Since the beginning of operation to the date of October 1998 the project has been credited with or prevented a total of $22,098,000 in current dollars. During the year of 1998 $1,040,000 dollars in damages prevented was credited to the project.

The summary and final phase of Hocking-Sunday Creek water resources development is that many public and private groups now use the land and water from Tom Jenkins Lake developed by the COE and ODNR for water supply and recreation. This use of multipurpose lakes led to the formation of The Ohio Department of Natural Resources in 1949 which has coordinated many times with the Corps of

Engineers on many water projects in Ohio. The vital personal and urban water supply of about 24 cities, towns, and units within the basin now come from both underground and surface streams and lakes. The 24 unit municipal water consumption for each day in the basin was about 6.9 mgd or 10.6 cfs in 1962. This very basic need for municipal water supply is expected to more than triple to 20 mgd or 30 cfs by the end of the century. The main source of municipal water in the basin is underground wells. Burr Oak Lake supplies a water treatment plant below the dam which has a guaranteed yield of about 1.0 mgd or 1.5 cfs. There are 86 lakes in the Hocking Basin with two acres of surface or larger that are used for many purposes. Private interests have built and developed three medium sized lakes, namely Lake Logan(340 ac.), Forked Run Lake(107 ac.), and Dow Lake(157 ac). Surface waters are also used by railroad, coal, mining, manufacturing, and lumbering industries for producing steam, processing material, and washing coal. The total water consumption from the Hocking Basin (not the Ohio River) in 1962 was about 20 mgd or 31 cfs, with about 50 percent going to industrial plants. Several cities and towns in the Hocking Basin also have a municipal sewerage treatment plant designed to use a certain amount of public water. The combined effort of safe water treatment and sewerage treatment plants has reduced the number of deaths from Typhoid fever remarkably. However, there is still a strong need for additional water supply each summer for optimum crop growth in the watershed. Many years after the formation of the Sunday Creek Watershed Association, the Burr Oak Dam Association, and completion of the Burr Oak Dam, the Hocking River Conservancy District was formed on 13 December 1963 at Athens, Ohio. This conservancy district has functioned since that date to develop and coordinate a comprehensive plan for the natural resources development of the Hocking River Basin.

The settlement and expansion of “the Ohio Country” began with the landing of the galley “Mayflower” at Marietta over 200 years ago in 1788. The westward movement came to the Hocking River basin about 10 years later. The economic, industrial, and water resources expansion and development of the basin began immediately and continues today. The future of the Hocking Basin and the State of Ohio has always been linked with extensive water resources development, water conservation, and flood plain planning and always will be.

3-03 PROJECT FORMULATION AND DESIGN

The location of Tom Jenkins dam was originally specified in House Document No. 762 to be on East Branch of Sunday Creek about 0.2 miles above the mouth, it was to be 750 feet high with an adjoining spillway crest at elevation 729 feet NGVD, a 16 foot spillway surcharge for the design flood, and a five foot freeboard above the design flood pool elevation of 745 feet NGVD, with an estimated cost of $695,000. The updated and final design was amended to a rolled earth fill dam at the same site with the top of dam at elevation 765.0 feet above NGVD, a 20 foot spillway design flood surcharge with a spillway level at elevation 740 feet NGVD plus a five foot freeboard. The water levels were for a year-round minimum conservation pool at elevation 710.0 feet NGVD covering 394 acres, a year-round water supply pool of 664 acres at elevation 721.0 feet NGVD, and an uncontrolled saddle spillway at elevation 740.0 feet NGVD. The flood control pool storage was established at elevation 740.0 feet NGVD to provide approximately 17,600 acre-feet of year-round flood storage. This flood storage represents an average runoff of 10.1 inches from the 32.8 square mile watershed. The estimated first cost had grown to $800,000 dollars for the State of Ohio and $1,200,000 Federal dollars by 1948. The Tom Jenkins dam was designed to be operated such that the reservoir would be filled to the spillway level, but not beyond, by the runoff from the standard project storm.

The preliminary spillway design flood was adopted from the area depth curves for the Muskingum River Basin, Ohio, Spillway Design Storms, dated 24 September 1946. The curves were based on storms for Smethport, Pennsylvania of 17-18 July 1942 and the September 1878 storm at Jefferson, Ohio. Later the storm of 4-5 August 1943, in the Little Kanawha Basin was studied and combined

with the previous Muskingum Document to create a final adopted spillway design storm and flood. The summer type standard project flood was derived from the Muskingum Basin Flood of 6-7 August 1935, and the winter type standard project flood was derived from the Ohio Valley Flood of March 1913.

3-04 CONSTRUCTION

The contract for construction of the Burr Oak Dam was awarded and work began on 18 March 1948. Closure was effected in November 1948 and construction of the dam was completed 3 February 1950.

The relocations program necessary for the construction of Burr Oak Dam did not affect any Federal or State highways. However, there are about 7.6 miles of county or township roads affected by the project. The original plan was to raise or improve about 3.0 miles of these roads and abandon the remaining 4.3 miles of road. The only utility involved was a 1.3 mile length of pipeline owned by the Buckeye Pipe Line Company. The plan was to replace this with a 1.5 mile length which was completed by 2 February 1952. The land acquisition program had progressed to the extent that the right to flood lands within the reservoir area was obtained by 2 February 1952. At that time the impoundment of water supply and conservation pool was initiated and the reservoir was placed in full flood control operation. The cost of construction was $2,086,500 which included portions of the cost of the Official Plan. The amount contributed by the State of Ohio was $495,000 for construction, $354,500 for land acquisition, and $30,000 for APW.

3-05 AUTHORIZED AND PROPOSED FLOOD CONTROL PROJECTS

(a) Lake Projects. The only presently authorized projects in the Hocking Basin are the Upper Hocking, which has been completed and the Rush Creek both being located in Fairfield, Hocking, and Perry Counties. These projects encompass 286 square miles of which 43 square miles are controlled by structures. These nine structures and 33 miles of channel improvement provide protection to 10,300 acres of flood plain. There are in the adjoining Muskingum Basin 24 potential upstream watershed projects, controlling 4,003 square miles of drainage area, with 850 miles of channel improvement, 250 retarding structures, which could provide storage of 156,600 acre-feet for floodwater detention, 29,400 ac.ft. of sediment, a surface-acre potential of 40,490, and a potential total storage of possibly 1,250,000 acre-feet. The structures would control 1,123 square miles of drainage area or about 28 percent of damages occurring within potential water sheds.

(b) Local Protection Projects. The only currently authorized or proposed local protection projects at this time in the Hocking Basin is at Athens. This project seems to be economically unjustified at this time. The only small local protection project is at Rockbridge.

(c) Future Studies. Future studies of the Hocking Basin include the possibility that the basin will be reviewed on a regular basis for possible water resources and recreational development. The Corps of Engineers has made or contracted flood plain studies for many counties in the State of Ohio and the basin. These include Flood Insurance Studies, Frequency Profile Studies, Inundation layouts, and Dam Break studies. The future of the Hocking Basin will probably include more counties and cities participating in the FEMA or Flood Plain Protection Program.

3-06 OPERATION

Flood Control Operation. Burr Oak Lake is considered a part of an integrated flood-control system for the entire Ohio River Basin, and the method of regulation is correlated to the fullest extent possible with the operation

of reservoirs on the other tributaries of the Ohio River while giving due consideration to local concerns and requirements.

During periods of storm runoff, the reservoir is operated to utilize the natural channel capacities by releasing storage at rates not to exceed the designated control stages of the Sunday Creek and Hocking River below the reservoirs as listed in Section VII. Storage of flood flows commence in advance of predicted damage stages at key points, and continue until predicted stages for all control points indicate that releases of stored waters from the reservoir, with proper allowances for time of travel will not cause stages in excess of the control stages. Gates are closed and all reservoir inflow stored for partial control of Ohio River floods when a crest stage above 45 feet at Belleville Lock is forecast by the U.S. Weather Service. Operation for reduction of Ohio River floods continues until the Ohio River at Belleville Lock has crested and fallen 1 foot and continued recession is indicated.

The plan of operation is based on having adequate flood forecasting and flood warning systems in effect. Streamflow data is obtained from the platform satellite network and from the reservoir reports. Precipitation amounts in and near the Hocking River Basin are received through the Corps of Engineers satellite-platform system, as well as precipitation data from the project reports which contain project gage data, data from observers in the Ohio River Network, and from NWS. Water Resources Engineering Branch personnel use current and previous rainfall, soil and foliage conditions, and stream gage data as input to the water control system to forecast lake and downstream stages. Times of beginning and ending of reservoir operation are based on the estimated time of water travel from the various dam sites to the mouth of the Hocking River at Hockingsport. At the end of the regulation period, outflows are gradually increased to the bankfull channel capacity below the dams and maintained at that rate until the flood storage is released, or until river stages at key stations require further storage operation.

SECTION IV - WATERSHED CHARACTERISTICS

4-01 GENERAL CHARACTERISTICS

The watershed of Sunday Creek occupies the central portion of the northwestern segment of the Hocking River Basin and includes portions of Athens, Morgan, and Perry Counties. Sunday Creek joins Hocking River at mile 40.4 near Chauncey, Ohio in Athens County, Ohio, about 10 miles above Athens, Ohio. East Branch of Sunday Creek joins Sunday Creek at mile 16.6, about 3.0 miles above Glouster, Ohio, about 0.4 miles southeast of Burr Oak, Ohio, in Athens County, Ohio. Tom Jenkins Dam is located on East Branch of Sunday Creek, 0.3 miles upstream from the junction of Sunday Creek, in Athens County, Ohio, and the portion of the basin upstream of Burr Oak Lake lies within Morgan and Perry Counties in southeastern Ohio. The East Branch of Sunday Creek Basin is elongated and roughly rectangular or almost long oval in shape with the principal axis, about 7 miles long, on a north south line. The maximum width is 3.0 miles with an average width of about 2.4 miles, and a total drainage area of 33 square miles. The Hocking River-Sunday Creek drainage basin map is shown on Plate No. 2-1, and the drainage basin characteristics are listed on Table No. 4-1, next page.

Sunday Creek with its two principal tributaries, East Branch and West Branch, drains a fan-shaped basin with a drainage area of 138 square miles. East Branch of Sunday Creek heads in the western part of Morgan County and flows 7 miles in a southerly direction through a crooked valley averaging about 1,000 feet in width to join the main stem 3 miles above Glouster. The stream has a total fall of 460 feet, of which 417 feet is in the upstream half of its length, the average slope being 27.0 feet per mile. Tom Jenkins Dam is located on East Branch of Sunday Creek approximately 0.2 miles above its mouth and about 57.2 miles above the mouth of the Hocking River. The drainage basin above the dam contains 32.8 square miles with a net sediment contributing area of 31.2 square miles above the flood control pool elevation of 740 feet NGVD. The general land use map is shown as Plate No. 4-1, and a streambed profile of East Branch of Sunday Creek is shown on Plate No. 4-2.

4-02 TOPOGRAPHY

The Sunday Creek watershed lies in the unglaciated portion of the maturely dissected Kanawha section of the Allegheny Plateau Physiographic Province in the eastern portion of the Hocking River Basin. The area is comprised of a very well dissected typical Appalachian terrain with rugged hill country and broad valleys along the main stream. The highest ridges in the watershed are at approximately 1140 feet NGVD, with a total relief of approximately 460 feet. Since the stream has a low gradient along its lower course with little entrenching and does its cutting mainly at the headwaters, the stream shows maturity in the cycle of erosion. The topography of the East Branch Basin is generally hilly with moderately steep slopes.

During Pleistocene time, a series of ice sheets advanced southward over the northern portion of the state of Ohio, with the furthest advance occurring about 18,000 years ago. The glacial border extended across the northeastern to the south central portion of the state along a line extending from just south of Canton, Ohio through Millersburg to Loudonville, and then south to just west of Zanesville and on west to Newark and Chillicothe. The effects of glaciation on the topography and drainage of Central Ohio are very obvious, with two very distinct belts or zones as a result. The surface effects of glaciation in the northern part of the state is not presently very visible, but the already near flat ground or terrain was flattened much more and all the streams in the northern glaciated belt drain north to the Great Lakes. The Sunday Creek Basin was in the lower nonglaciated zone and was not shaped by the glacier itself, but was heavily shaped by the glacier out wash. Pre-glacier streams such as the Haydensville River generally flowed northward and were blocked by the ice and outwash of the Illinoian Ice Sheet, Scioto Lobe, creating temporary reservoirs into which large quantities of glacial and waste land materials were deposited from the melting ice. Drainage along the main valleys was reversed,

now towards the Southeast, and in some places new valleys were cut into old rock divides.

TABLE No. 4-1

PRINCIPAL TRIBUTARIES OF HOCKING RIVER
AND GENERAL CHARACTERISTICS OF SUNDAY CREEK

Gaging Station or Tributary	Drainage Area (sq. mi.)	Elevation at Source (NGVD)	Length of Stream (miles)	Slope (ft/ (mi.)
Hocking River main stem				
above Hunters Run	36.6	997	15.7	11.9
at Lancaster	48.2	997	15.8	11.8
below Pleasant Run	85.6	997	18.0	11.8
above Rush Creek	98.6	997	20.3	11.8
Rush Creek at mouth	235	1070	37.2	8.4
below Rush Creek	334	997	20.4	11.8
Clear Creek at mouth	91.8	1095	23.0	15.1
below Clear Creek	433	997	22.4	10.7
at Enterprise	459	997	28.4	9.7
Scott Creek at mouth	39.8	850	9.0	15.0
at Logan	509	997	30	9.5
at Nelsonville	576	997	41	7.6
Monday Creek at mouth	116	940	27.0	10.4
at Chauncey	721	997	54	6.4
above Sunday Creek	723	997	54	6.4
Sunday Creek				
above East Branch	24.2	960	13.0	20.6
Tom Jenkins Dam	33.1	1025	21.5	15.6
East Branch at mouth	33.1	1025	21.5	15.6
Sunday Creek below East Branch	57.3	960	13.0	20.8
Sunday Creek at Burr Oak	57.5	960	13.0	20.8
West Branch Sunday Creek	42.5	1000	14.0	23.2
Sunday Creek at Glouster	104	960	17	16.8
Sunday Creek at mouth	139	960	27.2	11.5
Hocking River main stem				
Margaret Creek at mouth	60.0	830	12.9	14.7
Hocking River at Athens	937	997	63	5.6
Federal Creek at mouth	145	1040	23.8	19.1
Hocking R. below Federal Creek	1,139	997	84	4.9
Hocking River at mouth	1,197	997	95	4.6

* Data based on published U.S.G.S. Compilation, U.S.G.S Water Supply Paper, and Gazetteer of Ohio Streams.

4-03 GEOLOGY AND SOILS

The entire Sunday Creek drainage area is in the Kanawha Section of the great Allegheny Plateau and is a hilly dissected country. Although the Tom Jenkins damsite is situated well below the glacial boundary, the old drainage patterns of the area have been altered by glaciation. The consolidated rocks now appearing at the surface in the Sunday Creek drainage area are of sedimentary origin and belong to the Pennsylvanian geologic system. As the area lies along the western limb of the structural trough, the strata have a gentle dip to the southeast at the rate of about 30 feet to the mile; however, the rate is not constant due to localized minor folding. No indication of major faulting has been found in the area, although joint faulting fractures, which have resulted from stresses induced by uplift, are very numerous. The Pennsylvanian formations include and are made up of sandstone, shale, indurated clay, and coal, with a few thin beds of limestone. Except for isolated outliers of Monongahela beds found in the tops of high hills, the surface rocks of the area belong to the Conemaugh series. Allegheny formations underlie the rocks of the Conemaugh series. In the vicinity of the headwaters of the main stream, the

top member of the Allegheny formation, Upper Freeport or No. 7 coal is about 40 feet below the valley floor, while at the mouth of the stream the stratum occurs just above the stream bed. One of the most persistent and easily recognized stratum in the region is the fossiliferous limestone which is ordinarily less than two feet thick, outcrops at many spots throughout the basin, and ranges from 30 to 50 feet above the valley floor.

East Branch of Sunday Creek near the mouth is a flat, sluggish, swampy area with the stream reversing its direction of flow and following a crooked meandering course. The stream flows westward along the north side of the valley at the damsite. The width of the East Branch of Sunday Creek valley at the damsite at flood plain level is about 530 feet, at maximum flood control pool level the width is about 730 feet, and at the top of the dam it is approximately 950 feet wide. Only one limestone stratum, the Brush Creek which occurs 30 to 50 feet above the stream throughout the reservoir area, is present. The Allegheny series of rock, lie below the present flood plain and consist of shale and sandstone. In the lake area the alluvial valley fill ranges from about 15 feet to about 35 feet and is comprised of silt with varying amounts of clay, sand, and gravel. Flood plain alluvium occurs in two fairly distinct bands. A relatively impervious stratum, ranging from 12 to 20 feet in depth, composed of silt, sand and clay is underlain by a relatively pervious sand and gravel stratum ranging from 5 to 25 feet in depth. The residual soil on the valley walls ranges in depth from about 15 feet to about 20 feet and is comprised mostly of silt and clay with varying amounts of sand and fragments of shale and sandstone.

The Tom Jenkins dam site is underlain by Conemaugh and Monongahela series of the Pennsylvanian system. The hard, well cemented, medium to coarse grained Mahoning Sandstone, basal member of the Conemaugh series, is prominent. Bedrock beneath the alluvial fill in the valley bottom is a succession of shales and sandstones belonging to the Allegheny series in the vicinity of the damsite and of the Conemaugh series in the remainder of the reservoir. Although both abutments have adequate widths for an earth dam, a nose of the upland which forms the north abutment is fairly narrow being approximately 250 feet wide at elevation 740 feet NGVD. Topographic features of the ridge which form the south valley walls are favorable for tunnel and spillway sites. The dam is situated across the western end of the valley with the southern end of the dam tying into the rock bench formed by the south or left abutment. The existing saddle spillway was formed by cutting or deepening a natural saddle 57 additional feet in the rock bench about 900 feet south of the dam. The rock types exposed in the existing spillway cut slopes are interbedded sandstones and shales of the Lower Conemaugh formation.

Soils in the Sunday Creek watershed are variable in origin generally from sandstone and shale and from several associations usually the Gilpin-Zanesville-Keene and the Muskingum-Berks. The Gilpin-Zanesville-Keene association consists of well drained, moderately deep to deep upland soils that are sloping to steep and developed from sandstone and shale which are unglaciated and underlain by siltstone and limy and non-limy shale. The less sloping Zanesville soils on the ridge-tops are commonly used for cropland. The Muskingum-Berks association consists of well drained, moderately deep Muskingum soils and well drained, shallow Berks soils which are also sloping to rather steep. Shallowness to bedrock is a problem on Berks soils, which are usually all forested. The strip mine spoil in the West Branch of Sunday Creek has mostly clayey textures and is mostly medium acid to alkaline in reaction.

Soil erosion, particularly sheet erosion, and steepness of slope are the major management problems associated with both soil associations. Most of the Sunday Creek Basin land is fully committed to farming; however, some of the land within the watershed is too steep for cultivation. This steep land has been retained as forest or used for pasture. General farm crops are grown on the more gentle slopes and the remaining areas are used for pasture and woodlands. The Corps of Engineers 1965 survey report for the Hocking River Basin states that in 1959, 52 percent of the Sunday Creek Basin was in farm land and in 1962 about 41 percent of the basin was in was in forest land. Further investigation by the U.S. Department of Agriculture shows that over 90 percent of the East

Branch of Sunday Creek land or the Burr Oak Lake drainage basin is devoted to farm purposes. Surface mining contributes sediment and toxic acid to some streams in the West Branch of Sunday Creek, but the East Branch of Sunday Creek is relatively mine acid free.

4-04 EROSION AND SEDIMENT YIELD

The amount of sediment generated by a watershed depends on a number of factors including land use, physiography, rainfall and size and shape of the drainage basin. Rainfall dislodges soil particles from the earth, the first step in the erosion-sedimentation process. High intensity rainfalls with large sized raindrops produce the highest concentrations of sediment. Steep sloping land and land with poor vegetation produces high erosion and sedimentation. Larger drainage basins generally produce less sediment per square mile from a given storm than smaller basins because of the variation in land uses and rainfall rates. And the shape of a drainage basin is an indicator of the amount of bottom land available for sediment deposition before it reaches the reservoir.

The Burr Oak drainage basin lies in an unglaciated portion of the Sunday Creek-Hocking River Basin, thus the topography of the basin is generally steep with large areas of unvegetated farmland. This creates the potential for erosion and sedimentation in the basin. At Burr Oak Lake, soil erosion and siltation are occurring to a considerable degree at shoreline areas near boat launch points and elsewhere. Erosion problems are caused by a number of factors, including highly porous soils, wave action, lack of vegetation, pool drawdowns, and surface water runoff. At Burr Oak Lake all of the previously mentioned items plus certain surface mining action have contributed to the buildup of sediment and erosion. Surface water erosion has been caused by inadequate storm water drainage facilities and lack of vegetation. Drawdown erosion has been caused by lake drawdowns, normally on slopes of 0-7 percent. And severe shoreline erosion with significant soil loss has been caused by wave action, drawdowns and lack of vegetation on steep slopes of over 7 percent. Surface mining has also caused some slight difficulty at this lake; however, as a result of the combination of strip mining reclamation measures and the Hocking Conservancy District's reforestation program, soils in the Sunday Creek Basin are being conserved and restored; and erosion of slopes and siltation in Burr Oak Lake has been reduced as a result.

4-05 CLIMATE

a. General. Southeast Ohio has a climate essentially continental in nature, characterized by moderate extremes of heat and cold, and wetness and dryness. It is in the path of rain producing storms which move across the nation in a general west-to-east direction. The storms often converge in the Great Lakes region and leave by way of the St. Lawrence River Valley. The southern half of the state is visited more frequently by productive rainstorms. The lifting of moist air masses over the hilly terrain tends to increase the yield of rainfall, especially in winter and spring. Extreme amounts of precipitation and long periods of drought are relatively uncommon. Climatological data for three representative locations within or near the Burr Oak Lake Basin are presented in Table No. 4-2, (T4-1, table section).

b. Temperature. There are no climatological stations within the Tom Jenkins Lake Basin that record temperature data. However, temperature data is recorded at Athens, located just 28 miles below the dam and at several other adjacent stations near the basin. The normal annual temperature for ten NWS, Southeast Ohio Division stations through 1991 is 51.4 degrees, with monthly normals ranging from 28.0 degrees in January to 72.5 degrees in July. The extremes for the area are shown by the record minimum at Milligan, Ohio of -39 degrees on 10 February 1899 to the record maximum at Amesville of 110 degrees on 6 August 1916. The average length of the growing season for the Burr Oak Basin is approximately 182 days, extending from the latter part of April to the middle of October.

c. Precipitation. Precipitation data is recorded at Tom Jenkins Dam for the Burr Oak Lake drainage basin, and at Athens, Enterprise, Amesville, and several adjacent satellite stations just outside of the basin. Normal annual precipitation for the fifteen NWS-Southeast Ohio Division stations surrounding Burr Oak Lake through 1991 is 39.00 inches, with normal monthly precipitation ranging from 2.43 inches in October and 2.48 in February to 4.39 inches in July. The driest water years in or near the basin was 27.00 inches at Milligan, Ohio in 1895 and the record year of 1930 when the basin had 23.0 inches. The wettest recorded year in or near the basin was 43 inches in 1913 at the same Milligan station. Snowfall data is not officially measured at any location within the Burr Oak Lake Basin, but data is available nearby for the larger parent Hocking River Basin. Based on 95 years of data taken through 1991, average annual snowfall for the parent basin is about 18 inches and represents only a minor portion of the total precipitation. The record snowfall years are 1910 and 1917 at Amesville with 48.2 inches for both.

d. Evaporation and Wind. For most Scioto and Hocking River Basin reservoirs, the amount of water lost by evaporation is quite small. The amount of loss attributable to evaporation from the lake surface is the difference between actual evaporation from the lake surface and the evapotranspiration from that area before the reservoir was constructed. The average annual lake evaporation over the Burr Oak Lake Basin is about 32 inches. Comparison of the water surface evaporation with the water loss shows that the average increase in loss, or augmented evaporation due to the reservoir, is about seven or eight inches per year. Monthly evaporation data for Burr Oak Lake is shown on Table No. 4-3. The month of July has the greatest monthly loss.

Prevailing winds in the area are from the south and southwest for most of the year; in February and March prevailing winds are from the northwest. The mean annual wind speed, based on data from the Parkersburg-Marietta Airport, located 30 miles east, is 9.9 miles per hour. The maximum mean monthly wind speeds average between 11 and 12 miles per hour during the period November through April; minimum mean monthly wind speed is 7.4 miles per hour in August. Damaging windstorms are mostly associated with heavy thunderstorms, squall lines or large-area storms.

TABLE NO. 4-3

LAKE EVAPORATION LOSSES - SUMMARY

Average Annual Evaporation - inches* 32.0
Average Seasonal Evaporation (May-October) - inches* 24.4
Average Monthly Evaporation Losses

Month	Inches*	Ac-ft**
May	4.16	230.2
June	4.98	275.5
July	5.12	283.3
August	4.52	250.1
September	3.27	180.9
October	2.34	129.5
Seasonal Total	24.39	1349.5

* Vertical distance
** 1-inch loss from summer water supply pool (elevation 721.0 feet NGVD, surface area 664 acres) = 55.33 acre-feet.

4-06 STORMS AND FLOODS

a. General. Most floods in Ohio are caused by precipitation of unusual intensity or of unusual duration and extent. Floods may also result from a series of ordinary storms which follow one another in rapid succession, or from rain falling at relatively high temperatures on snow covered areas. At

times, though infrequently, flood conditions are caused or aggravated by ice jams, especially in the tributary streams. Severe thunderstorms frequently cause local flash flooding. General flooding occurs most frequently during January to March, but it can occur at any time of the year. In fact, the two greatest and most intense storms that have occurred in or near the Hocking River Basin were both in the month of July. The storm of 18-19 July 1889 centered over Logan, Ohio, and 6.06 inches of rain fell in 18 hours with 5.5 inches falling in 3.5 hours. The full center of this storm was at Rockport, WV, 50 miles to the southeast, where 18 inches of rain fell in 2 hours. The second great storm was 4 July 1969 centered over Wooster, Ohio, about 70 miles north of Tom Jenkins Dam. During this storm about 10-12 inches of rainfall fell, with some places having up to 16 inches of rain in a four day period. However, the intense summer rainfall was so concentrated that the storm was very routine at Burr Oak Lake. The other very intense summer storms are 3.45 inches of rain at Logan on 26 August 1890, 3.16 inches of rainfall in two hours on 13 June 1902 also at Logan, 22 July 1948 had a reported 10 inches of rainfall on Clear Creek near Logan, and 5.40 inches of rain at Lancaster on the night of 13 September 1938. Two other great storms were at near by Cambridge, Ohio with 7.09 inches of rain in 90 minutes on 16 July 1914, and Newcomerstown, Ohio with an 8.90 inches average rainfall on Wills Creek on 7 August 1935, with a 12.7 inch rain in 12 hours at one station. The four greatest and most intense winter storms that have occurred in or near Burr Oak Lake were all in the month of March. The storm of 4-12 March 1964 centered over Athens, Ohio, and 6.67 inches of rain fell; 25 February-6 March 1945 when 6.61 inches of rainfall was recorded at nearby Lancaster; 23-27 March 1913, when the average rainfall above Athens totaled 5.43 inches; and 12-14 March 1907, when average rainfall above Athens for the three days totaled 5.51 inches. The latter storm produced the flood of record in the Hocking Basin. The earliest storm and flood that records could be obtained occurred in 1873. Old newspaper accounts, however, indicate that major floods occurred in Athens and above in 1832, 1847, 1852, 1858, and 1859. Later newspaper records and high water marks show terrible flooding in 1907, 1913, 1922, 1937, and 1940.

The flooding characteristics of the Sunday Creek Basin can be partially described by comparing the 20 highest recorded and historical floods. These are shown on the next page in Table No. 4-4, as the highest recorded and computed crests for the years 1941 through 1990 at the Sunday Creek at Glouster gaging station below Tom Jenkins Dam on East Branch of Sunday Creek, plus the highest observed and estimated crests for the preceding 35 years. Although flows in Sunday Creek have been regulated by the Tom Jenkins Project since 1950, the flows shown in Table No. 4-4, next page, represent the natural flows that would have occurred without the regulation of Tom Jenkins Dam. The natural stages corresponding to the natural flows for the table are based on the day rating curve shown in Section VII.

Flooding characteristics of Sunday Creek below Tom Jenkins Dam can also be described by a flow frequency curve. Such a curve for Sunday Creek at the Glouster gaging station is given in Plate No. 4-3. The discharge rating table and rating curve for this station is shown in Section VII.

b. Storm and Flood of July 1873. The flood of July 1873 is conspicuous because it is the only major Hocking River flood of record that has occurred in the summer months. It was caused by a steady downpour of rain which fell from Thursday, 3 July, until the following Saturday. This flood is the fourth highest of record at Athens where it reached a stage equivalent to 23 feet on the present gage. The Hocking River-Sunday Creek valley was damaged throughout its length, with crop losses being especially severe. Information on high water marks, other than at Athens, and on recorded rainfall in the Sunday Creek Basin are very meager.

TABLE NO. 4-4
SUNDAY CREEK AT GLOUSTER, OHIO
MAXIMUM NATURAL FLOWS
COMPUTED CRESTS AFTER 1950

Date	Gage Height (feet)	Discharge (cfs)
14 Mar 1907*	18.80	11,000
10 Mar 1964	18.60	10,250
5 Mar 1963	18.50	9,420
24 May 1968	18.43	9,300
29 May 1990	18.10	7,930
26 Mar 1913*	17.70	7,000
15 Jan 1951	17.12	5,440
12 Apr 1948	17.05	5,300
13 Feb 1966	16.93	5,050
21 Apr 1940*	16.85	4,850
10 Apr 1942	16.72	4,600
27 Feb 1979	16.72	4,600
16 Apr 1922*	16.49	4,200
8 May 1961	16.48	4,150
4 Feb 1948*	16.40	3,985
17 Mar 1945	16.27	3,770
7 Mar 1944	16.26	3,760
8 Aug 1935*	16.25	3,725
23 Jan 1937*	16.22	3,660
20 Mar 1943	16.20	3,650

* Historical observed crests, obtained from many sources

c. Storm and Flood of February 1884. The Ohio Valley flood of February 1884 resulted from moderately heavy general rains falling from 4 to 14 February, during a midwinter thaw. The average precipitation recorded over the Hocking River watershed was 4.82 inches, 0.93 inch occurring on 6 February, the day of the heaviest rainfall. The period of maximum rainfall coincided with the culmination of the thaw on 5, 6, and 7 February. A flood crest of 24 feet was reached at Athens on 7 February, 2 days before the Ohio River crest at the mouth of the Hocking River. Bottom lands throughout the Hocking River-Sunday Creek were submerged and the flood exceeded in destruction and anguish any previously recorded flood on this stream. Specific high water marks on Sunday Creek are lacking.

d. Storm and Flood of March 1907. Damaging floods prevailed on the Ohio River, Hocking River, and Sunday Creek during the middle 10 days of March 1907. Serious damage resulted on all the rivers and small streams in southern Ohio, but probably the greatest havoc was wrought in the Hocking River valley. The flood here was caused by unusually heavy rains and melting snow over the entire Hocking River-Sunday Creek Basin. A light rain accompanied by temperatures considerably above normal, occurred during the first 11 days of March, melting the snow cover and saturating the ground. On March 12, 13, and 14 excessive rains fell over the entire Hocking River-Sunday Creek Basin, the average rainfall above Athens totaling 5.51 inches. The Hocking River and Sunday Creek both rose rapidly to the highest stage ever recorded to that time. At Athens, the flood reached a flood stage equivalent to 27.4 feet on the present gage on 13 March, 3 days before the crest on the Ohio River at the mouth of the Hocking River. Records indicate that the flood reached a stage corresponding to 18.8 feet on the present day Glouster gage, the highest stage ever recorded. The flood was very destructive throughout the Hocking River, especially in the Sunday Creek Basin, resulting in the flooding of every building on main street of Glouster. This very destructive flood swept away five or six store buildings, several highway and railroad bridges, and cut off all communications with Glouster.

e. Storm and Flood of March 1913. The storm causing this flood was general over the northern half of the Ohio River Basin, with the heaviest precipitation in the States of Indiana and Ohio. Rainfall of 1 to 1.5 inches occurred on 20 and 21 March throughout the Ohio Valley and thoroughly saturated

the ground, so that an unusually large percentage of subsequently heavy rain of the main storm, on 23 to 27 March, produced rapid runoff. All flood records on the southerly flowing tributaries of the Ohio River in Ohio and Indiana were broken. During a period of 4 days, from 23 to 27 March, the maximum rainfall recorded in the Hocking River Basin was 7.5 inches at Lancaster. The average rainfall over the portion of the basin above Athens is estimated at 5.43 inches. The flood attained stages on the Ohio River which are still the greatest of record in the 150 mile reach from old Lock 14 to Point Pleasant, WV, which is located 66 miles below the mouth of the Hocking River. The crest profile on the Hocking River and Sunday Creek generally paralleled that of the record flood of March 1907, being 2.4 feet lower at Logan, 3.5 feet lower at Nelsonville, and 3.4 feet lower at Athens. The crest stage of 24.0 feet, referred to the Athens gage, occurred on 26 March 3 days before the crest on the Ohio River at the mouth of the Hocking River. The flood reached a stage corresponding to 17.7 feet on the present day Glouster gage. The March 1913 flood caused the loss of 367 lives and damages amounting to $14.0 million (1913 dollars) in the Muskingum River Basin, and in the Scioto River Basin the flood caused the death of 145 people and property damages in certain areas of over $25.0 million (1913 dollars). Property damage was great throughout the Hocking River-Sunday Creek water shed but not nearly so great as experienced in 1907. There is no record for loss of life in the Sunday Creek Basin.

f. Storm and Flood of January 1937. A series of abnormally heavy rains in late December 1936 and most of January 1937 caused a major series of floods in the middle and lower portions of the Ohio River Valley. The total precipitation for January in the lower portion of the Ohio River Basin was more than 4 times the amount that normally occurs during the month. Tributary streams in the Hocking River Basin experienced successions of flood rises which moved out of the smaller streams to accumulate in the larger tributaries in increasingly higher stages and discharges after each storm. During the period of 20 to 25 January, inclusive, the rainfall over the Hocking River-Sunday Creek Basin ranged from 4.45 at Athens to 7.05 at Lancaster with the maximum for any one day being 2.0 inches at Lancaster. The resulting flood along the Hocking River was about 5.0 feet below the maximum flood of record. A crest of 22.7 feet was reached at Athens on 23 January, 3 days before the crest on the Ohio River at the mouth of the Hocking River. The crest on Sunday Creek was reached on 23 January with a present day stage of 16.22 feet. The damage, misery, and havoc from this flood was so great that several people in the Glouster area soon formed the Sunday Creek Watershed Association for the creation, development and promotion of a flood control project by the Works Progress Administration for the Sunday Creek Basin similar to the Muskingum Watershed Conservancy District. Their actions were partially successful by way of getting another study that produced a survey report recommending a flood control project for Sunday Creek.

g. Storm and Flood of April 1940. The flood of April 1940 resulted from excessive rains falling over the entire drainage basin during the period 16 to 20 April, inclusive, and saturation of the soil from preceding moderate rains increased the rates of runoff. The average precipitation over the Hocking River Basin amounted to 4.34 inches during the period 16-20 April, inclusive, and varied from 5.28 inches at Lancaster to 3.86 inches at Athens. The highest daily amount, 2.72 inches, fell at Lancaster on the 19th. The crest stage of 22.9 feet was reached at Athens on 21 April, 1 day ahead of the Ohio River crest at the mouth of the Hocking River. General flood conditions prevailed throughout the Hocking River Basin, particularly on Sunday Creek and Rush Creek, which resulted in serious urban and agriculture losses and damage to railways, highways, and farms at numerous points. Railroads were forced to suspend operations for periods ranging from 2 to 4 days. Urban damage was most severe along Sunday Creek at Glouster, where a present day stage of 16.85 feet was reached, and at Athens.

h. Storm and Flood of March 1945. The Ohio Valley was the scene of a great flood during the first half of March 1945 as a result of the melting snow and heavy rains. An unusually heavy snow cover had held over from January. On 1 February average snow depths on the ground ranged from 1 to 6 inches over the southern half of Ohio. Most of the snow was gone by the 8th

and the resulting runoff coupled with heavy rains during the last part of February caused a considerable rise in river stages. By 1 March the Ohio River was in flood stage, and heavy rains during the first 6 days of March aggravated the flood situation. Rainfall over the Hocking River Basin for the 10-day period, 25 February through 6 March, ranged from 5.75 inches at Athens to 6.61 inches at Lancaster and 6.62 inches at New Lexington. The maximum amount recorded for any one day was 3.31 inches at Lancaster on 6 March. At Enterprise the Hocking River reached a stage of 20.1 feet, being only 1.9 feet below the 1907 flood and 0.4 feet below the 1913 flood. The peak stage at Athens during this flood was 23.0 feet, the highest since the gage was established in 1915. The peak stage at Glouster was 17.7 feet, or about 3.6 feet lower then the 1907 flood. Serious damage to urban and rural properties, railroads, and highways resulted from this flood, and were greater than normal due to intensified wartime activities.

i. Storm and Flood of January 1959. The storm and flood of January 1959 is generally regarded as one of the highest of record throughout most sections of central Ohio. The conditions prior to the generalized rains on 20 and 21 January contributed greatly to the flood stages throughout the basin. Severe cold weather during December 1958 froze the ground to depths ranging from 6 to 18 inches. In addition a storm occurring between 14 and 17 January deposited from 0.50 to 1.84 inches of precipitation over the basin. The ground was thus saturated, frozen and covered with varying amounts of snow, all of which greatly contributed to the high percentage of runoff encountered after the generalized rain began. Most of the flood-producing rains fell between midnight on 20 January and noon on 21 January. Rainfall at Tom Jenkins dam for this storm was approximately 2.0 inches. The damage in the Hocking-Sunday Creek Basin was not as great as in other areas of the state, but was still severe. Glouster reached a modified crest of 14.55 feet and had a computed natural crest of 16.50 feet. Tom Jenkins dam was utilized and operated for the entire flood.

j. Storm and Flood of March 1963. With the beginning of March, winter weather, which had come close to exceeding the coldest of record, turned unseasonably warm. The ground was frozen to unusual depths. Thus the stage was set for excessive runoff from any rains which might fall. A large amplitude wave pattern over North America early in the month consisted of a ridge in the Eastern Pacific and a trough that extended from Hudson Bay into the Southern Plains. Heavy precipitation fell from the Central Plains eastward, in association with the trough. Amounts of 4 inches or more fell locally in some areas with 3.97 inches being recorded at Athens. Nearly all of this precipitation accompanied passage of a major storm system from the far Southwest, where it had developed the previous week, to the Midwest on the 4th, and New England on the 6th. The flood resulting from this storm caused a crest stage at Athens of 23.1 feet that was reached on 6th of March. Sunday Creek at Glouster crested the day before with a modified stage of 17.81 feet. Tom Jenkins dam was fully utilized to reduce the downstream crests by storage of water and reduced the Glouster crest by about 0.7 feet.

k. Storm and Flood of March 1964. The flood of March 1964 was the result of two storms. The first occurred on 4-5 March, when an average of 2.1 inches fell on the drainage area above Athens. This storm set the stage for excessive runoff from the second storm which occurred on 8-10 March and had a duration of approximately 24 hours. This second storm produced the maximum flood recorded for the gaging station at Athens which has been in operation since 1915. The Athens crest stage was 24.18 feet reached on 11 March. Sunday Creek at Glouster reached a modified crest stage on the 10 March of 17.53 feet. Tom Jenkins dam was fully operated for both storms and is credited with reducing the crest at Glouster by about 1.1 feet.

l. Storm and Flood of May 1968. Central and Southern Ohio experienced the worst widespread flooding since March 1913 during the latter part of May 1968. During the period 8-22 May, most areas in the southern part of the state received 3 to 5 inches of rainfall. This created saturated soil conditions over a large portion of the state and contributed to the large runoffs that occurred during the heavy rains of 23-24 May and 26-27 May. In

the Hocking River-Sunday Creek Basin the rainfall was from 3 to 5 inches for 23-24 May and 26-27 May had about 4.2 inches in the headwaters and about 2.4 inches in the lower Hocking-Sunday Creek area. The storms over the southern part of Ohio for May 1968 are estimated to be in the 50 to 100 year category and caused over 8.8 million dollars damage. Sunday Creek at Glouster crested on the 24th May at a modified stage of 17.78 feet. The computed natural crest for Glouster was 18.43 feet. Tom Jenkins dam was fully operated for this flood.

m. Storm and Flood of February 1979. Antecedent conditions prior to moderate rainfalls near the end of February 1979 were mainly responsible for flooding conditions in the basin. Soils were frozen and a snowcover persisted over most of central Ohio from early January to the onset of the major rainfall on 25-26 February. The area snowcover ranged from approximately 6 inches in the northern part of the state to 20 inches at McConnelsville. Based on data from Barnesville, Athens, and Glouster the snowcover on the Burr Oak Lake Basin prior to the initial thaw of 20 February was estimated to be about 16 inches. Temperatures rose to above freezing for the first time in nearly 4 weeks on 20 February and, combined with rainfalls of less than 0.5 inch on 21-22 February, created rapid melting of snow and runoff and rising stages along the basin's streams. Continued thawing combined with heavier rainfalls of approximately 1.5 inches over the basin on 25-26 February produced heavy runoff and considerable flooding in the Hocking Basin-Sunday Creek Basin. Total rainfall at Tom Jenkins Dam for the period of 25-26 February was 1.48 inches. The Hocking River at Athens reached a stage of 25.45 feet on 27 February. Sunday Creek reached a modified stage at Glouster of 15.90 feet and a computed natural stage of 16.72 feet. Tom Jenkins dam was utilized efficiently to reduce downstream flows and stages.

4-07 RUNOFF CHARACTERISTICS

The Sunday Creek watershed lies in an unglaciated section of the Appalachian Plateau, and is characterized by rugged, hilly country with broad valleys which are conducive to a faster concentration of runoff. Basin runoff is highest during the winter months when storm rainfall may combine with snow melt and when frozen or saturated ground can result in very low infiltration rates. Runoff is lowest during late summer and early fall when the ground is dry and infiltration losses are high. Table 4-5(page 4-12) presents average normal, maximum and minimum runoff from the watershed at Glouster below the Tom Jenkins damsite, based on 10 years of record (1950 through 1960) at the USGS gage. Flow frequency curves showing partial regulation for Glouster and Athens are shown as Plate Nos. 4-2 and 4-3.

4-08 WATER QUALITY.

Tom Jenkins Dam was built on East Branch of Sunday Creek in the northwest corner of a long fairly narrow valley, bounded by irregular, moderately steep walls that rise some 140 feet to a maturely dissected upland. Before the Pleistocene glacial epoch, the regional drainage direction was generally to the northwest, as a part of the Haydensville River. This drainage was reversed by the Illinoian Ice Sheet, Scioto Lobe. The drainage direction is now to the southeast. Part of Sunday Creek may have been a temporary lake as a consequence of glacial accumulations blocking normal drainage. This temporary lake filled with about 150 feet of materials consisting of silts, clays, sands, and some gravel. The bedrock in the area is part of the Conemaugh group of the Pennsylvanian period.

The Sunday Creek watershed lies in an unglaciated section of the Appalachian Plateau, and is characterized by rugged, hilly country with broad valleys which are conducive to a faster concentration of runoff. Basin runoff is highest during the winter months when storm rainfall may combine with snow melt and when frozen or saturated ground can result in very low infiltration rates. Runoff is lowest during late summer and early fall when the ground is dry and infiltration losses are high.

Land use patterns, including some strip mining of coal and agriculture, also exert strong influences on the chemical characteristics of basin waters. For example, sulfate concentrations are relatively high, as are total salt concentrations and buffering capacity (alkalinity). Iron and manganese, possibly because of the calcareous nature of the basin and neutralization of acid drainage, are not present at problematic concentrations. Levels of nitrogen and phosphorus are high in the watershed, and phosphorus appears to be the biologically limiting factor.

Water quality data collected by the Corps of Engineers from 1974 to 1989 indicated that water quality of the basin reflected the above conditions.

4-09 CHANNEL AND FLOODWAY CHARACTERISTICS

East Branch Sunday Creek Valley is a broad, flat-bottomed topographic feature which in places is more than a half mile in width. At the Burr Oak Lake dam site, the valley bottom narrows to about 530 feet. East Branch Sunday Creek, which meanders through the valley, is approximately 30 feet wide and touches the left valley wall at the dam site. The general elevation of the valley bottom is 733 feet NGVD. Time of travel of Tom Jenkins dam flood discharge to Glouster on Sunday Creek is about 3 hours and the time of travel to Athens on the Hocking River is approximately 18 hours.

TABLE NO. 4-5
MONTHLY AND ANNUAL RUNOFF
SUNDAY CREEK AT GLOUSTER BELOW TOM JENKINS DAM

Average Month	Normal Average Flow (cfs)	Maximum Average Flow (cfs)	Minimum Flow (cfs)
January	171.	408	11
February	201.	480	4
March	201.	360	42
April	186.	373	54
May	129.	285	45
June	48.	147	6.5
July	45.	237	3.6
August	25.	133	0.9
September	12.	65	0.9
October	28.	96	4.5
November	20.	50	0.9
December	14.	227	1.8
Annual	97.	140	29

4-10 ECONOMIC DATA

a. Population. Tom Jenkins Dam is in Athens County, and the East Branch Sunday Creek drainage basin above Burr Oak Lake lies wholly within Morgan County and Perry County. There are no major population centers within the Burr Oak-East Branch Sunday Creek Basin. The 1980 Ohio population census estimated that Glouster, located just downstream on Sunday Creek of the dam had a population of 2,211; and Chauncey, located at the junction of Sunday Creek and the Hocking River had a population of 1,050. Athens is the largest city in the Hocking River Basin and the county seat of Athens County. The city of Athens had a 1980 population 19,743; while a recent July 1994 total population estimate for Athens County was 60,465. Population figures for the Hocking River Basin is shown in Table No. 4-6 shown below. The estimated population for the basin for the year 2000 would be about 160,000 people.

TABLE No. 4-6

POPULATION OF HOCKING RIVER

AND SUNDAY CREEK BASINS

County or City	Population 1910	1920	1930	1940	1950	1960	1980
Athens Co.	44,900	48,060	42,260	43,890	43,890	45,290	50,000*
Athens	5,463	6,418	7,252	7,696	11,600	16,470	19,743
Glouster	2,527	3,140	2,903	2,847	2,327	2,255	2,211
Nelsonville	6,082	6,440	5,322	5,368	5,328	5,192	4,567
Fairfield Co.	28,550	30,280	33,460	37,210	40,110	48,850	60,000*
Lancaster	13,093	14,706	18,716	21,940	24,180	29,916	34,953
Hocking Co.	14,660	14,440	12,650	13,330	12,100	12,500	14,000*
Logan	4,850	5,493	6,080	6,177	5,972	6,417	6,557
Perry Co.	21,950	22,330	19,500	19,270	17,980	17,280	17,000*
New Lexington	2,559	3,157	3,901	4,049	4,233	4,514	5,178
Morgan Co.	1,240	1,100	860	950	650	560	500*
Washington Co.	420	370	300	350	330	300	280*
Total	12,260	116,580	109,030	115,000	115,060	124,780	142,000*

* 1980 county figures estimated, parts of each county are outside the basin.

b. Industry and Agriculture. In Morgan and Perry County, the principal industries are related to stone, clay, and glass. Manufactured goods include paperboard boxes, drain tile, pottery and brick. Agricultural items include dairy products, cattle, and calves. There is some bituminous coal mined in the basin.

Morgan County has a total land area of approximately 268,800 acres. Perry County has a total land area of 263,680 acres. Of this area, approximately 20% is devoted to cropland, 25% to pasture, 24% to woodlands, 27% to other farm land and farm facilities, and 4% to urban, built-up and other non-farm areas. The total land and water area within the Burr Oak Lake recreational area is approximately 1638 acres, or approximately 2.8% of the county area.

c. Flood Damages. Areas subject to flooding downstream of Tom Jenkins Lake along Sunday Creek consist of small farms, rural residences, and the small communities of Glouster, Trimble, Jacksonville, Redtown, and Chauncey, Ohio. Further downstream is the much larger city of Athens, Ohio and the Ohio University campus.

SECTION V - DATA COLLECTION AND COMMUNICATION NETWORKS

5-01 GENERAL

The Huntington District water control system consists of a state of the art computer, located in Water Resources Engineering Branch, and many Data Collection Platforms (DCP's) and Hydrologgers located throughout the district at various stream gaging and precipitation stations. DCP's collect, store, and transmit data via the Geostationary Operational Environmental Satellite (GOES) to various receiving sites. The current hydrologic network system is illustrated in Plate No. 5-1. Data collected by DCP's in the Huntington District are received by the Great Lakes and Ohio River Division (LRD) downlink in Cincinnati, Ohio, and disseminated at least hourly to the district water control system via the LRD water control system over a leased line.

Many DCP's, with added “voice” capability, and all Hydrologgers answer human telephone queries by simulated voice with latest or current readings and answer computer queries with stored data. There are two standard DCP's installed in the East Branch of Sunday Creek drainage basin. One is located at the Tom Jenkins intake structure, and a second is located just downstream of Tom Jenkins Dam. The DCP's transmit lake elevation and outflow stage data for the Tom Jenkins project.

All daily reservoir reports are now received through the District Intranet System for water control. The Hocking River Basin project reports electronically via the computerized District Intranet System. The projects transmit directly to the Water Control Section. The district radio network is used as backup, when needed. Data are also received from the National Weather Service (NWS) through the water control system. Reservoir project data are also disseminated back to the NWS from the water control system.

5-02 HYDROMETEOROLOGICAL STATIONS

a. Streamflow Stations. Several stream gaging stations, designed for the collection of hydrologic data, are located at strategic sites in and around the Sunday Creek Basin. Those stations pertinent to Tom Jenkins dam are shown in Table No. 5-1 (T5-2 in back table section).

(1) Stream Cooperative Program. The Corps of Engineers participates in the U.S. Geological Survey Federal-State Cooperative Water Resources Program under which the Survey installs, rates and maintains the gages at locations desired by the cooperating entity, except at Corps' projects where the lake and outflow gages are originally installed by the Corps. Under this program, the Survey maintains gages on Hocking River at Enterprise and Hocking River below Athens.

The Corps of Engineers also maintains several gages in the Hocking River Basin independent of the stream cooperative program. One of those gages is the lake gage at Burr Oak Lake.

(2) Collecting and Reporting Facilities. Strip chart recorders provide a graphical record of stream stage and a backup for Analog-to-Digital Recorder (ADR) devices. Shaft encoders are now being used to digitally record water levels. The data collection platforms mentioned earlier, in sub-section 5-01, have been installed at basin gages as listed in Table No. 5-1(T5-2, table section). The platforms store stage and precipitation data and every four hours transmit to the LRD computer downlink via the Geostationary Operational and Environmental Satellite. The Water Resources Engineering Branch water control system receives data automatically from the LRD water control system on a hourly basis. If desired, the District can also access the data at other times by operator control. The basin gage configuration is shown on Plate No. 5-2.

Some data collection platforms have the capability of reporting in response to a telephone query by computer, terminal or human. The query can be initiated at any time from the water control system, Project Office or the home of a

selected individual during off-duty hours. In response to a human caller, the platform will respond with the last recorded information such as stage with a synthesized voice. Information from the DCP's may also be obtained directly by the water control system computer. The DCP's can also dump several readings taken over a period of hours to a computer terminal. These DCP's have been installed at critical locations such as inflow, lake, outflow, and some control point stations.

(3) Reports. Currently, morning reports from the Tom Jenkins project, containing stage, precipitation, and operational data, are received in the Water Control Section as computer printouts from the water control system. They are received in the same format in which they are input at the Project Office. Stage data are converted to flow and the values are used in the forecasting process. Frequency of reporting, and thus data collection, are dependent on the degree of urgency of weather and/or flooding conditions as specified in Exhibit B, "Instructions to Damtender." The frequency ranges from daily (5 days per week) at about 0730 hours under Normal Conditions to hourly under Major Flood Conditions when the lake level approaches or threatens spillway elevation. Project data are submitted to the District water control system in accordance with the Schedule for Reading Gages, in Exhibit B. All satellite data are disseminated automatically by the LRD water control system to the District on an hourly basis.

b. Precipitation Stations.

(1) ORN Program. The Ohio River Reporting Network, a division-wide cooperative program with the National Weather Service, involves interchanges of information between the Weather Service and the Corps of Engineers which utilizes the respective installations and experience of the two agencies. The Weather Service recruits, trains, equips, and pays observers at Corps requested locations and receives and records data from them. The Weather Service also provides weather and stream stage data, Ohio River and tributary forecasts, regular and requested special forecasts, radar and other special reports on request.

In addition to reimbursing NWS for direct costs incurred on the Corps' behalf, Huntington District provides NWS with all precipitation, snow cover, and stage information received in the Water Resources Engineering Branch from reservoir and other reports, three-day pool and outflow forecasts, and depth reports from the Corps of Engineers' Snow Cover Reconnaissance.

Precipitation stations in and near the Tom Jenkins Lake watershed include Tom Jenkins Dam, Athens, Amesville, New Lexington, and Enterprise.

(2) Collecting and Reporting Facilities. Normal equipment is the 8-inch Standard Rain Gage with a metal support. All the above named stations have this standard gage. At ORN weather stations the rain gage is read and reported manually by telephone landline. Station locations within the Sunday Creek Basin are shown on the River Stage Network Map, Plate No. 5-1, and data collection and communication equipment utilized at all stations are listed in Table No. 5-2(T5-3 table section).

Some other stations within the Hocking River Basin utilize a tipping bucket precipitation gage which is interfaced to a data collection platform. The platform receives precipitation data from the gage electrically and transmits the data to the computer downlink via satellite.

(3) Reports. The Project Office transmits the data to the District water control system and also relays the data to NWS in Charleston.

Usage of data from these reports and data exchanged with the NWS is as described below.

The Water Resources Engineering Branch utilizes platform information, morning report information and Weather Service data in forecasting and computing average precipitation over the Burr Oak Lake Basin and Hocking River Basin District. Weather Service information for areas lacking Corps projects, when plotted on the District Isohyetal Map, provides better understanding of storm

movement and aerial intensity. This additional coverage contributes to improved water management decisions.

National Weather Service radar also provides valuable information for regulation and forecasting. Radar receivers at NWS display reflected “echoes” of precipitation in the form of a visual readout. These radar echoes show relative intensity and aerial extent of the precipitation. The NWS Hydrologist analyzes the radar information for position, direction and speed of movement, and estimates precipitation amounts and relays this analysis by telephone on request.

A large portion of the total precipitation information received by NWS comes through the cooperative ORN program. Complete district morning report data accessed from the Water Resources Engineering Branch mini-computer (water control system) are reorganized by NWS personnel into downstream format and inserted into the NWS Eastern data bank. The data are widely used by NWS elements such as those producing infiltration indices and short, medium and long-range forecasts, and by the River Forecast Center in Cincinnati which produces Ohio River and tributary stage and flow forecasts. The Charleston office utilizes the data early in their mid-morning weather report including any updating of forecast which may be indicated.

5-03 WATER QUALITY STATIONS

a. Facilities. A network of 10 water quality sampling stations were established at Burr Oak Lake. Primary stations located on the lake are shown in Plate 5-3. ALL primary stations within the basin are described in Table No. 5-3.

TABLE NO. 5-3
Description by Location of Burr Oak Lake
Primary Water Quality Sampling Stations

Station	Distance From the Dam	
TJE0002	15.75 miles	Above
TJE0003	0.3 miles	Above
TJE0004	3.0 miles	Above
TJE0005	4.4 miles	Above
TJE0006	7.0 miles	Above
TJE0007	9.0 miles	Above
TJE0009	50 feet	Below

b. Reporting. Water quality data collected at Burr Oak Lake is used to meet such objectives as:

(1) Establish baseline conditions and monitor subsequent changes;
(2) Identify water quality environmental problems;
(3) Study special problems or develop criteria for such solutions as modification of reservoir regulation procedures aimed at controlling or enhancing environmental conditions and meeting water quality objectives; and
(4) Provide a database adequate for understanding project conditions and for coordination with state agencies in regard to implementing any needed watershed pollution control.

Parameters to be measured, frequency of collection, and number of data collection stations at any one time are determined by specific project conditions. The water quality program design for Burr Oak Lake was structured to describe the various factors which affect water quality over the long term. Data collected are used for applications such as identification of trends which indicate problem conditions and reporting existing conditions. Basic studies consist of 5 essential components:

(1) In-situ measurements to evaluate distribution of various properties
(2) Wet chemistry and various types of solids for both immediate and long-term use

(3) Indirect but rapidly obtainable indicators of productivity such as chlorophyll and carbon
(4) Benthic organisms to monitor long-term quality of inflows and outflow
(5) Other biological measurements such as plankton and seston

Standard physical/chemical tests and reasons for testing are presented in Table No. 5-4.

c. Maintenance. Sediment and water samples are collected from Burr Oak Lake once every 5 years. Water samples are also collected every 10 years each month for the months April through September. During emergency or under adverse conditions water quality samples are collected on an as-needed basis. All cases data are collected for one or more of the following reasons:

(1) long term analysis
(2) problem identification or solution
(3) cause and effect relationships
(4) mathematical modeling
(5) predictive capability

Present sampling programs are oriented toward existing or potential effects and are structured to describe various factors at the project which affect water quality.

TABLE NO. 5-4

Standard Physical/Chemical Tests

Type of Test	Reason for Testing
Calcium (Ca)	Major Cations - Ionic Balance, ratios
Magnesium (Mg)	and relationships
Sodium (Na)	
Potassium (K)Sulfate (SO4)	Major Anions - Ionic Balance, ratios
Chloride (Cl)	and relationships
Nitrogen (N)	Nutrient
Nitrate + Nitrite	
Ammonia	
Total Kjeldahl	
Total Organic Carbon (TOC)	Nutrient
Phosphorous (P)	Nutrient
Total	
Filterable	
Solids	Equivalent Ambient Values, Correlation
Total	with optical measurements
Suspended	
Dissolved	
Hardness	Evaluate buffer capacity and Alkalinity characteristics
Metals	Important for hypolimnetic and outflow
Iron (Fe)	evaluations during stratification
Manganese (Mn)	
Dissolved Oxygen	Insitu parameters used to evaluate
Temperature	conditions for project operation
pH	
Specific Conductance	

5-04 SEDIMENTATION.

a. Lakes. The original sedimentation network consisting of 57 sediment ranges was established and surveyed in the Tom Jenkins (Burr Oak) Lake area during October-November-December 1950. Monuments were installed at the ends of the ranges and ground profiles were obtained along each range during February

1952. An index map showing the location of the sediment ranges is presented as Plate No. 5-4. A resurvey of all the sediment ranges was completed in 1965 with the mean date of resurvey to be 15 May 1965. The 1952 and the 1965 bottom profiles are shown on the same Plate No. 5-5. The computed sediment was assumed to have been deposited between 2 February 1952 and 15 May 1965. Using 176 acre-feet of accumulated sediment during the 13.3 year period, an average annual deposit of 13.2 acre-feet is computed. This is equal to 0.42 acre-feet of sediment per year for each square mile of drainage area above the flood control pool.

The second resurvey of seven selected sediment ranges at Tom Jenkins Lake was made in August 1975 with a mean survey date of 20 August 1975. The original, the 1965, and the 1975 bottom profiles are all shown on the same Plate No. 5-5. The computed sediment was assumed to have been deposited between 2 February 1952 and 15 May 1975. Using 247 acre-feet of accumulated sediment during the 23.6 years period, an average annual deposit of 10.5 acre-feet is computed. This is equal to 0.34 acre-feet of sediment per year for each square mile of drainage area above the flood control pool.

The third resurvey of eighteen selected sediment ranges was completed in October 1980 with the mean date of resurvey to be 15 October 1980. The sediment was assumed to have been deposited between 2 February 1952 and 15 October 1980. A visual inspection of the lake area was made on 12-13 August 1980 and no significant sedimentation problems were observed.

The fourth resurvey of thirteen selected sediment ranges at Burr Oak Lake was made in August 1984 with a mean survey date of 20 August 1984. Water depth was determined by the use of a fathometer but horizontal control was not maintained. The sediment was assumed to have been deposited between 2 February 1952 and 20 August 1984. Based on a visual inspection of the lake area made in August 1984 no significant or excessive sedimentation problems were observed.

Since the current rate of sedimentation at Tom Jenkins (Burr Oak) Lake did not appear to be detrimental to the effective operation and management of the project for authorized purposes at that time, it was recommended that the next sedimentation survey be of reconnaissance scope.

b. Stream. Sedimentation in East Branch of Sunday Creek within the area inundated by the conservation pool was analyzed as part of the 1984 sedimentation reconnaissance study.

5-05 COMMUNICATION NETWORK

The district communication network has many features. A high quality radio has been installed at the District Office, the Project Office, construction field offices, and navigation lock and dam installations. These installations also have commercial telephone service with computer modems for the District Intranet System. Data collection DCPs are installed at several stream gaging stations and precipitation stations in and near the Hocking River - Sunday Creek Basin. The DCPs transmit data (several readings over a period of hours) via the Gestationary Environmental Satellite (GOES) to a computer downlink that is linked by leased line to the Water Resources Engineering Branch WCS. As outlined in Table 5-1, voice DCPs have been added to several stream gaging stations. Plate No. 5-6 illustrates the manual radio communications network throughout the Hocking River-Sunday Creek Basin.

5-06 COMMUNICATION WITH PROJECTS

The telephone is utilized for normal communications by the Water Control Section, Scioto Area Office, and project personnel. Many of the reports are given by telephone with a computer modem utilizing the District Intranet System. District communications with individual projects normally occur through the Project Office. District radio is used for emergency backup communications; standard procedures require radios to be turned on at all times during working hours. During military emergency or national disaster, protected commercial telephone lines with the Scioto and Hocking River Basin

projects or special radio frequencies may be assigned by the Emergency Operations Manager. The District radio communication network is shown on Plate No. 5-7. Mobile radio, State Police, couriers, or other available means are utilized during an emergency when neither the telephone nor district radio is operational. The U.S. Postal Service is utilized for letters, reports, or other voluminous information, pictorial material, confirmation of Special Directives and other formal communication. Occasional visits to the projects afford an opportunity for office and project personnel to discuss ideas, problems, new procedures, etc.

5-07 COMMUNICATION WITH OTHERS

a. District Staff. Major flood conditions may require daily or more frequent briefings for key staff members. During floods or other disasters when the Emergency Operations Center is in operation, Water Resources Engineering Branch personnel distribute copies of all reports received for critical and adjoining areas to the Center, District Engineer, Chief Engineer, and Executive Officer. Storm analysis, critical situation information and operational data are provided to pertinent key staff as determined to be informational or necessary. The Public Affairs Office is kept advised to ensure proper public notification.

b. Emergency Management Division. The Water Resources Engineering Branch has no regular communication with Emergency Management Division (EMD) except as mentioned above when the Emergency Operations Center is in operation. When storms occur in the district or high precipitation is shown on a NWS Quantitative Precipitation Forecast, the Water Resources Engineering Branch telephones EMD to pass on the information. Frequently EMD personnel will visit the Water Resources Engineering Branch in person for further briefing. When EMD personnel learn of storms in or heading for the district, they visit the Water Resources Engineering Branch for evaluation and determination of impact. During these meetings, participants view Quantitative Precipitation Forecasts, other NWS forecasts and current information, District Isohyetal (precipitation) Maps, morning reports, etc.

c. Great Lakes and Ohio River Division Water Management Branch. Telephone land lines and the U.S. Postal Service carry all normal communications between the Water Resources Engineering Branch and the Water Management Division (WMD). Radio is used as backup in emergency situations. When desired, pictorial, handwritten or printed material can be transmitted in a matter of minutes over land lines by facsimile machine. A file containing observed data, 3-day forecasts of lake and outflow for all reservoir projects and 5-day flow forecasts for Ohio River tributary gage points is generated by the water control system. Subsequent to final modeling and certification, the file is transmitted to WMD by leased line. The Water Resources Engineering Branch briefs WMD personnel who call three times weekly, normally Monday, Wednesday and Friday, for updates on any and all special operations in the district. A Report of Deviation, revised Form 1018R, may be requested by WMD on the occasion of a special purpose operation at Tom Jenkins Dam outside the approved plan of regulation.

d. National Weather Service. Communication with the National Weather Service (NWS) begins with cooperative arrangements for the ORN program discussed earlier in sub-section 5-02b(1). Precipitation amounts are reported by telephone to the project and are included in the morning reports to the District water control system and the NWS in Charleston, WV.

The Division Office currently has a direct link with the NWS Automated Field Operating System (AFOS) and disseminates data from AFOS to the District water control system at least once an hour. Information formerly received from the NWS Weather Wire is also now received via the AFOS link in the Division Office.

e. U.S. Geological Survey. Communication between Water Resources Engineering Branch and U.S. Geological Survey (USGS) is varied and affected by the meshing of interests of the two entities. A large portion of the communication surrounds the stream Ohio Office of Disaster Services during an emergency. The Water Quality Section of Water Resources Engineering Branch

coordinates with SAO and HRCD in a cooperative summer water testing program at the project. The Water Quality Section also maintains contact, during the period of lake stratification, with the personnel of the Ohio Department of Natural Resources. The Water Quality Section of the Water Resources Engineering Branch also coordinates with The Hocking River Conservancy District in a cooperative summer testing program at all of the lake projects including Tom Jenkins. If a potentially or currently serious situation develops, the Water Quality Section Chief should meet with his personnel to discuss solutions to the situation. If necessary the Water Quality Section chief may begin a special study to determine the cause and/or remedy. Any time an unusual water quality situation occurs, an investigation is made into causes and ramifications to the extent warranted by the situation and the availability of manpower.

Tom Jenkins dam personnel coordinate, in person and by telephone, with Ohio Department of Natural Resources personnel concerning the forest fire protection agreement with the Forestry Division, stocking of the lake and tailwaters, enforcement of fish and game licensing, and boating safety. Project personnel cooperate with the State Health Department by sampling all drinking water for biological safety factors, mailing samples to Columbus for analysis, and receiving test results. A large portion of the communication surrounds the stream cooperative program discussed in sub-section 5-02a(1) and involves telephone discussions and mailed information on gage location, ratings, and rating extensions. Telephone requests are made by the Water Resources Engineering Branch for the USGS to repair a gage critical to regulation of a reservoir in flood condition. Annual meetings between USGS personnel and Water Resources Engineering Branch personnel are held at convenient times and locations to discuss the cooperative program.

f. State and Local Agencies. Communication with the Hocking River Conservancy District (HRCD) is normally coordinated through the Scioto Area Office (SAO). Typical communications with HRCD relate to coordination of special regulation requests and the cooperative water quality program at the Hocking River Basin projects. Communication with the Ohio Department of Natural Resources (ODNR) normally is coordinated through the ODNR Corps Liaison Office. Typical communications relate to requests for special releases from the projects or actions that affect fish and wildlife at the projects. The Water Resources Engineering Branch coordinates directly with the Ohio Department of Natural Resources' representative by mail. The State Highway Department coordinates details of road maintenance with the project office by telephone and in person.

County offices with which project personnel communicate are the Sheriff's and Health Department, the first in conjunction with patrolling and law enforcement contact, and the second concerning periodic inspection of the Marina in compliance with provisions of the Corps of Engineers lease.

g. General Public and Commercial Interests. The Water Resources Engineering Branch receives telephone calls from the general public about Burr Oak Lake, generally about fishing information and release of flows.

The project office answers many calls on such subjects as water surface area, maximum and average depth, extent of lake shoreline, swimming conditions, water clarity, and fishing success. Many others concern locations of picnic and other recreational areas, and downstream flooding potential. Neither the project or the District Office receives very many calls from commercial interests, except that the project does advise the Marina operator, Wayne National Forest, and the Burr Oak State Park of probable height of a flood rise and timing of impending outflow releases. There are no commercial interests immediately downstream from the dam on Sunday Creek that are vulnerable to flooding at discharge rates up to channel capacity. However, in order to advise recreators below the dam of impending increases in outflow, a discharge warning horn is sounded at the outlet works whenever the sluice gate opening is to be suddenly increased.

SECTION VI - HYDROLOGIC FORECASTS

6-01 GENERAL

Hydrologic forecasts of stream flows above and below Tom Jenkins (Burr Oak) Lake are vitally important to Water Control Management. The Water Resources Engineering Branch utilizes all available hydrologic and meteorologic data and the best methods available in preparing stream flow forecasts for the Sunday Creek and Hocking River Basin under low flow, normal flow and flood flow conditions for optimal project management.

a. Corps of Engineers.

(1) District Office. In accordance with ORDR 1110-2-27, dated 12 January 1976, Subject: Water Control Management Activities, the Water Resources Engineering Branch performs water control management activities for multi-purpose projects throughout Huntington District. These activities include the preparation of forecasts for lake inflows, lake levels, project outflows, water quality, outflow temperature, and flows at downstream stations to ensure the safe and efficient operation of the district projects. River forecasts prepared by the Corps of Engineers are generally used internally, and are not normally issued to the general public unless the National Weather Service is willing to make the release or agrees to such a release.

(2) Division Office. The Water Management Branch at the Great Lakes and Ohio River Division Office utilizes the 5-day tributary forecasts prepared by the individual districts to derive its own 5-day flow forecasts for stations along the Ohio River.

b. National Weather Service and Other Agencies. The National Weather Service (NWS) has the official responsibility for preparing forecasts of Ohio River and tributary stages and flows, and for transmitting data, forecasts, watches, and warnings to users and the general public. NWS also collects and evaluates weather data from a variety of sources to prepare short and long-term weather forecasts.

6-02 FLOOD CONDITION FORECASTS.

a. Requirements. The special requirement for flood forecasting is that the forecast be both accurate, usable, and timely. A breakdown or error in any of these areas can lead to a serious mis-operation of one or more reservoirs. The most effective method of forecasting has been to have accurate data for the storm and stream basin and to process or develop the forecast quickly, in order that it may be disseminated and used well before the flood or reservoir crests. A late or inaccurate, or even illegible forecast can often create a very bad or impossible situation for many people.

b. Methods. In order to achieve the most efficient water control management possible, a real-time computer model, developed for the Water Resources Engineering Branch by the Hydrologic Engineering Center (HEC) at Davis, California, was adapted and calibrated for use in management of the Hocking River - Sunday Creek Basin. The model, a major part of the District Water Control system, primarily uses real-time data from the Corps of Engineers' satellite-platform network in and adjacent to the basin, along with existing data bases. The model forecasts both reservoir inflow and releases and provides project operation based on downstream constraints. In addition to reservoir conditions, the model forecasts streamflows for all downstream control stations under both natural and regulated conditions. Currently, the model is being utilized for flow forecasts and will be expanded later to include water quality and temperature operations and forecasts. Numerous graphs of computerized data are produced by the Water Control Section. Plate

No. 6-1 shows the forecast area and reaches. Plate No. 6-2 shows the adopted unit hydrographs for the forecast areas, and Plate No. 6-3 shows the flow distribution for small increments of rainfall for the various forecast areas. Plate No. 6-4 is a manual forecast chart that may be used for the Hocking Basin if the computer fails. All of this data is now stored with the computer.

A typical sequence of events leading to water control management decisions is described as follows:

l. Satellite data, both stage and precipitation, are received from the LRD downlink, decoded and added to the resident data base. This is done automatically each hour.

2. Observed precipitation and stage data are reviewed graphically to insure integrity. Any necessary corrections are made and any missing data are added when available from supplementary sources.

3. The precipitation runoff model is executed based on observed data up to the time of forecast. If precipitation is occurring at the time of forecast then future precipitation is considered in the model execution. If necessary, the model base conditions are adjusted and the model is reexecuted to insure that observed conditions and time-of-forecast conditions in the model agree.

4. The operations model is then executed to obtain suggested project outflows and the downstream results of the suggested outflows.

5. Steps 3 and 4 are repeated to obtain subsequent forecasts that consider any additional precipitation (QPF), special regulation or other hypothetical analyses that may be required.

6. Forecast results are reviewed graphically using the display module of the water control system, after which water control decisions are made and key forecasts are saved in the data base.

6-03 CONSERVATION FORECASTS.

a. Requirements. The requirement for conservation forecasting is that the forecast be both accurate, usable, and timely. A breakdown or error in any of these areas can lead to a serious water crisis for one or more basins. The most effective method of forecasting has been to have accurate data for the area and stream basin and to process or develop the forecast quickly, in order that it may be disseminated and used well before the flood or reservoir crests. A late or inaccurate, or even illegible forecast can often create a very bad or impossible situation for many people. Low-flow conservation forecasts are usually for a longer period than flood forecasts and often are produced with a longer period of lead time. The amount of anguish from a unusable or misleading low-flow forecast can be the same as the anguish from a poor flood forecast.

b. Methods. In order to achieve the most efficient water control management possible, the same real-time computer model, developed for Water Resources Engineering Branch by the Hydrologic Engineering Center (HEC) was adapted and calibrated for use in conservation forecasting of the Hocking River - Sunday Creek Basin. The model, a major part of the District water control system, primarily uses real-time data from the Corps of Engineers' satellite-platform network in and adjacent to the basin, along with existing data bases. The model forecasts both reservoir inflow and releases and provides project operation based on downstream constraints. In addition to reservoir conditions, the model forecasts streamflows for all downstream control stations under both natural and regulated conditions. Currently, the model is being utilized for flood and conservation forecasts and will be expanded later to include water quality and forecasts.

A typical sequence of events leading to water control management decisions is the same as for a flood forecast:

l. Satellite data, both stage and precipitation, are received from the LRD downlink, decoded and added to the resident data base. This is done automatically each hour.

2. Observed precipitation and stage data are reviewed graphically to insure integrity. Any necessary corrections are made and any missing data are added when available from supplementary sources.

3. The precipitation runoff model is executed based on observed data up to the time of forecast. If precipitation is occurring at the time of forecast then future precipitation is considered in the model execution. If necessary, the model base conditions are adjusted and the model is reexecuted to insure that observed conditions and time-of-forecast conditions in the model agree.

4. The operations model is then executed to obtain suggested project outflows and the downstream results of the suggested outflows.

5. Steps 3 and 4 are repeated to obtain subsequent forecasts that consider any additional precipitation (QPF), special regulation or other hypothetical analyses that may be required.

6. Forecast results are reviewed graphically using the display module of the water control system, after which water control decisions are made and key forecasts are saved in the data base.

6-04 LONG RANGE FORECASTING.

a. Requirements. Long-range forecasts assist the Huntington District in water control management in the Hocking River Basin. A long-range forecast of a dry spring can allow earlier than normal warning to sporting clubs and fishing groups concerning the beginning of the recreational season. Plate No. 6-1 shows the forecast areas, and Plate No. 6-3 is a flow distribution Chart to be used during a drought. Since the conservation pool at Burr Oak Lake is regulated by the lake s1taff, if a drought is projected for summer, the summer minimum release may be slightly reduced where possible, to store some additional water for later release downstream. The additional storage and the later releases can supplement low flows in tributaries or downstream in the Ohio River, where abnormally low flow can cut off shipping. Knowledge of an impending drought in the fall could lead to early winter warning for downstream users.

The long-range forecasts are transmitted to the Division Headquarters Water Management Branch (WMB) allows the Division to inform the Mississippi Valley Division (MVD) of probable future conditions and to suggest specific items of water control management to the districts. MVD receives a 30-day forecast of flows to assist them in the scheduling of dredging in the Lower Mississippi River.

The 30-day forecast is produced utilizing flow data for the last available full month, and a computer program projects the flow in the river for one month in advance. For longer range forecasts, WMB utilizes a partial probability method made up of historic average monthly flows in the river and a computer program which projects probable future flows.

b. Methods. The Water Management Branch produces the 30-day forecasts requested by the Mississippi Valley Division by consulting the record of long-term average flows at various stations on the Ohio River and the latest Average Monthly Outlook for a 60 percent probability of precipitation being higher or

lower than normal. The method assumes that normal precipitation produced the long-term average flows in the river, and that variations from the normal precipitation will produce corresponding variations in stream flow.
When districts request longer term forecasts, WMB utilizes flow data for the last available full month, and a computer program projects the flow in the river for one month and two months in advance. For 10-day forecasts, WMB utilizes the regular 5-day forecast and extends it through the use of long-term normals.

6-05 DROUGHT FORECASTING.

a. Requirements. Drought forecasts also assist the Huntington District in water control management in the Hocking River Basin. Plate No. 6-1 shows the forecast area and reaches. A long-range drought forecast of a dry spring can allow earlier than normal warning to sporting clubs and fishing groups concerning the beginning of the recreational season. If a drought is projected for summer, the summer conservation release may be slightly reduced when possible to store some additional water for later release downstream, if not injurious to other project purposes. Since the conservation pool at Burr Oak Lake is regulated by the lake staff, a small amount of additional storage can be maintained there. Where this additional storage is possible, the later releases can supplement low flows in tributaries or downstream in the Ohio River, where abnormally low flow can cut off shipping. Knowledge of an impending drought in the fall could lead to early winter warning for downstream users.

The long-range forecasts to the Division Headquarters Water Management Branch (WMB) allows the Division to inform the Mississippi Valley Division (MVD) of probable future conditions and to suggest specific items of water control management to the districts. MVD receives a 30 day forecast of flows to assist them in the scheduling of dredging in the Lower Mississippi River.

The 30-day forecast is produced utilizing flow data for the last available full month, and a computer program projects the flow in the river for one month in advance. For longer range forecasts, WMB utilizes a partial probability method made up of historic average monthly flows in the river and a computer program which projects probable future flows.

b. Methods. The Water Control Section produces 30-day forecast each week as requested by the Mississippi Valley Division by consulting the record of long-term average flows at various stations on the Ohio River and the latest Average Monthly Outlook for a 60 percent probability of precipitation being higher or lower than normal. The method assumes that normal precipitation produced the long-term average flows in the river, and that variations from the normal precipitation will produce corresponding variations in stream flow.

When districts request longer term forecasts, WMB utilizes flow data for the last available full month, and a computer program projects the flow in the river for one month and two months in advance. For 10-day forecasts, WMB utilizes the regular 5-day forecast and extends it through the use of long-term normals

c. Reference Documents. Many of the basic documents for drought forecast are in the Corps of Engineers Library, Huntington District, Huntington, WV. This library contains records prepared by the Ohio Department of Natural Resources and the Ohio USGS for past drought periods, the Water Inventory of The Hocking Basin, Water Availability Studies for the Muskingum Basin, and the Ohio River Basin Comprehensive Study, prepared by the Great Lakes and Ohio River Division, Cincinnati, OH. Also included are the national and state weekly drought forecasts and Palmer Index summaries for the current and preceding drought period.

SECTION VII - WATER CONTROL PLAN

7-01 GENERAL OBJECTIVES

In accordance with ER 1110-2-8156, “Preparation of Water Control Manuals”, dated 31 August 1995, with ER 1110-2-240, “Water Control Management”, dated 8 October 1982, and ORDR 1110-2-27, "Water Control Management Activities", dated 12 January 1976, the plan of water control management and regulation reflects optimal consideration of the primary project purpose, namely flood control. In developing the plan of regulation, the following general requirements were considered and evaluated in preparing an overall effective water control plan for the Tom Jenkins Project:

1. Prevention or reduction of serious damages to the downstream communities of Glouster, Trimble, Chauncey, and Athens along Sunday Creek and Hocking River.

2. Reduction of agricultural losses from minor floods on Sunday Creek to the greatest extent consistent with the safe operation of the reservoir.

3. Through the use of sluice gates, maintenance of a year round water supply pool elevation 721.0 feet NGVD for general conservation and recreational purposes, subject to flood control during MIANO (Mid-April through November) and DEMIA (November to Mid-April).

4. Maintenance of a minimum flow in East Branch of Sunday Creek to prevent stagnation (normally 2 cfs) in the stream immediately below the dam.

5. Maintenance of a designated year round minimum pool of elevation 710 NGVD in accordance with an annual proposal by the Corps of Engineers, for conservation, siltation reserve and provision of minimum discharge. This pool is used in conjunction with the water supply pool.

7-02 FLOOD CONTROL

Tom Jenkins Dam on East Branch of Sunday Creek controls nearly all of the East Branch of Sunday Creek Basin and approximately 24% of the total Sunday Creek Basin. Close coordination of all of the Scioto, Muskingum, and Hocking River projects can adequately control Ohio River runoff during most major floods.

a. Requirements. Summer thunderstorms containing heavy rainfall over a short period of time can be destructive and produce areas of localized flooding. Because thunderstorms often affect only localized areas, it may be necessary to operate only individual reservoirs for flood control during these types of storms. Winter or spring-type storms can occur when soil, vegetation or snowcover conditions provide a high percentage or volume of runoff. These storms often cover more extensive areas and produce more generalized flooding conditions in the basin. These types of storms generally require operating several reservoirs in different basins for flood control.

(1) East Branch Sunday Creek Control. Tom Jenkins Dam is located approximately 0.3 miles above the mouth of East Branch of Sunday Creek, and controls 32.8 square miles, or nearly all of the total East Branch of Sunday Creek Basin. For the reach below Tom Jenkins Dam, the no damage stage is attained during the MIANO period (Mid-April through November) at a stage of 687 feet on the Burr Oak “A” gage and during the DEMIA period (December to Mid-April) at a stage of 688 feet on the Burr Oak “A” outflow gage, located about 0.6 mile downstream on the left descending bank of Sunday Creek. These stages at the Burr Oak “A” outflow gage have been selected as control stages for Tom Jenkins Dam. A special directive from the Water Control Section is required to release water at this level. The observed no damage channel capacity below the dam is somewhat higher than these previously designated levels, however, the

previously designated control stages will be followed. The observed no damage level for Sunday Creek has been recorded at about 900 cfs during the winter DEMIA, however, it will require a special directive from the Water Control Section to operate at this level.

At times it may be advantageous to regulate Tom Jenkins Dam by a comparison of available flood control storage at a given time. Percent storage utilization for Burr Oak Lake is now developed by the Water Control Section computer.

(2) Control of Sunday Creek. Sunday Creek is controlled through the optimal utilization of storage capacity at Burr Oak Lake. Outflow from this lake is normally regulated to maintain no-damage stages at control gages on Sunday Creek at the Burr Oak "A" gage and Sunday Creek at Glouster, Ohio.

(3) Major Flood. The taking line for acquisition of lands within the Tom Jenkins project area is at spillway elevation plus 10 feet or 750 NGVD. Through detailed investigations of potential flooding damages to unacquired property above the spillway elevation in the lake area, it has been determined that damage to these properties which would result from the use of surcharge storage would be more than compensated for by the reduction in flood damages along Sunday Creek and Hocking and Ohio Rivers. As a result there is no plan to limit surcharge operation of the reservoir to elevation 750 NGVD; the full 20 feet of surcharge storage may be used.

b. Normal Plan. The major features of the regulation plan adopted for Tom Jenkins Dam appear in the succeeding paragraphs.

(1) Regulation of Lake Level. Subject to flood control and low flow requirements, outflow will be regulated by the Damtender by operation of one sluice gate as necessary, to maintain the lake level at elevation 721 feet NGVD subject to regulation by the Water Control Section. The pool level is closely followed and adjusted by Special Directives issued by the Water Control Section to the project. During a local heavy storm the Damtender has both the authority and responsibility, in the event of an emergency, to close the gates to control damaging downstream flood conditions. This action must be reported to the District Office immediately.

(2) Major Flood. Normal regulation for East Branch Sunday Creek, Sunday Creek, and the Hocking River will be followed unless otherwise directed by the Water Control Section. If reservoir inflow is sufficient at Burr Oak Lake to exceed the spillway level, the reservoir will normally be regulated to minimize total dollar damages in the lake area and also downstream of the dam. Regulation will also be sensitive to temporary local concerns, potential loss of life, or damages to the project, which may override dollar values.

Following the utilization of the reservoir for flood control, it is desirable to empty the reservoir of flood storage as quickly as possible, considering any special operations, in view of the possibility of a major flood occurring at a time when the reservoir is partly filled. The reservoir storage will be released in such a manner that it will not add to any downstream control stages.

The original operations plan for Tom Jenkins Dan was compiled using several key graphs and charts. The area and capacity data are given in Plate No. 7-1, and the corresponding area capacity curves are shown on Plate No. 7-2. Sluice Gate rating curves and the spillway discharge rating curve are shown on Plate Nos. 7-3 and 7-4, respectively. The Burr Oak "A" gage rating curve is on Plate No. 7-5. Also, the rating curves for Glouster, Enterprise, and Athens are shown as Plate Nos. 7-6, 7-7, and 7-8, respectively. The Net Storage Curve for Burr Oak lake is shown as Plate No. 7-9, the Tailwater Rating Curve is Plate No. 7-10.

c. Emergency Plan. In the event that all communication is disrupted either between the Huntington District Office and or the Scioto Area Office and the Tom Jenkins Dam Project Office, the Scioto Area Office Manager will assume

responsibility for regulation if communication exists between the Area and Project Offices. Otherwise, the Damtender will assume regulation of the dam, as directed in Section I of "Instructions to Damtender", Tom Jenkins Dam, which appears in Exhibit B, to this manual. Project personnel will operate the reservoir in accordance with operating instructions given in Exhibit B. For a major flood where both Sunday Creek at Glouster, the "A" gage, and the flood control pool are sharply rising all excess inflow is stored. As the flood control pool approaches or reaches spillway crest elevation 740.0 feet NGVD, these instructions direct project personnel to open the sluice gates as necessary up to seasonal channel capacity to prevent or reduce the pool rise. If the pool continues to rise above elevation 740 feet NGVD during DEMIA or MIANO in spite of the channel capacity gate discharge, the instructions direct project personnel to utilize additional gate discharge up to full gate capacity as necessary to prevent or reduce further pool rise. When the pool has crested above elevation 740.0 feet NGVD during DEMIA or MIANO, receded, and the pool elevation has receded to elevation 740 feet NGVD, gate openings are gradually closed and the pool is maintained at that elevation until communications are restored with the District Office or Area Office.

7-03 OVERALL PLAN FOR WATER CONTROL

a. Requirements. Fish and food chain organisms require a continuous flow of oxygenated water for maintenance of normal vitality. Studies have shown that the natural flows are usually sufficient downstream from Tom Jenkins Dam for the maintenance of fishery habitat. Therefore a minimum discharge of 2.0 cfs is deemed sufficient as an aid to the natural flows in habitat maintenance, and beneficial under dry conditions when natural flows are diminished.

b. Control Plan. Normal control of minor storms and slight pool fluctuations are accomplished by manipulating one sluice gate in the inlet works at Tom Jenkins Dam. These sluice gates have a hand crank feature that allows all or nearly all water to be stored. This hand crank adjustment process is necessary only at times of an extreme drought.

7-04 STANDING INSTRUCTIONS TO DAMTENDER

The Tom Jenkins Damtender and staff operate the project in accordance with general instructions and special directives issued by the Water Control Section, and relayed to Burr Oak Lake project personnel.

a. Regulations. The above mentioned general instructions and special directives are written in accordance with regulations listed under Section 1-03 of this manual, Operating and Regulating Responsibility.

b. General Instructions. General instructions provide for routine reservoir regulation including the discharge limits, details of gate operation technique, collection and transmission of hydrologic and streamflow data, reservoir regulation at the start of a flood before contact can be made with the District Office, and emergency regulation in the event all communications fail during a flood. These instructions are contained in Exhibit B, "Instructions to Damtender". These instructions also establish the minimum number of observations to be made and are designed to insure that any necessary gate operations will be promptly executed and that special reports will be initiated by the Damtender before reservoir and stream conditions reach critical proportions. The general instructions apply at all times except when instructed by Special Directives, which will be applicable for a specific operation or period of time. If work is required after normal duty hours for the collection and transmission of hydrologic data, and for the execution of necessary gate operations, overtime will be approved by proper authority.

c. Special Directives. Special Directives are issued by the Water

Control Section to the project office for the Damtender's use. These directives are issued by telephone and confirmed by mail, and pertain to water control activities not covered by the general instructions. Special Directives are applicable for a specific operation or period of time and override the general instructions to the Damtender. The following is a list of typical occurrences which could call for the issuance of a Special Directive:

(1) Flood control

(a) Outflow reduction for Sunday Creek or the Hocking River Basin streams or Ohio River control.

(b) Release of flood storage and adjustments in rate of release.

(c) Above channel capacity discharge when inflow hydrograph is greater than available storage capacity.

(2) Special regulation for:

(a) Construction activities downstream affected by flow.

(b) Stream clean-up program.

(c) Emergency-Drowning or pollutant spill.

(d) Complete closure for inspection on emergency or periodic basis.

(3) Change in general instructions.

(4) Any and all other pertinent operations as deemed necessary by Water Resources Engineering Branch

7-05 RECREATION

a. Lake.

(1) Requirements. Recreational activities at Burr Oak Lake generally begin with fishing in April and continue through November. The peak fishing seasons for bass, crappies and walleye are spring and fall. Fishing for bluegill and catfish is most successful during the summer months. Burr Oak State park and Hocking River Conservancy District lands are open to State hunting and trapping seasons that fall between Labor Day and Memorial Day.

It is usually advantageous to maintain a constant pool level for recreational purposes. Noticeable variations in pool level can cause concern to visitors if they are not aware of the cause. Changing water levels affect boating safety by changing the normal view of the lake. Disorientation may occur to boaters or fishermen who are not familiar with the lake under variable pool level conditions. This is especially true at Burr Oak Lake, which has a long shoreline and numerous tributary streams. Higher pool levels after rainfalls can increase chances of boaters hitting newly inundated obstructions, or grounding themselves in shallow bay areas. Higher lake levels also cause difficulties in launching and retrieving boats. Lower lake levels bring submerged obstructions closer to the surface, creating possible snagging problems for fishermen.

(2) Control Plan. The water control plan at Tom Jenkins Dam attempts to maintain the pool level at or near water supply elevation 721 feet NGVD during all months of the year. Under normal conditions, this is accomplished by the action of the sluice gates in the inlet works. The manipulating of the sluice gates prevent unnecessary build-up of water level

under normal flow or minor storm conditions. At times, however, heavy runoff may require utilization of available flood storage at Burr Oak Lake, causing a rise in the lake level. Part of the plan of regulation includes forecasts of lake level and outflow rates.

b. Downstream.

(l) Requirements. Project personnel must maintain an awareness of downstream usage of Sunday Creek for both recreation and other purposes since safety of these interests is of prime importance to lake regulation. Any interest accustomed to using the stream at low water should be notified of impending high discharges.

(2) Control Plan. In order to be aware of downstream activities, project personnel make occasional surveys, during both low water and high water, to observe potentially hazardous situations. In the interest of downstream safety of life and property and integrity of stream banks, the water control plan limits the rate of increase or decrease of discharge in Sunday Creek at the outflow gage to no more than 1.0 foot per hour on the "A" gage, except during an emergency. If a spillway flood should occur, project personnel would evacuate downstream areas and remove any equipment which could be damaged by high discharge.

7-06 FLOOD CONTROL

a. Requirements.

(1) Lake. In accordance with State Code and the legal agreements with the Federal Government, the Ohio Department of Natural Resources has the responsibility for conservation of fish and wildlife at Burr Oak Lake. Conservation requirements in the lake are met by various features of the Department management program which includes stocking the lake, monitoring populations, general chemical water quality analyses, and administering licensing regulations for sport fishermen.

Fish and wildlife at Burr Oak Lake are affected by fluctuating lake levels. A stable or rising pool is required for fish spawning. Rises in pool level can affect ground nesting animals living near the pool. Drawdowns affect waterfowl and furbearing animals through elimination of shallow area feeding grounds. Drawdowns also affect hunters, especially during duck season, when shallow marsh areas are drained. Dry weather drawdowns expose muddy lake sides, and boat waves can then produce turbid water conditions an appreciable distance from the bank. This is the fertile littoral area into which fishermen cast. Fishing success suffers under such conditions because the lures are not easily visible.

(2) Downstream. Habitat maintenance, including a continuous flow of clean water at proper temperature, constitutes the conservation needs of the downstream aquatic community as to reservoir outflow. Lower food chain members which live on the bottom are dependent on clean rocks, gravel and sand for normal habitat. Silt and iron hydroxide, particularly under summer low flow conditions, can coat this habitat making it unsuitable. This suppresses that basic portion of the food chain and depresses populations of higher members until the habitat is improved, as by flushing, and populations of lower members reestablished. Water in lower zones of the lake, subject to reducing conditions common during stratification, contains iron which is soluble in the reduced state. When this water is released and aerated in the stilling basin, the iron is changed to insoluble oxide by oxidation and hydrolyzed to the hydroxide mentioned above.

b. Control Plan. As explained in subparagraph 7-05 a(1), the normal mode of regulation for both recreation and flood control, with the guiding principle of conserving storage capacity for possible early flood control needs, fosters a stable pool; however, downstream flooding may require gate

closure and consequent pool rise.

Water Resources Engineering Branch should attempt to be flexible in pool raising on behalf of fish spawning. When the Ohio Department of Natural Resources requests maintenance of a special pool level during a spawn, the Water Resources Engineering Branch normally will honor the request if it does not interfere with other project purposes. A minimum discharge of 2.0 cfs is maintained for the benefit of fish and water conservation downstream of Tom Jenkins Dam.

7-07 WATER QUALITY

Tom Jenkins Dam was built in 1950 on East Branch of Sunday Creek, a tributary of Hocking River, to form Burr Oak Lake. The lake has a drainage area of 32.8 square miles with a backwater pool for 7.8 miles at a water supply pool elevation of 721.0 feet (NGVD). The spillway is located at elevation 740 feet NGVD. Lake waters are released from the bottom of the intake structure through three gated sluices discharging to a horseshoe-shaped tunnel. Streambed elevation at the dam at the time of construction was 682 feet above sea level. Streambed elevation at the dam in 1989 was 688 feet above sea level (water quality profile data).

The project was designed for flood control, general recreation, water supply, and fish and wildlife enhancement. The outlet structure was not designed with maintenance or improvement of water quality as one of its purposes, therefore the quality of release water can not be regulated

7-08 SPECIAL PURPOSE REGULATION

a. Types. Either an increase or decrease in outflow may be requested by the public or by other governmental agencies, including state and local, or by higher authority within the Corps of Engineers. Two events which require special purpose regulation at Tom Jenkins Dam are periodic inspections of the dam and repairs to the dam or appurtenant structures.

b. Requirements. The state of Ohio has full responsibility for the water surface management of Burr Oak Lake, however, all releases of water from Tom Jenkins Dam must be approved by Corps of Engineers. All requests for special purposes regulation are presented to HRCD and coordinated between HRCD, the Scioto River Area Office, the Water Control Section, ODNR and the Water Management Division. Water Resources Engineering Branch investigates existing conditions and potential flood threat as part of the process, and normally concurs with HRCD opinions of releases which do not violate channel capacity discharge or significantly increase flooding potential.

c. Plan. Under normal conditions, all agencies involved are careful not to authorize actions which would create adverse conditions. In the interest of maintaining good public relations, requests for minor deviation may be coordinated by telephone and granted provided there are only minor adverse effects to the overall projects. Requests for major deviations may require additional analysis, with cooperation between agencies occurring by letter, telephone, or interagency meetings.

7-09 MINIMUM AND SEASONAL STORAGE

a. Requirements. Burr Oak Lake is maintained at or near the permanent year round water supply pool level of 721 feet NGVD and is not drawn down during DEMIA. The benefits from this include increased year round water supply, allowing year round water access to shoreline areas, decreasing shore erosion, and adding pool surface to the reservoir. Other benefits are to provide a maximum of recreational year round benefits during the spring,

summer, and early fall. The water supply pool is normally maintained by the sluice gates in the outlet works subject to operation of the gates for flood control.

b. Plan. The specified year round pool elevation and emergency drawdown schedules, however, are subject to change since they are directed by the Water Control Section through the Project Office.

7-10 DROUGHT CONTINGENCY PLAN

In accordance with ER 1110-2-1941, "Engineering and Design, Drought Contingency Plans," the drought contingency plan covering Burr Oak Lake is contained in Annex I of this manual.

7-11 MAJOR CONSTRAINTS

Constraints to regulation of the water control plan at Burr Oak Lake include interests both upstream and downstream of the dam which are affected by higher than normal pool elevations. Maximum allowable gage heights at the outflow gage restrict the total outflow that can be discharged from Tom Jenkins Dam during normal operations to protect farming interests downstream of Tom Jenkins Dam. Rising pool levels also affect recreation interests upstream and can inundate access roads within the flood pool. When the Burr Oak Lake pool level rises above elevation 723 NGVD and approaches elevation 728 NGVD, portions of the Burr Oak Marina, Burr Oak Lake Park bathing and camping areas, and the beach areas are inundated. Also portions of certain state feeder routes are cut off by the flood pool. As the flood pool rises, the proper authorities at both Wayne National Forest and Burr Oak State Park are notified of the impending high water levels.

7-12 FLOOD EMERGENCY ACTION PLAN

Notification of the public is carried out by the Scioto Area Office, the Readiness Branch, the Water Resources Engineering Branch, the National Weather Service and the District Public Affairs Office. These units utilize various types of mass media, telephone, radio, personal visitation, and the National Weather Service dissemination system depending on the type, urgency and target of the information. Information on planned additions or changes in lake regulation, such as for recreation or fishery enhancement, are disseminated by the Public Affairs Office from detailed statements by the Water Control Section. Daily reservoir and rainfall data are disseminated via computer terminal to the Weather Service by Project Office personnel. This information appears along with other weather and stage information provided by the Weather Service to mass media and county, state and Federal agencies.

Important public service messages of early significance concerning regulation of the lake for flood control are handled by the Public Affairs Office and disseminated via radio and/or television. Warnings of any unusual releases are transmitted downstream by project personnel in person and by telephone.

7-13 DEVIATIONS FROM NORMAL WATER CONTROL PLAN

a. Emergencies. Examples of some emergencies that can be expected to occur at a project are: drowning and other accidents, failure of the operation facilities, chemical spills, treatment plant failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Districts must inform their division office as soon as practicable. Prepare

written confirmation of the deviation and description of the cause and furnish it to the division water control manager. Divisions may develop forms to facilitate the reporting of emergency deviations.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. Construction accounts for the major portion of these incidents and typical examples include utility stream crossings, bridge work, and major construction contracts. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days. Each request is evaluated on its own merits. Consideration must be given to upstream watershed conditions, potential flood threat, condition of the lake, and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied with, providing there are no foreseen adverse effects on the overall regulation of the project (or projects) for the authorized purposes. Approval for minor deviations normally will be obtained from the Water Resources Engineering Branch Chief. Written confirmation explaining the deviation and its cause will be furnished to the division water control manager as soon as possible.

c. Planned Deviations. Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or telefacsimile to the division for review and approval.

SECTION VIII - RESULTS OF WATER CONTROL PLAN

8-01 GENERAL

The results of regulation for the authorized purposes of flood control, recreation and fish and wildlife enhancement at Burr Oak Lake are presented in the following paragraphs and referenced plates. Regulation for various hypothetical design floods and for representative actual floods demonstrate the capability of the project to control and pass runoff from the drainage basin. The same capability is described in probability terms by Plate No. 8-1, Frequency of Filling, and Plate No. 8-2, Flow Frequency below the dam at Glouster, Ohio. Plate No. 8-1 shows that the lake has been filled to elevation 731.5 feet NGVD only once since the flood control pool operation began, and based on studies at the time of design the pool would be filled to spillway level once in 190 years. Effects of the water control plan on recreation, fish, and wildlife are also presented in later paragraphs.

8-02 FLOOD CONTROL

Tom Jenkins Dam controls 32.8 square miles, or nearly all of the East Branch of Sunday Creek drainage basin. Tom Jenkins Dam controls approximately 24% of the Sunday Creek watershed area. The chief benefit of the dam is the reduction of flood heights at Glouster, Ohio. The secondary incidental benefits at all other downstream points on the Sunday Creek, Hocking, and Ohio Rivers. The application of the adopted water control plan to 2 hypothetical floods, 3 historical floods and 5 recent floods as they occurred are discussed in subsequent paragraphs.

a. Hypothetical Floods.

(1) Spillway Design Flood. During the time that Burr Oak Lake was planned and designed the present day criteria of a Spillway Design Flood had not been developed. The pre-World War II equivalent of a Spillway Design Flood was often called the Reservoir Design Flood. The Reservoir Design - Spillway Design Flood is the basis for determination of the spillway capacity required to provide safety of the dam during the most critical flood runoff over the basin. During the design of the project, estimates of this storm and flood were made in such a way that the reservoir would be filled to the spillway level, but not beyond, by the runoff from the maximum possible storm. The preliminary spillway design flood was adopted from the area depth curves for the Muskingum River Basin, Ohio, Spillway Design Storms, dated 24 September 1946. The curves were based on storms for Smethport, Pennsylvania of 17-18 July 1942 and the September 1878 storm at Jefferson, Ohio. Later the storm of 4-5 August 1943, in the Little Kanawha Basin was studied and combined with the previous Muskingum Document to create a final adopted spillway design storm and flood. The operation for this flood is shown on Plate No. 8-3. This early spillway design flood had an inflow crest of 53,700 cfs and was routed through the reservoir assuming both a full flood control pool at elevation 740 feet NGVD. The pool crest for this flood was elevation 760.0 feet NGVD, and adding five feet for freeboard gives a top of dam elevation of 765.0 feet NGVD.

Current Corps criteria specify that the Spillway Design Flood (SDF) be based on the runoff from the Probable Maximum Precipitation (PMP), as indicated first in Hydrometeorological Reports No. 33, which was later superseded by Hydrometeorlogical Bulletin No. 51 and 52. Probable Maximum Precipitation (PMP) is defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. Using current spillway design flood criteria based on HMR No. 33,the amended spillway design flood had an inflow crest of 77,500 cfs. The initial routing of this flood was on a water supply pool of 721.0 feet followed by a second routing on a full pool of 740 feet NGVD. The first routing produced a crest of 754.1 and the second routing had a crest of 759.9,

or a difference of 5.8 feet. These two routings are described in detail below, and indicate that the original, still existing spillway appears capable of safely passing this flood with appropriate freeboard to accommodate potential wind and wave conditions. The original Tom Jenkins Dam spillway appears to be near adequate as shown on Plate No. 8-4.

At the start of the flood with the pool at elevation 721 feet NGVD the reservoir would have been regulated to pass inflow and so as not to exceed the summer control stage elevation 687 feet NGVD at the Burr Oak "A" gage. By 0430 on the 1st day the stage at the "A" gage would have required the gates at Tom Jenkins Dam to be completely closed for Sunday Creek control. All inflow into Burr Oak Lake would have been stored until 1100 on the first day when the pool level would have reached the spillway crest and flow through the spillway would have begun. The reservoir pool would have reached a crest elevation 754.1 feet NGVD about 1930 hours on the first day with a maximum spillway discharge of 11,800 cfs. By 1900 on the 4th day the flow through the spillway would have receded sufficiently to permit the gates of Tom Jenkins Dam to be gradually opened to maintain the stage at the "A" gage at 687 feet until the pool receded to water supply pool elevation 721 feet NGVD.

At the start of the second flood with the pool at elevation 740 feet NGVD the reservoir would have been regulated to pass inflow so as not to exceed the summer control elevation 687 feet NGVD at the Burr Oak "A" gage. By 0430 on the 1st day the stage at the "A" gage would have required the gates at Tom Jenkins Dam to be completely closed for Sunday Creek control and flow through the spillway would have begun. The reservoir pool would have reached a crest elevation 759.9 feet NGVD about 1700 hours on the first day with a maximum spillway discharge of 21,500 cfs. By 0100 on the 5th day the flow through the spillway would have receded sufficiently to permit the gates of Tom Jenkins Dam to be gradually opened to maintain the stage at the "A" gage at 687 feet until the pool receded to water supply pool elevation 721 NGVD. This Spillway Design Flood operation is shown on Plate No. 8-4.

It is planned that after some of the more deficient projects are corrected for hydrologic deficiencies under the Dam Safety Assurance Program, Tom Jenkins Dam will be reviewed for further evaluation according to modern design criteria. Any possible remedial actions to correct any early spillway deficiency would come much later. Additional information will be provided when it becomes available, and after any remedial action is approved a new Spillway Design Flood, Current Criteria, will be issued showing inflow, outflow and pool elevation hydrographs.

(2) Standard Project Flood. Burr Oak Lake was planned and designed before the present day criteria of a Standard Project Flood had been developed. The pre-war equivalent of a Standard Project Flood was often called the Project Design Flood. The adequacy of the outlets for passing flood flows without overtopping the spillway crest was further investigated by their ability to contain the maximum flows resulting from the hypothetical flood called the Project Design Flood or later the Standard Project Flood. This theoretical flood would result from a storm probably in July or August designed to equal the worst combination of meteorologic and hydrologic conditions considered reasonably characteristic of the area. The areas most severe summer storm occurred at Newcomerstown, Ohio on 6 and 7 August 1935. The areas most severe winter storm was on the 22 to 26 March 1913 at Bellefontaine, Ohio. The 1913 storm had more volume, therefore it was selected and was recentered over the Burr Oak Basin as the standard project flood. A review of record storms indicated that most of the first inch of rainfall would filter into the earth crust and then a maximum infiltration rate of 0.05 inch per hour might be experienced and these values were adopted to determine the rainfall excess. The operation of Tom Jenkins Dam for the "1913-Standard Project Flood" is shown on Plate No. 8-5. At the start of the flood the reservoir would have been regulated so as not to exceed the winter control elevation 688 feet NGVD at the Burr Oak "A" gage until 0130 on the 2nd day when the heavy rainfall and rising river stages would have indicated that the control stages would have been

exceeded within a few hours. At this time, the gates at Tom Jenkins dam would have been closed. By the morning of the 5th day the stages at all of the control points in the Hocking River Basin would have permitted releases from the reservoir. However, the stage on the Ohio River at Lock and Dam No. 20 (now Belleville Lock and Dam) was 48 feet and forecasts would have indicated that a crest stage of about 61 feet would be expected in about the next 48 hours. In order to avoid increasing the crest stage on the Ohio River, the gates at Tom Jenkins Dam would have been kept closed. The pool level would have reached the spillway crest elevation 740 feet NGVD, and free flow through the spillway would have begun at 2200 on the 5th day. The reservoir pool would have reached a crest elevation of 740.1 feet NGVD at 1700 on the 6th day. By the morning of the 8th day the Ohio River at Lock and Dam No. 20 (now Belleville Lock and Dam) had crested and forecasts would have indicated a steady recession. The gate openings at Tom Jenkins Dam would have been gradually opened at the rate of no more than one foot per hour until the stage of 688.0 feet NGVD had been attained at the "A" gage and then the stage of 688.0 feet NGVD maintained until the pool had receded to the water supply pool level of elevation 721 feet NGVD. The computed flood crest reduction for Glouster was about 1.5 feet. The operation of Tom Jenkins Dam for this early Standard Project Flood, and the results at Glouster and Athens, are shown as Plate Nos. 8-5, 8-6, and 8-7, respectively. The same flood at old Lock No. 20, now Belleville Lock, is shown as Plate No. 8-8.

b. Representative Floods.

(1) General. The historical floods which were selected for illustration of the water control plan are the floods of March 1907, March 1913, and January 1937. Also selected were the floods of January 1959, March 1963, March 1964, May 1968, and February 1979 which illustrate floods actually regulated according to the water control plan. The flood of March 1907 and the flood of March 1913 were caused by widespread heavy rains which resulted in record stages along Sunday Creek and Hocking River. The flood of January 1937, which occurred while the nearby Muskingum River Basin reservoir system was under construction, stemmed from a series of severe storms and resulted in record stages along the Ohio River. The flood of January 1959 resulted from generalized rains with high runoff due to the saturated, frozen and snow-covered ground. The flood of March 1963 was caused by a very cold winter suddenly turning warm and a resulting heavy storm and huge runoff. The flood of March 1964 was caused by two storms about 5 days a part with the first setting the stage for the second. The flood of May 1968 was caused by a series of month long storms over Central Ohio that resulted in tremendous runoff and damage. The flood of February 1979 was caused by antecedent snowmelt and moderate rainfall falling on snow-covered and frozen ground.

(2) Storm and Flood of March 1907. Damaging floods prevailed on the Ohio River, Hocking River, and Sunday Creek during the middle 10 days of March 1907. Serious damage resulted on all the rivers and small streams in southern Ohio, but probably the greatest havoc was wrought in the Hocking River valley. The flood here was caused by unusually heavy rains and melting snow over the entire Hocking River-Sunday Creek Basin. A light rain accompanied by temperatures considerably above normal, occurred during the first 11 days of March, melting the snow cover and saturating the ground. On March 12, 13, and 14 excessive rains fell over the entire Hocking River-Sunday Creek Basin, the average rainfall above Athens totaling 5.51 inches. The Hocking River and Sunday Creek both rose rapidly to the highest stage ever recorded to that time. At Athens, the flood reached a flood stage equivalent to 27.4 feet on the present gage on 13 March, 3 days before the crest on the Ohio River at the mouth of the Hocking River. Records indicate that the flood reached a stage corresponding to 18.8 feet on the present day Glouster gage, the highest stage ever recorded. The flood was very destructive throughout the Hocking River, especially in the Sunday Creek Basin, resulting in the flooding of every building on main street of Glouster. This very destructive flood swept away five or six store buildings, several highway and railroad bridges, and cut off all communications with Glouster. The high water profile of this flood along

Sunday Creek is shown on Plate No. 4-2. The operation of Tom Jenkins Dam for the 1907 flood is shown on Plate No. 8-9, and the results for Glouster and Athens are shown on Plate No. 8-10 and 8-11. The same flood is shown for old Lock No. 20, now Belleville Lock, as Plate No. 8-12.

(3) Storm and Flood of March 1913. The storm causing this flood was general over the northern half of the Ohio River Basin, with the heaviest precipitation in the States of Indiana and Ohio. Rainfall of 1 to 1.5 inches occurred on 20 and 21 March throughout the Ohio Valley and thoroughly saturated the ground, so that an unusually large percentage of subsequently heavy rain of the main storm, on 23 to 27 March, produced rapid runoff. All flood records on the southerly flowing tributaries of the Ohio River in Ohio and Indiana were broken. During a period of 4 days, from 23 to 27 March, the maximum rainfall recorded in the Hocking River Basin was 7.5 inches at Lancaster. The average rainfall over the portion of the basin above Athens is estimated at 5.4 inches. The flood attained stages on the Ohio River which are still the greatest of record in the 150 mile reach from old Lock 14 to Point Pleasant, WV, which is located 66 miles below the mouth of the Hocking River. The crest profile on the Hocking River and Sunday Creek generally paralleled that of the record flood of March 1907, being 2.4 feet lower at Logan, 3.5 feet lower at Nelsonville, and 3.4 feet lower at Athens. The crest stage of 24.0 feet, referred to the Athens gage, occurred on 26 March 3 days before the crest on the Ohio River at the mouth of the Hocking River. The flood reached a stage corresponding to 17.7 feet on the present day Glouster gage. The March 1913 flood caused the loss of 367 lives and damages amounting to $14.0 million (1913 dollars) in the Muskingum River Basin, and in the Scioto River Basin the flood caused the death of 145 people and property damages in certain areas of over $25.0 million (1913 dollars). Property damage was great throughout the Hocking River-Sunday Creek water shed but not nearly so great as experienced in 1907. There is no record for loss of life in the Sunday Creek Basin. The high water profile of this flood on Hocking River and Sunday Creek is on Plate No. 4-2.

Neither Tom Jenkins Dam nor any of the flood control dams in the nearby Muskingum River Basin were built at the time of these two early March floods, but the two floods has been reconstituted. The regulation plan which would have been used for the floods of March 1907 and March 1913 is similar for the standard project flood for Burr Oak Lake. However, the reservoir pool would not have been exceeded spillway elevation level during either of these floods. At the onset of both floods the reservoir would have been regulated to maintain the water supply pool and so as not to exceed the winter control stage at the Burr Oak “A” gage until rising river stages at down stream points would have required the gates to be closed. By the morning of the 16th of March 1907 and the 29th of March 1913 the stages at all of the control points in the Hocking River basin would have permitted releases from the reservoir. However, the stage on the Ohio River at Lock and Dam No. 20 (now Belleville Lock and Dam) was reviewed and forecasts indicated that a crest stage would be expected in about the next 48 hours. In order to avoid increasing the crest stage on the Ohio River, the gates at Tom Jenkins Dam would have been kept closed. By the morning of the 17th of March 1907 and the 30th March 1913 the flood the Ohio River at Lock and Dam No. 20 (now Belleville) had crested and forecasts would have indicated a steady recession. The computed natural crest at Burr Oak Lake was approximately 3,440 cfs on 14 March 1907. In the reconstituted operation of Burr Oak Lake for March 1907, most of the inflow from the flood was stored in the reservoir, except for the minimum outflow and a period of gate operation on 12 and 13 March at the onset of the flood. The maximum pool level calculated for Burr Oak Lake was elevation 732.5 feet NGVD feet on 17 March 1907. In the reconstituted operation of Burr Oak Lake for March 1913, most of the inflow from the flood was stored in the reservoir, except for the minimum outflow and a period of gate operation on 24 March at the onset of the flood. The maximum pool level calculated for Burr Oak Lake was elevation 732.5 feet NGVD on 30 March 1913. These two flood crests of elevation 732.5 feet NGVD along with the 1937 flood are the three highest reconstituted pools for this reservoir. The gates were opened on 30 March to attain the winter control stage of 688.0 feet at the “A” gage and to drawdown the flood control pool. The

amount of computed flood crest reductions at Glouster for the two floods was 1.3 feet in March 1907 and 1.4 feet in March 1913. The operation of Tom Jenkins Dam for the 1913 flood is shown on Plate No. 8-13, and the results for Glouster and Athens are shown on Plate No. 8-14 and 8-15. The same flood is shown for old Lock No. 20, now Belleville Lock, as Plate No. 8-16.

(4) Storm and Flood of January 1937. A series of abnormally heavy rains in late December 1936 and most of January 1937 caused a major series of floods in the middle and lower portions of the Ohio River Valley. The total precipitation for January in the lower portion of the Ohio River Basin was more than 4 times the amount that normally occurs during the month. Tributary streams in the Hocking River Basin experienced successions of flood rises which moved out of the smaller streams to accumulate in the tributaries resulting in increasingly higher stages and discharges after each storm. During the period of 20 to 25 January, inclusive, the rainfall over the Hocking River-Sunday Creek basin ranged from 4.45 at Athens to 7.05 at Lancaster with the maximum for any one day being 2.0 inches at Lancaster. The resulting flood along the Hocking River was about 5.0 feet below the maximum flood of record. A crest of 22.7 feet was reached at Athens on 23 January, 3 days before the crest on the Ohio River at the mouth of the Hocking River. The crest on Sunday Creek was reached on 23 January with a present day stage of 16.22 feet. The damage, misery, and havoc from this record regional flood was so great that several people in the Glouster area soon formed the Sunday Creek Watershed Association as a Sanitary District for the creation, development and promotion of a flood control project by the Works Progress Administration for the Sunday Creek Basin similar to the Muskingum Watershed Conservancy District. The activities of this group lead to the formation of the Tom Jenkins Dam Association which eventually brought about the Tom Jenkins project as we know it today and many years later led to the formation of the present day Hocking River Conservancy District.

Tom Jenkins Dam was not built at the time of this flood but the reservoirs in the nearby Muskingum Basin were under construction, however, the flood of January 1937 has been reconstituted at Tom Jenkins Dam. The same plan of regulation as for the previously reconstituted floods would have been used. Again, the pool level would not reach spillway, but would have reached a record pool level of 733.2 feet NGVD, basically from a long steady volume of inflow not a high crest. The computed natural crest was 1160 cfs late at night on the 22nd of January, with slightly smaller crests of approximately 1130 cfs occurring near noon on 25th of January and 870 cfs occurring on the morning of 15 January. At the start of the flood the reservoir would have been regulated to maintain the water supply pool and so as not to exceed the winter control stage at the Burr Oak “A” gage until 0900 on the 15 January 1937, when the stage on the Hocking River at Athens was 16.7 feet and forecasts would have indicated that further rise was likely. At this time the gates at Tom Jenkins dam would have been closed in accordance with the plan for regulation for Hocking River control.

By 1500, 16 January 1937, the Hocking River at Athens had crested and forecasts would have indicated that further storage would not affect crest stages on the Hocking River. Accordingly, the District Office would issue special instructions to the damtender at Tom Jenkins Dam to gradually increase the gate openings not to exceed a rate of one foot per hour until the stage of 688.0 feet had been attained at the “A” gage and then to maintain the stage at 688.0 feet until the pool had receded to the water supply pool level. These instructions would have been followed until 1500, 18 January 1937, when the Ohio River stage at Lock and Dam No. 20 (now Belleville) was 39.0 feet and forecasts would have indicated a crest stage of about 42 feet in the next 36 to 48 hours. In order to avoid increasing the crest stages on the Ohio River, the gates at Tom Jenkins Dam would have been closed at this time. Additional heavy rains which occurred intermittently from 20 January through 24 January 1937 would have would have resulted in a revised forecast for the Ohio River after each period of significant rainfall. Accordingly all inflows into Burr Oak Lake would have been stored until 0900, 28 January 1937, when the Ohio River at

Lock and Dam No. 20 (now Belleville) would have crested and forecasts indicated a steady recession. At this time the gate openings at Tom Jenkins Dam would have been gradually increased not to exceed a rate of one foot per hour until the stage of 688.0 feet had been attained at the “A” gage and then the stage of 688.0 would have been maintained until the pool had receded to water supply pool level. The computed flood crest reductions for Glouster was about 2.1 feet. The operation of Tom Jenkins Dam for the 1937 flood is shown on Plate No. 8-17, and the results for Glouster and Athens are shown on Plate No. 8-18 and 8-19. The same flood is shown for old Lock No. 20, now Belleville Lock, as Plate No. 8-20.

A high water profile of the March 1907, March 1913, May 1938, and April 1940 along Sunday Creek from the mouth to the junction of East Branch just below Tom Jenkins dam is shown on Plate No. 4-2. The hydrographs shown in this and subsequent plates labeled "natural" represent the flow conditions that would exist without the Burr Oak Lake Project, and those labeled “modified” represent the inflow conditions that exist with the project. The outflow hydrograph represents the regulated outflow from Tom Jenkins Dam.

(5) Storm and Flood of January 1959. The storm and flood of January 1959 is generally regarded as one of the highest of record throughout most sections of central Ohio. The conditions prior to the generalized rains on 20 and 21 January contributed greatly to the flood stages throughout the basin. Severe cold weather during December 1958 froze the ground to depths ranging from 6 to 18 inches. In addition a storm occurring between 14 and 17 January deposited from 0.50 to 1.84 inches of precipitation over the basin. The ground was thus saturated, frozen and covered with varying amounts of snow, all of which greatly contributed to the high percentage of runoff encountered after the generalized rain began. Most of the flood-producing rains fell between midnight on 20 January and noon on 21 January. Rainfall at Burr Oak Lake for this storm was approximately 2.0 inches. The damage in the Hocking-Sunday Creek Basin was not as much as in other areas of the state, but was still severe. Glouster reached a modified crest of 14.55 feet and had a computed natural crest of 16.50 feet. Tom Jenkins dam was utilized and operated for this flood, and the natural crest was 980 cfs near midnight on 21 January. Gates were opened temporarily at the onset of the flood, then closed late on the 20 January to store the flood inflow. As a result of the storm, the pool elevation rose to elevation of 725.6 feet NGVD on 25 January and pool release began. Following the return to normal pool another major flood operation began on the on 9 February. As the pool continued to rise with the gates closed prior to this storm, outflow was limited to minimum stream flow, which had begun several days prior to this second storm. The peak inflow for the second storm was approximately 810 cfs on 10 February, and outflow was limited to minimum stream flow until the gates were opened on 11 February to begin drawing down the flood pool. The maximum pool observed was elevation 723.41 feet NGVD on 11 February. The computed flood crest reductions for Glouster was about 1.8 feet.

(6) Storm and Flood of March 1963. With the beginning of March, winter weather, which had come close to exceeding the coldest of record, turned unseasonably warm. The ground was frozen to unusual depths. Thus the stage was set for excessive runoff from any rains which might fall. A large amplitude wave pattern over North America early in the month consisted of a ridge in the Eastern Pacific and a trough that extended from Hudson Bay into the Southern Plains. Heavy precipitation fell from the Central Plains eastward, in association with the trough. Amounts of 4 inches or more fell locally in some areas with 3.97 inches being recorded at Athens. Nearly all of this precipitation accompanied passage of a major storm system from the far Southwest, where it had developed the previous week, to the Midwest on the 4th, and New England on the 6th. The flood resulting from this storm caused a crest stage at Athens of 23.1 feet that was reached on 6th of March. Sunday Creek at Glouster crested the day before with a modified stage of 17.81 feet. Tom Jenkins dam was fully utilized to reduce the downstream crests by storage of water and reduced the Glouster crest by about 0.6 feet.

The gates at Tom Jenkins dam were opened temporarily at the onset of the flood, then closed late on the 4th of March to store the flood inflow. As a result of the storm, the pool elevation rose to elevation of 729.02 feet NGVD late on the 8th of March and flood storage release began. The computed peak inflow for this storm was 4,950 cfs. Following the return to normal pool another major flood operation began on the on 19th of March. As the pool continued to rise a second time, with the gates closed prior to the 19th March storm, outflow was limited to minimum stream flow, which had begun several days prior to this second storm. The peak inflow for the second storm was approximately 960 cfs on 20 February, and outflow was limited to minimum stream flow until the gates were opened on 23 February to begin drawing down the flood pool. The maximum pool observed was elevation 722.2 feet NGVD on 23 February. The computed flood crest reductions for Glouster was about 0.6 feet for the 3rd of March.

(7) Storm and Flood of March 1964. The flood of March 1964 was the result of two storms. The first occurred on 4-5 March, when an average of 2.1 inches fell on the drainage area above Athens. This storm set the stage for excessive runoff from the second storm which occurred on 8-10 March and had a duration of approximately 24 hours. This second storm produced the maximum flood recorded for the gaging station at Athens which has been in operation since 1915. The Athens crest stage was 24.18 feet reached on 11 March. Sunday Creek at Glouster reached a modified crest stage on the 10 March of 17.53 feet. Tom Jenkins dam was fully operated for both storms and is credited with reducing the crest at Glouster by about 1.1 feet.

The gates at Tom Jenkins dam were opened temporarily at the onset of the flood, then closed late on the 4th of March to store the flood inflow. As a result of the storm, the pool elevation rose to elevation of 725.2 feet NGVD, about noon on the 7th of March and flood storage release began. The computed peak inflow for this storm was 1,560 cfs. Following the return to normal pool another major flood operation began on the on 9th of March. As the pool continued to rise a second time, with the gates closed prior to the 9th March storm, outflow was limited to minimum stream flow, which had begun several days prior to this second storm. The peak inflow for the second storm was higher than the first at approximately 3,160 cfs on 10 March, and outflow was limited to minimum stream flow until the gates were opened on 13 March to begin drawing down the flood pool. The maximum pool observed was elevation 730.0 feet NGVD on 13 March. The computed flood crest reductions for Glouster was about 1.1 feet for the 10th of March.

(8) Storm and Flood of May 1968. Central and Southern Ohio experienced the worst widespread flooding since March 1913 during the latter part of May 1968. During the period 8-22 May, most areas in the southern part of the state received 3 to 5 inches of rainfall. This created saturated soil conditions over a large portion of the state and contributed to the large runoffs that occurred during the heavy rains of 23-24 May and 26-27 May.

In the Hocking River-Sunday Creek Basin the rainfall was from 3 to 5 inches for 23-24 May and 26-27 May had about 4.2 inches in the headwaters and about 2.4 inches in the lower Hocking-Sunday Creek area. The storms over the southern part of Ohio for May 1968 are estimated to be in the 50 to 100 year category and caused over 8.8 million dollars damage. Sunday Creek at Glouster crested on the 24th May at a modified stage of 17.78 feet. The computed natural crest for Glouster was 18.43 feet. Tom Jenkins dam was fully operated for this flood.

The gates at Tom Jenkins dam were opened temporarily at the onset of the flood, then closed early on the 23rd of May to store the flood inflow. As a result of the storm and the long delayed release, the pool elevation rose to the highest pool crest since Tom Jenkins dam was built of 731.51 on the 31st of May, using 48.6 percent of the available storage. The computed peak natural crest for this storm was about 2,550 cfs on the 24th of May. The gates were opened on 31 May to begin drawing down the flood pool. The computed flood crest reductions for Glouster was about 0.65 feet for the 24th of May.

(9) Storm and Flood of February 1979. Antecedent conditions prior to moderate rainfalls near the end of February 1979 were mainly responsible for flooding conditions in the basin. Soils were frozen and a snowcover persisted over most of central Ohio from early January to the onset of the major rainfall on 25-26 February. Snowcover on the area ranged from approximately 6 inches in the northern part of the state to 20 inches at McConnelsville. Based on data from Barnesville, Athens, and Glouster the snowcover on the East Branch Basin prior to the initial thaw of 20 February was estimated to be about 16 inches. Temperatures rose to above freezing for the first time in nearly 4 weeks on 20 February and, combined with rainfalls of less than 0.5 inch on 21-22 February, created rapid melting of snow and runoff and rising stages along the basin's streams. Continued thawing combined with heavier rainfalls of approximately 1.5 inches over the basin on 25-26 February produced heavy runoff and considerable flooding in the Hocking Basin-Sunday Creek Basin. Total rainfall at Tom Jenkins dam for the period of 25-26 February was 1.48 inches. The Hocking River at Athens reached a stage of 25.45 feet on 27 February. Sunday Creek reached a modified stage at Glouster of 15.90 feet and a computed natural stage of 16.72 feet. Tom Jenkins dam was utilized efficiently to reduce downstream flows and stages.

The gates at Tom Jenkins dam were opened temporarily at the onset of the flood, then closed early on the 21st of February to store the flood inflow. As a result of the storm, the pool elevation rose to the crest of 729.33 feet NGVD, or 37.1 percent of the available storage, on the 28th of February. The computed peak natural crest for this storm was about 1,700 cfs on the 26th of February. The gates were opened on 28 February to begin drawing down the flood pool. The computed crest reductions for Glouster was about 0.72 feet for the 25th of March.

c. Benefits. During development of the Hocking River Basin Comprehensive Report, average annual benefits for the Tom Jenkins project were calculated based on 1965 flood damage survey data escalated to current values. Benefits included those experienced within the Hocking River Basin itself and for the Ohio River to the lower limits of the Huntington District. The estimated and calculated benefits for Tom Jenkins Dam total $22,098,000 through October 1998. This would be an annual savings of approximately $460,000 in unadjusted flood damage due to the operations at Tom Jenkins dam.

8-03 RECREATION

Success of the recreational purpose of the project, as measured by the number of visitors, has been excellent. Although no head count is made of the number of visitors at any of the Scioto or Hocking River Basin recreational facilities, it is estimated that approximately 150,000 visits are made to Tom Jenkins dam and two adjoining parks each year. Rapid changes in pool level tend to diminish recreational benefits by affecting boating, camping, hunting and fishing interests at Burr Oak Lake. Public campgrounds, concession areas and roads around Burr Oak Lake are susceptible to damages caused by high water levels. Burr Oak Lake has a large amount of year round storage, hence there is very little reason to drawdown the pool and disturb the recreation during the winter.

Before the recreational phase of the nearby Muskingum River Basin was initiated, the National Park Service assisted the Muskingum Watershed Conservancy District in the 1940's in estimating the recreational value of the 14 Muskingum River Basin projects. The value was estimated to be $807,000 per year. Thirty years later, conservative estimates placed the annual value in excess of $5 million. The total investment in recreational facilities at the Muskingum River Basin projects has been estimated at approximately $10 million; the cost of duplicating the recreation values provided by the District is in excess of $150 million.

The estimated recreation value for the Burr Oak State Park and Wayne National Forest is enormous and would approach $150,000 per year. The total investment in recreational facilities at the two parks would be about one million dollars; the cost of duplicating the recreation values and services provided by the two parks would be about 10 million dollars.

8-04 WATER QUALITY

a. Special Problems. Burr Oak Lake has a definite influence on water quality conditions below the impoundment. Very high sulfate concentrations are found in the watershed. The high sulfate values in the headwaters are expected to cause high concentrations of hydrogen sulfide gas in the tailwaters, which, under the right conditions, could indirectly cause damage to the discharge tunnel's concrete liner. Burr Oak Lake also has a potential for algal overproduction as indicated by historical dissolved oxygen and chlorophyll values. High manganese levels along with high sulfate levels and overproduction in the lake could cause taste and odor problems for downstream users.

b. Data Interpretation and Results. An interdisciplinary approach is used to evaluate the physics, chemistry, and biology of inflow streams, the lake, and the outflow. The following interpretations are based on data collected between 1974 and 1989.

(1) Physical/Chemical. The chemical composition of water may be defined by grouping substances which compose the dissolved solids. Relationships among groups of chemicals determine the type of water. In terms of major ions and descriptive parameters, water in the East Branch Sunday Creek Basin above Burr Oak Lake is classified as a calcium-carbonate type. This represents a balanced condition.

A lake structure will typically cycle from a mixed condition (Temperature same from top to bottom) to a stratified or layered condition (Temperature changes with depth). This is the result of thermal energy from the atmosphere gained and lost during the year. During the winter, water temperatures are the same from top to bottom and the lake is considered mixed. During Spring as air temperatures start to warm, so do surface water temperatures. This creates a surface layer called the epilimnion. Water temperatures near the bottom remain cool because they are not exposed to the sunlight or warmer air temperatures. This layer is called the hypolimnion. The layer in the middle is referred to as the metalimnion or transition layer. During the Fall season when air temperatures start to cool the surface water temperature also cools and mixes with water below at the same temperature. This process continues until water temperatures in the epilimnion are the same as the hypolimnion and the lake is once again mixed.

Burr Oak Lake remains nearly isothermal during the winter months. In the spring the lake stratifies and remains so until September or October. At that time the lake mixes and becomes isothermal again. The lake has a long average retention time of 91 days which directly affects the stratification pattern in the lake. As shown in Plate 8-21, the lake has a strong thermal stratification pattern. Specific conductance does not indicate any density layers in the lake resulting in interflows through the lake during the summer months. Thus water entering the lake remains in the lake for about 3 months before it is released to the downstream area.

Concentrations of dissolved oxygen remain constant throughout the water column after fall mixing in October and remain so until around the May/June time-frame after the lake has stratified. At that time dissolved oxygen levels in the hypolimnion decline rapidly until anoxic conditions are reached. Throughout the epilimnion dissolved oxygen remains above 5.0 mg/l, which includes about 75% percent of the lake. Since dissolved oxygen is one of the

key parameters for fishing, this represents the maximum amount of lake available for fishing during the stratification season. Plate 8-22 shows typical dissolved oxygen concentrations during the summer months.

East Branch of Sunday Creek is the major stream flowing into Burr Oak Lake. Dissolved oxygen concentrations in the inflow streams average 88% saturation and in the tailwaters average 90% saturation. The lake hypolimnion becomes anoxic, but this is most likely due to the long residence time rather than a high demand on oxygen. Tailwater re-aeration was considered excellent since dissolved oxygen concentrations are so high. A minimal dissolved oxygen sag would be expected downstream, but it is never realized because of the short distance downstream before East Branch Sunday Creek merges with Sunday Creek.

Sufficient quantities of phosphorous, nitrogen, and carbon are needed to have a productive lake. Burr Oak Lake is considered productive, with phosphorous as the limiting nutrient. Nutrients are transported along with the sediments. As water enters a lake, its velocity decreases and the sediments settle to the lakebed. During summer stratification, nutrients are released from the lakebed to the water column in the lake when the hypolimnion becomes anoxic. Algal blooms are not uncommon in the headwaters and at the upper end of the lake and aquatic plant growth is also apparent in the lake shallows. These two factors are most likely exerting a large demand on available nutrient supplies. Both nitrate/nitrite and phosphate are detectable in low concentrations in the tailwaters during the summer. Measurable levels of phosphorous in the tailwaters indicate that there are sufficient nutrients available for the aquatic community.

Mean pH values were usually around 7.0 in the headwaters and tailwaters, but increase to the middle sevens in the lake near the dam and near eight at the upper end of the lake. This was not reflected in the tailwaters. High pH values indicate high productivity. Long-term trends indicate no significant pattern in pH values over the entire watershed. Average alkalinity, a factor buffering pH, was around 90 mg/l $CaCO_3$ in the headwaters and tailwaters. Hardness levels at all stations were classified as moderately hard (ASTM).

At times concentrations of iron exceed the 1.0 mg/l standard in the headwaters, but usually remained within state standards. This is the same for the lake and the tailwaters. During stratification, iron levels exceed 1.0 mg/l in the hypolimnion, but remain below 0.2 mg/l in the epilimnion (Plate 8-23). There is therefore minimal effect on the lake fishery from iron. Tailwater concentrations of iron reflect the bottom level withdrawal from the reservoir. Long-term trends indicate no significant changes in iron concentrations. Concentrations of manganese remained below the standard of 1.0 mg/l and were usually below 0.5 mg/l in the headwaters. During lake stratification manganese exceeded 2.0 mg/l in the hypolimnion, but remained below 0.2 mg/l in the epilimnion (Plate 8-24). The high concentrations of manganese in the hypolimnion are reflected in tailwater readings because of bottom-level releases. Because these same concentrations do not mix throughout the water column during fall mixing, there should be little effect on fish populations in the lake.

(2) Biological. In a freshwater community, algae are the primary producers. They serve as the basis of the food chain and are the primary food source for most aquatic animals. The quantity and types of algae present in a stream or lake is dependent upon many factors, such as temperature, oxygen, light, nutrients and flow. All freshwater algae contain the green pigment chlorophyll. Therefore, the productivity of aquatic habitats can be monitored by measuring chlorophyll. Algal productivity was low in the headwaters with average chlorophyll concentration less than 8 ug/l, but productivity on the lake was considered substantial with average chlorophyll concentrations between 8 and 20 ug/l. There was an insufficient amount of macroinvertebrate data available to make a fair assessment of the inflow streams or the outflow. An intensive sampling effort is planned for 1999.

8-05 FISH AND WILDLIFE

Effects of the water control plan on fish and wildlife at Burr Oak Lake are associated mainly with pool level fluctuations in the lake and outflow from the outlet works.

Requirements of a constant or rising pool for fish spawning are incorporated into the water control plan at Burr Oak Lake. Walleyes need constant or rising pool levels for spawning beginning in mid-March, which falls during the spring flood period. Largemouth bass spawn during the period from the end of April through May, which is near or after the end of the spring flood period. The water plan at Burr Oak Lake will normally provide adequate pool conditions for fish spawning.

8-06 EMERGENCY DRAWDOWN

Since the Burr Oak Lake project has been operational, no emergency drawdown has occurred. The time required to draw down the reservoir from the maximum flood control pool (spillway crest elevation 740.0 feet NGVD) is dependent on the discharge allowed through the outlets. Assuming the outlets are opened to pass the maximum DEMIA discharge, the time required to drain the pool to the water supply level of elevation 721 feet NGVD is about 11 days, the time required to draw down the reservoir to the gate sill invert elevation 687.5 feet NGVD is approximately 18 days. If all of the sluice gates were fully opened, the reservoir could be drained to sill elevation in approximately 11 days. Emergency drawdown curves for Burr Oak Lake are shown on Plate No. 8-25.

Should emergency drawdown become necessary, various procedures such as surveillance of the dam or notification of key personnel may be placed into effect, depending on the cause and its severity. Detailed information concerning these emergency actions can be found in the Flood Emergency Plan for Tom Jenkins Dam.8-08 SPECIAL PURPOSE RELEASES

Special purpose regulation at Tom Jenkins Dam has been minimal since the project has been operational. In general, the only significant recurring deviations from the water control plan have been associated with periodic inspections of the dam and appurtenances and for maintenance or repairs. These deviations have had only minor impacts on the overall project.

8-07 FREQUENCIES AND DURATIONS

a. Natural Discharge-Frequency. The natural discharge-frequency curve for Sunday Creek at Glouster gage was developed on a regional basis in accordance with methods outlined in “Statistical Methods in Hydrology”, by Leo R. Beard, dated January 1962, and Bulletin 17A, “Guidelines for Determining Flood Flow Frequency”, published by the United States Water Resources Council and dated March 1976. A Log-Pearson Type III distribution was fitted to the annual event series at gaging stations in the Hocking and Muskingum River Basin. This enabled generalized relationships to be derived which relate frequency curve characteristics, mean, standard deviation and skew to individual basin factors. These data were utilized to make flow frequency estimates for the project drainage area.

The curve derived by plotting probable maximum flow to be expected below Tom Jenkins Dam against exceedence interval in years is shown as Plate No. 8-2. Flow values for selected exceedence intervals from 1 year to 200 years are given in Table No. 8-1.

TABLE No. 8-1

FREQUENCY SUMMARY
SUNDAY CREEK AT GLOUSTER,OHIO
MODIFIED BY TOM JENKINS DAM
ALL SEASONS – NATURAL

Exceedence Interval (years)	Natural Discharge (cfs)	Modified Discharge (cfs)
200	15,500	10,800
100	12,600	8,770
50	10,100	7,100
20	7,500	5,300
10	5,880	4,070
5	4,560	3,080
2	3,300	2,200
1	2,550	1,800

TABLE NO. 8-2

FREQUENCY SUMMARY
BURR OAK LAKE POOL ELEVATION DEVIATION - ALL SEASONS

Exceedence Interval (years)	Elevation (feet NGVD)
200	740.3
100	737.8
50	735.4
20	732.2
10	729.6
5	727.1
2	723.9
1	721.6

b. Pool Elevation Frequency. Peak pool elevations for all significant rises experienced during the actual operation of Burr Oak Lake through 1986 have been analyzed using graphical frequency procedures. The annual curve derived from this study is shown on Plate No. 8-1, Frequency of Filling. Duration of selected pool elevations have been derived from historical pool elevations experienced at the Burr Oak Lake Project for the same period ending in 1986. A frequency summary of Burr Oak Lake pool elevation deviations is shown on Table No. 8-2.

SECTION IX - WATER CONTROL MANAGEMENT

9-01 RESPONSIBILITIES AND ORGANIZATION OF CORPS OF ENGINEERS

(1) General. General authorities for allocation and regulation of reservoir storage in projects owned and operated by the Corps of Engineers are contained in legislative authorization acts and referenced project documents. These public laws and project documents usually contain provisions for development of water control plans, and appropriate revisions thereto, under the discretionary authority of the Chief of Engineers. Some modifications in project operation are permitted under laws passed since the original project authorization. Tom Jenkins dam at Burr Oak Lake is owned and operated by the U.S. Government. The Huntington District, Corps of Engineers is the operating agency for the project, with the administrative control under the Scioto Area Office within Operations Division.

(2) OCE Role in Water Control Activities. OCE will establish policies and guidelines applicable to all field offices and for such actions as are necessary to assure a reasonable degree of consistency in basic policies and practices in all Division areas. Assistance will be provided to field offices during emergencies and upon special request.

(3) Great Lakes and Ohio River Division. The Division Engineer has primary responsibility and authority for direct action with respect to all phases of reservoir regulation, including: (a) basic policies, criteria, and concepts that determine operating plans; (b) technical evaluations; (c) field operation; and (d) review and approval of reservoir regulation plans and manuals and related activities. The Division Office will coordinate water control management activities associated with interdistrict, interdivision and interagency water resource needs. As established in accordance with ER 1110-2-1400, the Great Lakes and Ohio River Division is responsible for administration of the Division Engineer's policy for water control management.

(4) Huntington District. District Engineers have the primary responsibility for (a) general management of reservoir regulation activities within their respective areas; (b) technical evaluations and performance of operations associated therewith; and (c) developing plans and manuals required for reservoirs and interrelated systems within their respective district area. The Water Control Section, within the Engineering/Construction Division, is the responsible element for all water control activities which include the following reservoir project functions:

(a) Flood control.

(b) Fish and wildlife enhancement.

(c) Recreation.

Water control plans include coordinated reservoir regulation schedules for project/system operation and such additional provisions as may be required to collect, analyze and disseminate basic data, prepare detailed operating instructions, assure project safety and carry out regulation of projects in an appropriate manner. Water control plans are developed to conform with objectives and specific provisions of project authorizing legislation and applicable Corps of Engineers' projects. They include any applicable authorities established after project construction. The water control plans are prepared giving appropriate consideration to all applicable Congressional Acts relating to operation of Federal facilities, i.e., Fish and Wildlife Coordination Act (P.L. 85-624), Federal Water Project Recreation Act - Uniform Policies (P.L. 89-72), National Environmental Policy Act of 1969 (P.L. 91-190), and Clean Water Act of 1977 (P.L. 95-217). Thorough analysis and testing studies are made as necessary to establish the optimum water control plans possible within prevailing constraints.

(5) Water Control Section. The Water Control Section delegated the responsibility to coordinate the operation of specific projects with Federal and State agencies, local entities, and the general public. The Division Engineer, ATTN: CELRD-EC-W, is advised, as soon as possible, of any coordination activities which may require a study, public hearing, or revision in operating plans. Districts are required to alert the Division Engineer, ATTN: CELRD-EC-W, of any significant deviations from routine regulation plans. The communication mode for the advisory is commensurate with the urgency of the situation and transmitted before a plan of action is implemented by the district. An organizational chart is shown on Plate No. 9-1 for Water Control Management at Burr Oak Lake. As shown on the chart, the Recreation-Resource Management Branch and the Scioto Area Office are responsible for supervision of the operation and maintenance of Tom Jenkins Dam. The Damtender at the dam regulates the project in accordance with general instructions and Special Directives issued by the Water Control Section through the Project Office. General instructions are included in “Instructions to Damtender”, Exhibit B, of this manual and Special Directives are issued and signed by the Chief, Water Control Section, for dissemination to the Damtender as necessary to efficiently regulate the project for optimal water control management for all project purposes.

During normal operations, the Water Control Section of the Water Resources Engineering Branch are involved in the following activities pertaining to water control management:

(a) Routine regulation of the lakes and dissemination of pertinent data.

(b) Investigations and refinement of regulation procedures such as analysis of past floods, channel investigations, improvement of forecasting, and planning programs with other agencies.

(c) Training personnel in flood control duties with visits to projects and instructing Water Resources Engineering Branch personnel from other sections.

(d) Development and application of mathematical modeling to complex reservoir systems.

(e) Operation of the Branch hydrologic data collection and water control management system, including computers and field equipment.

(f) Developing and conducting effective public information programs to inform and educate the public regarding Corps of Engineers' water control management activities.

(g) Preparing and submitting reports on lake regulations such as daily reports, weekly reports, monthly reports, annual reports, weekly briefings, and post-flood reports.

(h) Preparing and updating water control manuals for individual projects and master manuals for basins.

During flood or other emergencies, Water Resources Engineering Branch personnel are responsible for the following activities in regard to water control management:

(a) Evaluation and dissemination of current and forecast hydrologic, hydraulic and meteorologic data.

(b) Presentation of storm and flood analysis to the District Engineer and pertinent staff members.

(c) Providing liaison personnel to support Emergency Operations Center when it is operational.

(d) Regulation of all projects and systems in accordance with approved plans.

(e) Furnishing information to others such as reports to higher authority, status to Emergency Operations Center and data to Public Affairs Office.

Lines of communication between the various office elements are shown on Plate No. 9-1. Details and responsibilities of other elements are indicated in the overall district plan in the Emergency Operations Center Plan and ER 500-1-1, ER 500-2-1 and all annexes to these two ER's.

During normal non-flood periods, water control management activity is accomplished by personnel of the Water Control Section. During flood conditions and other emergencies, assistance of other Water Resources Engineering Branch personnel may be required to maintain effective water control management within the Huntington District. The area affected and magnitude of the flood determines the number of people engaged in each particular activity and assigned to each sub-basin or major river basin.

The National Weather Service and project personnel are provided with a list of names of Water Control Section personnel and home telephone numbers with instructions to contact them during off-duty hours if unusual conditions occur or a project is in a particular reporting schedule. During emergency conditions or flood regulation, Water Resources Engineering Branch staff are available from 18 to 24 hours daily, depending on the magnitude of each event. At each project, responsible personnel are on duty or on call at all times.

The Huntington District also works in cooperation with other Federal, State, local and private organizations and agencies, as has been illustrated throughout this report. A summary of the major relationships is shown on Plate No. 9-2.

9-02 REPORTS

Both Table No. 9-1 at the end of this section and Plate No. 9-3 contain a listing of the various Periodic and Special reports provided by Huntington District Water Resources Engineering Branch.

a. Periodic.

(1) Daily. Districts are required to report current hydrologic data daily as prescribed by the Division Office. A daily report is prepared five days per week by the Water Control Section of Water Resources Engineering Branch and, when staffing is provided, as under flooding conditions, on Saturdays, Sundays and holidays. After review, the report is sent over a leased line to the LRD water control system. The transmission includes morning lake elevation, rate of outflow, and 3-day forecast of lake and outflow for all reservoir projects. Ohio River morning stages and 24-hour rainfall, morning stage and flow and 5-day flow forecast for Ohio River tributary gage points complete the transmission and the report. The report items are prepared in accordance with ORDR 1110-2-20, CEORD-ED-W ltr, 10 Jul 69, CEORD-ED-W ltr, 23 Jan 67, and ORDR 1110-2-17.

Daily or more frequent briefings of the District Engineer and Chief Engineer containing pertinent hydrologic and meteorologic information are made during flood or other emergencies.

In carrying out water control activities, Corps of Engineers personnel must recognize and observe the legal responsibility of the National Weather Service

(NWS) and the National Oceanic and Atmospheric Administration (NOAA) for issuing weather forecasts and flood warnings, including river discharges and stages. River forecasts prepared by the Corps of Engineers in the execution of its responsibilities should not be released to the general public, unless the NWS is willing to make the release or agrees to such dissemination. However, release to interested parties of factual information on current storms or river conditions and properly quoted NWS forecasts is permissible. District offices are encouraged to provide assistance to communities and individuals regarding the impact of forecasted floods. Typical advice would be to provide approximate water surface elevations at locations upstream and downstream of the NWS forecasting stream gages. Announcement of anticipated changes in reservoir release rates as far in advance as possible to the general public is the responsibility of Corps of Engineers' water control managers for projects under their jurisdiction.

(2) Weekly. Each week a list of 24-hour reservoir effects at tributary gage points is transmitted to LRD. The list, which gives flows in cfs held out from or added to the natural flow, shows the data for an entire week ending with the current week. The gage point reported for the Hocking River Basin is Athens, Ohio on the Hocking River.

(3) Monthly. Engineer Regulation No. 1110-2-240, dated 8 October 1982 requires that a monthly record of reservoirs operated by the District be promptly prepared by Water Resources Engineering Branch according to 33 CFR 208.11 and maintained in tabular form readily available for transmittal to the Chief of Engineers or others on request.

(4) Reservoir Operations. Each District provides a review of meteorological influences and water control management activities to each of the meetings of the Reservoir Operations Coordinating Group. Huntington District personnel of the Water Control Section summarize and compare present weather with long-term normals and actual streamflows to mean annual values. They describe seasonal features of operation such as spring filling, summer outflow temperature control or fall drawdown, frozen lakes and effect of river ice on navigation, in addition to any significant flood control operations and damages prevented.

(5) Annual. The Division Engineer is required by ORDR 1110-2-27 and CEORD-ED-W Ltr, 30 Sep l977 to submit to OCE for approval an annual report on reservoir regulation activities of significance during the fiscal year ending and programs proposed for the year following. This report summarizes the water control activities throughout the Ohio River Basin. Therefore district input is mandatory. The following documentation of district programs and activities is requested by 1 November of each year:

(a) A brief summary highlighting the significant accomplishments attributed to each reservoir during the preceding fiscal year.

(b) Reservoir regulation manual submission schedule.

(c) Concise report on major accomplishments concerning personnel, training, model application, ADP use, data reporting and analysis, and general improvements in reservoir regulation activities.

By Executive Order 12088, the President ordered the head of each Executive Agency to be responsible for ensuring that all necessary actions are taken for control, prevention, and abatement of environmental pollution with respect to Federal facilities and activities under control of the agency. Annual Division Water Quality reports are required by ORDR-2-26. The report is submitted in two parts. The first part addresses the division Water Quality management plan while the second part presents specific project information. A major objective of this report is to summarize information pertinent to overall water management responsibilities. An Annual Water Quality Report by Districts to LRD includes narrative and tabular summaries of water quality activities and

conditions in the Districts. The District report contains a synopsis of activities, specific cases of interest, improvements during the year, and plans for future emphasis. The tabular portion includes an overview of water quality activities, an overview of water quality conditions, specific water quality control actions in coordination with the Water Control Section, special studies aimed at identification or solution of problems and problems requiring special studies with schedules for executing the studies. The annual water quality report is submitted by 1 December of each year.

b. Special Reports.

(1) Reports on Reservoir Operations During Flood Emergencies. Information on reservoir operations to be included in reports submitted to the Chief of Engineers during flood emergencies in accordance with ER 500-1-1 include rate of inflow and outflow in cfs, reservoir levels, predicted maximum level and anticipated date, and percent of flood control storage utilized to date. Maximum use should be made of computerized communication facilities in reporting project status to DAEN-CWO-E/CWE-HY in accordance with the requirements of ER 500-1-1.

(2) Post-Flood Report. Information on the operation of the affected reservoirs is gathered in accordance with ER 500-1-1. This report provides details on antecedent meteorologic and hydrologic conditions, description of the performance of the dam and appurtenant works, detailed analysis of the operating procedures, and effects of reservoir operation on the Hocking River and Ohio River. Reservoir effects include evaluation of the stage reductions at key stations and estimates of damages prevented. Conclusions are discussed with regard to adequacy of operating technique, performance of structures, and benefits derived from operations during the flood.

(3) Fiscal year budget requests for water control management activities are prepared and submitted to the Office of the Chief of Engineers in accordance with requirements established in Engineer Circular on Annual Budget Requests for Civil Works Activities. The total annual costs of all activities and facilities that support the water control functions (excluding physical operation of projects, but including flood control and regulation of navigation projects subject to 33 CFR 208.11) are reported. Information on the Water Control Data Systems and associated Communications Category of the Plant Replacement and Improvement Program is submitted with the annual budget. Reporting is in accordance with an Engineer Regulation and the annual Engineer Circular on Civil Works Operations and Maintenance, General Program.

(4) The Chief of Engineers and staff require information to respond to inquiries from members of Congress and others regarding runoff potentials. Therefore, the Division Engineer submits a snowmelt runoff and flood potential letter report covering the snow accumulation and runoff period, beginning generally in February and continuing monthly, until the potential no longer exists. Dispatch of supplemental reports is determined by the urgencies of situations as they occur. The reports are forwarded as soon as hydrologic data are available, but not later than the 10th of the month. For further information on reporting refer to ER 500-1-1.

(5) During major drought situations or low-flow conditions, narrative summaries of the situation are furnished to alert the Chief of Engineers regarding the possibility of serious runoff deficiencies that are likely to call for actions associated with Corps of Engineers' reservoirs.

(6) Master plans for water control data systems and significant revisions thereto are prepared by Division water control managers and submitted to HQDA (DAEN-CWE-HY) Washington, DC 20314, for review and approval of engineering aspects. Engineering approval does not constitute funding approval. After engineering approval is obtained, equipment in the master plan is eligible for consideration in the funding processes described in ER 1125-2-

301 and Engineering Circulars on the Annual Budget Request for Civil Works Activities. Master plans are maintained current and are updated as necessary to meet needs.

Modified master plans are submitted by 1 February if revisions are required to include equipment not previously approved or for changes in scope or approach. Submittal by the February date allows adequate time for OCE review and approval prior to annual budget submittals.

(7) Any additional or pertinent reports which are required from higher authority.

TABLE NO. 9-1

HUNTINGTON DISTRICT REPORTS
BY
WATER CONTROL SECTION

PERIODIC REPORTS - Computer reports keyed to forms formerly completed by hand as follows:

Daily Computer report of observed and forecast stages and flows including:

- Morning reservoir pool elevation, outflow, and three-day pool and outflow forecast.

- 24-hour rainfall, morning stage, flow and five-day flow forecast at Ohio River tributary gage points.

Weekly Reservoir effects at Ohio River tributary gage points.

Monthly Record of District reservoirs available on request.

Annually Summary of significant reservoir regulation activities for the year and of programs proposed for the following year.

SPECIAL REPORTS

Daily or more frequent briefing of District Engineer and Chief Engineer during flood or other emergencies containing hydrologic, meteorologic, and operational information, when and as requested.

Information relevant to flooded area or situation to the Emergency Operations Center (when functioning) such as pertinent data about the area, copies of reservoir morning and extra reports, relay of any verbal reports, relevant NWS zone forecasts and special bulletins, and computer-generated isohyetal map of the District.

Reports on reservoir operations to OCE during flood emergencies including inflow, outflow, pool elevation, predicted crest, and maximum storage utilization to date.

Post-flood reports.

Budget requests for water control management activities to OCE.

Snow-melt runoff and flood potential letter report to OCE.

Narrative summaries of major drought or lowflow conditions likely to call for regulations of District reservoirs.

Master plans for water control data systems and significant revisions thereto are submitted to HQDA (DAEN-CWE-HY) Washington, DC 20314, for review and approval of engineering.

Appendix E

Draft Interim Operating Plan

TOM JENKINS DAM
INTERIM OPERATING PLAN
13 March, 2012

The guidance detailed in this document supersedes the Tom Jenkins Dam Water Control Manual until such time that studies necessary to determine the risk to the project and the public imposed by an underground coal mining "corridor" beneath the lake are completed and the risks are fully understood. At that time, this plan may be revised. State officials in Ohio have been apprised of the operational changes. Environmental coordination and compliance with regards to these changes are discussed in Section I (6) National Environmental Policy Act Considerations of this document.

EXECUTIVE SUMMARY

A safety issue has been identified at Tom Jenkins Dam flood control project. Deviation from the Water Control Plan is necessary to assure that Tom Jenkins Dam is operated in a manner to reduce the likelihood of an uncontrolled release of stored flood water. Subsidence of the mine "corridor" either prior to or as a result of flooding in the drainage basin or breakthrough of the reservoir into the mine "corridor" during flooding in the drainage basin could cause an uncontrolled release, resulting in loss of life, and damage to downstream structures.

The Interim Operating Plan reviews why and describes how Tom Jenkins Dam will be operated with the elimination of control for Ohio River flooding (Ohio River Control) as described in the water control manual. The Dam will also be operated to reduce the amount of time that water is stored above elevation 725 (datum NGVD29) in order to reduce the duration water is above the "corridor" constructed below the lake valley floor for coal mining activity. A copy of this guidance has been included in the Dam Safety Emergency Action Plan (EAP) and as an addendum to the Water Control Manual.

The magnitude of the operational changes are found in Section I(4) Recommended Project Interim Operational Limits as of January 2012.

I. BACKGROUND

(1) DEFINITIONS

a. Interim Operating Plan (IOP) The IOP is the details of the temporary operational guidance for the dam. It supersedes the Water Control Manual until such time that scientific studies necessary to evaluate the risk to the project and the public imposed by an underground coal mining "corridor" are completed and the risks are fully understood. At that time, the plan may be revised.

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b. Ohio River Control. Ohio River Control is the act of closing a flood control project to effect a reduction of the crest on the Ohio River. There may or may not be local flooding in the vicinity of the project.

(2) PROJECT DESCRIPTION

a. Authorization. The Tom Jenkins Dam Project was authorized by the Flood Control Act of 1944. The project is an element of a comprehensive flood control plan for the Ohio River Basin. Existing project purposes include flood control, recreation, water supply and fish and wildlife enhancement.

b. General. Tom Jenkins Dam is located in Athens County, Ohio on East Branch of Sunday Creek, a tributary of Sunday Creek of the Hocking River. It is 0.3 miles above the mouth of East Branch, approximately 4.5 miles north of Glouster, Ohio. The project was completed in February 1950 and controls a 33 square mile drainage area. Total reservoir capacity is about 26,900 acre feet at the maximum flood control pool, elevation of 740 feet, which is equivalent to approximately 15.4 inches of runoff.

c. Dam. Tom Jenkins Dam is a rolled earth and rock fill impervious structure with a maximum height of 84 feet. The dam consists of a rolled impervious zone and two small upstream and downstream rock fill zones for increased stability. The crest length is 944 feet at elevation 765 feet with a 20 foot spillway design flood surcharge plus 5 feet freeboard above the spillway elevation of 740.0 feet. Note: All elevations referenced in this document are in NGVD29.

d. Outlet Works. The outlet works is located in the south left abutment, and consists of an approach channel, an intake structure with 3 gated rectangular 3.5-foot by 7.0 foot intake tunnels leading to the outlet tunnel, three service and three emergency screw stem operated gates each 4.0 feet by 7.0 feet, one 3.5-feet by 12.17-feet emergency bulkhead, and two low-flow control and water supply intakes which are now sealed, the machinery for operating the gates and bulkhead, and an 8.0 foot horseshoe tunnel discharging through the left abutment into a stilling basin 25 feet wide by 89 feet long into an outlet channel.

(3) RISK ASSESSMENT

With the introduction of an underground “corridor” for coal mining purposes beneath the Tom Jenkins Dam / Burr Oak Lake project, an increased risk to the public and to the integrity of the project is created when water is stored above the “corridor”. There is less than 60 feet between the lake valley floor and the top of the “corridor”. The primary concerns are that an uncontrolled release of the pool into the mine could occur if there is subsidence either prior to, or as a result of, flooding in the drainage basin, or there is a breakthrough of the reservoir into the mine “corridor” as a result of flooding in the drainage basin, subsequently allowing reservoir water to exit at some point outside the drainage basin. In order to understand the risk of storing water above the “corridor”, scientific studies must be completed.

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A water elevation in the lake greater than approximately 725 feet puts water above the mining "corridor". Approximately 84% of the available flood storage is above the "corridor" or otherwise above elevation 725 feet. See figure 1. A rain event sizeable enough to increase the lake elevation to 725 feet has a statistical occurrence of once every 1.75 years.

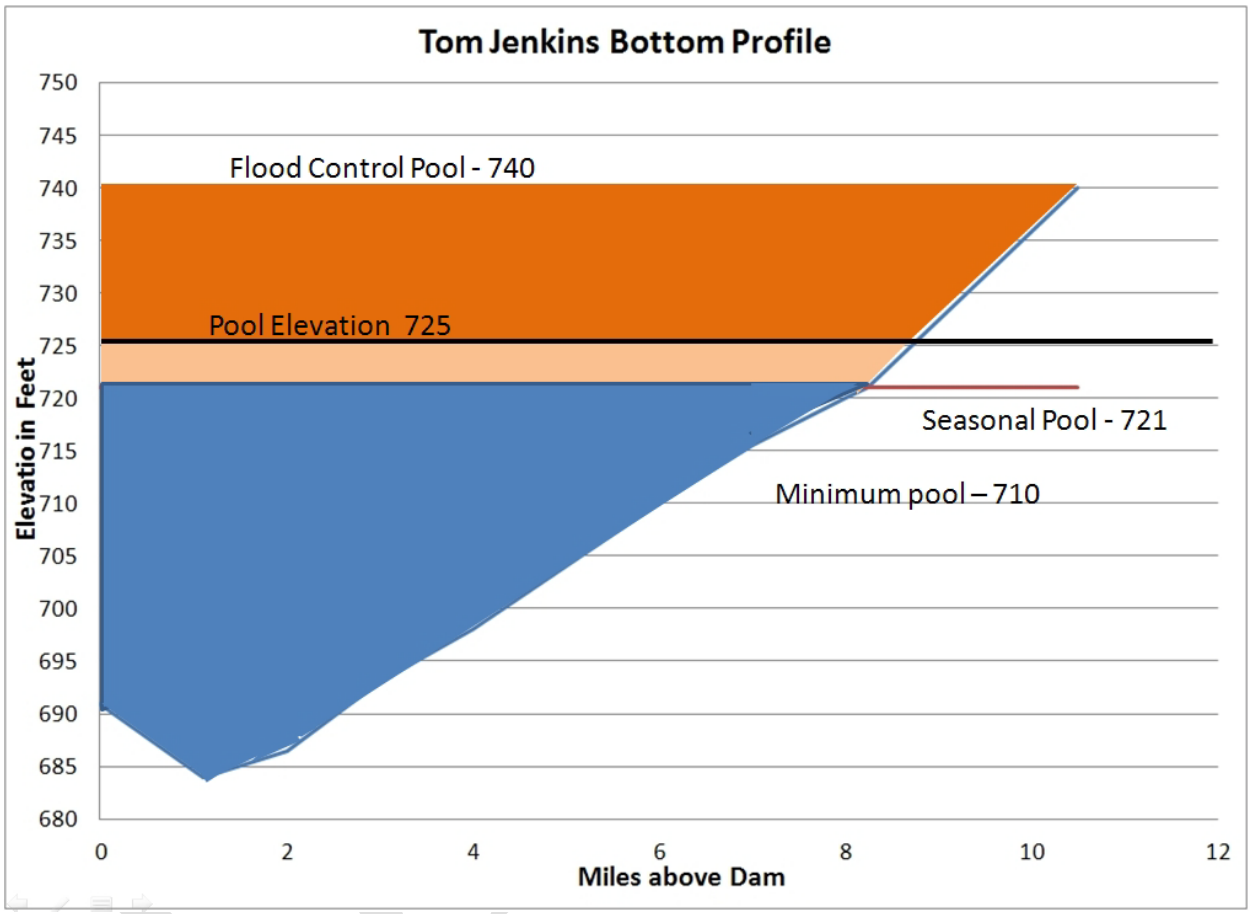

Figure 1. Tom Jenkins Dam backs water to elevation 721 year round with a flood control pool of 740. Having to limit the storage to elevation 725 is an 84% reduction in flood storage.

(4) RECOMMENDED INTERIM PROJECT OPERATIONAL LIMITS

Until appropriate scientific studies necessary to assess the risk posed by the underground "corridor" to the project and the public can be completed and the risks fully understood, the project will no longer operate for Ohio River Control. The project will continue to operate to reduce local downstream flooding using control stages as stated in the Water Control Manual for Sunday Creek and the Hocking River. Whenever the lake elevation is forecast to exceed elevation 725, based on rainfall on the ground, using CWMS model software, project conditions will be monitored as needed on an increased frequency. Water Management staff and project staff will work to lower the lake elevation as quickly as possible to achieve an elevation below 725.0 while controlling for local downstream flooding.

(5) SUMMARY OF JUSTIFICATION

Buckingham Coal Company was granted a permit (D-2223-3) from Ohio Department of Natural Resources (ODNR) to mine coal within the Burr Oak Lake State Park near Glouster, Ohio. In order to access coal reserves on the eastern side of East Branch of Sunday Creek, Buckingham Coal mined a "corridor" less than 60 feet beneath the valley floor of the reservoir following additional permit approval from the Mine Safety and Health Administration (MSHA). ODNR and MSHA permit files provided to the District indicate limited site-specific geologic data collected for the "corridor" location. The MSHA permit files indicate that between the roof of the then proposed mine and the valley floor/ground surface there is about 60 feet of overburden (i.e. unconsolidated (soil) and consolidated (bedrock) material) present. Of this thickness, about 20-22 feet is possibly unconsolidated material leaving about 40 feet or less consisting of consolidated material (bedrock). Furthermore, none of the drill hole information contained in the ODNR or MSHA permit files that the District has reviewed provides any indication of the bedrock's geologic condition or its degree of competency – key factors in making geotechnical engineering evaluations regarding subsidence and breakthrough potential.

This shallow bedrock interval is undoubtedly naturally weathered and fractured due to valley stress relief, regional jointing, rebound, and discontinuities common to sedimentary rock. Also, in many cases, the USACE has discovered faulting in valley floors when excavating to construct dams. The Office of Surface Mining Reclamation and Enforcement (OSMRE) indicates in their 2007 Guidance Manual "*Outcrop Barrier Design for Above Drainage Coal Mines*" that "*most rock and coal within approximately 200 feet of the ground surface are weathered and fractured, which can reduce its strength drastically,…*". MSHA's Engineering and Design Manual, Coal Refuse Disposal Facilities, Second Edition May 2009 references another MSHA document[1] from 2003 indicating "*that any location where the cover over a mine entry is less than 100 feet of* ***solid strata*** *(especially at locations near the outcrop where additional weathering and stress relief has occurred) is a concern for sinkhole development.*" [bold emphasis added] Sinkholes are a manifestation of subsidence on the ground surface.

The aforementioned MSHA Design Manual (2009) and MSHA's October 2007 Coal Mine Impoundment Inspection and Plan Review Handbook (Handbook Number PH07-V-1(1), updated 14 May 2010) specifically address the matter of attaining knowledge of the "*nature of the overburden*" or "*sufficient information on the geologic conditions (e.g., rock quality, joints, weathering)*" and its importance "*for an assessment of subsidence and breakthrough potential*". The mostly-unknown nature/geologic conditions and the limited thickness of the bedrock within the MSHA permit area warrant serious concerns about subsidence and breakthrough potential within the reservoir basin, both in the short-term and long-term.

The District's primary concerns are that an uncontrolled release of the pool into the mine could occur if there is subsidence of the mine "corridor" either prior to, or as a result of, flooding in the drainage basin or breakthrough of the reservoir into the mine "corridor" during flooding in the drainage basin, subsequently allowing reservoir waters to exit at some point outside the drainage basin. One potential exit point for reservoir waters into the Sunday Creek drainage basin exists

[1] "Guidance for Evaluating the Potential for Breakthroughs from Impoundments into Underground Mine Workings and Breakthrough Prevention Measures"

at the mine's portals/box cut area. Information obtained from ODNR permit application files indicate that the portals/box cut floor elevation is lower than the pool when water is above the "corridor". According to Buckingham's legal counsel, the lowest point of the box cut rim is 737 feet above mean sea level; however, no "as constructed" details of the portals/box cut area have been provided to date. The Tom Jenkins Dam was designed for flood control maintaining a year-round lake elevation of 721 feet with a spillway elevation of 740 feet. Maximum flood elevation is 761.4[2]. Consequences of the potential flooding resulting from an uncontrolled release of reservoir waters through the mine are not fully understood at this time.

To avoid the possibility of an uncontrolled release through the mine, storing water above elevation 725.0 feet will be reduced as much as possible while controlling for downstream flooding for Sunday Creek and the Hocking River according to the water control manual.

Operating the project for 'Ohio River Control' is more likely to hold water above elevation 725.0 feet than most reservoir operations to control for local downstream flooding. Therefore, water will not be stored in the Reservoir to reduce flooding on the Ohio River (i.e. elimination of 'Ohio River Control') until such time that scientific studies necessary to evaluate the risk to the project and the public imposed by the underground coal mining "corridor" are completed and the risks are fully understood.

If floodwaters begin to enter the mine due to subsidence or reservoir breakthrough or if water starts to exit the portal(s) causing flooding, immediate action may be necessary to lower the lake level below elevation 725.0 feet. This type of operation, limiting storage below 725 feet, would result in an 84% reduction in flood storage for the project. See figure 1.

In an effort to reduce the risk to the project and to public safety, appropriate scientific studies are needed to fully understand the full magnitude of all of the risks created by the mining activities. Until the studies are completed and the risks are fully understood appropriate interim risk reduction measures must be implemented.

(6) NATIONAL ENVIRONMENTAL POLICY ACT CONSIDERATIONS
NEPA documentation is currently under review for this IOP.

II. OPERATIONS

(1) INTERIM WATER CONTROL PLAN

a. Overview. The purpose of the Interim Operating Plan is to provide guidance for project operation until such time the risk associated with the mining is fully understood. The main goal of this plan is to decrease the likelihood of an uncontrolled release of flood water through the mine while minimizing downstream flooding. This plan utilizes all available tools in order to achieve these goals. Refer to Appendix B for a description of pool elevations behind the dam and downstream control points.

[2] Draft report for TJE PMF update 2011

b. Operational Guidance .

1. Downstream Controls

Tom Jenkins Dam is part of a comprehensive flood control plan to reduce flooding in the Ohio River Basin. Part of the operation, 'Ohio River Control', will be eliminated until such time that scientific studies necessary to assess the risk posed by the underground "corridor" to the project and the public can be completed and the risks fully understood.

The project has a negligible effect on water levels in the Ohio River and storing water above elevation 725.0 feet increases the risk to public safety and to the integrity of the project. The approximate control flow at the next downstream dam, Belleville Locks and Dam is 317,000 cfs with a stage of 45 feet. The maximum physical discharge from Tom Jenkins ranges from 1550 – 1850 cfs, depending on pool elevation. This is approximately 0.5 % of Belleville's total flow and a change in stage would not be measureable. Historical records indicate that the project has operated for Ohio River controls three times. Of these times, only one event shows the Ohio River exceeding a stage of 45 feet at Belleville.

- September 19, 2004 – Belleville 45.8 feet
- January 1, 1991 – Belleville 41.5 feet (forecasted to exceed 45 feet)
- March 6, 1955 – Belleville 41.3 feet (forecasted to exceed 45 feet)

2. Local Downstream Flood Control

The project purpose of flood reduction to the local downstream communities of Glouster, Trimble, Chauncey, and Athens along Sunday Creek and the Hocking River will continue as described in the water control manual. As the lake elevation approaches elevation 725 feet, project staff will continue to follow guidance in the water control manual for Sunday Creek and the Hocking River. At the same time they will make every effort to lower the lake elevation to less than elevation 725 feet if possible, thus minimizing the duration the pool is above that level. Local downstream flood control has priority. Those controls are:

Gage Name	**Summer 4/15-11/30**	**Winter 12/1-4/14**
"A"	14.5 ft	15.5 ft
Glouster	12.5 ft	14.0 ft
Athens	22.0 ft	22.0 ft

Required project releases will be determined based on forecasts developed using CWMS modeling software. Forecasts used for this scenario will be based on rain on the ground.

When the pool is forecast to exceed elevation 725 feet, Water Management will advise Office of Counsel, EOC, the Dam Safety Officer and the Commander.

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3. Post Flood Drawdown**.**

After the reservoir crests and if the pool elevation exceeds elevation 725 feet, the project will be operated to lower the pool elevation to elevation 725 feet as quickly as possible while not exceeding downstream controls according to the water control manual for Sunday Creek and the Hocking River. Gates should be opened as necessary to maintain downstream stage at or below controls until the lake elevation approaches seasonal pool elevation of 721.0. If a second rise were to occur, the project will return to operation as defined above.

c. Protocol for Implementation of Dam Safety Actions

1. Dam Safety Emergency

If observations of the lake indicate its integrity is in question or if subsidence is observed or if water is exiting from the mine portal causing flooding, the Commander may declare a Dam Safety Emergency depending on observed conditions.

If a Dam Safety Emergency has been declared, the Commander may exercise his emergency authority to increase the outflow to levels that will result in damage downstream of the project in order to reduce the potential of damages at locations not otherwise affected by the operation of the project.

It should be noted that if a large discharge is required without the use of the spillway, the discharge capacity is restricted to the capacity of the discharge tunnel. See plate 1 in Appendix A

When a dam safety emergency has otherwise been declared, the Water Resources Engineering Branch Chief shall inform the Dam Safety Officer and the Commander. After the Commander determines a course of action the Water Resources Engineering Branch Chief shall:

- Direct the project releases.
- Inform the Division Chief of Water Management
- Ensure that the EOC is informed
- Inform the National Weather Service Ohio River Forecast Center and Weather Forecast Offices

2. Emergency Operation

In the event that all communication is disrupted either between the Huntington District office and / or the Scioto Area Office and Tom Jenkins Dam Project Office, the Scioto Area Office Manager will assume responsibility for regulation if communication exists between the Area and the project Offices. Otherwise the Damtender will assume regulation of the dam. The project should make continuous and vigorous efforts to contact the District Office or the Scioto Area Office. If communication has been disrupted for more than THREE hours, project personnel will operate the reservoir based on guidance found in the Water Control Manual under “Instructions to the Damtender”.

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(2) EFFECT of the INTERIM OPERATING PLAN

a. Ohio River Flood Control.

Tom Jenkins Dam is operated for 'Ohio River Control' whenever the National Weather Service forecasts the river stage at Bellville Lock and Dam to exceed 45 feet. Over the past 49 years, there have been 3 events where Tom Jenkins Dam was operated for flood control on the Ohio River. They were

- September 2004 – stage at Belleville L/D was 45.80 feet
- January 1991 – stage at Belleville L/D was 41.50 feet
- March 1955 – stage at Belleville L/D was 41.30 feet

In two of the three events the Ohio River crested well below 45 feet at Belleville L/D, thus there has been one time in the past 49 years where Tom Jenkins Dam may have reduced the crest when the Ohio River reached 45.0 feet at Belleville L/D.

b. Local Flood Control.

There are no expected impacts to local flood control. Project staff will make an effort to keep the lake elevation below 725.0 while controlling for downstream flooding, but local flood control will have priority.

III. Communication and Coordination

(1) NOTIFICATION LIST

Notification lists for Government and Local Officials including USACE LRD, USACE Headquarters, and local officials are located in Tab 4 of the Emergency Action Plan.

(2) NORMAL COMMUNICATIONS

Communication between the Project, District, Division, and non-Corps entities is described in Chapter 6 of the Tom Jenkins Water Control Plan. Due to the additional forecasting requirement in the Hocking River Basin, the Water Management Section will remain in close contact with the National Weather Service Ohio River Forecast Center, and the Charleston Weather Forecast Office when precipitation events are projected in the Hocking River Basin. Contact numbers for these offices are located in Tab 4 of the Emergency Action Plan

(3) ENHANCED COMMUNICATIONS

a. Overview. When a large precipitation event is projected or has occurred in the Hocking River Basin above Tom Jenkins Dam, additional communications will occur between the interested entities. This section describes the expected nature of the interaction between the different entities. This section does NOT provide guidance for Project operation during the loss of communication between the Project and the District. That guidance is found in Chapter 2, Interim Operating Plan, Section C, Protocol for Implementation of Dam Safety Actions Item 2. Emergency Operation.

b. Dam Safety Emergency Action Plan. The Dam Safety Team has prepared and annually updates a Dam Safety Emergency Action Plan. Copies of this plan are stored at the District

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Office and at the Tom Jenkins Project Office. The plan provides contact information including: the project supervisor, Dam Safety Officer (DSO), USACE Headquarters, USACE Division, local community, and local law enforcement. In addition, two notification charts, a Dam Failure in Progress Condition (Red Sheet) and a Possible Dam Failure Condition (Yellow Sheet) provide notification requirements and notification priorities. These charts require notification of :

- Project supervisor (or alternate)
- DSO (or alternate)
- Local Official (if dam failure is in progress or if directly authorized by the DSO)

It is expected that the DSO will convene the Dam Safety Committee and contact the Commander and USACE Emergency Operations Center upon notification of a mining safety issue. The DSO will also contact the Division Dam Safety Program Manger and the Division DSO.

c. LRH Emergency Operations Center (EOC). The EOC opens upon direction of the Commander and will coordinate all action with the Ohio Emergency Management Agency. It is expected that the DSO will recommend that the Commander open the EOC when a mining safety issue is observed with the Project.

d. Tom Jenkins Project Personnel. Project personnel will utilize the Dam Safety Emergency Action Plan. Project personnel will also be in contact with the Water Management staff and with the local County Emergency Management Agency. These contacts will include briefing on current conditions, expected developments, and projected discharges and pool elevations.

e. Water Resources Engineering Branch, Water Management Section. The Water Management team will keep the DSO apprised of significant forecast events expected to impact the Hocking River Basin. If the forecasted Tom Jenkins Dam inflow results in a pool elevation near or above elevation 725, the Water Management team will contact the Scioto Area Office, the Dillon Project office, and the Tom Jenkins Project office. Contact information is in Appendix C and also in the Water Management Section with updated phone numbers and contact names.

If the forecasted Tom Jenkins Dam inflow results in a pool elevation above elevation 725, the Water Management team will advise Office of Counsel, EOC, the Dam Safety Officer, and the Commander. See appendix C for contact information. The Water Management team will be in constant contact with NWS personnel receiving updates on weather forecast and providing NWS hydrologist projections of pool elevations and outflow.

When directly authorized by the DSO, Water Management Personnel will inform the NWS hydrologist at the Ohio River Forecast Center, and the Charleston Weather Forecast Office that the USACE is concerned for the safety of the mining “corridor” which will result in the issuance of a Flash Flood Warning (and other appropriate warnings) for communities nearby.

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f. National Weather Service. The NWS is the sole federal agency authorized to issue flood and flash flood warnings. Upon notification of an emergency involving the integrity of the lake, the Charleston Weather Forecast Office, will:

- confirm the report
- issue the appropriate initial product
- make contact with personnel on the notification list and internal NWS support
- issue follow-up product
- issue flood warnings for lower reach if needed

The NWS will initially issue either a Flash Flood Warning (FFW), if mine subsidence or reservoir breakthrough has already occurred or if indication of imminent subsidence or breakthrough is evident. If mine subsidence or reservoir breakthrough has not yet occurred, but USACE personnel have expressed concern for the safety of nearby communities, the NWS will issue a flash Flood Watch (FFA). Follow-up products could include Flash Flood Statements (FFS), another Flash Flood Watch (FFA), or a Flood Warning (FLW) for downstream communities.

g. Ohio Emergency Management Agency and County Emergency Management Agency. Upon receipt of an update of the status of Tom Jenkins Dam pool and outflow projections, the state and county offices will disseminate this information to adjacent counties and take the necessary step to mitigate the risk to the local population.

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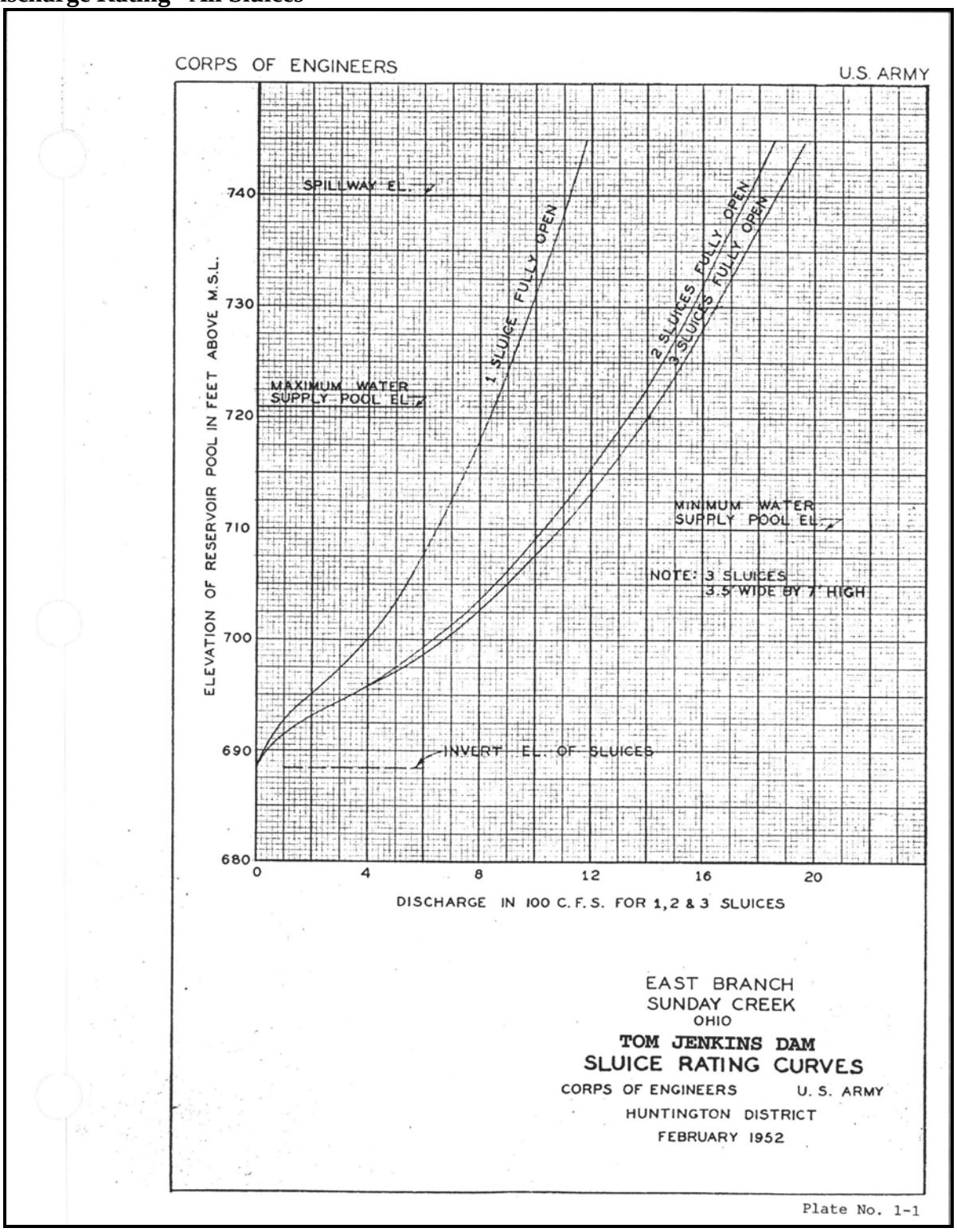
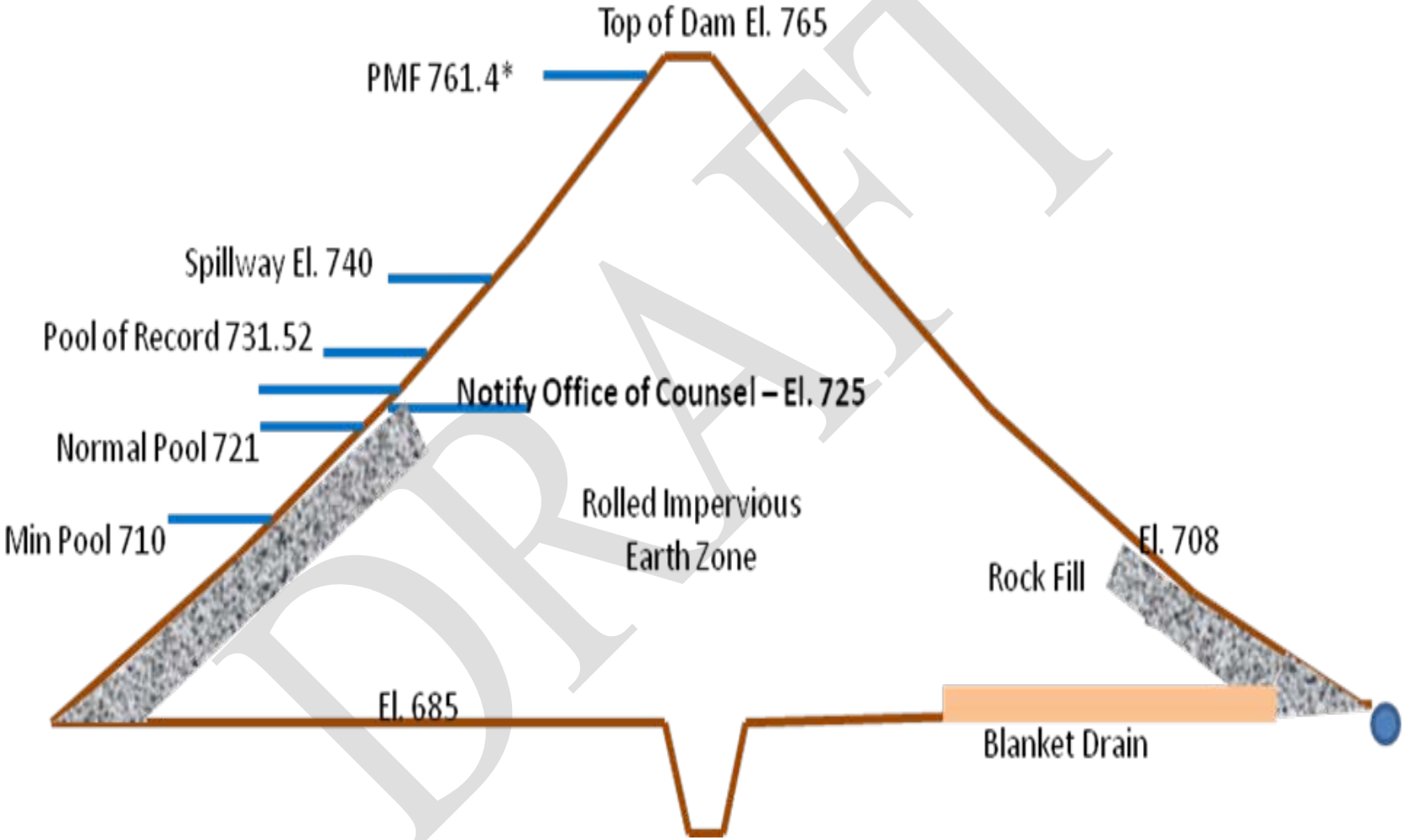
Appendix A

Plate 1
Discharge Rating –All Sluices



Appendix B

Tom Jenkins Dam



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TOM JENKINS DAM
EAST BRANCH OF SUNDAY CREEK, OHIO
Instrumentation Observation Schedule and Surveillance Plan

LEVEL I POOL EL. < 728.0	LEVEL II 728.0 ≤ POOL EL. < 731.0	LEVEL III POOL EL. ≥ 731.0
Inspect dam weekly.	Inspect dam daily.	Initiate 24-hour surveillance if needed.
Read piezometers monthly.	Read piezometers daily.	Read piezometers daily.
Survey surface displacement monuments and crest profile once every five years.	Evaluate when to dispatch Dam Safety/Geotechnical personnel to the project.	Dam Safety/Geotechnical personnel on site report to DSC, DSPM, EC-G Chief and DSO.
	Put District Engineering staff on alert; evaluate instrumentation; evaluate forecast and make pool predictions.	DSPM, EC-G Chief and DSO notify the Dam Safety Committee.
Sound piezometers annually to determine total depth (same month each year).	OR report conditions to the DSC (email acceptable)	
	DSC briefs DSPM; DSPM briefs EC-G Chief and DSO.	

NOTES:
1. Pool of Record Elevation – 731.52 (31 May 1968); 48.6% Flood Storage Capacity Utilized
2. Spillway Crest Elevation – 740.0
3. Summer Pool – El. 721.0; Winter Pool – El. 721.0; Maximum Design Pool – El. 759.9
4. DSAC Rating: IV

DSC = Dam Safety Coordinator *[Raynell Napier, (W) 304-399-6997, (M) 304-544-0106]*
DSPM = Dam Safety Program Manager *[Sean Carter, (W) 304-399-5212, (M) 304-730-3562]*
DSO = Dam Safety Officer *[John Jaeger, (W) 304-399-5254, (M) 304-751-7194]*

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Appendix F

Mailing List

Honorable John Kasich
Governor of Ohio
Riffe Center, 30th Floor
77 South High Street
Columbus, OH 43215-6117

Honorable Sherrod Brown
United States Senate
200 N High St. Room 614
Columbus, OH 43215

Honorable Rob Portman
United States Senate
37 West Broad Street
Room 300
Columbus, OH 43215

Honorable Bill Johnson
United States House of Representatives
258 Front St.
Marietta, OH 45750

Honorable Bob Gibbs
United States House of Representatives
1166 Military Road, Suite B3
Zanesville, OH 43701

Honorable Debbie Phillips
Ohio House of Representatives
77 S. High St
14th Floor
Columbus, OH 43215-6111

Honorable Troy Balderson
Ohio State Senate
1 Capitol Square, Ground Floor
Columbus, Ohio 43215

Larry Payne
Athens County Commission
5084 W. Clinton St., PO Box13
Albany, OH 45710

Mark Sullivan
Athens County Commission
15899 Millfield Rd.
Millfield, OH 45761

Lenny Eliason
Athens County Commission
11 Old Coach Rd
Athens, OH 45701

Mike Reed
Morgan County Commission
Riecker Building
155 East Main Street
McConnelsville, Ohio 43756

U.S. Environmental Protection Agency
77 West Jackson Boulevard
Chicago, Illinois 60604

Mary Knapp
U.S. Fish and Wildlife Service
Ecological Services
4625 Morse Road, Suite 104
Columbus, OH 43230

Ohio Environmental Protection Agency
Northeast District Office
2110 East Aurora Road
Twinsburg, OH 44087

Ohio Department of Natural Resources
Division of Wildlife
2045 Morse Road-Building G
Columbus, OH 43229

Ohio Department of Natural Resources
Division of Natural Areas and Preserves
2045 Morse Road- Building F1
Columbus,OH 43229

Mark J. Epstein, Department Head
Resource Protection and Review
800 E. 17th Ave.
Columbus, OH 43211-2474

Honorable Miles Wolf
Mayor of Glouster, OH
25 Fairview Avenue
Glouster, OH 45732

Honorable Robert Mattey
Mayor of Chauncey, OH
42 Converse Street
Chauncey, OH 4571

Honorable Paul Wiehl
Mayor of Athens, OH
3 Mary Street
Athens, Oh 45701

Dean Cain
Morgan County Commission
Riecker Building
155 East Main Street
McConnelsville, Ohio 43756

Tim VanHorn
Morgan County Commission
Riecker Building
155 East Main Street
McConnelsville, Ohio 43756

Glouster Library
20 Toledo Street
Glouster, OH 45732-9341