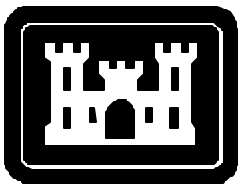


U.S. Army Corps of Engineers
Pittsburgh District

YOUGHIOGHENY LAKE WATER MANAGEMENT AND REALLOCATION STUDY

DRAFT FEASIBILITY REPORT

U. S. Army Corps of Engineers
Pittsburgh District

December 2002

Executive Summary

The Youghiogheny River Lake Water Management and Reallocation study, of which this Feasibility Report represents the Final Phase, was undertaken with the objective of improving the storage and release schedule of Youghiogheny River Lake to more effectively address the needs of its current and potential future users. These needs include recreation, preserving the natural environment and water supply. From the earliest Phase of the study, participation from all of the stakeholders, including the North Fayette Water Authority, Pennsylvania Fish and Boat Commission (PAFBC), the whitewater industry, the Chestnut Chapter of Trout Unlimited, the Youghiogheny Area Fisherman Association, the City of Connellsville, Fayette Forward (community group), Westmoreland County Conservation District, and the City of Dawson was encouraged and integrated into the generation of the alternatives.

The Municipal Authority of Westmoreland County (MAWC) owns and operates a large public water supply system that provides drinking water to approximately 400,000 people. The MAWC withdraws approximately forty-five percent of its total daily raw water supply from the Youghiogheny River for processing at its Indian Creek Water Treatment Plant (WTP) located near Connellsville, Fayette County, PA. The Indian Creek WTP is subject to Pennsylvania Department of Environmental Protection (PADEP) Water Allocation Permit No. WA-65-111E. This permit allows the MAWC to withdraw up to 50 million gallons per day (mgd) from the Youghiogheny River at Connellsville. The permit, however, also provides a protection provision to ensure that the federal low flow augmentation from the Youghiogheny River Lake is not compromised. Specifically, Permit Condition No. 6 mandates that the MAWC secure additional upstream storage at such time that the withdrawal rate at the Indian Creek WTP exceeds 28 mgd averaged in any thirty (30) day period when the flow measured at the U.S. Geological Survey stream gage at Connellsville is less than a PADEP established critical low flow rate. The MAWC first exceeded the 28 mgd limit for a single day on August 18, 1994. However, to date, the longest period that the MAWC withdrawal rate has exceeded the 28 mgd limit (averaged) is nine (9) consecutive days. For the ten year period running from January 1, 1991 to December 31, 2000, the MAWC exceeded the 28 mgd limit only 14 times, or less than 0.4% of the time. During calendar year 2000, the MAWC average withdrawal rate from the Youghiogheny River at Connellsville was 22.1 mgd.

Since the U.S. Army Corps of Engineers' Youghiogheny River Lake is located upstream of its intakes, the MAWC contacted the Corps in 1991 to explore the potential for reallocating a portion of the lake's low water storage to water supply. Reallocation is a reassignment of the dedicated use of existing storage space in a reservoir to a different use. Currently, the lake provides additional water to the Youghiogheny River during periods of low water for the sole purpose of improving water quality with an emphasis of diluting acid mine drainage (AMD) pollution. The opportunity for this reallocation was considered to exist because of the recent improvements in the water quality of the Youghiogheny River. This improvement is the result of more enlightened environmental practices of industry and modern mining techniques that reduce AMD pollution, along with an overall reduction in the area's heavy industry and mining. Consequently, the original authorized storage and release schedule for the lake (developed in 1940), that currently is being used provides more water than necessary to dilute the present AMD

pollution condition. In view of the considerable costs and negative impacts associated with alternative water supply strategies, storage reallocation appeared to be the most feasible and cost effective means to alleviate future public water supply shortages and avoid dramatic rate increases. The MAWC's request was to purchase storage space in the reservoir, thus allowing additional water to be released from Youghiogheny Dam during low water periods while still maintaining the present volume flowing further downstream past Connellsville.

Beginning in November 1991, several meetings were held with the MAWC, its engineering representatives, PADEP officials, staff members of Congressmen Austin J. Murphy and John P. Murtha offices, and the Corps. During these meetings, the Corps explained its protocol for studies, first involving an Initial Assessment (IA), followed by a Reconnaissance Effort (at Federal expense), and ultimately a cost-shared Feasibility Study. All participants agreed that utilizing storage within the lake could prove to be a highly effective means of satisfying the increased regional water supply demand.

The Pittsburgh District completed the IA in 1993. The IA defined the MAWC interest to have Youghiogheny River Lake's release schedule provide up to an additional 17 mgd (approximately 25 cfs) during periods of low water. The Federal interest was defined as slowing the rate of reservoir drawdown during normal and wet years in order to improve lake recreation conditions, and provide a more stable river downstream of the dam. The IA concluded that the use of a portion of the water in Youghiogheny River Lake currently assigned for AMD dilution can be reassigned to water supply, through a change in the dam's release schedule. The change uses the strategy of providing slightly less water from the lake's reserve when the river initiates its annual drawdown (usually in late spring), so that more water is available for the river later in the drawdown cycle, during the driest time of the year (usually in the late summer – early fall). The IA further concluded that the increase of base flows in the portion of the Youghiogheny River between the dam and Connellsville could slightly benefit the water quality of the river in this reach, while maintaining the existing base flow downstream of Connellsville. Base flow, sometimes called the dry weather flow, is the amount of water in a stream during the driest time of the year which is being provided solely by groundwater accretion and low water schedule reservoir releases.

Upon the IA approval in November 1993, the Pittsburgh District was then authorized to begin the Reconnaissance effort under the authority of Section 216 of the Flood Control Act of 1970, which authorizes studies to review the operation of completed Federal projects and recommend project modifications. Federal funds for this Reconnaissance study became available from Congress in 1995. The Reconnaissance study was completed in February 1997. The Reconnaissance effort defined a viable alternative release schedule using data from 1991 (dry year) and 1992 (wet year), and identified the MAWC as a potential cost-sharing partner for the Feasibility Phase.

This Feasibility study is cost-shared 50 percent by the U.S. Government and 50 percent by the local sponsor (the MAWC). The Pittsburgh District entered into a Feasibility Cost Sharing Agreement with the MAWC on April 21, 1999 in a signing ceremony held at the Connellsville City Council Chambers of the Connellsville Municipal Authority. This phase is to define the optimal storage and release schedule, conduct public participation sessions, and complete

compliance with the National Environment Policy Act (NEPA). Public meetings were held to inform stakeholders of the progress and conclusions of the study and to provide an open forum for the stakeholders to express their concerns about the direction of the study. The Feasibility Study initiation meeting was held on June 3, 1999 at the City of Connellsville Municipal Building. This public meeting outlined the study objectives and identified members for the public steering committee. Over 50 stakeholders attended the meeting including representatives of Federal, State, and Local governments, as well as concerned citizens.

One of the major objectives of the Feasibility Study is to determine the final alternative storage and release schedule. This proposed alternative schedule was designed: 1) not to adversely impact the authorized purposes of Youghiogheny River Lake, 2) to provide storage space for water supply purposes, and 3) to optimize the storage and release schedule for the project (the Federal Government interest). A major portion of the Feasibility effort was conducting detailed water quantity and water quality modeling of various alternative storage and release schedules in order to determine the optimum schedule.

The water quantity alternatives were judged based upon their impact to 1) the $Q_{7\text{-}10}$ flow rates at various downstream locations, and 2) reservoir drawdown. The $Q_{7\text{-}10}$ flow rate is defined as the annual 7-consecutive day average low-flow rate that occurs an average of once every 10 years. The $Q_{7\text{-}10}$ is used by PADEP as water quantity criteria for dilution in a stream. The $Q_{7\text{-}10}$ of the Youghiogheny River at Connellsville, as regulated by Youghiogheny River Lake is about 297 mgd. If the Youghiogheny dam did not exist, the $Q_{7\text{-}10}$ at Connellsville would be 68 mgd. The final proposed alternative, when fully implemented, will increase the $Q_{7\text{-}10}$ at Connellsville to 316 mgd. With the withdrawal of an additional 17 mgd at Connellsville, PADEP's water quantity criteria for dilution downstream of Connellsville would not be negatively impacted. The proposed alternative schedule rebalances releases from the dam so as to provide additional water in the river, as well as reducing the rate of drawdown that occurs in the reservoir during the recreation season. The annual late-spring early-summer conservation implementation of the proposed alternative will result in the drawdown in (lowering of) the lake being reduced from 34 feet to 23 feet during a wet year, from 44 feet to 29 feet in an average year, from 50 feet to 43 feet in a dry year, and by less than 1 foot during a drought. During the annual spring conservation period, using the proposed alternative, the flow at Connellsville will be reduced by up to 32 mgd. This change will slightly reduce the average flow (2,340 mgd) at Connellsville in the April – May period in order to slightly increase average flow (800 mgd) in the August – September period closer to the yearly average flow (1,690 mgd).

The proposed alternative did not change the flood control capability of the dam. The space available to capture floodwater, between elevation 1419 and 1470 in the winter and between elevation 1439 and 1470 in the summer, as originally designed, has not changed. The study focused on reallocating (redefining the use of) a portion of the stored water currently reserved for downstream AMD dilution, between elevation 1344 and 1439 in the summer and between elevation 1344 and 1419 in the winter, to water supply. The total amount of water supply that is being considered is equivalent to a volume of about 7% of the water currently dedicated to AMD dilution and about 4% of the total space behind Youghiogheny dam (between elevation 1344 and 1470). Since the proposed water supply is not utilizing any of the space allocated to flood control, there will be no change to the project's ability to store floodwaters. In addition, the

proposed alternative will not cause any downstream river flow rate or lake level that has not previously been recorded. The proposed alternative will create a more stable river downstream with higher base flows during extended dry periods.

The results of the water quantity modeling portion of the Feasibility study were presented at a one-day Public Steering Committee Meeting held on the Fayette Campus of the Pennsylvania State University in Uniontown, Pennsylvania on December 3, 1999. Stakeholders attending the meeting included representatives of Federal, State, and Local governments, as well as concerned citizens. The topics of the questions fielded at the meeting varied from global warming to the right of a regional water authority to remove water from its originating county for use in another county. The latter topic was the specific concern of Fayette County Commissioners who thought the removal of the water from their county would impact its future development. The meeting lasted over six hours with a majority of the time being dedicated to questions and answers. Subsequent to the meeting, the Pennsylvania Fish and Boat Commission provided the Corps with two additional alternative release schedules for evaluation. This then raised the total number of alternatives to eight.

As part of the study, these alternatives were examined and ranked or eliminated using criteria which included cost of implementation, negative impacts to the environment, the need for land acquisition (associated with a structural modification of the dam), and public acceptance. This process reduced the eight original alternatives to a final set of three. One of the three alternatives met only the water supply need. The other two alternatives met this need and the federal interest of optimized operations. These three alternatives were then examined in greater detail in the Final Phase of the study resulting in the recommended alternative.

Water quality modeling (both within Youghiogheny River Lake, and the downstream regulated reach of the Youghiogheny River), over the period of record was conducted to evaluate the potential for adverse impacts related to the alternative storage and release schedules. The water quality model development for Youghiogheny River Lake and the Youghiogheny River was performed under contract by a qualified local engineering firm, Advanced Technologies Systems, Inc (ATS). ATS utilized the generally regarded best technology available, the CE-QUAL-W2 model for the lake and the CE-Qual-RIV1 model for the river. While operating to meet the requested water supply withdrawal, no difference in water temperature was realized at any flow condition in the river. When operating for the Federal interest portion of the proposed alternative (a slower rate of fall of the pool level) during normal and wet years, a slight increase in water temperature of about 1^{o} C downstream of the dam was identified. The changed situation lies well within the range of normal conditions. With respect to the slight warming of the river in the reach downstream of the dam, the Pennsylvania Fish and Boat Commission (PAFBC) reviewed the technical portion of the feasibility study. In its August 3, 2000 letter to the Corps the PAFBC stated, "We do not believe the predicted slightly increased frequencies and ultimate maximum river water temperatures that would result from the proposed alternative would cause significant impacts to the fishery". The results of the water quality modeling were presented to a technical sub-committee of the Public Steering Committee on September 7, 2000 in Pittsburgh, PA and were presented at another Public Steering Committee Meeting on February 8, 2001 in Connellsville, PA.

Throughout the study process, public participation was solicited and encouraged. Several concerns raised during the Public Steering Committee meeting and the Technical Sub-Committee meeting made it apparent that the manner in which the recommendations would be implemented would be important. The most significant and frequently expressed concern was the perception that there would be no storage space available to other users/suppliers to meet future needs in the region. This concern was addressed on two fronts. First, the sponsor proposed an initial storage reserve of 2,950 acre-feet rather than the entire 10,000 acre-feet originally identified. Second, and most importantly, by mutual agreement, the remaining 7,050 acre-feet would be made available to any applicant, including the sponsor, subject to need. No applicant will be allowed to reserve storage space just to prevent others from doing so. All requests will follow existing state permit procedures. Although the water quality findings indicate that no significant negative impacts are expected, if an unforeseen significant negative impact occurs that can be conclusively traced to the revised operations, the District will discontinue the revised operations and either return to the schedule that was in effect prior to any revisions or make appropriate changes that will correct the problem.

This Reallocation Study was initiated under the assumption that all 10,000 acre-feet, upon approval of the report, would be immediately included in a formal water supply agreement. During the later stages of evaluation and review, the implementation process developed to address public comment and concern (see previous paragraph) invalidated that assumption. It did not, however, change the objectives or focus of this study. Analyses and findings are based on the full 10,000 acre-feet, which represents the end state condition. Implementation recommendations are based on easily separable federal and sponsor interests. Initially, the revised release schedule will only incorporate changes to Release Zones E, F, and G which will result in increased conservation in the spring and a reduction in the rate of reservoir fall in the late summer and fall periods. This change represents the federal interest not attributable to water supply and will create improvements for both reservoir and downstream recreation as discussed in this report. As water users purchase increments of the 10,000 acre-feet, the release schedule can be further revised to incorporate the additional water needed for downstream withdrawal. Changes for this purpose represent the sponsor interest and will involve revisions to Release Zones C and D. The revisions will be proportional to the size of the purchased storage increment. When the total purchased storage reaches 10,000 acre-feet, end state will be reached and no further revisions will be made under authority of this study.

In conclusion, the findings of the Feasibility Study indicate that the reallocation of reservoir storage and revision of the reservoir release schedule can provide supplemental water without excluding any future water user. In addition, it is anticipated that improved recreation associated with the project can be achieved without adversely impacting the existing authorized purposes of Youghiogheny River Lake. The opportunity now exists to redefine the use for a small portion of water stored in Youghiogheny River Lake to water supply. The additional water supply will better position the region for future economic growth. Furthermore, no water supplier will have exclusive rights to the entire reallocated storage capacity. Water conservation in the spring will have a positive effect on lake recreation and the lake fishery. Downstream whitewater recreation will benefit from the more stable river levels and spring release conservation, and downstream water quality may improve as a consequence of increased augmentation at base flows.

TABLE OF CONTENTS

List of Tables and Figures

1 INTRODUCTION

1.1 Study Authority

This feasibility analysis was conducted under the authority of PL 91-611, Section 216, 1970. Section 216 states

"The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest".

Corps of Engineers guidance in applying Section 216 is provided by ER 1165-2-119 (1982). This guidance encourages the use of Section 216 to examine current project operations and recommend improvements to better serve the current mix of users. Guidance concerning the approval authority for reallocation of storage space in multi-purpose Corps projects is provided in ER 1105-2-100 (22 April 2000). For projects where there will not be any significant impacts on other project purposes, 15 percent of the total capacity or 50,000 acre feet, whichever is less, may be allocated from storage authorized for other purposes or may be added to the project to serve as storage for municipal and industrial water supply at the discretion of the Commander, USACE. Reallocations that exceed the Commander's authority may be approved at the discretion of the Secretary of the Army if such reallocations do not require Congressional approval.

Other legislation that impacts this study includes Section 301(b) of the Water Supply Act of 1958, as amended, which authorizes the Corps of Engineers to include water supply storage in a multi-purpose reservoir provided that it is economically justified and the cost of including the storage is borne by a non-Federal entity. Section 301(b) is the authority by which the Corps may include municipal and industrial water storage in reservoir projects. The terms "municipal and industrial", while not defined in the legislative history of the Water Supply Act, have been defined by the Corps to mean supply for uses customarily found in the operation of municipal water systems, and for uses in industrial processes. The non-Federal sponsor acquires a permanent right to the use of storage as long as the space is physically available, however reallocation does not guarantee a firm yield of water.

1.2 Study Purpose and Scope

The purpose of this feasibility study is to examine the storage and release schedule of Youghiogheny Lake to determine the potential for reallocating a portion of lake storage for water supply. In addition, this study examines how reallocation could enhance recreation in Youghiogheny Lake and downstream. This report recommends the most effective storage and release schedule to achieve the desired purpose and will act as a decision document to officially add water supply as an authorized project purpose.

Municipal Authority of Westmoreland County (MAWC), the non-Federal sponsor for this feasibility analysis, is currently permitted by the Pennsylvania Department of Environmental Protection (PADEP) to withdraw as much as 50 MGD from the Youghiogheny River. However, the PADEP permit requires the identification of additional supply sources when withdrawal from the Youghiogheny River and the Indian Creek reservoir exceed 28 MGD averaged over a 30-day period. Since the maximum daily withdrawal from Indian Creek reservoir is 5 MGD, withdrawal in excess of 28 MGD indicates that withdrawal from the Youghiogheny River is in excess of 23 MGD. The 23 MGD withdrawal threshold has never been exceeded over a 30-day average, but was exceeded on a single day basis for the first time in 1991 and has been occasionally exceeded on a single day basis since then (see the Economics Appendix for a more detailed discussion).

The February 1997 Water Management and Reallocation Reconnaissance Study report recommended further examination of storage reallocation and modification of the Youghiogheny Lake release schedule. The Reconnaissance Study examined five categories of alternatives including

- no action,
- structural modifications to provide additional storage,
- release schedule modifications without storage reallocation,
- release schedule modifications with storage reallocation, and
- storage reallocation and in-lake withdrawal.

The Reconnaissance Report recommended that alternatives concerning reallocation and release schedule modification be developed and assessed during the feasibility investigation. Alternatives that rely on structural modifications to the dam and in-lake withdrawal were not recommended for further analysis and are not developed in the feasibility investigation.

1.3 Previous Studies

Ohio River and Tributaries: Youghiogheny River Lake Reservoir Regulation Manual. U.S. Army Corps of Engineers, Pittsburgh District, revised June 1979. This manual contains the standard operating procedures for the lake including flood control schedules and regulation procedures and low flow augmentation schedules and procedures. This document is also a source of information pertaining to the authorization and construction of the dam.

Analysis of Water Supply Potential of the Youghiogheny River Lake, U.S. Army Corps of Engineers Pittsburgh District, 1981.

Drought Contingency Plan for Youghiogheny River Lake Basin, Pennsylvania and Maryland, U.S. Army Corps of Engineers (USACE), 1992.

Youghiogheny River Lake Storage Reallocation, Initial Assessment, U.S. Army Corps of Engineers (USACE), 1993.

Youghiogheny River Lake Reallocation of Storage Reconnaissance Study, Water Quality Analysis, U.S. Army Corps of Engineers (USACE), 1996..

Youghiogheny River Lake Water Management and Reallocation Study, U.S. Army Corps of Engineers (USACE), 1997.

Sedimentation Report for Youghiogheny River Lake, U.S. Army Corps of Engineers (USACE), 1999.

Draft Youghiogheny Reservoir Master Plan Update, U.S. Army Corps of Engineers (USACE), 1999.

Water Quality Model Development for Youghiogheny River Lake and Youghiogheny River. Advanced Technology Systems, Inc. (ATS), 2000. Prepared for the Municipal Authority of Westmoreland County and the U.S. Army Corps of Engineers, Pittsburgh District.

2 EXISTING CONDITIONS

2.1 General Location and Basin Characteristics

The Youghiogheny River is a perennial stream originating in the mountainous region of northeastern West Virginia and western Maryland that flows, in a generally northern direction paralleling the West Virginia - Maryland border, for a distance of about 39 miles (see figures 1 and 2 at end of text). It then empties into the Youghiogheny River Lake. The Youghiogheny River Dam is located about 1.3 miles upstream of the town of Confluence, PA, where the Youghiogheny River is joined by the Casselman River. Downstream of the dam, the Youghiogheny River flows in a northwesterly direction as it meanders 74.2 miles through several communities to its mouth at the Monongahela River in the City of McKeesport, PA.

The main channel of the Youghiogheny River upstream of the lake is incised in a gorge-like valley at an average depth of 450 feet with an average stream slope of 21 feet per mile. The tributaries are much steeper with average slopes from two to seven times that of the upstream main channel. The basin configuration is roughly elliptical, approximately 39 miles from north to south and 14 miles from east to west. The upper portion of the basin lies in the Allegheny Mountain section of the Appalachian Plateau, which is bordered on the west by Laurel Hill and on the east by Negro Mountain. Basin elevations range fom 720 feet above the National Geodetic Vertical Datum (NGVD) at the mouth of the river to 3,360 feet NGVD at the southern tip of the basin.

The total drainage area of the Youghiogheny River is 1,763 square miles of which 434 square miles are contributory to the Youghiogheny River Lake. Approximately 72.3% of the total drainage basin lies in Pennsylvania, 23.6% in Maryland, and 4.1% in West Virginia (ATS, 2000).

2.2 Project History

The initial construction phase of the Youghiogheny River Lake project began in July 1939. Limited flood control regulation began in December 1942 and full flood control regulation began in January 1948. The Youghiogheny River Lake is currently operated for flood control, low flow augmentation for water quality, and recreation. Flood control storage is particularly effective in reducing flood stages in the Youghiogheny River valley. Stage reductions are also

effected along the Lower Monongahela and Upper Ohio Rivers. The Youghiogheny River Lake in combination with Tygart, Kinzua, Tionesta, Union City, Woodcock, East Branch Clarion, Mahoning, Crooked Creek, Conemaugh, Loyalhanna, Berlin, Michael J. Kirwan, Shenango, Stonewall Jackson, and Mosquito Creek Lakes provides flood protection for the Upper Ohio River Valley.

2.3 Youghiogheny River Dam - General Description

The dam consists of a rolled earth fill, impervious core structure with an uncontrolled side channel spillway (crest elevation 1,468 ft.). Its top length is 1,610 feet and its maximum height is 184 feet above the streambed elevation of 1,316.64 feet. The outlet works consist of an intake orifice, 18 feet wide by 110 ft long, slanted at a 34-degree angle from the horizontal. The invert is at elevation 1328.5 ft and the top is at elevation 1389.5 feet.

The discharge from the towers is controlled by three service vertical lift gates, 4.25 ft wide and 20 feet high at invert elevation 1316.4 feet. The outlet also includes a concrete lined tunnel, 1,800 feet long and 16 feet in diameter.

2.4 Youghiogheny River Dam – Hydropower Facility

A Federal Energy Regulatory Commission (FERC) license for construction of a retrofit non-Federal hydroelectric generating facility at Youghiogheny Dam was granted in 1985. Construction of the facility, now operated by D/R Hydro Company, began in February 1988 and the plant was operational in December 1989. The hydroelectric plant is located near the east abutment and on the downstream side of the dam. It is adjacent to the downstream end of the outlet tunnel and utilizes flow drawn through a penstock that splits off the tunnel. The project's total rated generating capacity was 7 megawatts (MW) at licensing, and is currently 12 MW.

The hydropower plant operates run of river, i.e., the volume of water released is determined by criteria other than hydropower generation. When the water discharge is greater than the turbine's flow capacity (1,600 cfs) a wheel gate directs excess water to the stilling basin. Under the FERC license, D/R Hydro is required to maintain a minimum dissolved oxygen concentration of 7.0 mg/l in the tailwaters. To meet this minimum requirement during the summer season blowers are used that force air into the discharged water.

2.5 Youghiogheny River Downstream of the Youghiogheny River Lake

The river has generally been viewed as having two reaches in Pennsylvania; from the dam near Confluence to Connellsville, and from Connellsville to the confluence with the Monongahela River at McKeesport. Each reach has distinguishing characteristics.

The Youghiogheny River meets with a major tributary, the Casselman River just downriver from the Youghiogheny Dam in the town of Confluence. From Confluence, the Youghiogheny River flows approximately 29.5 miles in a northwesterly direction through Fayette County, PA to Connellsville, PA. The river typically flows through steep-sided walled valleys and is not easily accessible over most of the reach.

The river reach from the Youghiogheny Dam to Connellsville, PA is characterized as scenic with high recreational value and supporting abundant fish and wildlife habitat. The reach below Ohiopyle, PA is popular for white-water rafting and is characterized by rapids separated by pool areas. The rapids generate significant mixing of water, leading to increased dissolved oxygen in the river.

After Connellsville, the river flows with less of a gradient for another 45 miles to the mouth at McKeesport, PA. At McKeesport, the Youghiogheny River joins the Monongahela River 15.6 miles above the mouth of the Monongahela River in Pittsburgh, PA. A 4.2-mile reach of the Youghiogheny River, upstream of its mouth, is in the pool of the Monongahela River Navigation Dam No. 2. This reach can be characterized as more developed and more accessible, with several river towns and agricultural areas along its length. Industrial land use becomes more common in the downstream portions of this reach. Acid mitigation and pollution control have improved the fertility of this reach over recent decades. Several high quality warm-water and cool-water sport fisheries are supported in the river between Connellsville and McKeesport.

2.6 Project Area Social and Economic Characteristics

Important socioeconomic indicators for the study area are provided in Table 2.1. In general, the population in the study area has grown more slowly and tends to be older than the overall state populations, with the exception of Preston, WV, which exhibits characteristics that are similar to the state average. The study area population also has lower median household income and more of the population living below the poverty line than the overall state populations.

Table 2.1. Socioeconomic Indicators

	Pennsylvania				Maryland		West Virginia	
	Fayette	Somerset	Westmoreland	State	Garrett	State	Preston	State
Population 2000	148,644	80,023	369,993	12,281,054	29,846	5,296,486	29,334	1,808,344
Population % change 1990 to 2000	2.3%	2.3%	-0.1%	3.4%	6.1%	10.8%	1.0%	0.8%
Density per sq. mile 2000	188.2	74.4	361.0	274.0	46.1	541.9	45.3	75.1
Persons < 18 yrs.	22.7%	22.3%	22.0%	23.8%	25.1%	25.6%	23.7%	22.3%
Persons 19 – 64 yrs.	59.2%	59.7%	59.7%	60.6%	60.0%	63.1%	61.3%	62.4%
Persons > 65 yrs.	18.1%	18.0%	18.3%	15.6%	14.9%	11.3%	15.0%	15.3%
Median Household Income*	$25,878	$28,665	$34,073	$37,267	$30,197	$45,289	$26,097	$27,432
Percentage Below Poverty Level*	19.1%	13.7%	10.2%	10.9%	15.8%	9.5%	17.8%	16.8%

* indicates 1997 model based estimate

Source: U.S. Census Bureau

Table 2.2 presents selected economic indicators that exhibit the general decline in mining related and manufacturing related industries within the study area. Only Westmoreland County, PA experienced an increase in the number of manufacturing related establishments during 1993 – 1999. Garrett County. MD was similarly the only county in the study area that did not experience a decline in mining related industries during the same time period.

Table 2.2 Selected Economic Indicators

	Pennsylvania				Maryland		West Virginia	
	Fayette	Somerset	Westmoreland	State	Garrett	State	Preston	State
Total establishments 1999	2,827	1,943	9031	293,491	867	127,431	604	41,451
Total establishments 1993	3,063	1,855	8255	280,503	795	118,870	549	39,375
Percent change 1993 to 1999	-8%	5%	9%	5%	9%	7%	10%	5%
Mining related establishments 1999	21	40	29	913	12	106	13	682
Mining related establishments 1993	39	42	42	1,124	12	103	24	1,047
Percent change 1993 to 1999	-46%	-5%	-31%	-19%	0%	3%	-46%	-35%
Manufacturing related establishments 1999	124	122	609	17,038	51	3,972	28	1,510
Manufacturing related establishments 1993	141	121	554	17,994	56	4,296	41	1,813
Percent change 1993 to 1999	-12%	1%	10%	-5%	-9%	-8%	-32%	-17%

Source: U.S. Census Bureau

2.7 Water Quality

2.7.1 Youghiogheny River Lake

The lake is characterized as a relatively cool impoundment that exhibits summer thermal stratification. Typical of reservoirs with bottom discharge, inflow and discharge processes are significant factors in the vertical advection of heat. Throughout the summer months, the strata of cold, relatively dense water impounded in the spring are withdrawn and replaced by overlying

strata that have been warmed by water surface heat transfer, solar absorption, and warm summer inflows (USACE, 1997).

Because of the bottom-discharge induced vertical advection of heat, Youghiogheny River Lake is warmed to considerable depth by late summer. However, the depth of the reservoir (54.3 ft mean depth/121 ft. maximum depth), limited warming from solar radiation, the temperature of the spring storage (<20 degrees C), and other factors cause the Youghiogheny River Lake to support a "two tier" (i.e., warm and coldwater) fishery (USACE, 1997). The cool reservoir discharge (rarely exceeding 20 degrees C) is critical to the maintenance of the coldwater trout fishery in the tailwaters and the Youghiogheny River downstream.

The Youghiogheny River Lake can be characterized as being well aerated to considerable depths year round (USACE, 1996). Anaerobic conditions (1.0 mg/l DO or less) are present only near the sediment-water interface in the very deepest reaches of the reservoir below the intake structure for the discharge (USACE, 1996). The minimum dissolved oxygen concentration necessary for the survival of most fish is approximately 4.0 mg/l. In the deepest portion of the reservoir (near the dam), dissolved oxygen concentrations less than 4.0 mg/l are generally not found at depths less than 80 feet during the summer months. In the reservoir's shallower upstream portion, dissolved oxygen concentrations less than 4.0 mg/l are not usually encountered at depths of less than 30 feet during summer stratification (USACE, 1996).

Bottom withdrawal acts to minimize summer anaerobic conditions in the deeper portions of the reservoir by continuous evacuation of hypolimnetic water. There is no significant loading of oxygen demanding waste materials from upstream municipalities or industries (USACE, 1996).

The Youghiogheny River Lake is considered oligotrophic and a fragile aquatic system because of very low alkalinity and a low level of productivity (USACE, 1997). In this steep sided reservoir littoral plants are scarce, plankton growth and organic matter are low in proportion to the total volume of water, and there are low concentrations of phosphorus, nitrogen, and calcium. The lake has a mean alkalinity of 9 mg/l, whereas, a minimum of 20 mg/l is considered required for a lake to be considered productive and fertile (USACE, 1997).

Historically, the lake has had low pH values due to acid mine drainage, which had detrimental effects on the fishery. The majority of these mines have been closed or reclaimed, and the lowest pH values have not been observed in the past few years. There are no known sources of sanitary sewage on the Youghiogheny River Lake, although several are suspected. Houses located along the lakeshores have septic systems with leach fields in shallow soils that are marginally suited for this use. In addition, the marina does not currently offer any sewage disposal facilities for boaters, but a disposal tank has been purchased and will be installed once all the necessary permits have been obtained. Fecal coliform, a bacterium found in sewage, is measured at the beach and has not exceeded state or federally regulated levels.

2.7.2 Youghiogheny River Downstream of the Dam

The downstream summer season cooling effect of Youghiogheny Dam releases is substantial, but is moderated by the mixing with the Casselman River 1.2 miles downstream of the dam. The extent of this moderation varies as the uncontrolled flow of the Casselman River varies relative

to the release from the Youghiogheny Dam. Summer warming, from ambient air temperature and other tributaries, generally means that the summer water temperature regime of the river at Connellsville, PA (river mile 44.7) has warmed to the point that it is very similar to that of the Youghiogheny River inflow into the lake at Friendsville, MD (USACE, 1996).

The Youghiogheny River meets Pennsylvania Fish & Boat Commission classification criteria for "approved trout waters" along a 29 mile reach of river between the Dam and South Connellsville, PA (USACE, 1996). Downstream of South Connellsville, the river warms to a point where conditions no longer support a year round coldwater fishery (USACE, 1996).

During summer stratification, anoxic conditions (dissolved oxygen levels of 1 mg/l or less) can persist near the reservoir discharge invert. The discharge through the Corps of Engineer's tunnel is turbulent and efficiently aerates the summer season oxygen deficient intake waters as they are released. However, under the FERC license, D/R Hydro is required to maintain a minimum dissolved oxygen concentration of 7.0 mg/l in the tailwaters. To meet this minimum requirement, they utilize blowers during the summer season to force air into the water as it is discharged.

Water quality improvements have occurred in tributaries downstream of the dam. Summer season pH values of the Casselman no longer violate Commonwealth of Pennsylvania standards (pH 6.0), and now usually exceed the pH of the waters discharged from Youghiogheny Dam (USACE, 1996). This improvement in water quality is reliable enough to no longer require forced spillage from the dam at higher Casselman River flows, as mandated by the current Youghiogheny River Lake release schedule. Improvements in acid mine drainage (AMD) from the Casselman River have been so effective that pH data from the Casselman when compared to pH data from the Youghiogheny River indicate that the Youghiogheny River Lake discharge is currently more acidic than the Casselman (USACE, 2001a). The 1998 mean pH for the Casselman sample point was 7.5 (max 9.1/min 6.5) and the mean pH value for the Youghiogheny River was 6.63 (max 7.54/min 6.24) (USACE, 2001a).

2.8 Environmental Resources

2.8.1 Terrestrial Habitat

The terrain surrounding the lake is mountainous and forested with mature hardwoods. The lake drainage area has been estimated at 85% forested and 15% agricultural (Proch and Greiner, 1986). Because of the maturity of undisturbed forest around Youghiogheny River Lake, a wide variety of wildlife typical of mature forested areas is present. The lakeshore floodplain, located between the normal winter pool elevation and the normal summer pool elevation, near the mouths of moderately sloping tributary valleys, is subject to prolonged flooding. The lakeshore floodplain rarely produces sufficient ground cover of the kind to encourage wildlife. The steep topography that generally surrounds the reservoir precludes the establishment of large areas of wetlands. However, some wetlands have developed at or near the mouths of several tributaries to the reservoir (see section 4.6 of the Environmental Assessment for more detailed discussion).

2.8.2 Aquatic Habitat

The topography of the region prior to the reservoir's construction dictates the shoreline and bottom contours of the reservoir. The reservoir's productivity is further modified by fluctuating water levels, which change the shoreline, depth, in-stream cover, and other numerous factors throughout the year. Despite the limitations, the Youghiogheny River Lake offers unique and valuable aquatic resource features. The lake provides a varied warm water, cool water, and cold water fishery and is the only lake in southwest Pennsylvania boasting a naturally reproducing walleye fishery.

The Youghiogheny River Lake's outflow fishery (1.0 mi.) is the most intensively managed catchable trout stream in southwest Pennsylvania (PAF&BC, 1996). Trout are stocked year round. The 27.5 river miles from Confluence, PA (just downstream from the dam outflow) to South Connellsville, PA is managed intensively with brown and rainbow trout stocked annually. The reach of river from Connellsville to the mouth at McKeesport (45 miles) has increased fertility and water temperature supporting a high quality warm water and cool water fishery (see section 4.7 of the Environmental Assessment for more detailed discussion).

2.9 Recreational Resources

2.9.1 Recreation: Youghiogheny River Lake

Youghiogheny River Lake recreational opportunities include camping, picnicking, fishing, boating, swimming, hunting, cross country skiing, and sightseeing. Sightseeing is the major form of recreation at the lake followed by boating and fishing. During 1996 – 2000 (Federal fiscal years), boating accounted for 15% and fishing accounted for 13% of all Youghiogheny River Lake recreation participation. Lake recreation facilities include seven boat ramps, one marina with approximately 300 slips, and 625 private docks. Table 2.3 presents total visitation to the Lake and boating and fishing participation.

Table 2.3 Youghiogheny River Lake Recreation Visits FY 1996 – FY 2000

	Total	Boating	Fishing
2000	575,166	85,926*	75,500*
1999	683,906	101,333	98,414
1998	605,849	96,943	77,246
1997	560,111	78,416	68,558
1996	568,965	85,000*	74,686*
* indicates participation estimated from 1997 – 1999 average			
Source: USACE			

2.9.2 Recreation: Youghiogheny River

The 27-mile stretch of the Youghiogheny River downstream of the lake consists of two major recreation areas: the 20-mile section known as the "middle Yough" (Confluence to Ohiopyle)

and the 7-mile "lower Yough" (Ohiopyle to Stewarton). The reaches provide favorable recreation conditions when the Confluence gage reads between 1.9 and 3.5 feet for the Confluence to Ohiopyle reach and between 1.8 and 2.5 feet for the Ohiopyle to Stewarton reach (USACE, 1992).

The segment flowing from the Dam for 27 miles below the Youghiogheny Lake has been designated as a "scenic river." A Department of the Interior Study under the Wild and Scenic Rivers Act found that the river "can only be described in superlatives—even the casual observer is impressed with the outstandingly remarkable qualities of the river's scenery and its whitewater" (USDOI, 1978).

The middle and lower Youghiogheny River contains whitewater of a character that typically does not exist on other rivers in the same region during the summer season. It is one of very few whitewater rivers available with any degree of reliability during the summer for the whitewater enthusiast in the entire Mid-Atlantic region of the United States. Even during August, Class III plus whitewater is reliably available during most years. During calendar year 2000, 96% of the boating trips in the Youghiogheny River took place between May and October. Table 2.4 presents boating and fishing participation on the Youghiogheny River during 1996 – 2000.

Table 2.4 Youghiogheny River (Ohiopyle State Park) Recreation 1996 – 2000

	Total Park Attendance	Boating	Fishing
2000	2,136,008	121,474	16,911
1999	2,026,449	113,570	17,883
1998	2,027,998	121,070	16,710
1997	1,940,000*	125,000*	16,500*
1996	1,935,672	124,272	16,339
* indicates incomplete data but expected to be greater than 1996			
Source: Ohiopyle State Park			

2.10 Reservoir Operations

The Youghiogheny River Lake operations are dictated by an approved storage and release schedule designed to meet the primary project purposes of flood control and low flow augmentation for water quality control of acid mine drainage. The current flood control schedule was developed in 1940 after a study of the floods during the period of record and the theoretical floods that could occur during the life of the project. The regulation of the lake for low flow augmentation is based on the stream's natural flow at Connellsville, PA and available reservoir storage conditions.

In 1990, the Pittsburgh District prepared a Drought Contingency Plan (DCP) for the Youghiogheny River Lake Basin. Revised in 1992, the DCP's primary value is in identifying drought conditions, documenting data needed in decisions, and defining the coordination needed to manage the basin's water resources to ensure that they are used in a manner consistent with

the needs that develop (see the Youghiogheny River Lake Operations Appendix for a more detailed discussion).

3 EXPECTED FUTURE CONDITIONS

3.1 Project Purposes

The Youghiogheny River Lake is currently operated for flood control, low flow augmentation for water quality, and recreation. During the last two decades, a dramatic shift in the commercial-industrial mix and the demographics of the region has taken place. The region has lost a significant portion of its heavy industry, which once dominated the employment base. This loss of heavy industry, as well as a reduction in the severity of acid mine pollution from tributary streams has reduced the pollution load of the Youghiogheny River (see section 2.4 above and section 4.5 of the Environmental Assessment for a more detailed discussion). There are currently no indications of abatement or reversal of these trends. Population increases in the study area are expected to be modest with growth significantly below the national average, and acid mine drainage control continues to be a priority for the Pennsylvania Department of Environmental Protection. The Youghiogheny River Lake project is expected to fully support authorized project purposes for the foreseeable future.

3.2 Recreational Releases

In support of downstream whitewater recreation, current dam operations occasionally take advantage of opportunities to enhance downstream flow by coordinating release schedule changes with heavy weekend use of the river. These minor nuances in the release schedule are typically conducted by slightly lowering the volume of water released during the week and then compensating with greater releases during the weekend. However, these slight adjustments can only be accomplished under limited favorable conditions. These discretionary release adjustments are expected to continue into the foreseeable future.

4 PROBLEMS AND OPPORTUNITIES

4.1 Water Supply

The local sponsor is seeking a reallocation of storage that would provide a flow of 17 MGD (approximately 25 cfs), during those days when additional augmentation would be required, over and above the flow resulting from the current release schedule to be withdrawn from the Youghiogheny River at South Connellsville. This storage reallocation would require that water supply be added as a project purpose to the Youghiogheny River Lake project. The water supply needs analysis (ER 1105-2-100, 22Apr 2000 and IWR Report 96-PS-4, Dec 1998) is presented in the Economics Appendix.

4.2 Lake Recreation

Although Youghiogheny River Lake provides opportunities for boating and fishing, the boating season is truncated by the annual summer drawdown. Many popular access ramps are unusable as early as August because of reduced lake elevations. The marina and private docks are

similarly affected each year. The boating season could reasonably extend through the fall if access were available. Concerns about the abbreviated boating season have been a longstanding complaint of the local community.

5 PLAN FORMULATION

5.1 Planning Objectives and Constraints

5.1.1 Planning Objectives

The objective of this analysis is to determine if the current Youghiogheny River Lake release schedule could be modified to increase base flow augmentation releases to provide downstream water supply as indicated above and improve upon other project purposes, such as lake related recreation.

This study develops and evaluates alternative release schedules, to determine which would meet the study sponsor's water supply needs within the constraints described below. The impacts of the alternative release schedules on other project purposes are assessed so that an optimal alternative that provides water supply and improves upon other project purposes may be identified. The impacts assessed in this analysis include water quantity and water quality impacts in the Youghiogheny River Lake and Youghiogheny River, and any associated environmental and economic effects. Eight alternative release schedules were assessed as part of this Feasibility Study.

5.1.2 Constraints: Reservoir Operations

Planning constraints related to reservoir operations include maintenance of the project's existing ability to support currently authorized project purposes and to support other incidental uses. Currently authorized project purposes are: flood control, low flow augmentation for water quality control, fish and wildlife, general recreation, and white water recreation. Of these project purposes, only flood control and low flow augmentation for water quality have allocated storage in the Lake.

5.1.3 Constraints: Downstream Conditions

In addition to support of currently authorized project purposes, there are two downstream conditions that are of major significance to the local population that are especially sensitive to the dam's release schedule and operation. The first area of sensitivity is white water rafting, which is totally reliant upon releases from the dam. Current dam operations include the coordination of releases with weekend white water rafting uses, whenever pool elevations and climatologic conditions allow. This release schedule coordination is expected to continue regardless of the alternative selected. Nonetheless, white water related downstream flow and stage duration impacts are included in the assessment of each alternative.

The second area of sensitivity is the cold-water trout fishery that is maintained by cold-water releases from the dam. The seasonal extent of this fishery along the Youghiogheny River would be impacted by modifications to the release schedule as more or less cold water from the dam is released into the river at various times of the year. The temperature related impact on the trout fishery is assessed for each alternative.

5.2 Identification of Alternatives

Alternative plans to provide water supply and optimize dam operations were developed by the Corps in coordination with the local sponsor, the Pennsylvania Department of Environmental Protection (PADEP), and the Pennsylvania Fish and Boat Commission. Initially, the local sponsor examined the potential to simply petition PADEP for an amendment to their water allocation permit that provides the sufficient supply. This request was denied. The Youghiogheny River downstream of the dam is "fully permitted" by PADEP, which indicates that all available uncontrolled flow is allocated to users and any additional withdrawal of uncontrolled flow would be detrimental to the river and related ecosystems.

The alternative plans assessed in this feasibility study can be grouped into three categories: development of alternative water supply sources, structural modifications to the Youghiogheny River Dam, and modifications to the Youghiogheny River Dam release schedule. Alternatives in the first two categories were not considered beyond the preliminary screening phase of the plan formulation process. Eight alternative release schedules were assessed for water quantity impacts and three of the eight, which exhibited favorable water quantity impacts, were also assessed for water quality impacts.

5.3 Preliminary Screening of Alternatives

5.3.1 Alternative Water Supply Sources

The only alternative source of water supply that can be integrated into the existing water supply infrastructure and meet water supply needs is the construction of a new impoundment near the mouth of Indian Creek (downstream of the existing dam). Conceptual design indicates the dam would have a watershed of approximately 121 square miles and have a total dam height of 226 feet (MAWC, 1997). At maximum pool, the storage volume would be approximately 70,600 acre-feet. The estimated cost for the project was approximately $58 million (Corps of Engineers Civil Works Construction Cost Index System (CWCCIS), EM 1110-2-1304 revised 31Mar01). This alternative was rejected due to the high cost of construction and the anticipated extensive environmental impacts associated with a new impoundment (see the Economics Appendix for a more detailed discussion).

5.3.2 Direct Withdrawal from Youghiogheny River Lake

Direct withdrawal from the Youghiogheny River Lake would alleviate the need to modify the existing release schedule and would have minimal, if any, downstream impacts. This alternative was assessed in the Reconnaissance phase. However, the costs of this approach would be much higher than the storage reallocation and withdrawal from existing facilities in South Connellsville. Direct withdrawal would require an extensive trunk-main connection to the water treatment plant or the construction of a pre-treatment plant as well as the construction of intake and pump facilities at the Youghiogheny River Lake. This alternative was rejected due to the high cost of construction and the anticipated extensive environmental impacts associated with new piping, pumping, and treatment facilities.

5.3.3 Structural Modifications to the Youghiogheny River Lake to Increase Storage

The possibility of modifying the structures of Youghiogheny River Lake to add additional storage for water supply has been previously studied (USACE, 1981). Structural modifications would include raising the dam crest and supplementing the foundation as required to withstand the increased hydrostatic load. Two specific cases were considered: (1) increasing the summer pool elevation 2 feet from 1439' to 1441' and a full pool elevation 1.5 feet from 1470' to 1471.5'; and (b) increasing the summer pool elevation 5 feet from 1439' to 1444' and full pool elevation 4 feet from 1470' to 1474'. The first example would provide an additional 5,500 acre-feet of storage and the second an additional 14,500 acre-feet.

The first case would not provide sufficient additional storage to meet the water supply needs, and the second case results in significant loss of recreational structures that would be unacceptable to local recreational users of the lake. The 1997 Reconnaissance study concluded that structural modifications do not warrant further consideration and consequently were not further analyzed in this feasibility study.

5.4 Development of Alternatives

The alternative release schedules were developed according to the reservoir's guide curves that are used to determine operations at Youghiogheny Lake. It is important to note that no changes were made to the reservoir's guide curves as part of this study.

Youghiogheny River Lake's Guide Curves and the current release schedule are presented and discussed in the Youghiogheny River Lake Operations Appendix. Developed as part of the project's authorized operational schedule, the guide curves define unique operational characteristics of the dam. A maximum winter pool level of 1419.0 feet above the National Geodetic Vertical Datum of 1929 (NGVD) is maintained during January and February to assure that adequate storage exists within the project to store up to 6.5" of runoff. This target pool is raised during March, reaching its summer pool level of 1439.0 feet by 1 April. At this elevation, an additional 51,500 acre-feet of water is stored and made available for low flow augmentation for water quality. The storage above minimum pool (elevation 1344.0 feet) is divided into seven zones, Zones A through Zone G.

Pool elevation is plotted daily on the guide curves. This determines the release zone, identified as Zones A through G. The uncontrolled flow at Connellsville (Connellsville's flow less Youghiogheny Lake's outflow) is computed and utilizing the zone determined from the guide curves the appropriate release volume is identified on the release schedule. The local sponsor withdraws water from the Youghiogheny River approximately 29 river miles downstream of the dam at South Connellsville, PA. Currently, uncontrolled flow at Connellsville is augmented by releases from Youghiogheny Lake according to the existing storage and release schedule. The release zones, which are based upon the guide curves, determine the release rate from the project. As stated above, the guide curves and zone delineation were not changed as part of this study.

The current release schedule and all eight alternatives are found in Table 5.1. Changes to the current release schedule are highlighted on the table. Alternatives 1 through Alternative 6, were

developed by members of the Pittsburgh District's Water Management Team. Alternatives 7 and 8 were developed by PA Fish and Boat Commission personnel.

Current Release Schedule The current release schedule has been utilized since the project went into operation. It was designed to provide low flow augmentation for water quality and to force an early drawdown of the summer pool during a wet year. The current schedule was modeled as part of this analysis to allow for a direct comparison of a "no change" alternative.

Alternative 1 This alternative was first developed during the Reconnaissance Study, although it was not modeled as part of that study. It was developed by simply adjusting the outflow in Zone C, in order to obtain an additional 25 cfs (amount requested by the study sponsor) during uncontrolled flows of 0-300 cfs. To balance this increase in discharge at a typically dry period, there had to be some conservation of water. This was accomplished by reducing the releases in Zone C by 25 cfs when the uncontrolled flow at Connellsville was between 300-1000 cfs. In addition, Zone D was reduced by 100 cfs during the same uncontrolled period. The rationale was that these reductions would provide additional storage for the increased outflow during Zone C, 0-300 cfs uncontrolled releases. The remainder of the schedule was left intact, as this alternative was thought to meet the needs of the study sponsor with minimal impact to Youghiogheny Lake's overall operation.

Alternative 2 Alternative 2 is the same as Alternative 1, with additional modification to the Zones E, F, and G. This is the alternative that was modeled and discussed in the Reconnaissance Study. In addition to meeting the needs of the local sponsor, it was configured to minimize the "forced drawdown" that occurs in these Zones. The outflows for these zones were determined by targeting at least 800 cfs total (outflow + uncontrolled) at Connellsville to provide a good whitewater rafting experience at Ohiopyle.

Alternative 3 Alternative 3 was the result of the suggested approach of "combining" Zones C and D. This was proposed because examination of past operations, indicated that oftentimes the pool elevation fluctuated between Zones C & D. Only Zones C & D were changed in this simulation. Releases from the current release schedule for Zones C & D were averaged to yield the values used for both Zones C & D, thereby effectively creating one large zone. This was done for all uncontrolled flows at Connellsville from 0-1000 cfs.

Alternative 4 Alternative 4 was similar to Alternative No. 3, as it too combined Zones C and D. However, this alternative uses the same outflows for Zones C developed in Alternative 1, for Zones C and D.

Alternative 5 Alternative 5 is the same as Alternative 3, except changes to Zone B were also made. These changes applied only to the releases when the uncontrolled flow was 0 to 300 cfs. For Zone B, when uncontrolled flow is between 0 to 100 cfs, the release was increased 25 cfs, from 300 to 325 cfs. Also for Zone B, when uncontrolled flow is between 100 to 300 cfs, the release was increased 50 cfs, from 250 to 300 cfs.

Table 5.1 Comparison of Current and Alternative Release Schedules

Storage-Release Schedule	Uncontrolled Flow at Connellsville (CFS)	Outflow from Dam (CFS)						
		Zone						
		A	B	C	D	E	F	G
Current	0-100	200	300	400	600	900	1200	1500
	100-300	150	250	350	550	800	1100	1500
	300-500	100	200	300	500	700	1000	1500
	500-1000	100	100	200	400	600	900	1500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 1	0-100	200	300	425	600	900	1200	1500
	100-300	150	250	375	550	800	1100	1500
	300-500	100	200	275	400	700	1000	1500
	500-1000	100	100	175	300	600	900	1500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 2	0-100	200	300	425	600	800	900	900
	100-300	150	250	375	550	700	800	800
	300-500	100	200	275	400	600	600	600
	500-1000	100	100	175	300	500	500	500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 3	0-100	200	300	500	500	900	1200	1500
	100-300	150	250	450	450	800	1100	1500
	300-500	100	200	400	400	700	1000	1500
	500-1000	100	100	300	300	600	900	1500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 4	0-100	200	300	425	425	900	1200	1500
	100-300	150	250	375	375	800	1100	1500
	300-500	100	200	275	275	700	1000	1500
	500-1000	100	100	175	175	600	900	1500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 5	0-100	200	325	500	500	900	1200	1500
	100-300	150	300	450	450	800	1100	1500
	300-500	100	200	400	400	700	1000	1500
	500-1000	100	100	300	300	600	900	1500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 6	0-100	200	325	500	500	800	900	900
	100-300	150	300	450	450	700	800	800
	300-500	100	200	400	400	600	600	600
	500-1000	100	100	300	300	500	500	500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000

Table 5.1 Comparison of Current and Alternative Release Schedules

Storage-Release Schedule	Uncontrolled Flow at Connellsville (CFS)	Outflow from Dam (CFS)						
		Zone						
		A	B	C	D	E	F	G
Alternative 6 cont.	>Zone Limit	100	100	100	100	100	100	500
Alternative 7	0-100	200	350	500	500	900	1200	1500
	100-300	150	300	450	450	800	1100	1500
	300-500	100	200	400	400	700	1000	1500
	500-1000	100	100	300	300	600	900	1500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500
Alternative 8	0-100	200	350	500	500	800	900	900
	100-300	150	300	450	450	700	800	800
	300-500	100	200	400	400	600	600	600
	500-1000	100	100	300	300	500	500	500
	1000-Zone Limit	1000	1000	1300	1500	1700	2000	3000
	>Zone Limit	100	100	100	100	100	100	500

Alternative 6 This alternative is the same as Alternative 5, with changes to Zones E, F, and G. The changes to Zones E, F, and G are the same as those described in Alternative 2. Again, these changes were designed to minimize the forced drawdown during wet years, while providing an enjoyable whitewater recreation trip downstream.

Alternative 7 Alternative 7 is identical to Alternative 5, except that the release rate for Zone B, when the uncontrolled flow at Connellsville was 0-100 cfs, was increased from 325 cfs to 350 cfs. The theory here was to simulate the impact of an additional 25 cfs over and above the 25 cfs increase requested by the study sponsor.

Alternative 8 Alternative 8 is identical to Alternative 6, except that the release rate for Zone B, when the uncontrolled flow at Connellsville was 0-100 cfs, was increased from 325 cfs to 350 cfs. The theory here was to simulate the impact of an additional 25 cfs over and above the 25 cfs increase requested by the study sponsor.

5.5 Comparison of Alternatives

A two stage modeling process was used to assess the impacts of the alternative release schedules. The first stage modeled water quantity impacts in the Lake and in the river downstream. The key water quantity impact assessment criteria are:

- reservoir pool elevations;
- $Q_{7\text{-}10}$ flows at Confluence, PA; and
- flow and stage duration at Connellsville, PA.

Alternatives exhibiting favorable water quantity impacts were also assessed for water quality impacts in the second stage of the modeling process. Critical water quality assessment criteria are:

- reservoir water temperature;
- reservoir dissolved oxygen levels;
- water temperature in the river downstream of the dam;
- dissolved oxygen levels at four downstream river stations: Confluence, Ohiopyle, Connellsville, and McKeesport.

A discussion of water quantity and water quality model development and results are provided below.

5.5.1 Water Quantity Impacts Assessment: Model Development

A simulation model, originally developed by the Pittsburgh District for a Planning Assistance to States (Section 22 low flow study), was recompiled. The results were reviewed and deemed acceptable for this study without modification. This model was used to simulate the impact of the current release schedule and eight alternative release schedules. The model computed pool elevation, reservoir outflow, and regulated flows at Connellsville and Braddock, Pennsylvania. Two separate time frames, utilizing input from two different sources, were modeled. In addition, flows were developed for Confluence, Pennsylvania, which were used to analyze schedule change impacts on the recreation industry (see the Water Quality Technical Appendix for a more detailed discussion).

5.5.2 Water Quantity Impacts Assessment: Youghiogheny River Lake

Reservoir drawdown curves were developed to identify the impact of alternative release schedules on reservoir pool elevations. Curves were developed for the current release schedule and all eight alternatives. The drawdown curves for the current release schedule are presented in Figure 3. A set of three curves was developed for each alternative. The three curve set represents the expected drawdown at the reservoir under dry, average, and wet conditions (i.e., the 25^{th}, 50^{th}, and 75^{th} percentile conditions, respectively).

Drawdown curves for each of the eight alternatives were compared to the current release schedule (see the Water Quality Technical Appendix for a more detailed discussion). Alternatives 1, 3, 4, 5, and 7 have relatively minor impacts (less than 2 feet) on the pool elevations in the Youghiogheny River Lake during dry, average, or wet conditions. The greatest difference was noted during late June and July, when the drawdown curves for all three conditions were higher than those from the current release schedule. However, this difference diminishes at the end of July, when all drawdown curves converge to those from the current release schedule. This convergence on the current set of drawdown curves is due to the fact that only two zones from the current release schedule were actually modified for all five alternatives. As a result, once gate operations were governed by the remaining unchanged zones, the resulting pool elevations (and therefore their drawdown curves) were essentially the same.

Alternatives 2, 6, and 8 have significant (i.e. greater than 10 feet) impacts to pool elevations during the later part of the recreation season under average and wet conditions. During a dry year, higher pools were also observed, although not as significant as those of the average and wet years. Each of these alternatives maintains summer pool longer and causes the pool to fall at a slower rate than the current release schedule. Table 5.2 presents pool elevation changes for Alternatives 5 and 6.

Table 5.2 Projected Pool Elevation Changes* (feet)

	Release Schedule Alternative 5			
Rain Year	July	August	September	October
Dry	0	1	0	-1
Average	0	1	1	0
Wet	0	1	0	0
	Release Schedule Alternative 6			
Dry	1	3	1	5
Average	1	5	7	14
Wet	2	6	9	12
*as projected for the end of the month				

5.5.3 Water Quantity Impacts Assessment: Youghiogheny River (Q_{7-10} Flows)

Two products were computed to review the riverine results. The first product, the Q_{7-10} flows, were used to quantify the impact of the proposed alternative release schedules by comparing them to the Q_{7-10} flows computed from the current release schedule. The second product, flow and stage duration curves were developed to assist in the environmental and economic assessment of the alternatives.

A Q_{7-10} flow rate is defined as the 7-consecutive day average low-flow rate that occurs once in 10 years. This flow rate is used as a benchmark by PADEP for low-flow water quality issues. Historical Q_{7-10} flow rates, were computed by the Pittsburgh District Army Corps of Engineers, and are used by the Pennsylvania Department of Environmental Protection in their permitting process for water withdrawal. The computation of Q_{7-10} flow rates for this analysis, utilized 69 years of daily flow data, from 1930 through 1998.

In order to assess the water quantity impacts of the alternative release schedules on the Youghiogheny River during low flow conditions, Q_{7-10} flow rates were developed for the current and eight alternative storage-release schedules. If a change to the storage-release schedule resulted in a decrease to the Q_{7-10} flow near Confluence, the alternative was not given further consideration in this study. Confluence was used as the target because the water supply withdrawal points are located upstream of the Connellsville gage. Since the withdrawal rates have varied over the years, the impacts of increased discharges for water supply were more easily quantified at the Confluence gage.

Five of the eight alternative release schedules reduced the Q_{7-10} flow rates at Confluence and were therefore eliminated from further consideration. The remaining three, Alternatives 2, 6 and 8 resulted in increases to the Q_{7-10} flow rate at Confluence. These three alternatives are assessed for flow and stage duration impacts in the river and water quality impacts in the lake and river.

5.5.4 Water Quantity Impacts Assessment: Youghiogheny River (Flow and Stage Duration)

A practical way to evaluate day-to-day river flow variability and the permanence of characteristic low-flow rates is the flow-duration curve. The flow duration analysis consists of the development of a cumulative frequency distribution that shows the percentage of time the indicated flows have been equaled or exceeded.

Flow-duration curves were developed from the daily flow data generated by the model under the current storage-release schedule and storage-release schedules for Alternatives 1, 2, 5, and 6. Flow and stage duration curves were developed for the outflow from the Youghiogheny River Lake and the Youghiogheny River at Confluence. The flow-duration curve analysis shows that Alternative 1 would have negligible impacts to the flow and stage conditions at the Youghiogheny River Lake outflow and the Youghiogheny River at Confluence. It also shows that Alternative 5 would have minor impacts to flow and stage conditions at Youghiogheny River Lake outflow, but the alternative would decrease the amount of time flow rates in the Youghiogheny River at Confluence are between 550 cfs and 700 cfs (i.e., stages of 1.8 feet and 2.0 feet, respectively). Alternatives 2 and 6 would impact the flow and stage conditions at both locations. These alternatives conserve flow during wet periods more aggressively than Alternatives 1 and 5 so that the storage can be released during dry periods to provide higher Q_{7-10} flow rates.

5.5.5 Water Quantity Impacts Assessment: Review

Table 5.3 shows a synopsis of the water quantity impacts of the eight release schedule alternatives.

Alternative 1 was not used for input to the Water Quality Models, due to its detrimental impact to the Q_{7-10} at Confluence. Alternative 2 was selected as input to the Water Quality Models. This decision was based on the increase in the Q_{7-10} flow at Confluence and Connellsville, and the positive impact of holding high pool elevations in the summer. No further evaluation was conducted on Alternatives 3 and 4 due to the negative impact on the Q_{7-10} flow. Although Alternative 5's detrimental impact to the Q_{7-10} flow at Connellsville could have been enough to exclude it from being considered as input to the water quality models, the team decided to model it to see the results of the reduction of Q_{7-10} flow at Confluence. Furthermore, Alternative 5 was believed to meet the needs of the local sponsor with minimal impact to all other authorized project purposes. Alternative 6 (and 8) yielded the greatest increases to the Q_{7-10} flow rates. It was used as input to the water quality models.

Table 5.3 Water Quantity Impacts Assessment

Alternative	Q_{7-10} flow	Youghiogheny River Flow & Stage	Youghiogheny River Lake Pool Elevation
1	-10 cfs at Confluence	Negligible flow and stage impacts	Negligible pool elevation impact during recreation season
2*	+10 cfs at Confluence	Negligible flow and stage impacts	Increases pool elevation during the recreation season
3	No change at Confluence	No further evaluation	No further evaluation
4	-20 cfs at Confluence	No further evaluation	No further evaluation
5*	+10 cfs at Confluence	Negligible flow and stage impacts	Negligible pool elevation impact during recreation season
6*	+10 cfs at Confluence	Negligible flow and stage impacts	Increases pool elevation during the recreation season
7	+10 cfs at Confluence	Negligible flow and stage impacts	Negligible pool elevation impact during recreation season
8	+10 cfs at Confluence	Negligible flow and stage impacts	Increases pool elevation during the recreation season

* Indicates alternative was selected as input into the Water Quality Model

Alternatives 7 and 8 were not used for input to the Water Quality Models. The other schedules were modeled with increases at the lower zones of 25 cfs. Alternatives 7 and 8 included increases of 50 cfs, which is considered to be a major change. As such, it would require modifications to the reservoir's guide curves, which is outside of the scope of this study.

5.5.6 Water Quality Impacts Assessment: Lake Water Quality Model Development

The water quality model used for Youghiogheny River Lake was developed by the U.S. Army Corps of Engineers Waterways Experiment Station and is a longitudinal-vertical hydrodynamic and transport model intended for lakes, reservoirs, and navigation pools. This model has been widely used and tested on numerous water bodies and found to be reliable. The model was developed and calibrated on 1992 data, which is considered a normal to wet year. Data from 1991, a severe draught year, was used to verify the model and test it under hydrologically extreme conditions. Output from the reservoir model provides part of the input necessary to develop the riverine model.

5.5.7 Water Quality Impacts Assessment: Lake Water Quality Model Results

Generally, the results of the lake water quality model demonstrate that there would be little change in reservoir summer thermal and chemical stratification patterns with any of the modeled operational alternatives during dry years like 1991. However, during normal to wet years such as 1992, when higher summer pool elevations would occur, especially under alternatives 2 and 6, deep lake water in the vicinity of the intakes would tend to be both cooler and more anoxic.

The primary interest is in the number of days dissolved oxygen is less than 4 and 7 mg/l for the alternatives. This information is summarized for 1991 in Table 5.4, and for 1992 in Table 5.5. The effects of the alternatives on dissolved oxygen at the intake level are generally small for 1991 due to the low pool level in the summer. In 1992, the number of days during which dissolved oxygen is less than 4 mg/l or 7 mg/l is higher for the alternatives, with maximums of 7 and 12 days, respectively, for Alternative 6. It should be noted, however, that the number of days of lower dissolved oxygen concentrations with Alternative 6 is less than the modeled current conditions for 1991.

General observations show that the effects of Alternatives 5 and 6 are not significantly different for 1991, while Alternatives 2 and 6 are about the same for 1992. The overall results also show that among the three alternatives, Alternative 5 has the least impact.

Table 5.4 Dissolved Oxygen in the Lake at the Intake Elevation for 1991

	Minimum DO (mg/l)	Maximum DO (mg/l)	Number of Days DO less than 4 mg/l	Number of Days DO less than 7 mg/l
Modeled Current	2.01	10.74	53	126
Modeled Alternative 2	2.18	10.74	50	123
Modeled Alternative 5	2.05	10.74	50	123
Modeled Alternative 6	2.05	10.74	50	123

Table 5.5 Dissolved Oxygen in the Lake at the Intake Elevation for 1992

	Minimum DO (mg/l)	Maximum DO (mg/l)	Number of Days DO less than 4 mg/l	Number of Days DO less than 7 mg/l
Modeled Current	2.61	10.73	31	109
Modeled Alternative 2	2.33	10.73	41	118
Modeled Alternative 5	2.71	10.73	32	114
Modeled Alternative 6	2.33	10.73	38	121

5.5.8 Water Quality Impacts Assessment: Riverine Water Quality Model Development

The water quality model used for the Youghiogheny River downstream of Youghiogheny Dam was also developed by the U.S. Army Corps of Engineers Waterways Experiment Station and used 1992 and 1991 to represent wet to normal and dry years, respectively. The riverine model divides the 74.2-mile length of the Youghiogheny River between Youghiogheny Dam and its confluence with the Monongahela River into 43 cross-sectional segments. The two main parameters modeled in this study were water temperature and dissolved oxygen. These were emphasized because they are the parameters most likely to be influenced by the identified release schedule modifications. A conservative tracer and chemical and biological oxygen demand (CBOD) were also simulated. The conservative tracer was used to assess travel times and check against mass-balance and stability problems, while the CBOD was included to model dissolved oxygen depletion.

5.5.9 Water Quality Impacts Assessment: Riverine Water Quality Model Results

Since all of the operational alternatives considered would result in a 25 cfs increase in high quality flow augmentation, it is a fundamental study assumption that all river water quality parameters, with the possible exceptions of water temperature and dissolved oxygen concentrations, would be improved by any of the alternatives being considered. Water temperature in particular is a sensitive issue because of the outstanding coldwater fishery that exists in the reach of the river between the dam and Connellsville.

As discussed above, Alternatives 2 and 6 result in a cooler discharge from the dam during normal and wet years. However, even with a somewhat cooler discharge, the water storage and release operational alternatives being considered would occasionally result in somewhat warmer river water. This would happen because during flow rises in the Casselman River, the alternative release schedules discharge less reservoir water. During the summer the Casselman River and other tributaries of the Youghiogheny River are not as cool as the water discharged from Youghiogheny Dam. Therefore, on these occasions the net impact would be some warming in the regulated reach of the river.

A primary concern is with the number of days that water temperature exceeds 20 degrees Celsius, which is a threshold temperature for a high quality cold water fishery. This information is summarized in Tables 5.6 and 5.7. The number of days water temperature exceeds 20 degrees Celsius is generally higher in 1991 than in 1992, apparently because of the dry conditions of 1991. The number of days water temperature exceeds 20 degrees Celsius was marginally increased by the alternatives in 1991, except at McKeesport where the alternatives appear to make no difference. In 1992, the number of days that water temperature exceeds 20 degrees Celsius was approximately the same at each of the four stations for the alternatives.

Table 5.6 Number of Days Water Temperature Exceeded 20°C for 1991

	Confluence	Ohiopyle	Connellsville	McKeesport
Modeled Current	16	22	75	130
Modeled Alternative 2	23	38	73	130
Modeled Alternative 5	19	29	80	130
Modeled Alterative 6	17	27	78	130

Table 5.7 Number of Days Water Temperature Exceeded 20°C for 1992

	Confluence	Ohiopyle	Connellsville	McKeesport
Modeled Current	2	4	20	101
Modeled Alternative 2	4	6	20	101
Modeled Alternative 5	3	5	22	100
Modeled Alternative 6	1	4	22	99

The results for dissolved oxygen were also compared at four stations (Confluence, Ohiopyle, Connellsville, and McKeesport). A primary concern was the number of days that dissolved oxygen was less than 7 mg/l. None of the alternatives show any appreciable impact on the dissolved oxygen in the river for 1991 or 1992. It was only at McKeesport in 1991 that dissolved oxygen was less than 7 mg/l, but the condition was the same for all the alternatives. Again, 1991 was a relatively dry year for which water temperature at McKeesport was mostly greater than 25 degrees Celsius, 5 degrees higher than the threshold level of 20 degrees, during the summer period, resulting in low dissolved oxygen levels.

In summary, it is expected that the alternatives would cause some fluctuations in both the water temperature and dissolved oxygen of the Youghiogheny River. However, it does not appear that the fluctuations are significant for any of the alternatives when compared to variations that already occur between different years.

5.6 Economic Impacts Assessment

The Youghiogheny River Lake Project provides economic value and supports economic behavior, such as recreation, real estate development, and economic development in a number of ways that are based on services provided by the dam and the impounded water. Services provided by the dam and impounded water include project purposes such as, flood control, water quality maintenance, recreation, and fish and wildlife habitat. Services may also be other than project purposes, such as water supply and hydropower production. If the implementation of an alternative plan were to change the type or level of service provided by the dam and/or impounded water in any way, such as increasing the volume of water available for hydropower production or decreasing the quality of fish habitat, there would be an associated change in economic value or behavior that would be considered an economic impact. Typically, the greater the magnitude of the change in service provided the larger the economic impact. Very small changes in services provided would result in very small economic impacts.

Economic impacts can be estimated as changes in value, such as changes in the price of a service provided by the dam or as changes in the willingness to pay for services. These changes in value are often used in benefit/cost analyses. Economic impacts can also be estimated as changes in economic activity, such as changes in local business revenues due to increased recreational activity on the river or lake. Changes in economic activity are often referred to as regional economic impacts. Financial impacts are typically estimated as changes in the costs of supporting economic activity, such as the cost to the local sponsor for construction of a new impoundment on Indian Creek.

Critical physical and environmental factors that support services provided by the Youghiogheny River Lake Project have been identified and analyzed during the Reallocation Study. These critical factors include water quality (dissolved oxygen levels) in the lake and river, water quantity in the lake (pool elevation) and in the river (flow), and water temperature in the lake and river. Analyses of these critical factors are presented in the preceding section. Alternative plans that affect one or several of these critical factors could thereby affect services provided by the project. Significant impacts on critical physical and environmental factors may result in economic impacts due to the effect on services provided. Conversely, changes to physical and environmental factors that are within the range of natural variability and are of a trivial magnitude would be expected to result in minor economic impacts.

Economic impacts were assessed for the No Action Alternative and for Alternatives 5 and 6. Alternative 6 was selected for economic impact analysis because it provides the most favorable recreation opportunities and meets the needs of the local sponsor. Alternative 5 was selected because it meets the needs of the local sponsor with the least change to existing conditions. Alternative 2 was not selected for further analysis because it does not provide as much opportunity for recreational enhancement as Alternative 6.

The water quality and water quantity effects identified above for release schedule Alternatives 5 and 6 will impact services provided by the dam and impounded water. Some of the impacts on the services provided by the dam and impounded water will result in changes in economic values or behavior. These impacts include water quantity and to a lesser degree water quality effects in

the lake that are expected to cause economic impacts to lake recreation (boating) and hydropower generation. The water quantity and water quality effects in the river are expected to be negligible and will not cause measurable economic impacts. The following is a discussion of the economic impacts of each of the alternative plans.

5.6.1 Economic Impact: No Action Alternative

The no action plan does not change the dam's existing release schedule, withdrawals would continue from the Youghiogheny River at Connellsville at levels that are consistent with existing withdrawals. It is assumed under the no action scenario that the local sponsor would be required to construct and operate an impoundment at Indian Creek, in order to meet PADEP requirements. Construction of the Indian Creek impoundment will not affect existing services provided by the Youghiogheny River. Therefore, the no action alternative plan imposes no changes on services currently provided by the Youghiogheny Dam and Lake project.

Full design and operational planning for the Indian Creek impoundment have not been completed, due to its high cost. The construction schedule, labor requirements, and material requirements have not been specifically identified. However, it is clear that construction of the Indian Creek impoundment would generate economic impacts for the local economy in terms of increased employment, wages, and revenues. However, these construction related impacts would be short term and it is anticipated that much of the services and materials required to build the impoundment would come from outside the local region. A quantitative estimate of construction related economic impacts cannot be performed until more planning and construction information is available.

Operation of the Indian Creek impoundment may generate economic impacts for the local economy by increased employment and expenditures related to the operation and maintenance of the dam and through recreational opportunities generated by the impounded water. Operation and maintenance plans for the dam have not yet been developed; therefore a quantitative estimate of the economic impacts of operation and maintenance cannot be formulated at this time.

Recreational opportunities at the Indian Creek impoundment are based on the assumption that boating, fishing, and swimming access would be available. Recreation related economic impacts of the proposed impoundment, would include regional economic development benefits such as, increased employment, wages, and revenues in the local economy. National economic development benefits would include the value of additional recreation trips and any increases in recreational values due to recreational use of the impoundment. These RED and NED benefits may be preliminarily estimated once a recreation plan for the impoundment is developed.

Overall, planning for the Indian Creek impoundment has not yet been developed enough to provide information that can be used to project the full economic impacts of constructing and operating the impoundment. Given this limited information, it appears that the economic impacts from construction would be short term and may be relatively small if services and materials required to build the dam come from outside of the local economy. The largest and longest lasting economic impacts would be due to recreational opportunities at the impoundment. However, the extent of these opportunities has yet to be defined.

5.6.2 Economic Impact: Release Schedule Alternative 5

Release schedule Alternative 5 was designed to minimize impacts to existing project purposes while providing an additional 17 mgd (approximately 25 cfs) during those days when additional augmentation would be required. Reservoir and riverine modeling projections indicate that water quantity and water quality effects in the lake and in the river would be negligible (see section 5 above). The negligible effects on critical factors relating to services provided by the dam and impounded water would cause no measurable changes to those services and therefore would cause no measurable economic impacts. Minor economic impacts to hydropower production are presented in Table 5.12.

5.6.3 Economic Impact: Release Schedule Alternative 6

Release schedule Alternative 6 was designed to provide an additional 17 mgd (approximately 25 cfs) during those days when additional augmentation would be required, similar to Alternative 5. In addition, Alternative 6 proposes an adjustment to project operations as a result of changed conditions. This investigation indicated that improved recreational opportunities at the lake could be achieved by increasing pool elevations in the late summer and early fall. Increasing pool elevations at that time of year would significantly extend the boating season on the lake, which has been a long standing request by the local boating and business community. The potential economic impacts of an extended lake boating season are discussed below.

5.6.3.1 Economic Impact: Release Schedule Alternative 6 – Lake Boating

Release schedule Alternative 6 produces higher pool elevations in the late summer and early fall months, as described in section 5 above and in the Water Quality Technical Appendix. The timing of these higher pool elevations would extend the Youghiogheny Lake boating season by providing water to boat ramps, marina docks, and private docks that are currently unusable (dry) during portions of the main boating season (May – October). Table 5.8 presents critical pool elevations for Youghiogheny Lake boating facilities and the estimated additional amount of time each facility would be usable in an average weather year under release schedule Alternative 6. The main boating season extension estimates presented in Table 5.8 are based on the assumption that, in general, weather conditions bring the main boating season to a close at the beginning of November. The boating use estimates presented below are also based on the assumption that boating during the winter and spring boating season would not be affected by release schedule Alternative 6. The boat ramp at Tub Run would not be affected since the annual closing of this facility is coordinated with the closing of the adjacent campground, typically soon after Labor Day.

Table 5.8 Release Schedule Alternative 6 Lake Boating Season Extensions

Facility	Minimum Usable Pool Elevation	Existing End of Facility Availability	Proposed End of Facility Availability	Facility Availability Extension
Spillway	1391	November	November	No Change
Somerfield N.	1397	End October	November	1 week
Somerfield S. (Marina)	1399	Mid October	November	2 weeks
Jockey Hollow	1420	Mid September	Early October	3 weeks
Mill Run	1430	Mid August	End August	2 weeks
Private Docks	1415	End September	Mid October	3 weeks

Source: Pittsburgh District, Operations and Readiness Division

As presented above, the additional availability of boating facilities is dependent upon pool elevations that will change from year to year due to annual rainfall and runoff conditions. The projections presented in Table 5.8 are based on average year pool elevations. Boating facility availability would be expected to be greater than the projections presented above during wet years and less than the projections during dry years. Variations in pool elevations, due to annual variations in rainfall and runoff, cause fluctuations in boating use of the lake from year to year. Boat use of the lake can also be impacted by maintenance operations at the dam, such as the Spillway Ramp reconstruction in FY 2000. Table 5.9 presents estimated annual total recreation visitation to the lake and estimated annual boating use.

Table 5.9 Youghiogheny Lake Total Recreation and Boat Use (Visits)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000
Total Visits	568,965	560,111	605,849	683,906	575,166
Boat Use	85,000*	78,416	96,943	101,333	85,926*

*Estimates based on average percentage of boat use

Source: Pittsburgh District, Operations and Readiness Division

The projected changes in boat use at the lake that would result from release schedule Alternative 6 are presented in Table 5.10. These projections are based on average weekly use of each facility (FY 1997 – FY1999) during the late summer and early fall, as calculated from monthly facility use estimates provided by the Pittsburgh District, Operations and Readiness Division. The projected number of additional trips for each facility is the product of estimated average weekly use and the projected number of additional weeks the facility would be available under this alternative plan. For private docks, it was assumed that there is one visit per dock each week.

Table 5.10 Release Schedule Alternative 6 Additional Lake Boating Trips

Facility	Additional Availability	Average Number of Weekly Trips	Total Projected Increase in Trips
Somerfield N.	1 week	422	422
Somerfield S. (Marina)	2 weeks	1,097	2,197
Jockey Hollow	3 weeks	816	2,448
Mill Run	2 weeks	136	272
Private Docks	3 weeks	625	1,875
Total Projected Annual Increase in Lake Boating Trips			7,214

The economic impacts of increased boating at the lake can be viewed from two perspectives: (1) regional economic impacts that include increases in sales, income, and employment, and (2) national economic development benefits that include the increase in recreational value that boaters receive when they take additional boating trips on the lake. The regional economic impacts estimated for the extension of the boating season are calculated as sales and income effects. Sales effects are the sum of increased expenditures by boaters (direct effects), the related expenditures by businesses required to meet the additional demand for goods and services (indirect effects), and the expenditures of employees whose wages are related to the initial direct expenditures (induced effects). Regional economic impacts can also be measured as income effects that are the related changes in regional incomes due to the direct, indirect, and induced sales effects described above. Employment effects are the increased number of jobs associated with the sales and income effects. The projected boating season extension on the Youghiogheny Lake would not be expected to increase employment in terms of additional jobs, but it would increase labor hours and wages. This increase in wages is captured in the income effects mentioned above.

RED Impacts

Table 5.11 presents the projected regional economic impacts associated with release schedule alternative 6. The direct per trip boater spending at Youghiogheny Lake is calculated from a Pittsburgh District analysis of 1996 day use visitor spending at the lake. The 1996 per trip spending estimate ($17.19) was inflated to March 2001 dollars ($19.32) using the standard Consumer Price Index. Direct, indirect, and induced effects were calculated using the online "Worksheet for Estimating Economic Impacts of Visitor Spending at Corps of Engineers (CE) Projects" described in Technical Report R-98-1 "Estimating the Local Economic Impacts of Recreation at Corps of Engineers Projects – 1996". Calculations used default model settings, recreational boater participation as estimated in the previous section, and the individual spending data found in the Pittsburgh District's 1996 analysis.

Table 5.11 Release Schedule Alternative 6
Projected Regional Economic Impacts

	Sales	Income
Direct Effects	$139,374	$72,475
Indirect Effects	$25,087	$12,544
Induced effects	$66,900	$36,237
Totals	$231,361	$121,256
Note: Based on 7,214 additional boating trips		

NED Impacts

National economic development benefits that would result from release schedule Alternative 6 are estimated as the increase in recreational value that boaters receive when they take additional boating trips on the lake. The value of a single boating trip on the Youghiogheny Lake is based on the FY 2001 Unit Day Values for General Recreation as reported in Economic Guidance Memorandum 01-01. The maximum general recreation value ($8.46) is applied to boat trips on the lake based upon the ease of access, outstanding aesthetic quality, high carrying capacity, distance to other similar facilities and excellent boating opportunities available on the lake. National economic development benefits are calculated as the product of the Unit Day Value ($8.46) and the projected number of additional boat trips (7,214). The total national economic development benefit associated with this alternative plan is $61,030 ($8.46 * 7,214 = $61,030).

5.6.3.2 Economic Impact: Release Schedule Alternative 6 – Hydropower

Increased pool elevations will also affect hydropower generation at the dam. This alternative plan affects hydropower generation by increasing the hydraulic head at the generating plant, changing the flow through the plant, and by decreasing dissolved oxygen levels at the plant intake. The economic impacts related to hydropower generation are discussed below.

Higher pool elevations in the lake during the late summer and early fall will increase the hydraulic head at the hydropower facility, which allows the facility to generate more electricity. The economic benefits of increased electric production during this time of year, however, are offset by lower flow rates through the hydropower facility that would occur during water conservation periods. Discussions with personnel at D/R Hydro, the company that operates the hydropower facility, indicate that there is no economic impact associated with increased pool elevations due to the offsetting effects of seasonally increased hydraulic head and decreased flow.

Higher pool elevations in the lake during the late summer and early fall also impact hydropower production due to the increased number of days that dissolved oxygen levels are projected to fall below 7 mg/l at the hydropower plant intake (see section 5 and table 5.3 above). The hydropower facility is required to use low pressure blowers to increase dissolved oxygen levels when dissolved oxygen levels measured at the intake fall below 7 mg/l. D/R Hydro estimates the cost of running the blowers to be $200 per day. The projected economic impacts to hydropower production under release schedule alternatives 5 and 6 are presented in Table 5.12.

Table 5.12 Projected Hydropower Economic Impacts (Annual)

	Days DO < 7 mg/l	Additional Days	Additional Cost
Existing Release Schedule	109	-	-
Release Schedule Alt. 5	114	5	$1,000
Release Schedule Alt. 6	121	12	$2,400
Note: Based on $200 per day blower cost, as per communication with D/R Hydro			

5.6.3.3 Economic Impact: Release Schedule Alternative 6 – Riverine Impacts

Release schedule Alternative 6 is projected to have only negligible impacts on water quantity and water quality conditions in the river (see section 4). The changes to water quantity in the river are very small, and although minor increases in flow are conceptually beneficial to whitewater rafting on the river, the changes are too small to have a measurable economic impact. Similarly, water quality conditions, water temperature and dissolved oxygen levels, would be only slightly affected by the alternative plan. The minor effects on water quality are not projected to have measurable impacts on the existing cold water fishery. Given the low level of projected impacts to riverine conditions, there are no measurable economic impacts attributed to changes in riverine conditions associated with release schedule Alternative 6.

5.6.4 Construction and Operations Cost Assessment

Modification of the release schedule, without reallocation of storage, imposes no construction or additional operations costs. However, reallocation of storage imposes a financial cost to the non-Federal sponsor for the capital investment of the reallocated storage, which is calculated as the greatest of (1) either benefits or revenues foregone by the reallocation, (2) the replacement cost of the reallocated storage, or (3) the updated cost of storage in the Federal project as specified in ER 1105-2-100. The non-Federal sponsor is also responsible for construction and operational costs associated with the reallocation, including costs of revising the project's water control plan.

The cost of reallocated storage presented here is based upon reallocation of 10,000 acre-feet of storage to water supply from low flow augmentation for water quality. Under release schedule Alternative 6, water supply would continue to be withdrawn from the Youghiogheny River approximately 29 river miles downstream of the dam at South Connellsville, PA. Currently, uncontrolled flow at Connellsville is augmented by releases from Youghiogheny Lake according to the existing storage and release schedule. Under this alternative, the Lake's release schedule would be modified to augment uncontrolled flow in order to provide 17 million gallons per day for water supply purposes (approximately 25 cfs), during those days when additional augmentation would be required. This water would be released into the reach of the Youghiogheny River extending from the Lake discharge to the withdrawal point in South Connellsville. Existing project purposes, including low flow augmentation for water quality and white water recreation would be maintained.

This cost of storage analysis discusses and calculates costs (where applicable) for each of the three cost calculation methods mentioned above: discusses benefits foregone due to reallocation; foregone revenues; and the replacement cost of reallocated storage. The updated cost of storage

in the Federal project establishes the appropriate (preliminary) cost of storage to be allocated to the non-Federal sponsor. A test of financial feasibility that compares the annual cost of storage to the non-Federal sponsor to the annual cost of the non-Federal sponsors most likely, least costly water supply alternative is also presented below.

5.6.4.1 Benefits Foregone

The Youghiogheny Lake currently provides the following categories of downstream benefits: flood control, water quality control, fish and wildlife support, general recreation, white water recreation, and hydropower. Benefits provided by the pool include general recreation and fish and wildlife support. Benefits would be foregone if the proposed reallocation and modified release schedule were expected to reduce the generation of benefits in any benefit category. Reallocation of 10,000 acre-feet of storage to water supply and modification of the release schedule to augment uncontrolled flow are not anticipated to negatively impact any of the benefits currently generated by the project (see Economic Impacts of Alternatives section of the Economics Appendix).

The proposed reallocated storage accounts for approximately 4% of the Lake's storage capacity (242,090 acre-feet). The proposed reallocation does not reduce the amount of storage available for flood control. The proposed reallocation would, however, reduce low flow storage by 10,000 acre-feet. The possibility of reallocating 10,000 acre-feet from low flow augmentation to water supply is due to historic and continuing water quality improvements downstream of the dam that have reduced the reservoir storage needed to maintain downstream water quality.

A 12 MW hydropower generator operates at the outflow of the dam. Higher pool elevations in the lake during the late summer and early fall will increase the hydraulic head at the hydropower facility, which allows the facility to generate more electricity. The economic benefits of increased electric production during this time of year, however, are offset by lower flow rates through the hydropower facility that would occur during water conservation periods. Discussions with personnel at D/R Hydro, the company that operates the hydropower facility, indicate that there is no economic impact associated with increased pool elevations due to the offsetting effects of increased hydraulic head and decreased flow. Therefore, the proposed reallocation will not reduce benefits related to hydropower production.

Current dam operations take advantage of opportunities to enhance downstream whitewater rafting by coordinating release schedule changes with heavy weekend use of the river. These minor nuances in the release schedule are typically conducted by slightly lowering the volume of water released during the week and then compensating with greater releases during the weekend. These slight adjustments are not guaranteed and can only be accomplished under limited favorable conditions. These opportunistic releases will continue under the existing and proposed release schedules. Therefore, there is no expectation of reduced whitewater recreation benefits.

Water quantity and water quality modeling were undertaken in the feasibility analysis to quantify the impacts of proposed reallocation and modification to the release schedule. The critical downstream water quality parameters identified in the feasibility analysis were water temperature and dissolved oxygen levels in the Youghiogheny River from the dam to McKeesport, PA. The preliminary findings of the feasibility level modeling analysis of the

reservoir and the river indicate that there is no discernable difference in the projected ranges of water temperature and dissolved oxygen levels between the existing storage allocation and release schedule and the proposed reallocation and modified release schedule. Therefore, the proposed reallocation and modified release schedule are not expected to adversely impact water quality benefits provided by the project. General recreation and fish and wildlife related benefits are not expected to be adversely impacted by the proposed reallocation and modified release schedule because of the slight change in release and the associated minimal impacts on water quality.

Youghiogheny Lake also provides pool related benefits, including general recreation, and fish and wildlife support. The proposed reallocation and modified release schedule will not change the overall magnitude of the drawdown within the Youghiogheny River Lake as it is required for flood protection. The proposed action will cause slightly more water to be held in the Lake during spring and early summer so that water conserved during the wet time of the year can be released during the driest portion of the water year (mid and late summer months). Water quality modeling studies indicate that during normal years, only a very slight cooling of the deepest waters in the Lake would occur. In a very dry year, minor warming of the deepest waters would occur during the late summer. These changes are slight and within the range of normal temperature fluctuations. Therefore, no adverse effects are expected to result from these minor temperature changes. Dissolved oxygen levels at the hydropower intake will be lowered due to the longer duration of higher pool elevations. However, the minimal cost this imposes on the hydropower facility are offset by the benefits of slightly increased hydraulic head. Overall, there is no net effect on hydropower related benefits.

Since the late spring and early summer pool will be held slightly higher with a slower drawdown than is currently implemented, there will be some positive general recreation and fish and wildlife benefits from implementing the proposed action. These potential benefits include increased fish productivity in the Lake and a longer boating season due to extended dock and ramp access. Benefits related to the extended boating season are presented in the Economic Impacts of Alternatives section of the Economics Appendix.

Revenues foregone are defined as the reduction in revenues accruing to the U.S. Treasury based upon any existing payment agreements related to the project. Revenues foregone to hydropower would be based upon the projected reduction in hydropower output due to the reallocation or modified release schedule. Since there are no payment agreements to the U.S. Treasury related to this project and there is no projected reduction in hydropower output due to the reallocation and modified release schedule, there are no revenues foregone associated with the proposed reallocation and modified release schedule.

5.6.4.2 Replacement Costs

Total replacement costs are the costs of providing project benefits that are lost or diminished due to the proposed reallocation. Flood control replacement costs are the costs of providing equivalent flood control protection if reallocated storage is being taken from the flood control pool. Low flow augmentation costs are calculated as the cost of providing an alternative source of flow augmentation. Hydropower replacement costs are calculated as the benefits foregone to hydropower if reallocated storage is being taken from the hydropower pool or as the lowest cost

of obtaining power from alternative sources in order to fulfill existing contractual commitments. In this analysis, there is no change in the volume of flood control storage, there is no hydropower pool identified for this project and no net reduction in the hydropower plant's generating capability, and no reduction in low flow benefits due to improved water quality in the receiving waters. Therefore, there are no replacement costs to be estimated for this study.

5.6.4.3 Updated Cost of Storage

This method of calculating the cost of capital investment in reallocated storage space is based upon the estimated cost of building the existing storage project today. Construction costs unrelated to storage such as construction costs of recreational facilities are not to be included in construction costs used to calculate the updated cost of storage. The proportion of the updated cost of storage allocated to the non-Federal sponsor is calculated as the proportion of existing usable storage to be reallocated. Usable storage is defined as the amount of storage remaining after 100 years of dam operation.

The 1998 Report on Sedimentation of Youghiogheny River Lake was used to estimate usable storage. That report calculated the Full Pool at the Lake to contain 254,811 acre-feet and sedimentation through 1998 to account for 4,208 acre-feet. Extrapolation to one hundred years would increase 1998 sedimentation levels by an additional 3,471 acre-feet. The same study identified the Minimum Pool at 5,040 acre-feet. Table 5.13 presents the calculations used to determine usable storage. The reconnaissance study identified 10,000 acre feet as the storage required to achieve the 17 MGD withdrawal sought by the local sponsor. The proportion of usable storage required by the proposed reallocation is approximately 4% (10,000/242,092 = .0413).

Construction costs are updated in four categories using the Engineering News Record (ENR) construction cost index and the Corps of Engineers Civil Works Construction Cost Index System (CWCCIS) as identified in EM 1110-2-1304. The four cost categories include dams and appurtenances, buildings and grounds, relocations, and land. The value of lands are updated by the weighted average update of all other project features, as per the Water Supply Handbook, revised IWR Report 96-PS-4, December 1998. Since the CWCCIS dates back only to 1967, the ENR construction cost index is used to update project costs to 1967.

Table 5.13 Usable Storage Calculations (ac. ft.)

Full Pool	254,811
- sedimentation up to 1998	4,208
Total Storage	250,603
- Minimum Pool	5,040
Actual Storage	245,563
- extrapolated sedimentation	3,471
Usable Storage	242,092

The original construction costs for dams and appurtenances and relocations are identified in the reconnaissance study. The buildings and grounds category identified in the reconnaissance study includes the costs of land acquisition. The costs of land acquisition identified in the 1938 project audit was subtracted from the cost of buildings and grounds identified in the reconnaissance study so that the cost of lands could be updated separately according to procedures outlined in the Water Supply Handbook. The period of expenditure for each project feature is 1939 – 1951 (mid-point 1945) as identified in the 1992 Youghiogheny River Lake Summary of Pertinent Data dated 20 September 1992. Table 5.14 presents the cost update calculations from the mid-point of expenditures (1945) to 1967, using the ENR construction cost index. Table 5.15 presents the cost update calculations from 1967 to Fiscal Year 2002 using the CWCCIS, revised 31 March 2001.

Table 5.14 Updated Cost of Construction 1945 – 1967 ($ thousands)

Cost Category	As-built Joint-Use Cost	ENR index 1945	ENR Index 1967	Update Factor	1967 Cost
Dams & Appurtenances	$4,970	308	1074	3.487	$17,330
Buildings & Grounds	$1,113	308	1074	3.487	$3,881
Relocations	$2,086	308	1074	3.487	$7,274
Lands & Damages	$831	N/A	N/A	N/A	N/A
Totals	$9,000				N/A

Table 5.15 Updated Cost of Construction 1967 – FY 2002 ($ thousands)

Cost Category	1967 Cost	1967 CWCCIS	FY 2002 CWCCIS	FY 2002 Cost
Dams & Appurtenances	$17,330	100	527.87	$91,482
Buildings & Grounds	$3,881	100	496.53	$19,271
Relocations	$7,274	100	538.98	$39,205
Lands & Damages	N/A	N/A	18.36*	$15,255
Totals	N/A			$165,213

* Derivation of Lands & Damages Update Factor:
As-built Joint-Use Cost (-) Lands and Damages = $8,169.
FY '02 Cost (-) Lands and Damages = $149,958.
Ratio 149958 / 8169= 18.36

The updated FY 2002 total cost of construction is $165,213,000, excluding interest during construction. The non-Federal sponsor's proposed proportion of usable storage is .0413. The updated cost of storage allocated to the non-Federal sponsor is $6,823,300 ($165,213,000 * .0413 = $6,823,300). The updated cost of storage is the highest cost of the three cost calculation methods, (i.e., benefits or revenues foregone by the reallocation, replacement cost of the reallocated storage, and the updated cost of storage in the Federal project), and therefore will be used as the cost to the non-Federal sponsor for the capital investment of reallocated storage. The non-Federal sponsor is also responsible for a proportional share of operation and maintenance costs, the cost of updating the project's water management plan, and any costs specific to the reallocation, such as environmental mitigation costs.

5.6.4.4 Test of Financial Feasibility

The test of financial feasibility compares the non-Federal sponsor's cost for the capital investment of reallocated storage at the project (identified in section 5, above) to the cost of the most likely, least costly alternative that would be taken by the non-Federal sponsor to meet projected water supply needs. Costs are annualized over a 50-year planning horizon using the current Federal discount rate, 5.875%.

The local sponsor has indicated that the most likely least cost alternative to reallocating storage at Youghiogheny Lake is the construction of a new impoundment at Indian Creek. The new impoundment would consist of a 226-foot tall dam located at the mouth of Indian Creek just downstream of the far smaller existing dam. Although the purpose of the dam is to provide 17 MGD of water supply to the local sponsor, the dam must be designed to meet numerous criteria including maintenance of low flow in Indian Creek and drought contingencies. Total storage volume would range from 6,827 million gallons at pool elevation 1140 feet to 23,000 million gallons at pool elevation 1245 feet. The estimated 1976 cost of construction was $25,220,610. This cost is updated to FY 2002 by comparing the CWCCIS index for reservoirs in FY 1977 (226.15) to the index in FY 2002 (588.79). The resulting adjustment factor is 2.604 (588.79/226.15 = 2.604) and the updated FY 2002 cost of construction for the Indian Creek impoundment is $65,662,800.

Annual costs include operation and maintenance costs. FY 2002 operation and maintenance costs for Youghiogheny Lake are estimated to be $600,000. The proportion allocated to the non-Federal sponsor is $24,780 ($600,000*.0413 = $24,780). Operation and maintenance costs for the Indian Creek impoundment are assumed to be one-half of the operation and maintenance costs for Youghiogheny Lake, or $300,000. Other costs, if required, would be included in the annualized costs allocated to the non-Federal sponsor, such as costs relating to environmental mitigation, additional construction that may be required for the reallocation, and the cost of updating the project management plan. Table 5.16 presents the annualized costs of reallocating storage at Youghiogheny Lake and the annualized costs of constructing a new impoundment at Indian Creek (based upon the FY 2002 discount rate of 5.875% and a 50 year time horizon). The comparison of annualized costs indicates that reallocation of storage in Youghiogheny Lake is a less costly alternative for the non-Federal sponsor.

Table 5.16. Annualized Cost Comparison

	Reallocation of Storage	Construction of Impoundment
Total Construction Cost	$6,823,300	$65,662,803
Annualized Construction	$475,978	$4,064,518
Operation & Maintenance	$24,780	$300,000
Total Annual Cost	$500,758	$4,364,518

5.7 Plan Selection

Release schedule Alternative 6 is selected as the most favorable plan for providing water supply to a downstream municipal water authority facility and for increasing recreational benefits provided by Youghiogheny Lake. This alternative has no detrimental environmental or economic impacts and optimizes the reservoir release schedule by generating new water supply benefits and enhancing lake recreation benefits. Release schedule Alternative 5 would adequately accommodate water supply storage reallocation of 10,000 acre-feet of storage and releases of 17 MGD without detrimental environmental or economic impacts. However, release Alternative 6 is the preferred option because changed conditions at the project (improved downstream water quality) provide an opportunity to increase lake recreation benefits with no adverse effects on other authorized project purposes. Therefore, the changes in the release schedule for the federal interest not attributable to water supply are defined as the added changes to Alternative 5 that were made to create Alternative 6.

6 PLAN IMPLEMENTATION

6.1 Local Agency Coordination

Beginning early in plan development, a conscious effort was made to maintain a strong agency and public involvement. An extensive list of stakeholders and water users was developed. A Public Steering Committee was formed to act as a sounding board and to provide input for the study. A Technical Subcommittee was formed to address the more technical water quantity and water quality issues. A number of meetings and/or briefings were held with various agencies and local interest groups in order to obtain feedback at various points in the study process. A listing of meetings/briefings is provided on pages 44-45. Membership rosters for the Steering Committee and the Technical Subcommittee are provided on page 46. The District also posted study information on the District Internet site for general public access.

6.2 Non-Federal Sponsor

Non-Federal participation is defined by Section 932 of the Water Resources Development Act of 1986. This law further amends the Water Supply Act of 1958 (Public Law 85-500). In accordance with ER 1105-2-100 (22 April 2000), the cost allocated to the non-federal sponsor, i.e., the price to be charged for the capital investment for the reallocated storage, will normally

be established as the highest of the benefits or revenues foregone, the replacement cost, or the updated cost of storage in the federal project. As identified in Section 5 above and in the Economics Appendix the costs to be reallocated to the water supply storage are calculated as the updated cost of storage.

The repayment rate used to calculate annual payment for reallocated storage is the yield rate defined in Section 932 of the Water Resources Development Act of 1986. Economic Guidance Memorandum 01-02 "FY 2002 Interest Rates" identifies the current yield rate of 5.625%. The repayment rate will be readjusted every five years. The maximum repayment period for reallocated storage is 30 years from the date the Water Supply Agreement is signed by the Assistant Secretary of the Army (Civil Works).

The following calculations are reproduced from the model Water Supply Contract, which is provided in ER 1105-2-100. The total cost of reallocated storage is $6,823,300. Annual repayment costs allocated to the Non-Federal partner are $500,758 per year for 30 years, which also include the share of annual operations and maintenance costs allocated to the non-Federal sponsor of $24,780 per year.

Table 6.1 Non-Federal Partner Annual Payment Calculations

$6,823,270 * 0.069758051 amortization factor based on 30 payments, with interest at 5.625 %.	$475,978
Operation and maintenance: 100 % * 4.13% * $600,000	$24,780
Specific water supply facilities: 100% * $ 0 estimated	$0
Repair, rehabilitation and replacement: 100 % * $0	$0
Specific water supply facilities: l00% * $0 estimated	$0
Total	= $500,758

7 CONCLUSIONS

A number of alternatives were examined to provide additional water supply to the local sponsor. These alternatives have been evaluated based on their environmental, social, cultural and economic impacts, as well as engineering feasibility. The alternatives have also been judged against National and local objectives.

The Recommended Plan best serves the overall public interest without significant adverse effects. This Plan consists of the following components:

1. Storage in the amount of 10,000 acre-feet will be made available for reallocation from water quality storage to water supply;
2. The existing release schedule will ultimately be modified as proposed by Alternative 6. In the interim, while there is no signed water supply agreement in place, the modification will be limited to that part of Alternative 6 that meets only the federal interest not

attributable to water supply. As water supply agreements are implemented, release modifications will be adjusted proportionally.

Subject to review and comment, it is concluded that a storage reallocation at the Youghiogheny River Lake Project to allocate up to 10,000 acre-feet of storage for the purpose of water supply can be accomplished in accordance with the provisions of the Water Supply Act of 1958, as amended, and in accordance with Corps of Engineers policy. Engineering Regulation (ER) 1105-2-100 (22 April 2000) states that:

> *"Reallocation or addition of storage that would seriously affect other authorized purposes or that would involve major structural or operational changes requires Congressional approval. Provided these criteria are not violated, 15 percent of the total storage capacity allocated to all authorized project purposes or 50,000 acre feet, whichever is less, may be allocated from storage authorized for other purposes. Or, this amount may be added to the project to serve as storage for municipal and industrial water supply at the discretion of the Commander, USACE."*

The Municipal Authority of Westmoreland County (MAWC) is seeking a reallocation of approximately 10,000 acre-feet storage, which would provide 17 million gallons per day (MGD), during those days when additional augmentation is required, to be withdrawn from the Youghiogheny River at South Connellsville. This represents approximately 4 percent of the total storage capacity allocated to all project purposes. The storage reallocation will not result in any serious effects on other authorized project purposes, and will not require major structural or operational changes. Therefore, based on existing legislation and U.S. Army Corps of Engineers regulations, approval of the Reallocation Report by the Commander, USACE, will automatically result in water supply becoming a project purpose. This is in accordance with the provisions of the Water Supply Act of 1958, as amended.

The second recommendation of this feasibility study is to modify the release schedule as proposed in Alternative 6 to reflect changed conditions. This release schedule alternative optimizes the benefits generated by the project. Downstream water quality improvements allow the release schedule to be modified to enhance reservoir recreation, provide adequate water supply to the withdrawal location at South Connellsville, and not diminish other project purposes including, flood control, water quality maintenance, recreation, and fish and wildlife habitat. Under release schedule Alternative 6, project benefits related to reservoir recreation would be increased. Release schedule Alternative 6 generates no measurable net benefits or net costs related to other project purposes. Because there will not be a water supply agreement in place immediately, the modifications will not include water for water supply. Instead, initial modifications will be limited to those that fulfill only the federal interest and will provide the recreational benefits discussed earlier. As storage space is purchased, release modifications will be made to proportionally accommodate the incremental water supply requirement.

The purchase of 10,000 acre feet of water supply storage in the Youghiogheny River Lake by the local sponsor would be subject to cost sharing, financing, and other requirements defined in the Water Storage Agreement between the United States of America and the local sponsor. For the full 10,000 acre-feet, the total cost of reallocated storage would be $6,823,300. Annual

repayment costs allocated to the Non-Federal partner would be $500,758 per year for 30 years, which also include the share of annual operations and maintenance costs allocated to the non-Federal sponsor of $24,780 per year. For purchases of amounts less than 10,000 acre-feet, the costs would be proportional.

8 RECOMMENDATIONS

I have carefully reviewed the water supply problems of the study area and the proposed solution documented in this report. There is a current and future need for additional water supply. There are also historic and continuing water quality improvements downstream of the Youghiogheny Dam that have reduced the storage space required to maintain water quality in the Youghiogheny River. Furthermore, it is evident through the analysis conducted for this feasibility report that modifications to the existing release schedule can increase the benefits provided by the project.

Based on the findings in this study and the Environmental Assessment, it is recommended that 10,000 acre-feet of storage in the Youghiogheny River Lake Project between elevations 1439.0 and 1344.0 be made available for reallocation from the existing water quality storage to municipal and industrial water supply. To better accommodate reallocation of storage and to improve lake recreation, in response to changed project conditions, I further recommend that the project release schedule be modified in accordance with the release schedule developed for the selected plan. However, until such time that a formal water supply agreement (or agreements) is (are) signed, only the federal interest portion of the selected plan not attributable to water supply will be implemented. For water supply agreements less than the full 10,000 acre-feet amount, the release schedule will be adjusted proportionally. Specifically, the release increase made for water supply will be adjusted as additional storage space is purchased. This action will satisfy the immediate needs of the study area and the future needs in the region.

RAYMOND K. SCROCCO
Colonel, Corps of Engineers
District Engineer

Figure 1. Map of Study Area

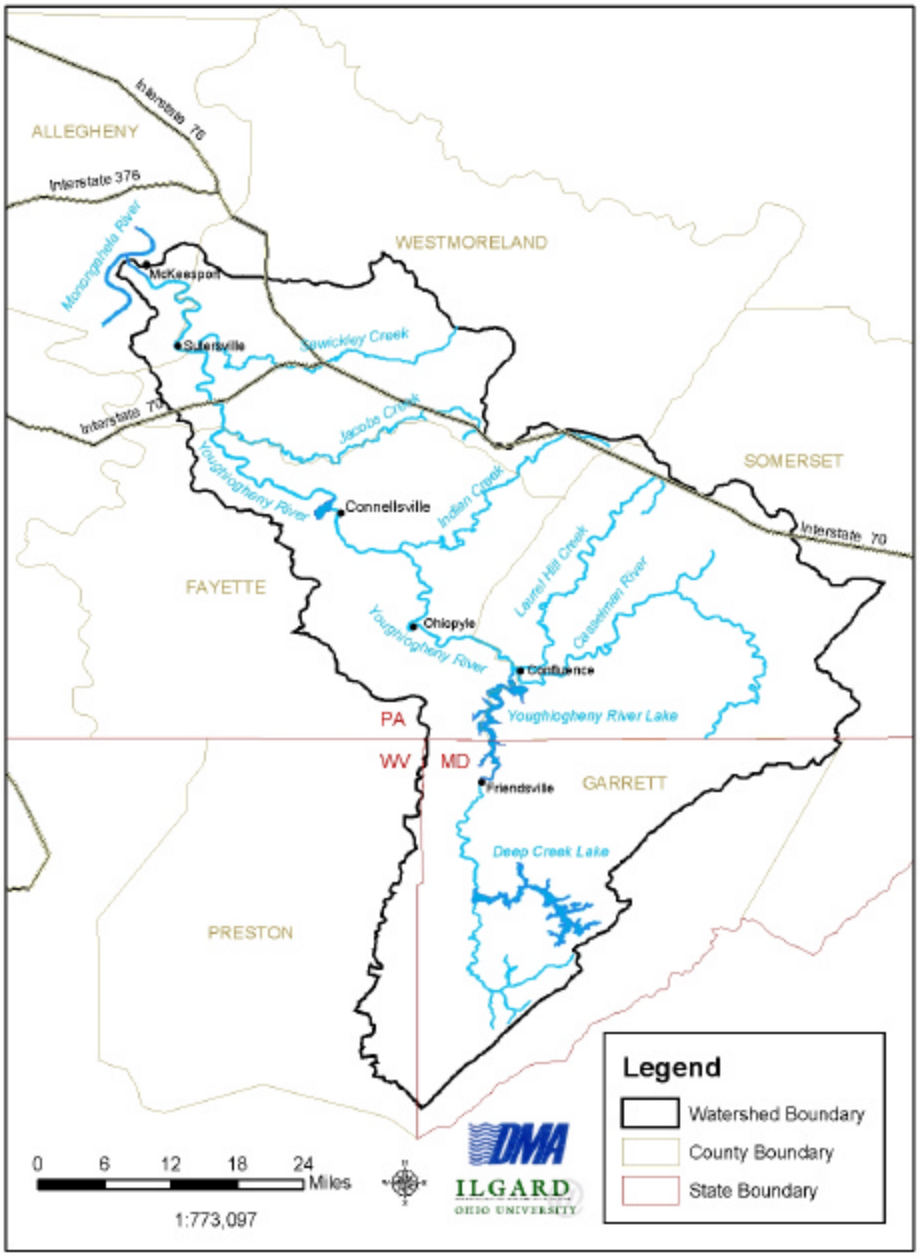


Figure 2. Map of Youghiogheny River Lake

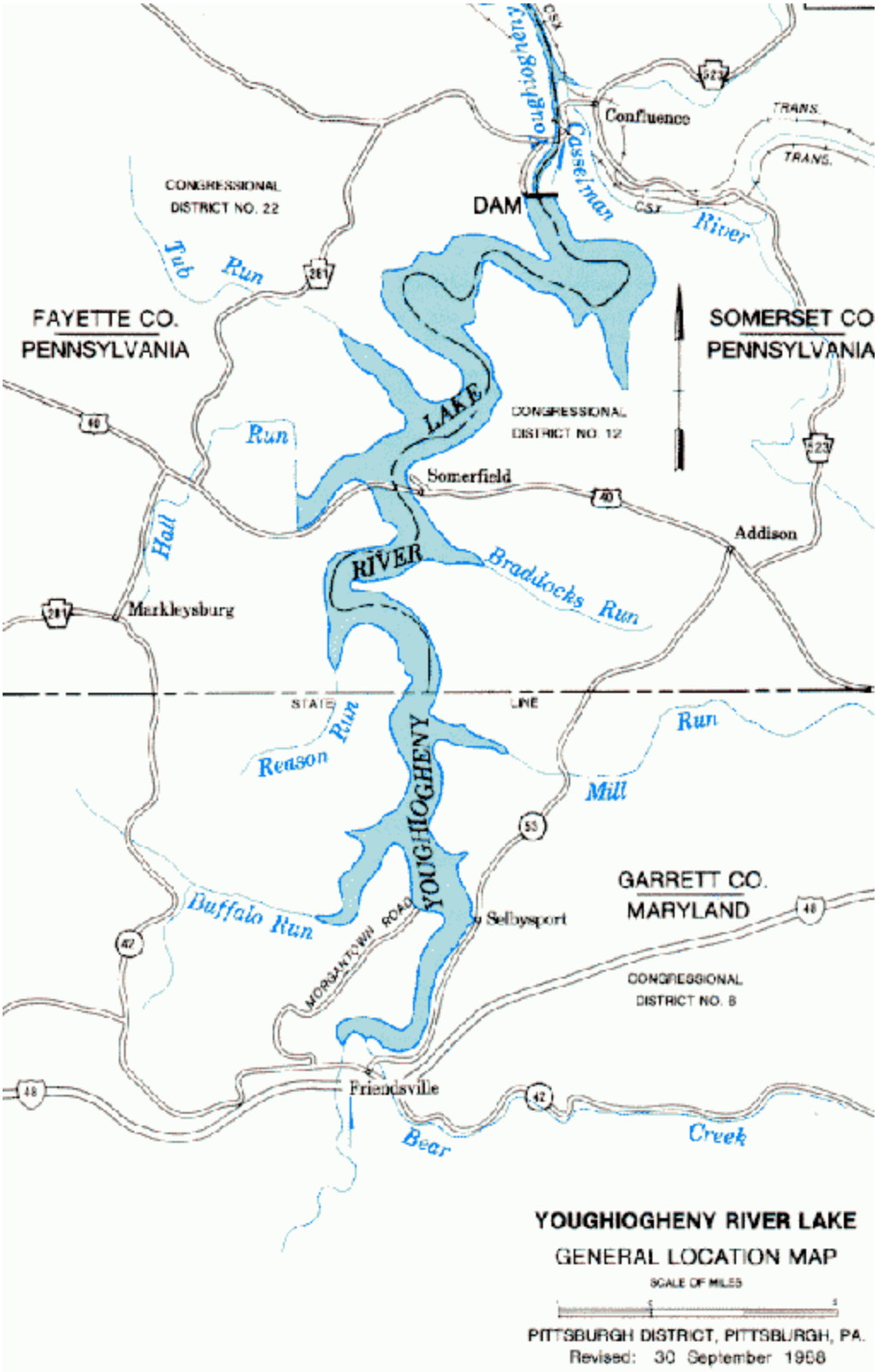
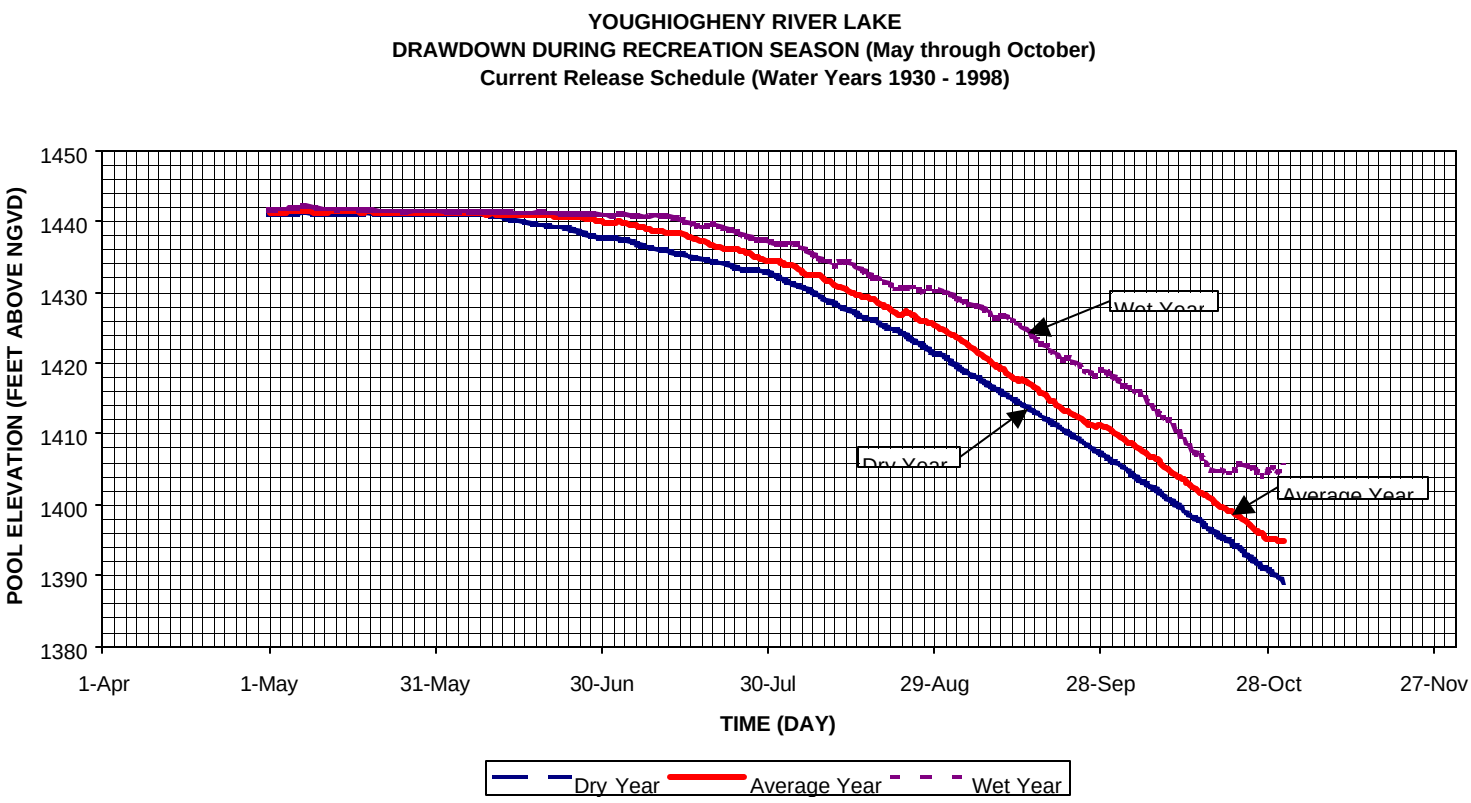


Figure 3. Current Release Schedule Drawdown Curves



YOUGHIOGHENY RIVER LAKE WATER MANAGEMENT AND REALLOCATION STUDY

Public / Agency Involvement
Feasibility Phase

1999

June — Feasibility Phase is initiated. Study Initiation meeting in Connellsville. Outlined study plan, informed stakeholders, identified Steering Committee members.

July — Briefing for Fayette-Forward Environmental Action Committee in Uniontown. Outlined study plan, solicited comments and suggestions.

December — First Steering Committee (see attached membership roster) meeting at PSU, Fayette Campus. Presented water quantity findings, solicited feedback, solicited public input to identify environmental impacts, start of water quality phase.

2000

January — Briefing for Youghiogheny River Outfitters in Pittsburgh.

June — Meeting with Pennsylvania Fish and Boat Commission in Pittsburgh. Presented preliminary water quality findings, solicited input relative to fishery impact.

June — Briefing for Youghiogheny River Council at Fireman's Park, Sutersville.

September — Meeting of Technical Subcommittee (see attached membership roster) in Pittsburgh. Reviewed water quantity findings, presented water quality findings, solicited feedback.

2001

February — Public Meeting in Connellsville. Presented water quantity and water quality findings, presented draft alternatives, presented preliminary environmental findings, solicited feedback.

April — Attended meeting in Connellsville sponsored by mayor. Answered questions, briefly described current plans and procedures.

June — Met with DEP (via telcon) to discuss permit withdrawal/reservoir release connection.

June — Met with Crouse & Company (A-E hired by Fayette County) in Pittsburgh to discuss their study plans, briefed them on our status.

July	Met with Rep. Shaner and Dr. Colvin in Connellsville. Discussed general viewpoints on water use. Answered questions.
July	Initial draft Feasibility Report and EA completed.
September	Revised draft Feasibility Report and EA completed.
December	Met with MAWC to discuss revised draft report. Initial discussion on possible changes to withdrawal plans based on public input.

2002

March	Attended meeting in Uniontown.
June	Team Meeting with MAWC in Greensburg. Finalized pending changes to report and withdrawal plans.
July	Contacted Crouse & Company for update on their study. No progress, waiting for us to finish our study first.
August	Team Meeting with MAWC and DEP. Briefed DEP on proposed changes to water withdrawal, agreed on mechanism for other user requests.
September	Briefed Fayette County Commissioner on proposed recommendations.
October	Met with Dr. Colvin (Concerned Citizens Committee) to discuss revised implementation plans.

MEMBERSHIP ROSTERS

TECHNICAL SUBCOMMITTEE

U.S. Fish & Wildlife Service
U.S. Department of Energy
Office of Sen. Richard Kasunic
Pennsylvania Fish & Boat Commission
Pennsylvania Department of Environmental Protection
Ohiopyle State Park
Westmoreland County Conservation District
Fayette County Conservation District
Municipal Authority of Westmoreland County
North Fayette Municipal Authority
Mayor, Borough of Dawson
D/R Hydro Company
Yough Riverwatch, Inc.
Trout Unlimited, Chestnut Ridge Chapter
Yough Area Fisherman's Association
Laurel Highlands River Tours
Mountain Streams and Trails
Riversport
U.S. Army Corps of Engineers

STEERING COMMITTEE

Trout Unlimited, Forbes Trail Chapter
City of Connellsville
Concerned Citizens Committee Against Water Reallocation
Office of Congressman John Murtha
Office of Representative James Shaner
Office of Representative Bill DeWeese
Office of Congressman Franck Mascara
National Pike Water Association
Fayette County Commissioners Office
Connellsville Area Historical Society
+ members of the Technical Subcommittee
+ members of the general public