APPENDIX C

INVESTIGATION AND ANALYSES

INVESTIGATIONS AND ANALYSES

Refer to the 1974 Work Plan – FEIS for specific methodology for each study area. As described below, additional work was done on specific issues as a part of this supplemental evaluation.

Geologic Investigation

A subsurface investigation was conducted in March 2005. The geologic investigation consisted of geologic mapping, exploratory borings, and test pits. The boring program consisted of 10 borings. Boring locations and depths were selected to characterize the subsurface conditions of the proposed dam location. Boreholes included both vertical and angled holes. The borings were drilled to depths ranging from 22 feet to 102.5 feet. The total aggregate length of all the borings was 565 feet. The test pit program consisted of 30 test pits. Embankment volumes were computed using AutoCAD. Volume of available on-site borrow material was estimated based on an extensive evaluation of the boring and test pit logs obtained from the subsurface investigation. The earthen material to be used to construct the embankment will come from the auxiliary spillway (ASW) excavation, from the sediment and flood pools above the dam site and from a small area downstream of the dam (See maps Appendix B). Rock excavation is anticipated to be required during construction of the ASW south of dam. Volumes of earthen material to be excavated from the ASW were computed using AutoCAD.

A preliminary geologic investigation of Site 23 was conducted in May 1999. The geologic investigation consisted of geological mapping and test pits. The test pit program

consisted of 16 test pits. Test pit locations were selected to characterize the availability of soil borrow material appropriate for a clay core (Zone I material) for the embankment. Site 23 is underlain by the Devonian Hampshire Formation. The valley floor of Cullers Run in the area evaluated consists mainly of Potomac fine sandy loam and Tioga fine sandy loam.

Engineering

Planning investigations were conducted to determine final planning designs and costs for Site 16. Detailed topographic mapping and aerial photo coverage for Site 16 and the Lost River Valley were completed in 2005. The aerial photographs used in the development of the topographic maps were taken on March 18, 2005. Horizontal and vertical ground control was established by GPS and by detailed field surveys. New black and white aerial photography was obtained at nominal negative scales of 1 inch=800 feet and 1 inch=1,200 feet using a fully calibrated RC-30 precision mapping camera mounted in a twin engine aircraft. The aircraft was equipped with a GPS unit. The topographic mapping was compiled/digitized at a scale of 1 inch=200 feet with 2-foot contour intervals and index contours at 10-foot intervals. The maps were produced in AutoCAD format. Stage-area relationships for Site 16 were developed in AutoCAD. Stage-storage volumes were then computed using the average-end-area method.

The dam was proportioned using the NRCS Water Resource Site Analysis Computer (SITES) Program. SITES routed the estimated design-storm runoff from the contributing watershed through the dam. The principal spillway, auxiliary spillway, and top of dam

routings were completed to determine the crest elevation of the principal spillway and auxiliary spillway and the elevation of the top of dam. Delineation of the drainage area, and the determination of the reservoir characteristics, were based on USGS topographic mapping, topographic mapping from aerial photography and land-based surveys, GIS databases, and field reconnaissance. The structure is planned with a single-stage principal spillway system composed of a standard Dx3D reinforced concrete drop inlet riser, a reinforced concrete pipe, and a reinforced concrete outlet basin resting on bedrock. The crest of the riser was set at the elevation of the sediment pool plus water supply pool. The sediment pool consists of the volume of sediment accumulation estimated to occur during the 100-year life of the project. This amount is approximately 212 acre-feet. The water supply pool consists of 400 acre-feet of storage for rural water supply. The principal spillway was sized to empty the flood storage pool (volume between the riser crest elevation and the ASW crest elevation) in 10 days or less. Net flood storage was determined by routing the principal spillway storm through the riser and principal spillway structures without flow through the auxiliary spillway. The crest elevation of the auxiliary spillway was set to store the net flood volume (runoff from the watershed above the dam minus the design discharge through the principal spillway) resulting from the combined10-day/100-year rainfall event, the sediment accumulation, and the water supply storage. The top of dam elevation was set by calculating the freeboard required to prevent the dam from overtopping during the 6-hour Probable Maximum Precipitation (PMP) storm.

Several auxiliary spillway widths and PMP scenarios were considered when determining the top of dam elevation. Final proportioning was accomplished by comparing cost of ASW excavation, embankment construction cost, and estimated land rights cost. Three basic auxiliary spillway alignments were evaluated. The alignments include: the original configuration proposed in the 1970 investigation with the outlet channel discharging onto a relatively wide and flat pasture; a shorter curved spillway discharging around the south dam abutment and plunging over the steep abutment near the toe of the dam; and a straight alignment discharging southward away from the dam into the adjacent hollow. The third alignment is the preferred alignment for the ASW at Site 16 to provide a more stable outlet away from the dam and to avoid potentially impacting a residence directly downstream of the originally planned ASW.

Site 16 is planned as a zoned earth and rock fill embankment with an impervious clay core and a rock shell. The slopes of the embankment are 3:1 upstream and downstream to provide adequate stability. A chimney drain will be constructed on the downstream side of the impervious core to control seepage through the core and act as a filter and transition zone.

Construction cost estimates for Site 16 were based on computed quantities of all items with an allowance of 20 percent for contingencies. Unit prices were developed from a study of similar projects in the past in WV.

A safe yield analysis was conducted as part of the planning process to determine the adequacy of Site 16 for water supply.

Economics

Flood damages for agricultural properties, transportation infrastructure, businesses, utilities, and public and private property were initially established via personal interviews. Information regarding physical losses, land use changes, and land values was also collected at this time. The flood of October 1954 was the baseline flood, with damages correlated to the statistical frequency of that event as well as larger and smaller flood occurrences. In subsequent supplements, flood damages were updated using appropriate price indexes as described in the NRCS Economics Guide. Flood damages for all properties were computed for the "with" and "without" project scenarios using the frequency-damage relationships method. NRCS computer programs were used to process average annual damages.

Costs and benefits were updated from the 1974 Work Plan – FEIS using the Consumer Price Index, the Engineering News Record, and other appropriate indices. Categories of flood damages were reviewed for accuracy and verified by field reviews in the watershed.

A recreational study was done in 2004 to assess recreational amenities in the area and the degree to which they might meet the current recreation demand. The study concluded that recreational needs, other than fishing, were being provided by existing facilities. Incidental recreation benefits were determined using the 2001 National Survey of

Fishing, Hunting, and Wildlife-Associated Recreation and user day information from the West Virginia Division of Natural Resources, updated to current dollar values.

Water supply needs were determined by the Sponsors, with assistance from NRCS. Census information, highway development, housing growth, and information contained in the 2004 Hardy County Water Resources Study were used to determine water supply needs. Water supply benefits were determined using the methods described in Section 2 of Principles and Guidelines and the National Watershed Manual.

Census information, input from local sponsors, guidance from the county field office and other sources were used to identify any potential environmental justice issues. No issues were identified through any of these means.

All costs and benefits were based on 2006 prices. Costs and benefits were amortized at 5.125% for 100 years. All other categories of benefits were computed as described in the 1974 Work Plan – FEIS.

Hydrology and Hydraulics

Hydrologic and hydraulic investigations consisted of an analysis of rainfall runoff relationships using computer models of the watershed. The models were calibrated by comparing the output files to the previous modeling done for the 1974 Work Plan – FEIS, which were calibrated to a reproduction of an actual storm event and matching surveyed high water marks. Rainfall data was obtained from NOAA Atlas 14. Soils data was

obtained from the Soil Survey of Grant and Hardy Counties, West Virginia. Land use information was coordinated with local NRCS field office personnel. Hydrologic soil-cover complexes and runoff curve numbers were computed using the procedures in the NRCS National Engineering Handbook, Section 4. Storm runoff was estimated using the runoff curve number method.

Cross section data were obtained from topographic mapping, with a 2-foot contour interval, developed for this study. Cross section locations were selected to reflect the flood stages at points of damage, restriction and grade control. All bridges and culverts were field surveyed to obtain structural geometry in order to compute the backwater effects of those structures. Elevations for the mapping and surveying were referenced to the North American Vertical Datum of 1988.

Channel and floodplain geometry and roughness factors (Manning's "n") for the watershed were assigned on the basis of field inspection of the streams and their adjacent areas.

Flood routings were performed using procedures in NRCS Technical Release No. 20 (TR-20). Various frequency one-day storms were routed to establish discharge-frequency relationships.

Water surface elevations were computed using the NRCS WSP-2 computer program as described in Technical Release No. 61. Flood profiles were drawn showing computed water surface elevations for the selected recurrence intervals.

Cultural Resources

A total of five prehistoric sites, identified in the initial Phase I cultural resources investigation (Nemal 2005), were recommended for Phase II testing. Two of these sites were subsequently determined to be outside of the area of potential effect. One site was upstream of the permanent pool and the other was downstream of the proposed dam. Because adverse impacts to these two sites can be avoided, WVSHPO concurred that Phase II investigations on these two sites were not necessary.

Realignment of the auxiliary spillway configuration after 2005 resulted in a change to the land acquisition boundary. As a result, about 49 acres of additional land area required cultural resources evaluation. In 2008, studies to determine if cultural resources were present on the additional 49 acre area and to investigate the three Phase II sites identified in the 2005 investigation (plus any additional Phase II sites) were commissioned (Bodor and Franz 2008). The Phase I investigation consisted of systematic shovel test pits at 15-meter intervals. Phase II investigations included background research and laboratory testing in addition to excavating 1-meter by 1-meter test units. Phase II analyses concluded that no further study was recommended for these three sites as none were potentially eligible for listing on the *National Register of Historic Places* and that the sites were found to have limited additional research potential.

By letter of January 29, 2009, WVSHPO concurred with the findings of these cultural resources investigations in that the Site 16 project will have no effect to cultural resources that are eligible for inclusion in the *National Register of Historic Places.* This letter is contained in Appendix F.

Environmental Analyses

A fishery survey was conducted on Lower Cove Run on April 25, 2005 by WVDNR and NRCS personnel. This survey was conducted by triple pass backpack electrofishing techniques in the approximate location of the proposed embankment. The survey resulted in the collection of 985 fishes comprised of seven species. Population estimates from the triple pass depletion method showed a total fish abundance of 1,267 fish per 100-meter stream reach. Estimated biomass per 100-meter stream reach was estimated to be 3.785 Kg (8.36 pounds). The fish survey report is included, in its entirety, in Appendix D.

Wetland delineations for the 234.4 acre project area were completed by NRCS biologists, a hydrologist and soil scientist in October 2007 (Appendix D – Wetlands Delineation Report). A total of 25.65 acres of wetlands were identified using procedures and methodologies prescribed in the US Army Corps of Engineers Wetlands Delineation Manual – Technical Report Y-87-1 (January 1987). Delineated wetlands are shown on the Wetland Delineation Map – Appendix B.

The affects of the proposed Site 16 project upon wildlife habitat within the project area was evaluated using the Pennsylvania Modified Habitat Evaluation Procedures (PAM-HEP, USFWS 1980) to determine the number of habitat units before project implementation. This data was compared with the number of habitat units calculated for conditions after project implementation to determine changes in habitat units resulting from the project. PAM-HEP models were selected for indicator species appropriate to the habitats within the Lower Cove Run site. Indicator species used included fox squirrel, black-capped chickadee, eastern meadowlark, red fox, mink and channel catfish. Habitat parameters defined in the habitat suitability models for each indicator species were measured within each habitat compartment on the project location.

Habitat for the existing conditions was calculated to be 412.3 habitat units (HUs). Habitat units calculated for projected conditions with the project installed amounted to 315.1 HUs. This difference of about 97 HUs indicates a reduction of about 24 percent of the wildlife habitat for the indicator species used in this model. Habitat improvements in the 46.6 acre reservoir, largely for channel catfish, were calculated to be about 30.4 HUs. This improvement limited habitat decreases to about 66.8 HUs or about 16 percent of the before project estimate.

It should be noted that the PAM-HEP methodology allows for the comparison of habitat suitability for varying conditions upon a piece of property. As with most scientific models, the more variables for which data is provided (input) will usually result in more accurate predictions (output). The use of additional indicator species, representing a

more diverse range of habitat variables, may have resulted in a lesser difference of HUs for existing conditions compared to habitat after the project is installed. For example, the models suggest that habitats for song and insectivorous birds, including migratory songbirds, would decline in quality, at least temporarily, following installation of the project. The model failed to account for increases in suitable habitat for waterfowl, shorebirds and colonial wading birds that will likely result from the creation of the 46.6 acre reservoir and wetland mitigation. The PAM-HEP models are useful in identifying habitat components that are most likely to be impacted by the project and which should be included within habitat minimization and mitigation proposals. Mitigation and habitat enhancement plans for terrestrial and aquatic habitats will be finalized in consultation with the WVDNR, USFWS and USFS biologists.

Riparian and in-stream habitat for the affected portion of Lower Cove Run was analyzed using Rapid Bioassessment Protocols (Barbour, et al. 1999). The results from this evaluation were used to determine the type and extent of habitat enhancements that may be needed to minimize or mitigate habitat changes that may result from converting approximately 3,040 linear feet of perennial cold water stream to a 46.6 acre impoundment. Riparian and in-stream habitat enhancements will be provided along the approximately 810 feet of stream between the dam's outlet and the lower project boundary and, if necessary, areas upstream of the impoundment on National Forest property. This work will be conducted in consultation with WVDNR, USFWS and USFS biologists.

Effects of the Recommended Plan on Resources of National Recognition

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Air Quality	Clean Air Act, as amended (42 U.S.C. 7401 et seq.)	Watershed not within a clean air non-attainment area.
Areas of Particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Not present in planning area
Endangered & threatened species critical habitat	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)	Adverse affects to listed species are not expected. *US Fish & Wildlife Service* letter of August 15, 2005 (Included in Appendix F)
Fish & wildlife habitat	Fish & Wildlife Coordination Act, (16 U.S.C. Sec. 661 et seq.)	86.6 acres of woodland, hayland and pastureland permanently inundated or used for dam, spillway and borrow. 40.2 acres of riparian and terrestrial habitats subjected to temporary inundation for floodwater detention. Eliminate 0.58 miles of perennial stream and subject 0.27 miles of stream to temporary inundation. Create 46.6 acres of permanent lake environment.
Flood plains	Executive Order 11988, Flood Plain Management	Flood frequency and magnitude will be reduced on floodplains in the Lost River valley.
Historical & cultural properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.)	No sites on National Register of Historic Places in project area.
Prime & unique farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act, the Farmland Protection Policy Act of 1981	Eliminate 27.9 acres of prime farmland.
Water quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	No change in State water classifications anticipated.
Wetlands	Executive Order 11990, Protection of Wetlands; Clean Water Act of 1977 (33 U.S.C. 1251 et seq.); Food Security Act of 1985	An estimated 16.02 acres of wetlands will be eliminated.
Wild & Scenic Rivers	Wild & Scenic Rivers Act, as amended (16 U.S.C. 1271 et seq)	No adverse affect.