COVER SHEET

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR
AMENDMENT TO LICENSE

HOLTWOOD HYDROELECTRIC PROJECT
Docket No. P-1881-050

Section 3
Environmental Analysis
Pages 29 through 132

FEIS

3.0 ENVIRONMENTAL ANALYSIS[15]

3.1 GENERAL SETTING

The Susquehanna River, one of America's largest rivers, is approximately 410 miles long. The river forms in upstate New York and west-central Pennsylvania and drains a watershed area of more than 27,000 square miles. It is an important tributary to the Chesapeake Bay, providing more than 60 percent of the freshwater to the Bay. The name of the river comes from an Algonquian word for "muddy water." This term may still be an appropriate description of the Susquehanna today as the river can be very turbid, particularly during higher flow events. There is also considerable run-off from agricultural areas that have long been a major contributor to nutrient loading in the Chesapeake Bay.

The Holtwood Project is located approximately 25 miles upstream of Chesapeake Bay at river mile (RM) 25 and 15 miles upstream of the 536-MW Conowingo Project located at RM 10. It is approximately 8 miles downstream of the 418-MW Safe Harbor Project located at RM 33. The 1,071-MW Muddy Run Pump-Storage Project, FERC Project No. 2355, is located in between the Holtwood and Conowingo projects and uses the Conowingo Pond as its lower reservoir. The Peach Bottom Atomic Power Station, which is located on the York County side of Conowingo Pond, withdraws cooling water from the pond.

Conowingo Pond extends upstream to the tailrace of the Holtwood powerhouse. Upstream of the Holtwood dam is a reservoir known as Lake Aldred. Lake Aldred occupies a fairly straight channel that varies in width from approximately 0.25 to 0.75 of a mile. Several islands are located throughout Lake Aldred, ranging from 500 feet to nearly a mile in length and up to 300 acres in size. The average depth of Lake Aldred is variable, although there are some very deep areas (>100 feet) along the eastern shore just above the project and some shallow areas along the shorelines and the downstream side of islands. A total of 16 tributaries enter Lake Aldred. These are primarily small streams, and only three (Pequea Creek, Conestoga River, and Otter Creek) would be considered fairly large (classified as 3rd order[16]). The surrounding topography is steep, with limited access points to the reservoir due to a combination of the steep topography and a Norfolk Southern rail line that runs along the Lancaster County shoreline.

---

[15] Unless otherwise noted, the information in this section was derived from the application for amendment of license for this project (PPL, 2007a).

[16] Strahler's (1952) stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. A stream with no tributaries (headwater stream) is considered a first order stream. A segment downstream of the confluence of two first order streams is a second order stream. Thus, a nth order stream is always located downstream of the confluence of two (n-1)th order streams.

There is an area approximately 1-mile-long and 0.5-mile-wide immediately downstream of Holtwood dam that is directly affected by project operations. Within this area are two distinct segments, the relatively narrow, deep project tailrace and the broader, rocky area downstream of the project dam that constitutes the project bypassed reach. Several large islands are located within this section, including the approximately 0.5-mile-long Piney Island, which, in combination with Barkley Island at its downstream end, separates the tailrace from the bypassed reach. Although these were historically two distinct islands, they are now joined and are generally referred to as Piney Island in this document (see figure 2).

The area downstream of the bypassed reach is primarily rock ledge interspersed with shallow pools and some aquatic vegetation. There is also a distinct channel in the eastern portion of the bypassed reach along the western side of Piney Island (Piney Channel). The tailrace is a deep channel that remains fully wetted by backwater from Conowingo Pond when the Holtwood Project is not generating. Water currents are fast throughout the entire downriver area when the project is generating and/or spilling. Immediately below this 1-mile area, the Norman Wood Bridge (Route 372) crosses the river and the river transitions into Conowingo Pond.

3.2 SCOPE OF CUMULATIVE EFFECTS ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (50 CFR §1508.7), an action may cause cumulative effects on the environment if its effects overlap in space and/or time with the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over time, including hydropower and other land and water development activities.

Based on information in the license application, agency comments, other filings related to the project, and preliminary staff analysis, we identified water quality and fisheries as the resources that have the potential to be cumulatively affected by the increased capacity and improvement of fish passage at the Holtwood Project.

3.2.1 Geographic Scope

The geographic scope of the analysis defines the physical limits or boundaries of the proposed action's effects on the resources. Because the proposed action would affect the resources differently, the geographic scope for each resource may vary. For water quality, the geographic scope extends from the upstream Safe Harbor Project downstream into Chesapeake Bay, because operations at the Holtwood Project could affect river flows and operations at the downstream Conowingo Project and, in turn, flows in the 10 miles of river downstream of the Conowingo Project into the Chesapeake Bay. For fisheries resources, the geographic scope of the analysis extends from the Susquehanna River Basin upstream of the York Haven Project downstream into the Chesapeake Bay, because

fish passage success at the Holtwood Project would affect diadromous fish populations migrating from the Chesapeake Bay upstream to the basin above the York Haven Project.

3.2.2 Temporal Scope

The temporal scope of our cumulative effects analysis in the EIS includes past, present, and future actions and their possible cumulative effects on each resource. Based on the existing and proposed license term, the temporal scope looks 16 years into the future, concentrating on the effect of reasonably foreseeable future actions on the resources. The historical discussions are, by necessity, limited to the amount of available information for each resource.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

3.3.1 Engineering Review

The following section discusses the anticipated environmental-related effects that could occur during construction mobilization, site set up, implementation of the proposed project modifications (see figure 3), and demobilization from the site.

Spillway Rubber Dam

The existing spillway is a concrete ogee spillway with a crest at El. 165.0 feet. The crest of the spillway is increased to El. 169.75 feet through the use of wooden flashboards and inflatable rubber dam sections for a total of five separate segments separated by concrete piers. Beginning at the existing powerhouse, the first segment consists of a 40-foot-long by 4.75-foot-high inflatable dam section. The second segment consists of a 300-foot-long by 4.75-foot-high inflatable dam section. The third and fourth segments consist of 387-foot-long by 4.75-foot-high inflatable dam sections. The final segment is 2,368 feet long with 4.75-foot-high wooden flashboards supported by steel pins. Since 2004, PPL has been installing 200 feet of 6-foot-high flashboards on the western end of the first segment as a public safety measure for people accessing the edge of the river directly below the dam for recreational purposes.

The second and third segments of the inflatable rubber dam have been damaged and are currently deflated. PPL has installed wooden flashboards with metal pins upstream of the inflatable bladders to maintain the increased crest of the dam as a temporary measure. The first short segment has been damaged and repaired, but needs to be replaced. PPL proposes to continue to use the existing configuration of flashboards.

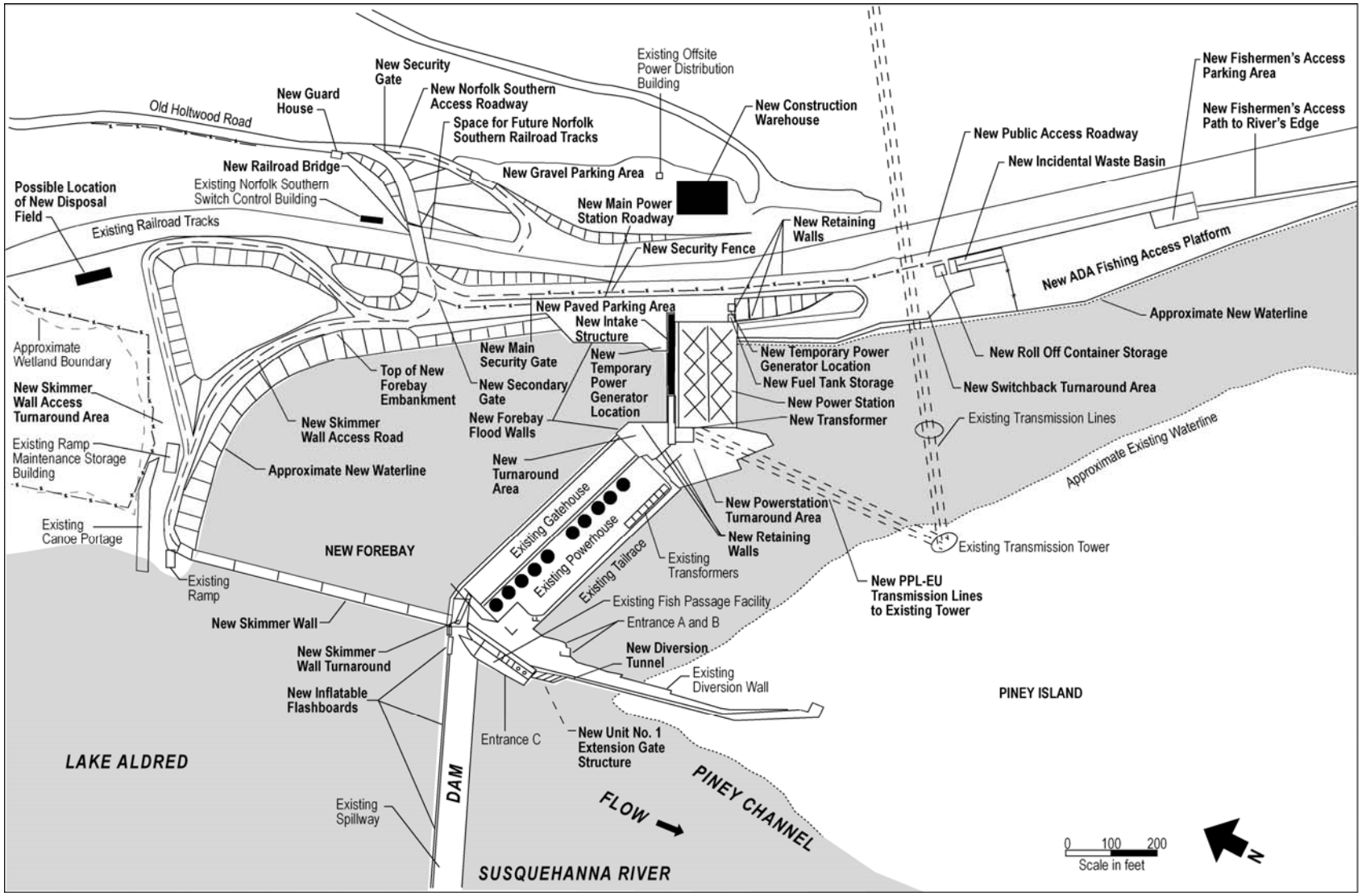


Figure 3. Detailed view of proposed and existing facilities at the Holtwood Project. (Source: PPL, 2007a, as modified by staff)

Skimmer Wall

The existing skimmer wall and timber crib piers are nearing the end of their useful life. Additionally, the arched openings are inadequately sized to accommodate the proposed project's increased flow requirements. PPL proposes to remove the existing wall and to replace it with a new 600-foot-long concrete skimmer wall in the same location and orientation as the existing wall. A total of six concrete piers would be installed to support the wall. The new wall would be fundamentally the same elevations as the existing skimmer wall such that the top elevation would be at El.187.0 feet, extending down to El. 157.5 feet, approximately 12.25 feet below the normal maximum water surface elevation. The top of the wall would include a full-length roadway for improved access along the wall to the upper end of the fish passage facilities. The new skimmer wall would provide better site access and accommodate the increase in flow to the powerhouse.

Forebay

The existing forebay is inadequately sized to accommodate the increased flows for the proposed project. PPL proposes to expand the north and east areas by removing existing soil and rock. The forebay expansion would allow the increased flow to reach the powerhouse while maintaining the current water surface elevations upstream of the powerhouse intakes.

Intake and Powerhouse

A new powerhouse and intake would be constructed to accommodate two new turbine generator units. Because the new units would become the largest units at the expanded project, they would be operated sequentially, except during the fish passage season when other units would be operated preferentially to enhance fish passage. The reconfigured Unit 1 would provide conservation flows to Piney Channel to enhance upstream fish passage and mitigate for shallow water riverine habitat that would be lost due to tailrace excavations. As inflow increases, additional units would be brought into service, depending on any environmental constraints that may be in effect.

Turbine Generator Units

PPL evaluated units of various capacities to optimize annual generation within economic parameters, resulting in the selection of two vertical Kaplan units. The units would be located in the new powerhouse with an output of 40.3 MW each at their most efficient operating point at the rated head, for a total of 80.6 MW. PPL also proposes to replace two existing, retired water driven exciters with turbine generator units. The new units would be vertical Francis units capable of generating 1.18 MW each for a total of 2.36 MW. The units would each be directly coupled to an alternating current synchronous generator. The unit replacements would require limited physical modifications to the powerhouse and water passages. The units would not only increase

the overall capacity of the project, but would also be equipped for black-start capability. This would enhance PPL's ability to bring the electrical system back on line quickly following a major system outage.

PPL has been upgrading existing units within the powerhouse over time, including the replacement of the runners and shafts on six of the ten existing generating units (Units 3, 5, 6, 8, 9, and 10). PPL proposes to replace the runners and shafts on Units 1 and 2 in 2009, coincident with the proposed expansion of the project, and to replace the runners and shafts on Units 4 and 7 in 2010 and 2011, respectively. PPL estimates that the runner replacements would increase the total capacity of the project by 4.1 MW. The existing Holtwood powerhouse communications system would also be expanded with additional telephones, public address stations, and PPL NET computer stations for the new units.

Substation and Transmission

The new units would require the installation of a 69-kilovolt (kV) substation on the east side of the river, down river and adjacent to the existing powerhouse transformer deck. The installation would include a transmission line dead-end structure, a 69-kV motor-operated disconnect switch, generator step-up transformer foundation and oil containment, and an associated high-voltage and medium-voltage bus structure. A new 45/60/75-megavolt ampere generator step-up transformer would be installed in the new 69-kV switchyard to accommodate the new units. A centralized plant control system would be installed to allow control, monitoring, and alarming for the new units in the existing control room. The plant control system would interface with the existing Network Control System.

Diversion Wall

The existing diversion wall between the tailrace and the river channel downstream of the dam would be modified to allow the discharge from Unit 1 to pass under the existing tailrace fish lift entranceway and the deflection wall. Passing discharged water in this manner would control flows through Piney Channel to enhance fish passage on the west side of Piney Island.

Tailrace Channel

The tailrace channel would be modified to accommodate the increased discharge from the proposed project. Piney Channel would also be modified to accommodate the redirected discharge from Unit 1. These modifications would: (1) decrease hydraulic losses and subsequent backwater effects, which currently limit the existing project's generating capacity; (2) increase the tailwater flow capacity for the new units; and (3) eliminate high velocity zones, which have potentially limited fish passage effectiveness.

Related Site Work

In addition to the specific items listed above, the following additional site work would be associated with the expansion project:

- Relocation of access roads.
- Relocation of the existing powerhouse truck access.
- Replacement of the guardhouse.
- Replacement of the existing tour building.
- Replacement of the existing warehouse.
- Replacement or relocation of the ramp area maintenance storage building.
- Reconfiguration of the boat ramp and maintenance dock area.
- Relocation of off-site power.
- Relocation of telecommunications systems.
- Replacement of the wastewater treatment system and relocation of existing wastewater piping.
- Replacement of the sewage treatment system.
- Relocation of the existing sewage system piping through the existing powerhouse and new powerhouse to the new sewage treatment system.

Fish Lift Attraction Water Supply

A new intake pipe would be installed to provide at least 650 cfs directly from the forebay into the fish passage distribution system piping. The modification would enhance the fish lift attraction water supply by increasing the amount of attraction flow by at least 300 cfs, allowing the fish lifts to operate at their full attraction water design capacity of 800 cfs.

Fish Lifts

The existing fish lift entrance C located below the dam would be modified to protect the entrance gates from repeated damage during flood events. The tailrace crowder track would also be extended in an attempt to eliminate shadows in the area of the crowder where shadows appear to discourage migratory fish from entering the crowder channel. PIT tag readers would be installed at the fish lift entrances, and eel ramps would eventually be placed at the project after studies are conducted to determine the optimum locations.

Recreational Enhancements

Several recreational enhancements are proposed which would require new or modified structures as discussed in section 3.3.5, *Recreational Resources*.

Construction-related Noise

Typical noises in the Holtwood area include Holtwood warning sirens, passing freight trains, and road traffic across the Norman Wood Bridge (Route 372). Sound is buffered by the dense forests and steep sides of the Susquehanna River valley.

Excavation and construction activities would occur during 10-hour workdays Monday through Friday for approximately 2.5 to 3 years. Construction activities may continue overnight or on weekends depending on conditions. During this time, drilling would occur throughout the bulk of the work day, and blasting would likely occur once or twice per day, generally around noon and around dinner time as necessary over the 3-year construction period. Drilling would likely be the noisiest component of the construction activities, and would be avoided at night when possible. Overall, the noise from the construction would likely be relatively constant and monotonous.

The proposed construction activities would likely produce sounds with similar magnitudes as presently found at the project; however, the additional noise would be more frequent. Based on U.S. Environmental Protection Agency (EPA) criterion for protecting against hearing loss, noise levels are not a threat to health and welfare at levels below 70 decibel on the A-weighted scale (dBA) for a continuous 24-hour period. All activities located at least 1,600 feet from proposed construction projects would likely receive safe sound emission levels (table 3).

Construction-related Air Emissions

EPA and the state, through Pennsylvania DEP, regulate air quality in the proposed construction area. EPA has established National Ambient Air Quality Standards (NAAQS) for criteria pollutants that include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), lead (Pb), ozone (O_3), particulate matter less than 10 microns (μ) in diameter (PM_{10}), and fine particulate matter less than 2.5 μ in diameter ($PM_{2.5}$).

To identify an area by its air quality, EPA designates all geographic areas in the state as attainment, non-attainment, or unclassifiable. An area is designated attainment for a particular pollutant if its air quality meets the NAAQS for that pollutant. When air quality in an area meets all standards, the area is considered to be in attainment. If the concentration of a criteria pollutant in an area is found to exceed the regulated or threshold level of the NAAQS, the area is considered a non-attainment area for that particular pollutant. A designation of unclassifiable is made when there is currently insufficient data for determining attainment or non-attainment.

Table 3. Estimated decibel (dBA) levels at various distances from sound emission sources with levels above, equal to, and below the EPA criterion for noise safety. (Source: PPL, 2007a)

	dBA Range					
Distance (feet)	**Siren**	**Route 372**	**Train**	**Train Whistle**	**Rock Drill**	**Blasting**
50	130–120[a]	80–65[a]	90–80[a]	100[a]	100–90[a]	100–90[a]
100	124–114[a]	75–59[b]	84–74[a]	94[a]	94–84[a]	94–85[a]
200	118–108[a]	68–53[c]	78–68[a]	88[a]	88–78[a]	88–79[a]
400	112–102[a]	62–47[c]	72–62[b]	82[a]	82–72[a]	82–73[a]
800	106–96[a]	56–41[c]	66–56[c]	76[a]	76–66[b]	76–67[b]
1,600	100–90[a]	50–35[c]	60–50[c]	70[b]	70–60[c]	70–61[c]
3,200	94–84[a]	44–29[c]	54–44[c]	64[c]	64–54[c]	64–55[c]
6,400	88–78[a]	38–23[c]	48–38[c]	58[c]	58–48[c]	58–49[c]

[a] Level is above the EPA criterion for noise safety.

[b] Level is equal to the EPA criterion for noise safety.

[c] Level is below the EPA criterion for noise safety.

The area considered in this EIS for the proposed expansion of the Holtwood Project is located in Lancaster and York counties in southeastern Pennsylvania. These two counties are located in Pennsylvania Air Quality Region 3 (South Central) and are both in attainment for all of the criteria air pollutants except for fine particulate matter less than 2.5 microns (μ) in diameter ($PM_{2.5}$) (EPA, 2008). EPA is working with Pennsylvania DEP to develop a plan to reduce $PM_{2.5}$ emissions such that attainment is achieved by April 2010 (5 years from the date of designated non-attainment) (Pennsylvania DEP, 2007a, b).

Air emissions during construction are expected to be negligible and to be within standards for all criteria. However, the emission of fine particulate matter would hinder efforts to reduce $PM_{2.5}$ emissions to acceptable levels in the short-term. Air emissions would result from construction equipment in the form of dust and equipment exhaust.

It is possible that dust would result from the movement of construction vehicles and equipment over roadways and in construction areas. In particular, movement of excavated material from the construction site to the retired ash basins on the hillside above the project would require transport over 1.5 miles of public roads and would likely result in some dust emissions. Visible dust emissions would be controlled using water spray on haul roads and in excavation areas as necessary.

Heavy equipment would emit diesel fuel exhaust. These emissions are expected to be minimal and are not expected to impact residences in the area. Equipment would be kept in good repair to limit emissions.

3.3.2 Geology and Soils

3.3.2.1 Affected Environment

Bedrock Geology

The project lies in a belt that is underlain with mainly pre-Cambrina schists, gneisses, quartzites, slates, and very old igneous rocks. Historically, the Susquehanna River narrowed and deepened through the Holtwood region, passing through a series of bedrock gorges. The Holtwood gorge is the largest, with a length of about 3 miles and width of about 0.5 mile.

On the river bottom on the eastern side of the Susquehanna River, just downstream of the Holtwood dam, there is a narrow chasm almost 1 mile long with vertical walls. Historical surveys have shown that, in some locations, the gorge is about 200 feet deep. The gorge may have been formed by many river potholes being formed at the upstream end of the gorge, growing and emerging, while new potholes were forming. The current gorge now forms the tailrace of the project.

Soils

Soils in the project area are mainly Manor and Mt. Airy soils, Fluvaquents, and Udifluvents. Manor soils, located along Lake Aldred and downstream of the dam on both sides of the river are coarse loams, deep and well drained. They are found on hilltops and broad side slopes on the uplands. Mt. Airy soils, occurring with Manor soils on the York County side of the river, are moderately deep, somewhat excessively drained soils, and are found on ridgetops, side slopes, and hillsides. Fluvaquents and Udifluvents are found in the area of the dam on the Lancaster County side of the river and on Piney Island. These soils have characteristics that are too variable for strict classification, but are typically found on floodplains.

Most of the shoreline along the project area consists of steep, rocky, and vegetated bank. However, a few areas along the eastern portion of Lake Aldred include more gentle slopes. These areas are generally fully vegetated except during periods of drawdown when unvegetated portions of unconsolidated deposits may become exposed. The project area downstream of the dam is primarily composed of lightly vegetated bedrock. Several steeper vegetated islands are located below the dam.

Coal silt has moved downstream as a result of prior historical coal processing activities upstream in the watershed. The location of the proposed forebay expansion and powerhouse is the former site of a generating facility that burned coal dredged from the river upstream of the dam. Coal dredging activities no longer occur, and coal silt is still present in areas upstream and downstream of the dam. An archeological and

geomorphological survey conducted in March 2006 revealed that a portion of the proposed excavation areas along Piney Island contains coal silt deposits up to 5 feet deep (Cress et al., 2006).

Erosion and Sedimentation

No significant erosion, mass soil movement, or slumping is known to occur in the immediate project area, and none was observed during the public site visit. Significant erosion is occurring upstream of the project, and a large amount of sediment has washed into Lake Aldred. The reservoir has historically retained sediment; however, USGS has determined that the sediment and nutrient storage capacity of the reservoir has been reached and that it no longer effectively traps sediments (USGS, 1997).

3.3.2.2 Environmental Effects

All work to be performed as part of the proposed project would be undertaken in accordance with best management practices and sediment and erosion control plans to be developed by PPL and local, state, and federal agencies to ensure that any release of sediments to nearby watercourses would be minimized.

The proposed action would require excavation and removal of approximately 40,000 cy of reservoir silt over the underlying bedrock to enable the construction of the foundation of the new skimmer wall. The silt would be removed by underwater dredging. The removal of these sediments could cause some of the sediments to become resuspended in the water column and pass downstream through the dam gates or powerhouse. The reconfigured skimmer wall area could alter flow patterns and velocities in the area that may result in further silt movement and release until equilibrium conditions are reached.

The proposed action would also require the excavation of approximately 362,181 cy of rock and 303,842 cy of soil to expand the forebay area and prepare the powerhouse site. Geotechnical investigations indicate that the majority of this material is bedrock, and therefore there is limited concern about sediment movement in these areas. The majority of the material would be removed in the dry, with the remainder occurring under water. Removal of loose material would be by mechanical methods and underwater dredging. Bedrock would be removed after demolition using controlled blasting techniques above and below water.

Approximately 802,972 cy of rock and 4,035 cy of soil would need to be excavated in the tailrace area to allow for the larger discharge capacity of the expanded project. Removal of loose material would be by mechanical methods and underwater dredging. Bedrock would be removed after demolition using controlled blasting techniques above and below water. Excavation of the tailrace along the edges of Piney Island and Barkley Island would involve excavation of bedrock and coal silt. The potential release of coal silts could occur during the short period of excavation. The geology and channelization of the riverbed along Piney Island would prevent any long-term erosion despite the increased tailrace flows. The excavation is also intended to

preserve the current water surface elevations in the tailrace under the higher flows and, therefore, should not increase overflow on Piney Island or affect the coal silt layer present on Piney Island.

Excavation of approximately 70,695 cy of rock is proposed downstream of the dam in Piney Channel west of Holly Island to accommodate the rerouted discharge from Unit 1 (see figure 2). The excavation is designed to reduce water levels and velocity conditions in the area, which would reduce erosion potential in Piney Channel despite higher typical flows. This area contains minimal amounts of sediment due to historical scouring during periods of flow over the spillway. Removal of loose material would be by mechanical methods and underwater dredging. Bedrock would be removed after demolition using controlled blasting techniques above and below water.

Flow modeling of the proposed excavation project indicates that water levels and velocities are not expected to increase beyond current levels downstream of the Norman Wood Bridge (Route 372). Therefore, we would not expect increased erosion along the islands downstream of the Holtwood Project.

PPL states that approximately 1,900,000 cy of excavated rock and soil will need to be disposed of on- or off-site. PPL proposes to use a retired ash basin[17] located on PPL lands in Lancaster County on the hillside above the project for disposal of approximately 1,790,000 cy of excavated rock and fill. Approximately 110,000 cy of the excavated material would be reused. This includes (1) approximately 86,910 cy of rock to elevate the new roadway over the Norfolk-Southern railroad track; (2) approximately 19,260 cy of rock and fill to riprap the forebay embankment; (3) approximately 1,950 cy of rock to riprap a portion of tailrace embankment; (4) approximately 250 cy of rock to create a new formal parking area on McCall's Ferry Road; and (5) approximately 370 cy of rock and fill to armor Piney Island. Some material may also be used for the installation of cofferdams and temporary berms prior to start of construction, most of which would be removed after construction is complete. Reservoir sediments would be disposed of at a site to be defined in the sediment and erosion control plans. None of excavated materials would be deposited in the river. Appropriate measures, as defined in the proposed erosion and soil control plan, would be taken to ensure that the resulting site would not be subject to erosion and sediment transport to surrounding lands and water bodies.

The proposed construction would require the creation of several temporary access roads downstream of the dam and along the shoreline and Piney Island. Where possible, PPL plans to use existing roads, although in some cases those roads may need to be widened, and some new roadways would need to be constructed. Construction and use of these roads could potentially cause some sediment to enter the river. Access roads

---

[17] PPL indicated in its supplemental filing of October 3, 2008, that ash basin #1 is proposed as the primary disposal area and that ash basin #2 is not currently proposed for disposal.

constructed in the river channel may be subject to wash-outs during high flow events, potentially resulting in transport of roadway material downstream. These materials would primarily consist of 2A stone, a coarse aggregate with rocks approximately 2 inches in size. The sediment and erosion control plans would contain provisions to control movement of these materials.

Construction of recreational facilities and improved access areas for fishing or boating upstream and downstream of the dam may require some small levels of ground disturbance and clearing. Proposed construction and disturbance are limited, and potential impacts due to construction would be controlled in these areas through implementation of the sediment and erosion control plans. Any effects from recreational use of these facilities would be addressed as part of PPL's ongoing maintenance of their recreational facilities.

Once construction is complete, the final grades and slopes in the vicinity of the expanded forebay and new powerhouse should be stable and resistant to erosion and sediment transport. The reconfigured tailrace channel and river channel downstream of the dam should be resistant to erosion based on the design criteria. We do not expect the increased discharge from the existing and new powerhouses or the proposed conservation release to Piney Channel from Unit 1 would increase erosion and sediment transport.

The new operating regime is expected to result in some isolated drawdowns of the reservoir slightly below El. 167.5 feet due to the combined effects of the drought plan and minimum flow proposal in dry years. We do not expect that these isolated events would increase erosion along the shoreline of Lake Aldred.

The proposed flow regime would primarily result in the release of water through the new tailrace channel, which would be sized and configured to accommodate the increased flow, rather than spilling the flows over the crest of the dam. We expect the tailrace channel would be more stable than the existing tailrace channel, with less loose material available for transport.

The sediment and erosion control plans would be developed in consultation with appropriate resource agencies and would be expected to address the concerns raised above. Implementation of the plan, including appropriate best management practices, would reduce the potential for erosion and sediment transport to occur and would also control any that does occur. Once construction is complete, we expect that newly disturbed areas would be left in a stable state and that any transported sediment would quickly settle and any turbidity would dissipate.

3.3.2.3 Unavoidable Adverse Effects

Even with approved erosion and sediment control measures in place, some temporary release of sediment would be likely to occur from construction activities and blasting at the project.

3.3.3 Aquatic Resources

3.3.3.1 Affected Environment

Water Quantity

The Holtwood Project is located about 25 miles upstream of the Chesapeake Bay (see figure 1) on the Susquehanna River. The vast majority of the flow reaching the project area is released from the Safe Harbor Project located about 8 miles upstream. Downstream of Safe Harbor dam, many tributaries enter Lake Aldred (the project reservoir). The two largest tributaries, which are Pequea Creek and the Conestoga River, only account for about 2 percent of total mean monthly flow at the Holtwood Project. Table 4 provides the mean monthly flow at Holtwood, Pequea Creek, and the Conestoga River and shows that flows are normally highest in March and April and lowest in August and September.

Table 4. Mean monthly flows (cfs) from 1931–2005 at the Holtwood Project. (Source: PPL, 2007a, as modified by staff)

Month	Susquehanna River[a]	Conestoga River[b]	Pequea Creek[c]
Period of Record	**1931–2005**	**1928–2005**	**1977–2005**
January	40,900	477	348
February	44,600	548	259
March	76,100	686	353
April	79,600	629	293
May	48,500	454	199
June	28,900	385	158
July	16,000	313	138
August	12,600	244	108
September	14,300	229	121
October	18,200	219	146
November	29,900	287	152
December	40,600	409	216

[a] From data collected by PPL at Holtwood.

[b] From USGS gage no. 01576500, Conestoga River at Lancaster, PA.

[c] From USGS gage no. 01576787, Pequea Creek at Martic Forge, PA.

Comparison of water surface elevation data from the Safe Harbor tailrace and the Holtwood forebay indicates that the Safe Harbor Project releases control water surface elevations at the upper end of Lake Aldred when Safe Harbor is generating, with a gradient of higher elevations to lower elevations from upstream to downstream. During periods when Safe Harbor is not generating, no gradient in water surface elevation exists between the two dams. Throughout the summer, peak generation typically occurs at the Safe Harbor Project during the afternoon (3 p.m. to 8 p.m.), with the amount of water released during the peak hours dependent on river flow. During this operation, water surface elevations can be noticeably higher (>1 feet) in the area immediately downstream of Safe Harbor dam than in the remainder of Lake Aldred. The area immediately downstream of Safe Harbor dam is characterized by a narrow channel along the eastern shoreline, a number of small islands, and many bedrock and boulder protrusions. Channel morphology in this area constricts and confines the discharge from Safe Harbor dam. Downstream from this area is a slight gradient in water surface elevation that extends downstream approximately 3 miles below Safe Harbor dam to Pequea Creek. From Pequea Creek to Holtwood dam, the river widens considerably and the water surface elevation is controlled by the Holtwood dam and operation of the hydroelectric plant. The area most influenced by the Safe Harbor Project represents a relatively small portion of Lake Aldred (about 220 acres or about 10 percent of the total reservoir).

When river flow is less than about 30,000 cfs, Holtwood generally, to the extent possible, operates on a daily peaking basis using its limited reservoir storage to collect inflows from the Safe Harbor Project and incoming tributaries, and concentrating releases during the peak electrical demand periods during the day. During extreme low inflow periods, the Holtwood Project generates power for as little as 3 to 5 hours per day in order to maintain seasonal reservoir levels as required by the existing license. Historically, during low flow periods, PPL has typically operated the Holtwood Project on a weekly cycling basis, by using the limited reservoir storage to capture inflow from the weekend to be released during weekday demand periods. Generation during the weekend may be limited. When river flows exceed approximately 25,000 cfs, the plant normally generates on a 24-hour basis or may operate for slightly fewer hours at either a best gate position or at full hydraulic capacity. Although there are no water withdrawals from Lake Aldred, many consumptive uses that occur throughout the large (26,794 square mile) drainage area above the project affect inflow to the reservoir.

Tailrace and Bypassed Reach

Downstream of the powerhouse, the tailrace area remains fully wetted by backwater from the Conowingo reservoir. Water currents reach 7.5 to 10 feet per second (fps) throughout this section when the project is generating. The water surface elevation in the tailrace fluctuates by approximately 10 feet between periods of full generation to non-generation. Some areas of the tailrace contain deep pockets greater than 70 feet deep. The bypassed reach is primarily rock ledge interspersed with shallow, interconnected pools with some vegetation and receives flow during spillage over the

dam. Table 5 shows the percent of time per month that river flow exceeds the existing hydraulic capacity of the Holtwood Project, resulting in spill at Holtwood dam.

Table 5. Percent of time flow exceeded the project hydraulic capacity under current conditions at the Holtwood Project. (Source: PPL, 2007a)

Month	Percent of Time River Flow Exceeds Existing Project Hydraulic Capacity (31,500 cfs)
January	42.7
February	36.6
March	86.6
April	91.3
May	65.3
June	29.2
July	15.1
August	8.1
September	11.0
October	17.5
November	36.1
December	47.6

Note: Data based on flows measured at Holtwood for 1917–1996.

Currently, there is no minimum flow requirement below the Holtwood Project. However, leakage through the dam and flow from a 10-inch pipe through the dam maintain a small, continuous flow in the bypassed reach. The flow rate through the pipe depends on the water surface elevation of Lake Aldred, but is estimated by PPL as approximately 11 cfs at maximum normal water elevations. Leakage through the flashboards varies based on reservoir elevation and the adequacy of seals between flashboards, but has been calculated to range between 4 and 40 cfs. When the generating units are not operating, leakage through the units maintains an estimated 210-cfs continuous flow in the tailrace.

For the downstream Conowingo Project, on June 14, 2006, SRBC approved a new Pond Management Plan (Plan) to address reservoir management during low flow periods.[18] The Plan is intended to retain sufficient storage in Conowingo reservoir to

[18] As of the date of this application, the plan had not been submitted to the Commission for approval.

accommodate the various uses during low flow or drought periods while sustaining adequate flows in the river downstream of the Conowingo Project to the Chesapeake Bay. Inflow to the Conowingo Project is almost totally dependant on the discharge from the Holtwood Project, except for the relatively small tributaries that flow into the impoundment below Holtwood dam and the inflow and withdraws by the Muddy Run Pump-Storage Project. During non-generation periods at the Holtwood Project, the water level in the Conowingo reservoir normally controls the tailwater elevation below Holtwood dam. The Conowingo Project has a maximum hydraulic capacity of about 85,000 cfs. Other generating facilities on the Conowingo reservoir include the 1,071-MW Muddy Run Pump-Storage Project and the Peach Bottom Atomic Power Station, which relies of water withdrawals from Conowingo reservoir for cooling purposes and has a generation capacity of over 2,100 MW. Table 6 summarizes of the maximum hydraulic capacities and usable storage volumes at nearby hydroelectric facilities.

Table 6. Maximum discharge and usable storage at nearby hydroelectric facilities. (Source: PPL, 2007a; Safe Harbor Water Power Corporation, 2008)

Project	Maximum Plant Discharge (cfs)	Usable Storage (acre-feet)
Safe Harbor[a]	113,000	68,870
Holtwood[b]	31,500	15,224
Muddy Run[c]	32,000	34,000
Conowingo[d]	85,000	33,800

[a] Storage volume is based on the volume in the upper 17 feet.

[b] Storage volume noted for Holtwood is between El. 163.5 feet and the top of the flashboards/ rubber dam at El. 169.75 feet. The current summer storage volume between El. 167.5 feet and El.169.75 feet is about 5,833 acre-feet.

[c] The Muddy Run Pump-Storage Project has a maximum pumping discharge of 24,000 cfs.

[d] Storage volume is between El. 108.5 feet and 104.5 feet; between the normal maximum level and the normal minimum level due to operational issues with the Muddy Run Pump-Storage Project.

Water Quality

The water quality of the lower Susquehanna River in the vicinity of the Holtwood Project is generally considered good and meets state water quality standards most of the time. The lower Susquehanna River, however, has had a history of high turbidity levels and sediment loading, high nutrient loading, and low DO levels in two of the larger hydroelectric project reservoirs (Safe Harbor and Conowingo projects). The project reservoir, Lake Aldred, however, is smaller and more riverine in nature than the larger

upstream and downstream reservoirs. PPL reports that recent studies on Lake Aldred indicate that reservoir stratification (which typically has resulted in low DO levels in the deeper parts of the larger Susquehanna River reservoirs) generally does not occur in Lake Aldred. DO levels in Lake Aldred consistently exceeded state standards, with the lowest level recorded in the 2006 studies at 5.27 milligrams per liter (mg/L). One factor that may also result in higher DO levels in Lake Aldred is that the upstream Safe Harbor Project has had turbine venting systems installed in two of their generating units since 1986. Those systems were installed so that Safe Harbor Project discharges would meet state standards for DO (minimum of 4.0 mg/L). Sediment loading in Lake Aldred is substantial, although long-term data for the Susquehanna River indicate that the trend is improving. Nutrient loading is also continuing in Lake Aldred, as a result of tributary or Susquehanna River inflow from upstream agricultural areas. However, the 2006 studies indicate relatively low and improving nutrient levels in the reservoir, compared to historical data.

Continuous monitoring during the summer months in the Holtwood tailrace in 2005 and 2006 revealed that DO levels are also typically high, with 99.3 percent of the samples exceeding the state standard in 2005 and 100 percent of the samples exceeding the state standard in 2006. DO levels were generally higher during periods of generation than during periods of non-generation. A turbine aeration study of existing Holtwood units found that DO could be increased from 0.2 to 0.8 mg/L depending on the gate settings and valve openings of the studied unit.

Flows and water quality may be highly variable in the bypassed reach downstream of the Holtwood dam, which also includes Piney Channel, located just to the west of Piney Island, which forms the west bank of the tailrace channel. During high flow periods, which typically occur in the spring months but may occur at any time of the year (see table 5), heavy spillage occurs over Holtwood dam, and the bypassed reach has the character of a large river with heavy rapids that probably well oxygenate the waters. During typical summer months, however, flow over the dam mostly ceases (except for leakage) and the bypassed reach becomes an area of shallow pools with often minimal flow among the pools. Under these conditions, where DO levels are controlled by the photosynthesis/respiration cycle in the pools, DO levels may range from high during the daylight hours because of photosynthesis, to low overnight as photosynthesis ceases and plant respiration occurs. Studies conducted in 1980 and 2007 found that low DO levels occasionally occur in some of the isolated pools very early in the morning, but such conditions are not common, with only two instances recorded in 2007 where DO levels fell to under 3.0 mg/L.

Fishery Resources

The fishery resources in the Holtwood Project area are substantial with both an important resident warmwater fishery, and the presence of anadromous and catadromous species that require upstream and downstream passage over the project. Primary warmwater game species that occur both in Lake Aldred and in the river downstream of

the project include smallmouth bass, walleye, channel catfish, and pan species such as redbreast sunfish, bluegill, black and white crappie, and pumpkinseed. Other common species that occur in Lake Aldred include gizzard shad, quillback, spotfin shiner, and common carp. Gizzard shad and spotfin shiner may serve as forage species for the game species. Lake Aldred supports an active boat and shoreline sport fishery for the resident species, and some fishing also occurs in the project tailrace, from the shoreline.

The Susquehanna River has had an active program for restoring anadromous fish populations for the past 35 or more years. Historically, the river supported large runs of American shad, river herring (blueback herring and alewife), hickory shad, as well as the catadromous American eel. These populations declined in the late 1800s and early 1900s because of the construction of canal feeder dams, overfishing, water pollution, and eventually the construction of the hydroelectric dams between 1904 and 1928. The upstream York Haven Project at RM 54 was the first hydroelectric dam on the river constructed in 1904. The dam, however, was a low-head structure from 6 to 22 feet high, and may have been partially passable by shad during higher-flow periods.

The Holtwood dam was constructed in 1910 at RM 25, and at 55 feet high, totally blocked upstream fish migration. Two fishways were constructed at Holtwood at the time of its initial construction—a rock ramp type fishway on the west shore of the spillway, and a pool-and-weir type fishway on the east shore of the tailrace (figure 4). Neither fishway reportedly ever passed shad successfully, but the rock ramp fishway did pass some American eel, although the numbers are not known. In 1928, the 95-foot-high Conowingo dam was constructed at RM 10 and became the downstream most dam to totally block fish migration on the river.

The modern fish restoration efforts on the Susquehanna River began in the 1950s and 1960s with a number of feasibility studies, followed by the construction of a trap and trucking facility at Conowingo dam in 1972, the initiation of fertilized shad egg stocking in the basin, the construction of a shad hatchery by Pennsylvania FBC in the mid-1970s, and the total closure of the shad fishery in the Susquehanna River and upper Chesapeake Bay by the state of Maryland in 1980. The numbers of shad returning to the river increased through the years, and by 1991 a new fish lift was constructed at the Conowingo Project, followed by new fish lifts at the Holtwood and Safe Harbor projects in 1997.

Figure 4. Abandoned Holtwood rock ramp spillway fishway (top) and tailrace fishway (bottom), constructed circa 1910. (Source: Staff)

The current fish lifts (located in the tailrace and eastern end of the spillway) at the Holtwood Project have not been substantially modified since first constructed in 1997, but the lifts have not been effective in passing shad in many years (figure 5). Table 7 summarizes the passage of American shad at the four lower river hydro projects for the past 12 years, and table 8 shows a comparison of the passage at the Conowingo and Holtwood projects. Table 8 shows that passage success at Holtwood has been variable, ranging from as high as 63 percent of the shad passed at Conowingo to as low as 3 percent of the shad passed at Conowingo. For the 12 years of concurrent operations, the average success rate has been about 32 percent. Generally, higher success rates have occurred during years with lower river flows, while lower success rates have occurred in years with higher flows, although the years with the highest average May flows (1998 and 2002) did not have the lowest success rates (table 8). During higher flow periods when Holtwood dam is spilling, fish are attracted into the bypassed reach and have difficulty finding the attraction water flow from the spillway fish lift, because of the competing higher-volume river flows over the dam. Under these conditions fewer fish enter the tailrace and area available for passage through the tailrace fish lift.

Few other anadromous species pass upstream through the lower Susquehanna projects, including Holtwood dam. The peak passage of river herring occurred at Conowingo in 1997 and 2001, when about 243,000 herring passed in 1997 and 292,000 herring passed in 2001. During those same years, only about 1,000 herring passed the Holtwood Project, less than 1 percent of the number passed at Conowingo. Since 2003, the number of herring passed at Conowingo has been less than 1,000 fish, with no herring recorded in some years. Since 2003, only sporadic herring passage has occurred at Holtwood with no herring recorded in some years. Only occasional hickory shad have been passed at Conowingo during the past 12 years, with essentially none appearing at Holtwood dam. Small numbers of striped bass have been lifted at Conowingo dam (typically in the hundreds of fish per year), and a few of those have been passed at Holtwood. Catadromous American eel elvers[19] do appear at the base of Conowingo dam, and a few may be passed at Conowingo through the fish lift, although fish lifts are not effective in passing elvers and are difficult to quantify. Some of those eels that manage to pass Conowingo may appear at Holtwood.

[19] Elvers are juvenile American eel that ascend the river during the spring and summer months.

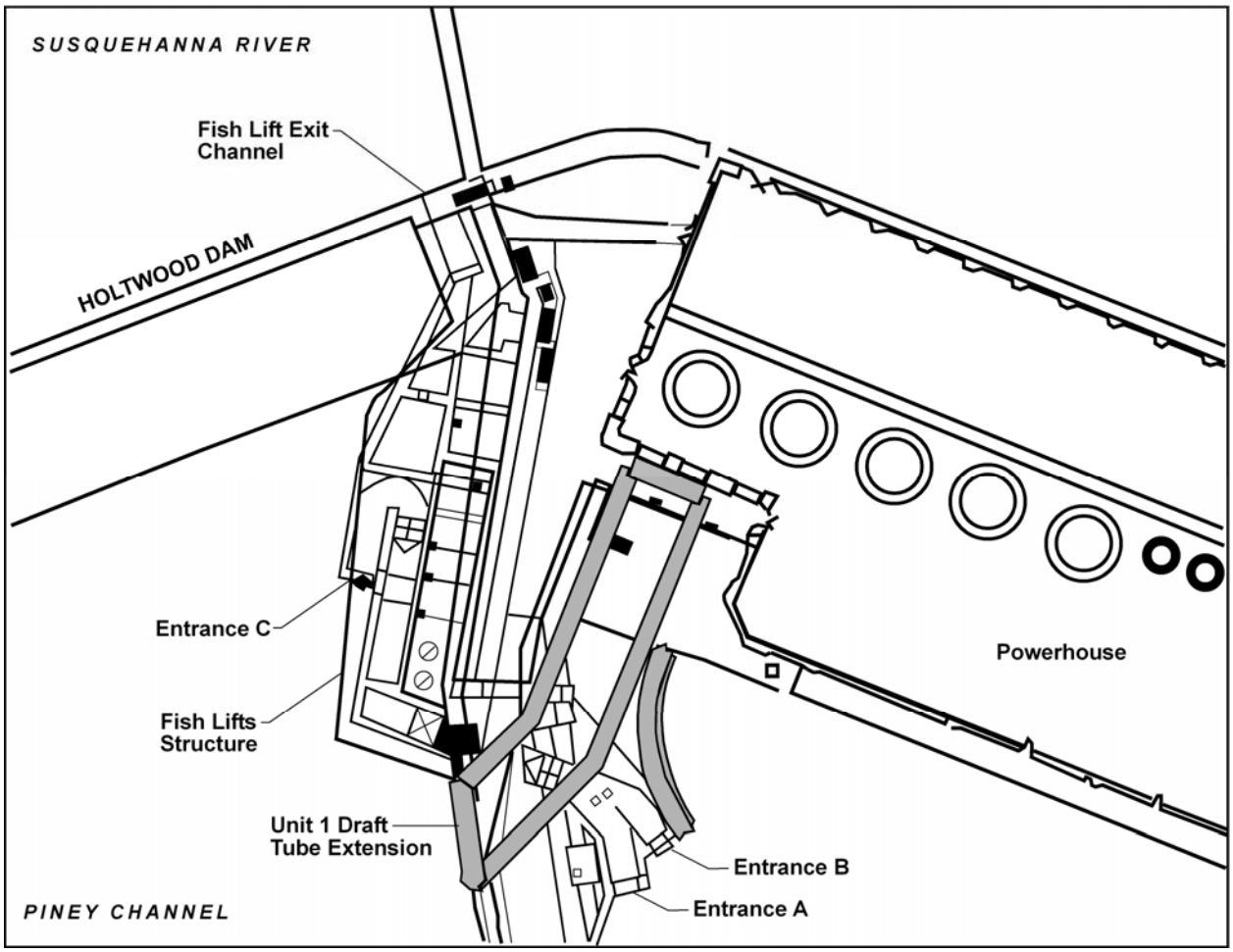


Figure 5. Upstream fish passage facilities at the Holtwood Project, showing the proposed Unit 1 draft tube extension. (Source: PPL, 2007a, as modified by staff)

Table 7. Summary of American shad passage on the Susquehanna River, 1997–2008. (Source: PPL, 2007a; Pennsylvania FBC, 2008)

Year	Conowingo[a]	Holtwood	Safe Harbor	York Haven
1997	90,971	28,063	20,828	--
1998	39,904	8,235	6,054	--
1999	69,712	34,702	34,150	--
2000	153,546	29,421	21,079	4,675
2001	193,574	109,976	89,816	16,200
2002	108,001	17,522	11,705	1,555
2003	125,135	25,254	16,646	2,536
2004	109,360	3,428	2,109	219
2005	68,926	34,156	25,425	1,772
2006	56,899	35,968	24,929	1,913
2007	25,464	10,338	7,215	192
2008	19,914	2,795	1,252	21

[a] This is only passage through the East Fish Lift, which releases fish into Conowingo reservoir.

Table 8. Comparison of American shad passage at the Conowingo and Holtwood projects, 1997–2008. (Source: PPL, 2007a; Pennsylvania FBC, 2008)

Year	Conowingo	Holtwood	% of Conowingo	Mean May Flow (cfs)
1997	90,971	28,063	30.8	30,630
1998	39,904	8,235	20.6	75,060
1999	69,712	34,702	49.8	20,590
2000	153,546	29,421	19.2	53,790
2001	193,574	109,976	56.8	18,750
2002	108,001	17,522	16.2	79,500
2003	125,135	25,254	20.2	42,050
2004	109,360	3,428	3.1	58,368
2005	68,926	34,156	49.6	20,855

Year	Conowingo	Holtwood	% of Conowingo	Mean May Flow (cfs)
2006	56,899	35,968	63.2	24,887
2007	25,464	10,338	40.6	32,151
2008	19,914	2,795	14.0	47,887[a]
Average	88,451	28,322	32.0	NA

[a] Based on provisional flow data from the USGS Marietta, PA, gage.

Several other species have successfully used the fish lifts in the lower Susquehanna River, including substantial numbers of game species such as walleye and smallmouth bass. From 1997 to 2007, 49 fish species have been recorded in the fish passage facilities of the lower Susquehanna River (Shiels, 2007). The species, however, that dominates fish passage through the lower river dams is the gizzard shad, which is not anadromous, but makes an upriver migration during the spring months from Chesapeake Bay, apparently for spawning. The gizzard shad, however, is not considered a game or sport species, does not support a directed fishery, and is considered by many to be useful only as a forage species for other fish during its juvenile life stage. The number of gizzard shad annually passing the lower river dams typically numbers in the hundreds of thousands and comprised about 75 percent of all fish passed over the lower river dams from 1997 to 2007 (Shiels, 2007). During this period, the number of gizzard shad annually passing Conowingo dam ranged from 305,000 to 950,000, with annual passages of 53,000 to 430,000 at Holtwood dam. The average annual gizzard shad passage at Conowingo was about 522,000 during this period, and 172,500 at the Holtwood Project (Shiels, 2007).

Freshwater Mussels

PPL conducted a mussel survey in the project area in late summer (September) 2005 (Normandeau, 2006). Areas surveyed included Lake Aldred, the tailrace, and the bypassed reach downstream of Holtwood dam. The survey found that habitat in the tailrace and bypassed reach was generally not suitable for mussels because of the predominantly bedrock/boulder substrate in those areas. No live mussels and only a few spent shells were found during surveys of the tailrace and bypassed reach, although a few live mussels were found in a small area of suitable substrate about 0.5 mile downstream of the Norman Wood Bridge (Route 372), which is the extreme lower end of the tailrace. Live species observed included one yellow lampmussel and five eastern elliptio, along with several spent shells of eastern elliptio and eastern floater. More suitable mussel habitat occurs in Lake Aldred, and four species were found during the survey, including eastern floater (most common), eastern elliptio (second most common), yellow lampmussel (uncommon), and triangle floater (only one individual observed). None of these species are listed as threatened or endangered at the state or federal level. Fish host species for these four mussel species are found in Lake Aldred.

3.3.3.2 Environmental Effects

Water Quantity

Potential effects on water quantity could occur during both the construction and operational phases of the amended project. Project construction would involve major areas of excavation related to construction of the new forebay and powerhouse, excavation to widen and deepen the tailrace to accommodate increased flows from the powerhouse, and excavation in parts of the bypassed reach including near Piney Island. Operation of the new powerhouse would double flows passing through the generating units compared to existing operations and would increase the project hydraulic capacity from 31,500 to 62,100 cfs, substantially reducing occurrences of spillage over Holtwood dam. The volume of usable storage within Lake Aldred is relatively small, especially during the summer recreation season, and would remain unchanged under the proposed action. The total amount of water released downstream on a daily basis would generally continue to be dictated by the amount of water received from the Safe Harbor Project operations and the run-off from intermediate drainages, less reservoir evaporation. Implementation of the daily volumetric minimum flow release, the 200-cfs conservation releases to Piney Channel and to the bypassed reach, and the drought operations plan would increase minimum daily and continuous discharges to the lower Susquehanna River below the Holtwood Project. The conservation releases also would provide a continuous flow to areas below the dam that (except for minor leakage) currently receive flow only when the dam is spilling.

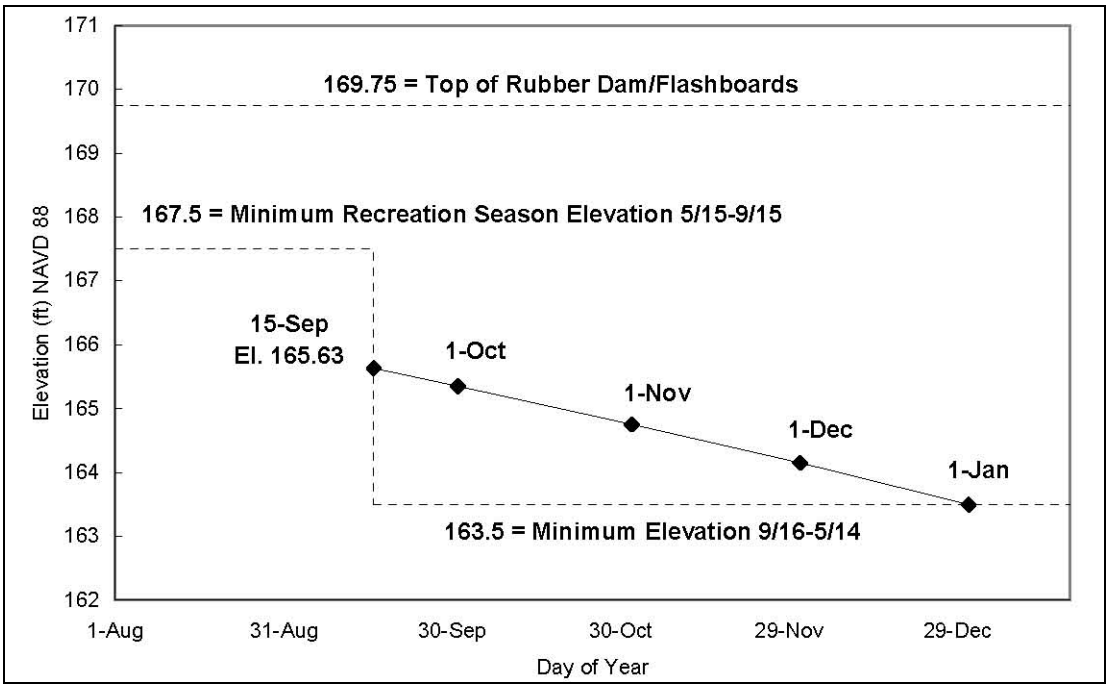
Effects of Proposed Operations on the Water Level of Lake Aldred

As noted in section 2.2.2, PPL proposes to modify the operation of Lake Aldred so that reservoir water elevations would change slightly from current operations.

Under its proposed operations, PPL would provide a minimum flow of 200 cfs to Piney Channel and would release up to 44 acre-feet per day (about 22 cfs) from Lake Aldred during drought conditions, for compensation flows for upstream water consumption at other PPL generation facilities within the Susquehanna River watershed.[20] These proposed operations could result in drawdowns below the summer-time minimum El. of 167.5 feet during drought conditions, although modeling indicates that this typically would occur in late-summer or early-fall, at about the time the minimum level would change to El. 163.5 feet (September 15). Thus, PPL proposes a new rule curve for drought operations between September 15 and December 31, whereby the minimum pond level would drop to El. 165.63 feet on September 15 and then on a straight line to El. 163.5 feet on January 1 (figure 6). This would result in maintenance of higher reservoir levels during the fall months during drought year operations.

---

[20] This value includes the proposed consumptive use at the Brunner Island Steam Electric Station downstream of Harrisburg, PA, and requires approval by SRBC.



Notes: Elevations for October 1 = 165.3, November 1 = 164.7, and December 1 = 164.1.

Figure 6. Proposed post-recreation season drought operations rule curve for the 44 acre-feet compensation flows. (Source: PPL, 2007a)

The COA also provides for PPL to operate the amended project to release the lesser of either the net daily inflow to Lake Aldred or a minimum streamflow (including leakage) equal to, on a daily volumetric basis, 98.7 percent of the minimum flow required by the Commission (QFERC) to be released at the downstream Conowingo Project as shown in table 9. The inflow to Lake Aldred includes releases from the Safe Harbor Project and inflow from tributaries such as Pequea Creek and the Conestoga River that enter Lake Aldred directly, minus reservoir evaporation. The COA does not specify where this minimum release would be made from the project, except that it would include all releases, including leakage, so some of the minimum flow would likely be made through the powerhouse into the tailrace. In its draft Minimum Stream Flow Operating Procedures (MSFOP) manual filed on June 19, 2008, PPL also proposes to release the lesser of either a continuous minimum flow of 800 cfs from the project, or net inflow to Lake Aldred. MSFOP flows would begin at the latter of either the initiation of Unit 1 discharges to Piney Channel or the initial operation of the new exciter replacement units in the existing powerhouse. The settlement agreement between PPL and Exelon dated May 5, 2008, states that the provision of these flows would not be delayed beyond 3 years after the date of the Commission's final order approving the Holtwood license amendment. According to the MSFOP, this continuous minimum flow is a provision of the settlement agreement between PPL and Exelon (the Conowingo and Muddy Run

licensee), which on October 23, 2008, was filed with the Commission. No other flow recommendations have been made by commenting entities.

Table 9. Conowingo Project licensed minimum flows, and minimum flows (cfs) that would be released from the Holtwood Project to meet the 98.7 percent requirement. (Source: PPL, 2007a, exhibit B)

Period	Flow (cfs)	98.7 Percent[a]
March	3,500	3,455
April	10,000	9,870
May	7,500	7,403
June 1–September 14	5,000	4,935
September 15–November 30	3,500	3,455
December 1 until end of February	1,750[b]	1,727

[a] 98.7 percent is the approximate drainage area difference between the Holtwood and Conowingo Projects.

[b] During this period, the daily average minimum flow is 1,750 cfs, which can be met by intermittent flows such as up to 6 hours of no flow followed by 6 hours of flow at 3500 cfs and the rest of the day at 1,750 cfs, resulting in a daily average minimum flow of 1750 cfs.

As an alternative trigger flow for drought operations, the 7-day 10-year low flow (Q7-10 flow) has been suggested by SRBC, but the QFERC flow is higher than the Q7-10 flow of 2,743[21] cfs and therefore more restrictive.

Our Analysis

Analyses conducted by PPL with the OASIS[22] modeling indicate that except under extreme low inflow conditions, PPL would be able to operate the Holtwood Project and maintain Lake Aldred under the proposed reservoir elevations. However, the analyses showed that there would be occasions when the combination of the effects of reservoir evaporation, the conservation releases, and daily volumetric releases would cause the

[21] This is the PPL estimated Q7-10 value at USGS gage no. 01576000 Susquehanna River at Marietta, PA upstream of the Holtwood Project, but representing about 97 percent of the drainage area at the Holtwood Project.

[22] OASIS is a hydrological model developed by HydroLogics, Inc., which is widely used to model hydropower projects and reservoir systems.

summer recreational pool levels to fall below El. 167.5 feet. Three scenarios were modeled by PPL:[23]

- without drought operations (about 250-cfs minimum flow);
- drought operations using the Q7-10 trigger; and
- drought operations using the QFERC trigger.

As expected, the OASIS modeling showed that the greatest effect on Lake Aldred water levels would occur under the QFERC trigger flow as compared to the other two scenarios. Table 10 shows that the greatest effect would be from September 1 to September 15. After September 15, the proposed water level drops to El. 163.50 feet (see figure 6). For comparison purposes, table 10 also provides the water levels expected in the September 1 to 15 time frames without drought operations and under the Q7-10 trigger flows. Table 11 shows that during the May 15 to October 30 period, inflow to Lake Aldred drops below the QFERC flow trigger rarely in July, about 10 percent of the time in August, 20 percent of the time during the September 1 to 15 period, and less than 10 percent of the time during the last half of September and the month of October.

Table 10. Lake Aldred water surface elevation (feet) with proposed daily volumetric minimum flow releases, conservation releases, and with drought operations with the QFERC trigger. (Source: PPL, 2007a, as modified by staff)

% Exceedance	May 15–31	June	July	August	Sept 1–15	Without Drought Operations Sept 1–15	Q7-10 Sept 1–15
100	167.47	167.56	167.61	166.28	165.97	166.57	166.41
99	167.67	167.67	167.67	167.48	166.13	166.79	166.62
98	167.67	167.67	167.67	167.67	166.73	167.22	167.02
97	167.67	167.67	167.67	167.67	167.17	167.58	167.48
96	167.67	167.67	167.67	167.67	167.38	167.67	167.55
95	167.67	167.67	167.67	167.67	167.67	167.67	167.67
90	168.08	167.67	168.08	168.08	167.79	168.02	167.95
85	168.08	168.08	168.08	168.29	168.08	168.11	168.08
80	168.50	168.08	168.50	168.50	168.34	168.42	168.41

Note: For comparison purposes, the September 1–15 elevation results for the without drought and Q7-10 trigger are also provided.

[23] The modeling did not include the 800-cfs minimum flow that recently was proposed as part of the Exelon-PPL Settlement Agreement.

Table 11. Inflow (cfs) to Lake Aldred based on data from USGS gage no. 01576000 Susquehanna River at Marietta, Pennsylvania. (Source: USGS, 2008)

	May 15–31	June	July	August	Sept 1–15	Sept 16–30	October
Minimum Flow	8,948	4,979	2,660	2,691	1,990	1,423	1,495
QFERC Flow	7,403	4,935	4,935	4,935	4,935	3,455	3,455
% Exceedance							
95	14,378	8,804	4,716	3,756	3,121	2,875	3,601
90	16,063	10,380	5,751	4,497	3,905	3,504	4,208
80	19,696	12,782	7,365	5,456	4,922	4,418	5,356

Note: To represent the slightly larger drainage area at Holtwood, these values were prorated by 1.0309.

Table 10 also shows that during normal and above-normal inflow conditions, the proposed action would not noticeably affect Lake Aldred water levels. During some flood events, the proposed action would have only a very minor effect on the water level in Lake Aldred because more water could be routed through the powerhouse, but during most of the larger flood events that exceed the proposed hydraulic capacity of the project, the effect would not be noticeable.

Additional effects of proposed operations on the reservoir level of Lake Aldred are addressed in *Fishery Resources* below, section 3.3.4.2 in *Terrestrial Resources*, and section 3.3.5.2 in *Recreational Resources*.

Effects of Proposed Operations on Spill Frequencies

The proposed operations would result in more flow used by generation after the construction of the new powerhouse. Under proposed conditions, the maximum generation flow would increase from the existing 31,500 to 62,100 cfs, resulting in a higher percentage of flow directed to the tailrace and a corresponding decrease of spillage at Holtwood dam.

Our Analysis

Based on flow records at Holtwood dam between 1917 and 1996, table 12 provides a summary of the expected reduction in the occurrence of spillage over Holtwood dam. PPL also plans to counteract the hydraulic and environmental effects associated with this change in flow distribution by substantial excavation of the tailrace area.

Table 12. Average monthly and annual spillage over Holtwood dam under current and proposed project operations. (Source: PPL, 2007a, exhibit B)

Month	Percent of Time River Flow Exceeds Current Capacity (31,500 cfs)	Percent of Time River Flow Exceeds Proposed Capacity (62,100 cfs)
January	42.7	18.5
February	47.2	20.7
March	86.6	51.6
April	91.3	53.3
May	65.3	26.9
June	29.2	9.7
July	15.1	6.3
August	8.1	6.1
September	11.0	6.4
October	17.5	9.2
November	36.1	14.1
December	47.6	20.6
Annual	38.2	17.2

Additional effects of proposed operations on spill frequencies are addressed in *Water Quality* and *Fishery Resources* below, section 3.3.4.2 in *Terrestrial Resources*, and section 3.3.5.2 in *Recreational Resources*.

Effects of Proposed Excavation of the Existing Tailrace Area and the Piney Channel Area on Flow Conveyance Capacities and Velocities

The tailrace channel would be widened and deepened to accommodate flows from the new powerhouse that would be twice as large as existing flows in the tailrace. PPL indicates that the tailrace excavation has been designed to limit changes to elevation and velocity in the tailrace area, so the functioning of the existing and proposed turbines are not affected and water velocities in the tailrace area do not hinder upstream fish passage.

PPL would also excavate in Piney Channel to improve the hydraulics for upstream fish passage and ensure that flow releases into the Piney Channel are distributed in the most effective way to enhance habitat protection and recreational resources including whitewater paddling recreation. The proposed diversion of the Unit 1 discharge from the tailrace to the channel on the west side of Piney Island would result in approximately 1,200 to 3,150 cfs of water flowing through Piney Channel during generation periods.

During non-generation periods PPL purposes to maintain a minimum conservation flow to the Piney Channel of 200 cfs.

Our Analysis

PPL indicates that it would need to excavate about 807,000 cy material, mostly bedrock in the tailrace area to allow for the larger discharge capacity of the expanded project. The excavation would occur between the eastern shore of the tailrace and Piney Island. The excavation is intended to preserve the current water surface elevations in the tailrace under the higher flows, and therefore should not increase overflow onto Piney Island. The excavation plan was developed by PPL after extensive bathymetric studies and modeling to ensure that water levels would not increase under proposed conditions. In addition, the plan provides for somewhat lower flow velocities through this area to ensure a suitable zone of fish passage based on criteria developed with the resource agencies. The zone-of-passage criteria are a depth of at least 3 feet over a 12-foot wide area and velocities that are ≤6 fps. Under the proposed conditions, there are two key areas for maintaining these criteria in the tailrace—the upper area near the powerhouses and the lower area near the downstream end of Piney Island. Figures 7 and 8 present flow velocities in these areas. Both figures indicate that even at full generation, which PPL describes as a the worst case scenario, there would be low velocity zones especially on the Piney Island side of the channel to provide better upstream shad migration routes.

Based on the same modeling, PPL developed existing and proposed tailwater rating curves (figure 9). This figure shows that in the upper reaches of the tailrace near the proposed and existing powerhouses, at the proposed maximum generation capacity of 62,100 cfs, the tailwater elevation would be slightly lower than the tailwater elevation that occurs at 31,500 cfs for the existing powerhouse.

Approximately 71,000 cy of material would be excavated downstream of the dam in Piney Channel west of Holly Island to accommodate the rerouted discharge from Unit 1 (see figure 2). Under existing conditions, during non-spillage periods, this area receives about 15 to 51 cfs from a combination of leakage through the dam, leakage from the flashboards and flow from a 10-inch-diameter pipe near the middle of the dam. Figure 10 shows that under proposed conditions when Unit 1 is operating at 3,150 cfs, most of the velocity in this area would be under 3 fps with a few areas such as near the Storm Hole whitewater feature having higher velocities in the 7 to 9 fps range. Figure 10 also shows 261 cfs or more would spread out over a large portion of the larger area below the main bypassed reach. Table 13 provides a summary of the flows and depths in the Piney Channel area based on flow releases of 3,150, 1,200, and the conservation flow value of 200 cfs from Unit 1.

Additional effects of proposed excavation of the existing tailrace area and the Piney Channel area are addressed in *Water Quality* and *Fishery Resources* below, section 3.3.4.2 in *Terrestrial Resources*, section 3.3.5.2 in *Recreational Resources*, and section 3.3.6.2 in *Land Use and Aesthetic Resources*.

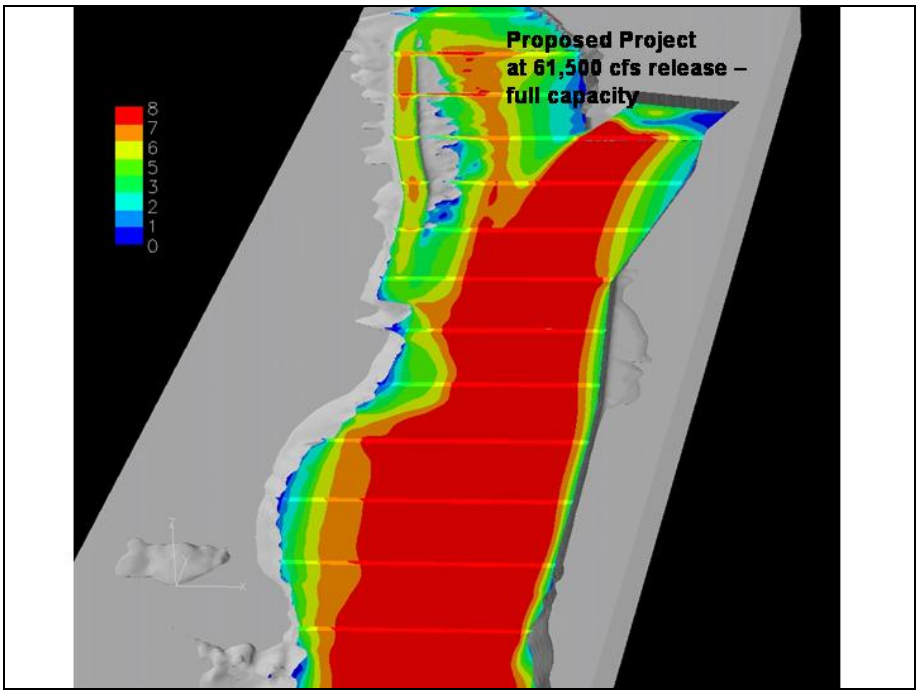


Figure 7. 3-D modeling of the upper tailrace area of the Holtwood Project under full generation. (Source: PPL, 2007a)

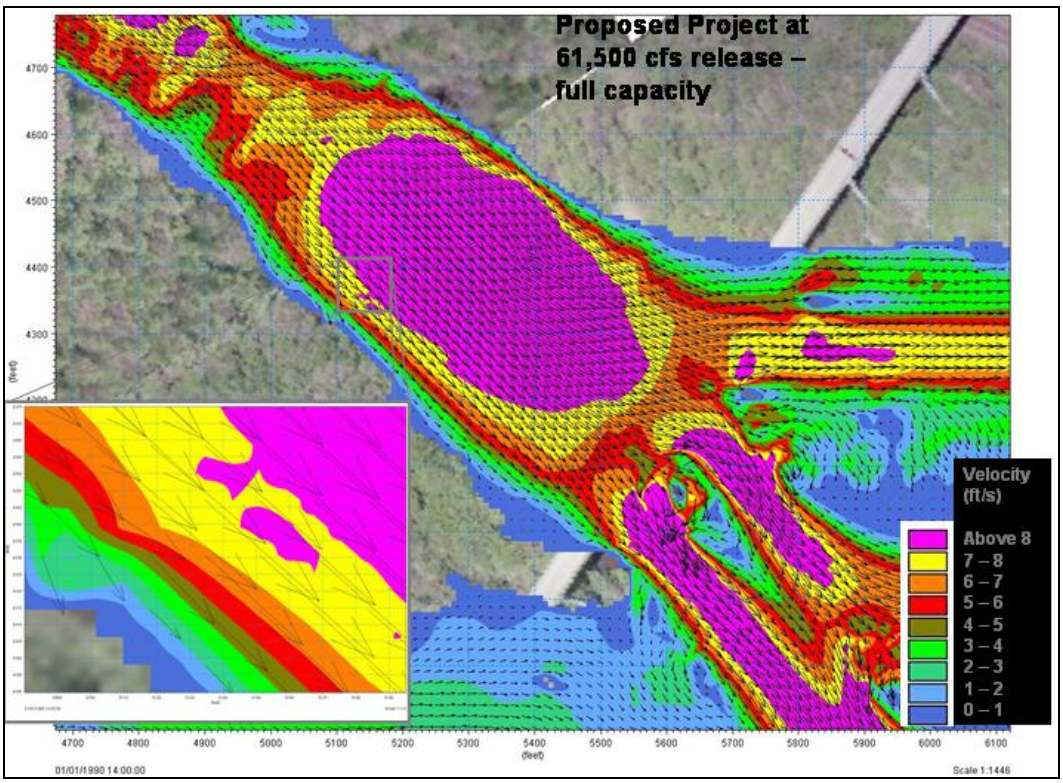


Figure 8. 2-D modeling of the lower tailrace area of the Holtwood Project under full generation. (Source: PPL, 2007a)

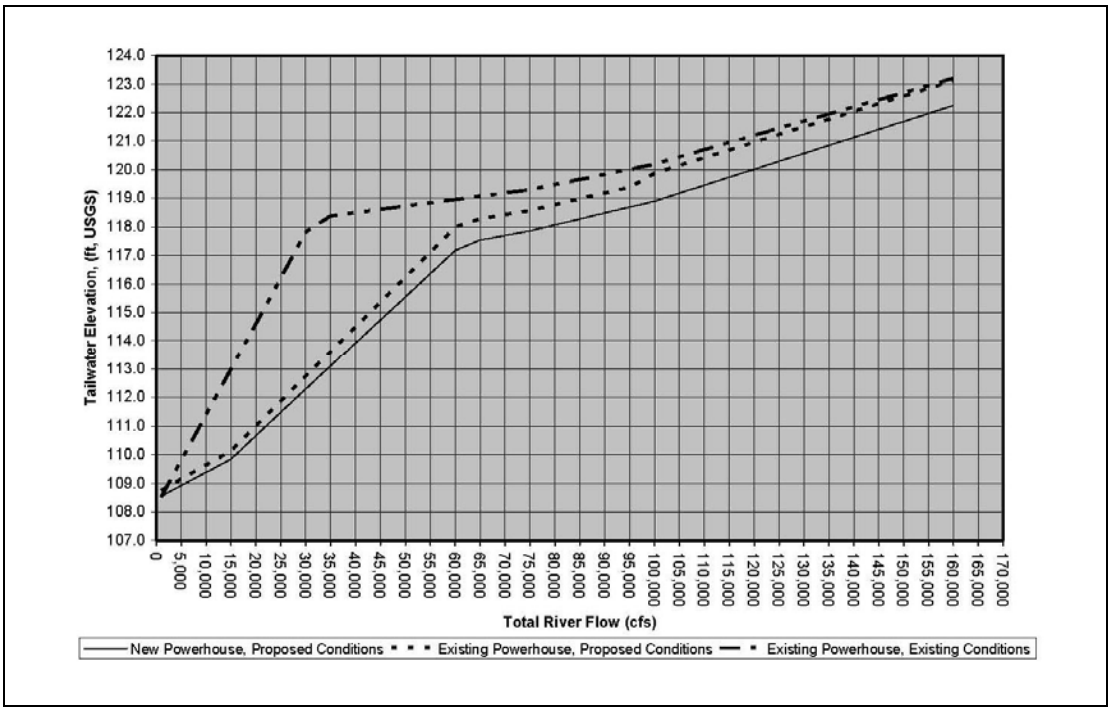


Figure 9. Calculated tailwater rating curves for existing and proposed conditions. (Source: PPL, 2007a)

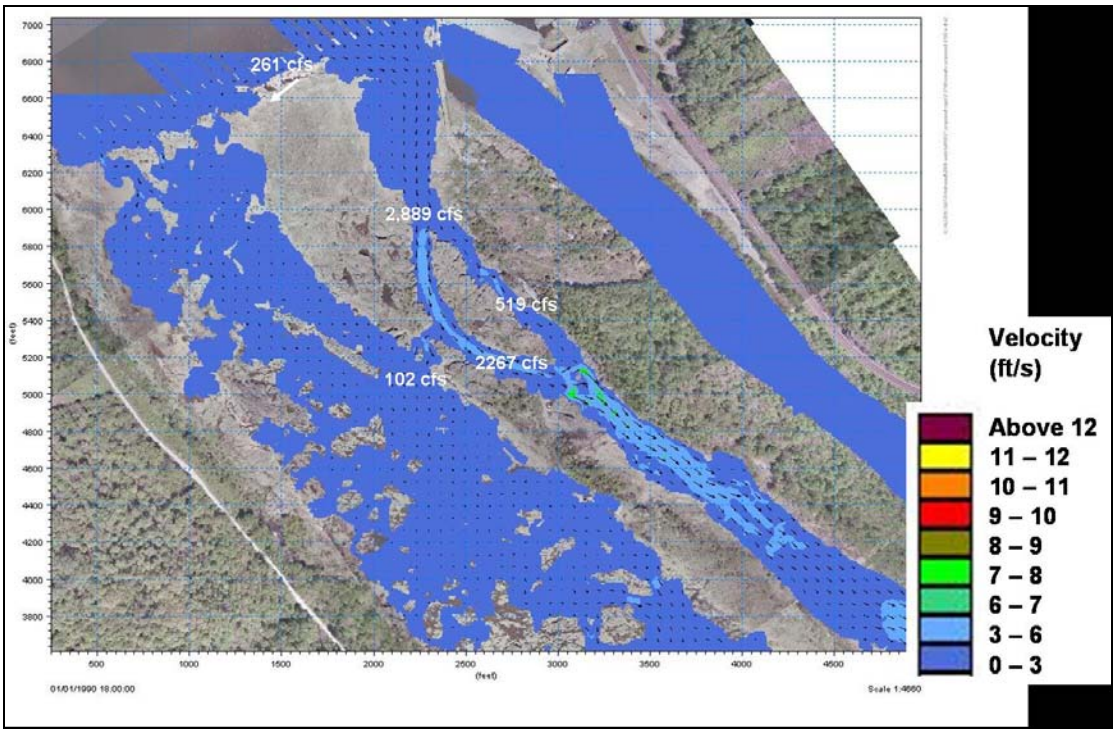


Figure 10. 2-D modeling results for velocity in the Piney Channel and bypassed reach with a proposed release of 3,150 cfs from Unit 1. (Source: PPL, 2007a)

Table 13. Flow velocities and depths in Piney Channel from Unit 1 releases. (Source: PPL, 2007a)

Flow from Unit 1 (cfs)	General Piney Channel Velocity (feet/second)	Velocity (feet/second) near Storm Hole	General depth in Piney Channel (feet)
3,150	2 to 3	7 to 9	4 to 10
1,200	1 to 4	As high as 5	Greater than 3
200	Less than 1	About 2 to 3	Generally 1 to 3

Effects of the Proposed Operation on Inflow to the Downstream Conowingo Reservoir

Currently the Holtwood Project does not have a minimum flow requirement. However, leakage through the dam, flashboard leakage, and leakage through the generating units normally supply 220 to 250 cfs to Conowingo reservoir. Under its proposed operations, PPL would operate the amended project to release inflow to Lake Aldred or a minimum streamflow (including leakage) equal to, on a daily volumetric basis of 98.7 percent of the minimum flow required by the Commission (QFERC) to be released at the downstream Conowingo Project (table 9). In addition, during drought conditions, PPL would release up to 44 acre-feet per day (about 22 cfs) from Lake Aldred, for compensation of upstream consumptive water withdrawals at other PPL generation facilities within the Susquehanna River watershed.[24] In its draft MSFOP filed on June 19, 2008, PPL also proposes to begin at the latter of either the initiation of Unit 1 discharges to Piney Channel or the initial operation of the new exciter replacement units in the existing powerhouse, to release the lesser of a continuous minimum flow of 800 cfs from the project, or release the amount of flow to the Conowingo Project equal to the net inflow to Lake Aldred.

Our Analysis

The Conowingo Project is almost totally reliant on inflow from Holtwood, except for short-term fluctuations caused by operations of the Muddy Run Pump-Storage Project. Only two relatively substantial tributaries enter Conowingo reservoir downstream of Holtwood—Muddy Creek and Conowingo Creek—which in combination with smaller tributaries have a total drainage area of about 300 square miles. This equates to only slightly more than 1 percent of the total drainage area at Conowingo. The Muddy Run Pump-Storage Project, Peach Bottom Nuclear Atomic Station, and two

[24] Mitigated releases from Lake Aldred for upstream water withdrawals require approval by SRBC.

municipal water intakes are located on Conowingo reservoir (see figure 1). Critical operational levels for these facilities are provided in figure 11. In addition to the importance for maintaining water levels within Conowingo reservoir for these facilities, releases from Conowingo are the major source of fresh water for the upper end of the Chesapeake Bay.

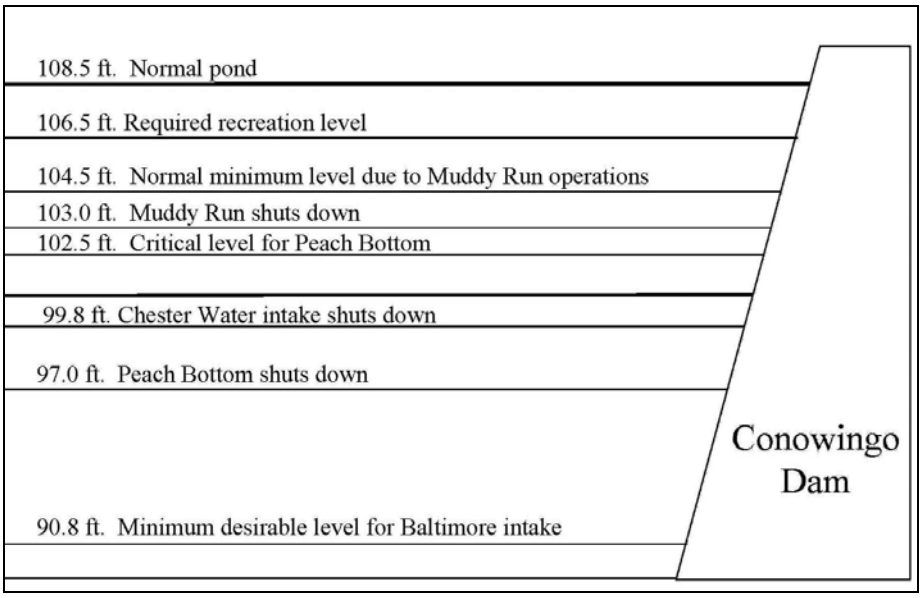


Figure 11. Critical operational elevations in the Conowingo reservoir. (Source: Brownell, 2007)

PPL conducted modeling of the existing and proposed conditions at Holtwood with use of the OASIS model to replicate the hydrology under historic and proposed management conditions based on 1930 to 2002 hydrologic data.[25] All of the modeling used current operation parameters for the Conowingo Project and the Muddy Run Pump-Storage Project throughout the modeling period, even though the Muddy Run Pump-Storage Project was not operational until the late 1960s. Table 14 provides a summary of the results of the modeling for the entire timeframe:

- historical Holtwood operating conditions;
- without drought operations;
- drought operations using the Q7-10 trigger; and
- drought operations using the QFERC trigger.

Hydrological modeling, no matter how detailed is not expected to be 100 percent accurate because of the numerous variables involved. However, the results of the OASIS

[25] As previously noted, this modeling did not include the recently proposed 800-cfs minimum flow from the Holtwood Project.

hydrological modeling shown in table 14 demonstrate that the ability of the licensees of the Conowingo Project and Muddy Run Pump-Storage Project (both owned by Exelon) to maintain Conowingo reservoir levels would substantially improve under proposed conditions with or without drought operations and in combination with the continued release of minimum flows from the Conowingo Project to the lower Susquehanna River.

Table 14. Recreation season modeled end-of-day Conowingo reservoir levels. (Source: PPL, 2007a)

	Existing Holtwood Conditions	Without Drought Operation	With Drought Operations (Q7-10 trigger)	With Drought Operations (QFERC trigger)
1930–2002				
June median	108.50	108.50	108.50	108.50
July media	108.50	108.50	108.50	108.50
August median	108.00	108.06	108.06	108.06
September 1–15 median	107.41	107.70	107.72	107.72
June 1–September 15 minimum	100.50	101.75	101.74	101.76

Under proposed conditions, PPL would have the ability to discharge approximately 62,100 cfs from the powerhouses instead of the current 31,500 cfs. The maximum hydraulic capacity of Conowingo, as licensed, is 85,000 cfs. The combination of the discharge from Holtwood under proposed conditions and from the Muddy Run Pump-Storage Project, which has a maximum capacity of 32,000 cfs,[26] exceeds the capacity at Conowingo by approximately 9,000 cfs. However, based on the useable storage volume of 5,833 acre feet at Lake Aldred during the summer when inflows are normally the lowest (a mean value below 15,000 cfs), PPL could only maintain a flow rate of 62,100 cfs for under 2 hours without violating the minimum reservoir levels at Lake Aldred. A flow of 9,000 cfs (in excess of the Conowingo hydraulic capacity) for 2 hours is about 1,500 acre-feet or less than 5 percent of the usable storage of Conowingo reservoir for its normal range of operation between El. 104.5 and 108.5 feet. Therefore,

[26] This is the maximum generating flow, which occurs during periods of the day with maximum electrical demand. The project also withdraws water from Conowingo reservoir during off-peak periods (nights and weekends).

spillage at Conowingo reservoir should not occur under these low flow and peak demand conditions.

Under higher flow and flooding conditions, the proposed operations at Holtwood would not affect downstream conditions because of the minor amount of storage within Lake Aldred.

Additional effects of proposed excavation of the existing tailrace area and the Piney Channel area are addressed in *Water Quality* and *Fishery Resources* below, section 3.3.4.2 in *Terrestrial Resources*, section 3.3.5.2 in *Recreational Resources*, and section 3.3.6.2 in *Land Use and Aesthetic Resources*.

Water Quality

Potential effects on water quality would occur during both the construction and operational phases of the amended project. Project construction would involve major areas of excavation related to: construction of the new forebay and powerhouse, excavation to widen and deepen the tailrace to accommodate the increased flows from the powerhouse, and excavation in the bypassed reach to improve the hydraulics for fish passage. A total of about 1.9 million cy of material would be excavated and removed from the site. There would also be access road construction and operations associated with these excavation activities, to allow equipment to access the sites and remove excavated materials. Much of the area to be excavated would be bedrock, but there still would be the potential for release of fines, including during the construction and removal of the access roads.

Project operations would result in the approximate doubling of river flows passing through the generating units, compared to existing operations, with the project hydraulic capacity increasing from 31,500 to 62,100 cfs. This would substantially reduce the spillage over Holtwood dam, potentially reducing the aeration effect of that spillage. During low-flow periods, however, PPL proposes to release a 200-cfs minimum conservation flow into the Piney Channel and bypassed reach.

Our Analysis

No entities made specific recommendations for protecting water quality during construction, but PPL indicates that it is preparing an erosion and sedimentation control plan in consultation with Pennsylvania DEP and other agencies, and that it would be required to obtain National Pollutant Discharge Elimination System and section 404 permits for construction. These measures would likely protect water quality during construction, although some unavoidable runoff of sediment and fines may still occur, particularly in areas that would involve in-river construction. PPL would attempt to do as much work as possible in the dry behind cofferdams, however, because of the large area proposed for excavation and access roads, particularly at the lower end of the tailrace, some in-river work would likely be required. We recommend that PPL be required to

file its erosion and sedimentation control plan with the Commission for approval prior to the commencement of construction to ensure that appropriate erosion control measures and best management practices would be used during the construction period.

Once the amended project begins operation, river flows would be distributed differently than under current operations, with more flow passing down the tailrace and less spillage over the dam. Table 12 shows the average monthly spillage that would occur under current and proposed operations. This would reduce spillage on an annual basis from about 38 to 17 percent of the time, with the greatest monthly reductions occurring during the spring months, when water quality (DO) would not be a concern. During the summer months, when lower DO levels have occurred in the Susquehanna River, spillage is currently uncommon, although it would be further reduced under proposed operations. Aeration from summertime spillage would not likely be a significant factor under current operations, so additional reduction in this spillage under proposed operations would have little effect on water quality. Studies have indicated that DO in the isolated pools in the Holtwood bypassed reach are currently controlled by the photosynthesis/respiration cycle, and this would continue to be the case under proposed operations, for most of the bypassed reach. One exception would be in the Piney Channel, which is proposed to receive a minimum conservation flow of 200 cfs. This flow would act to improve water quality by maintaining riverine conditions in the channel, likely connecting some of the isolated pools in the area, and acting to reduce the effects of the photosynthesis/respiration cycle.

The existing generating units at Holtwood dam provide some aeration during operation (0.2–0.8 mg/L), but the proposed new units are not expected to provide that aeration benefit. During the summer months, most of the flow from the Holtwood Project would be released through the generating units, and it is expected that the new more efficient units would be preferentially operated. This could result in somewhat lower DO levels in the tailrace, and although current operations seldom result in DO levels that do not meet state standards, there is the potential that the frequency of violations could increase. Pennsylvania DEP, in its April 15, 2008 request for additional information on PPL's application for WQC, requested that PPL provide a DO monitoring plan for the tailrace, Piney Channel, and the bypassed reach. PPL, in its June 13, 2008 response to DEP, disagrees that there is any indication of a potential DO problem at the project, but at the same time proposes to conduct monitoring studies to identify whether Holtwood operations affect DO levels, and to identify measures that could be implemented to improve any lower DO levels observed. PPL proposes to conduct the studies from 2010 through 2012, so that both existing and proposed conditions can be studied. Implementation of these proposed studies, which would include DO monitoring during the summer months in the tailrace, should identify whether any increase in violations is occurring as a result of the operation of the new units, and would allow PPL to implement measures that would improve DO levels in the tailrace. Any DO monitoring plan would be prepared in consultation with Pennsylvania DEP and other agencies, and would be filed with the Commission for approval.

Fishery Resources

Proposed construction and operation of the amended project would have the potential for substantial effects on the local fishery resources, both beneficial and adverse. These would include effects of construction activities on the migration of fish through the project area, and on spawning and other life history stages of resident species; effects of proposed reservoir operations on aquatic resources in Lake Aldred; effects of proposed fish passage improvements on the efficiency and success of upstream and downstream fish passage at the project; effects of increased entrainment of both resident and diadromous fishes as a result of increased flows passing through the generating units instead of over the spillway; and effects of proposed project flow releases on aquatic resources in both the bypassed reach and tailrace channel downstream of the project.

Effects of Construction

The proposed construction would affect a large area in the vicinity of the project, including Lake Aldred immediately upstream of the dam (new skimmer wall, enlarged forebay, and new powerhouse), and large areas of river bed and shoreline excavation in the tailrace from the immediate vicinity of the powerhouse to well downstream of the Norman Wood Bridge (Route 372). Some excavations are also planned in the bypassed reach to the west of Piney Island. Construction effects would include direct disturbance and loss of aquatic habitat via excavation and placement of new facilities; mortality or disturbance of fish due to blasting, resulting in fish avoiding important habitat areas or altering migration patterns; and construction runoff of sediment or fuel/chemicals, adversely affecting water quality in the vicinity of important habitat areas. Some commenting entities have expressed concern about the scale of the construction and effects on riverine habitat, and Interior included a preliminary fishway prescription to require the licensee to file a plan detailing how it would maintain uninterrupted fish migration and operation of the fish passage facilities during construction. Interior also recommended preparation of a compensatory mitigation plan for the loss of river and wetland habitat, and later clarified that this recommendation was related primarily to ensuring that upstream passage of American shad during the construction of the Holtwood Project expansion would be no less efficient than during the previous 11 years of operation of the Holtwood fish lifts (letter from L.M. Miller, Project Leader, Mid-Atlantic Fishery Resources Office, FWS, Harrisburg, PA, to K.D. Bose, Secretary, FERC, filed September 5, 2008). This recommendation was also the subject of discussion during a section 10(j) teleconference on September 3, 2008. In its June 13, 2008, response to the Pennsylvania DEP April 15, 2008, request for additional information on PPL's application for WQC, PPL provided updates on its final excavation plans and its plans for minimizing/mitigating effects of construction on aquatic resources.

Our Analysis

PPL indicates that it would excavate about 1.9 million cy of material, most of which would be bedrock, and thus would require substantial blasting. Much of the excavation as currently proposed (figure 2) would occur in the river channel, in and along the tailrace, in the bypassed reach, and in Lake Aldred immediately above the dam. Most of these areas probably are not prime fisheries habitat (such as spawning or early nursery habitat) because of the depths or velocities (too deep or too swift), or the substrate (primarily bedrock). Some areas are also not currently wetted habitat. For example, the area where the new forebay and new powerhouse would be placed is currently a land area—the site of the former steam generating station. Thus, it is unlikely that resident fish would be substantially affected by construction activities. Some fish could be affected by blasting, by avoiding areas that are close to blasting activities, although much of the blasting work would likely be conducted in the dry behind cofferdams. The extent of in-water blasting, however, has not been provided by PPL, so there still could be some direct fish mortality by in-water blasting. PPL indicates that many of the final details of construction would not occur until a contractor is selected and final plans are formulated by the contractor. This is understandable, but PPL should file additional details of its final excavation plans with the Commission and state/federal agencies, prior to commencement of construction. Details of blasting activities should be filed and approved prior to the initiation of construction activities that involve blasting. Any fish that would avoid areas of heavy construction activities would likely continue to function in other areas that are undisturbed by construction.

Many of the areas proposed for construction, however, are used by migratory fish during their upstream and downstream migration. Upstream migrating fish use the tailrace and bypassed reach during the spring migrations, and the exit from the fish lifts deposits fish immediately upstream of the dam in the vicinity of the skimmer wall. Any blasting or excavations in these areas during fish migration periods could act to delay migration or prevent fish from continuing their migration. PPL would need to schedule construction activities to avoid the migration periods and those areas that are used by migratory fish during the migration periods. We agree with the Interior preliminary fishway prescription to require PPL to file a plan detailing how it would maintain uninterrupted fish migration and operation of the fish passage facilities during construction. In its June 13, 2008, filing in response to Pennsylvania DEP, PPL provides a draft plan for avoiding fish migration periods during construction. While this plan appears generally adequate, it should be updated as the final construction plans are prepared by the selected contractor.

We also agree with FWS that the efficiency of shad passage during project construction should be maintained at a minimum level equal to the average passage efficiency (adjusted by river flow) that has occurred since the Holtwood fish lifts began operation in 1997. FWS indicated that the average efficiency from 1997 through 2007 was 33.7 percent, which is the percentage of the shad passed at the Conowingo Project that were also passed at Holtwood. Although FWS believes that level of efficiency is not

adequate for long-term restoration of American shad to the basin, it is willing to accept that as the minimum efficiency during the 3-year construction period. Both FWS and Pennsylvania FBC also indicated, during the September 3, 2008, teleconference, that the target efficiency for each year of construction should be based on the mean May river flow, which has been shown to have a relationship to passage efficiency at Holtwood (efficiency is typically low during high flow years and higher during low flow years). Both agencies stated that any loss of upstream shad production, even for 1 year, as a result of construction-related effects on fish passage, could have effects 4 to 6 years in the future, as that year-class returns to spawn.

FWS recommends that the efficiency of upstream passage of shad at Holtwood be determined during each year of construction, based on fish lift counts at both Conowingo and Holtwood. If the minimum efficiency level is not met, then PPL should mitigate for the loss of production by those shad that failed to reach upstream spawning areas during the following year by stocking additional shad fry in the Susquehanna River. FWS presents a regression equation based on percent efficiency versus mean May river flow for the 11 years of fish passage data included in the license amendment application, and recommends that equation be used to determine the target efficiency in any year based on the mean May river flow. If the target efficiency is not met, PPL would mitigate for the number of shad that failed to achieve passage at Holtwood by stocking additional shad fry the following year, based on 2,050 fry per fish that failed to achieve passage.[27]

We generally agree with FWS's concept for mitigating any adverse effects on passage that may occur. However, we question FWS's use of its regression equation to determine the target efficiency, because the FWS method for developing this equation may not be valid statistically. FWS states that, because the plot of fish lift efficiency (in percent) versus mean May river flow indicated a non-linear relationship, the mean May flow data was $\log_{10}$ transformed and a "least squares" linear regression was performed on the transformed data set. Our review of this methodology indicates that, when using percent values as a dependent variable in regression analysis, an arcsine transformation of the data, not a $\log_{10}$ transformation, should be made. This would result in a regression equation with a lower r-square value, indicating that the relationship between mean May flow and fish lift efficiency is not as strong. PPL, in its comments filed on September 11, 2008, also questions the method used by FWS to determine whether construction activities are causing a decrease in shad passage, stating that the FWS methodology is flawed and does not provide a statistically valid approach for distinguishing between the variability in passage that has occurred at Holtwood over the years, and any effects of construction. PPL also states that the number of fry per adult fish proposed by FWS (2,050) is incorrect, and that any fry replacement rate should be based on recent Susquehanna River data that show that stocking of 314 fry is required to return one adult

[27] FWS states that the number of fry per adult shad is based on a stock recruitment analysis reported in Atlantic States Marine Fisheries Commission (2007).

shad to the river. Further, PPL points out that any fry replacement program may be limited by the number of shad eggs that typically are available for hatchery programs on the Atlantic coast.

We agree that there may not be a good basis for the FWS's use of 2,050 fry per adult,[28] but at the same time PPL's suggested number of 314 fry per adult may not be appropriate. The FWS recommended providing a number of fry that would be produced by naturally spawning adults if they were trucked upstream, but the 314 fry number suggested by PPL is the estimated number of fry stocked from the hatchery that results in the return of one adult shad to the river (Susquehanna River Anadromous Fish Restoration Cooperative, 2008).

We suggest a more simplistic approach to (1) determine the target efficiencies that should occur during the construction period, and (2) mitigate any reduced passage efficiencies during the construction period. Target efficiencies would be determined by ranking the mean May flows that have occurred during fish lift operations from 1997 through 2008, and averaging the actual efficiencies that have occurred over a range of flow brackets. Table 8 shows the mean May flow and Holtwood fish passage efficiency (as percent of the Conowingo passage lifted at Holtwood) for 1997 through 2008. Table 15 ranks the mean May flows from lowest to highest, along with the corresponding fish passage efficiency at Holtwood. Those data indicate that the 12 years of operation can be divided into three groups of 4 years, based on the mean May flows. The four lowest flow years have flows ranging from 18,750 cfs to 24,887 cfs; the four mid-flow years range from 30,630 cfs to 47,887; and the four high-flow years range from 53,790 cfs to 79,500 cfs. The average passage efficiency for each of the flow brackets is 54.9 percent for low flows, 26.4 percent for mid flows, and 14.8 percent for high flows. We suggest that a more simplistic approach for determining target efficiencies for each year of construction would be as follows:

Mean May Flow (cfs)	Required efficiency
< 30,000	55%
30,000–50,000	26%
> 50,000	15%

[28] According to table 10.6 in Atlantic States Marine Fisheries Commission (2007), the stock recruitment analysis shown is "hypothetical," and the primary purpose of table 10.6 is to assess the fish passage efficiencies that would be required at Holtwood and York Haven projects to achieve shad population growth in the river.

Table 15. Flows ranked, lowest to highest, with corresponding fish passage efficiency. (Source: Staff)

Mean May Flow (cfs)	Holtwood Passage as % of Conowingo Passage	Average for Flow Range
18,750	56.8	
20,590	49.8	
20,855	49.6	
24,887	63.2	54.9
30,630	30.8	
32,151	40.6	
42,050	20.2	
47,887	14.0	26.4
53,790	19.2	
58,368	3.1	
75,060	20.6	
79,500	16.2	14.8

Once the target efficiencies are determined for each year of construction, and assuming that a "shortfall" of adult fish occurs that year due to lower passage efficiency, FWS recommends that PPL mitigate that shortfall the following year by stocking shad fry equivalent to that lost production. We agree with the concept of providing mitigation for this lost production in the following year, but question whether mitigation should be provided only by stocking additional shad fry. Assuming that we use our target efficiencies stated above, and using 2008 passage data, the required passage at Holtwood would have been 5,178 shad (26 percent of the 19,914 shad passed at Conowingo). Even though no construction was occurring at Holtwood in 2008, the actual passage was 2,795 shad, or a shortfall of 2,383 shad. At 2,050 fry per fish, this would require that 4.885 million fry be stocked the following year. This number of fry is about the same as the total number of fry produced by Pennsylvania FBC in 2006, which required the collection of about 19 million shad eggs (Susquehanna River Anadromous Fish Restoration Cooperative, 2008). This illustrates that a shortfall of less than 2,400 fish may require additional fry production about equal to the entire fry production program, and that higher shortfalls could many times exceed the current program (a 5,000-fish shortfall would require production of more than 10 million fry). Using the PPL number of 314 fry-per-adult return, the required production would be 748,262 fry. Using the hatchery survival from egg to fry of about 26 percent from above, about 2.9 million eggs would be required to produce that number of fry. Based on discussions during the September 3,

2008, teleconference, the current shad egg supply on the Atlantic coast is limited, and it is doubtful that the current egg supply could support additional production for mitigating any construction-related effects.

The above example illustrates that an alternative method for mitigating any construction effects on Holtwood passage should be considered. The most logical alternative would be to truck adult fish from Conowingo in the year following a shortfall at Holtwood due to construction. Once a shortfall has been determined to have occurred at Holtwood, the resource agencies and PPL would have nearly a year to determine the best method for mitigating the shortfall the following year, and if trucking is an option that would be implemented, this would allow sufficient time for PPL to mobilize trucks and equipment and to coordinate with the Conowingo licensee on the logistics of trucking shad from Conowingo. The west lift at Conowingo is still operated to collect shad for tank spawning and may also be available for providing adult shad for trucking.

The above example also shows that it may be difficult to identify an effect of construction versus other effects on fish passage that may be occurring on the lower Susquehanna River in any one year (fast rising water temperatures, Conowingo or Muddy Run operations, etc.). Consultations among the agencies, PPL, and the Conowingo licensee immediately after the conclusion of the spring fish passage operations would be an important step in determining whether construction at Holtwood or other factors may have influenced passage efficiency at Holtwood. Thus, we conclude that to mitigate any effects of project construction on fish passage efficiency at Holtwood, PPL should prepare a mitigation plan for Commission approval, after the post-season consultations described above. We expect that during those consultations, if construction effects are identified, PPL and the agencies would determine the shortfall of shad that would need to be mitigated, using the methodology we suggest above, and then determine the best method for mitigation; either additional fry production (if agreement can be made on the number of fry to be stocked, and if an adequate egg supply is expected to be available) or trucking of adult shad from Conowingo. The final mitigation plan, with agency comments on the plan, would need to be filed with the Commission for approval by September 1 (about 2.5 months after conclusion of the spring fish passage season), in order to allow sufficient time for Commission approval and for PPL to prepare for and implement the plan in the following spring.

Regarding runoff of sediment or fuel from construction areas, PPL indicates that it is preparing erosion and sedimentation control plans in consultation with Pennsylvania DEP and other agencies, and that it will be required to obtain National Pollutant Discharge Elimination System and section 404 permits for construction. These measures would likely prevent major adverse effects on water quality that could affect fisheries habitat, although some unavoidable runoff of sediment and fuel spills may still occur, particularly in areas involving in-water construction. As we stated above, it would be appropriate for PPL to file its erosion and sedimentation control plan with the Commission for approval prior to the commencement of construction, to ensure that appropriate erosion control measures and best management practices would be used

during the construction period. Implementation of this plan should protect fisheries habitat during construction.

Effects of Proposed Reservoir Operations on Aquatic Resources in Lake Aldred

As noted above, PPL proposes to modify the operation of Lake Aldred so that reservoir levels would change slightly from current operations. PPL proposed a new rule curve for drought operations that would result in maintenance of higher reservoir levels during the fall months during drought year operations. This is described in section 3.3.3.2 under *Water Quantity*.

Our Analysis

PPL's proposed changes in its reservoir operations are not substantially different than current operations for most of the year. Aquatic resources in Lake Aldred would continue to experience drawdowns of up to about 6 feet during the early spring, but then drawdowns would be reduced to about 2 feet during the remainder of the spring and summer months. In mid-September, a 6-foot drawdown would be re-established, unless drought operations are initiated and about a 4-foot drawdown would be implemented. Thus, early-spring spawners would continue to experience deeper drawdowns, but most spring spawners and adults and juveniles rearing during the summer months would continue to experience drawdowns of only about 2 feet. Adverse effects of the existing drawdown regime in Lake Aldred have not been documented, and the reservoir continues to provide a good warmwater fishery. The only difference in the proposed reservoir operations would be the potential reduced drawdowns during the fall months during drought operations. This should have a positive effect by maintaining more aquatic habitat later into the fall period.

Effects of Proposed Fish Passage Improvements

The proposed license amendment includes several measures to improve upstream fish passage at the project, as discussed in section 2.2.1.

All of the proposed enhancements to the fish passage facilities are included in the COA between PPL and Pennsylvania DEP (table A-2), and are generally supported by the other resource agencies. Interior's preliminary fishway prescription (table 2) also requires the same fish passage enhancements as provided for in the COA. Both the COA and Interior's prescription also include measures for evaluating the efficiency of the fish passage facilities and for making further improvements if the passage efficiency does not meet agreed to targets.

For downstream passage, PPL proposes to continue its current operational protocols of a combination of spillage and turbine passage through the generating units with known higher fish survival rates. The COA and Interior's preliminary fishway prescription also include measures for evaluating the efficiency of downstream passage by requiring discrete survival studies, establishing target survival rates (only the COA

provides target survival rates at this time), and making further improvements for downstream fish passage if target rates are not met (tables 2 and A-2).

The COA and Interior's preliminary fishway prescription also include provisions for the future development of upstream and downstream passage facilities for the catadromous American eel, as well as for evaluating the efficiency of the upstream and downstream eel passage facilities.

Our Analysis

Anadromous Species

As we described above, upstream fish passage for the primary species of interest in the Susquehanna River, American shad, has not been highly efficient at Holtwood since the fish facilities went into operation in 1997. Major identified problems with the system have been attraction of shad into the bypassed reach section of the river away from the powerhouse and the fish lift entrances; probable velocity barriers in the tailrace, reducing the number of fish that reach the powerhouse and its fish lift entrances; tailrace flow patterns that reduce the chances of fish successfully finding the fish lift entrances; and internal deficiencies in the fish lift, such as an entrance/crowder channel with shadows that discourages shad from proceeding further into the facility, and an attraction water supply system that can not operate at its full design capacity without causing vortices that may confuse fish at the exit channel. Our review of PPL's proposal to address the known deficiencies with upstream fish passage (the COA), and Interior's preliminary fishway prescription, indicates that PPL and the agencies have developed an adequate plan to address the deficiencies. Implementing these measures as part of the project expansion, which in itself should improve fish passage by reducing the attraction of fish into the bypassed reach, would likely result in an overall improvement in fish passage efficiency at the Holtwood Project.

Both the COA and Interior prescription also include provisions for the evaluation of the efficiency of the fish passage facilities, and for making further improvements if the passage efficiency does not meet agreed to targets. The COA specifies what those target efficiencies should be, but the Interior prescription does not. The COA specifies that there would be Tier I and Tier II studies and target efficiencies (table A-2). The Tier I target efficiencies are that at least 75 percent of the shad that pass the downstream Conowingo Project also pass through the amended Holtwood Project, and that 50 percent of the shad pass the Holtwood Project within 5 days of passage at Conowingo. If the 3 years of Tier I studies show that these target efficiencies are not met (based on an annual average among the 3 years), PPL would consult with Pennsylvania DEP and other agencies to develop a plan for a radio telemetry study to assess shad behavior below the project and to determine the percentage of shad that enter Holtwood Project waters and then successfully pass through the Holtwood fish passage facilities. This Tier II study would continue for a minimum of 4 years, concurrent with fish counts and PIT tag monitoring, to determine if at least 85 percent of the shad that enter Holtwood Project

waters successfully pass through the Holtwood fish facilities. If that target efficiency is not met at the end of the Tier II studies, the licensee would consult with the agencies and prepare a plan for additional operational or structural modifications to the fish passage facilities at the project to improve that efficiency.

This two-tier approach for evaluating fish passage improvements at the project is a reasonable technique for assessing the efficiency of the facilities. The target efficiencies also appear reasonable, although the COA does not provide the basis for the specific efficiencies. The Holtwood Project is the second project located only 25 miles upstream from Chesapeake Bay; therefore, the efficiencies should be higher so that a large portion of the shad population is able to successfully pass the Holtwood Project and the two upstream hydroelectric projects at Safe Harbor and York Haven to reach the most suitable and the larger area of spawning and rearing habitat upstream of the dams. We conclude that the two-tier evaluation approach should be implemented as part of the license amendment, although it would be appropriate for the various study plans and any proposals for later modification of the fish passage facilities to be filed for Commission approval.

American Eel

American eel passage currently does not occur through the hydropower projects on the Susquehanna River. Only small numbers of eels have been collected downstream of the Conowingo Project in recent years, either by the existing fish lifts or by experimental devices (FWS, 2006). American eel, however, remain a target for passage in the river, and the COA and Interior's preliminary fishway prescription include measures for eel passage (see tables 2 and A-2). These measures include a stepwise program for siting, constructing, and evaluating eel fishways that would be triggered when eel passage becomes operational at the downstream Conowingo Project, or when eel stocking into Conowingo reservoir begins as part of an agency-approved plan, or when the agencies determine that available data indicate that sufficient numbers of eels are available below Holtwood to require passage.

For downstream eel passage, the COA calls for the implementation of downstream passage measures either 3 years after eel passage becomes operational at the amended Holtwood Project, or 3 years after eel stocking into Lake Aldred begins as part of an agency-approved plan, or when the agencies determine that available data indicate that sufficient numbers of eels are available upstream of Holtwood to require downstream passage. PPL would conduct a discrete survival study for downstream eel passage, and if the study finds that a minimum survival of 85 percent is not achieved at the project, PPL would consult with the agencies and propose operational or structural modifications that would improve downstream eel passage survival at the project. Any measures provided would be evaluated for passage efficiency after they become operational.

These provisions of the COA and Interior's preliminary fishway prescription would provide a reasonable approach for implementing upstream and downstream

American eel passage at the Holtwood Project, when required. There are now only small numbers of eels in the Susquehanna River, and few of those likely ascend the river as far upstream as Holtwood. Once eel passage is provided at the downstream Conowingo Project and the numbers of eels approaching Holtwood increase to the point where passage is also required at Holtwood, the measures included in the COA and Interior preliminary fishway prescription would provide for timely development of upstream eel passage, and eventually downstream eel passage.

Passage of Resident Species

PPL, through the COA, proposes to operate the fish facilities at Holtwood from April 1 through June 30 for the upstream passage of resident species, even though this period would also encompass the upstream migration of anadromous species. As we described above, the lower Susquehanna River fish facilities pass a substantial number of resident species during their current spring operations, although operating during the expanded proposed period would increase the time that the fish facilities are operational by 4 to 6 weeks. Pennsylvania FBC, in its section 10(j) comments, recommends that the Holtwood fish facilities also be operated during the fall period (September 1 to October 15) for upstream resident fish passage for a 5-year period, and then evaluate with the agencies whether changes should be made to resident fish passage operations. PPL is opposed to any operations for resident fish passage during the fall months.

Our Analysis

Increasing the period of operation of the Holtwood fish facilities would likely increase the passage of resident species, although the species most likely to benefit would be the gizzard shad, which dominates the catch during the spring passage season. There would appear to be little benefit in increasing the numbers of gizzard shad passing upstream, which already number in the hundreds of thousands of fish. Pennsylvania FBC recommends fall operation based on the premise that additional upstream movement of resident fish also occurs in the fall, and that additional fall passage data would allow evaluation of this movement. Pennsylvania FBC also states that it believes the low abundance of freshwater mussels in the lower Susquehanna River reservoirs may be related to lack of passage of the host fish species. Fall operations would allow further evaluation of the mussel/host fish linkage. PPL, however, does not propose fall operations because there is no supporting information that these operations would benefit resident species, and because of its concern about possible damage to the fish lifts during the fall months, which could in turn affect their ability to operate in the following spring. It states that if the fish lift components are damaged by fall storms (hurricanes) or other breakdowns, there may not be sufficient time to make repairs in time for the spring migration period. However, if it is required to conduct fall operations, PPL requests that it be given the option to suspend those operations to protect the fish lift components from fall storm damage, or be allowed to delay or modify spring operations to complete any required repairs.

We agree that additional spring fish facility operation could be beneficial to some resident fish species that make upstream movements during the spring, with the exception of gizzard shad that already occurs in large numbers. Substantial upstream movement of important game species such as walleye and smallmouth bass already has been documented (Shiels, 2007), and additional operation would allow more of these species to pass Holtwood dam.

The primary basis cited by Pennsylvania FBC for requiring fall operations for resident fish would be as an experiment to determine if substantial fall movements occur. Because no fall fish passage operations have occurred on the Susquehanna River, we really do not know whether any species would be available for passage, and in what numbers. PPL's concern, however, about potential damage or additional maintenance requirements for fall operations appears to be a legitimate one, and we agree that the spring operations should not be put into jeopardy.

In the draft EIS, we concluded that only 1 year of fall operations should be attempted because of the potential for fall fish lift breakdowns to affect spring operations. The agencies, however, in their comments on the draft EIS, provide information that indicates the potential for fall damage to the fish lifts as a result of fall storms/hurricanes is remote (fall flows that could damage the fish lifts have occurred only 7 percent of the time over 75 years of record). In addition, the agencies commented that the results of only 1 year of testing, as we recommended, could be influenced by unusual (either high or low) flow conditions or by strong or weak year classes that may affect the numbers of fish available for passage. We agree that 1 year of fall operations, as we initially recommended, may not provide an adequate sampling of the fall period to determine whether fall operations would benefit resident species or the re-colonization of mussels in the lower Susquehanna River. We also believe that the potential for storm damage to the fish lift during the fall period is low, and that weather forecasting, particularly for hurricanes, would provide PPL adequate warning to shut down and remove key lift components before a major flow event would occur. Thus, we now conclude that fall operations should occur on an experimental basis for a 5-year period, similar to the spring operations for resident species, followed by an evaluation of the results by the licensee and agencies to determine if additional fall operations are warranted. Any plan to continue fall operations would then need to be filed with the Commission for approval. Spring fish lift operations would still have priority over fall operations, so in the event that the fish lifts are threatened by potential storms or hurricanes during fall operations, PPL should not hesitate to shut down operations and secure important lift components so that spring operations are not affected.

Effects of Increased Entrainment and Impingement

Installation of the proposed new generating units at Holtwood would approximately double the hydraulic capacity of the project and result in a reduction of spillage at the project on an annual basis from about 38 to 17 percent of the time (table

12). This would increase the potential for both anadromous and resident fish to be impinged on the trashracks or entrained in the generating units, resulting in some increased mortality during passage through the units. The COA and Interior's preliminary fishway prescription both include provisions for monitoring downstream passage of anadromous and catadromous fish through the project, including conducting discrete survival studies. Based on the results of those studies, PPL would modify project operations or structures to meet the agreed-to target survival rates (95 percent for juvenile shad, 80 percent for adult shad, and 85 percent for American eel). Neither the COA nor the Interior prescription includes any requirements for protection of resident species, and none of the agencies provide any recommendations related to resident species.

Our Analysis

Operation of the amended project would increase the percentage of time that most of the river flow would be passing through the generating units, instead of over the spillway. That would result in greater numbers of both anadromous and resident fishes approaching and passing through the trashracks and generating units. The existing units at Holtwood have trashracks with a bar spacing of 4 inches, except that Units 8, 9, and 10 have trashracks with a bar spacing of 6 inches, installed during the adult shad outmigration period, to allow downstream passage through the trashracks and generating units. The proposed new units would have trashracks with a bar spacing of 7 inches to facilitate downstream passage of adult shad. The potential for fish impingement on the trashracks would be minimal with trashrack spacing of 4 to 7 inches. Virtually all smaller fish that would comprise the majority of the fish that would be passing downstream through the units (see below), would pass through trashracks with clear spacing of these sizes. The exception would be very large fish, which might be unable to pass through the trashrack opening, but would have the swimming ability to avoid being impinged on the racks. There is the potential for some adult American shad to be impinged on trashracks with a 4-inch spacing (it has been observed by staff at other projects), but PPL already provides trashracks with 6-inch spacing on three units for downstream shad passage. The new units would have trashracks with 7-inch spacing, further reducing the potential for impingement of adult shad and other larger fish.

The potential for greater fish entrainment at the project may not substantially increase fish mortality. Preferential operation of the new, larger, more efficient units would result in more fish friendly passage than through the existing units. The proposed units would be large (282 inches or 23.5 feet in diameter) Kaplan units, with a slow runner speed (85.7 revolutions per minute) and a maximum efficiency of 94.75 percent. The units would also incorporate other fish friendly designs, such as limiting the number of wicket gates and stay vanes, a smaller wicket gate overhang, and limiting the gaps between the runner and the discharge ring. The large unit size, slow rotation, and reducing the areas within the unit where fish strike could occur would improve fish survival during passage.

Predicted survival rates for the existing and new units are based on a literature review and some empirical data collected at Holtwood (balloon tag studies). PPL predicted survival rates for American eel, post-spawn adult shad, post-spawn herring, and juvenile shad and herring to range from 48 to 84 percent for the existing double-runner units, 66 to 90 percent for the existing single-runner units, and 88 to 98 percent for the proposed Kaplan units. For the two proposed smaller exciter replacement units (Francis units with a runner diameter of 52 inches), PPL predicted survival ranging from 23 to 89 percent for the same species. These units have a much smaller hydraulic capacity (300 cfs versus 15,000 cfs for the Kaplan units), so the likelihood for fish to be attracted to and pass through these units would be low, compared to passage through the Kaplan units.

The provisions of the COA and preliminary fishway prescription would require discrete fish survival studies for the primary anadromous and catadromous species of interest (shad and American eel), so the predicted survival rates would be verified by empirical data. Because specific target survival rates have been agreed to as part of the COA, PPL would continue to work with the resource agencies to achieve those rates, should the studies indicate those rates are not being achieved. Thus, any effects of entrainment mortality on anadromous and catadromous species would be addressed through the COA, if adopted, and it would be appropriate to include those provisions of the COA as conditions of the license.

The COA or preliminary fishway prescription, however, provides no measures for the protection of resident fish, associated with turbine entrainment. Although this was not raised as a major issue by commenting entities, we assessed this issue by reviewing the Electric Power Research Institute (EPRI) Turbine Entrainment and Survival Database (EPRI, 1997) to determine whether the resident species that occur in Lake Aldred would be subject to entrainment, and the size classes of fishes that would be entrained. EPRI (1997) reviewed the results of 43 fish entrainment studies conducted at hydroelectric projects located primarily in the northeast, southeast, and midwest United States in the early to mid 1990s. The EPRI review indicated that most of the warmwater species occurring in Lake Aldred have been entrained in other hydroelectric projects, although the extent of entrainment varied among species and from project to project. One constant observation was that typically most of the fish entrained were less than 4 inches in length and were often juvenile fish or species such as minnows that never exceed a length of 3 or 4 inches. EPRI found that overall, 90 percent of the fish entrained in the 43 studies were less than 4 inches long.

EPRI (1997) also reviewed the results of 51 turbine mortality tests at hydroelectric projects throughout the United States (multiple tests were often conducted at different units at the same project). EPRI found that survival usually exceeded 90 to 95 percent for fish less than 4 inches long (the size class most likely to be entrained), although survival was reduced as fish length increased. Large, slow-speed Kaplan turbines, similar to the larger units proposed at Holtwood, typically showed the highest survival rates, usually exceeding 90 percent. This is consistent with PPL's prediction that survival rates would be higher in the Kaplan units. Because it is likely that most of the resident

species that would be entrained at Holtwood would be less than 4 inches long, and a relatively high percentage of those fish entrained would survive passage, there is little basis for requiring any fish protection measures at the project specifically for resident species, or for requiring mitigation for any resident fish mortality that may occur. Resident fish would still be afforded some protection, however, by the measures provided for anadromous and catadromous species, because those measures would be operational from about April 15 through at least late-fall (table 2), when most resident fish movement would likely occur.

Effects of Proposed Project Flow Releases

The proposed amendment would result in the re-distribution of flows at Holtwood, with higher flows being passed down the tailrace channel (from the existing 31,500 cfs to the proposed 62,100 cfs), a reduction in the spillage over the project dam, a minimum conservation flow release of 200 cfs into the Piney Channel, a release of the Unit 1 generation flows of about 1,200 to 3,150 cfs to the Piney Channel instead of to the tailrace, a continuous release to the bypassed reach approximately equal to the existing leakage from the dam, and a drought release of 44 acre-feet per day from storage if approved by SRBC. There would also be habitat modification associated with some of the releases. The tailrace channel would be widened and deepened to accommodate the higher flow in the tailrace and ensure that adequate zones of passage for fish migration (areas of adequate depths and water velocities that do not exceed fish swimming speeds) are maintained in the tailrace. Excavations would also occur in Piney Channel to improve the hydraulics for upstream fish passage and ensure that flow releases into the Piney Channel are distributed in the most effective way for habitat protection. The major increase in tailrace flows is an integral part of the project expansion, but the additional releases into Piney Channel and the bypassed reach, and the drought operations, are part of the COA.

The COA also provides for PPL to operate the amended project to release a minimum streamflow (including leakage) equal to, on a daily volumetric basis, 98.7 percent of the minimum flow required by the Commission to be released at the downstream Conowingo Project or the net daily inflow into Lake Aldred. The COA does not specify where this minimum release would be made from the project, except that it would include all releases, including leakage, so some of the minimum flow would likely be made through the powerhouse into the tailrace. PPL also now proposes to release a continuous minimum flow of 800 cfs from the project, or net inflow into Lake Aldred, whichever is less, which would begin at the latter of either the initiation of Unit 1 discharges to Piney Channel or the initial operation of the new exciter replacement units in the existing powerhouse. No other flow recommendations have been made by commenting entities for the protection or enhancement of aquatic habitat downstream of the project.

Our Analysis

The aquatic habitat in the tailrace channel can currently be characterized as a deep run, with a mostly bedrock substrate and a strong current during project operation, but minimal current and more pool-like character when the project is shut down (there is no minimum flow requirement but about 210-cfs leakage occurs through the existing generating units). The tailrace remains wetted (and deep in many locations) during shutdowns because the downstream Conowingo reservoir backwaters into the tailrace upstream to the Holtwood powerhouse. The water surface elevation fluctuates about 10 feet between full operation and project shutdown (PPL, 2007b). The tailrace serves as a migratory corridor for diadromous species, plus adult and juvenile resident fishes likely use the tailrace channel for foraging. Spawning probably does not occur in the channel because of excessive depths, high velocities, fluctuating water levels, and unsuitable substrate. Under proposed operations, the tailrace channel aquatic habitat would remain essentially the same, although the tailrace would be widened and deepened in some locations to accommodate the higher powerhouse flows. The predominantly bedrock channel would remain, with water surface elevations and velocity fluctuating depending on powerhouse operations. The tailrace would continue to serve as a migratory corridor, although passage conditions would improve with the excavations to ensure adequate zones of passage. Resident species would likely continue to use the modified tailrace as they do under existing conditions.

Piney Channel currently only receives substantial flows when the Holtwood dam is spilling or the spillway fish lift is in operation and attraction water is being released. The channel runs through bedrock outcrops and when watered is being spilled, the channel is riverine in nature with rapids and riffles, and in fact is used by whitewater boaters. During periods of no spill over Holtwood dam, and only leakage from the dam, the channel is dewatered in many locations with some isolated shallow pools. When watered during the spring migration period, American shad and other fish use Piney Channel as a migratory route to approach Holtwood dam and access the spillway fish lift. Resident species may also use the channel for foraging, but probably not for spawning because of the fast flows and bedrock substrate. Under proposed operations, Piney Channel would receive a minimum conservation flow and an additional flow from the discharge of Unit 1, plus excavations would be made to ensure adequate fish passage and proper distribution of flows.

PPL (2007b) modeled various flows versus weighted usable area, an index of habitat, for several resident species and life stages (smallmouth bass, walleye, channel catfish), and found that habitat suitability was generally highest at flows of about 200 to 500 cfs. However, flows as high as 1,200 cfs and 5,000 cfs would provide the highest suitability (based only on depth and velocity) for smallmouth bass and walleye spawning, respectively, although the reach would probably not provide the best spawning substrate for either species. At Piney Channel flows of up to 3,150 cfs, PPL (2007b) concluded that suitable conditions for upstream shad passage would occur, although certain areas would require excavation to ensure that passage barriers do not occur at some flow levels.

Provision of flows to Piney Channel ranging from a minimum conservation flow of 200 cfs to a maximum Unit 1 discharge of 3,150 cfs would enhance aquatic habitat in the channel, while also providing improved fish passage through the channel up to the spillway fish lift at Holtwood dam. This would be a major enhancement for a channel that currently is dewatered for much of the year, during non-spill periods. PPL, however, has not specified a proposed flow release schedule for the channel. We expect that higher flow releases via the Unit 1 discharge would occur during the spring months, to coincide with the shad migration season, with lower flows scheduled for the summer period. The actual operation of Unit 1 would also likely depend on electrical demand. PPL provided a draft MSFOP in its June 13, 2008, response to Pennsylvania DEP, but that manual did not provide a specific schedule for releases into Piney Channel, because it would depend on a number of operating factors. So, it appears that Piney Channel would experience a range in habitat conditions associated with the range of flows noted above.

The remainder of the bypassed reach below Holtwood dam (west of Piney Channel) currently receives substantial river flows (into the hundreds of thousands of cfs) when the Holtwood dam is spilling, but flashboard leakage flows of only about 20 cfs plus a flow of about 11 cfs through a pipe during low-flow periods. When the dam is spilling heavily, the reach has the characteristics of a large river with high velocities and heavy rapids, but when spill ceases, the reach becomes a series of isolated pools with substantial wetland areas and scrub-shrub growth in the downstream end of the reach. Some of the isolated pools maintain sufficient water quality and have adequate substrate to support spawning by nest-building centrarchid species (bluegill, redbreast sunfish) during periods of low or no spill (PPL, 2007b). Fish use of the reach during heavy spill conditions is not known, because conditions are too dangerous to sample during those periods. American shad, however, are known to migrate into the reach during the spring migration period, which is one of the reasons for the low efficiency of the existing project fish lifts.

The current habitat conditions in the bypassed reach would continue with the amended project, although the periods of spillage and associated riverine conditions would be substantially reduced, from about 38 percent to 17 percent of the time on an annual basis. Thus, the period of time that the reach would remain as a series of isolated pools and wetlands, some that contain rare plant species, would increase. PPL proposes to maintain current leakage flow into the reach, so habitat conditions should remain the same as currently occurs during the summer months, although for a greater period of time during the year. It is not clear, however, how PPL would specifically maintain the current leakage flow, except that it would continue to operate the existing 10-inch pipe and would allow continued leakage through the flashboards.

The reach would continue to receive heavy spill flows during the spring runoff and other periods of high flows, but spillage would cease faster than under current conditions. This would enhance the spring shad migration by reducing the attraction into the bypassed reach, allowing fish to more easily locate the entrances to the fish lifts and improve their efficiency in moving shad past the Holtwood Project.

Freshwater Mussels

Few mussels were found in areas downstream of Holtwood dam during the licensee's surveys, but unsuitable (bedrock) substrate may be the primary reason for the low numbers. Better mussel habitat occurs in Lake Aldred and four species were found during the reservoir surveys. No commenting entities made specific recommendations regarding measures for freshwater mussels, but Pennsylvania FBC commented that mussel populations in the lower Susquehanna River reservoirs are depressed. It believes this may be the result of a severed or weakened host fish linkage caused by these hydropower facilities, related to the historical lack of fish passage up the river, and the inability of host fish species to distribute glochidia to colonize upstream areas.

Our Analysis

Construction and operation of the amended project should have minor effects on mussel populations in the area. None of the areas proposed for excavation or major construction activities are known to contain suitable mussel habitat or concentrations of mussels. Mussel populations in Lake Aldred would not be affected by project operation, because the proposed reservoir operations would remain essentially the same as now, with the exception of slightly higher minimum reservoir levels during the fall months, if drought operations are implemented. This should be a small benefit to mussels in that more aquatic habitat would remain wetted later into the fall. Regarding Pennsylvania FBC's concern about the historical lack of passage for fish host species, the proposed amended project includes several enhancements for fish passage, including additional operation of the fish lifts at Holtwood for resident fish passage. Many of the fish host species for the mussel species that occur in Lake Aldred also occur in the reservoir and in the Susquehanna River, and would be available for passage through Holtwood and upstream projects.

3.3.3.3 Cumulative Effects

Based on information in PPL (2007a), agency comments, other filings related to the project, and staff analysis, we identified water quality and fisheries as the resources that have the potential to be cumulatively affected by the increased capacity and improvement of fish passage at the Holtwood Project. For water quality, we proposed that the geographic scope would extend from the upstream Safe Harbor Project downstream to Chesapeake Bay, and for fisheries we proposed a geographic scope of the Susquehanna River Basin upstream of the York Haven Project downstream to the Chesapeake Bay. Some commenters on the scoping document (FWS) recommend that the geographic scope for this analysis be expanded, and we will attempt to discuss potential cumulative effects on a wider geographic area to the extent that available information in the record allows. We choose a temporal scope looking ahead 16 years, concentrating on the effects of reasonably foreseeable future actions on the resources.

Water Quality

In section 3.3.3.1, we discussed that the lower Susquehanna River has had a history of high turbidity levels and sediment loading, high nutrient loading, and low DO levels in two of the larger hydroelectric project reservoirs (Safe Harbor and Conowingo projects). DO is the primary water quality parameter that could be cumulatively affected by hydropower operations in the lower Susquehanna River. The high sediment and nutrient loading is primarily associated with the large amount of agricultural lands and active farming in the middle and lower Susquehanna River basin, and some runoff from the more populated urban areas such as Harrisburg, York, and Lancaster. Once river flows reach the larger reservoirs of the lower river, however, water velocities decrease, less mixing occurs within the water column, and stratification sets up whereby the colder deeper parts of the reservoir no longer mix with the warmer surface waters, due to differences in density. The DO in the deeper part of the reservoir (the hypolimnion) is consumed by normal decay processes, and because the hypolimnion and the surface waters (the epilimnion) can no longer mix, DO levels in the hypolimnion drop to very low levels (often zero), while the epilimnion maintains relatively high DO levels. Stratification occurs in both the Safe Harbor and Conowingo reservoirs, but generally not in Lake Aldred because of its more riverine nature and lower storage capacity.

Low DO levels occur in the hypolimnion of both the Safe Harbor and Conowingo reservoirs, and because both projects withdraw water from the hypolimnion for power generation, they may release waters low in DO. As a result of previous studies and regulatory action on this issue, both Safe Harbor and Conowingo have installed turbine aeration systems on at least some of their generating units. The success of these systems is not precisely known, although recent water quality data from Lake Aldred indicate that DO levels in Lake Aldred consistently exceed state standards, with the lowest level recorded in 2006 studies at 5.27 mg/L. This is an indication that Safe Harbor is not releasing low DO waters into Lake Aldred. Holtwood flow releases are also well oxygenated. Continuous monitoring during the summer months in the Holtwood tailrace in 2005 and 2006 revealed that DO levels are typically high, with 99.3 percent of the samples exceeding the state standard (4.0 mg/L) in 2005, and 100 percent of the samples exceeding the state standard in 2006. Data on DO levels downstream of Conowingo are not immediately available.

The proposed amended project would continue operations similar to current operations, although more flow would be passed through the generating units because of the capacity expansion. Waters released from Holtwood should continue to have relatively high DO levels, although there is the potential for slightly lower DO levels in the releases from the new units, because those units may not oxygenate the flows during passage, as now occurs with the existing units (reportedly 0.2–0.8 mg/L). This, however, may have little effect on DO levels within Conowingo reservoir and downstream of Conowingo because of the large storage capacity of Conowingo. During summertime low-flow periods, Conowingo has essentially total control over the Susquehanna River flows into the lower river and Chesapeake Bay. Based on our review of gage data from

the Conowingo USGS gage (no. 01578310), Conowingo is able to cease generation for an entire weekend, except for the minimum flow, and resume generation on Monday morning as power demand increases. Flow releases from Holtwood, which would be at a minimum 98.7 percent of the minimum flow requirement at Conowingo, or a continuous flow of 800 cfs, would likely have little effect on Conowingo operations, would not likely have any effect on the stratification in Conowingo reservoir, and in turn would not affect the DO in the Conowingo releases. During the summer months, the minimum release from Holtwood would be 4,935 cfs (the Conowingo minimum flow requirement is 5,000 cfs), and this could assist Conowingo in meeting its minimum flow requirement without utilizing storage, but may not be of sufficient volume to have any effect on stratification in the reservoir. If any effects of the Holtwood releases were to occur, however, by acting to break up the stratification, these effects would be beneficial, in that bottom waters would be re-oxygenated prior to release below Conowingo.

Considering that proposed Holtwood operations would actually release more flow downstream on a more continuous basis than current summer peaking operations, and those releases should continue to be well-oxygenated, we conclude that these operations would not cumulatively affect water quality in the lower Susquehanna River and Chesapeake Bay, except potentially in a positive way.

Fisheries

As we described previously, the current fish passage facilities at Holtwood are not effective in passing a high percentage of the shad that are passed at the downstream Conowingo Project. The average efficiency of the Holtwood facilities during the first 12 years of operation has been only 32 percent of the fish passed at Conowingo, with some years well below that average. Because Holtwood is only the second of four lower river hydro dams that shad must pass before reaching the larger areas of suitable spawning habitat in the basin, the efficiency should be higher. Simple math illustrates that, if all the fish facilities on the lower river were 90 percent efficient, only about 66 percent of the fish approaching Conowingo dam would be successful in passing the fourth dam (York Haven). The deficiencies of the Holtwood fish passage facilities are well documented, so PPL proposes substantial enhancements to that system as part of the proposed amendment. The amendment itself should improve fish passage by diverting flows out of the bypassed reach and into the tailrace where fish would have a greater chance of finding the fish lift entrances. The other enhancements were described in section 3.3.3.2 and include improvements to the mechanics of the fish lifts, and measures to improve passage in the bypassed reach that would bring more fish into the vicinity of the fish lift entrance. These enhancements should substantially improve the efficiency of the upstream fish passage facilities at Holtwood, but the PPL proposal also includes a program for monitoring passage, and if passage efficiency does not meet agreed-to targets, PPL would make operational or structural modifications to improve efficiency.

For downstream passage, Holtwood is also an important project in that it is one of four projects that downstream migrants from the upper basin must pass before reaching

the Chesapeake Bay and Atlantic Ocean. PPL proposes to monitor survival of downstream migrants past the project, and to make additional operational or structural changes to improve survival, if required. So, for anadromous and catadromous species, the proposed amendment and associated fish passage improvements should have a positive cumulative effect on these populations, in turn positively affecting any fisheries that may develop for these species, once the management agencies decide to re-open the fisheries. These improvements should allow more fish to reach spawning grounds in the upper basin (or in the Sargasso Sea, for American eel), and to in turn successfully emigrate from the Susquehanna River to the Chesapeake Bay and Atlantic Ocean.

For resident fish species, PPL proposes to expand the period of operation for upstream passage of resident species, while measures provided for downstream passage of anadromous and catadromous species should also provide some level of protection for resident species, related to turbine entrainment. Although it is unclear what the benefits may be for additional passage of resident species, additional passage of these species would somewhat restore the connectivity of fisheries habitat in the lower Susquehanna River, and may result in a positive cumulative effect on resident species.

3.3.3.4 Unavoidable Adverse Effects

Project construction would involve a large amount of excavation in and near the riverbed. Although PPL would use sedimentation and control measures and best management practices during construction, there still is the potential for some runoff of sediment and fines from the site to the river, or generation during in-river construction, having localized effects on water quality and aquatic habitat.

Project operation would result in some unavoidable fish entrainment and mortality, although the overall effects on the local fish populations are not expected to be substantial.

3.3.4 Terrestrial Resources

3.3.4.1 Affected Environment

Upland Vegetation

The oak, hickory, pine forest association reaches its northern limit in the lower Susquehanna watershed. Historically, these species dominated the area, but have since become less common because of the conversion of land for agricultural, timber harvest, residential and commercial uses, and disease (in the case of chestnut). Vegetation located around Lake Aldred today is considered to be second and third growth timber dominated by hickories and pitch pine, as well as white, chestnut, and scarlet oaks. Softwood stands consisting of eastern hemlock, eastern red cedar, eastern white pine, and ornamental species such as Scotch pine also can be found in various sections of the project area.

Wetlands

Wetlands are extremely limited on the shoreline of the reservoir, largely due to relatively abrupt shoreline topography. National Wetlands Inventory maps indicate that wetlands are clustered near the Conestoga Islands, and also on the east shoreline of Lake Aldred in Martic Township. The majority of these small palustrine forested (PFO) and palustrine scrub/shrub wetlands range from less than 1 acre to 3 acres in size. National Wetlands Inventory maps also indicate two palustrine emergent wetland (PEM) areas associated with Weise Island totaling approximately 17 acres in size. In addition, soil surveys of Lancaster and York counties indicate the predominance of Mt. Airy and Manor soils which are moderately deep, somewhat excessively drained soils, generally found on ridgetops, side slopes, and hillsides. These soil series rarely form hydric soils, and therefore would be unlikely to enable the development of wetlands.

Wetland surveys that PPL completed in 2005 and 2006 found additional wetlands and expanded the known boundaries of most National Wetlands Inventory-mapped wetlands. Most of the larger islands in Lake Aldred were classified as completely PFO, which are dominated by woody vegetation at least 20 feet tall. Shoreline PEM, typically dominated by low growing herbaceous vegetation, are not numerous or extensive in the project area. Where these wetlands do occur, they rely on regular wetting by reservoir water level fluctuations. In contrast, the PFO in the project area are above the influence of daily fluctuations and rely primarily on annual flooding and overbank flows to maintain wetland structure and function. The wetlands functions include providing habitat for wildlife, endangered species, and fish, as well as stabilizing the shoreline.

The remnants of an old canal in York County have since filled in and now serve as a linearly shaped palustrine scrub/shrub wetland, dominated by woody vegetation less than 20 feet tall. Hydrology is maintained by trapped runoff and intercepted groundwater, not reservoir fluctuations or annual river floods. Below Holtwood dam an approximately 34-acre “riverbed emergent marsh” contains a patchy mosaic of equal parts rock, open water, and PEM. Although plant diversity is low in this area, the wetland remains partially submerged throughout the year because of its mid-channel location, and pools within it serve as fish rearing habitat. Other wetlands below Holtwood dam are labeled “erosional remnant wetlands” and have developed in scoured-out depressions of bedrock that trap water from precipitation and high river flows. In 2006, additional wetlands were mapped downstream of the dam and in a retired ash basin where excavated material may be disposed. Some emergent wetlands have formed along ledge areas in the tailrace that were excavated in 1997 to reduce fish stranding problems. These areas experience wide fluctuations in water levels due to changing flows in the tailrace during operational activities.

Special-status Plant Species

PPL contacted Pennsylvania DEP and conducted field surveys to identify special status plant species that may occur in the project area. Four state-listed species were

found on project property: scarlet ammannia, American holly, sticky goldenrod, and white doll's daisy. In addition, St. Andrew's cross, which is being reviewed for rarity and potential future listing, was found. A summary of the status, habitat requirements, and occurrence within the project area for each species is presented in table 16.

Table 16. Special-status plant species with the potential to occur in the Holtwood Project area. (Source: PPL, 2007a)

Common Name (Scientific Name)	Status	Habitat Association in Proposed Project Region	Known or Potential Occurrence in Project Area
Scarlet ammannia (*Ammannia coccinea*)	SE	PEM wetlands and riverine shorelines with deep muddy soils	Observed in PEM wetlands surrounding Lake Aldred
White doll's daisy (*Boltonia asteroides*)	SE	Moist, well-drained soils with full sun to partial shade	Observed throughout the bypassed reach
Vasey's eupatorium (*Eupatorium godfreyanum*)	TU	Open woods and disturbed open sites	Observed on Piney Island
St. Andrew's cross (*Hypericum stragulum*)	TU	Dry woodlands, dry sandy soil	Observed on Piney Island
American holly (*Ilex opaca*)	ST	Moist, well-drained soils with full sun to partial shade	Observed on Piney Island and several other islands in the bypassed reach.
Sticky golden-rod (*Solidago spathulata* ssp. *Randii* var. *racemosa*)	SE	Gravely soil with full sun	Observed on rocky outcrops within the bypassed reach

Notes: SE – Pennsylvania Endangered

ST – Pennsylvania Threatened

TU – Tentatively Unknown (state of Pennsylvania classification of plant species believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficient data.)

Wildlife

The forested area surrounding Lake Aldred provides habitat for a variety of woodland species such as red and gray fox, raccoon, red and gray squirrel, chipmunk, turkey, opossum and white-tailed deer. Species such as the yellow-billed cuckoo, black-

capped chickadee, house wren, song sparrow, white-breasted nuthatch, brown creeper, and an assortment of woodpeckers were abundant along the wooded shorelines of the project lands. Warblers, tanagers, and orioles were also observed using the forests during migration in late May 2005. Wildlife that inhabit the non-forested cover types and suburban areas of the project area include American robin, eastern bluebird, woodchuck, skunk, mourning dove, and rock dove.

Two retired ash basins are located on PPL lands within a mile from the powerhouse, and PPL currently proposes these sites as the locations for disposal of excavated materials. The habitat immediately surrounding these locations is forested and contains similar woodland species as found along Lake Aldred. The oldest ash basin is approximately 32 acres, has been capped with topsoil, and is now used as an agricultural field. The more recently retired ash basin is approximately 43 acres and is now grassland-savannah, with a dominant autumn and Russian olive stand. The wildlife in the habitat would be similar to those found in the non-forested cover types described above. A thin wetland marks the northern boundary of the more recently retired ash basin. Common yellow throat was heard singing from this wetland during the avian surveys of 2006. In addition, avian surveys recorded prairie warbler, blue-wing warbler, yellow-breasted chat, and white-eyed vireo using the retired ash basins and forested edges.

The open water area of Lake Aldred provides habitat to a variety of aquatic-dependent wildlife. Mud imprints along the shores of the reservoir indicate that mammals such as mink and raccoon use the margins of the reservoir for foraging. Several river otter or muskrat middens were observed below the dam. The 2006 springtime bird surveys revealed a diversity of migrating warblers and other songbirds using the upland habitat in York and Lancaster counties, as well as the vegetated islands below Holtwood dam (i.e., Piney Island). A heron feeding ground is located just downstream of the Piney/Barkley Island complex. A dozen or more great blue heron feeding among the shallow riffles below the Norman Wood Bridge (Route 372) is not uncommon on a daily basis. Resident bald eagles and osprey, which are discussed in greater detail below, use the reservoir and river downstream of the dam. Turtle species such as snapping turtles, red-eared sliders, painted turtles, common map turtles, and wood turtles were all seen basking along the reservoir shores in late May 2005.

Between the Holtwood facility and the mouth of the Susquehanna River in the Chesapeake Bay, the wildlife community is similar to that surrounding Lake Aldred. The Chesapeake Bay provides habitat for a wide variety of birds that stop at the bay during spring and fall migrations. The Atlantic coast is one of four main migratory flyways in North America and the bay is an important resource for raptors, songbirds, and shore birds that migrate along this route. In addition, about one million swan, geese, and ducks winter on the bay (FWS, 2008).

Wetlands provide ideal habitat for amphibians and pollinating insects. Many frogs take advantage of the erosional remnant wetlands that lay in rock depressions, protected from predatory fish. Gray tree frogs were heard calling at these erosional remnant

wetlands on islands downstream of Holtwood dam, and the pools contained tadpoles of numerous amphibian species during the early summer. Later in the summer, frog species such as the pickerel, green, leopard, and bull frog were observed along tributaries and wetlands. Butterflies were plentiful during the flowering periods for wetland vegetation. Prominent species such as the monarch, viceroy, tiger swallowtail and zebra swallowtail were among the species observed from August to September 2005.

Sensitive Wildlife

Sensitive wildlife species include those listed by the state of Pennsylvania as threatened, endangered, proposed threatened, proposed endangered, or at risk. The project area does not contain any species that are federally listed as threatened or endangered, or critical habitat for such species.

PPL consulted with the Pennsylvania Game Commission and Pennsylvania FBC to identify sensitive wildlife species with the potential to occur in the project area. Five species—three birds and two reptiles—were identified. Table 17 presents these species, their habitat requirements, and notes on their occurrence within the project area.

Table 17. Special-status wildlife species with the potential to occur in the Holtwood Project area. (Source: PPL, 2007a)

Common Name (Scientific Name)	Status	Habitat Association in Proposed Project Region	Known or Potential Occurrence in Project Area
Bald eagle (*Haliaetus leucocephalus*)	ST	Nests in mature forests with ample supply of fish in immediate vicinity	Two active nests in the project area
Osprey (*Pandion haliaetus*)	ST	Nests in mature forests with ample supply of fish in immediate vicinity	Two active nests in the project area
Prothonotary warbler (*Protonotaria ctirea*)	SR(P)	Nests in wooded areas near water, especially swamps and flooded areas near large rivers	No sightings in the project area, but sightings reported along the Susquehanna River north of the project, and suitable habitat exists in the project area.
Red-bellied turtle (*Pseudemys rubriventris*)	SE	Deep, slow moving water with sandy substrate and aquatic vegetation	No habitat in the project area due to lack of submerged aquatic vegetation

Common Name (Scientific Name)	Status	Habitat Association in Proposed Project Region	Known or Potential Occurrence in Project Area
Rough green snake (*Opheodrys aestivus*)	SE	Wet meadows and woodlands areas along lakes and streams	No sightings in the project area

Notes: SE Pennsylvania Endangered
ST Pennsylvania Threatened
SR(P) Pennsylvania Rare (Proposed)

3.3.4.2 Environmental Effects

Wetlands

PPL conducted wetlands surveys that indicate wetlands are present within the tailrace and along the shores of Piney Island. Construction activities would include tailrace excavation and clearing for access roads. These activities could affect wetlands by removing vegetation, altering hydrologic characteristics, and compressing soils.

PPL states that its construction plans minimize effects on wetlands to the greatest extent possible. During the application preparation process, PPL worked with the Corps, Pennsylvania DEP, and Pennsylvania Department of Conservation and Natural Resources (Pennsylvania DCNR) to discuss potential effects of the proposed amendment on wetlands and to identify ways to minimize these effects.

The excavation of some wetland areas would be unavoidable. Excavation of the project tailrace would remove a total of 0.73 acre (31,694 square feet) of wetlands. The majority of these wetlands (30,300 square feet) are PFO and the remainder is PEM. Construction of the lower tailrace access road and access road on Piney Island would temporarily remove 0.5 acre (21,860 square feet) of PFO wetlands.

Improvements to recreational facilities at the Pequea Boat Ramp, the tailrace, and along McCall's Ferry Road in York County would also affect wetlands and floodplain forest areas. Approximately 400 square feet of forested floodplain would be converted to a fishing platform in the tailrace. Expansion of the Pequea Boat Ramp would affect 0.7 acres (30,620 square feet) of floodplain forest. Approximately 0.1 acre (6,000 square feet) of upland forest understory would be converted into a parking area along McCall's Ferry Road.

To minimize the temporary effects associated with the access roads associated with excavation in the tailrace, PPL would remove the road following construction and develop and implement a plan to reclaim the affected wetland habitat. PPL had proposed to mitigate permanent wetland effects by restoring wetland function to areas around the York Furnace Boat Ramp on Lake Aldred or at another suitable location. In comments on the draft EIS, PPL indicates that it would construct a wetlands mitigation project along

Landis Run in Manheim Township and would provide further details following consultation with Pennsylvania DEP.

PPL's proposed mitigation for amendment effects on wetlands and uplands area would include creating more than 2.1 acres (90,000 square feet) of new wetlands; enhancing more than 1.5 acres (65,000 square feet) of PFO wetland with riparian buffer tree plantings along Landis Run; enhancing approximately 1.8 acres (78,000 square feet) of upland forested buffer plantings; removing three dams on Pequea Creek, Groff Run, and the Conestoga River; restoring 3,200 linear feet of streambed on the Pequea Creek; and planting 5 acres (217,800 square feet) of forested riparian buffer adjacent to the Susquehanna River on existing PPL lands currently in agricultural production.

FWS commented that a visit to the proposed mitigation site[29] in September 2007 indicated that existing hydrologic conditions at the site were not suitable for the creation of wetlands. It also noted that the levels of excavation required to improve hydrologic conditions and challenges with enforceability make the site unacceptable. FWS recommends that PPL develop and implement a wetland mitigation plan that would create, restore, or preserve wetlands and riverine habitat. FWS recommends that PPL submit the plan to FWS and other resource agencies for approval prior to construction.

Our Analysis

Construction of the proposed project would remove approximately 0.73 acre of PFO wetlands and temporarily affect a combined 0.5 acre of PFO and PEM wetlands at the construction site within the tailrace and on Piney Island. Permanent effects would occur to wetlands within the tailrace excavation area, which includes three small islands in the middle of the tailrace and shoreline along the downstream end. The construction of access roads for the excavation sites would temporarily affect wetlands along the northeastern shore of Piney Island. Changes in project operations would have indirect effects on wetlands by changing existing patterns of scour and inundation. The wetland near the retired ash basin would not be affected as it is outside of the area where excavated material would be deposited.

Disturbance to wetlands would result in a loss of wetland function, including wildlife habitat, flood attenuation, and retention of sediment and nutrients. If PPL prepares and implements a wetland mitigation plan that would result in the creation, enhancement, or protection of wetlands, as recommended by FWS, the effects of the loss of wetland functions would be minimized.

The proposed operations would divert water that currently flows over the Holtwood dam and into the bypassed reach through the new powerhouse and into the excavated tailrace. The magnitude of high flows within the bypassed reach would be

---

[29] We assume that this comment is in reference to a visit to the proposed York Furnace Boat Ramp wetland restoration site.

reduced. The spatial arrangement of wetlands in the bypassed reach is highly variable from one year to the next, depending on patterns of sediment deposition following the springtime floods. These wetlands could be affected by proposed operations that could change the current level of water supply to the bypassed reach and alter past patterns of sediment disposal. Increased flows in the tailrace could also affect wetlands if there is a subsequent change in inundation frequency for shoreline vegetation. Additionally, increased flow releases could lower the water level in Lake Aldred and affect wetlands located on the reservoir margins.

PPL states that the proposed project would alter the present hydrology experienced by the wetlands in the bypassed reach, but the excavation within the tailrace would allow the channel to contain increased flow volumes without increasing the water surface elevation. Within the bypassed reach, spill events during the growing season are infrequent. This would not change following construction. PPL also notes the proposed project would direct flows from the Unit 1 generating turbine into Piney Channel. These flows are expected to deposit sediment and create additional sites for wetland development. PPL states that increases in flow releases associated with the proposed project would not affect the hydrology of Lake Aldred, except during severe drought conditions that only occur every 50 to 100 years. PPL does not expect any change in vegetation structure that may occur during drought years to be permanent, because upland species would not survive water levels associated with the predominant hydrologic conditions at the reservoir.

The proposed project operations would not create changes in water surface elevations in the tailrace or in Lake Aldred that would affect wetlands. Proposed operations would likely affect wetland areas in the bypassed reach because they would reduce scouring flood flows and alter patterns of sediment deposition. The release of water from Unit 1 into the Piney Channel could create new wetland areas, offsetting the affects in the bypassed reach. However, because the formation of new wetlands would be variable from year to year, these affects have not been quantified. The implementation of a wetland mitigation plan that would create, enhance, or protect wetlands, as recommended by FWS, would minimize the overall effects on wetland functions in the project area.

Special-status Plants

Four sensitive plant species—American holly, St. Andrew's cross, white's doll daisy, and sticky golden rod—are located near areas where construction activities would occur. American holly is located on Piney Island and could be affected by the construction of access roads. The other two species occur in the bypassed reach and Piney Channel. Proposed excavation within Piney Channel could affect these species. A fifth species, Scarlet ammannia, is located in PEM wetlands along the perimeter of Lake Aldred and could be affected by fluctuating reservoir levels.

PPL surveyed and mapped the occurrence of American holly on Piney Island and used the maps when designing the plans for access roads to minimize effects on this species to the greatest extent practical. PPL estimates that approximately four American holly saplings would be removed and that no effects on St. Andrew's cross would occur. Along the southwestern side of Piney Island, an access road would remove approximately 3 percent of the white doll's daisy population. No proposed construction activities would occur in areas with sticky golden rod. PPL proposes to prepare a plan, for Pennsylvania DCNR approval, that would restore habitat for American holly and white doll's daisy temporarily affected by construction. The proposed plan would also incorporate measures to control the spread of noxious weeds in areas disturbed by construction.

Pennsylvania DCNR commented that proposed project construction would have direct effects on American holly and white doll's daisy, and notes that it is working with PPL to develop an active management and monitoring plan for American holy, white doll's daisy, and sticky golden rod. Pennsylvania DCNR commented that both white doll's daisy and sticky golden rod occur in the bypassed reach and could be affected by project operations that would reduce scouring associated with flood flows and reduce flows in the bypassed reach during summer months. In response to DCNR comments, PPL has agreed to provide irrigation flows of approximately 1,000 cfs for 1 hour on days when river flows are between 31,000 and 61,500 cfs. Based on previous flows in low, moderate, and high flow years, PPL expects that the frequency that it would need to supply irrigation flows to the bypassed reach would range from 0 days per month in low flow years to 14 days in June in a high flow year.

Our Analysis

PPL has made reasonable efforts to develop construction plans and facility designs that avoid effects on sensitive plants. However, construction of the proposed project would affect American holly and white doll's daisy. These effects would occur at the individual plant level and would not affect the entire population. Implementation of a monitoring and adaptive management plan, developed in consultation with Pennsylvania DCNR, would mitigate effects on special-status plants associated with proposed construction.

White doll's daisy and sticky golden rod both occur in the bypassed reach and grow in areas scoured by seasonal floods. Scarlet ammannia occurs along the margins of Lake Aldred in PEM wetlands. New hydrologic conditions in these areas resulting from operations of the proposed project could affect these species.

PPL states that a reduction of flood scouring in the bypassed reach would likely affect white doll's daisy. However, because sticky golden rod occurs at a higher elevation, which is typically dry but receives scouring during very high floods, PPL states that the proposed project would not affect this species. At the request of Pennsylvania DCNR, PPL has agreed to include sticky golden rod in the special-status species monitoring and adaptive management plan. PPL also notes that during severe drought

years, required conservation flow releases may lower the level of Lake Aldred. However, because reservoir levels would return to the normal level, PPL does not expect the proposed project to affect scarlet ammannia.

The proposed project would reduce seasonal flood flows in the bypassed reach, thereby decreasing scouring of areas colonized by white doll's daisy and sticky golden rod. Decreased scour could make this habitat suitable for other species that could outcompete the species of concern. Additionally, flows directed from Unit 1 into the Piney Channel could spill into the bypassed reach, inundating some white doll's daisy. The reduction of flows over the Holtwood dam would also affect white doll's daisy during the summer growing season when these plants require occasional root wetting. The implementation of the irrigation flows would mitigate this effect. Proposed project operations would not affect the upland area on Piney Island where American holly and St. Andrew's cross occur. Following severe drought years, the return of typical reservoir levels would re-water PEM wetlands occupied by scarlet ammannia. Additionally, these periods are expected to be short-term and rare, with more typical conditions returning with increased precipitation following the drought. Drops in Lake Aldred reservoir levels would not affect the long term viability of this population. Consultation with Pennsylvania DCNR to develop and implement a monitoring and adaptive management plan for white doll's daisy and sticky golden rod would mitigate effects on special status plants associated with the proposed project operations.

Wildlife

Construction activities could affect wildlife by removing habitat and disturbing wildlife with increased noise and human activity. Loss of habitat and increased disturbance could reduce breeding and foraging success, indirectly causing mortality or population declines. Collisions with vehicles and effects from the use of explosives could directly cause mortality.

PPL acknowledges that construction would affect wildlife through disturbance associated with loud noises and human activity. Excavation within the tailrace would remove shallow pools that are used as foraging areas for predatory wildlife, including great blue heron, mink, river otter, and raccoon. Additionally, depositing excavated rock into the retired ash basins would remove the agriculture field and grassland habitats, reducing food sources for deer, raccoon, wild turkey, and other grassland birds. However, the deposited rock would provide shelter for reptiles and small mammals. Following construction, PPL would remove all temporary access roads and restore these habitats with the planting of native species.

FWS commented that effects on riverine habitats associated with excavation in the tailrace have not been quantified. FWS recommends PPL mitigate for the effects on wildlife associated with the removal of the shallow pools in the tailrace by restoring, enhancing, or protecting similar habitat.

Our Analysis

Construction activities associated with the proposed project would create an unavoidable disturbance to some wildlife, a temporary loss of 9 acres of upland forest, and a permanent loss of approximately 6 acres (261,360 square feet) of upland forest habitat. During construction, large, mobile wildlife species, including great blue heron, would likely temporarily avoid the areas because of construction noise and habitat disturbance. Because the construction sites do not provide unique habitat in the area, these wildlife species are likely to use other habitats nearby. Some small and less-mobile species, such as small rodents and snakes that use forested habitats, could be affected more because of vegetation removal, the construction of access roads, and construction traffic. Excavation in the tailrace would eliminate some shallow pool habitat that provides foraging area for birds and mammals that eat fish and aquatic invertebrates. This habitat is not unique to the area and may be replaced by similar areas associated with flow releases in Piney Channel; however, use levels suggest it is a valuable resource for local wildlife. Quantifying the net loss (or gain) of such habitat under proposed flow conditions would enable PPL to more accurately assess these effects. If areas temporarily affected by construction activities are restored, as proposed by PPL, effects on wildlife would be reduced. Additionally, if PPL quantifies the loss of shallow pool habitat and prepares and implements an appropriate mitigation plan that protects, enhances, or preserves similar habitat, as recommended by FWS, effects of construction on wildlife could be further reduced.

Operation of the proposed project could affect wildlife if fluctuating water levels in Lake Aldred or the Susquehanna River downstream of Holtwood dam modify the character of existing habitat or food supply. In addition, wildlife also could be affected by operational activities on project lands including vegetation management and recreational use.

PPL acknowledges that during severe drought years, the water level in Lake Aldred could fall below current levels of normal fluctuation. Under these conditions, small wildlife species accessing the edge of the reservoir, like turtles, amphibians, and small mammals, would have to travel a greater distance between the water and surrounding vegetation. However, these periods are expected to be short-term and rare, with more typical conditions returning with increased precipitation following the drought.

PPL proposes to develop a land and shoreline management plan to protect plant and wildlife species on project lands. FWS recommends that PPL prepare, file, and implement a shoreline management plan for project lands, but recommends that the plan include lands within 330 feet of the high water mark and measures to protect wildlife habitat within this buffer area.

Operation of the proposed project is expected to improve fish passage at the Holtwood Project, increasing the number of shad that reach spawning areas. Increasing the shad population would increase food availability for animals that prey on fish, including eagles, osprey, and heron. Low water levels in Lake Aldred associated with

extreme drought years would affect species that frequently travel between the water and terrestrial vegetation. Increased travel time between vegetative cover and the water could make these animals more susceptible to predation and desiccation. Lower reservoir levels could also expose breeding areas for some amphibians or dewater basking areas for turtles. However, as noted by PPL, these effects are expected to be temporary and rare. Landscape management and recreational activities associated with the project could affect wildlife in areas surrounding the project waters. If PPL develops and implements a shoreline protection plan, as recommended by FWS, effects on wildlife could be reduced.

Special-status Wildlife

Two active bald eagle nests and two active osprey nests are located in the vicinity of project facilities. Suitable nesting habitat for prothonotory warbler is also present in the project area. Construction activities, including the blasting of bedrock and the operation of large vehicles have the potential to disturb these species, causing them to abandon nests. Bald eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. § 668 et seq.) from reduced productivity, nest abandonment, or injury that may occur as a result of construction noise.

PPL revised the original construction plans to reduce effects on a new bald eagle nest on Piney Island. New construction plans maintain an appropriate buffer distance between construction activities and the new nest site, as well as the other bald eagle and osprey nests in the project area. PPL has prepared a draft eagle monitoring and management plan in consultation with FWS. PPL filed the draft plan with the Commission on June 19, 2008, with its responses to the Commission's additional information request. Additionally, to avoid effects on nesting eagles and osprey, PPL proposes to sequence the timing of construction activities such that no work would occur within the buffer area during the nesting season. PPL maintains that the project would not affect PFO wetlands, the preferred habitat for prothonotory warbler.

FWS recommends that PPL finalize and implement the eagle monitoring and management plan prior to the commencement of construction.

Our Analysis

Bald eagles vary in their susceptibility to disturbance. Some eagles are not easily disturbed by the presence of human activity, while others tolerate very little activity before leaving the area. The new eagle nesting pair on Piney Island is at the southern end of the island, near the Norman Wood Bridge (Route 372) across the river. Because this nest location is subject to frequent highway noise, the pair of eagles that built it are likely more tolerant to noise than other nesting pairs. Nevertheless, blasting and hauling bedrock out of the tailrace is expected to be noisy. Implementation of an eagle protection plan, as proposed by PPL and recommended by FWS, that includes seasonal restrictions on activities, nest buffers, noise reduction measures, monitoring of eagle behavior, and streambank stabilization measures to protect nest trees, would minimize effects on bald eagles. The implementation of similar measures would also minimize effects to osprey.

Although PPL states that the project would not affect PFO wetlands, and therefore not affect prothonotory warbler, the three islands in the tailrace that would be removed are classified as PFO. If the removal of these areas occurs outside of the breeding period for the prothonotory warbler, or if PPL surveys the area and confirms the absence of nests prior to excavation, effects to the warbler could be minimized.

Operations of the proposed project are not expected to affect terrestrial habitat used by sensitive species. Surface water elevation is expected to remain similar to past levels within the tailrace and along Lake Aldred. As such, project operations would not affect habitat that supports bald eagles, osprey, and prothonotory warbler. Potential increases in fish populations associated with the proposed modifications to the project would provide more food for the eagle and osprey.

3.3.4.3 Cumulative Effects

Implementation of the proposed project is expected to improve fish passage at Holtwood. Improved fish passage would provide access to spawning habitat further up the Susquehanna River for anadromous species. Successful spawners and smolts would migrate down stream to the mouth of the Susquehanna River in the Chesapeake Bay, where they spend several years in the marine environment. Over time, if the proposed fish passage improvements are successful, fish populations in the Chesapeake Bay would increase, which would increase the food supply for fish eating birds and mammals in the Bay and lower Susquehanna River Basin.

3.3.4.4 Unavoidable Adverse Effects

Construction of the proposed project would permanently remove about 1.24 acres (54,000 square feet) of wetlands and 6 acres (261,360 square feet) of upland forest.

3.3.5 Recreational Resources

3.3.5.1 Affected Environment

Recreation Areas

The public has access to the shoreline within the project boundary for recreational activities, with the exception of areas containing project works. PPL provides formal public access to the project as part of the Holtwood Environmental Preserve, and at other recreation areas administered by various state and local agencies and organizations. Figure 12 identifies lands and formal recreation sites within the Holtwood Environmental Preserve, and recreation sites administered by other entities in proximity to the Holtwood Project boundary.

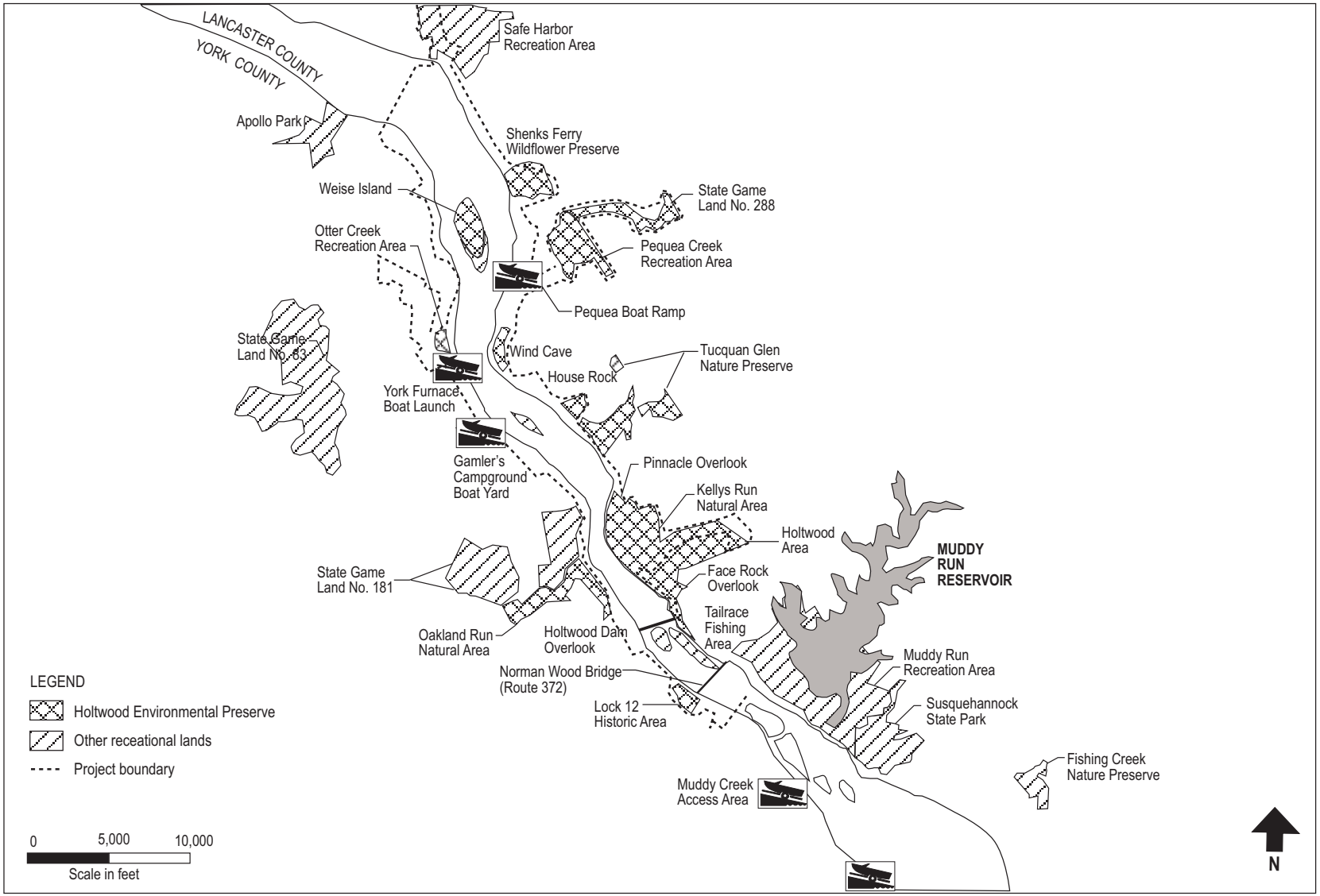


Figure 12. Location of public recreation areas at the Holtwood Project. (Source: PPL, 2007a, as modified by staff)

Holtwood Environmental Preserve

Following is a description of the recreational facilities associated with the Holtwood Environmental Preserve.

Otter Creek Recreation Area—The Otter Creek Recreation Area, located within the project boundary, includes facilities for camping, picnicking, boating, and hiking. The Otter Creek campground includes 90 campsites, and adjacent to the campground, the camp office and store, flush toilets, and showers. Hiking trails in the vicinity include the Otter Creek Trail, Game Land Trail, Urey Trail, and Mason-Dixon Trail. The Otter Creek picnic area is located along the waterfront adjacent to the campground. The York Furnace boat ramp is located near Route 425 and Indian Steps Road, with parking space for 26 cars and 32 cars with trailers. The Urey Overlook, accessible to the public only on foot via the Urey and Mason-Dixon Trail, provides a picturesque view of Lake Aldred, Weise Island, and surrounding area. PPL's property extends up the Otter Creek ravine for approximately 2 miles and includes 190 acres that have been designated as a natural area to remain in a generally undisturbed condition. Rustic trails into this area provide access for hikers and anglers.

Lock 12 Historic Area—The Lock 12 Historic Area, located within the project boundary, has facilities for picnicking and historic appreciation. The site includes the restored Lock 12 of the abandoned Susquehanna and Tidewater Canal, a restored limekiln, a picnic area with 14 tables and related facilities, including permanent toilets.

Holtwood Tailrace Fishing Area—The tailrace fishing area, located within the project boundary, is lighted and is normally open to the public for fishing at all hours, year-round. Anglers enter from a parking area south of the plant and fish from the shoreline downstream from the plant. Walkways and steps provide access for anglers.

Holtwood Area—The Holtwood Area, partially located within the project boundary, has facilities for picnicking, outdoor sports, hiking, and environmental education. This area has two picnic areas, each with a pavilion seating 100 people and associated facilities, a large field sports area, hiking trails (including Kellys Run Trail and Conestoga Trail), Holtwood Arboretum, and the Holtwood Environmental Center.

Pinnacle Overlook—The Pinnacle Overlook is located within the project boundary atop a bluff some 500 feet above Lake Aldred. The view of the central portion of Lake Aldred and surrounding river hills is considered one of the premier vistas along the Lower Susquehanna. The Pinnacle Overlook includes a picnic area with six tables and facilities.

Kellys Run Natural Area—The Kellys Run Natural Area, located partially within the project boundary, includes 125 acres of woodland situated between the

Pinnacle Overlook and the Holtwood Area. Within the Kellys Run Natural Area is the 8.5-mile-long Kellys Run-Pinnacle Trails system, including a portion of the Conestoga Trail. Interior has designated the 2-mile-long Kellys Run Trail linking the Holtwood Area and the Lake Aldred waterfront at the mouth of Kellys Run as a National Recreation Trail.

Pequea Creek Recreation Area—The Pequea Creek Recreation Area, located within the project boundary, includes a campground located on the south side and a picnic area located on the north side of Pequea Creek and about 3 miles of hiking trails. The campground has 103 camping sites for travel trailers, recreational vehicles and tents, a group camping area, a large pavilion, an office and store, flush toilets and showers, and a game room. The picnic area has 50 tables, a play area, and portable toilets.

Pequea Boat Ramp—PPL owns and maintains Pequea boat ramp located within the project boundary at the mouth of Pequea Creek, on the east side of the railroad. The Pequea boat ramp includes two boat launching ramps and an adjoining paved parking area with space for 60 cars with trailers and an additional 17 cars. PPL leases a portion of land from the railroad company for use of an access road leading from the Pequea boat ramp parking area across railroad company land and under the railroad bridge to a filled-in waterfront area between the railroad and Lake Aldred. This area serves as a fishing area and is one of the most popular shoreline fishing sites along Lake Aldred. For safety, PPL has installed and maintains chain-link fence between the fishing area and the railroad.

Shenks Ferry Wildlife Preserve—The 40-acre Shenks Ferry Wildflower Preserve, located within the project boundary upstream from the Pequea boat ramp, is one of the most popular attractions in Lancaster County. The preserve is renowned for its large variety of spring wildflowers, with at least 73 species in bloom between mid- March and the end of May.

Face Rock Overlook—The Face Rock Overlook is located on project land above and inland from the Holtwood dam and power plant. The overlook offers a scenic view of the Holtwood power facilities and the river downstream, and has picnic facilities, parking and water. This area is temporarily closed during national security alerts because of adjacent transmission facilities.

Holtwood Dam Overlook—The Holtwood Dam Overlook, located within the project boundary at the right (west) abutment of Holtwood dam, provides a view of the dam, power plant and fish lift, and the river area downstream. The overlook has been closed for security purposes since September 11, 2001.

Counselman Run Natural Area—The Counselman Run Natural Area is located outside of the project boundary, midway between the Otter Creek Recreation Area and Holtwood dam. This 50-acre site, accessible by foot from the

Mason-Dixon Trail, contains large old-growth trees and large stands of native rhododendron.

Oakland Run Natural Area—The Oakland Run Natural Area is located about 1 mile north of Holtwood dam outside of the project boundary, adjoining State Game Lands No. 181 and extending up Oakland Run to Wallace Run. The Mason-Dixon Trail, minor trails, and unimproved roads provide access to the area. This 145-acre site contains a bald eagle nest and large old-growth trees and large stands of native rhododendron.

Islands—The wooded islands within the project boundary in Lake Aldred are used for picnicking, hiking, and hunting. No facilities are provided, but PPL provides trash and debris removal and general maintenance on a routine basis. The southern end of the largest island, Weise Island, has a natural sandy beach and is very heavily used during the recreation season. The construction of temporary duck blinds is permitted. The interiors of the islands are left undisturbed for wildlife habitat, erosion control, and for hiking in a natural environment.

Holtwood Portage and Tailwaters—Canoers and kayakers coming downriver are directed by large signs to the portage area, located within the project boundary, on the Lancaster County shore of Lake Aldred about 800 feet upstream from Holtwood dam. The portage area has a telephone from which boaters may call the Holtwood Project control room to request that licensee personnel transport the boaters and their craft around Holtwood dam to the Muddy Creek boat access, about 1 mile downstream from the dam on the York County side.

PPL conducts maintenance activities on its recreational lands and facilities, including tree cutting; hiking trail and picnic area maintenance; water and electric systems; boat dock installation, removal, and maintenance; boat launch ramp maintenance; debris removal; portable toilet installation and maintenance; and maintenance of information and public safety signs.

Other Recreational Access

PPL leases lands outside the project boundary to clubs, societies, and other organizations or businesses for public purposes compatible with the objectives of the Holtwood Environmental Preserve. These leases add up to almost 80 acres of lands that support recreational and educational uses adjacent to the project boundary. Several commercial facilities also provide access to Lake Aldred.

Private access from shoreline residences is available from the 70 residential properties leased by PPL to individuals. Several commercial facilities also exist to provide access to Lake Aldred. These include commercially operated marinas, boatyards, and campgrounds. A private launch area is located on the north shore and Pequea Creek Boat Club and Arrowhead Marina are located on the south shore of Pequea Creek. Gamler's Marina is a privately owned facility adjoining

the Indian Steps Museum to the south. In addition to the marina, the site includes campsites, vacation cottages and a restaurant.

Recreational Use

Most recreational use of the project occurs at formal access sites. Shoreline anglers and whitewater boaters appear to be the two unique user groups that regularly access the project using informal trails, generally in the area of the bypassed reach on the western shore downstream of the dam. People generally park on the side of the gravel surfaced McCall's Ferry Road, north of Lock 12 Historic Area, and follow informal trails to the bypassed reach.

Sightseeing and hiking are the most popular recreational activities at the sites within the Holtwood Environmental Preserve, followed by camping, recreational boating and fishing. Table 18 summarizes the estimated annual recreational use at the Holtwood Environmental Preserve by recreation site during the period 2001 through 2006. Based on these data, recreational use has declined at the project during this period a total of 73 percent, from 528,100 visitor days in 2001 to 142,100 in 2006. During 2006 for the sites for which data were provided, Pequea boat ramp received the most use (25 percent), followed by the Holtwood Area and Pinnacle Overlook (both at 14 percent).

Lake Aldred is popular for boating, angling, and water-skiing. It provides opportunities for walleye, bass, catfish, panfish, and muskellunge angling. Formal public boat access to the reservoir is provided at York Furnace and Pequea boat launches and shoreline access is available at these sites, as well as Otter Creek Recreation Area.

Portages around the project dam average about a dozen annually and vary in size from one or two canoes or kayaks to large groups such as the Susquehanna Sojourn, occurring annually every June, where 50 to 75 canoes and water-craft require portaging services.

Land-based recreation activities within the project boundary include hunting, hiking, sightseeing and wildlife watching, camping, and picnicking, among others. Hunting for waterfowl, pheasant, rabbit, squirrel, and deer is permitted on 2,200 acres of land surrounding the project, including lands within the Holtwood Environmental Preserve.

Sightseeing activities are enhanced by various scenic vistas throughout the project area, such as Urey, Pinnacle, and Face Rock overlooks. Birdwatchers congregate to see migrating warblers in early spring, nesting bald eagles and ospreys in late spring, and herons on the river in August. The Shenks Ferry Wildflower Preserve is a popular site for viewing the 73 species of wildflowers that bloom from mid-March through May. Educational exhibits, programming, and public outreach are provided at the Holtwood Environmental Center, Lock 12 Historic Area, and via the Holtwood hotline (800-354-8383).

Table 18. Estimated recreation use at the Holtwood Environmental Preserve by recreation site (2001–2006). (Source: PPL, 2007a)

Site Name	2001	2002	2003	2004	2005	2006
Otter Creek Campground	82,400	73,900	90,400	47,600	21,100	15,000
Otter Creek Picnic Area	41,700	27,400	26,500	6,600	2,900	2,000
York Furnace Boat Ramp	68,900	64,000	55,600	9,600	11,400	4,600
Lock 12 Historic Area	51,500	57,900	118,600	100,800	33,200	14,300
Holtwood Tailrace Fishing Area	16,100	15,300	10,400	6,100	4,200	5,000
Holtwood Area	41,000	44,300	47,000	38,400	36,700	19,700
Pinnacle Overlook	36,900	31,400	20,900	39,900	28,000	19,300
Pequea Boat Ramp	63,000	47,900	38,300	30,100	44,900	35,600
Pequea Creek Recreation Area	62,400	68,000	59,400	25,400	37,700	15,500
Face Rock Overlook	64,300	106,200	128,600	17,300	11,400	11,000
Total	**528,100**	**536,200**	**595,700**	**321,800**	**231,400**	**142,100**

Lake Aldred Reservoir Elevations

Lake Aldred extends from the Holtwood dam up the Susquehanna River a distance of approximately 8 miles to the base of the Safe Harbor Project. During the recreation season, between May 15 and September 15, PPL maintains the reservoir between El. 169.75 feet and El. 167.5 feet, as required under the existing FERC license. The minimum operating level during the remainder of the year is El. 163.5 feet. Under existing recreation season operating levels (between El. 169.75 and El. 167.75 feet), public boat launches on Lake Aldred are useable, and the majority of Lake Aldred is navigable and clear of major boating hazards. Rocks and shallows are generally found near the shores and islands.

Recreational uses downstream of the project include shoreline fishing (primarily in the tailrace fishing area) and whitewater boating (primarily in the bypassed reach). The tailrace channel remains fully wetted by backwater from Conowingo Pond, regardless of project operations. When the project is not generating, leakage through the units into the tailrace is about 210 cfs. During project releases, water velocities are 2.5 to 7.5 fps in the upper portion of the tailrace and the tailrace becomes more shallow near the Norman Wood Bridge (Route 372), causing velocities to increase to 7.5 to 10.0 fps for a 1,000-foot section of river. This general area, known as Cully's Falls, is relatively shallow, and local anglers indicate that it is a good location to catch smallmouth bass.

When discharges from the Safe Harbor Project exceed 31,500 cfs, the existing hydraulic capacity of the Holtwood Project, water spills over the dam into the project bypassed reach. This area is subject to a wide variety of flows on an annual basis, and during the summer months, there is typically little to no spill over the dam. During periods of spill, the eastern side of the bypassed reach, the Piney Channel, creates numerous natural eddies, riffles, and runs as water is passed through the canyon-like walls that form the boundaries of the channel. The remaining western side of the bypassed reach consists of braided channels with pools, riffles, and runs. The pools in the upper two thirds of the area are shallow with a rocky bottom, while the pools in the lower third are mostly contiguous with emergent vegetation. During times of no spillage or low flows, anglers and sightseers access the riverbed along the exposed rocks of the project bypassed reach.

As stated previously, public recreational access is provided to the tailrace area at Holtwood Tailrace Fishing Area. Recreational use of the tailrace area is estimated to include both sightseeing (estimated at about 35 percent) and angling use (estimated at about 65 percent). See section 3.3.3, *Aquatic Resources*, for discussion regarding fisheries within the project, including Lake Aldred and the tailrace area.

Whitewater Boating

At flows approaching 50,000 cfs or greater, the project bypassed reach downstream to the Norman Wood Bridge (Route 372) is favorable for whitewater

boating. As identified by the Susquehanna Surf Guide (Lauks, 2008) and American Whitewater (American Whitewater et al., 2007), there are three named whitewater features in Piney Channel, three features in the bypassed reach downstream of the dam, and five named features downstream of the Norman Wood Bridge (Route 372), just over 1 mile downstream of the project. During periods of spill, these eleven named waves and hydraulics, as well as other features, provide opportunities for intermediate, advanced, and expert whitewater boaters. While the length of the reach is short, the number and quality of the play features are considered to be exceptional, and draw significant use from around the region (American Whitewater et al., 2007).

Table 19 provides an estimate of the boatable flow ranges under existing conditions for each of the whitewater boating features. Table 20 summarizes the estimated average number of boating days by month at each of the identified whitewater boating features downstream of the project. Under existing conditions, the project experiences flows of 50,000 cfs or greater about 84 days per year, with about 49 of these days occurring during March through May.

Table 19. Estimated boatable flow range at primary whitewater features. (Source: PPL, 2007a)

Whitewater Boating Feature	Stage (Susquehanna at Harrisburg)[a]		Flow Range at Harrisburg[b] (cfs)		Approximate Flow Range at Holtwood[c] (cfs)	
	Low	High	Low	High	Low	High
Storm Hole	5.5	6.7	50,384	79,801	50,000	80,000
Playspot	6	7.5	62,789	98,809	60,000	100,000
Yesterday	7	No limit	86,978	No limit	90,000	No limit
Playspot II	7.5	9.5	98,809	144,901	100,000	150,000
Powerline	7.5	No limit	98,809	No limit	100,000	No limit
Rumble Pit	7	8.5	86,978	122,055	90,000	120,000
Pleasant Surprise	7.5	9.5	98,809	144,901	100,000	150,000
Rock N Roll	8	10	110,493	156,230	110,000	160,000
Accelerator	10	12.5	156,230	212,857	160,000	220,000
Mama Bear	11	No limit	178,816	No limit	180,000[d]	No limit
Bear Trap	13.5	No limit	235,923	No limit	240,000[d]	No limit

[a] Lauks, 2008.

[b] Based on USGS gage no. 01570500.

[c] Holtwood flow assumed equal to Harrisburg flow as approximation and rounded.

[d] Mama Bear and Bear Trap are located at the upper end of Conowingo Pond and are affected by the combined plant and bypassed reach flow.

Table 20. Estimate of average number of boating days under existing conditions. (Source: PPL, 2007a)

Whitewater Boating Feature	Average Available Boating Days by Month												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Storm Hole	3.4	3.7	8.3	9.2	6.7	2.0	1.0	0.3	0.6	1.3	2.9	4.5	43.8
Playspot	2.9	3.6	8.2	8.9	5.5	1.4	0.6	0.2	0.4	1.1	2.3	3.6	38.6
Yesterday	2.6	3.1	9.1	8.4	3.1	0.8	0.2	0.1	0.2	1.0	1.5	2.6	32.9
Playspot II	1.3	1.5	4.4	3.7	1.6	0.3	0.1	0.1	0.1	0.5	0.7	1.3	15.5
Powerline	2.1	2.4	7.4	6.7	2.5	0.6	0.2	0.1	0.1	0.8	1.1	2.0	26.0
Rumble Pit	1.2	1.6	3.9	3.6	1.9	0.3	0.1	0.1	0.1	0.4	0.7	1.3	15.0
Pleasant Surprise	1.3	1.5	4.4	3.7	1.6	0.3	0.1	0.1	0.1	0.5	0.7	1.3	15.5
Rock N Roll	1.1	1.2	3.8	3.2	1.3	0.3	0.1	0.1	0.1	0.4	0.7	1.1	13.3
Accelerator	0.4	0.4	1.4	1.4	0.5	0.1	0.0	0.0	0.0	0.2	0.2	0.4	5.0
Mama Bear	0.5	0.5	1.8	1.9	0.4	0.2	0.0	0.1	0.1	0.2	0.2	0.3	6.1
Bear Trap	0.1	0.3	0.7	0.6	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.1	2.2
Average	1.5	1.8	4.9	4.7	2.3	0.6	0.2	0.1	0.1	0.6	1.0	1.7	19.4
Any[a]	6.5	7.5	19.0	19.3	11.1	3.0	1.2	0.4	0.8	2.5	4.7	7.6	83.6

[a] Indicates any one feature available.

3.3.5.2 Environmental Effects

Recreation Enhancements

As part of the proposed project redevelopment, PPL proposes to provide additional fishing and boating access at points below the dam and powerhouse and to improve the existing boating access points on Lake Aldred, including: a new elevated roadway over the Norfolk-Southern railroad, a new parking area and reconstruction of the tailrace fishing area, improvements to boat ramps at York Furnace boat launch, and improvements to the Pequea Creek Recreation Area.

For the elevated roadway, PPL proposes to create a bridge over the Norfolk-Southern railroad track along the Lancaster County shore. The proposed elevated roadway would provide recreational access to a new parking area between the railroad right-of-way and the Holtwood tailrace. Two parking areas would be constructed to allow parking for 20 cars, with three accessible parking spaces. The railroad bridge and parking areas would be located above the normal high water level. From the parking area, an accessible trail would provide access to a fishing platform along the Holtwood tailrace. PPL proposes to leave in place one of the abutments from the southern temporary tailrace bridge to serve as a tailrace fishing platform.

For the York County parking area, in the area where white water boaters currently park, PPL would provide formal parking along the existing McCall's Ferry Road in York County and improve trail access from the parking area to the bypassed reach downstream of the Holtwood dam. The parking area (about 17 spaces) would be created by widening McCall's Ferry Road by 27.5 feet over a 137-foot-long area. This area would be outside of a 600-foot buffer from the existing eagle nest on the York County shore.

At the York Furnace boat launch, PPL proposes to extend the two existing boat ramps down to El. 160 feet. At Pequea Creek Recreation Area, PPL proposes to undertake parking and boat launch improvements in coordination with a plan by Pennsylvania Department of Transportation to replace the existing bridge over Pequea Creek. PPL initially proposed to expand the Pequea Creek Boat Launch area to include the addition of 27 boat trailer spaces, three car parking spaces, one additional boat ramp that extends down to El. 160 feet, and an accessible fishing platform and dock. Based on consultation with the resource agencies, PPL proposes to reduce the number of parking spaces to 18 boat trailer spaces in order to minimize fill volume in the floodplain zone.[30] Due to the lost parking spaces during the revision of the plan, PPL proposes to consult with the resource agencies to attempt to secure lands upland of the rail line crossing at Pequea Creek to provide the boat trailer parking spaces.

---

[30] PPL provided the revised plan for the Pequea Creek Boat Launch in its supplement filing of October 3, 2008.

Our Analysis

PPL's proposed construction of project facility modifications and recreation enhancements would restrict public access during construction of the recreation facilities where enhancements are implemented and in the areas around the project structures and tailrace and bypassed reach where channel excavation would occur. Restricted access would displace recreation use of about 15,000 recreation days[31] during the 3-year construction period in the tailrace area. The construction-related effects on recreational opportunities, such as angling, sightseeing and whitewater boating, would be short-term. Some minor displacement of recreation use at the York Creek boat launch and Pequea boat ramp and the parking area would occur, but the proposed construction would occur during the fall and winter periods, when recreational use of this area would typically not be as great as during the primary recreation season. See also below, *Lake Aldred Reservoir Elevations* and *Downstream Recreational Opportunities*, for further discussion of potential effects of project operations on recreational opportunities and access.

After the construction period, the proposed recreation improvements would enhance recreation opportunities at the project, especially at downstream locations. The proposed improvements, such as the proposed elevated access road to the project tailrace and the new parking area and tailrace fishing access area, would provide enhanced public access for recreation at the project tailrace and river corridor lands. The proposed enhancements would improve the boat launching areas and extend the boat ramps to accommodate lower reservoir elevations that would occur during some periods under the proposed action. The proposed parking area and trail access to the river below the dam would help to enhance recreation access to this area.

Lake Aldred Reservoir Elevations

PPL's proposed modifications to project operations could affect reservoir elevations and associated recreation access and use of Lake Aldred. PPL proposes to change the existing license conditions to allow drawdowns below the existing minimum level (El. 167.5 feet, as required under the existing license) from May 15 to September 15 during drought operations (see section 3.3.3, *Aquatic Resources*). The minimum El.163.5 feet during the non-recreation season would remain unchanged. For drought operations, PPL proposes a new rule curve between September 15 and December 31, whereby the minimum pond level would drop to El. 165.6 feet on September 15 and then on a straight line to El. 163.5 feet on January 1 (see figure 6, in section 3.3.3, *Aquatic Resources*). PPL also proposes to provide a River Hotline with information regarding reservoir level (measured at the Holtwood dam), and to develop a website that would provide reservoir level information, expected generation schedules, and whether drought operations are in effect.

---

[31] Based on the recreation day visitor estimates for 2006.

Our Analysis

The proposed operations would result in water surface elevations below the existing minimum surface El.167.5 feet during the recreation season (May 15 through September 15). Table 21 summarizes the minimum elevations that would occur under the proposed action, based on OASIS modeling for the period January 1930 through September 2002 under non-drought and alternative drought operational scenarios (see also section 3.3.3, *Aquatic Resources*). Under all scenarios, during the May 15 through end of July time period there would be occasions when the reservoir elevations would go below El.167.5 feet, with the lowest, worst case scenario of about El. 166 feet (under QFERC drought operations), or 1.5 feet below that which would currently occur under the existing license during this period.

Table 21. Summary of Lake Aldred minimum elevations under proposed conditions.[a] (Source: PPL, 2007a, as modified by staff)

	Non-Drought[b]		**Drought Q-710[c]**		**Drought QFERC[d]**	
	Min. Elevation	**% Time below El. 167.5 feet**	**Min. Elevation**	**% Time below El. 167.5 feet**	**Min Elevation**	**% Time below El. 167.5 feet**
May 15–31	167.46	1	167.47	1	167.47	1
June	167.55	0	167.56	0	167.56	0
July	167.61	0	167.62	0	167.61	0
August	166.76	1	166.64	1	166.28	2
Sept. 1–15	166.57	3	166.41	4	165.97	5

[a] Based on OASIS modeling for the period January 1930 through September 2002 (73 years).

[b] Based on operations with the proposed daily volumetric minimum flow release and the conservation releases, without drought operations.

[c] Based on operations with the proposed daily volumetric minimum flow release and the conservation releases, and with drought operations assuming a Q7-10 trigger flow.

[d] Based on operations with the proposed daily volumetric minimum flow release and the conservation releases, and with drought operations assuming a QFERC trigger flow.

In May 2005, PPL drew the lake levels down for maintenance and also conducted an assessment of navigation hazards and access limitations at low lake levels, including the potential 165-foot elevation that would occur at the end of the recreation season during the drought period. Four areas in particular were identified as having potential for concentrated boating hazards: below Safe Harbor dam, Weise Island, the York Furnace boat launch, and Duncan Island. At El.165.5 feet, the assessment showed that (1) there would be a small area around Duncan Island where navigation hazards would occur, and (2) the rocks in front of the York Furnace boat launch would be inundated but may not be adequately submerged to prevent boaters from striking them.

In addition, the area below Safe Harbor dam was identified as a navigational challenge at any water level.

In terms of the boat launch access, at El. 165 feet, the York Furnace boat ramp would probably require extension further into the channel, and the boarding docks would likely need to be repositioned accordingly. Gamler's Campground has two separate boat launches, one near the boat yard and one near the campground, and the assessment indicated that both would probably be unusable at El. 165 feet. Most of the private boat ramps would probably not be useable, and many private docks were dewatered at water surface El. 165 feet. The four boat launches at Pequea Creek (PPL's Pequea boat ramp and a private launch located on the north shore, and Pequea Creek Boat Club and Arrowhead Marina located on the south shore) would likely be useable, and the canoe portage would likely be unaffected at water surface El. 165 feet.

The areas around Duncan Island and below Safe Harbor dam are locations where boating hazards would occur at even higher reservoir elevations. The boating hazards in front of York Furnace boat launch could create an additional boating hazard area, compared to what currently occurs at higher reservoir elevations. However, this area could be marked and/or the final design for the proposed modifications to the York Furnace boat launch area could incorporate measures to address this potential boating hazard.

The public boat ramps were determined to be marginally functional at El. 165 feet, and most of the private boat ramps along the shoreline used by residents would probably not be useable at water surface El.166.5 feet. In addition, the assessment indicated many private docks were dewatered at water surface El.165 feet.

PPL's proposed modifications to the boat ramp access area, specifically modifications to extend the boat ramps, would help ensure that recreational boating access would continue to be provided at the project during the periods when lower reservoir elevations may occur. The functional elevation of the end of the boat ramps would need to be sufficient to provide boating access during the summer recreation season (i.e., May 15 through September 15), so that recreational boating access would still be provided during the primary recreation season (the period it occurs under existing operations), which under the modeled elevation would be about El. 166 feet during this period. The proposed extension of the boat ramps would address the potential adverse effects of reduced reservoir elevations on public boating access during drought operations at the project.

During the remaining period (September 16 through May 14), the minimum reservoir elevation would remain the same as under the existing condition of El. 163.5 feet. The reservoir would be lowered similar to under existing conditions during the fall period, except under drought condition operations. PPL's proposed rule curve for drought operations would result in the maintenance of higher reservoir levels during the fall months during drought year operations, and would help reduce potential

adverse effects of a sudden decrease in reservoir elevations during the fall shoulder season recreation period.

PPL's proposed measures to provide reservoir level and anticipated generation information at the project, through the telephone hotline and website, would provide the means to provide the public easily accessible information regarding reservoir elevations at the project. This would allow the public to take better advantage of recreational opportunities at the project reservoir.

Downstream Recreation Opportunities

PPL's proposed tailrace excavation and proposed changes to project operations would affect whitewater boating, angling and other recreation activities in the project's tailrace and bypassed reach and the reach immediately downstream of the project. PPL's proposed project modifications and operations would reduce the instances of spillage at Holtwood dam and would alter the timing, duration, and magnitude of flows in the tailrace, Piney Channel, and the bypassed reach as compared to existing conditions (see section 3.3.3, *Aquatic Resources*).

Construction activities associated with the project structures and tailrace excavation would cause the closure of the tailrace and bypassed reach and restrict public access to these areas during the construction period. This closure would displace recreational opportunities in this area, such as tailrace angling and sightseeing, and whitewater boating opportunities, during this period.

Effects on Angling and Sightseeing Opportunities

Although discharges into the tailrace would be approximately double under the proposed action compared to what is currently released, tailrace excavation would be designed to accommodate the increased volume, such that there would be no net change in water level experienced in the tailrace area under the proposed operations. Flows within the bypassed reach would occur less frequently and in smaller magnitude than under existing conditions. The exception would be in the Piney Channel area, where the proposed diversion of flows from Unit 1 would occur. In addition, PPL proposes to maintain a minimum flow of 800 cfs (see section 3.3.3, *Aquatic Resources*). Therefore, during non-generation periods, Piney Channel would have more consistent and deeper water as compared to existing conditions. Under existing conditions during non-spill periods, the channel is typically comprised of small pools among the rocks. The conservation release would help to connect and replenish the pools in Piney Channel on a more consistent manner.

The proposed action would have both beneficial and adverse effects on recreational angling and sightseeing opportunities within the project bypassed reach. Decreased spillage frequency would increase the periods when the bypassed reach rock outcroppings are accessible for sightseeing and angling activities. However, there could be a decrease in fishing opportunities in the bypassed reach, where pools would not be

replenished as frequently from water spillage as under existing conditions. Also, decreased spillage would result in fewer viewing opportunities related to water flows in the bypassed reach.

Effects on Whitewater Boating Opportunities

American Whitewater et al. (2007) states the proposed operations would result in a reduction of about 52 percent (or 40 days) when whitewater boating opportunities would occur downstream of the project. American Whitewater et al, states channel excavations could directly or indirectly adversely affect whitewater play features and flow availability by changes in the flow volume, velocity, direction, and/or complexity. In addition, American Whitewater, et al, states the proposed modifications could directly impact whitewater features by dewatering downstream features through flow diversion, or altering features through changes in flow direction or complexity.

The Pennsylvania FBC states support for preserving of certain whitewater features for recreational kayakers, creating additional features, and providing prescribed boating releases to preserve the quality of kayaking opportunities.

Under the whitewater agreement, PPL would fund the design of two whitewater features and would submit the proposed final design and proposed schedule for implementation to the Commission for approval, including documentation of consultation conducted with Pennsylvania DEP and recreational stakeholders. Within one year of completion of the whitewater boating features, PPL would conduct an assessment of the whitewater features, including assessment of the characteristics of the features at various flows and determination as to whether the features meet their fundamental purpose as designed, which would be filed with the Commission. PPL would provide additional funding for feature maintenance over the term of a new license should the need arise. In the event that any of the features are determined to have an adverse effect on fish passage or to impair the operations of the project, PPL would upon approval from the Commission, remove the features or conduct corrective measures and engage in negotiations with the recreational stakeholders to arrive at alternative provisions to address whitewater paddling concerns.

Within 1 year of completion of the channel modifications, PPL would develop and file with the Commission a report describing any project-related adverse effects on the recreational value of the existing whitewater feature known as Storm Hole, including documentation of consultation with recreational stakeholders and Pennsylvania DEP. If the assessment identifies significant project-related adverse effects, PPL would include in the report proposed corrective measures, including a proposed schedule for implementing of these measures. PPL would implement the approved corrective measures.

In terms of the timing of the proposed whitewater boating flows, the whitewater agreement stipulates that PPL would operate Unit 1 with restricted Area Regulation whenever river flow exceeds 30,000 cfs as measured at the USGS gage at Marietta, PA,

during October through May and whenever river flow exceeds 45,000 cfs during June through September. These triggers were derived to produce 264 hours of boatable flow conditions on an annual average basis. On weekdays, these releases would be scheduled for a minimum 3-hour period within a 4-hour window prior to dusk. On weekends, the releases would be scheduled for a minimum 6-hour period between 10 a.m. and 6 p.m. PPL would consult annually by May 1 with the boaters to schedule an additional 18 hours of Unit 1 operations to provide boating flows at the new features. In the event that the scheduled hours coincide with Unit 1 operations discussed above, PPL would be under no obligation to reschedule the planned additional boating hours. PPL would be able to deviate from these proposed whitewater boating flows during periods when net inflow to the Holtwood facility is less than the minimum flow obligations established in the WQC, upon the declaration of a generation emergency in the PJM Interconnection, or in the event of an emergency as defined in the WQC.

Once the rerouting of Unit 1 is complete, PPL proposes to post the planned Unit 1 operating schedule and any available information on the scale and duration of anticipated spills over the dam, on a company web site on a day-ahead basis.

Our Analysis

Under the proposed action, the frequency of spill events to the bypassed reach would be reduced by about 5 percent in August to about 38 percent in April and May as compared to existing conditions (see table 12, in section 3.3.3, *Aquatic Resources*). Table 22 summarizes the boatable flow range that would be available for each of the primary whitewater boating features downstream of the project under PPL's proposed conditions. The whitewater boating features downstream of the project generally require minimum spillage flows of between approximately 18,500 and 203,500 cfs, or a river flow between 50,000 and 235,000 cfs under existing conditions. Under proposed conditions, these features would remain available at flows ranging from 70,000 to 240,000 cfs, as a result of water diverted to the proposed powerhouse and the rerouting of Unit 1 flows to the Piney Channel area.

As part of a controlled flow study conducted in May 2006, participants were provided two controlled flow releases of 3,150 cfs and 7,000[32] cfs in Piney Channel and asked to rate the overall experience for navigability, quality of features, and aesthetics. Overall, participants indicated that 3,150 cfs, while navigable, was generally not favorable for whitewater boating opportunities. The whitewater feature known as Storm Hole, located near the downstream tip of Holly Island, begins to show optimum configuration, including size of standing waves, presence of eddies, etc., at flows of approximately 7,000 cfs under the current Piney Channel configuration. Based on the whitewater boating assessment, PPL's proposed excavation above Storm Hole is not

[32] Project flow conditions of 50,000 cfs would result in a flow of approximately 7,000 cfs in Piney Channel.

expected to significantly change the feature. Two whitewater features, Mama Bear and Bear Trap, would be generally unaffected by the proposed project operations. These features are located downstream of the convergence of the project tailrace, Piney Channel, and the bypassed reach, and are therefore affected by total project flows, irrespective of the distribution of such flows downstream of the project.

Table 22. Estimated boatable flow range at primary whitewater features under the proposed operations. (Source: PPL, 2008)

General Location	Whitewater Boating Feature	Approximate Flow Range at Holtwood[a]	
		Low	High
Piney Channel	Storm Hole	70,000	100,000
	Playspot	90,000	130,000
	Yesterday	110,000	No limit
Bypassed reach	Playspot II	130,000	170,000
	Powerline	130,000	No limit
	Rumble Pit	110,000	140,000
Downstream of Norman Wood Bridge (Route 372)	Pleasant Surprise	130,000	170,000
	Rock N Roll	140,000	190,000
	Accelerator	190,000	240,000
	Mama Bear	180,000	No limit
	Bear Trap	240,000	No limit

[a] Flow range accounts for diversion to new powerhouse and Unit 1 discharge to Piney Channel.

Table 23 summarizes the change to the expected number of boating days at each play feature on an annual basis as compared to existing conditions.

Table 23. Summary of changes to annual whitewater boating days by whitewater boating feature. (Source: PPL, 2008)

General Location	Whitewater Boating Feature	Condition		Change
		Existing	Proposed	
Piney Channel	Storm Hole	43.8	24.4	–19.4
	Playspot	38.6	17.8	–20.8
	Yesterday	32.9	21.9	–11.0
Bypassed reach	Playspot II	13.6	7.8	–5.9
	Powerline	26.0	15.1	–10.9
	Rumble Pit	15.0	9.5	–5.5
Downstream of Norman Wood Bridge (Route 372)	Pleasant Surprise	13.6	7.8	–5.9
	Rock N Roll	13.3	7.1	–6.2
	Accelerator	4.6	2.7	–1.9
	Mama Bear	6.1	6.1	0
	Bear Trap	2.6	2.6	0
Total existing features		210.1	122.8	–87.5
Average existing features		19.1	11.2	–7.9
Any[a] existing features		83.6	50.5	–33.2
Additional new features[b]			69.6	
Total all old and new features		210.1	192.4	–17.7
Average old and new features		19.1	16	–3.1

[a] Indicates any one feature available.

[b] Includes 2 new features, assumed functional at spills of 62,100 cfs.

PPL's proposed measures under the whitewater agreement would provide the means to mitigate for the reduction in the existing whitewater boating opportunities at the project, as a result of the change in project operations as compared to existing conditions. PPL's proposed whitewater boating access enhancements would provide enhanced public access to the project reaches downstream of the project. The proposed flow information would help to inform whitewater boaters and other recreation visitors of the potential whitewater boating flow opportunities downstream of the project. The proposed provision of whitewater boating flows for 264 hours (equivalent of 33 days x

8 hours per day = 264 hours) would replace the 264 hours of boating opportunities that would lost under the proposed operations. The creation of the two new whitewater features would replace features where use would be diminished by the reduced flows in the bypassed reach.

Recreation Use Monitoring

Interior recommends that PPL, after consultation with FWS, Pennsylvania FBC, Pennsylvania Game Commission, Pennsylvania DEP, and Pennsylvania DCNR, monitor recreational use of the project areas to determine whether existing access facilities are meeting demands for public use of fish and wildlife resources. Interior recommends that monitoring studies begin within 6 years of issuance of the amended license, and that every six years during the term of the license, PPL file a report with the Commission on the monitoring results, that would include (1) the annual recreation use figures; (2) a discussion of the adequacy of the applicant's recreation facilities; (3) a discussion of the need for additional recreation facilities at the project site; (4) any recreation plans proposed by the applicant to accommodate or control visitation in the project area; and (5) documentation of agency consultation and agency comments on the report.

PPL in its reply comments filed on June 19, 2008, states that it routinely monitors recreational use at the project and periodically files with the Commission a FERC Form 80, and that recreational facilities are periodically inspected by Commission staff and reviewed for adequacy and public safety. PPL states that these standard provisions of the existing project license adequately address Interior's recommendations in this matter.

Our Analysis

The proposed actions would entail modifications to existing recreation facilities and implementation of additional new facilities at the project. In addition, PPL's proposed modification to project operations, including potential modification of reservoir elevations and flow regime below the project, would have the potential to alter recreation opportunities at the project, such as boating access and available flows.

While PPL is required to submit a Form 80 Licensed Hydropower Development Recreation Report every 6 years, this report would not require annual recreation use estimates and other information specific to monitoring of the proposed changes to recreation opportunities at the project, such as assessment of the adequacy of the boating access ramps under the proposed operational changes. In addition, during the construction period, recreational use and access would be restricted and would affect recreational opportunities at the project during this period. A recreation use monitoring plan would provide the means to monitor the potential effects of the proposed action on recreational use and access at the project, both during project construction and post construction in terms of potential effects of the proposed operations.

Specifically, an effective recreation monitoring plan would include provisions for the development, in consultation with FWS, Pennsylvania FBC, Pennsylvania Game Commission, Pennsylvania DEP, and Pennsylvania DCNR, and implementation of a recreation monitoring report to include:

- estimates of annual project-related recreation use visitation;
- assessment of the effects of proposed project construction on recreation opportunities and access at the project during the construction period;
- assessment of the effects of project operations, i.e., reservoir elevations and provision of flows downstream of the project dam, on recreation access and opportunities at the project;
- assessment of the adequacy of the existing project's recreation facilities;
- assessment of the need for additional recreation facilities at the project site;
- description of any recreation plans proposed by PPL to accommodate or control visitation in the project area; and
- documentation of agency consultation and agency comments on the report.

The monitoring plan would also include provisions for filing the recreation use monitoring report with the Commission for review annually during the construction period associated with the proposed action, and every 6 years, in conjunction with the filing of the Form 80 report, following the completed construction of the proposed project.

3.3.5.3 Unavoidable Adverse Effects

Construction activities would result in the unavoidable restriction to some existing recreational facilities during the 3-year construction period.

3.3.6 Land Use and Aesthetic Resources

3.3.6.1 Affected Environment

Land Use

The lands within the project boundary comprise about 6,320 acres, including 2,400 acres of lakebed under Lake Aldred, and are almost entirely owned and managed by PPL. The lands on and immediately surrounding the Holtwood Project are largely wooded but contain recreational areas, scattered residential neighborhoods and farmland. No significant agricultural activities occur on project lands with the exception of roughly 300 acres of land that are leased by PPL to private individuals. In all but about 5 percent of the shoreline, there is at least a 200-foot forested buffer around the river within the project boundary.

Portions of the project area below the Holtwood dam and powerhouse are backwatered from the downstream Conowingo Project and are included within the FERC boundary of that project. Within this joint project area, PPL has developed and manages recreational access, and has been responsible under its existing license for managing lands and waters within this area, except for limited lands owned by Exelon.

PPL owns a majority of the land around Lake Aldred and leases portions of it to individuals and local organizations. Numerous cottages and several businesses are located around the reservoir. Lands are currently leased to individual families for cottage sites. PPL's policy is not to award any additional leases for summer cottages or other uses that might conflict with the objectives of maximum public use and maintaining the attractive environment of the Holtwood Environmental Preserve (see section 3.3.5, *Recreational Resources*). However, to accommodate as many valid recreational uses as possible, it is also PPL's policy not to cancel existing leases, as long as private use of cottages are compatible with recreational and environmental programs and facilities and otherwise meet legal requirements. Lessees are required to obtain PPL's permission for any building additions and tree removal.

Until 1999, a coal-burning steam electric plant occupied the land adjacent to the Holtwood hydroelectric station. The land where the coal plant was located has not been developed, and currently essentially exists as a brownfield.

Aesthetics

Views within the project area include project facilities, including the Holtwood dam. The existing project powerhouse is located on the east side of the river along the Lancaster County shoreline.

The project lands include many areas of high aesthetic value because of their topography, geology, and vegetation. Portions of the Tucquan Creek, a tributary to Lake Aldred, are designated as Scenic River sections under the Pennsylvania Scenic Rivers Program. Tucquan Creek from the headwaters near Rawlinsville, Pennsylvania, to the confluence of Clark Run near River Road is designated as a scenic segment, while the segment from River Road to the confluence at the Susquehanna River in Lake Aldred is designated as a wild segment.

The Otter Creek tributary gorge and the Muddy Creek area include some of the largest stands of virgin mixed mesophytic forest east of the Appalachian Mountains. The stands include an important Eastern Hemlock component, while in higher elevations, the stands include more oaks. The Kellys Run and Oakland Run sites also contain mature ravine forest, and are notable for their rock outcrops.

Overlooks in the area include the Pinnacle Overlook, offering a clear view of the upper, narrow part of the Susquehanna River canyon and notable for the scenic cliff exposures and pine-oak forest, and the Urey Overlook, also offering striking cliffs and views of the river. Other overlooks, such as at Face Rock, provide additional views of the Susquehanna River and the Holtwood Project.

3.3.6.2 Environmental Effects

Land Use

PPL's proposed construction activities would restrict recreational access and change land use at the project.

PPL proposes to develop and implement a lands and shoreline management plan, in consultation with the resource agencies in order to develop long-term management objectives and implement a long-term management program for project lands to ensure the continued preservation of project lands, shoreline buffers, historical and archeological resources, and the protection of sensitive species, such as the bald eagle.

Interior also recommends that PPL develop a shoreline management plan specifically for licensee-owned lands abutting project waters within 330 feet of the high water elevation (a distance that encompasses the preferred buffer zone width for species of concern avian and terrestrial at the project). This buffer zone would include measures for the protection of resources needed for project-related purposes, such as protection of fish and wildlife habitat, providing public access for recreation, and protecting sensitive, unique, or scenic areas. Interior recommends that the plan include, but need not be limited to: (1) a description of those lands covered by the plan, including a drawing or map showing their location relative to project facilities or project waters and measures to include those lands within the project boundary; (2) a description of how the land would be managed and used for each parcel of shoreland covered by the plan; (3) a discussion of how the plan addresses the following considerations: selection of lands that are largely undisturbed and free from any observable past alterations that may have impaired their ability to provide the necessary protection and enhancement of wildlife and plant species; selection of additional lands to provide additional buffering capacity against adjacent land disturbances in ecologically sensitive areas; selection of lands that would protect riparian corridors; and (4) an implementation schedule.

Interior recommends that PPL prepare the plan after consultation with FWS, Pennsylvania FBC, Pennsylvania Game Commission, Pennsylvania DEP, Pennsylvania DCNR, and affected or interested municipalities or organizations.

Our Analysis

PPL's proposed construction activities associated with the proposed project would result in potential short-term effects on land resources within the project. The proposed action would involve the construction of temporary access roads for project construction vehicles, closure to the public of land areas that provide recreational access during the construction period, and physical changes to the configuration of the tailrace channel as a result of the proposed excavation. Construction of temporary access roads would result in the removal of some trees and ground clearing activities associated with the proposed construction and creation of temporary access roads. We discuss the

potential effects of the construction of the temporary access roads in section 3.3.4.2, *Terrestrial Resources*.

The proposed action would also result in long-term effects on land use as a result of the proposed new powerhouse, new tailrace area, and proposed new and modifications to recreational facilities and access at the project (see also section 3.3.5, *Recreational Resources*). Under the proposed action, the new powerhouse would be built adjacent to the existing powerhouse on lands previously occupied by a coal-burning plant. In addition, PPL proposes to make some of the temporary access roads permanent, to serve as recreational access roads. The other roads would be removed and replanted with native species to restore disturbed areas.

A land and shoreline management plan for lands within the project boundary would provide the means to help ensure that project lands are managed for the protection of project resources and purposes. PPL does not provide specific details on what its proposed land and shoreline management plan would include, but proposes to develop, in consultation with resource agencies, and implement a land management program for project lands. Interior's recommendation includes measures to establish a shoreline buffer zone on licensee-owned land for the protection of project resources. Some of these lands are within and some lands are outside of the existing project boundary. In addition, Interior recommends that the buffer zone include lands within 330 feet of the high water elevation, stating that this distance would encompass the preferred buffer zone width for species of concern, avian and terrestrial, at the project.

The purpose of the shoreline management plan would be to develop and implement measures to protect resources needed for project-related purposes, such as protection of fish and wildlife habitat, providing public access for recreation and protection of sensitive, unique, or scenic areas. Within the existing project boundary, in all but about 5 percent of the shoreline, there is at least a 200-foot forested buffer around the river. The shoreline buffer may not necessarily need to extend the 330-feet along the entire project reservoir and reach immediately downstream of the project in order to provide adequate protection of project resources. These areas may be less or greater than a 330 foot buffer zone, depending on project resources and access. Therefore, assessment of the lands needed for inclusion within the project boundary for project purposes and protection of resources affected by the project as part of the development of the plan would help to establish the locations where such a shoreline buffer would require adjustment of the existing project boundary. In addition, this assessment would identify locations where the existing project boundary may not encompass new project-related recreation access facilities that are developed as part of the proposed action, such as the new tailrace access area and access road.

Development and implementation of a lands and shoreline management plan in consultation with FWS, Pennsylvania FBC, Pennsylvania Game Commission, Pennsylvania DEP, Pennsylvania DCNR, and affected or interested municipalities or organizations, including the assessment and inclusion of lands necessary for the

protection of project-related resources and purposes within the project boundary, would provide the means to help ensure long-term protection and appropriate management of project lands. We conclude that an effective plan should include: (1) assessment of the lands to be included within a shoreline buffer (including rationale for extending the shoreline buffer beyond that which currently exists at the project) and lands to be included within the project boundary for the protection of project resources, such as protection of fish and wildlife habitat, providing public access for recreation, and protecting sensitive, unique, or scenic areas; (2) a description of those lands covered by the plan, including any proposed revisions to the project boundary and revisions to exhibit G, if necessary; (3) a description of measures to be implemented for the management and use of project lands; (4) measures for the coordination of the plan with other resource management plans and programs for the project, such as the historic properties management plan, long-term monitoring program of wetlands and state threatened and endangered plants, and the bald eagle protection plan; (5) measures to revise and update the plan; and (6) a schedule for implementation of the plan and associated management measures.

Aesthetics

During the proposed 3-year construction period, construction-related activities, including the construction of the new powerhouse and excavation of the forebay and area downstream of the powerhouse, would have significant short-term effects on aesthetic resources within the project. We discuss the effects of construction activities on noise and air emissions in section 3.3.1, *Engineering Review*. Therefore, we discuss effects on the visual resources in this section. In addition, PPL's proposed project operations would slightly alter the elevations at Lake Aldred and alter flows downstream of the project, and proposed modifications and new project facilities would result in long-term changes to the aesthetics associated with the project area.

Our Analysis

The proposed excavation activities downstream of the project and the construction of temporary access roads would result in the clearing and alteration of vegetation and changes in the topography at the project. Temporary access roads would be built wide enough in some stretches for two trucks to pass one another and would be located in various locations around and downstream of the existing powerhouse. During the construction period, the two to three trailer-mounted lights, each consisting of four flood lights on roughly 30-foot stands, for evening and overnight work would be visible from various locations within and adjacent to the project, including the Face Rock Overlook and the Norman Wood Bridge (Route 372). These construction-related activities would all result in short-term adverse effects on aesthetic resources in the project during the construction period. In addition, recreational sightseeing and aesthetic viewing of the project reach downstream of the project would be displaced

during the construction period, due to the closure of this area to recreational access (see also section 3.3.5, *Recreational Resources*).

The proposed excavation activities would permanently alter the topography of the areas of excavation. The excavation of the forebay would alter a portion of the site of the old coal fired steam electric station. Excavation downstream of the project would slightly widen the channel and would remove small portions of Piney and Barkley Islands and the Lancaster County shoreline. Additionally, a portion of Piney Channel, the channel on the western side of Piney Island, would be excavated. After construction activities are completed, some of these roads would be removed, while others would remain to serve as recreational access roads or would be replanted with native species to restore disturbed areas.

The portions of the impoundment are characterized by a steep topography and would be minimally affected by the potential reservoir level drawdowns during drought conditions. However, in areas that have a more gradual slope, lower reservoir elevations resulting from implementation of the daily volumetric releases and conservation releases during drought operations could increase exposed mudflats along portions of the shore and sandbars extending from islands. These mudflats and sandbars would be visible from boats, the shore, and from the scenic overlooks. However, since these lower elevations would typically occur primarily during drought periods during the late recreation season, they would not result in significant adverse effects on aesthetic resources.

The proposed conservation releases into Piney Channel would alter the aesthetics of the channel from an area typically comprised of intermittent and isolated pools to an area that is more completely wetted and riverine in nature. The bypassed reach would receive fewer occasions of spillage, altering the aesthetic viewing nature of the bypassed reach to receive fewer viewing occasions of high flows.

3.3.6.3 Unavoidable Adverse Effects

No unavoidable adverse effects were identified.

3.3.7 Cultural Resources

3.3.7.1 Affected Environment

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), requires that the Commission evaluate the potential effects of its proposed actions on properties listed or eligible for listing on the National Register. The Commission must take into account whether any historic property could be affected

within the project's area of potential effects (APE).[33] The APE for the proposed amendment to the Holtwood Project includes Piney Island, Piney Channel, Upper and Lower Bear Islands, the project tailrace area, the new or improved recreational areas, and proposed stream and wetland mitigation areas.

Prehistoric Overview

Three major cultural stages or periods delineate the prehistoric developments in the eastern United States:

- Paleo-Indian Period—10,000 B.C. or more to 8,000 B.C.
- Archaic Period—8,000 B.C. to 1,000 B.C.
- Woodland Period—1,000 B.C. to 1550 A.D.

A fourth, the Historic Period, describes the time of European-Indian contact. These periods represent distinctly different adaptations to the environment, and each is characterized by certain distinctive cultural, social, economic, and technological changes. The past 12,000 years or more reveal slow, steady evolutionary growth and change.

From an archaeological perspective, Lancaster County is part of the Middle Atlantic Culture Province of the Eastern Woodlands.

Paleo-Indian Period—10,000 B.C. or more to 8,000 B.C.

During the Paleo-Indian Period, cold-adapted animals of the Pleistocene era were prevalent (woolly mammoth, mastodon, certain species of bison, caribou and others). Indians subsisted primarily by hunting and foraging. They ranged over considerable distances in search of food and suitable materials for tools and were likely organized into loosely knit bands of individuals related by kinship. Settlements were relatively small and temporary, and located where food and water could easily be obtained. Although several Paleo-Indian artifacts have been recovered at sites along the river in both Lancaster and York counties and on a few of the river islands, no Paleo-Indian site has been excavated in Lancaster County or in south-central Pennsylvania.

Archaic Period—8,000 B.C. to 1,000 B.C.

The nearly 7,000-year span of time that constitutes the Archaic Period in American prehistory in Lancaster County was characterized by an environment that was

---

[33] The area of potential effects is defined in the Advisory Council on Historic Preservation's regulations (36 CFR 800.16[d]) as "geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of Historic Properties, if any such properties exist."

becoming warmer, and by the human adaptation to a deciduous broadleaf forest inhabited by modern animal species.

Excavations on Bear Island between the Holtwood and Conowingo dams, on Piney Island located just south of the Holtwood dam, Duncan Island, and Fisherman's Run at the south end of Washington Boro yielded significant sites that have provided important insights into the Late Archaic cultures of Lancaster County and the Lower Susquehanna Valley as a whole.

The Archaic Period is considered a time of "settling in," a period of restricted wandering as band territories became established. It is the longest and most varied of the three prehistoric periods. Archaic sites and surface collections representing this stage of cultural development are common throughout Lancaster County, including base camps, hunting camps, rockshelters, etc. Settlements were often large, with numerous Archaic sites occurring along the Susquehanna River, on the islands, along all the tributary drainages and in a variety of different ecological niches.

Woodland Period—1,000 B.C. to 1550 A.D.

Four major developments used to define the Woodland Period are the rise of agriculture, settled village life, the development of pottery, and the presence of the bow and arrow. As plant cultivation diffused from a Mexican source, the native populations north of Mexico began to place greater emphasis upon plants as a food source. The diffusion of a pottery-making tradition from the Mid-Atlantic coastal region into the Susquehanna Valley possibly occurred as early as 1,000 to 1,200 B.C. The shift from carved soapstone bowls to clay-fired pottery is illustrated by a flat bottom, straight sided ceramic vessel found in the late 1950s on the lower end of Bear Island.

From 1200 to 1550 A.D., an indigenous population of people lived along the fertile flood plains of the Susquehanna River and its larger tributary streams in the area, forming what is known as the Shenks Ferry Culture. There are more than 40 sites in Lancaster, Lebanon, and York counties thought to be of the Shenks Ferry Culture, including some on PPL property.

During the early period of their settlement, Shenks Ferry people lived in circular, bark-covered huts in open sites and locations. By about 1450 A.D., however, the villages were built closely together within stockaded walls for defensive purposes. Around 1550 A.D., Susquehannock Indians that had been living along the Susquehanna River to the north began moving down and settling in the same areas that were inhabited by the Shenks Ferry people. Shortly thereafter, evidence of the Shenks Ferry people as a separate culture disappears from the archeological record.

Historic Overview

Europeans came into contact with the Susquehannock Indians when Captain John Smith journeyed up the Susquehanna River in 1608. When the Europeans arrived, the

Susquehannock Native Americans were avid traders and supplied the overseas market with furs in exchange for guns, brass kettles, steel knives, glass beads, rum, and other objects. In 1681, King Charles II granted William Penn the land between the 39th and 42nd degrees of north latitude and from the Delaware River westward for five degrees of longitude. Penn began purchasing the claims to the land of the Indians who lived there. The influence of European culture and disease, and battles with the Iroquois for the supremacy to trade with the Swedish, Dutch, and English uprooted the Susquehannock lifestyle, and by 1789, all of the claims in the Commonwealth of Pennsylvania had been purchased.

Religious sects seeking religious freedom, including Mennonites, Moravians, Dunkards, Scotch-Irish Presbyterians, Quakers, and members of the Church of England, were some of the first settlers to the area. Germans were particularly attracted to the interior region of Pennsylvania, including Lancaster, Berks, Northampton, and Lehigh counties, and transformed the area into a rich farming region. By the 1750s, the southeast area of Pennsylvania had been developed into an exceptional farming area and produced surpluses for export, adding to Pennsylvania's wealth. In York County, Germans generally settled in the limestone valleys, Quakers settled in the northern part of the county, and Scotch-Irish and English settled in the southern part.

Battles of the Civil War occurred in York County, including the farthest northward thrust of the Confederate Army. Confederate forces pushed across the county as far as the Susquehanna River, but were barred from significant further advance when the bridge at Wrightsville was burned.

Fostered by the completion of the Susquehanna and Tidewater Canal in 1840, commerce and transportation depended heavily on the rivers in Pennsylvania. The 42.5-mile canal consisted of 27 lift locks, 2 guard locks, 4 dams, 5 culverts, and 6 aqueducts and stretched from Wrightsville, Pennsylvania, to Havre de Grace, Maryland. From there, steam tugs towed canal boats to Philadelphia and Baltimore. While operational, the canal allowed the mule-drawn coal and lumber boats to navigate around the 230-foot fall of the Susquehanna River. The canal system was abandoned in 1894, concurrent with the advent of the railroad. The remains of lock number 12, a 17-foot-wide, 170-foot-long lock, lie in the project area. Although parts of the lock are gone, such as hinged wooden gates that fit to each end of the lock, the schist-stone walls of the lock remain. The Lock 12 Historic Area is currently used for its historical and educational value.

Constructed between 1905 and 1910, the Holtwood Project was placed in commercial service in October 1911 with five units in operation. Between 1912 and 1924, five additional units were installed, raising the station output to 107.2 MW nameplate rating.

In 1924, two 25-MW steam turbine generators were installed at the site. These units were fueled with anthracite coal that was dredged from the river in Lake Aldred. These units operated until 1972, when they were shut down and retired due to age and

lack of emissions control equipment. In 1955, an additional 80-MW steam turbine generator was installed. This unit was also fueled with anthracite coal dredged from the river in both Lake Aldred and Lake Clarke above Safe Harbor dam. Dredged coal was used until 1973, after which all fuels were transported to the plant by truck. The third steam turbine unit was shut down and retired in 1999 due to age, economics and pending environmental regulation. All plant facilities associated with the coal-burning operations were demolished in 2000.

Known Historic Properties

Most of the land and water area within the project boundary[34] and a small amount of land owned by PPL outside the project boundary comprise the Holtwood Environmental Preserve. These areas in the preserve include approximately 5,000 acres, and provide for both active and passive recreational opportunities and for the protection of natural areas along the River. The areas include Shenks Ferry Glen Wildflower Preserve, Lock 12 Historic Area, Holtwood Pinnacle Overlook, Otter and Pequea Creek Recreational Areas and Lake Aldred (see figure 12). Each of these areas is managed to benefit environmental resources and provide recreational and educational opportunities. In addition, there are other PPL-owned woodland tracts adjacent to the reservoir, and below the dam and powerhouse. Previous studies have identified five sites within the Holtwood Environmental Preserve that are listed on the National Register. These sites are described below and a more detailed description of each site can be found in the Holtwood Initial Consultation Document.

The Big and Little Indian Rock Petroglyphs (listed April 3, 1978) are located in the Susquehanna River, about 4,000 feet downstream from Safe Harbor dam. These petroglyphs consist of human, animal and geometric forms carved and pecked into the mica-schist outcrops. Although all authorities agree that they are of Indian origin, their dating is still uncertain.

The Shenks Ferry site (listed March 3, 1982) is located north of Pequea, in Martic Township, Lancaster County. The site is currently the only clear example of Shenks Ferry peoples being acculturated by Susquehannocks in the sixteenth century.

Duncan Island (listed May 10, 1984) is located in Lake Aldred about 3 miles upstream from Holtwood dam. Previous investigations have identified diagnostic artifacts, possibly 8,000 B.C. to 1,000 B.C., at this site.

Indian Steps Cabin (also known as Indian Steps Museum, listed March 9, 1990) is located near York Furnace, in Lower Chanceford Township, York County. John E. Vandersloot, a York attorney, built Indian Steps Cabin in 1912 as a memorial and museum dedicated to a culture with which he had become deeply fascinated. Indian

---

[34] Excluding the land and water area at and in the immediate vicinity of the powerhouse and the dam.

Steps Museum is among the oldest in the country entirely devoted to American Indian cultures.

Colemanville Covered Bridge (listed December 11, 1980) is located at the Fox Hollow Road crossing of Pequea Creek, in Conestoga and Martic townships, Lancaster County. The bridge is one of a group of some 30 Lancaster County covered bridges that the Pennsylvania Historic and Museum Commission nominated for inclusion in the National Register as thematic resources. The county of Lancaster owns the Colemanville Covered Bridge. It was erected in 1856, is 170 foot long with a road width of 15 feet, and was washed off its abutments by the Agnes Flood, lifted back with the help of two cranes, repaired by Amish carpenters, and dedicated December 10, 1973. The bridge was subsequently moved a short distance downstream and placed on new, higher abutments. The bridge continues in use to automobile traffic and appears to be in excellent condition.

The Holtwood Hydroelectric Plant is designated as an American Society of Mechanical Engineers International Historic Engineering Landmark for the installation of the first Kingsbury thrust bearing. The thrust bearing supports the entire weight of the rotating components of the turbine and generator, approximately 220 tons. The first bearing was installed on Unit 5 in 1912 and was dedicated in 1987. Kingsbury style bearings are installed on all the main turbines at the Holtwood Project. Given its status as an International Historic Engineering Landmark, the project also is eligible for the National Register. PPL assessed the historical significance of the Holtwood Project and concluded that the Holtwood dam and powerhouse may be eligible for listing in the National Register. PPL submitted a completed Pennsylvania Historic Resource Survey Form to the Pennsylvania SHPO on May 22, 2008.

Archaeological Sites

Previous archaeological studies have identified Piney Island as a place of great significance for archaeological resources. PPL conducted a geomorphological survey, with archaeological sampling, of Piney Island in 2006. The purpose of the survey was to identify those areas of the island where there are established soils with the potential to contain diagnostic artifacts. Cress et al. (2006) indicates that large portions of Piney Island contain very deep deposits of recent fill and coal dust and thus show low potential for adverse effects to intact archaeological sites. Only one area, located on the northeast edge of the island, was found to contain soils that show the potential for intact archaeological resources. The survey also included Upper and Lower Bear Island and determined that portions of those islands also have established soils with the potential to contain diagnostic artifact. The SHPO in letters dated May 30, 2008, and June 6, 2008, has noted that the areas proposed for the stream and wetland mitigation have a high probability for archaeological content.

Areas of Tribal Concern

The archaeological record indicates that the Susquehanna River area has been inhabited by Native Americans for at least 10,000 years, as shown in the range of prehistoric sites within the project area. There was a very clear and strong presence of Native Americans in the Susquehanna River valley when the earliest European explorers first entered the region, and it continued well into the period of European settlement. This presents a well-justified traditional connection on the part of different Native American groups to the land that includes the project area.

Under section 106 of the NHPA, the Commission is obligated to seek out any federally recognized Indian tribes that may have a traditional cultural or religious connection to land under its jurisdiction and to involve them in the consultation. The Seneca Nation of Indians and Towanda Band of Senecas have been identified as having a traditional connection to the project area. PPL invited representatives from these tribes to comment on the initial consultation document and the draft license application, and neither tribe has notified PPL or the Commission that they have any interest in the proposed action.

3.3.7.2 Environmental Effects

Archaeological Properties

The proposed action has the potential to affect archaeological resources by means of new construction and erosion. Given the different land-use histories of the areas that may be affected, the potential for adverse effects on archaeological properties at the project is conditioned by the land use history of the different specific areas in which construction is proposed. Each of the areas that may be subject to proposed actions will be considered in turn.

A new powerhouse would be constructed where a parking lot adjacent to the original powerhouse now exists. Excavation significantly below grade would be required. A recent geomorphological and archaeological survey (Cress et al., 2006) included a review of the logs of 30 borings conducted in the proposed construction area. The review of these boring logs revealed that the area has no potential to contain intact cultural material. This action therefore has no potential to adversely affect archaeological properties.

Piney Island, immediately downstream of the powerhouse, is the location of several proposed actions. With the addition of a second powerhouse using the existing tailrace, PPL would need to increase the hydraulic capacity of the tailrace. PPL proposes to accomplish this by making the tailrace both deeper and wider, including excavating a portion of Piney Island that forms the western border of the tailrace. To provide the heavy equipment needed to excavate the tailrace channel, PPL proposes to create access roads along the shorelines of Piney and Barkley Islands. Given the

potential for significant archaeological sites on Piney Island, each of these proposed actions has the potential to adversely affect archaeological properties.

Piney Island is a low-lying island within the main channel of the Susquehanna River, and as such it is subject to frequent floods which, over time, have altered the island's soil stratigraphy. In addition, Piney Island lies immediately downstream of a large riverbed coal mining operation, and previous pedestrian surveys have identified extensive layers of coal dust. The likelihood that there are soils that feature a mature stratification is, therefore, not assured across the island.

Any excavation or ground-disturbing activities within the area of intact soils may constitute an adverse effect on archaeological properties. The SHPO, by letter dated January 22, 2007, advised that no further testing was needed at the site unless ground disturbing activities were proposed in this or in other areas that may contain archeological resources.

In conjunction with the proposed powerhouse redevelopment, PPL proposes certain recreational enhancements, including improvements to existing facilities including fishing access at points below the dam and powerhouse and potential enhancements to existing boating access points. All work is expected to take place within existing recreation areas. No adverse effects on archaeological properties are expected.

The Corps noted in its letter of September 23, 2008, that the SHPO had not had an opportunity to review the revised plans for proposed recreational areas and stream and wetland mitigation areas. The Corps further noted that PPL is conducting an additional archaeological survey of about 2 acres, including these areas that would involve ground-disturbance. The findings of the survey and any SHPO review would be addressed in the historic properties management plan being developed by PPL in consultation with the SHPO.

An issue was raised about the potential for proposed changes to affect water velocities downstream of the project and whether these could create erosion on Bare Island, approximately 1.5 mile downstream of the Holtwood Project. Bare Island is known to contain archeological resources. As described in section 3.3.3.2, *Aquatic Resources*, under *Water Quantity,* water velocities downstream are not expected to increase as a result of the proposed action. However, PPL did evaluate this area in 2006 and concluded that soil that may contain archeological resources was stable and well armored against erosion by bedrock outcroppings (Cress et al., 2006).

Historic Buildings and Structures

The proposed action has the potential to affect the Holtwood dam complex. A new diversion tunnel is proposed that would divert water from Unit 1 (the most upstream unit on the existing powerhouse) through the existing diversion wall. This would involve enlarging the opening through which Unit 1 currently discharges into the tailrace and constructing a tunnel through the existing, modern diversion wall. This

would change the existing powerhouse and therefore has the potential to adversely affect the historic property.

The proposed new powerhouse has the potential to affect the visual and spatial character of the existing dam and powerhouse complex by introducing a new structure and an enlarged forebay. The effect of the change in the visual character of the existing complex is mitigated by the design of the addition that replicates the function and appearance of the existing powerhouse and forebay. In addition, the new powerhouse would complement the existing powerhouse in scale and massing. Neither the new diversion tunnel nor the addition of a new powerhouse would alter the characteristics that would qualify the Holtwood dam and powerhouse complex for listing in the National Register. PPL and the Pennsylvania SHPO are developing an historic properties management plan to protect historic and archaeological resources during project construction and throughout the term of the license. The plan should be completed and accepted by the Commission prior to the commencement of construction.

3.3.7.3 Unavoidable Adverse Effects

No unavoidable adverse effects were identified.

This page intentionally left blank.