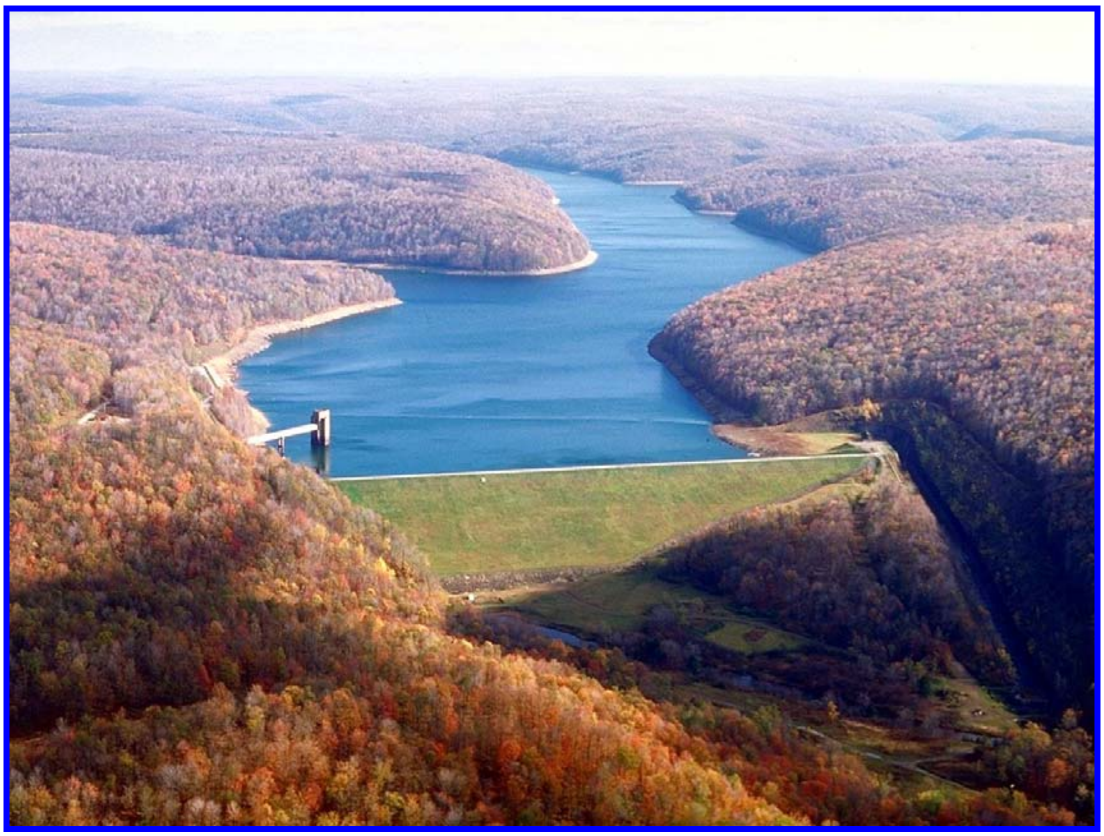
US Army Corps of Engineers
Pittsburgh District

June 2009

East Branch Dam
Elk County, Pennsylvania
Interim Risk Reduction Measures



Environmental Assessment

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Assistance Provided to the Pittsburgh District

The impact analysis presented in this Environmental Assessment of the modified operation of East Branch Dam and Clarion River Lake represents the combined efforts of the Pittsburgh District Corps of Engineers, the Corps of Engineers Engineering, Research and Development Center (ERDC), the Pennsylvania Fish and Boat Commission (PAF&BC) and Pennsylvania Department of Environmental Protection (PADEP). The District is indebted to members of the PAF&BC, PADEP and ERDC for their exemplary cooperation, outstanding technical expertise, and eager willingness to help the Pittsburgh District define and quantify changes to an inherently complex hydrologic system and the impacts of these changes on the aquatic environment within East Branch Lake and the East Branch Clarion and Clarion Rivers. The model study reports prepared by these agencies, which were used to predict many of the impacts described in Section 6 of this assessment, are attached as **APPENDICES A, B** and **C**.

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EA Summary

1. Preliminary dam safety studies completed in January 2008 revealed that East Branch Dam may have structural deficiencies that could cause it to fail unexpectedly.
2. Because of confirmed and unconfirmed risk, the District, whose priority in mission execution is public safety, decided in February 2008 to lower the operating pool to make the dam safer until further studies can be completed.
3. The new maximum summer pool was lowered about 20 feet (from elevation 1670 to 1650) to reduce the hydraulic head and seepage within the dam.
4. The maximum winter pool was lowered about 28 feet (from elevation 1651 to 1623).
5. East Branch Dam is currently operating safely under this new operating schedule and will continue to provide flood risk reduction downstream as it has since it was constructed. Periodic storage of floodwaters will not reduce dam safety.
6. The lower operating pool will remain in effect for at least the next 3 -5 years until the dam can be repaired.
7. Although the summer pool is lower, the lake will remain available for recreation in 2009 and thereafter. The District is proposing to extend the boat launching ramp near the dam to extend the boating season into mid-September. It currently goes out of service around mid-August under the interim operating schedule. The ramp extension is planned for the late summer/early fall of 2009.
8. Except possibly for a one month period in November during a severe drought there would be sufficient storage in the lake under the new lower 1650 operating pool to continue to provide downstream low flow water quality releases that have historically been provided under the original authorized water control plan.
9. The District modified the dam's outflow control tower in October 2008 to provide added flexibility to maintain optimum lake and downstream water temperatures during warmer periods (summer and early fall).
10. The extensive analysis conducted to prepare this Environmental Assessment concluded that for the current interim 1650 operating pool:
    - The modified dam outlet will provide sufficient water at correct temperatures to ensure that the Domtar paper mill can continue to operate and meet their NPDES discharge criteria.
    - The lake will continue to provide good downstream water quality.
    - No NPDES permit holders along the Clarion River will be adversely affected.
    - The unique lake trout fishery in East Branch Lake will be preserved.
    - The 8-mile long trophy brown trout fishery along the Clarion River between Johnsonburg and Ridgway will be preserved.
    - Neither recreation nor economic conditions would be significantly affected.
    - The Federally-designated Wild and Scenic portions of the Clarion River will not be adversely affected.

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1.0 East Branch Dam - General Information

1.1 Need and Purpose for the Project and Environmental Assessment

In January 2008, East Branch Dam was determined by the Corps of Engineers to be potentially unsafe. To protect public safety, the Corps temporarily changed the operation of the dam in February 2008 by lowering the summer and winter pools to reduce the hydraulic stress on and within the dam to acceptable levels. This Environmental Assessment (EA), prepared to comply with Federal environmental protection statutes, evaluates the environmental, social and economic effects of the new interim dam operating schedule.

1.2 Project Authorization and Construction History

East Branch Dam was authorized for construction by the Flood Control Act of December 22, 1944 (Public Law 534 of the 78th Congress, second session, H.R. 4485), which provides in Section 10, as follows:

> "…that the general comprehensive plan for flood control and other purposes, approved in the Flood Control Act of June 28, 1938, for the Ohio River Basin, is hereby modified to include the construction of flood-control works for the protection of Ridgway, Johnsonburg,… and vicinity in the state of Pennsylvania…"

The authorized project purposes of East Branch Dam include reduction of flood stages on the Clarion River, water conservation, water quality, low flow augmentation, recreation and conservation of fish and wildlife.

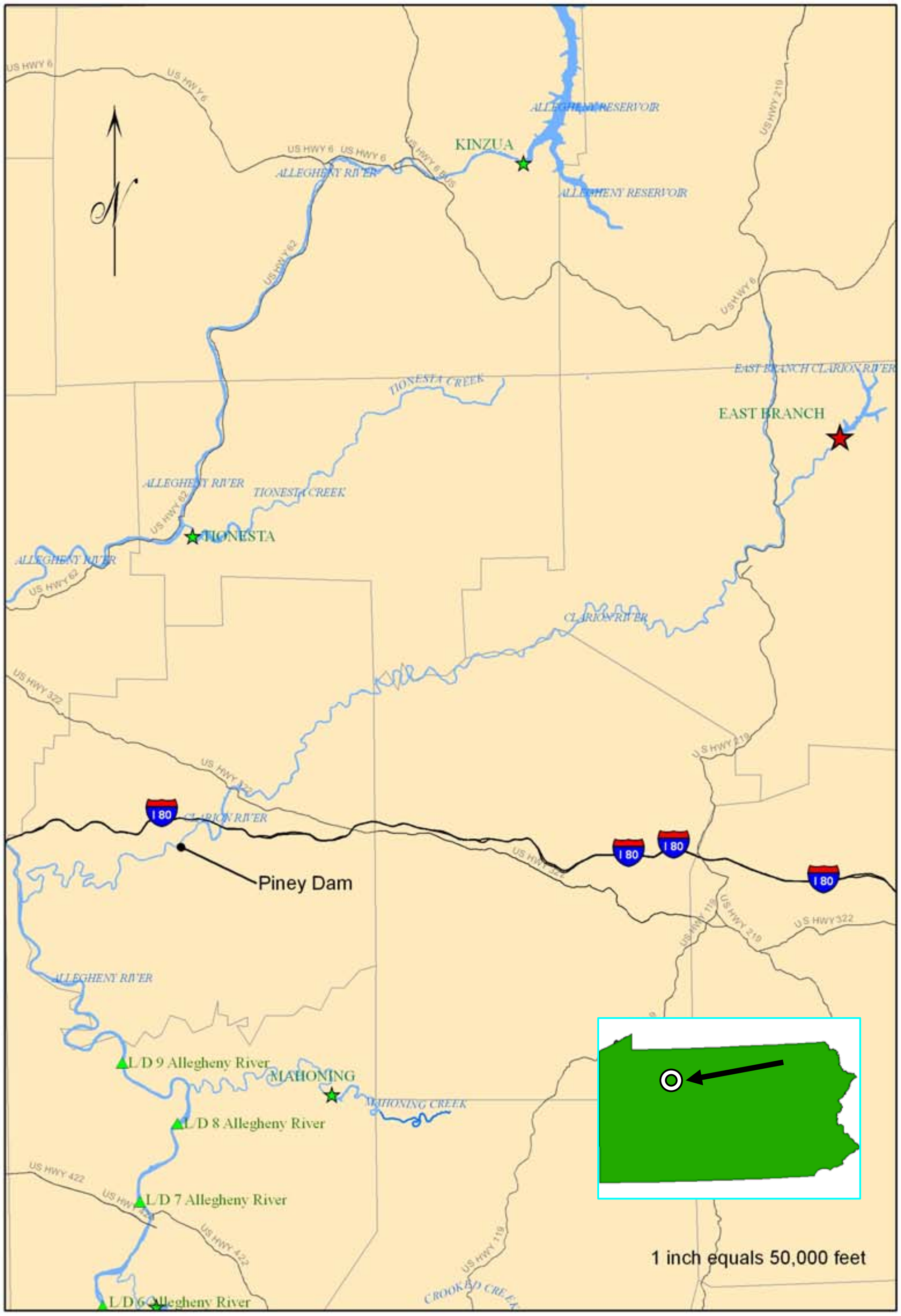
Construction of the dam began in June 1947 when the initial construction contract was awarded. The dam was completed and put into full operation by June 1952.

The Flood Control Act of 28 June 1938 provides the authority to pursue the seepage corrections at East Branch Dam. Under current policy, Seepage Control and Static Instability Correction projects are types of rehabilitation projects and will be pursued under the Construction General program in accordance with Engineer Circular 11-2-194.

1.3 Location

East Branch Dam, which forms Clarion River Lake, is located in a remote, rural area of northwestern Pennsylvania in Elk County on the East Branch Clarion River. (See **FIGURES 1** and **4**) The dam is situated 7.3 miles upstream of the community of Johnsonburg. At Johnsonburg the East Branch and West Branch Clarion Rivers join forming the Clarion River main stem. (**FIGURE 1** shows the general location of East Branch Dam). The community nearest to the dam is the small village of Glen Hazel, which lies less than two miles downstream. Bendigo State Park is about three miles downstream of the dam. The community of Ridgway is located about 15.7 miles downstream of the dam or about 8 miles downstream of Johnsonburg. From Johnsonburg the Clarion River flows west-southwest in a very sinuous course for approximately 102 miles to its confluence with the Allegheny River about 2 miles south of the community of Foxburg. See also the Western Pennsylvania Conservancy WEB site: http://www.paconserve.org/rc/pdfs/crwtm.pdf

FIGURE 1 – General Location, East Branch Dam



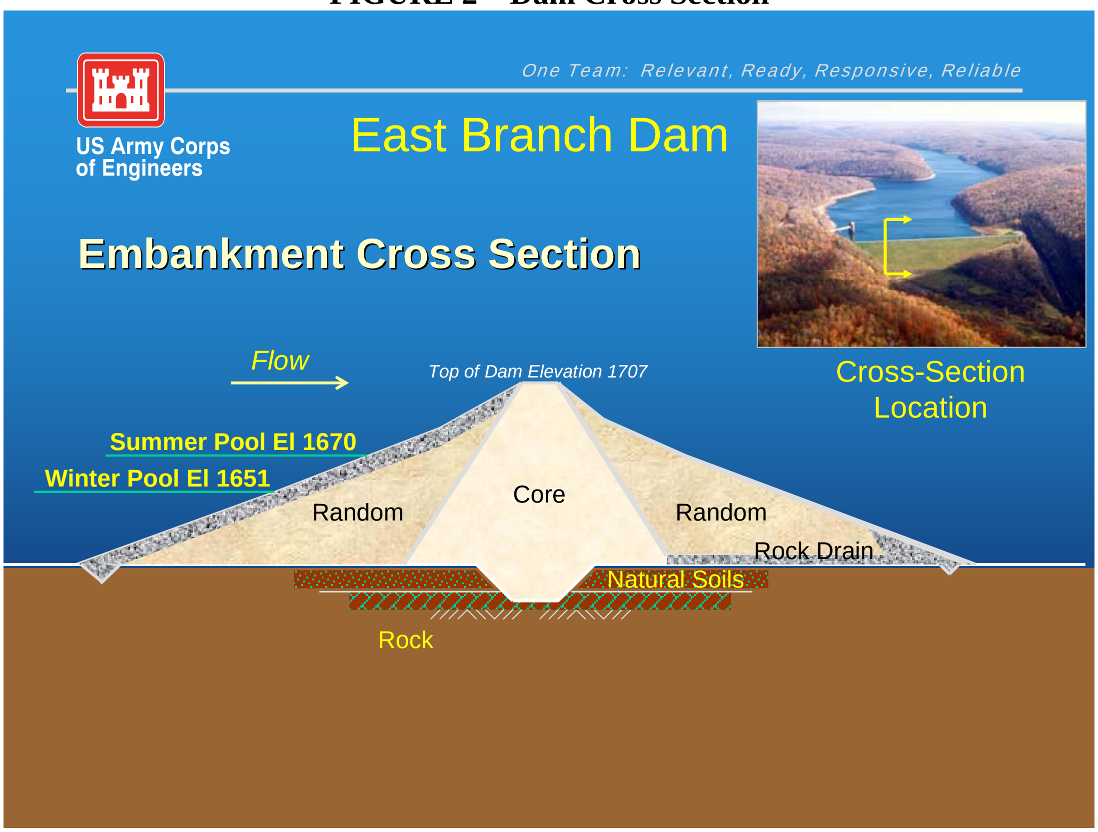
1.4 Structural Data

1.4.1 Dam

The dam is a rolled earth fill embankment with outlet works located at the right descending abutment and an emergency spillway located in the left abutment. (***NOTE***: *Right and left bank are always from the perspective of looking downstream*.) The embankment is 1,725 feet long and has a height of 184 feet, with top of dam elevation 1707 feet above the National Geodetic Vertical Datum (NGVD). (***NOTE****: All future references to elevation are in feet above NGVD.*) The width is 20 feet at the top of the dam with a maximum width of 1,115 feet at the base. A layer of rock protects the upstream slope from wave erosion. The downstream slope has a grass cover.

The dam consists of a central core of select impervious material with random fill zones on the upstream and downstream sides. See a cross section of the dam depicted in **FIGURE 2** below:

FIGURE 2 – Dam Cross Section



To give some perspective on the height of the dam embankment, see **Photo 1** below.

Photo 1 - A portion of the downstream face of the dam looking at the right abutment. The picture was taken from near the base of the dam. From its base to the top, the dam is 184 feet high.

1.4.2 Spillway

A concrete-lined spillway is located at the left end of the embankment in the left abutment rock, aligned roughly perpendicular to the dam axis. The spillway keeps the dam from overtopping during extreme rainfall events. The project has only experienced spillway flow once, in 1972 during Hurricane Agnes. The spillway entrance is an uncontrolled weir 250 feet wide at crest elevation 1685.0. The inlet weir is straight and parallels the right side of the channel. (See **Photos 2** and **3**) During high water events, flood water goes over the spillway weir and enters the spillway chute which is a 2,105 foot-long concrete channel that ends in a stilling weir with dispersal bucket for energy dissipation. (See **Photo 4** showing the concrete lined spillway).

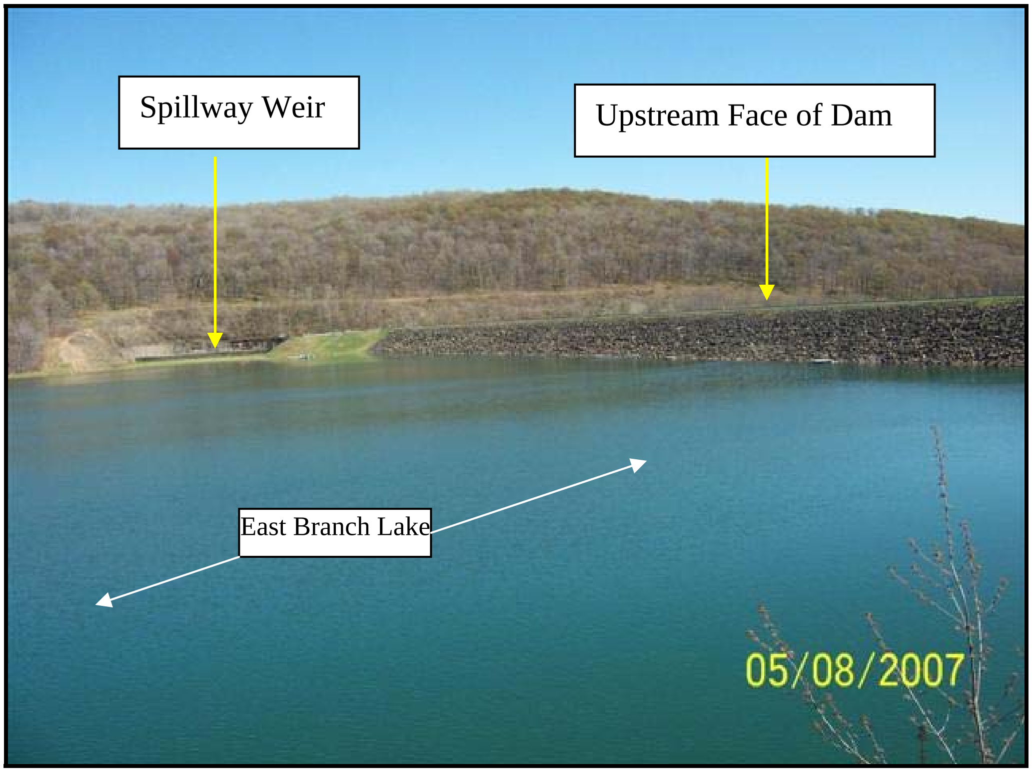


Photo 2 – Looking from the right descending bank across the lake to the spillway weir at the left descending bank

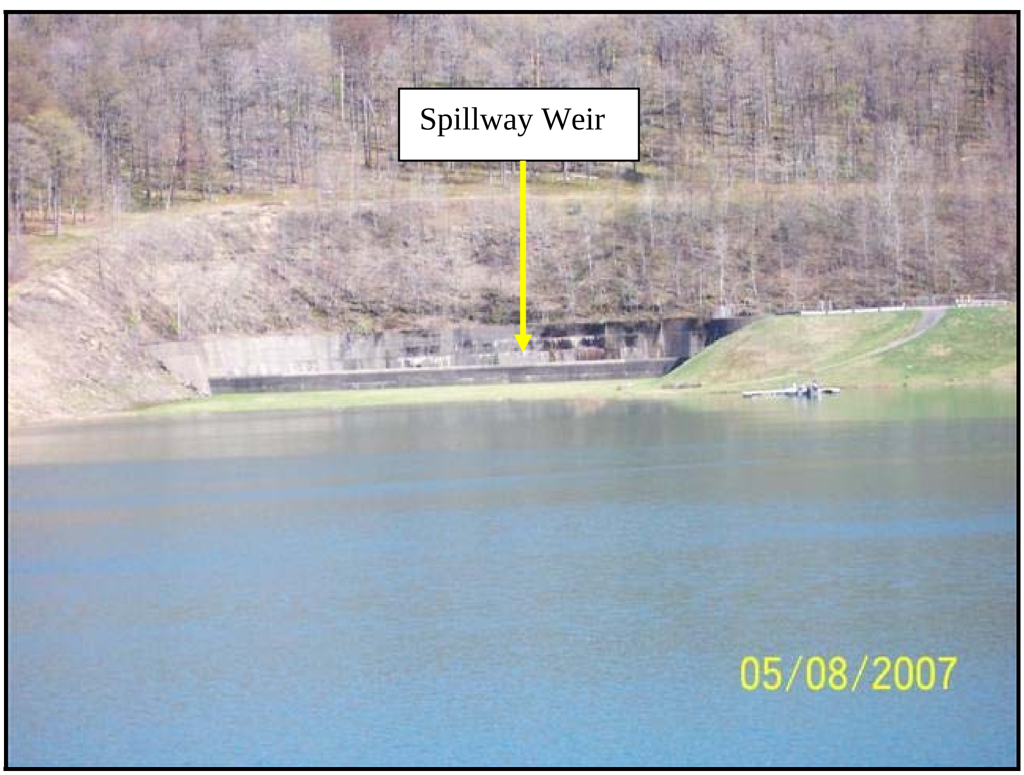


Photo 3 – Closer view of spillway weir.

Photo 4 - A view from inside the cavernous, concrete-lined spillway looking downstream. The spillway weir would be behind and to the right of the photographer. If you look closely, three inspectors are in view which helps give perspective to the photo.

1.4.3 Intake Tower and Outlet Works

The outlet works are located at the right abutment and consist of an intake tower seen in **Photo 5** to the left, a single barrel concrete-lined tunnel through the bedrock of the right abutment, and a stilling basin. The tunnel is 10 feet in diameter and approximately 1,250 feet in length. **Photos 5** and **6** show the control tower in the lake and **Photo 7** shows the downstream discharge exit of tunnel outlet. East Branch Dam discharges water from the reservoir through several gates and intakes located at various elevations within the intake tower. Two large 3' x 4”x 12’ sluice gates are located at the base of the tower at elevation 1531 which is the elevation of the original East Brach Clarion River channel bottom.

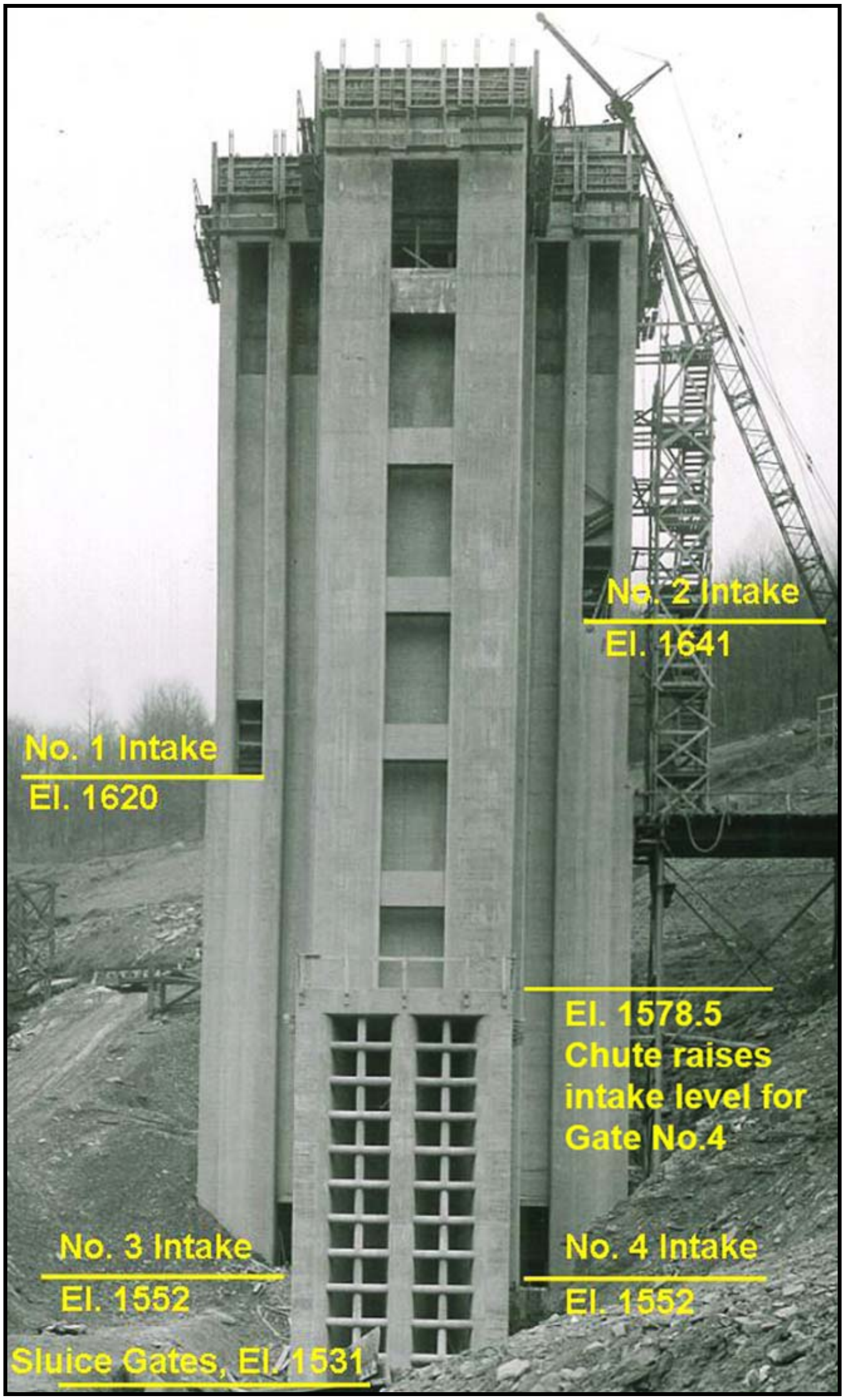


Photo 6 - The control tower and its water intakes under construction in the late 1940's. The water quality control gate intakes are at elevations 1641, 1620 and 1552. An external water intake extension or "chute" was installed on the face of the control tower in October 2008 that effectively raised the elevation of the No. 4 intake 26.5 feet from 1552 to 1578.5. This provided more flexibility to control the temperature of water discharges when the pool surface drops below elevation 1620 at intake No. 1. See Section 6.6 for more information about the "chute" and the reasons for its construction.

If needed, the large sluice gates could drain the reservoir completely leaving “run-of-river” channel flow to safely pass through the dam's right abutment outlet works. Four water quality control intakes are located in the intake tower and are used for downstream water quality flows. One intake is located at elevation 1641, one at elevation 1620 and two are located at elevation 1552. (As described in Section 6.6, one of the 1552 intakes was modified by the installation of an external "chute" which effectively raised its elevation 26.5 feet, from elevation 1552 to 1578.5) The District can selectively withdraw water from any or a combination of these intakes to control water quality. During normal operations, most downstream flow is obtained from the water quality control intakes. The location and operation of these gates is an important consideration in this EA because their operation affects lake and downstream water temperatures and aquatic life.

Photo 7 to the right looks upstream into the tunnel that discharges flow from the outlet works. This discharge is located at the downstream face of the dam at the right abutment.

1.4.4 Summary of Seasonal Reservoir Operations

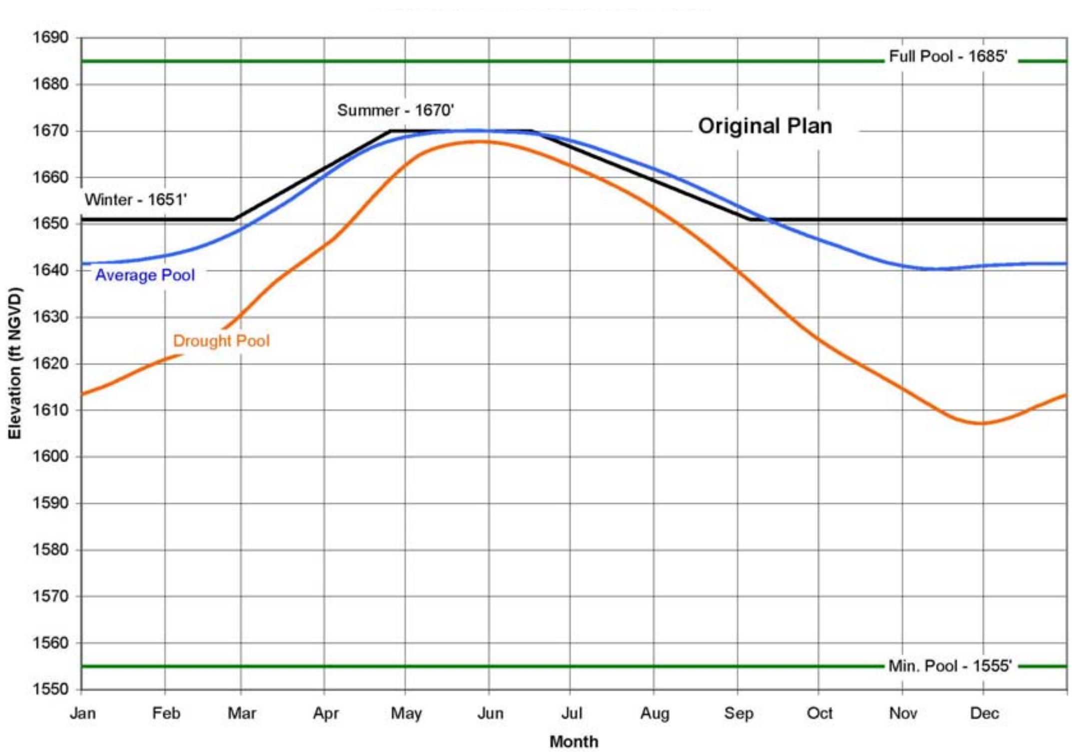
The elevation of the reservoir behind East Branch Dam is seasonally adjusted throughout the year to best meet its authorized purposes. The minimum pool is at elevation 1555 and full pool is 130 feet higher at elevation 1685, which corresponds to the top elevation of the spillway weir (described in Section 1.4.2). (Minimum pool is defined as the level at which there is a negligible volume of water-storage capacity. With a minimum pool, the dam would be operated where the outflow from the control tower would equal the inflow into the lake.) Under average operating conditions, the maximum summer conservation level is at elevation 1670 (summer pool). This elevation is reached by 1 May and maintained until 10 June when water is then released to augment downstream flow and improve water quality, allowing the reservoir to fall to elevation 1651 (maximum winter pool) by 5 September. A maximum winter conservation level of 1651 is then maintained until 1 March, at which time spring filling occurs until elevation 1670 is attained on 1 May.

(***NOTE:*** *The maximum summer and winter conservation pool levels of 1670 and 1651, respectively, are maximum target elevations; the operation of the reservoir causes the levels to fluctuate either higher or lower depending upon meteorological conditions and downstream flow requirements.)*

A simple graph shown below (GRAPH 1) depicts the average pool operations. The graph shows how the monthly pool elevations vary over a one-year time period for both average and dry conditions. The blue line depicts pool elevation for average conditions; the orange line represents the pool levels during dry conditions; and the black line represents the target pool elevations. The horizontal green lines depict the maximum (full) pool at elevation 1685 and minimum pool at elevation 1555.

Drawdown, to meet downstream low flow augmentation requirements (during the drier summer and fall), normally begins in mid-June at elevation 1670 and ends in mid-November at elevation 1640. Although the maximum winter conservation pool of elevation 1651 is normally reached by 5 September each year, the pool elevation is frequently lower due to downstream low flow requirements. Downstream low flow augmentation schedule is always given priority over managing East Branch Lake elevations. Low water releases range from 80 to 220 cubic feet per second (cfs) during the average drawdown period.

GRAPH 1 - AUTHORIZED WATER CONTROL PLAN



2.0 Structural Issues at East Branch Dam

2.1 History of Dam Seepage

All dams have some seepage as impounded water seeks paths of least resistance through the dam and its foundation. Seepage must be controlled to keep a dam safe. If seepage is uncontrolled, it can lead to piping, which is the subsurface erosion or movement of soil materials through a dam. Piping can eventually cause serious internal erosion that could cause a dam to fail if not corrected. East Branch Dam has a history of seepage problems which are described below.

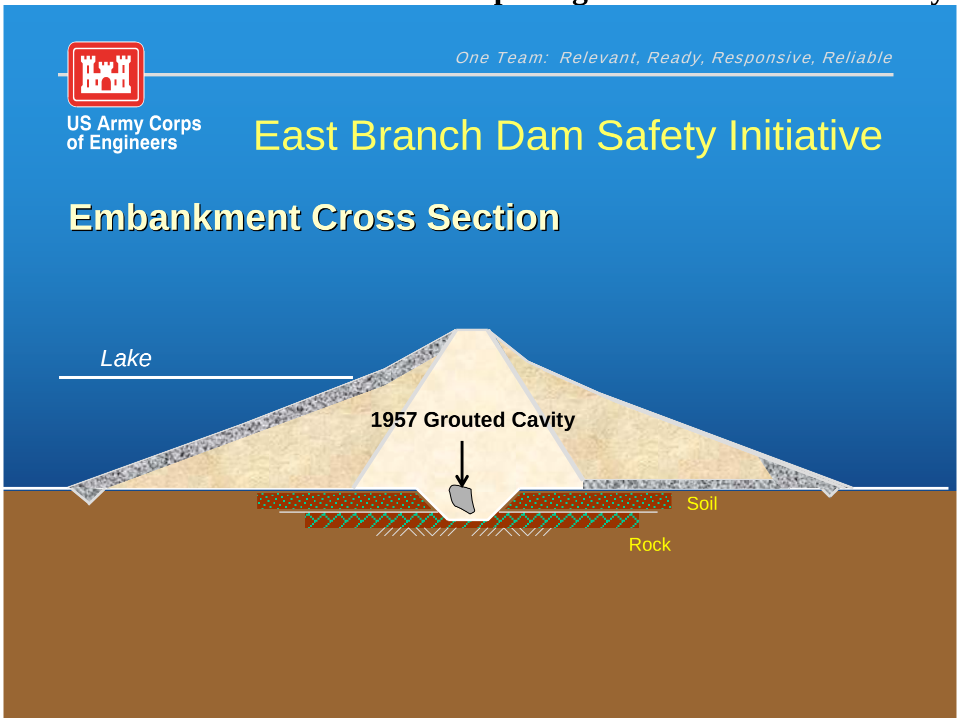
2.1.1 Left Abutment Seepage Incident

In 1953 the District determined that some seepage was occurring near the left abutment of the dam. The District judged that the seepage path was either a continuous open joint in bedrock or a series of interconnecting joints through a sandstone layer in the left abutment. The District attempted to rectify this problem through grout holes drilled radially into the broken rock strata. This work was completed in January 1956. This grouting work was only partially successful and considerable seepage continues from the left abutment.

2.1.2 Right Abutment Seepage Incident

The dam experienced a serious seepage incident in 1957. On 8 May 1957 the reservoir manager reported seeing muddy water flowing from the rock drain at the downstream toe of the dam in the original stream channel. Further analysis and core drilling in May 1957 revealed the presence of a significant void within the core of the dam created by piping and internal erosion. See **FIGURE 2** (pg. 4) showing the core and **FIGURE 3** below depicting a cavity within the core. Internal erosion if left untreated could have caused East Branch Dam to fail. Consequently, due the size of this void and the accelerating rate of erosion that was occurring, emergency action was taken and the pool was drawn down from summer pool (elevation 1670) to near minimum pool (elevation 1555). This action minimized the static load on the dam to ensure it would not fail. Emergency repairs were made, lasting from June until November 1957. The repairs consisted principally of filling the void with grout and consolidation grouting the surrounding area of soft embankment soils. Because of the seriousness of this incident, a number of monitoring instruments, called piezometers, were installed in the area of the repaired void and elsewhere on the dam to monitor internal seepage pressures within the dam’s interior. (A piezometer is a small diameter water well used to measure the hydraulic head or water pressure within the dam's foundation soil or rock.) These instruments have been closely watched since 1957. The dam has performed safely since this incident including during the maximum pool of record that occurred in 1972 from flooding caused by Hurricane Agnes. During this storm water discharged through the spillway.

FIGURE 3 - Dam Cross Section Depicting an Erosion-caused Cavity



2.2 Recent Risk Analyses

Almost 65 percent of the dams managed by the U.S. Army Corps of Engineers across the United States are over 30 years old, and 28 percent have reached or exceeded their 50-year design life.[1] Many are in need of major repair or rehabilitation to ensure their continued safe operations for future generations. The Corps' foremost concern is managing the risks for its dams and protecting the public against the devastation that would be caused by dam failures.

Because the Corps is responsible for the safety of approximately 600 dams, a method was needed to prioritize site-specific dam safety investigations and dam safety improvement investments. To this end, the Corps initiated a Risk Analysis for Dam Safety Program to aid in allocating investments to improve the safety of the large number of dams for which it is responsible. The program has an initial screening level evaluation called the Screening Portfolio Risk Analysis (SPRA). The SPRA relies on knowledgeable individuals to assess the relative risk of dams in terms of a number of scripted criteria based on available information.

East Branch Dam was screened in 2006 as part of the Corps' SPRA. This process rates the safety of dams by categorizing them in the following five Dam Safety Action Classes (DSAC):

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[1] Infrastructure Report, http://www.usace.org/reportcard/2005/page.cfm?=23
Joint COE Bureau of Reclamation Dam Safety Risk Management Charter, http://www.usbr.gov/ssle/damsafety/jointventures/jointriskcharter.pdf

DSAC I – URGENT AND COMPELLING (Unsafe)
DSAC II – URGENT (Unsafe or Potentially Unsafe)
DSAC III – HIGH PRIORITY (Conditionally Unsafe)
DSAC IV – PRIORITY (Marginally Safe)
DSAC V – NORMAL (Safe)

As a result of the SPRA, East Branch Dam was classified as a DSAC II. A primary reason for this classification was concern over the structural integrity of the 1957 repair near the right abutment. East Branch Dam is the only dam in the Pittsburgh District to receive this rating. A dam with this classification is considered to have failure initiation foreseen or very high risk. Foreseen failure initiation means the dam has confirmed and/or unconfirmed safety issues and failure could begin during normal operations or from a flood or earthquake event.

To confirm the conclusions of the SPRA, the Pittsburgh District partnered with the Bureau of Reclamation in January 2008 to perform a Potential Failure Mode Analysis (PFMA) and a more detailed quantitative risk analysis of the dam. These analyses confirmed that internal erosion of the previous 1957 repair area was the most critical and most likely mode of failure and the primary threat to public safety. Based upon this risk analysis the estimated probability of failure and consequent downstream loss of life were found to be above a threshold that justified expedited action to reduce risk.

If a sudden, catastrophic failure of East Branch Dam were to occur, there would be major consequences in terms of life loss, property loss, and environmental damage from sudden flooding. The downstream population at risk is approximately 8,800 persons with life loss estimated to be between 10 and 130 persons. Economic losses were estimated to be at least $200 million.

2.3 District Emergency Action

Public safety is the Corps' number one priority at all of its operating facilities. Given this priority and the conclusions of the above risk analyses, the District realized that immediate emergency action was needed to minimize the risk of East Branch Dam failing unexpectedly. The District quickly determined that the only effective and expedited way to ensure the safety of East Branch Dam, in the short term, would be to lower the static load on the dam by reducing the elevation of the operating pool. The questions that had to be addressed were how far the pool should be lowered to achieve the requisite measure of safety, and what environmental, economic and social impacts would result from lower operating pools.

In February 2008, the District formulated several alternative interim (temporary) operating plans and implemented one that would allow the safe operation of the dam until more comprehensive studies could be performed that would lead to permanent dam repairs and restoration of the authorized water control plan. The emergency action implemented is referred to in this EA as Alternative 1 and is described in the section below.

3.0 Alternative Risk Reduction Solutions

A description of all of the alternative water control plans the District considered to achieve the desired level of safety at East Branch Dam is contained in this section. By law and Corps policy, the alternative of "No Action" (doing nothing) must also be addressed and is, therefore, included in the alternative descriptions below.

3.1 "No Action" Alternative

Because the Corps is responsible to protect public safety, the District could not ignore the potential threat posed by a catastrophic failure of East Branch Dam as identified by the dam safety studies. In February 2008, as previously noted in this assessment, the District was compelled to lower the elevation of the operating pool as an emergency action to protect public safety until required dam repairs could be identified and completed.

The Council on Environmental Quality's regulations (40 CFR Parts 1500-1508) for implementing the procedural provisions of the National Environmental Policy Act requires Federal agencies to consider the alternative of "No Action", which, for East Branch Lake would mean doing nothing and operating the dam normally regardless of the identified safety concerns. However, doing nothing is impossible because in early 2008 emergency action was taken to lower the pool. Therefore, for the purposes of this EA, the "No Action" alternative is defined as making no internal repairs to the dam, regardless of its condition.

The emergency action taken in early 2008 did make the dam safe for the few years it will take to make necessary repairs. However, the lowered pool by itself would not meet the Corps' tolerable risk guidelines as a long term, permanent fix. Therefore, under the "No Action" alternative as defined above, the District, in lieu of making dam repairs, would have to implement one of the following two options to permanently reduce the risk of dam failure:

Option 1 - The first option would be to permanently and dramatically lower the operating pool and the elevation of the uncontrolled spillway to ensure the pool would not rise beyond a specified elevation. Under this option the spillway would be lowered to approximately elevation 1610. At this elevation, the maximum size lake created by the dam would be limited to approximately 500 acres. (At normal summer pool, elevation 1670, the lake is 1,160 acres and at elevation 1650, the new interim maximum summer pool, the lake is 900 acres.)

Option 2 - The second option would be to permanently raise the lowest gates to drain the lake and allow a permanent run-of-river condition. Under this option, the lake would be lost; the dam would not provide any of its authorized purposes, which are flood control, low flow augmentation, recreation, fish and wildlife conservation and water quality enhancement.

3.2 Alternative 1, Interim Lower Operating Pool – Elevation 1650

Under Alternative 1, the original authorized target maximum summer pool elevation 1670 (shown as a black line on GRAPH 2 below) would be dropped by 20 feet to elevation 1650 and the target or "normal" maximum winter pool, elevation 1651, would be reduced to elevation 1623. The new target pool is shown in red. It must be understood that the lake level is not static and constantly varies depending upon operational requirements, weather conditions, precipitation and runoff. The average pool elevation (shown in green for Alternative 1) represents what would usually occur in a year of average precipitation. (The "average" pool for the original plan is shown as a blue line in GRAPH 3)

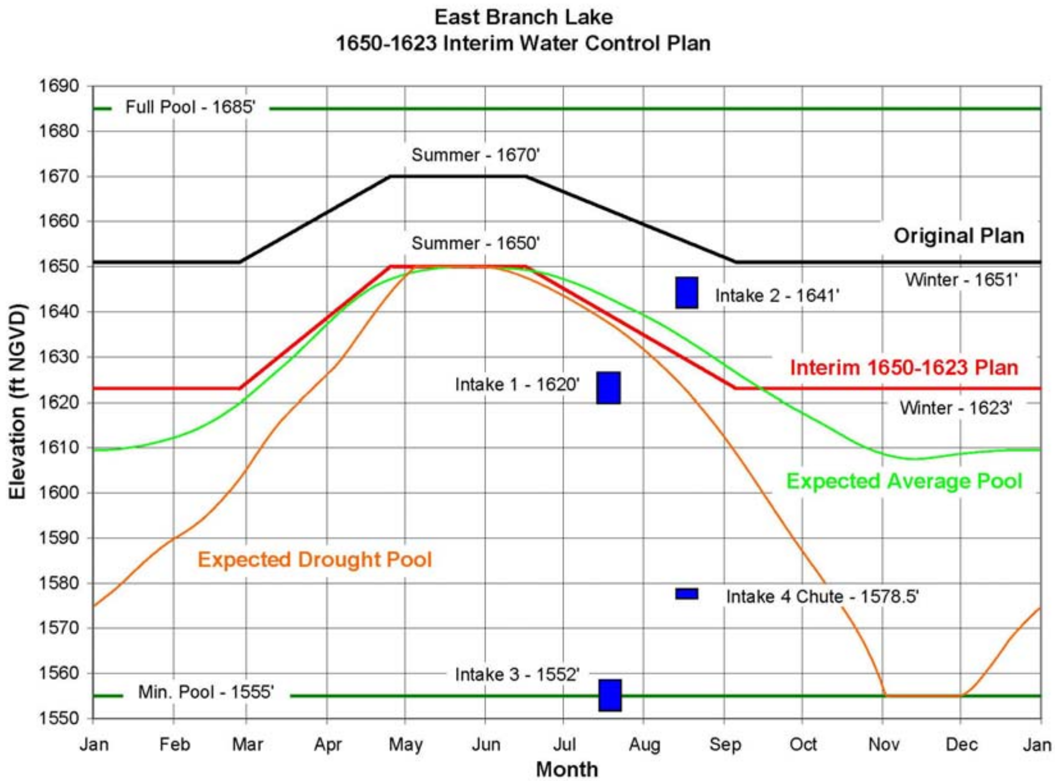
NOTE:

- *Alternative 1 was implemented in February 2008 as an emergency action.*

- *For ease of identification, the alternative operating water control plans described in the Environmental Assessment are frequently identified using only their maximum summer conservation pool elevation. For Alternative 1, this elevation is 1650. For Alternatives 2, 3 and 4, the maximum summer pool elevations are 1640, 1630 and 1610, respectively. These elevations and their respective Alternative numbers (1-4) are used interchangeably, i.e., 1640 = Alternative 2, 1630 = Alternative 3, and 1610 = Alternative 4.*

- *The analysis of each alternative water control plan considers two hydrologic conditions, "normal" or average precipitation, and drought.*

GRAPH 2 - INTERIM WATER CONTROL PLAN WITH SUMMER POOL AT 1650 - ALTERNATIVE



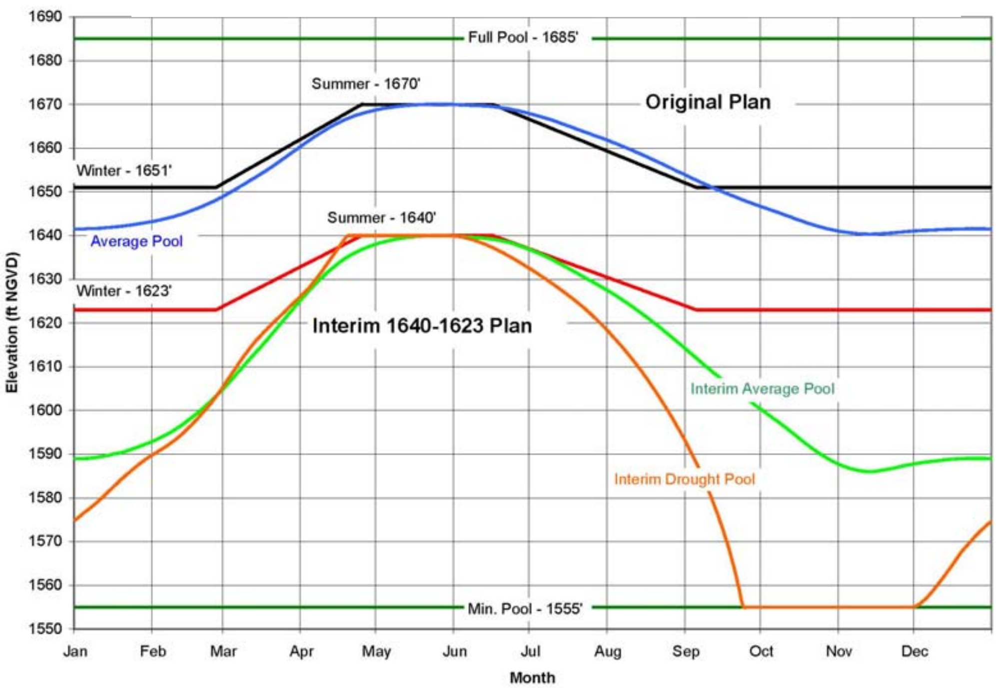
For reference, this graph also shows the relative elevations of the water quality intakes (blue rectangles) and the location of a new intake (the "chute") used to release water downstream (See Section 6.6 for more detail). The bottom of the rectangle represents the lowest elevation from which the intake can draw water from the lake. This is very important with respect to controlling lake and downstream water temperatures.

During average rainfall conditions there would be sufficient volume in the reservoir to maintain current downstream low flow augmentation. However, as noted by the orange line, under this interim operating plan during drought conditions no flow augmentation would be available during the month of November. **The downstream low flow augmentation schedule will not change until there is no storage left in the reservoir.** (Storage is defined as the volume of water remaining in the lake that can be released to augment downstream flows. All of the storage in the lake down to elevation 1555 (minimum pool) is dedicated to low flow augmentation. Below elevation 1555, there would be no storage left that could effectively be used to augment downstream flow; the lake would at that point be a creek and inflow to the lake would equal outflow from the dam.)

3.3 Alternative 2, Interim Lower Operating Pool - Elevation 1640

Under this alternative, the new target maximum summer conservation pool would be at elevation 1640, 30 feet below the normal summer pool elevation of 1670. The target maximum winter conservation pool would be 1623, the same elevation as for Alternative 1. GRAPH 3 depicts how this interim operating pool compares with the implemented plan. During dry conditions (orange line), there would be no low flow augmentation between approximately the third week of September to the end of November. The average winter pool between mid-October and mid-January would be at approximately elevation 1590. From mid-January, the dam would be operated to store water so that the maximum summer pool elevation of 1640 would be reached by mid-May. The pool would be maintained at 1640 for about 4 to 5 weeks, and then in mid-June the pool would begin to drop as water is released for low flow augmentation until October when the process is started again. The downstream low flow augmentation schedule will not change until there is no storage left in the reservoir.

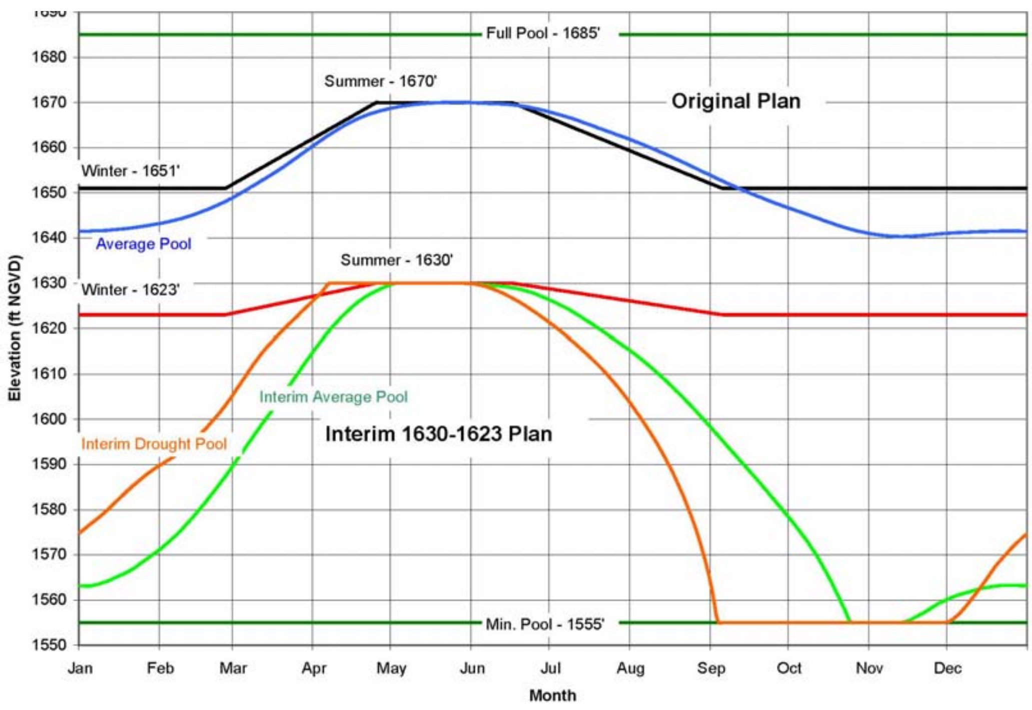
GRAPH 3 – INTERIM WATER CONTROL PLAN WITH SUMMER POOL AT 1640 - ALTERNATIVE 2



3.4 Alternative 3, Interim Lower Operating Pool - Elevation 1630

This alternative would lower the target maximum summer conservation pool 40 feet below the normal summer maximum of 1670. The maximum target winter summer conservation pool, elevation 1623, would be the same as for Alternatives 1 and 2. This alternative is shown below on GRAPH 4. This alternative would be similar to Alternative 2 except that in an average year there would be no low flow augmentation between mid October and mid November (green line in Graph 4). During a drought year (orange line) minimum pool would be reached in early September, about 3 weeks earlier than in Alternative 2. The downstream low flow augmentation schedule will not change until there is no storage left in the reservoir.

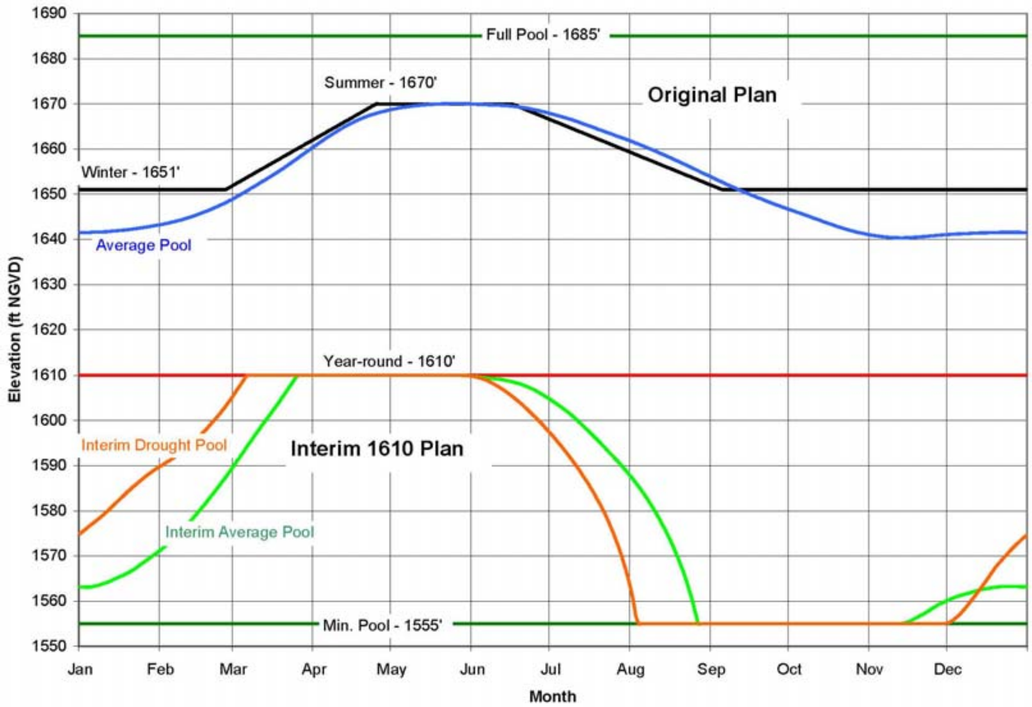
GRAPH 4 – INTERIM WATER CONTROL PLAN WITH SUMMER POOL AT 1630 – ALTERNATIVE 3



3.5 Alternative 4, Interim Lower Operating Pool - Elevation 1610

Alternative 4 would drastically lower the target maximum summer conservation pool to elevation 1610, or 60 feet below the normal maximum summer pool level. Under this alternative, the maximum winter pool elevation would be 1610, the same as the summer pool. This is shown as the red horizontal line on GRAPH 5. Under this alternative, for average conditions, no augmentation flows would be available between approximately the third week of August and mid-November. Under drought conditions there would not be sufficient storage for low flow augmentation for approximately a four month period, August through November. The downstream low flow augmentation schedule will not change until there is no storage left in the reservoir.

GRAPH 5 – INTERIM WATER CONTROL PLAN WITH SUMMER POOL AT 1610 - ALTERNATIVE 4



3.6 Alternative Interim Pool Selection

After conducting a preliminary evaluation of in-lake and downstream impacts for all of the above alternative interim water control plans, the District selected Alternative 1 that lowers the maximum summer pool 20 feet from elevation 1670 to 1650 and lowers the maximum winter pool from 1651 to 1623. This emergency action allows the dam to operate with decreased risk at a lower level and minimizes in-lake and downstream impacts (based upon a preliminary analysis). When the District decided to implement this alternative in February 2008 the pool was at approximately 1650 and rising. At that time, instead of storing water to arrive at a summer pool of 1670 by May 1, as is normally done, water was released to maintain the 1650 pool elevation. Because of this major operational change, the District conducted several public meetings in March to inform local officials, state and Federal natural resource agencies and the general public of our actions. In addition, the District coordinated extensively both informally and formally with interested Federal, state, local natural resource agencies, and other citizens and citizen groups.

A more detailed description of the implemented interim operating pool is provided below.

3.7 Detailed Description of Alternative 1

Because of the potential risk of dam failure, the following water control plan was implemented until further engineering studies could be completed to confirm if there were structural deficiencies that would need to be repaired. The target maximum summer pool, elevation 1670, will be reduced approximately 20 feet to elevation 1650, and the target maximum winter pool, elevation 1651, will be reduced 28 feet to elevation 1623. The new average minimum winter pool will be reduced from 1640 to 1607.5, approximately 32.5 feet. (***NOTE***: *The average pool will usually be lower than the target pool shown as a green line on GRAPH 2 due to operational requirements and variations in weather, precipitation, and runoff in any given year*.)

Under this new operating regime, the lake surface area will be reduced during the summer from about 1200 acres to 900 acres and during the winter from about 900 acres to about 600 acres. See **TABLE 1** below.

TABLE 1 – Comparison of Original and New Operating Pool Elevations and Lake Surface Areas

	Original Pool Elevation/Acreage	**New Pool Elevations/Acreages**	**Change**
Maximum Summer Pool	1670 feet 1200 Acres	1650 feet 900 Acres	-20 feet -300 Acres
Maximum Winter Pool	1651 feet 900 Acres	1623 feet 600 Acres	-28 feet -300 Acres

GRAPH 2, shown previously, depicts how the pool would be operated on an interim basis under both average and dry conditions. For comparison purposes, this graph also includes curves showing originally authorized pool elevations. The target pool curves are shown in black and red. The average pool curves are noted in blue and green, and drought operation under Alternative 1 is shown in orange.

Also seen in GRAPH 2, under drought conditions (the orange line) the minimum pool, elevation 1555, is reached for about one month during November. At this point, inflow into the lake equals outflow from the dam and all storage for low flow augmentation has been discharged. The lowest gates in the dam are at elevation 1531; at 1555 the pool is approximately 24 feet deep at the dam. (See **Photo 6,** showing gate intake elevations).

Under the above operating pool, the annualized probability of failure is reduced substantially. This risk reduction is largely due to reduced pore pressures driving failure initiation, improved ability to drawdown from a lower pool, and reduced likelihood of breach formation leading to catastrophic uncontrolled release of the pool. In addition, the downstream population at risk, in the event of failure, would be reduced with a lower operating pool due to a smaller reservoir volume contributing to downstream inundation.

3.7.1 Implemented Alternative - Storage and Release Schedule

Under the new interim operating schedule there will be no changes made to the current downstream release schedule unless there is no storage available, due to drought. The pool will simply be operated at a lower level. Continuation of the current release schedule is considered a high priority in order to provide necessary flows to all downstream water users, including the Domtar paper mill at Johnsonburg, the City of Ridgway and the Piney Hydroelectric (peaking) plant near Clarion, PA, and also to protect water quality and aquatic life.

3.7.2 Flood Control Operations

Flood control operations would not be affected by the new interim operating pool. Should excess runoff from local storms cause the pool level to rise above the new maximum summer conservation pool, elevation 1650, there will be no deviation from the release schedule during flooding conditions, as defined in the reservoir regulation manual. The pool will continue to operate as it now does to control downstream flooding. The only change will be the new interim target pool elevations described above. Flood control operations may cause the pool to rise above 1650. However, because this would only be a temporary increase in loading, the risk of failure does not markedly increase. The problem with East Branch Dam lies in static loading, i.e. where a stable pool puts constant pressure on the dam. When the reservoir rises above 1650, excess water would be released in a controlled manner as soon as downstream conditions permit, allowing the pool to return to the new interim pool elevation that is scheduled for that particular time of year.

3.7.3 Special Short Term Operations

Twice a year, under normal operating conditions, the District informally modifies water discharges from East Branch Dam to benefit two annual sporting events, the Ridgeway Triathlon scheduled during the third weekend of April and a local fishing derby scheduled for the first weekend of May. For these two events, the District attempts to optimize stream flows for canoeing and kayaking in the case of the triathlon and for fishing in the case of the fishing derby. Under the new lower interim operating pool, the District intends to continue this practice as long as interim pool is at or above the expected average level at that time of year.

3.7.4 Drought Operations

The most severe drawdown at East Branch Lake occurred during the drought of 1991. In that year, the maximum summer conservation pool of 1670 was reached in June, as is normally achieved. Due to drought conditions that occurred over the summer and fall, the lake was lowered through downstream flow augmentation from the summer pool level of 1670 to below elevation 1605 in December. (Average minimum winter pool is elevation 1640.) A drought of this magnitude is estimated to have approximately a 100-year recurrence interval. Even when the pool dropped below elevation 1605 during the 1991 drought there was sufficient storage in the reservoir to meet the downstream low flow augmentation schedule, with no curtailment of normal downstream releases.

Under average weather conditions, the scheduled drawdown during the summer and fall to reach the new average interim winter pool elevation of 1607.5 will not cause the lake to enter a drought emergency level as defined in East Branch's drought contingency plan. However, under the new interim operating pool, should the watershed experience an extended dry period, such as during the 1991 drought, the drawdown would be from elevation 1650 to the minimum pool (elevation 1555). At minimum pool elevation 1555, the lake would enter a drought emergency stage and scheduled releases would be curtailed to follow the guidance outlined in the approved drought contingency plan.

3.8 Secondary Interim Risk Reduction Measures Implemented

In addition to the primary action of lowering the operating pool, the following secondary actions were adopted to help ensure the safe operation of the reservoir:

a) Implement an extensive communication plan to keep all stakeholders and the public informed of activity at East Branch Dam. A stakeholders meeting with affected local, state and Federal agencies was held in Ridgway on March 14, 2008. This meeting, held at the request of the Corps, provided a forum to explain in detail to all interested stakeholders, the dam safety problem and our interim risk reduction strategy. In addition, a public meeting for all local residents was held on the evening of March 24 at the same location in Ridgway to inform the public of the Corps' interim actions. After the presentations at each meeting, the Corps entertained questions from the audience to clarify issues. In April 2008, the District hosted public on-site tours of the dam to address questions regarding the dam and our actions to reduce risk and determine needed repairs. On October 15, 2008, the District held another afternoon stakeholders meeting at East Branch Dam and an evening public meeting at the Johnsonburg High School auditorium to provide additional information about the District's actions.
b) Enhance existing instrumentation and perform instrumentation readings more often to better monitor the condition of the dam to include testing, replacing and adding instrumentation where necessary.
c) Implement cross-training of regional staff to support staff at the dam.
d) Initiate 24-hour staffing to monitor the condition of the dam around the clock.
e) Update the existing Emergency Action Plan to re-evaluate emergency procedures.
f) Develop new inundation mapping to better define the floodway downstream of East Branch Dam.
g) Conduct drills and exercises to better educate staff and local emergency management personnel.
h) Pre-position contracts/materials for emergency response and improved lighting systems.
i) Improve outlet gate reliability by making some necessary repairs, which are the part of normal maintenance.

4.0 Additional Actions Taken to Determine Dam Condition

Immediately after the decision was made to lower the target maximum summer conservation pool to elevation 1650, the District charted a course to determine how best to determine what, if any, repairs to the dam would be needed to allow the dam to be returned to normal operations. To this end, the District quickly mobilized to perform a seepage flow path or "Willowstick" analysis, which is explained below.

4.1 Willowstick Analysis

In May 2008, the District contracted with a geophysical firm to attempt to map internal flow paths within the East Branch Dam embankment, specifically on the right portion of the dam (facing downstream) which has been identified as the primary area of concern. Seepage flow path mapping used the AquaTrack technique developed by Willowstick Technologies, a geophysical method that uses an electric current (low- voltage, low-current audio frequency) to energize the groundwater or seepage in the area being surveyed. AquaTrack technology is a minimally invasive, environmentally benign procedure, which potentially allows seepage flow paths at depth to be inferred. For an earthen dam, electrodes are placed upstream and downstream of the embankment. The upstream electrode is placed in the reservoir. The downstream electrode is placed at locations where seepage has been observed (such as visible seeps, well casings, or other downstream locations) to facilitate contact with seepage flowing through the embankment. The electric current follows the path of least resistance (usually along paths of concentrated seepage) through, beneath, and/or around the earthen embankment. Instruments placed at the dam's ground surface detect the electric current as a magnetic field, from which the location of seepage is inferred.

The locations of measurement stations are obtained using a Global Positioning System (GPS) unit and are recorded in a data logger along with the magnetic field data. The measured magnetic field data are then processed and plotted to graphically depict the extent of subsurface water saturation in the area of study. The goal of the Willowstick survey at East Branch Dam was to define as accurately as possible seepage flow paths within the embankment and foundation to guide forthcoming exploration (borings) and design for repair of the dam. Although the AquaTrack technology can potentially identify groundwater concentrations and probable flow paths (if groundwater flow is sufficiently concentrated) it does not identify the amount of water or the direction of groundwater flow along a particular pathway. It also will not identify voids within an embankment. Attempts to identify voids and embankment water levels will require follow-up geotechnical drilling.

4.1.1 Results of Willowstick Analysis

The Willowstick analysis completed in July 2008 suggested the presence of three primary flow paths within the dam near the right abutment. These flow paths suggest the presence of water both within the zones of random fill and the core of the dam. This study confirmed that the lowering of the pool to reduce risk of failure was an appropriate response.

4.2 Geotechnical Drilling

The results of the Willowstick seepage flow path surveys confirmed a need to conduct follow-up drilling and sampling (borings) as well as a need for the installation of additional piezometer monitoring wells. The results of seepage flow path surveys are being used to specifically target some of the locations of borings and well installations. The drilling and sampling would be accomplished with dry rotary drilling or sonic resonance methods that will not adversely impact the embankment. Drilling is being accomplished using truck mounted, skid or track mounted drill rigs. The drilling will attempt to verify the flow paths found from the Willowstick flow path mapping, and attempt to determine if any voids in the embankment exist. Most importantly, the exploratory drilling will help define what repairs are possible and necessary and the extent of repair work needed to return the operation of the dam to its normal operating conditions, i.e., a maximum summer conservation pool of 1670 and a maximum winter pool of 1651.

Drilling began in the fall of 2008 and is scheduled to finish in the spring of 2009. This schedule takes into account that drilling cannot be performed during harsh winter weather conditions.

4.3 Additional Risk Reduction Evaluations

In March 2009 the District confirmed through further analysis that the current interim operating pool provides a substantial reduction in risk and no further lowering of either the summer or winter conservation pools will be needed for the foreseeable future. The current interim operating pool will be maintained until all necessary dam repairs have been completed. At the present time, it is anticipated that this lower pool will be in effect for a minimum of two years or until 2011. The interim pool could remain in place longer if unexpected structural complications are encountered within the dam or if the funding stream necessary to effect repairs in a timely manner is restricted. After repair, the structural integrity of the dam will be well within tolerable levels of risk, and operations will be returned to the originally authorized operating regime with a maximum summer pool at 1670 and maximum winter pool at 1651.

5.0 Present Environmental Setting

5.1 Land Use

The project area in northwestern Pennsylvania is rural in character being largely forested. Small communities along the East Branch include Glen Hazel and Johnsonburg at the headwaters of the Clarion River where the East Branch joins the West Branch forming the Clarion River. Downstream of Johnsonburg, along the Clarion River, are the communities of Ridgway and Clarion. The largest industrial facility in the area is the Domtar paper mill located in Johnsonburg. Land use bordering the river downstream to the community of Ridgway consists primarily of Allegheny National Forest land, and State Game Lands 25, 44, 54, 283 and 74. In addition, Bendigo State Park is located along the East Branch Clarion River just downstream of Glen Hazel. Clear Creek State Park and Cook State Forest are located just downstream of the Allegheny National Forest boundary. See **FIGURE 4 -** Area Map, next page.

5.2 Physiography

Average basin relief above East Branch Lake is 400 to 500 feet. Elevations in the basin range from the streambed elevation of 1525 feet at the dam to 2,250 feet NGVD along the northern ridge boundary. The East Branch Clarion River headwaters are flat, marshy and sluggish along the north and west ridges. The banks of the East Branch River vary in height from seven feet in the vicinity of the dam to two feet in the headwaters. The banks of the tributaries are proportionally less in height with narrower valleys in the middle reaches.

5.3 Geology/Soils

Bedrock in the site of East Branch Dam is composed of shales and sandstones of the Pocono, Mauch Chunk, Pottsville, and Allegheny formations of the Mississippian and Pennsylvania series. The sandstones are generally fine to medium grained while the shales tend to be silty. Structurally, the formations are well jointed and essentially flat with a maximum dip of about three percent from the left abutment upstream and toward the right abutment. All the rock contains fractured surfaces which can be weathered to depths of 160 feet. Deep and open vertical fractures were observed during the construction of East Branch Dam and were reportedly continuous from the upper abutments down to the valley (the deepest center point of original stream channel). The rock formations are situated on the western flank of the Hebron Anticline (an upward fold of stratified rock) and have been deformed into a series of northeast-trending gentle folds.

The reservoir valley lies south of the glacial terminus and was probably eroded during glacial time to a depth of about 40 feet below the streambed. The valley was refilled with soil deposits eroded from the valley walls, which are part colluvial (soil movement down from steeper slopes) and part alluvial (soils deposited by water). These deposits are poorly stratified and contain materials ranging in size from silt with traces of clay to large blocky boulders of sandstone. The only strictly alluvial materials were found in the middle of the valley and generally consist of fine to coarse sand with some fine gravel and a small amount of silt.

The types of soils along the East Branch Clarion and Clarion Rivers vary depending upon location and slope conditions. Generally, along the steep slopes, soils are moderately deep, well drained and were formed from weathered sandstone and shale. Along the narrow flood plains, soils are generally acidic, stony silt loams.

A number of oil and gas wells were located at the dam site prior to construction, including the dam foundation area. Complete records pertaining to the plugging of these wells are not available; however, there are references to well plugging activity during dam construction.

5.4 Climate and Hydrologic Data

The climate in the area is humid and temperate with an appreciable variation in temperature. Frequent and rapid changes in weather are due to frontal air mass activity. Prevailing wind direction is from the west or has a westerly component. Temperatures above 90 degrees Fahrenheit in the summer and below 0 degrees Fahrenheit in the winter are recorded normally 11 and 15 days, respectively, per year, with extremes of 103 degrees and minus 37 degrees on record. The mean annual temperature is approximately 47 degrees, and the average frost-free period ranges from 110 to 140 days.

Precipitation is well distributed across the seasons with a normal average totaling about 42 inches annually. The monthly normal is highest in June and July, with about 4.5 inches, and lowest in February, with about 2.8 inches. Average annual snowfall over the basin is approximately 60 inches. Snowfall frequently remains on the ground during the winter, and East Branch Lake frequently contains an ice cap into March. River stages rise to flood heights at least once during most years. Floods of high magnitude occurred in September 1861, June 1889, March 1913, March 1936, July 1942, November 1950, June 1972, and January 1996. These data indicate that there is a probability of serious flooding during any season of the year. The frequency of flooding is usually the highest in late winter-early spring.

The East Branch Clarion River basin lies in northwestern Pennsylvania and is roughly rectangular in shape, being approximately 10 miles in the longitudinal direction and seven miles in the transverse direction. The basin's drainage area above the dam is 72.4 square miles. The average daily flow released from the dam is 148 cubic feet per second (cfs); average daily minimum and maximum flows are 20 cfs and 1610 cfs, respectively.

5.5 Terrestrial and Aquatic Biological Resources

5.5.1 Forested Upland and Riparian Areas

The Clarion River drains a mountainous area of the Allegheny Plateau and flows through narrow valleys with steeply forested slopes dominated by almost continuous mature deciduous hardwood and coniferous species. The northern portion of the East Branch Clarion River basin, which includes East Branch Lake, is almost entirely wooded with little development. The southern and western portions of the basin are less rugged and largely devoted to agricultural use. Most of the forest in northwestern Pennsylvania, including the area around East Branch Dam and Clarion River is within the southern edge of the Hemlock-White Pine-Northern Hardwoods region described by Braun[2]. The forest within Cook State Forest located about 55 river miles downstream of East Branch Dam intermingles with the Mixed Mesophytic Forest region. The forested area within the Clarion River Basin consists of mature, second-growth northern hardwoods populated by such species as northern red oak, white oak, chestnut oak, red maple, black cherry, beech, sugar maple, yellow birch, tulip tree, sweet birch, white ash and cucumber magnolia. Hemlock is common on moist northeast slopes and white pine is found on drier southwest slopes. The understory is usually limited by the dense canopy and is dominated by such species as eastern hop hornbeam, serviceberry rhododendron, mountain laurel, pin cherry, sassafras, dogwoods, wild hydrangea, viburnums, blueberry and huckleberry. Typical forest ground cover includes wood fern, partridge berry, oxalis, and club mosses. The East Branch of the Clarion River and lake riparian areas are narrow because of the steep topography and are dominated by sycamore, birch, ash, red maple, ironwood, American hornbeam, elms, and silver maple with an understory dominated by witch hazel, alder, dogwood, elderberry, and willow.

5.5.2 Wetlands

Because lake shorelines are steeply sloped and because the lake pool elevation varies dramatically year round (more than 20 feet between winter and summer pool elevations with

[2] Braun, E. Lucy, Deciduous Forests of Eastern North America, 1950

an even greater elevation changes during high runoff events) shoreline wetlands are sparse. Almost of all of the lake's wetlands are located at the head of tributary embayments where slopes are more gentle and streams can provide wetland hydrology when pool elevations are low, including the East Branch Clarion River inflow, the South Fork of Straight Creek, Straight Creek, and Fivemile Run.

East Branch Lake wetland types include wooded, lacustrine emergent and scrub/shrub, unconsolidated shore and aquatic beds. Subclasses included rooted vascular for aquatic bed, cobble-gravel for unconsolidated shore, persistent and non-persistent emergent wetlands and broad-leaved deciduous forested wetlands. Shoreline wetland community composition is dependent on specific hydrologic regimes created by lake pool elevations. Wooded wetlands are located between 4 and 10 feet above summer pool elevation (1670 to 1680); scrub/shrub and emergent wetlands from 10 feet below to 10 feet above summer pool elevation (1660 to 1682); unconsolidated shore are located between 5 feet below and 5 feet above winter and summer pool elevations, respectively (1645 to 1675); and aquatic beds from 10 feet below to summer pool elevation (1660 to 1670). Rooted aquatic vegetation is uncommon around the reservoir. This is due to normal pool fluctuations caused by project operations, lack of shallow water littoral zone, lack of nutrients, and a rocky bottom with little sediment to support root growth.

East Branch Lake is 5.7 miles long and has 20 miles of shoreline at summer pool, but there is less than a mile of emergent and scrub/shrub shoreline wetlands, only a few aquatic beds, and few acres of wooded wetland around the lake area. However, there are roughly 80 acres of emergent and scrub/shrub wetlands in tributary embayments. Wooded wetlands are dominated by birch, sycamore, and basswood; scrub/shrub and emergent wetlands by willows, alders, dogwoods, buttonbush, spiraea, woolgrass, common rush, knotweeds, swamp milkweed, boneset, spikerush, sneezeweed, St John's wort and marsh purslane; unconsolidated shore by late season annual pioneers; and aquatic beds by pondweeds and water celery. Significantly, while more than 30 percent of Pennsylvania's vegetation is dominated by non-native species, there is so little disturbance in the Clarion River basin that non-native species are uncommon.

Downstream of East Branch Dam, according to the Fish and Wildlife Service's wetlands mapping web site (http://www.fws.gov/wetlands/data/), forested, scrub/shrub and emergent wetlands are present along most of the East Branch Clarion River, just downstream of the dam to near the Indian Run confluence to the East Branch upstream of Johnsonburg. The density of these wetlands reduces downstream from Johnsonburg to Ridgway. Below Ridgway, especially below the confluence of Toby Run, there are relatively few wetlands along the river most of the way downstream to the Allegheny River.

5.5.3 Wildlife

According to the Wild and Scenic River eligibility report prepared by the U.S. Forest Service[3], wildlife habitat in the Clarion River corridor can be roughly divided between near

[3] Clarion River and Mill Creek Wild and Scenic River Eligibility Report, Allegheny National Forest, U.S. Forest Service, Warren, PA, 1996.

shore riparian/wetland habitat and upland forested habitat on the steep slopes of the river valley. At least 64 species of mammals, birds, reptiles and amphibians are associated with the wetland/riparian habitat, and as many as 82 wildlife species utilize the mature upland forested habitat at some points in their life cycles. The large sections of Federal and state forest lands and game lands that border the East Branch Clarion River and Clarion River corridors provide good habitat for wildlife species that are less tolerant of human disturbance.

The lands surrounding East Branch Lake also provide a variety of wildlife habitats that support numerous species. Stands of Allegheny hardwoods provide good quantities of food and have a high value for a diversity of wildlife, including game birds, song birds, small mammals, and many woodland amphibian and reptile species.

Mammals are among the most identifiable wildlife associated with the Allegheny hardwood environment. These species also play a significant role in the overall ecosystem. The white-tailed deer is the most popular and abundant large mammal at the East Branch Clarion River Lake project. With the large amount of protected land in the vicinity, suitable habitat for the proliferation of white-tailed deer exists, even with moderate hunting pressure in the area. Black bear are also found in the project area. Smaller mammals in the project area may include opossum, squirrels, woodchucks, chipmunks, skunks, rabbits, porcupines, shrews, voles, moles, bats, weasels, mink, beaver, coyotes, fox, mice and muskrats.

There are numerous species of birds, both resident and migratory, that utilize the lands around East Branch Lake and the lake itself. Common bird species may include Baltimore oriole, yellow warbler, great crested flycatcher, red-tailed hawk, wood thrush and downy woodpecker. Ruffed grouse and wild turkey also use this forest cover type. Abundant cavities that can be produced in hardwood forests are generally lacking at East Branch. Where available, cavities can provide nest and den sites for squirrels, raccoons, owls, woodpeckers and various passerine bird species. Cavities are especially valuable if located close to a food source. However, there appears to be a paucity of oaks and other mast producing trees around the lake. During the spring and fall migrations, the reservoir provides a resting stop for various species of waterfowl, including tundra swans, common mergansers, coots, wood ducks and Canada geese. Kingfishers and herons are also commonly observed. Many raptors, including bald eagles and ospreys, have been regularly sighted at the lake.

Red spotted newts and northern red-bellied snakes are abundant at the project.[4] Amphibians and reptiles, such as the slimy salamander, wood frog, and eastern garter snake are also probably common on project lands, as are various other snake and turtle species. Hellbenders are also found within the tailwater area.

A unique caddisfly, *Rhyacophila vuphipes,* was collected from the outflow area in the fall of 1987. This species was not known to inhabit Pennsylvania before this sighting. Another aquatic insect survey was conducted in the summer of 1994 along Fivemile Run,

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[4] Master Plan, East Branch Clarion River Lake, USCOE, Pittsburgh District, 1999.

with five samples collected from June through September. Results of the sampling identified 10 taxa of *Tricoptera* and two specimens of *Ephemeroptera.* The acidic condition at the time of sampling was the cause of this relatively low number of taxa and species collected. Over the period of record, as water quality has improved the percent of pollution intolerant macroinvertebrate species has improved, both in the lake inflow and outflow. As would be expected, the abundance and diversity of benthic species have increased commensurately with water quality improvements.

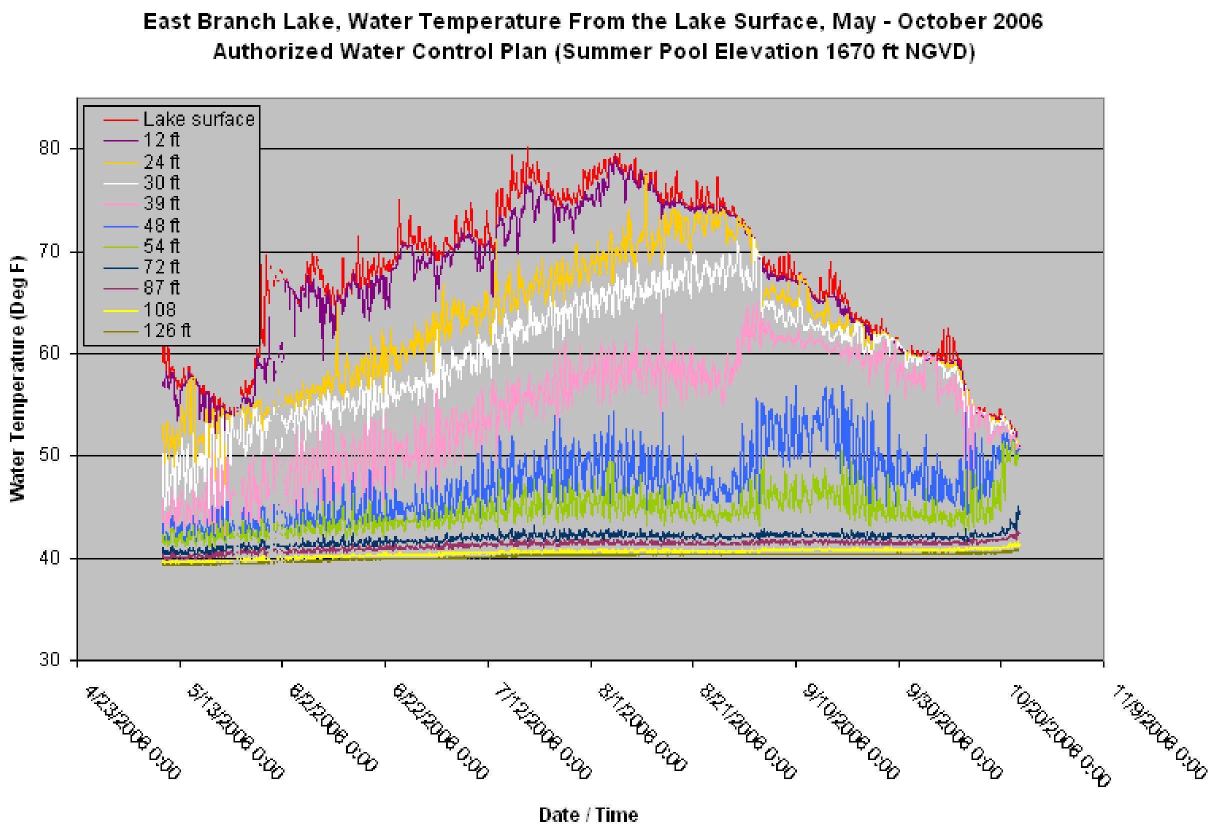
5.6 Lake and Downstream Water Quality

East Branch Lake can be described as a clear, cold, deep and moderately oligotrophic headwater impoundment. The lake is oligotrophic (lacking in plant nutrients and oxygen rich throughout) because of its headwater location; the depth, shape, and geologic base; relatively small drainage area; high degree of forested area and lack of agriculture or other developed lands in the watershed; and historical mine drainage degradation. These factors result in low nutrient loading from the watershed, which limits lake productivity. Cold lake temperatures result from the cool local climate, the elevation of the project, basin topography and forest cover. The elevation of the East Branch Project is the highest of any multi-purpose reservoir in the District and the north to south orientation of the reservoir permits considerable shading by the surrounding hills. The shaded, flat-bottomed, v-shape basin morphology and substantial depth produce rather permanent cold temperatures in the hypolimnion (bottom water strata).

East Branch Lake is a dimictic lake, exhibiting characteristic summer and winter stratification. During the summer months, the lake forms a distinct epilimnion (surface strata), metalimnion (mid level strata) and hypolimnion (bottom strata). This stratification is triggered by the warming of surface waters by summer thermal radiation. The strata are identified by ranges of temperature as depicted in EXHIBIT 1. The epilimnion forms from the lake surface to approximately 30 feet in depth, with water temperatures exceeding 68 Degrees Fahrenheit (F) near the surface. The metalimnion, which lies between 30 and 50 feet from the surface, is well defined and very stable, established by the elevation of the intake (elevation 1620) used during the summer season. The reservoir is clear, and light penetrates below the metalimnion. The hypolimnion, generally located 50 feet below the lake surface, remains cold throughout the summer months, where water temperatures in the 80 feet deep strata below elevation 1610 down to the lake bottom do not usually exceed 43° F. More than 50 percent of the total volume of water in the reservoir is dense, cold winter and spring runoff, which is stored in the hypolimnion. During the winter, typical inverse stratification develops, in which colder water lies over warmer water because of density differences.

EXHIBIT 1 shows lake water temperatures near the dam between May and October 2006, prior to implementation of the current interim water control plan (1650). This location is the deepest section of the lake. Each color-coded, vertical line on the graph represents water temperature at a specified depth from the lake surface. The insert on the upper left side of the EXHIBIT shows 11 separate color-coded depths ranging from the surface to 126 feet deep. As can be seen, in 2006, the epilimnion was located between the lake surface and 30 feet in depth (between the red and white lines), the metalimnion between 30 and 48 feet (white and blue lines), and the hypolimnion below 50 feet (green line). Summer stratification begins in late April or early May (when the temperature lines are further apart) and usually continues through October. This is an important factor in determining impacts of alternatives as presented later in Section 6. Prior to implementation of the current interim water control plan (Alternative 1, 1650 pool), the lake was most stratified during late July, and the lake hypolimnion remained very cold (37-50 ° F) throughout the summer season.

EXHIBIT 1



Because of the cold hypolimnetic water temperatures and low primary biological productivity, East Branch Lake remains well aerated from the lake surface to bottom year round. Dissolved oxygen levels are usually close to saturation in the lake epilimnion and hypolimnion. Lowest oxygen levels in the lake generally occur in the metalimnion layer, from July – September, but levels are still adequate to support game fish and other aquatic life.

It is noteworthy that all of the storage in East Branch Clarion River Lake is exclusively dedicated to downstream low flow augmentation for water quality. Since the project became fully operational in December 1952, downstream water quality objectives have been achieved by flow and water temperature regulation of the Clarion River at Johnsonburg, PA, primarily to mitigate extreme Biological Oxygen Demand (BOD) caused primarily by paper mill effluents in the Clarion River.

5.6.1 Mine Drainage Abatement Measures

Both basin geology and acid pollution influence lake water quality. Because the basin is sandstone, the buffering capacity of the lake and adjoining tributaries is low, compounded by drainage from bituminous coal mines, primarily surface mining, and acid precipitation. Historically, the lake was severely degraded by acid mine drainage (AMD), primarily from surface coal mining carried out between 1948 and 1960 in the western portion of the basin. Because of the severity of the acid conditions and related biological sterility of the impoundment, the lake was at one time locally referred to as the "Dead Sea of Elk County"[5]. In 1969, a lime neutralization plant was installed on Swamp Creek. Since this single tributary contributed, and continues to contribute, approximately 80% of the acid loading in the drainage area controlled by the dam, the treatment plant significantly reduced the acid load of the reservoir. Water quality improved so dramatically following installation that, by the early 1980's, the lake was healthy enough to support a fishery.

Between 1996 and 2002, the Corps partnered with the Elk County Conservation District, the Elk County Fishermen, the PA DCNR and others on an in-stream limestone sand application program, in order to increase alkalinity of the East Branch Clarion River Lake and its tributaries and to reestablish and enhance fisheries. Throughout the application period, a total of 671 tons of limestone sand was placed in 17 tributaries of the East Branch (between 49 and 124 tons of limestone sand per year), including Smith Run. Since these applications showed substantial water quality benefits, more permanent solutions were pursued. Passive mine drainage treatment systems have recently been constructed on Johnson Run, Twomile Run, and Gum Boot Run, and in 2002 the active lime treatment plant on Swamp Creek was upgraded. For more information see the following web site: (http://www.dep.state.pa.us/dep/DEPUTATE/minres/Districts/homepage/Knox/Watershed/East%20Branch/East%20Branch%20Report%202002.htm).

Smith Run makes up approximately 12% of the drainage area controlled by the East Branch Dam. It is one of the last of the seven major mine drainage degraded tributaries of the East Branch identified by the DEP in 1969 that has not yet been permanently reclaimed.

It should be noted that although there has been a continuing trend towards improving lake water quality since the early 1980's, AMD continues to be the primary water quality problem, and alkalinity concentrations, stream buffering capacity, and biological productivity are still depressed. Because of the lack of stream buffering, and the continuing presence of AMD in the watershed upstream of the dam, the potential remains for a fish kill should the Swamp Creek AMD facility fail to function properly.

As a consequence of the original operational schedule (downstream low flow augmentation), the buffering benefits of the lake, and AMD mitigation efforts in the watershed, a portion of the Clarion River now supports a coldwater, trophy brown trout fishery, and the lake supports a unique three tiered fishery with surface warm water, mid depth cool water and deep cold water components.

[5] Pittsburgh District Corps of Engineers, Water Supply Potential of East Branch Clarion River Lake, 1984

As one progresses downstream from East Branch Dam, the dam's influence upon Clarion River water quality diminishes. The AMD dilution that the dam provides in the upper reaches of the Clarion River is not as effective below Piney Dam due to uncontrolled tributary inflow. The Western Pennsylvania Conservancy notes on their WEB site that despite the Clarion River's remarkable recovery from decades of pollution, its water quality is not completely restored. Below Piney Dam, mine drainage enters the river from impaired tributaries such as Piney, Deer, and Licking creeks, and ultimately flows into the Allegheny River. Treating these discharges will be a key to improving water quality in the region.

5.7 NPDES Permits

The Pennsylvania Department of Environmental Protection (PADEP) agreed to help the District determine the potential effects that alternative interim operating pools could have on National Pollutant Discharge Elimination System (NPDES) permit holders that are located downstream of East Branch Dam along the East Branch Clarion and Clarion Rivers. NPDES permits are Federal permits issued under the authority of the Clean Water Act by the Commonwealth that specify the acceptable quality of wastewater discharges to surface waters via effluent limits and contain other legally binding conditions. The Federal Government has delegated its authority to the Commonwealth to issue said permits. The most common types of wastewater discharges covered by these permits are from sewage treatment plants and industry. For more information on NPDES permits, see **APPENDIX B**.

According to information supplied by PADEP there are five NPDES permit holders downstream of East Branch Dam. These are noted below:

NPDES Permit Holders

Domtar Paper Mill – Industrial Waste Treatment Plant Discharge
Johnsonburg Borough – Sewage Treatment Plant Discharge
Ridgway Borough – Sewage Treatment Plant
PA American Water Company – Industrial Waste Treatment Plant Discharge
PA American Water Company – Sewage Treatment Plant Discharge

In order for the above facilities to meet the stated effluent criteria of their NPDES permits, they need to have a certain minimum flow in the Clarion River to dilute discharges to acceptable levels. **TABLE 2** below shows what minimum flow is needed at Johnsonburg for each of the above permit holders.

TABLE 2 – Flow Requirements for Holders of NPDES Permits

Permit Holder/ River Mile	Minimum River Flows At Johnsonburg Required to Meet NPDES Permit Requirements*
Domtar Paper Mill/ RM 101	80 cfs
Johnsonburg Borough/ RM 100	30 cfs
Ridgway Borough/ RM 92	30 cfs
PA American Water Company/ RM33	20 cfs
PA American Water Co. (Outfall is within slackwater of Piney Reservoir/ RM 32)	0 cfs - As long as the Piney Dam Reservoir Exists

*These minimum flows were estimated by PADEP. As one progresses downstream, the drainage basin for the Clarion River increases in size which would tend to increase tributary inflows and thus provide added dilution potential.

5.8 East Branch Lake Aquatic Life Resources[6]

As mentioned above, East Branch Lake is a deep, steep sided, cold, well oxygenated, oligotrophic reservoir. The lake is over 100 feet deep near the dam and bottom water temperatures remain in the low 40's even in late summer. Due to the presence of cold, clear deep water, the Pennsylvania Fish and Boat Commission (PAF&BC) stocks the lake with lake trout fingerlings on an annual basis. Lake trout have been stocked since the 1970's. Although there is no current evidence that lake trout reproduce, they survive over warm weather months due to well oxygenated conditions in the deep colder portions of the lake.

In addition to lake trout, the PAF&BC regularly stocks the lake with brook trout fingerlings. Routine brown trout stocking was formerly practiced but discontinued by the PAF&BC in 2001. Rainbow smelt (a cold water species) were stocked in the lake in 1976 and 1977 and in tributary streams in 1979 and 1980. The stockings produced a small self-sustaining population that persisted for a while, but gradually declined. Rainbow smelt have not been captured in sampling programs since 1990.

East Branch Lake also supports a cool water fishery component and is stocked annually by the PAF&BC with walleye fry and tiger muskellunge fingerlings. Smallmouth bass are found in the lake and are self sustaining. However their growth rates are slow, most likely due to a low forage base, which is caused by a limited littoral zone around the reservoir and its inherent infertility.

According to the PAF&BC, rock bass, which were first captured in 1977, have become the most numerous fish species in the reservoir. In addition to rock bass, yellow perch, brown bullheads and white suckers are found in the reservoir; pumpkinseed sunfish are also present, but in limited numbers due to limited shallow water and low fertility. **TABLE 3** below summarizes numerically and by biomass night electro-fishing data from East Branch Lake compiled between 1992 and 2003. The three largest numbers of fish taken during this sampling period were yellow perch (32.25%) followed by smallmouth bass

[6] PA Fish and Boat Commission, communication, 2008.

(26.05%), and rock bass (17.68%). Interestingly, species by percent total weight basis (biomass) showed that smallmouth bass were 53.2 % of the total weight of fish followed by white sucker at 13.05% and rock bass at 6.49%. Although the total number of yellow perch was the highest, they only represented 5.34% of the total catch by weight. Even though the smallmouth bass represented the largest percent of the catch by weight, they were small in size, averaging approximately 3.4 ounces. In contrast, the average weight of white suckers was nearly one pound (15.3 ounces), but only 43 were taken. The sizes of other game fish were also small, averaging between 3 and 4 ounces, which may indicate a reduced forage base for top predators.

TABLE 3 - Night Electro-fishing Fish Data Summary, East Branch Lake, 5 Oct 92 Through 20 Oct 2003, Combined

NUMERICALLY			BIOMASS		
SPECIES	NUMBER	PERCENT BY NUMBER	SPECIES	TOTAL WEIGHT (grams)	PERCENT OF TOTAL WEIGHT
Yellow perch	983	32.25%	Smallmouth bass	76,343	53.20%
Smallmouth bass	794	26.05%	White sucker	18,733	13.05%
Rock bass	539	17.68%	Rock bass	9,307	6.49%
Pumpkinseed	336	11.02%	Pumpkinseed	8,513	5.93%
Walleye	131	4.30%	Brown bullhead	8,111	5.65%
Brown bullhead	77	2.53%	Yellow perch	7,661	5.34%
Johnny darter	57	1.87%	Walleye	6,744	4.70%
White sucker	43	1.41%	Muskellunge	3,926	2.74%
Muskellunge	40	1.31%	Northern pike	1,676	1.17%
Brook trout	16	0.52%	Lake trout	1,304	0.91%
Golden shiner	10	0.33%	Brook trout	878	0.61%
Lake trout	9	0.30%	Bluegill	187	0.13%
Northern pike	7	0.23%	Johnny darter	57	0.04%
Sculpin	2	0.07%	Golden shiner	36	0.03%
Bluegill	1	0.03%	Sculpin	10	0.01%
White crappie	1	0.03%	White crappie	5	0.00%
Blacknose dace	1	0.03%	Blacknose dace	3	0.00%
Fantail darter	1	0.03%	Fantail darter	1	0.00%
TOTAL	3,048			143,495	

5.9 East Branch Clarion River/Clarion River Aquatic Life Resources[7]

The East Branch Clarion River that extends from East Branch Dam down to its confluence with the West Branch Clarion River at Johnsonburg is classified as a high quality, cold water fishery. Cold water supplied by outflows from East Branch Lake allows trout to

[7] PA Fish and Boat Commission, communication, 2008

survive year-round in this river reach. The Pennsylvania Fish and Boat Commission stocks this reach with trout from its hatcheries. This reach also supports a limited wild, reproducing population of brook trout.

The Clarion River from its headwaters at Johnsonburg at the confluence of the East Branch Clarion and West Branch Clarion Rivers is approximately 101 miles long. The Pennsylvania Fish and Boat Commission surveyed the river in 1982 and again in 2003. In 2003, the Commission surveyed the river between the confluence of Toby Creek near river mile 84 downstream to the beginning of backwater from the Piney Reservoir near the mouth of Mill Creek at river mile 37. The Commission noted that the water quality of the Clarion River, which was historically degraded by acid mine drainage and industrial pollution, has improved greatly in the 20-year interval between surveys. The Commission reported that the improvements to the Clarion stem from acid mine drainage abatement programs, especially from the Little Toby Creek watershed that enters the Clarion River near river mile 84 (about 8 miles downstream of Ridgway) and improvements in industrial discharges from the Johnsonburg paper mill and industries located in St. Mary's that discharge into Elk Creek. Elk Creek empties into the Clarion River at Ridgway.

The Clarion River fishery has responded to the water quality improvements and now supports a diverse community of fishes, but due to infertility it is still somewhat limited in productivity. The Commission regularly stocks the Clarion River with brown trout and walleye fingerlings with the hope of establishing a self sustaining walleye fishery. The reach of the Clarion from Johnsonburg to Ridgway, a distance of about 8.6 miles, is classified as a trophy brown trout fishery and regulated by the Commission as "all tackle catch-and-release". This section of the river is extremely popular with trout fishing enthusiasts.

The sampled section of the Clarion River between Little Toby Creek and the Piney Reservoir headwaters supports excellent self-sustaining smallmouth bass and pan fish populations. In addition, the coldwater releases and flow augmentation from East Branch Dam allow stocked fingerling brown trout to survive and mature into large size adults. The trophy brown trout reach of the Clarion River between Johnsonburg and Ridgway was upstream of the Fish Commission's 2003 survey reach.

In 2006 PADEP recommended changing the 37.4 miles of the lower Clarion River from the upstream limits of Piney Reservoir downstream to the mouth at the Allegheny River from a cold water to a warm water stream. The recommendation was based upon the physical characteristics of the water body, dominance of warm water fish species, and the management and stocking of warm water fish by the PA F&BC.

Fish found within the Clarion River include, but are not limited to the following species: brown trout, walleye, brook trout (probably migrated from stocked tributaries), smallmouth bass, rock bass, bluegill, brown bullhead, common carp, golden redhorse, black redhorse, northern hog sucker, white sucker, yellow bullhead, logperch, river chub, silver shiner, striped shiner, variegated darter, banded darter and greenside darter.

5.10 Endangered Species

By letter dated June 4, 2008, the District, in response to the Section 7 of the Endangered Species Act requested information from the State College Office of the U.S. Fish and Wildlife Service on the presence of threatened or endangered species or their habitat within East Branch Lake and the East Branch Clarion and Clarion Rivers downstream of East Branch Dam. They responded with a letter dated September 19, 2008, indicating that except for occasional transient species, no federally-listed or proposed threatened or endangered species under the jurisdiction of the USFWS were known to occur within the project impact area. A copy of this letter is contained in **APPENDIX E.**

The District also contacted the Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, and Pennsylvania Department of Conservation and Natural Resources to determine the presence of state listed fish, reptiles, amphibians, birds, mammals, invertebrates and plants that may be present in the project area. By letter dated October 27, 2008, the Fish and Boat Commission indicated that four state-listed rare or protected species were in the general project area: the mountain brook lamprey, gilt darter, river redhorse and timber rattlesnake. The gilt darter and mountain brook lamprey occurred in the Clarion River. The river redhorse inhabits the portion of the Clarion River near its mouth at the Allegheny River. The timber rattler can be found on south-facing bluffs overlooking the Clarion River. A copy of the Fish and Boat Commission's letter is contained in **APPENDIX E.**

5.11 Wild and Scenic River

In March 1996, a Wild and Scenic River Eligibility report was completed by the U.S. Forest Service, Allegheny National Forest, for 92 miles of the Clarion River from Ridgway to its confluence with the Allegheny River and 19 miles of Mill Creek from its headwaters to the confluence with the Clarion River upstream of Clarion. The report determined the eligibility of these streams for inclusion into the National Wild and Scenic Rivers System. The Wild and Scenic Rivers Act (Public Law 90-542), passed on October 2, 1968, protects free-flowing rivers that possess outstandingly remarkable characteristics. Eligibility is determined based upon whether the river segment(s) are free flowing and have outstandingly remarkable value (scenic, recreation, fish, and wildlife, heritage, etc.). To make this decision, the resources of the river and river corridor (¼ mile on either side) were inventoried.[8]

The Clarion River was included in the original Wild and Scenic Rivers Act but in 1969 was determined ineligible due to poor water quality from acid mine drainage, untreated domestic sewage and industrial wastes. Since 1969, as water quality improved, interest grew in re-examining the river to determine its eligibility to be included within the Nation's list of Wild and Scenic Rivers. The Forest Service's eligibility report concluded that 51.7 miles of the Clarion River, downstream from the Allegheny National Forest/State Game Land #44 boundary (just downstream of Ridgway) to the beginning of the slackwater created by Piney Dam could qualify for inclusion in the Wild and Scenic River system. The river was judged to have outstanding visual character and recreational value for canoeing, picnicking,

[8] U.S. Forest Service, "Clarion River and Mill Creek Wild and Scenic River Eligibility Report", 1996.

sightseeing, camping, birding, wildlife watching, fishing and hiking. According to the Eligibility Report, the Clarion River is classified as a C1 resource. "C" meaning that it is a flat flowing river with velocities that make it desirable for canoeists of all abilities, and "1" meaning that the river has fast moving water with riffles and waves and few or no obstructions, all of which are easily avoided with little training. The risk to swimmers is slight with self-rescue judged as being easy.

As a result of the re-evaluation process, on June 4, 1996, Congressman Clinger introduced a Bill, H.R. 3568, during the Second Session of the 104th Congress that designated 51.7 miles of the Clarion River as a component of the National Wild and Scenic River System. This bill, which was approved, named specific river reaches as either scenic or recreational. The river reaches are identified in **TABLE 4** below:

TABLE 4 – Clarion River Wild and Scenic River Reaches

River Reach Description	Classification
8.6 Mile Reach - Allegheny National Forest /State Game Lands #44 boundary to Portland Mills	Recreational River
8 Mile Reach - Portland Mills to Allegheny National Forest boundary ,located 0.8 miles downstream of Irwin Run	Scenic River
26 Mile Reach - 0.8 miles downstream of Irwin Run to State Game Lands 283 boundary, located 0.9 miles downstream of Cooksburg bridge	Recreational River
9.1 Mile Reach 0.9 miles downstream of Cooksburg bridge downstream to the Piney Run Dam backwater, located 0.6 miles downstream of Blyson Run	Scenic River

5.12 Noise/Aesthetics

The East Branch Clarion River Lake, the East Branch Clarion River, and Clarion River corridor is primarily forested and one of the least developed areas in Pennsylvania. The undisturbed tracts of forest land along the river corridor provide outstanding aesthetic quality and contributed heavily to the determination that 51 miles of the Clarion River between Ridgway and the Piney Dam headwaters were included in the Wild and Scenic River system.

The lake area can be noisy, especially during warm and sunny summer days, due to the operation of power boats. There is no horsepower limit within the lake. Summer weekends at the lake are usually noisier than during the week due to heavier usage.

The rivers downstream are too shallow for power boating and can be navigated only by canoes, kayaks, rafts and other shallow water craft. Given the remote nature of the river corridor and the types of recreation supported by the East Branch and Clarion rivers, the corridor is usually quiet.

5.13 Recreation Resources

5.13.1 East Branch Lake Recreation

East Branch Lake is one of the most popular sites for recreation in northwestern Pennsylvania. The area in the vicinity of the dam is maintained by the Corps. In this area, the Corps provides public camping and picnicking areas and a boat launching ramp on the left descending bank, just upstream of the dam. East Branch campground, managed by the Corps, is open from mid-April to mid-October. The remainder of the land surrounding the lake is managed by the Commonwealth as Elk State Park, Elk State Forest, and state game land. Unlimited horsepower boating is allowed on the lake and water skiing is very popular. The state operates a boat launching ramp at the upper end of the lake within Elk State Park. Fishing is also popular at the lake, which has both cold-water and cool-water components. Lake trout survive within East Branch Lake due to the cold water present at lower depths year-around and muskellunge, walleye and smallmouth bass (cool water species) are also present and sought after by anglers. Ice fishing is also permitted during the winter after the lake freezes over. Hunting within the state game lands around the reservoir is popular, and deer, turkey and bear are regularly taken. Hunting is not permitted on Corps-managed land near the dam or within camping areas. **TABLE 5** below presents an estimated breakdown of the type of recreation activities occurring at East Branch Dam. The data was based upon visitor data taken from 1998 to 2007. As can be seen in the table, for this period, the three top activities were boating (36%), fishing (24%) and sightseeing (16%). However, water dependent activities (i.e., boating, fishing, swimming, and water skiing) made up 70% of all recreational usage.

TABLE 5 - Recreational Activities, East Branch Lake, Percent Usage, 1998-2007

Activities	**Percentage**
Boating	36.10%
Camping	0.60%
Fishing	24.26%
Hunting	0.10%
Picnicking	9.89%
Sightseeing	16.29%
Swimming	0.04%
Water Skiing	10.26%
Winter	0.00%
Other	2.46%
Total	**100.00%**

Average visitor days at the project are shown in **TABLE 6** below. These values represent all the types of recreational activities shown in **TABLE 5** above. As noted in this table, the largest and most expected number of visitor days occurs during the warmer recreation season, June through September.

TABLE 6 - Average Annual Visitor Days, East Branch Lake, 1998-2007

Month	Average Visitor Days
Oct	2,510
Nov	1,993
Dec	1,301
Jan	988
Feb	1,009
Mar	1,230
Apr	4,396
May	6,479
Jun	20,777
Jul	26,858
Aug	20,992
Sep	14,095
Total	**102,625**

5.13.2 Clarion River Recreation

As mentioned previously in this assessment, 51 miles of the Clarion River between Ridgway and the beginning of slackwater created by Piney Dam has been included in our Nation's Wild and Scenic River system. Because of its superior scenic and recreational qualities, the area is immensely popular for recreation. It is an extremely popular natural resource for tubing, canoeing, kayaking and rafting. During the later summer, the river does get shallow and portage is required in places. Several canoe liveries operate along the Clarion River. Fishing on the Clarion River, especially between Johnsonburg and Ridgway, is very popular. This 8-mile reach of river is recognized as a trophy brown trout fishery that attracts fisherman from many areas.

5.14 Socio-Economic Conditions

Based upon the year 2000 census, the population of communities directly adjacent to the Clarion River was 33,699. Annually, from 1990 to 2000, the population of these same communities, on average, decreased by 0.1 percent resulting in a reduction of 332 persons (the population was 34,031 in 1990). Minorities in the Clarion River Valley consist of very small portions of the population; only 2.1 percent (699 persons) of the total population of this area were classified as minority.

The percentage of adults older than 25 years of age with no high school diploma in the Clarion River Valley was 16.2 percent (3,413 persons). In contrast, the percentage of adults older than 25 years of age with at least a bachelor's degree in the overall Clarion River Valley was 15.7 percent (3,305 persons), slightly lower than the number of persons without a high school diploma.

Average median household income for the Clarion River Valley in 2000 was $32,510. Average per capita income for 2000 was $17,177 in the Clarion River Valley communities. The unemployment rate at the time of the 2000 census in the Clarion River Valley was 6.9 percent (1,120 persons). The Clarion River Valley combined, had a poverty level of 15.0 percent (4,701 persons).

The average vacant housing rate for the Clarion River Valley was 29.9 percent (5,610 housing units). Of the occupied housing units, the average percentage of those units that were renter-occupied for the Clarion River Valley was 27.9 percent (3,661 renter-occupied housing units). The average median house value in the Clarion River Valley was $67,677. The number of households expending at least 30 percent of their annual income towards housing costs in the Clarion River Valley was 14.8 percent (1,025 owner-occupied housing units).

5.15 Air Quality

According to the Environmental Protection Agency's Web site (http://www.epa.gov/air/urbanair/6poll.html), the Clean Air Act requires EPA to set National Ambient Air Quality Standards for six common air pollutants. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. These pollutants can harm your health and the environment, and cause property damage. Of the six pollutants, particle pollution and ground-level ozone are the most widespread health threats. EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels.

In April 1999, EPA issued a Clean Air Act violation notice to Willamette Industries, Inc., the former owner of the Domtar paper mill in Johnsonburg. Prior to Domtar's acquisition of the plant, Weyerhaeuser acquired it in June 2002 after the company’s merger with Williamette. EPA and the Commonwealth of Pennsylvania alleged that Weyerhaeuser modified and operated two coal-fired power boilers without required upgrades to air pollution control equipment. The complaints also alleged that Weyerhaeuser failed to obtain required state-issued permits limiting sulfur dioxide emissions, and violated Clean Air Act standards applicable to fossil-fuel-fired steam generating units. In October 2003, as a consequence of EPA's consent decree, Weyerhaeuser completed installation of state-of-the-art sulfur dioxide (SO2) scrubbers on the plant’s power boilers, at a cost of about $5.5 million. The consent decree required Weyerhaeuser to operate these scrubbers in accordance with standards designed to reduce SO2 air emissions by up to 95 percent.

Based upon a review of the Pennsylvania Bureau of Air Quality and EPA's web sites, in March 2009, the air quality of Elk, Jefferson and Clarion Counties is good and does not exceed any of the criteria for the six common air pollutants, including SO2.

5.16 Cultural Resources

Two investigations were conducted at East Branch Lake to determine the presence of historic and archaeological resources. The first, a study conducted in 1950 by the Smithsonian Institute was part of the Interagency Archaeological Program in cooperation with the National Park Service and the Corps. Ralph S. Solecki of the River Basin Surveys branch of the Smithsonian conducted the survey. William Mayer-Oakes of the Pittsburgh Carnegie Museum assisted in the Smithsonian's survey. This survey found no cultural resources in the project area. The second investigation was conducted in 1989 by Archaeological Service Consultants, Inc., of Columbus, Ohio. This second investigation, spearheaded by Dr. Flora Church, confirmed the results of the first, that no archaeological properties are present on federal lands at East Branch Dam. The District consulted with the Pennsylvania Bureau for Historic Preservation (PaBHP) in arriving at this determination.

At the time of the 1989 survey, the dam and its supporting structures were not included as they were not 50 years of age, which is the typical age threshold for consideration of eligibility for listing to the National Register of Historic Places. Now that the dam has reached 50 years of age, the District will conduct an evaluation of the dam's potential historical significance and consult with the PaBHP under Section 106 of the National Historic Preservation Act on the potential effects of any action involving permanent repairs. It is the District's preliminary opinion that the dam and its supporting structures are potential eligible for listing based on the association of this facility with federal programs for flood control, water quality and recreation, which are events important in broad patterns of our history (Criterion A, National Register of Historic Places eligibility criteria).

6.0 Impacts of the "No Action" Alternative and Alternatives 1-4

This section of the EA analyzes the impacts of: "No Action," and the four Alternative interim water control plans that were described in Section 3.0.

6.1 Environmental Parameters Not Affected By Alternatives.

A number of environmental parameters described in Section 5 of this EA will not be affected by any of the alternative interim pools or "no action." These are described below. To avoid redundancy in an already complex assessment, the parameters below will not be separately addressed for each of the alternatives.

6.1.1 Terrestrial Habitat

The alternative interim operating pools would not affect existing terrestrial habitat along the East Branch Clarion River or Clarion River because downstream flow releases would be within the range of historic releases from East Branch Dam.

6.1.2 Land Use, Physiography, Geology, Soils, Air Quality

Because the action alternatives will be limited to temporarily changing the water control plan, land use will not change, nor will physiography, geology, or soils or air quality be affected.

6.1.3 Environmental Justice

Minority and low income populations within the communities downstream of East Branch Dam consist of less than 2.1% of the population. Any social or economic effects that can be attributed to the revised operation of East Branch Dam would affect all citizens equally, except for those whose businesses are recreation oriented and dependent upon the lake and the Clarion River. Consequently, the interim operation of the dam would not disproportionately affect minority or low income populations and, therefore, no environmental justice impacts can be attributed to any of the alternatives described in this EA.

6.1.4 Cultural Resources

The adoption of an interim operating schedule is not an activity that would qualify as a Section 106 "undertaking," in that it has no potential to affect an historic property.

6.2 "No Action" Impacts

As noted in Section 3.1, because emergency action was taken to modify the water control plan in early 2008, "No Action" cannot mean doing literally nothing. Because of safety concerns, "No Action" would require implementing one of two possible construction options to permanently reduce the risk of dam failure, either lowering the spillway elevation to 1610 to permanently and drastically reduce the pool (Option 1) or opening the gates to eliminate the pool altogether and allow East Branch to flow relatively unrestricted through the dam's outlet works (Option 2). Either Option would require Congressional approval to be implemented since the authorized purposes of East Branch Dam, a federally authorized civil works project, would be permanently and significantly changed.

6.2.1 Public Safety Impacts

Options 1 and 2 will allow the dam to permanently operate safely. However, under both options, the flood control capabilities will be significantly reduced. It is estimated that East Branch Dam prevents nearly $5,400,000 in flood losses annually. Under Option 1 which maintains a 1610 pool with a 1610 spillway, flood reduction benefits would be reduced by 73 to 85 percent for average and dry conditions, respectively. Option 2, where East Branch Dam is operated full time with its gates fully open, will cause the loss of over 91 percent of its flood reduction benefits. Option 2 would essentially turn East Branch Dam into a "dry dam". Because of limited gate capacity, during heavy rains the dam will occasionally create a small lake behind it but only long enough for the lake to drain out. The lake would be intermittent, depending upon precipitation and snowmelt conditions, and never reliably present during any particular time of year. Just the loss of flood control benefits alone would make both of these options unacceptable.

6.2.2 Water Quality Impacts

Water quality would also suffer from the implementation of either "No Action" option due to the loss of low flow augmentation water during critical times of the year when it is most needed. In average year, under Option 1, with a permanent 1610 pool, there would be no flow augmentation between the end of August and middle November, a period of approximately two and one half months. Under a drought scenario, there would be no low flow augmentation for four months from beginning of August to the end of November. For

Option 2 (permanently opened gates) downstream water quality conditions would be worse because there would be no low flow augmentation for the entire year.

6.2.3 Lake and Downstream Fishery Impacts

Under Option 1, the pool would be reduced from the normal 1200 acre lake to 500 acres. This pool would not maintain the present cold water lake trout fishery because lake temperatures in the normally colder hypolimnion (lake bottom) would exceed 60 Degrees F (See **TABLE 8**). **TABLE 9** shows that 100 percent of the lake would exceed 60 degrees during September and October. In addition, the cool water component of the East Branch Lake fishery would also be lost. As shown on **TABLE 9,** 100 percent of the lake would exceed 77 Degrees F (the maximum survival temperature for cool water species) during September and October. The warm water fishery would not be temperature limited. Under Option 1, the lack of low flow augmentation during September and October would result in the loss of the sustainable cold water fishery in the East Branch Clarion and Clarion Rivers downstream of the dam. Also under Option 1, the lowered pool will expose sediment that has accumulated on the lake bottom. During high rainfall conditions, exposed sediment would become suspended in the lake and discharged downstream. The re-suspended sediment would cause severe impacts to the aquatic habitat downstream. Sedimentation would clog gills, smother eggs and fill in the interstices amongst the cobble, gravel and rock that make up river bottom habitat which is so very important for benthic macroinvertebrates and fish.

Under Option 2, there would be no permanent pool which would eliminate the current lake fishery. More importantly, untreated AMD still flows into the lake even though much of it is being treated. Currently the untreated AMD is being diluted by the lake. Under Option 2 the AMD dilution would be lost which would severely affect the river fishery below East Branch Dam.

Under Option 2 where the gates are left in an open position, the river would become free flowing; stream velocities will be much higher than under Option 1 during both normal and high flow periods, and higher volumes of sediment would be transported downstream. For potentially three or more years, downstream sedimentation would be severe as the river down cuts through the fine depositional material on the lake bottom to bed rock. Any exposed sediment will continue to erode until all the sediment is either washed downstream or becomes stabilized through natural processes.

6.2.4 Impacts to NPDES Permit Holders

As noted in **TABLE 11**, for Options 1 and 2 under average conditions, none of the NPDES permit holders would be in violation of their discharge requirements. There would be sufficient natural flow without low flow augmentation from East Branch Dam for all the permit holders including the Domtar paper mill to meet their discharge requirements. This is not the case however under drought conditions. Industrial and municipal NPDES permit holders, whose regulated discharges are dependent upon low flow augmentation from East Branch Dam during a drought, would find themselves in violation of their permits under both "No Action" options. Under Option 1 (1610 pool with a 1610 spillway) all of the NPDES permit holders, except for the PA American Sewage Treatment Plant (STP) would violate their permits between mid September and all or portions of November. Under Option 2 (no pool with run-of-river condition), the impacts would be especially severe. The Johnsonburg Sewage Treatment Plant (STP), Ridgway STP and PA American Water Plant would exceed their discharge criteria between early June and the latter part of November. Under Option 2, the Domtar Mill would fare worse and would be in violation for up to 200 days between the latter part of May and early December.

6.2.5 Socio-Economic and Recreation Impacts

Under Option 1, a smaller 500-acre lake would remain behind the dam at elevation 1610. Under this Option, the dam would retain minimal low flow augmentation capabilities. Its value for recreation would be limited due to difficult access with no useable boat launching ramps the entire year. Only lightweight carry-in craft such as canoes and kayaks could be used within the residual lake for recreation by the adventurous. As shown below on **TABLES 6A**, under average conditions, the recreation and economic impacts would amount to an approximate 42 percent loss of benefits or about $38.3 million. During drought conditions shown on **TABLE 6B** the loss of annual economic and recreation benefits compared to baseline conditions (1670 pool) would be worse totaling 54.3 percent, which translates to a loss of $49.7 million.

Because the spillway would have to be lowered under this Option, the dam would only be able to provide very limited flood control as compared to the 1670 pool. It is estimated that under Option 1, the flood control capabilities would be reduced by approximately 85 percent under average conditions and 73 percent under drought conditions leaving many persons downstream at risk when flooding occurs. As noted, the flood control capability is higher under drought conditions because the pool would be lower creating added flood storage below the spillway elevation.

Under Option 2, leaving the gates permanently opened in a run-of-river condition would cause greater in-lake and downstream adverse economic and recreation impacts than Option 1. Opening the flood gates would drain the lake and permanently eliminate all lake based recreation. The lack of low flow augmentation provided by the lake would adversely affect downstream recreation by eliminating all low flow augmentation, which is especially important during dry periods. This would significantly affect not only recreation but also business and industries. As shown on **TABLE 6A**, for Option 2, under conditions of average precipitation, there would be a 53.2% percent loss of recreation and economic benefits, totaling approximately $48.7 million per year. Under drought conditions, as shown on **TABLE 6B** the losses over baseline conditions (1670 pool) would amount to 64.7%, which translates into a $59.2 million loss of recreation and economic benefits for the region.

Also under Option 2, almost all flood control benefits afforded by the dam would be lost because the flood gates would remain open. The size of the opened flood gates would restrict only extremely high river flows which, during high rainfall events would tend to create a temporary lake behind the dam. The lake would drain very quickly. It is estimated

that over 90 percent of the flood reduction capabilities of the dam would be lost under Option 1 for both average and drought conditions.

TABLE 6A - "No Action" Annual Economic and Recreation Impacts, Average Conditions

Average Precipitation	Pool 1670		NO ACTION - OPTION 1 Pool 1610/Spillway 1610		NO ACTION - OPTION 2 RUN-OF-RIVER	
	Visitor Days	Dollar Value	Visitor Days	Dollar Value	Visitor Days	Dollar Value
Total Benefits	361,000	$91,618,000	284,100	$53,227,000	288,500	$42,922,000
Lost Benefits	0	$0	-76,900	-$38,391,000	-72,500	-$48,696,000
% of Lost Benefits	N/A	N/A	-21.3%	-41.9%	-20.1%	-53.2%

TABLE 6B - "No Action" Annual Economic and Recreation Impacts, Drought Conditions

Drought Condition	Pool 1670		NO ACTION - OPTION 1 Pool 1610 Spillway 1610		NO ACTION - OPTION 2 RUN-OF-RIVER	
	Visitor Days	Dollar Value	Visitor Days	Dollar Value	Visitor Days	Dollar Value
Total Benefits	361,000	$91,618,000	218,100	$41,867,000	170,300	$32,367,000
Lost Benefits	0	$0	-142,900	-$49,751,000	-190,700	-$59,251,000
% of Lost Benefits	N/A	N/A	-39.6%	-54.3%	-52.8%	-64.7%

6.2.6 Wild and Scenic River Impacts

Under both options, low flow augmentation would be severely affected. Without the diluting effects of low flow augmentation provided by East Branch Lake, acid mine drainage concentrations would increase along with increases in industrial and sewage treatment plant discharges. The resultant water quality degradation combined with a reduced river flow during the recreation season could result in a re-evaluation and potential loss of the Clarion River's Wild and Scenic status.

6.2.7 Wetland Impacts

Under Option 1, the present wetlands within the lake would be lost and new wetlands would re-establish at a lower elevation within the reservoir. Downstream wetland impacts under Option 1 would be severe due to loss of low flow augmentation during the latter half of the growing season. The downstream wetlands affected by the lack of flow would be desiccated and lost. These wetlands would likely re-establish during the next growing season, but their quality would become degraded due to late growing season desiccation.

The effect of Option 2 upon existing wetlands would be the most significant since there would be no low flow augmentation available throughout the year. Under Option 2, all wetlands around the lake that are dependent upon the presence of a pool would be lost. Some wetlands in the former lake area would re-establish after the river bottom sediments and river banks stabilize. The downstream wetlands dependent upon low flow augmentation would also be permanently lost. New downstream wetlands would re-establish based upon future uncontrolled run-of-river conditions. The loss (or gain) in downstream wetland acreage as a result of returning to a run-of-river flow condition is unknown.

6.2.8 Endangered Species Impacts

As noted in Section 5.13, no Federally-listed threatened or endangered species or their habitats are known to occur in the project area. There are four rare or protected state-listed species are found in the project area: the mountain brook lamprey, gilt darter, river redhorse and timber rattlesnake. According to the Pennsylvania Fish Commission, the four aquatic species are found in the lower Clarion River; consequently, they could possibly be adversely affected by increased turbidity associated especially with Option 2. The timber rattlesnake would not be affected by either option under "No Action".

6.3 Impacts of Interim Alternative Operating Pools - General

Two primary hydrologic conditions were used to evaluate impacts of the interim alternative pools, average precipitation and drought. The principal effects of the alternative pools relate to the aquatic ecosystem of and recreation on East Branch Lake, the East Branch Clarion and Clarion Rivers downstream of East Branch Dam, and water users along the Clarion River. As one would expect, the environmental effects of Alternatives 1 through 4, having target summer pools at 1650, 1640, 1630 and 1610, respectively, are very similar; the effects vary not by type but by degree. To avoid redundancy where practicable, discussions of the effects of the alternatives are grouped together; significant differences are noted. Alternative 4 differs from the other three interim water control plans because the target summer and winter pool elevations do not change. They are both at elevation 1610. As will be seen, this alternative causes the most severe impacts.

6.4 Public Safety Impacts

Without question, the most important impact of consideration and the principal reason for the current action is public safety. The lowering of the summer pool by twenty feet from approximately elevation 1671 to 1650 for Alternative 1 reduced the static pressure on the dam and provided an acceptable margin of safety. More detailed studies conducted on the dam after the interim operating pool was implemented confirmed that the new interim operating pool will continue to provide the level of risk reduction needed until repairs can be made. The other alternatives will, as described below, further increase the safety of the dam until required repairs are completed.

6.4.1 Public Safety Impacts, Average Conditions, Alternatives 1- 4

All of the interim water control plans would progressively reduce the risk of dam failure by lowering the static pressure on the dam. There is an inverse relationship between safety and pool elevation. As the pool is reduced, the margin of safety rises. Obviously then, the safest pool level is provided by Alternative 4 with a constant maximum 1610 pool elevation. The dynamic pressures on the dam contributed by flood water storage do not contribute to safety issues at East Branch Dam. Any floodwaters stored would be quickly released as efficiently as possible to return the reservoir to its pre-storm levels. Therefore, the flood protection mission of the dam would not be adversely affected by any of the interim pool alternatives. The lower the pool, the more flood waters can be stored for a given storm event. Since the pool was designed to operate at 1670, a lower pool would simply provide increased flood storage capacity within the reservoir.

6.4.2 Public Safety Impacts, Drought Conditions, Alternatives 1-4

In a drought condition, inflow to East Branch Lake from the East Branch River and its tributaries would be reduced. Under these alternatives the pool elevations would simply drop to lower than normal levels as water is released from the dam to augment low flows downstream. As a direct consequence, the static load behind the dam would obviously lessen as the pools approach minimum pool, which would further enhance the safety of the structure. As noted in the above paragraph, temporary flood control storage does not affect the safe operation of the dam.

6.5 Water Quality Impacts, Lake and Downstream, Average and Drought Conditions, Alternatives 1-4

As noted in Section 5.6, the East Branch of the Clarion River Lake is a clear, cold, deep and moderately oligotrophic headwater impoundment. Prior to 1969, the lake was severely degraded by mine drainage, but with the construction of passive and active mine drainage abatement projects in the watershed, water quality improved dramatically. However, the lake is still very lightly mineralized and buffered, and continually receives a significant load of acidity from old bituminous coal mines and atmospheric deposition.

East Branch Lake now supports a quality tiered fishery having cold water, cool water and warm water components as a direct consequence of recent water quality improvements, using selective withdrawals from East Branch Lake during the 1970's and 1980's, and continued stocking by the Pennsylvania Fish and Boat Commission. In addition, low flow augmentation from waters stored in the lake significantly benefits the lower 7.2 miles of the East Branch of the Clarion River and the entire 101 mile length of the Clarion River. Habitat quality is tied to water temperature and since more than 50 percent of the total volume of water in the reservoir remains colder than 50 degrees F throughout the year, both the lake and the downstream regulated reach support unique cold water fisheries.

Notwithstanding these improvements, the lake remains slightly acidic and its alkalinity and pH buffering capacity are so low that it is extremely vulnerable to even moderate increases in acid loading. Consequently, despite the water quality improvements, the lake fishery remains extremely vulnerable to water quality degradation through AMD shock loading should the Swamp Creek treatment plant fail for any reason.

Alternative 1 - The lower 1650 interim operating pool (Alternative 1) was implemented in 2008 as an emergency measure to protect public safety. Hydrologic conditions that occurred in the lake afterward were average from May through August; however, a drought condition developed from September through November. Under average conditions, water quality impacts were negligible. During the drought, as the pool elevation dropped, lake temperatures and stratification patterns changed significantly and water quality worsened. Lake acidity concentrations increased, pH values decreased, water clarity decreased to the lowest level since 1997, and during November, hypolimnetic dissolved oxygen levels dropped lower than had ever been documented in the lake.

Despite the above changes, water quality impacts were only considered moderate because cold, good quality, aerated water still remained in the lake. Furthermore, the drought-induced water quality changes did not affect downstream water quality because the lake's low flow augmentation schedule was not interrupted. Moreover, in the future, the new water quality intake installed in October 2008 at elevation 1578.5 will increase the District's operational flexibility to minimize lake and downstream water temperature impacts during both drought and average conditions. Thus, until the dam is repaired, the temporary operation of East Branch Lake under Alternative 1 will not cause any long term, significant adverse water quality impacts either within the lake or downstream.

For Alternatives 1640, 1630 and 1610, lake water quality problems observed during 2008 would become progressively more severe as the pool elevation drops and conditions change from average to drought. Under these alternatives, East Branch Lake would likely slip back into a seriously acid-degraded condition. Lower pool elevations and reduced lake volumes would result in the loss of lake dilution and neutralization benefits; exposure and re-suspension of the lake sediment load; and modification of lake stratification patterns and water temperatures, which would negatively impact water quality both in the lake and downstream. As shown below in **TABLE 7** while water quality impacts with the 1640 alternative during average conditions would be moderate (comparable to those observed with the 1650 drought), water quality impacts for all other alternatives under both average and drought conditions would be severe. When the lake water quality would be poor (Alternatives 1640 drought, and 1630 and 1610 average and drought conditions), or when the lake empties and the downstream augmentation would be interrupted, the impacts on downstream water quality would also be severe.

TABLE 7 - East Branch Clarion River Lake, Water Quality Impacts on September 1st when Lake Water Quality Conditions Would be the Poorest

Alternative	Average Conditions			Drought Conditions		
	Pool Elevation (ft NGVD)	Maximum Pool Depth (ft)	# Days no Pool (No low flow augmentation)	Pool Elevation (ft NGVD)	Maximum Pool Depth (ft)	# Days no Pool (No low flow augmentation)
Authorized (1670)	1652	121	0	1650	119	0
Alternative 1 (1650)	1628	97	0	1612	81	30 (11/2-12/1)
Alternative 2 (1640)	1614	83	0	1593	62	74 (9/20-12/1)
Alternative 3 (1630)	1598	67	26 (10/20-11/15)	1555	24	88 (9/5-12/1)
Alternative 4 (1610)	1555	24	87 (8/20-11/15)	1555	24	119 (8/5-12/1)

Yellow = moderate water quality impacts
Orange = Severe water quality impacts during the summer/fall season until the lake becomes run of river (when there is no storage left). When run of river conditions prevail, water quality will improve slightly.

In summary, East Branch Lake is extremely vulnerable to even moderate increases in acid loading, and although the fishery is healthy, it could easily be lost if water quality continues to decline. With the 1650 alternative, under average and drought conditions, impacts would be minor. However, under the 1640 drought, and 1630 and 1610 average and drought alternatives, lake and downstream water quality could be severely impaired and lake and downstream fisheries severely impaired or lost entirely.

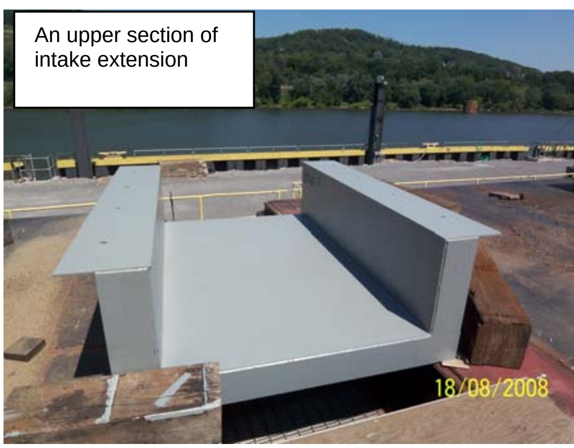
6.6 Outlet Modification To Improve In-Lake and Downstream Water Temperature Management – 1650 Pool.

Water temperature management in the late summer/early fall is critical to the operation of the Domtar Mill, the lake trout fishery in East Branch Lake and the cold water trout fishery downstream in the East Branch Clarion and Clarion Rivers. Because of the higher in-lake and colder release water temperature problems encountered in the summer of 2008, the District quickly assembled an ad-hoc study team to determine if a practicable method could be implemented to allow more normal temperature releases while operating at a lower 1650 interim pool.

The District considered several alternatives to keep cold bottom water in the lake through the late summer/early fall when critically needed to maintain the lake trout fishery and to discharge warmer surface waters to keep from stressing the downstream fishery with water that is too cold. The end result of this investigation was the design and installation of a heavy, metal “U” shaped intake extension that added another “intake” opening in the water control tower. This extension, fabricated by the District, was bolted to the front of the control tower over one of the gate intakes at 1552 to allow water to be withdrawn from upper, warmer levels of the reservoir at elevation 1578.5 after the 1620 intake (number “1” intake shown on **Photo 6**) goes out of service due to the lowering of the pool as required under the new interim operating plan. Two photos of this intake extension, constructed in three separate sections to ease installation, are shown below.

As shown on Graph 2, intake No. 1 would go out of service in late September under average conditions and around mid-August during a drought. Until the intake extension at elevation 1578.5 was installed in October 2008, colder bottom water had to be released from the 1552 intake after the 1620 intake went out of service. When the pool goes below 1620, the extension will now permit blending of warmer surface water with colder water from the bottom of the reservoir to better control the temperature of both the lake and downstream releases. The extension will permit water to be taken from elevation 1578.5 until the usual mid-October change to total cold water releases from the 1552 gate (intake #3) is required.

With the intake extension in operation, July and August releases will only be about 5 degrees higher than normal and September releases will be about 5-8 degrees cooler than normal. During the rest of the year, the temperature of the lake and downstream releases should be very close to historical values. This modification will ensure that temperature extremes, like those encountered in the late summer of 2008, will not occur for the life of the 1650 interim operating pool.



6.7 Lake Fishery Impacts – General

6.7.1 Methodology to Assess/Quantify Lake Fishery Habitat Impacts

As noted in Section 5.8, the fishery at East Branch Lake is three tiered; it contains a cold water, cool water and warm water component. The lake is sufficiently deep and cold to allow lake trout to survive over the summer. The warm water fish species in East Branch Lake, such as brown bullhead, yellow perch, pumpkinseed, and bluegill are not affected by gradual exposure to progressively colder water. These and other warm water species commonly found in East Branch Lake regularly survive winter temperatures where the entire lake water column approaches 33 degrees F in the winter. These species become relatively inactive in colder water, however they do survive. The reverse is not true for the cold and cool water species that populate East Branch Lake; they are adversely affected as lake temperatures warm.

As can be seen in **TABLE 8** below, optimum water temperatures for the coldwater lake trout range between 46 and 55 degrees F, and the maximum survival water temperature is 60 degrees F. Brown trout can tolerate warmer water than either lake trout or brook trout and can survive temperatures up to 75 degrees F. Cool water fish, such as walleye thrive at water temperatures which range between 55 to 68 degrees F. These temperatures are considered too warm to allow the survival of lake trout, and too cold to permit the optimum growth of warm water fishes (brown bullhead). For warm water brown bullhead, optimum water temperatures range between 64 and 90 degrees F and the maximum water temperature is 95 degrees F.

TABLE 8 – Optimal Water Temperatures for Cold, Cool, and Warm Water Fish, Degrees F

Species	Spawning	Growth	Survival
Lake Trout	46	45-55	55-60
Brook trout	45-55	57-60	33-72
Walleye	45-50	55-68	77
Brown trout	48-60	65-75	77
Smallmouth bass	60	68-70	?
Muskellunge	48-60	58-83	90
Brown bullhead	?	64-90	95

Because the cold water and cool water fisheries in the lake are temperature limited, the District used Thermal Habitat Volume (THV) as the parameter to assess lake fishery impacts. The impact to these two fishery components is measured by the reduction in the volume of optimum cold and cool water habitat that occurs with each successively lower alternative interim pool. THV is measured in acre-feet, and represents a volume of water whose temperature is optimal for cold water and cool water species. An acre-foot of volume is equivalent to one surface acre, one foot deep. The volumes were calculated by ERDC through the application of the CE-QUAL-W2 temperature model that is described below in paragraph 6.7.2.

Lake trout is a cold water species with a natural distribution that is primarily dependent on the species requirement for cold water and relatively high concentrations of dissolved oxygen (Martin and Oliver 1980[9]), the fundamental thermal niche is identified as 10 plus or minus 2 degrees C (Magnuson et al, 1990[10]). Investigations by O’Connor et al.

9 Martin, N.V., and Olver, C.H. 1980. The lake charr, Salvelinus namaycush. In Charrs: salmonid fishes of the genus Salvelinus. Edited by E.K. Balon. D.W. Junk Publishers, The Hague, Netherlands.

pp. 205–277.

10 Magnuson, J.J., Meisner, J.D., and Hill, D.K. 1990. Potential changes in the thermal habitat of Great Lakes fish after global climate warming. Trans. Am. Fish. Soc. 119: 254–264.

(1981[11]), suggest that lake trout growth is optimal within this temperature range. Volume of water within this fundamental thermal niche has been established as a strong predictor of lake thermal habitat. Thermal Habitat Volume with the preferred thermal range of 46.4 to 53.6 Deg F was the best predictor of yield or potential harvest (for lake trout) compared to the thermal habitat area, lake area, lake volume, or other indices of thermal habitat variability (Christie and Regier 1988[12]).

6.7.2 ERDC, East Branch Clarion River Lake and Downstream Temperature Model (CE-QUAL-W2)

The Corps' Engineering Research and Development Center (ERDC) located in Vicksburg, Mississippi, was tasked with modeling the temperature changes in East Branch Lake and the East Branch Clarion and Clarion Rivers downstream for each of the four alternative interim operating pools, 1650, 1640, 1630 and 1610. The model study was necessary to help determine temperature-related impacts that the alternative interim pools could have on the cold and cool water fisheries located both within the lake and downstream. The model used for this study was CE-QUAL-W2 (W2) Version 3.6, which is a two-dimensional (laterally-averaged) hydrodynamic and water quality model for simulating surface water systems, including rivers, lakes, reservoirs, and estuaries. This model has been successfully applied to over 200 different systems throughout the U.S. and abroad.

For this study, 69 miles of river downstream of East Branch Dam were modeled including the East Branch Clarion River downstream of the dam and the Clarion River downstream to river mile 40. The primary focus of the study was on temperature and flow/stage calibration/ verification for the entire system. Once the system was calibrated and verified, alternative runs were made using initial and boundary conditions from the calibration (2007, an average to wet water year) and verification (1991, a dry water year) runs with new reservoir releases. A total of five alternative runs were made for each year and included:

- No modifications with water surface elevation (WSEL) at 1670
- Alternative 1 with WSEL Elevation 1650
- Alternative 2 with WSEL at 1640
- Alternative 3 with WSEL at 1630
- Alternative 4 with WSEL at 1610

For additional detail on W2 see **APPENDIX C**

6.7.3 Lake Fishery Impacts, Average and Drought Condition, Alternatives 1-4

The primary products of ERDC's model are simulated lake and downstream water temperatures for the months of April through October for all alternatives including the authorized water control plan (1670). The six month period from April through October represents the worst case warm weather stratification period. The period between November

11 O'Connor, D.V., Rottiers, D.V., and Berlin, W.H. 1981. Food consumption, growth rate, conversion efficiency, and proximate composition of yearling lake trout. Great Lakes Fish. Lab. Ann Arbour, Michigan, Admin. Rep. No. 81-5.

12 Christie, G. C., and Regier, H.A. 1988. Measures of optimal thermal habitat and their relationship to yields for four commercial fish species. Can. J. Fish. Aquat. Sci. 45: 301-314.

and March is not critical since the entire water column in the reservoir normally remains below 60 Degrees F during this time. ERDC used the alternative results from the CE-QUAL-W2 model to calculate the volume of water less than 60 Degrees F and 77 Degrees F as monthly values (30 days) for the simulation period of the average and drought years. For more detail see **APPENDIX C**. **TABLE 9** shown below shows the percent loss of cold and cool water THV for average and drought conditions by alternative.

As noted in the table, there is a general increase in the amount of THV lost as the alternative pools become progressively lower. Generally, this loss worsens during drought conditions for most months and alternatives. Interestingly, the table shows that for every alternative during the months of September and October, the percent loss of THV is actually worse for average than for drought conditions for both cold and cool water habitat. When the percent loss reaches 100 percent, all low flow augmentation water has been expended and the pool is operated as run-of-river, i.e., water temperature of the outflow equals inflow.

The table clearly shows that the 1650 pool causes the least percent loss of THV of all the alternatives. Even with a loss of 57 percent of the habitat during average conditions in October, sufficient habitat would remain in the lake to preserve the cold and cool water fisheries. For the 1640, 1630 and 1610 pools (Alternatives 2, 3 and 4, respectively) the cold and cool water fisheries would be lost under average conditions. This would be the case even for drought conditions, although the table shows that there would be a smaller percent of THV lost. The reasoning for this is as follows: Should a drought occur a year after the implementation of either Alternatives 2, 3 or 4, the cold and cool water fisheries would have already been severely impacted during the previous year by the loss of 95 to 100 percent of the cool and cold water THV in September and October under average conditions as the table shows.

TABLE 9- East Branch Lake - Percent Loss of Cold Water and Cool Water Thermal Habitat Volume by Alternative, for Average and Drought Conditions

Month 30-day Average	Cold Water Fishery Less Than 60 Degrees F								Coolwater Fishery Less Than 77 Degrees F							
	1650		1640		1630		1610		1650		1640		1630		1610	
	Ave.	Drght.	Ave.	Drght.	Ave.	Drght.	Ave.	Drght.	Ave.	Drght.	Ave.	Drght.	Ave.	Drght.	Ave.	Drght.
April	13	22	26	32	37	45	72	65	13	21	26	32	37	45	72	65
May	17	21	31	33	42	48	40	72	13	22	27	33	40	46	53	68
June	17	22	29	31	37	47	51	73	16	20	30	34	44	47	54	70
July	12	19	21	30	37	47	51	80	22	25	37	35	53	52	62	79
August	7	17	30	33	59	54	66	86	28	26	49	41	69	57	73	82
September	45	20	73	37	100	63	100	98	45	32	73	47	100	67	100	98
October	57	38	95	59	100	85	100	100	57	38	95	59	100	85	100	100

6.8 Downstream Fishery Impacts, Average and Drought Conditions, Alternatives 1-4

6.8.1 In-stream Flow Study by PAF&BC

The Pennsylvania Fish and Boat Commission agreed to help the District determine stream impacts that could be caused by five alternative interim operating plans and compared the impacts of these plans to the normal operation of the reservoir. A report prepared by the Commission in August 2008 is attached to this EA as **APPENDIX A**. This study utilized brown trout as the species of primary biological and recreational importance in the Clarion River that would be affected by various releases associated with interim operating pools with a summer conservation pool elevation of 1650 (the current operation pool), elevation 1640, 1630 and 1610. The study used the normal pool operation (summer pool elevation 1670) as the benchmark to compare changes in habitat within the Clarion River for both average and drought conditions. The model correlates usable trout habitat to flow and used median monthly or daily flows to determine usable habitat for each month and season as well as annually. Data for average conditions extended over a 30 year period from 1970 to 1999, and drought flows were the actual daily flows from May 1991 to April 1992. This analysis was based upon flow data and not temperature. A full analysis of impacts must correlate these two factors.

For additional detail see **APPENDIX A**.

6.8.2 PAF&BC Model Results

Two primary factors impact the downstream fishery: habitat availability and water temperature. The PA Fish and Boat Commission analyzed the impacts of changing flows on in-stream habitat downstream of the dam. The results of this study indicate that during normal years at pool elevation 1650 the amount of brown trout habitat provided is equal to the amount of brown trout habitat provided at 1670. The 1670 traditional operating scenario served as the standard for comparison in their analysis and provided more usable habitat in drought years, even though habitat was found to be 24.91% (range: -50.88% to +0.46%) less than same scenario in a normal flow year. The 1650 pool was the best of the interim scenarios evaluated, but showed a troublesome 49.71% decline in November habitat during drought conditions (compared to the 1670 pool) when the system literally ran out of stored water. Based upon habitat availability, this condition (during a drought in November) would create a habitat bottleneck that would limit trout populations to an unknown degree.

The PAF&BC model and report does not address water temperature changes. Except for November, under the interim operating schedule, the District will maintain downstream water temperature criteria for the 1650 alternative, even during a drought. During this one month time period in November, when no augmentation flow is available from East Branch Lake, water temperatures should nevertheless be sufficiently cold at this time of year to maintain the cold water fishery in the East Branch and Clarion Rivers. Pool elevations 1640, 1630 and 1610 fared progressively worse in drought years when the fall habitat bottleneck extended progressively earlier to August under the 1610 scenario when stored water was exhausted. (See **APPENDIX A** for more detail.)

The PAF&BC further documented that under drought conditions, the major differences among the 1640, 1630 and 1610 pools (Alternatives 2, 3 and 4, respectively) occur during a four-month period in the late summer/fall months of August, September, October and November. Because of the lack of augmentation flows, the habitat loss during September ranges from -15.43% for 1640, to -70.08 % for 1630 and -79.86% for 1610. For the months of October and November, the habitat losses are identical for all three alternatives because the maximum winter pool level of 1610 is already reached during a drought with no low flow augmentation. In October, the reduction is 73.81% and for November the reduction is 54.09%. For Alternative 4, which keeps a pool at 1610 year around, the habitat is further reduced downstream by 71.64% in August. Again, this severe reduction in habitat is caused by lack of available augmentation flows. In early summer (June and July) and again in winter (December, January and February), there is no habitat reduction for any of the alternatives. In the spring when water would normally be stored, it is released to maintain the lower pools. Under these conditions, habitat actually increases between March and May. The summer loses are not offset by these gains.

6.8.3 ERDC – Downstream Temperature Model Results

ERDC used the CE-QUAL-W2 model to predict what stream temperatures would be at Johnsonburg for Alternatives 1-4. The temperature data was correlated with the PAF&BC's flow data to determine the severity of the impacts to the brown trout fishery at Johnsonburg. The limiting temperature used to determine impacts on the coldwater fishery was 77 Degrees F (25 Degrees Celsius), which is the maximum survival temperature for brown trout. **TABLE 10,** below, shows time periods when downstream brown trout habitat is flow limited and water temperature exceeds brown trout survival criteria for both average and drought conditions. The model was run using only the upper gates in the summer, using the 1620 gate until it runs out of water and then using the new intake extension at 1578.5. **NOTE**: *This model did not include blending from multiple intakes, which skews the results making the impacts appear to be worse than they actually would be.* The District can and will blend water from the warmer surface and colder bottom to meet downstream temperature criteria (below 60 degrees F) through the use of the intake extension that was installed in October 2008, expressly to control water temperatures. The table below shows when blending is available to ensure that the downstream temperature criterion for brown trout is not exceeded.

TABLE 10 – Time Periods When Downstream Brown Trout Habitat is Flow-Limited and Water Temperatures Exceed Survival Criteria (77 Degrees F) for All Alternatives at Johnsonburg, Average and Drought Conditions

	Average Conditions		**Drought Conditions**	
	# Days Habitat is Flow Limited, No Low Flow Augmentation* (Dates)	**# Days Water Temp Exceeds Survival Criteria per ERDC Model Results (Dates) **** ________ **Days Can't Blend (Dates)**	**# Days Habitat is Flow Limited, No Low Flow Augmentation* (Dates)**	**# Days Water Temp Exceeds Survival Criteria per ERDC Model Results (Dates) **** ________ **Days Can't Blend (Dates)**
1670	0	0 ________ 0	0	0 ________ 0
Alternative 1 - 1650	0	3 (7/30, 7/31, 8/04) ________ 0	30 (11/2-12/1)	2 (8/30-31) ________ 30 (11/2-12/1)
Alternative 2 - 1640	0	23 (6/4, 6/20, 6/27, 6/30, 7/10, 7/12, 7/27- 8/7, 8/13, 8/18, 8/31, 9/6, 9/8) ________ 0	74 (9/20-12/1)	1 (7/23) ________ 74 9/20/12/1
Alternative 3- 1630	26 (10/20-11/15)	106 (25 May-8 Sep) ________ 26 (10/20-11/15)	88 (9/5-12/1)	2 (7/22-23) ________ 88 (9/5-12/1)
Alternative 4 -1610	87 (8/20-11/15)	106 (4/25-9/8) ________ 87 (8/20-11/15)***	119 (8/5-12/1)	1 (7/23) ________ 119 (8/5-12/1)

* From PAF&BC in-stream flow study, ** ERDC CE-QUAL-W2, Water Temperature Model. *** ***NOTE***: *There are only 19 days (Between 8/20 and 9/8) when blending is not possible and when temperatures exceed the 77 Degree F criteria. The impacts caused by this combination would be severe.*

TABLE 10 above shows that for Alternative 1650 there are three days (July 30, 31 and August 4) when the ERDC model predicts that water temperatures under average conditions exceed 77 Degrees F. However, the District will be able to blend colder water in its releases to preserve cold downstream temperatures. For drought conditions at 1650, there will be a one month period when flow is limited (no augmentation water between 11/2 and 12/1), but only two days (8/30-31) where the ERDC model predicts temperatures will exceed 77 degrees. During August, there will be sufficient cold water for blending to eliminate this temperature problem. During the time period when we cannot blend (11/2 to 12/1), the air temperature will be cold enough to maintain water temperatures below 77 Degrees F. Thus, for Alternative 1, the remaining stream habitat that would occur during a drought between November and December will be cold so the cold water fishery would survive, but probably with a lower population. This would not be considered a significant adverse impact.

For Alternative 2, the ERDC model predicts that for 23 days between June and September, water temperatures would exceed 77 Degrees F for average conditions and only one day (7/23) during a drought. For both periods, the District will be able to blend discharge water to maintain temperatures below 77 Degrees F. For average conditions the habitat would not be flow limited. Under drought conditions, the habitat would be flow limited for 74 days between 9/20 and 12/1, but the temperature will be below the 77 Degree F criteria.

For Alternative 3, river flow would be limited for both average and drought conditions for 26 days and 88 days respectively, but during these periods the temperatures would not exceed criteria. For this alternative, the river and brown trout community would be adversely affected during a drought by the loss of physical habitat, as predicted by the PAF&BC model, but not by high water temperature.

Alternative 4 causes the most severe impacts to the fishery. It shows that for average conditions, river flow would be limited for 87 days between 8/20 and 11/15; the river temperature is exceeded for 106 days between 4/25 and 9/8. It is under this alternative that the two primary factors limiting the brown trout fishery coincide. **TABLE 10** shows that under Alternative 4 the flow is limited **and** the temperature is above 77 Degrees F for a 19 day period between 8/20 and 9/8. The combination of lack of flow and high temperatures for this 19 day period would effectively eliminate the cold water fishery in the Clarion River at Johnsonburg. Trout would likely have to be restocked in this portion of the river in the spring when temperatures and flows are not an issue. According to the ERDC model, under drought conditions the river would not be temperature limited.

NOTE*:* *The operation of East Branch Lake throughout a given year is inherently complex. Intuitively it would appear logical that there should be more temperature limiting days (< 77 Degrees F) during a drought when it is hot and dry than during average conditions. ERDC's temperature model shows the opposite to be true for the drought that occurred in 1991 compared to temperature data for 2007, which were used to calibrate the model. In 1991 water volumes less than 60 Degrees F in the lake were markedly greater during April* *through July than during 2007 - even though there was a drought later in the summer and fall in 1991. This would mean that a larger volume of colder water would have been stored in 1991 than in 2007. From August through October, lake volumes were greater in 2007 than in 1991, which is what you would expect because during the 1991 drought the District was releasing more low flow augmentation water to meet downstream requirements. The water released would have been colder than normal because it would have come from the bottom of the lake. Moreover, during the 1991 drought, the District did not run out of augmentation water, even during the worst of the drought. These unusual conditions likely influenced the model output.*

In summary, **TABLE 10** shows that except for Alternative 4 under average conditions, the habitat within the Clarion River would only be flow limited during periods when low flow augmentation is not available; temperatures would not be a factor in brown trout survival. According to the PAF&BC's model study, Alternative 1 at 1650 will not affect the downstream fishery during average conditions. This was confirmed by the Corps' temperature model study which showed that under average conditions at river mile 36 on the Clarion River there is negligible impact to water temperature for all alternatives. During drought conditions, habitat availability for the 1650 alternative would be impacted for one month during November when there is no low flow augmentation water available from East Branch Lake. During this period brown trout are spawning. However, both PAF&BC and District fishery biologists consider that this one month impact to the brown trout fishery during November to be moderate, since water temperatures will be low. Numbers of fish may be reduced, but the fishery would survive.

For the other alternatives (1640, 1630 and 1610) during drought conditions, impacts to the downstream fishery at Johnsonburg would be severe due primarily to habitat loss as predicted by the PAF&BC model.

The ERDC model demonstrates that as the distance from the dam increases, the influence of releases on downstream water temperature diminishes. Because the greatest impacts would be at Johnsonburg, this EA does not address habitat/water temperature further downstream.

6.9 Impacts to NPDES Permit Holders, Average and Drought Conditions, Alternatives 1-4

TABLE 11 below is based upon information provided by the Pennsylvania Department of Environmental Protection. The left hand column shows the existing NPDES permit holders downstream of East Branch Dam and the second column shows the minimum flows (cubic feet per second, cfs) required in the Clarion River, as measured at Johnsonburg, to meet their permitted effluent criteria. The remaining columns show the number of days and time of year for each alternative interim operating pool during average and drought when the permit holders would be out of compliance due to lack of sufficient river flow.

This table shows that under average conditions for every alternative, all of the NPDES permit holders would meet their discharge requirements. Under drought conditions, there would be sufficient river flow for all of the NPDES permit holders under Alternative 1. As would be expected, the table shows a gradual increase in the number of days that the Johnsonburg sewage treatment plant, Ridgway sewage treatment plant and Pennsylvania American Water Company's discharges would exceed their permit criteria for subsequent alternatives. This occurs due to a longer loss of low flow augmentation water for progressively lower alternative pools. This ultimately means that under drought conditions, if discharges continue unabated, water quality in the Clarion would be seriously degraded. **TABLE 11** shows, for example, that the Domtar Mill would be in violation for the month of November under Alternative 2 and up to 75 days for Alternative 4. What the impact of the violations would be on each permit holder would be a PADEP decision.

The table also clearly shows the influence of tributary inflow downstream of East Branch Dam. The greater the basin area that contributes to Clarion River flow the less flow is needed at Johnsonburg for downstream NPDES permit holders to meet their effluent criteria. That is why there is a decrease in the number of days that permit holders would be out of compliance during drought conditions as one progresses downstream.

TABLE 11 - Days and Time of Year When NPDES Permit Holders Would Be Out of Compliance, Alternatives 1, 2, 3, 4 and "No Action"

		Number of Days When The Flow At Johnsonburg Is Less Than Minimum NPDES Flow Requirements (See Note)					
Permit Holder/River Mile	Minimum Flow at Johnsonburg To Meet NPDES Discharge Requirements	No Action, Option 1 - 1610 Pool with 1610 Spillway	No Action, Option 2 - Flood Gates Left Open, No Permanent Pool	Alternative 1 – Summer Pool 1650 Winter Pool 1623	Alternative 2 – Summer Pool 1640 Winter Pool 1623	Alternative 3 – Summer Pool at 1630 Winter Pool 1623	Alternative 4 – Summer Pool at 1610 Winter Pool 1610
Domtar Mill IW*/ RM-101	80 cfs	[2]A - 0 [3]D - 75 [15 Sep-30 Nov]	A - 0 D - 200 [20 May-10 Dec]	A - 0 D - 0	A - 0 D – 30 [1-30 Nov]	A - 0 D – 45 [15 Oct-30 Nov]	A - 0 D - 75 [15 Sep-30 Nov]
Johnsonburg STP*/ RM-100	30 cfs	A - 0 D – 60 [15 Sep-15 Nov]	A - 0 D - 175 [1 Jun-25 Nov]	A - 0 D - 0	A - 0 D – 15 [1-15 Nov]	A - 0 D – 30 [15 Oct-15 Nov]	A - 0 D – 60 [15 Sep-15 Nov]
Ridgway STP/ RM-92	30 cfs	A - 0 D – 60 [15 Sep-15 Nov]	A - 0 D - 175 [1 Jun-25 Nov]	A - 0 D - 0	A - 0 D – 15 [1-15 Nov]	NA- 0 D – 30 [15 Oct-15 Nov]	A - 0 D – 60 [15 Sep-15 Nov]
PA American IW/ RM-33	20 cfs	A - 0 D – 55 [15 Sep-10 Nov]	A - 0 D - 160 [10 Jun-20 Nov]	A - 0 D - 0	A - 0 D – 10 [1- 10 Nov]	A - 0 D – 25 [15 Oct-10 Nov]	A - 0 D – 55 [15 Sep-10 Nov]
PA American STP/ RM 32	0 cfs[1]	A - 0 D - 0	A - 0 D - 0	A - 0 D - 0	A - 0 D - 0	A - 0 D - 0	A - 0 D - 0

[1] As long as the pool at Piney Dam exists
[2] A = Average Conditions
[3] D= Drought Conditions
* IW = Industrial Wastewater, STP = Sewage Treatment Plant

NOTE: *In order to meet NPDES pollution standards, significantly less flow is required than for other downstream criteria. A "normal" year will keep the river above Q7-10 flow and within NPDES compliance, even without the lake to provide augmentation.*
(Q7-10 flow is the statistical average minimum flow that occurs for 7 days once in 10 years.)

NOTE ALSO: *If a lower interim operating pool other than Alternative 1 would be implemented at East Branch in the future due to unexpected dam safety concerns, PADEP may re-evaluate effluent standards based upon time of year and amount of time that a given permit holder would be expected to exceed their current NPDES discharge criteria.*

6.10 Socio Economic and Recreation Impacts

6.10.1 Socio Economic and Recreation Impacts, In-Lake and Downstream, Average Conditions – Alternative 1 (1650 Pool)

The alternate summer pool elevation of 1650 under average conditions does impact some recreation activity at East Branch Lake. The lake would not be available for power boating in the late summer and early fall because both the state and Corps' boat launch ramps would not be accessible. In 2008, due to dry conditions that prevailed in the project area, the Corps' ramp went out of service on August 18. The Corps anticipates that in 2009 the launching ramp at the dam will go out of service shortly after Labor Day, September 7. Additionally, some incidental impacts to those businesses such as restaurants, hotels, and others that provide goods and services to recreation enthusiasts in the area are anticipated. However, the 1650 interim operating pool during average conditions would not impact recreation activity downstream of the dam along the Clarion River, or those businesses that utilize the Clarion River as a source to operate since flows, water temperature and water availability would remain at an acceptable level. **TABLE 12** shows that under average conditions, visitor days at East Branch Lake will decline by approximately 3.8 percent (13,800 visitor days). Total recreation and economic benefits are estimated to fall by $831,000 which is less that a 1.0% decline. Background information concerning how these numbers were generated is contained in **APPENDIX D**.

TABLE 12 - Total Lost Recreation and Economic Benefits, Average Precipitation Condition, Reducing Normal Summer Pool Elevation 1670, To Interim Risk Reduction Summer Pool Elevations 1650

	Pool 1670		**Pool 1650**	
Average Precipitation	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**
Total Benefits	361,000	$91,618,000	347,200	$90,787,000
Lost Benefits	0	0	-13,800	-$831,000
% of Lost Benefits	N/A	N/A	-3.8%	-0.9%

6.10.2 Socio Economic and Recreation Impacts, In-Lake and Downstream, Drought Conditions –Alternative 1 (1650 Pool)

Under drought conditions, the recreation and economic impacts of Alternative 1 would be more pronounced. Boat launch ramps would be inaccessible at East Branch Clarion Lake for a longer period of time that would further decrease the visitor days and recreation benefits at the lake. Additionally, under drought conditions, this alternative would impact the flow along the Clarion River downstream of East Branch Dam to a greater extent, thus adversely impacting recreation along the river. During severe droughts under this alternative, river flows along the Clarion River will be reduced, which could impact a number of businesses. Industries such as the Piney Hydro-Electric Plant, Domtar Corporation-Johnsonburg Paper Mill, a few sewage treatment plants, and other businesses could experience some minor effects. However, these impacts, being short term, would not be expected to have any lasting socio-economic impacts, such as business closures or sustained increased unemployment. **TABLE 11** indicates that for drought conditions none of the NPDES permit holders would violate effluent standards.

TABLE 13 below displays that combined visitor days at East Branch Lake and along the Clarion River are estimated to decline by 33,300 under the drought condition, which is a 9.2%

decline. The dollar value of total benefits, including both recreation and economic, are estimated to decline approximately $7.8 million dollars, or approximately 8.6%. Additional information concerning these values is contained in **APPENDIX D**.

TABLE 13 - Total Lost Recreation and Economic Benefits, Drought Condition, Reducing Normal Summer Pool Elevation from Elevation 1670 to 1650

	Pool 1670		**Pool 1650**	
Drought Condition	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**
Total Benefits	361,000	$91,618,000	327,700	$83,729,000
Lost Benefits	0	$0	-33,300	-$7,889,000
% of Lost Benefits	N/A	N/A	-9.2%	-8.6%

6.10.3 Socio Economic and Recreation Impacts, In Lake and Downstream, Average Conditions - Alternatives 2, 3 and 4 (1640, 1630, 1610 Pools, Respectively)

Under the Alternatives 2, 3 and 4 that have lower summer pools of 1640, 1630 and 1610, respectively, recreation impacts within East Branch Clarion Lake would progressively worsen for each lower pool for the average condition. Under average conditions for both alternate summer pools 1640 and 1630, the District estimates that flows along the Clarion River would not be impacted to a degree large enough to impact recreation activity along the river. However, for Alternative 4 with a summer pool at elevation 1610, reduced flows along the river are anticipated to impact recreation along the Clarion River. Additionally, there would continue to be greater incidental impacts to those businesses such as restaurants, hotels, and others that provide goods and services to recreation enthusiasts in the area as the pool levels are reduced. Businesses along the Clarion River that use the river as a source to operate would continue be unaffected at the 1640 alternate pool level, but begin to show minor impacts at the 1630 level, and to be impacted to a much greater degree at the 1610 level as flows, water temperature, and water availability are impacted to greater degree. This is shown in **TABLE 14** that compares the total visitor days and benefits realized at the normal summer pool elevation of 1670, the interim risk reduction pool elevation of 1650, and the alternate risk reduction levels of 1650, 1640, and 1610. At pool elevation 1640, visitor days would decline by 8.1%, while dollar benefits would decrease by 1.9%. A 14.3% decrease in visitor days and 9.4% drop in dollar benefits would be experienced at the 1630 pool elevation. Finally, a 21.3% and 41.9% decline in visitor days and dollar benefits respectively would occur at the 1610 pool elevation. Detailed information concerning these numbers can be obtained in **APPENDIX D**.

TABLE 14 - Total & Lost Recreation and Economic Benefits, Average Conditions, Reducing Normal Summer Pool Elevation 1670, To Elevations 1650, 1640, 1630, & 1610

Average Precipitation	**Pool 1670**		**Pool 1650**		**Pool 1640**		**Pool 1630**		**Pool 1610**	
	Visitor Days	**Dollar Value**	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**
Total Benefits	361,000	$91,618,000	347,200	$90,787,000	331,600	$89,838,000	309,500	$82,990,000	284,100	$53,227,000
Lost Benefits	0	0	-13,800	-$831,000	-29,400	-$1,780,000	-51,500	-$8,628,000	-76,900	-$38,391,000
% of Lost Benefits	N/A	N/A	-3.8%	-0.9%	-8.1%	-1.9%	-14.3%	-9.4%	-21.3%	-41.9%

6.10.4 Socio Economic and Recreation Impacts, In Lake and Downstream, Drought Conditions –Alternatives 2, 3, and 4 (1640, 1630, 1610 Pools, Respectively)

Under the drought condition, recreation visitor days and dollar benefits would continue to decline at both East Branch Lake and along the Clarion River under Alternatives 2, 3 and 4. Recreation related businesses and those businesses utilizing the Clarion River as a source to operate would experience a continued decline in benefits in conjunction with drops in pool elevations. At Alternative 2, with a summer pool level at 1640 under a drought condition, visitor days along the lake and river would decline by 13.2% while dollar benefits would decline by 17.9%. During drought conditions at pool level 1630, annual visitor days would decline by 23.5% and dollar benefits would fall by 24.9%. At the lowest considered pool level of 1610, visitor days and dollar benefits would significantly decline by 39.6% and 54.3% respectively. Information concerning the actual number of visitor days and dollar value impacted can be found in **TABLE 15**. Additional information on these numbers can be found in **APPENDIX D**.

The alternate risk reduction measures of lowering the normal summer pool from 1670 to 1650, 1640, 1630 and 1610 are temporary measures to lower the risk of failure until a permanent solution is implemented. The interim risk reduction of pool elevation 1650 was ultimately chosen and implemented in February 2008. Since each of the alternate risk reduction measures are temporary solutions, until a permanent fix is implemented, it is not anticipated that any of these measures would have a permanent socio-economic impact on the surrounding areas. Thus, no permanent impacts to population, employment, income, or other relevant measures would be anticipated.

TABLE 15 - Total & Lost Recreation and Economic Benefits, Drought Condition, Reducing Normal Summer Pool Elevation 1670 To Alternate Summer Pool Elevations 1650, 1640, 1630, & 1610

Drought Condition	**Pool 1670**		**Pool 1650**		**Pool 1640**		**Pool 1630**		**Pool 1610**	
	Visitor Days	**Dollar Value**	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**	**Visitor Days**	**Dollar Value**
Total Benefits	361,000	$91,618,000	327,700	$83,729,000	313,300	$75,220,000	276,100	$68,767,000	218,100	$41,867,000
Lost Benefits	0	$0	-33,300	-$7,889,000	-47,700	-$16,398,000	-84,900	-$22,851,000	-142,900	-$49,751,000
% of Lost Benefits	N/A	N/A	-9.2%	-8.6%	-13.2%	-17.9%	-23.5%	-24.9%	-39.6%	-54.3%

6.11 Wild and Scenic River Impacts

6.11.1 Wild and Scenic River System Impacts, Average and Drought Conditions - 1650 Pool

Under average conditions, the aesthetic character of the Federally designated Wild and Scenic reach of the Clarion River will not change because downstream flow augmentation for Alternative 1 (1650) will be maintained as under the original authorized Water Control Plan.

Although flows in the Clarion River will be lower during a drought, the water quality will still be adequate under Alternative 1 to preserve the existing cold water fishery in the Clarion River except for a one month period during November. For this 30-day period, the fishery would be moderately stressed by reduced flow. Due to the time of year, the water temperatures will remain sufficiently cold during this low flow period and water quality will remain sufficiently high to allow cold water species to survive. Boating by small watercraft, such as rubber rafts, canoes and kayaks may be limited in certain reaches; however, there is little boating in November. Since water quality will generally remain good under the 1650 operating scheme, the overall aesthetic character of the river will remain largely unaffected. Given that November is two months past the main recreation season, Alternative 1, even under drought conditions, would not cause significant, long term impacts to either the recreational or scenic portions of the designated 51-mile Wild and Scenic River reach.

6.11.2 Wild and Scenic River System Impact, Average and Drought Conditions - 1640, 1630, 1610 Pools

Under the remaining alternatives, the impacts to the Wild and Scenic portions of the river would gradually worsen as the pool is lowered from 1640 to 1610. As shown on **TABLE 10,** for Alternative 3, river habitat would be flow limited for 26 days between late October through mid-November during average conditions and for 88 days between early September and early December under a drought. For Alternative 4, the river would be flow limited for 87 days between mid-August and mid-November during average conditions and for 119 days between early August and early December during a drought. All of the river flow reductions would occur late in the recreation season for all alternatives. Alternative 2 would not significantly impact the river from a Wild and Scenic perspective. The impacts of implementing Alternatives 3 and especially 4 would be significant. Under these alternatives, downstream water quality would suffer which is the primary reason why the Clarion was rejected as a Wild and Scenic River when originally considered in 1969. Consequently, if either Alternative 3 or 4 were made permanent, it would likely affect the Wild and Scenic River designation of the Clarion River, depending upon the extent of water quality degradation. However, assuming that in a few years the dam will be repaired and returned to the authorized water control plan, the impacts would ultimately be temporary for all of the alternatives. Thus, the impacts, even from Alternative 4, if implemented on a temporary basis, would likely not result in a repeal of the Wild and Scenic River designation.

6.12 Wetland Impacts

6.12.1 In-Lake and Downstream Wetland Impacts Average and Drought Conditions, Alternatives 1-4

Since the lake provides the hydrology for existing shoreline wetland, impacts of dropping the pool elevation at least 20 feet during the spring / summer growing season will be severe. The existing wetlands will be stranded high above the new lake elevation without a hydrology source. Wooded wetlands will not be impacted since they can survive a temporary loss of hydrology, but emergent, scrub/shrub and aquatic beds will be desiccated and lost. However, new shoreline wetlands will eventually develop in the band located between approximately 6 feet below to 10 feet above the new 1650 summer pool elevation (1645 – 1660). If slopes in headwater embayments are gentler with the lower pool elevation, which would be more conducive to colonization, acres of wetland area may actually increase. These new wetlands will be transitional, and once we return to normal reservoir operations, the original wetlands would be expected to re-vegetate within a few seasons. Thus, there will be no permanent net loss of wetlands attributable to the 1650 interim pool under either drought or average conditions.

The loss of wetlands for the remaining alternative interim operating pools would be similar in that existing wetlands would be lost and replaced with new wetlands that would develop at a lower elevation. The amount of wetland acreage that temporarily develops would be dependent upon lake bank slopes that are present at the lower pools. Once the temporary pools are replaced with the normal pool after the dam is repaired, the original wetlands present at the normal 1670 pool would re-establish.

Under average conditions with the 1650 interim summer pool elevation, there will be no impact to existing wetlands located downstream of the dam on the East Branch of the Clarion and the Clarion Rivers. This is because the authorized low flow augmentation schedule will not be interrupted and downstream wetland hydrology will not change. As can be seen in **TABLE 16** below, wetlands would be affected by Alternative 4 under average conditions and Alternatives 2, 3 and 4 under drought conditions during the summer growing season.

The table shows for Alternative 2 there will be no flow augmentation for 74 days between September 20 and December 1. The impacts to wetlands would be minimal since the lack of flow occurs near the end of the growing season. The same is true for Alternative 3. For Alternative 4, there will be wetland impacts during both average and drought conditions because the lack of augmented water begins in August during the latter end of the growing season. The wetlands affected by the lack of flow would be desiccated and lost. These wetlands would likely re-establish during the next growing season, but their quality may become degraded due to late growing season desiccation. (The duration of the dry period has a greater impact on wetlands than the season of the dry period.) Ultimately, for all of these alternatives, there will be no net loss of wetlands because once the dam is repaired and normal downstream flow augmentation is resumed the original wetland areas would re-establish.

TABLE 16 – Number of Days with No Low Flow Augmentation to Support Downstream Wetlands

Alternatives	**Number of Days No Low Flow Augmentation.** ***Note*****:** *Growing Season Extends from April Through September*	
	Average Conditions	Drought Conditions
1670	0 Days	0 Days
Alternative 1 – 1650	0 Days	30 Days (11/12-12-1)
Alternative 2 – 1640	0 Days	74 days (9/20-12-1)
Alternative 3 – 1630	26 Days (10/20-11/15)	88 Days (9/5-12/1)
Alternative 4 - 1610	87 Days (8/20-11/15)	119 Days (8/5-12-1)

6.13 Endangered Species Impacts, Average and Drought Conditions, Alternatives 1-4

According to the U.S. Fish and Wildlife Service, no Federally-listed threatened or endangered species or their habitats are known to occur in the project area. Thus, neither the implemented 1650 interim pool, nor the 1620, 1630 or 1610 pools would affect Federally-listed species. Four rare or protected state-listed species are found in the project area: the mountain brook lamprey, gilt darter, river redhorse and timber rattlesnake. According to the Pennsylvania Fish Commission, the four aquatic species are found in the Clarion River. As noted in their letter contained in **APPENDIX C**, the Commission does not anticipate any impacts to the aquatic species as long as sediment and erosion controls are implemented during construction. Timber rattlesnake habitat will not be affected by the implementation of any of the alternative interim pools or by the repair Alternatives A or B. Should the dam be replaced as described in Alternative C, the area required for borrow activity and dam construction would have to be defined and evaluated at a future date to determine if critical rattlesnake habitat is present.

6.14 Impact Summary Table

TABLE 17 below summarizes the impacts of all of the interim alternative operating pools considered and discussed in detail above. This table also includes the two "No Action" Options for comparison purposes.

The discussion of impacts of the various repair options is presented after **TABLE 17**.

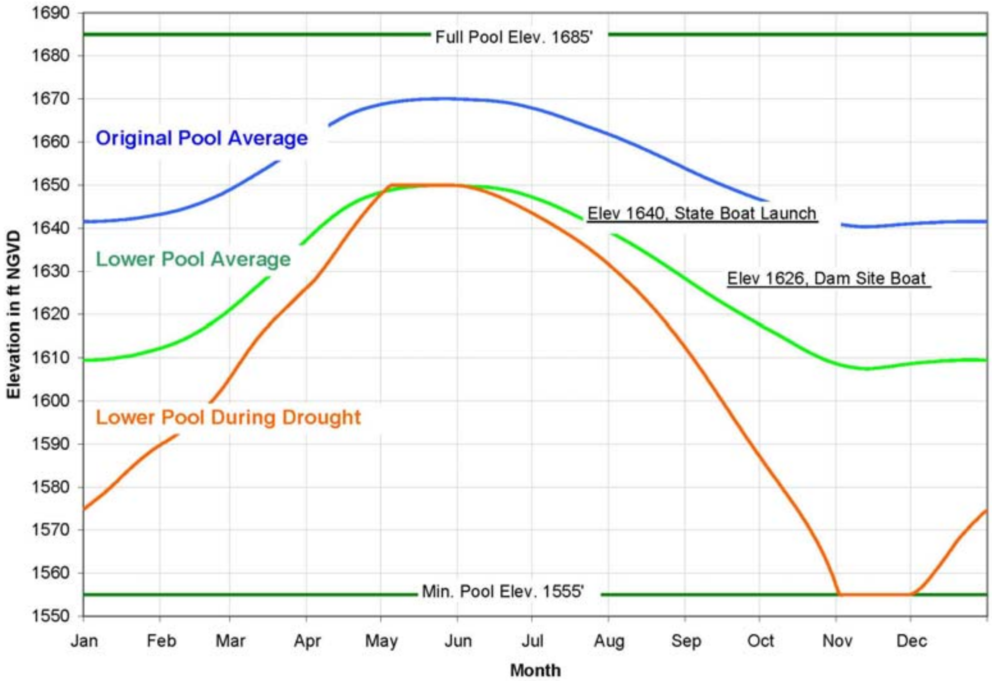
TABLE 17 - East Branch Dam – Summary of Interim Risk Reduction Measure Impacts, Lake and Downstream

Environmental Parameters	No Action - Option 1, Permanently lower Pool and Spillway to 1610	No Action - Option 2, Permanently Raise Flood Gates, No Pool.	Alternative 1 – 1650 Operating Pool	Alternative 2 – 1640 Operating Pool	Alt. 3 1630- Operating -Pool	Alt. 4 1610-Operating Pool -
Public Health and Safety	Ave. Conditions: Dam can operate safely but there would be a loss of 85 percent of flood control benefits due to lack of storage capacity. Dry Conditions: Dam can operate safely but there would be a loss of 73 percent of flood control benefits due to lack of storage capacity.	Ave. Conditions: Dam can operate safely. Loss of 91 percent of flood control benefits. Dry Conditions: Dam can operate safely	Ave. Conditions: Dam can operate safely Dry Conditions: Dam can operate safely	Ave. Conditions: Dam can operate safely Dry Conditions: Dam can operate safely	Ave. Conditions: Dam can operate safely Dry Conditions: Dam can operate safely	Ave. Conditions: Dam can operate safely Dry Conditions: Dam can operate safely
Lake Water Quality	Ave. Conditions: Severe effects Dry Conditions: Severe Effects	Ave. Conditions: - No Lake Dry Conditions: - No Lake	Ave. Conditions: No significant effects Dry Conditions: Moderate effects. New intake will help preserve water temperatures in lake.	Ave. Conditions: Moderate effects Dry Conditions: Severe Effects.	Ave. Conditions: Severe effects Dry Conditions: Severe Effects.	Ave. Conditions: Severe effects Dry Conditions: Severe Effects
Downstream Water Quality	Ave. Conditions: Severe effects. No low flow augmentation for 2.5 months between late August and mid Nov. Dry Conditions: Severe effects. No low flow augmentation for 4 months from August through November.	Ave. Conditions: Severe effects. No low flow augmentation at all. Dry Conditions: Severe effects. No low flow augmentation at all.	Ave. Conditions: No Effects Dry Conditions: Moderate effects. No low flow augmentation for 30 days in Nov.	Ave. Conditions: Moderate effects Dry Conditions: Severe effects. No low flow augmentation for 74 days between Sept. and Dec	Ave. Conditions: Moderate effects. No low flow augmentation for 26 days between Oct and Nov Dry Conditions: Severe Effects. No low flow augmentation for 88 days between Sept. and Dec.	Ave. Conditions: Severe effects. No low flow augmentation for 87 days between Aug. and Nov. Dry Conditions: Severe effects. No low flow augmentation for 119 days between Aug. and Dec.
Lake Fishery	Ave. Conditions: Severe impact. 100% cold water THV lost. Dry Conditions: Severe. 100% loss of cold water THV	Ave. Conditions: Severe effect. Lake fishery permanently lost. Dry Conditions: Severe effect. Lake fishery permanently lost.	Ave. Conditions: Moderate effect. 57% Loss of Thermal Habitat Volume (THV) cold water habitat (< 60 Deg. F) Sufficient THV remains to preserve lake cold water fishery Dry Conditions: Greater % loss of THV under average conditions	Ave. Conditions: Severe impact 95% cold water THV lost. Dry Conditions: Greater % loss of THV under average conditions	Ave. Conditions: Severe impact. 100% cold water THV lost. Dry Conditions: Greater % loss of THV under average conditions	Ave. Conditions: Severe impact. 100% cold water THV lost. Dry Conditions: Severe. 100% loss of cold water THV
Downstream Fishery	Ave. Conditions: Severe effect. Loss of low flow augmentation for 2.5 between late Aug and mid Nov. Dry Conditions: Severe effects. Loss of low flow augmentation for 4 months August through November	Ave. Conditions: Severe effect. Total loss of cold water fishery due to lack of low flow augmentation. Severe impacts to downstream cool and warm water fisheries during high basin precipitation events that will wash accumulated lake bottom	Ave. Conditions: No effect Dry Conditions: Moderate effect. Loss of low flow augmentation for 30 days in Nov.	Ave. Conditions: No effect Dry Conditions: Severe effect. Loss of flow augmentation for 74 days	Ave. Conditions: Moderate effect. Loss of low flow augmentation for 26 days between Oct and Nov Dry Conditions: Severe effects. Loss of low flow augmentation for 88 days between Sep. and Dec.	Ave. Conditions: Severe effect. Loss of low flow augmentation for 87 days between Aug and Nov. Dry Conditions: Severe effects. Loss of low flow augmentation for 119 days between Aug. and Dec.,

Environmental Parameters	No Action - Option 1, Permanently lower Pool and Spillway to 1610	No Action - Option 2, Permanently Raise Flood Gates, No Pool.	Alternative 1 – 1650 Operating Pool	Alternative 2 – 1640 Operating Pool	Alt. 3 1630- Operating -Pool	Alt. 4 1610-Operating Pool -
		sediment downstream. Dry Conditions: Severe effect. Total loss of cold water fishery				
NPDES Permit Holders	Ave. Conditions: No effects Dry Conditions: Severe effects. Domtar affected for 75 days, Johnsonburg and Ridgway STP's affected for 60 days and PA American affected 55 days	Ave. Conditions: No effects Dry Conditions: Severe effects. Domtar affected for 200 days, Johnsonburg and Ridgway STP's affected for 175 days and PA American affected 160 days	Ave. Conditions: No effects Dry Conditions: No effects	Ave. Conditions: No effects Dry Conditions: Significant effects. Domtar affected for 30 days, Johnsonburg and Ridgway STP's affected for 15 days and PA American affected 15 days	Ave. Conditions: No effects Dry Conditions: Significant effects. Domtar affected for 45 days, Johnsonburg and Ridgway STP's affected for 30 days and PA American affected 25 days	Ave. Conditions: No effects Dry Conditions: Severe effects. Domtar affected for 75 days, Johnsonburg and Ridgway STP's affected for 60 days and PA American affected 55 days
Socio-Economics and Recreation	Ave. Conditions: Severe effect. 21.3% loss of visitor days and 41.9% loss of total economic benefits Total loss of boat ramp access for 12 months Dry Conditions: Severe effect 39.6% loss of visitor days and 54.3% loss of total economic benefits Total loss of boat ramp access for 12 months	Ave. Conditions: Severe effect. 20.1% loss of visitor days and 53.2% loss of total economic benefits Dry Conditions: Severe effect 52.8% loss of visitor days and 64.7% loss of total economic benefits	Ave. Conditions: Minor effect. 3.8% loss of visitor days and 0.9% loss of total economic benefits Dry Conditions: Moderate effect: 9.2% loss of visitor days and 8.6% loss of total economic benefits	Ave. Conditions: Minor effect. 8.1% loss of visitor days and 1.9% loss of total economic benefits Dry Conditions: Moderate effect: 13.2% loss of visitor days and 17.9% loss of total economic benefits	Ave. Conditions: Moderate effect. 14.3% loss of visitor days and 9.4% loss of total economic benefits Dry Conditions: Severe effect: 23.5% loss of visitor days and 24.9% loss of total economic benefits	Ave. Conditions: Severe effect. 21.3% loss of visitor days and 41.9% loss of total economic benefits Dry Conditions: Severe effect 39.6% loss of visitor days and 54.3% loss of total economic benefits
Wild and Scenic River Status	Ave. Conditions: Significant effect due to loss of low flow augmentation and reduction in water quality. Dry Conditions: Significant effect due to loss of low flow augmentation and reduction in water quality.	Ave. Conditions: Severe effect due to no low flow augmentation and attendant water quality degradation from industry and acid mine drainage and sediment wash-out from the lake. Dry Conditions: Severe effect due to no low flow augmentation and attendant water quality degradation from industry and acid mine drainage	Ave. Conditions: No effect Dry Conditions: No effect	Ave. Conditions: No effect Dry Conditions: Moderate effect due to loss of low flow augmentation and reduction in water quality	Ave. Conditions: Moderate effect due to loss of low flow augmentation and reduction in water quality Dry Conditions: Significant effect due to loss of low flow augmentation and reduction in water quality	Ave. Conditions: Significant effect due to loss of low flow augmentation and reduction in water quality Dry Conditions: Significant effect due to loss of low flow augmentation and reduction in water quality
Wetlands	Ave. Conditions: Significant effect due to permanent wetland losses Dry Conditions: Significant effect due to permanent wetland losses	Ave. Conditions: Severe: Permanent loss of lake area wetlands Dry Conditions: Severe: Permanent loss of lake area	Ave. Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored Dry Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored	Ave. Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored Dry Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored	Ave. Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored Dry Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored	Ave. Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored Dry Conditions: Minor short term effect. Wetlands lost will re-establish after pool is restored

Environmental Parameters	**No Action - Option 1, Permanently lower Pool and Spillway to 1610**	**No Action - Option 2, Permanently Raise Flood Gates, No Pool.**	**Alternative 1 – 1650 Operating Pool**	**Alternative 2 – 1640 Operating Pool**	**Alt. 3 1630- Operating -Pool**	**Alt. 4 1610-Operating Pool -**
		wetlands				
Endangered Species	Ave. Conditions: Severe effect. Loss of low flow augmentation for 2.5 months between late August and mid November may affect state listed species. Dry Conditions: Severe effects. Loss of low flow augmentation for 4 months from August through November may affect state listed species.	Ave. Conditions: Severe effect. Loss of all low flow augmentation may impact state listed species in the lower Clarion River due to water quality degradation. Dry Conditions: Severe effects. Loss of all low flow augmentation and increased water quality degradation may impact state listed species.	Ave. Conditions: No effect Dry Conditions: No effect	Ave. Conditions: No effect Dry Conditions: Severe effect. Loss of flow augmentation for 74 days	Ave. Conditions: Moderate effect. Loss of low flow augmentation for 26 days between Oct and Nov Dry Conditions: Severe effects. Loss of low flow augmentation for 88 days between Sep. and Dec.	Ave. Conditions: Severe effect. Loss of low flow augmentation for 87 days between Aug and Nov. Dry Conditions: Severe effects. Loss of low flow augmentation for 119 days between Aug. and Dec.,

GRAPH 6 – ALTERNATIVE 1, SHOWING ELEVATION OF BOAT RAMPS WHEN THEY GO OUT OF SERVICE FOR AVERAGE AND DROUGHT CONDTIONS



6.15 Cumulative Impacts of Alternative Plans

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) define cumulative effects as, "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions (40 CFR §1508.7)". Cumulative effects assessments focus upon the beneficial and adverse impacts that past, present and potential future actions could have on the ecosystem and human community being affected by an action.

In simple terms, a cumulative effects analysis considers the impacts of a proposed action in relation to what else is occurring, has occurred, or potentially may occur in a given project area. To keep a cumulative effect analysis meaningful, bounds must be set to establish a reasonable time frame and impact area. For this project, the impact area considered is East Branch Lake and the East Branch Clarion and Clarion Rivers downstream to the head of the Piney Fork Dam slackwater. A rough time frame for future actions would be 20 years from the present.

6.15.1 Past and Present and Future Actions

The cumulative impacts described below would be the combined effect of the past, present and reasonably foreseeable future actions and how they would affect the entire project area defined above. This discussion is necessarily qualitative since future actions are based upon a mixture of professional judgment and common sense rather than on specific quantifiable variables, such as numbers of new recreational cabins to be constructed along the Wild and Scenic reach of the project area.

6.15.2 Cumulative Effects of Proposed Alternatives

Each alternative described within this report, except for "No Action" achieves the desired margin of safety. The description of the effect of past, present and reasonably foreseeable future actions upon seven environmental parameters evaluated in Section 6 are presented below in **TABLE 18** in a tabular summary format to facilitate ease of reading and comparison.

TABLE 18 – Cumulative Effects Assessment

Resource	Past Actions +	Present Actions +	Future Actions =	Cumulative Effects
Public Health and Safety	East Branch Dam was constructed to provide flood protection and low flow augmentation Impact - Positive	Interim operating pool will ensure public safety for residents downstream until the dam is repaired. Impact - Positive	The dam will be repaired to allow the pool to be operated normally Impact – Positive	Public health and safety is preserved Cumulative Effect - Positive
East Branch Water Quality and Lake Fishery	Industrial/municipal discharges were not initially controlled which along with AMD caused severe water quality and aquatic habitat degradation Impact – Negative	AMD treatment is ongoing which greatly improves water quality and allows the lake to sustain a deep coldwater Lake Trout fishery as well as a cool water fishery containing small mouth bass, muskie and walleye. The modification of the control tower in 2008 allows better control of water temperature releases during warmer weather and will preserve the lake trout fishery during the time that the interim pool is in effect. Impact - None	AMD treatment measures will continue. Lake water quality will continue to improve and allow the lake to become a more productive fishery. Impact - Positive	Water quality and lake fishery will continue to improve over time. Cumulative Effect - Positive

East Branch Clarion River and Clarion River Downstream of Dam Water Quality and Fishery	AMD and industrial discharges severely degraded the water quality of the East Branch and Clarion Rivers Impact - Negative	The control tower modification through allows more control of water temperature releases that will help maintain the cold water fishery downstream Impact – None	AMD controls will continue to be implemented. The dam will be repaired and returned to normal operating conditions. NPDES permits will continue to protect the river. TMDL's will be established that will further protect downstream water quality. Impact - Positive	East Branch and Clarion Rivers will continue to support high quality downstream fisheries. Cumulative Effect - Positive
NPDES Permit Holders Downstream	Industrial and municipal discharges were not controlled when East Branch Lake was initially constructed. Impact on Industry - None	State controls were implemented via NPDES permits. The permits control the amount of pollutants that can be discharged from industries and municipalities. The interim operating pool will not affect municipal sewage treatment or water treatment facilities. Impacts – None	The dam will be repaired and returned to normal operating conditions. NPDES permits will continue. Possible restrictions based upon future TMDL's established for the river. Industries and municipalities will continue to work with the state to accommodate restrictions on discharges. Impact - None	Cumulative Effect - None
Recreation Lake	Recreation has been a popular activity especially since the improvements in lake water quality Impact - Positive	The interim pool will temporarily decrease lake recreation by reducing the amount of time that the two boat launching ramps can be used Impact - Negative	The dam will be repaired and lake recreation will return to normal. Impact - Positive	Cumulative Effect - None
Recreation	After AMD treatment was	The interim pool	After the dam is repaired, the	Cumulative Effect - None

Downstream	implemented on tributaries to East Branch Lake, 51 miles of the Clarion River was designated a Wild and Scenic River. The river corridor is a popular destination for fishing, small non-powered water craft (canoes, kayaks, rafts, etc.) swimming, and other river oriented recreation activity. Impact -Positive	operations will not significantly affect downstream recreation. Impact – None	lake will be operated normally. Impact -None	
Wetlands	AMD and industrial pollution may have affected wetland development, but the extent of the negative impact is unknown. Impact - Unknown	Temporary loss of wetlands at higher lake elevations and temporary re-establishment of wetlands at lower pool elevation Impact –Temporary	The pool will eventually be restored to allow normal flow augmentation downstream. Impact - Positive	Cumulative Effect - None
Endangered Species	AMD and industrial pollution eliminated any endangered species present in the Clarion River Impact - Negative	Interim Pool may cause some minor effects during droughts in November due to a reduction in river flow. Impact- Negative	Pool will be returned to normal operating conditions. “Normal” downstream flows restored during drought conditions Any lost habitat will be restored Impact – Positive.	Cumulative Effect - None

7.0 Status of Compliance with Environmental Protection Statutes

TABLE 19 below lists the Federal Statutes with which the Corps of Engineers must comply.

TABLE 19 – Compliance With Federal Statutes

FEDERAL STATUTES	Interim Operating Pool - 1650	Permanent Repair Alternatives
Archeological and Historic Preservation Act as amended, 16 U.S.C. 469, et seq.	FC	FC
Clean Air Act as amended, 42 U.S.C. 7401, et seq.	FC	FC
Clean Water Act (Federal Water Pollution Control Act) as amended, 336 U.S.C. 1251, et seq.	FC	FC
Endangered Species Act as amended, 16 U.S.C. 1531, et seq.	FC	FC
Federal Water Project Recreation Act as amended, 16 U.S.C. 406-1 (12), et seq.	FC	FC
Fish and Wildlife Coordination Act as amended, 16 U.S.C. 661, et seq.	FC	FC
Land and Water Conservation Fund Act as amended, 16 U.S.C. 4601-4601-11, et seq.	FC	FC
National Environmental Policy Act as amended, 42 U.S.C. 4321, et seq.	FC**	FC**
National Historic Preservation Act as amended, 16 U.S.C. 470a, et seq.	FC	FC
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	FC	FC
Rivers and Harbors Act, 91 U.S.C. 122, et seq.	FC	FC
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	FC	FC
Wild and Scenic Rivers Act as amended, 16 U.S.C. 1271, et seq.	FC	FC
EXECUTIVE ORDERS, MEMORANDA, ETC.		
Floodplain Management (E.O. 11988)	FC	FC
Protection of Wetlands (E.O. 11990)	FC	FC
Protection of Children (E.O. 13045)	FC	FC
Environmental Justice in Minority Populations and Low-Income Populations (E.O.12898)	FC	FC
Analysis of Impacts on Prime and Unique Farmland	FC	FC
State And Local Policies	FC	FC

FC = full compliance; NA=- not applicable

****Full compliance achieved after the District Engineer signs the FONSI.**

8.0 Agencies/Parties Consulted During Preparation of EA

US Fish and Wildlife Service - State College Field Office
U.S. Forest Service, Allegheny National Forest
Pennsylvania Fish and Boat Commission
Pennsylvania Department of Environmental Protection
Pennsylvania Department of Conservation and Natural Resources
Western Pennsylvania Conservancy
Domtar Paper Mill, Johnsonburg
Clarion River Municipal Partnership

8.1 Mailing list of parties to receive EA / draft FONSI for review and comment:

US Environmental Protection Agency, Region 3
US Fish and Wildlife Service - State College Field Office
U.S. Forest Service, Allegheny National Forest
Pennsylvania Fish and Boat Commission
Pennsylvania Department of Environmental Protection
Pennsylvania Game Commission
Pennsylvania Department of Conservation and Natural Resources
Western Pennsylvania Conservancy
Domtar Paper Mill
Clarion River Municipal Partnership
City of Saint Marys
Johnsonburg Borough
Jones Township Supervisors
Clarion, Forest, Elk, Jefferson, Armstrong County Emergency Services
PA American Water Company
Ridgway Borough and Township Commissioners
Trout Unlimited
PEMA - Western Region Office
North Central PA Regional Planning and Development
Public Libraries in Johnsonburg, Wilcox, Ridgway, Clarion, Brockway, Saint Marys Dubois, Brookville, Mt Jewett, Smethport, Emporium, Marienville, and Kane
Interested Federal, State and Local Political leaders, Local Citizens and Citizen Groups

9.0 CONCLUSIONS

The District acted decisively in February 2008 by lowering the East Branch pool when it became clear that the dam could potentially fail unexpectedly. This decision was based upon the need to protect public safety; to protect the integrity of East Branch Dam; to minimize impacts to natural resources within East Branch Lake and the East Branch Clarion and Clarion Rivers downstream; to minimize impacts to downstream water users; and to maintain as much as possible the continued operation of the dam to provide its authorized project purposes until repairs could be made. Lowering the summer pool by 20 feet and the winter pool by 28 feet has reduced the hydraulic load on and within the dam sufficiently to allow it to operate safely. The authorized low flow augmentation schedule that has been followed since the dam was constructed will continue under the lower interim pool to ensure that downstream interests will be served. The extensive analysis conducted for this environmental assessment confirmed that the current lower interim pool operations will cause some minor temporary impacts but no permanent, long term adverse impacts to either the environment or the social-economic fabric of the region. In the fall of 2008, the District modified one of the control tower's lower water quality intakes to better regulate lake and downstream water temperatures. This action will help preserve the lake's unique lake trout fishery and the downstream cold water fishery until dam repairs are completed. It is estimated that this interim operating pool will likely remain in effect for another three to five years or until plans can be finalized and implemented to repair the dam. Until the repairs are made, operating the lake under the revised schedule will allow the dam to continue to function safely to provide its authorized purposes, namely, flood control, low flow augmentation, water quality improvement, fish and wildlife conservation and recreation.