Water Supply Assessment for Upper Mulberry River Dam No. 8

Hall County, Georgia

Prepared for:

Georgia State Soil and Water Conservation Commission

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January 4, 2008

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EXECUTIVE SUMMARY

The Georgia Soil and Water Conservation Commission (GSWCC), in partnership with the Natural Resources Conservation Service (NRCS) and the Georgia Environmental Protection Division (EPD) initiated a study to evaluate whether or not any of the existing watershed dams, designed and constructed under federal laws PL 544 and PL 566, could be modified to serve as water supply reservoirs. The evaluation process went through several iterations, the most recent of which can be found in the Finding Report dated December, 2007 on file with the GSWCC. The Finding Report identified 20 structures that had sufficient potential for relatively high yields with relatively small environmental and infrastructural impacts, when compared to the other projects evaluated. The selected twenty dams were further evaluated to identify project parameters.

The following report summarizes the evaluation of the Upper Mulberry River Dam No. 8 dam located in Hall County, Georgia. For the purposes of this report, the existing normal pool will be raised to impound a water supply pool having a surface area of approximately 193 acres.

For convenience, the following summary lists the major findings of this evaluation. This summary should not be utilized as a separate document or in lieu of reading the entire report, including the Appendix.

- Approximately 381 acres of land will be impacted by the proposed reservoir and dam raising
- Approximately 2 structures will be impacted by the proposed reservoir and dam raising
- Four county roads will be impacted.
- For the modeled conditions, the drought of record in the Upper Mulberry River basin is the period 1999-2000. For a water supply storage of approximately 1,900 million gallons and supplementation of natural reservoir inflow by pumped diversions (maximum 10 million gallons per day, mgd) from nearby Mulberry River, the safe yield of the reservoir is estimated to be 2.6 mgd.
- Approximately 0.5 acres of palustrine wetlands will be impacted by the proposed reservoir and dam raising
- Approximately 28 acres of lacustrine/palustrine open waters will be impacted by the proposed reservoir and dam raising
- Approximately 21,630 linear feet of lower perennial streams will be impacted by the proposed reservoir and dam raising
- Approximately 1,184 linear feet of intermittent streams will be impacted by the proposed reservoir and dam raising
- Review of existing threatened and endangered species information identified nine protected species documented from Jackson and Hall counties, Georgia.
- Review of available resources did not indicate any identified cultural resources, trout streams, or 303(d) or 305(b) listed streams within the maximum reservoir pool limits of Upper Mulberry River 08.
- Project cost is estimated in 2007 dollars at $113,000,000.

PREFACE

The results of the analyses presented herein are based in part upon United States Geological Survey (USGS) quadrangle maps and, therefore, should be utilized for planning purposes only. If the subject project is identified as having a possibility of progressing past this analysis, additional studies will be required. These studies will include but not be limited to detailed environmental evaluations, detailed yield analyses, preliminary engineering design, and detailed cost estimating. These additional studies will be required prior to beginning detailed design work and/or land acquisition. The level of study presented herein shall be considered as a screening tool to evaluate the proposed project relative to other projects. Until further studies are performed, actual yield and costs associated with the entire project cannot be readily determined.

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INTRODUCTION

The project team of Schnabel Engineering South, LLC (Schnabel), Jordan Jones and Golding (JJ&G), Joe Tanner and Associates, and the Law Office of William Thomas Craig were retained by the Georgia State Investment and Financing Commission as the agent for the Georgia Soil and Water Conservation Commission to evaluate 166 existing flood control structures. The subject structures were originally designed and constructed under Federal laws PL 544 and PL 566 to control storm water runoff (flooding) and collect sediment. The goal of this evaluation was to identify impoundments that could be enlarged to provide a relatively reliable water supply. The results of the evaluation were utilized to select twenty of the dams and reservoirs that had potential for relatively high yields with relatively small environmental and infrastructural impacts, when compared to the other projects evaluated. The selected twenty dams were further evaluated to identify project parameters. The additional evaluation included the following:

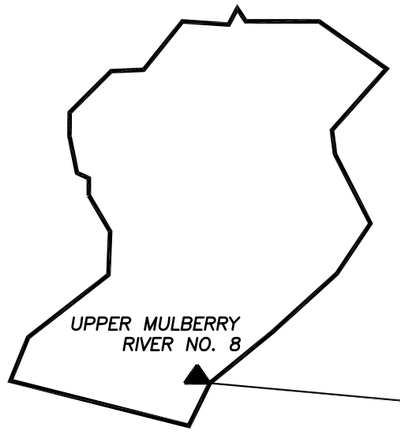
- More detailed yield analyses
- More detailed environmental evaluation
- Cost estimation of proposed modifications

The Upper Mulberry River Dam No. 8 in Hall County, Georgia was one of the structures selected for further evaluation.

BACKGROUND

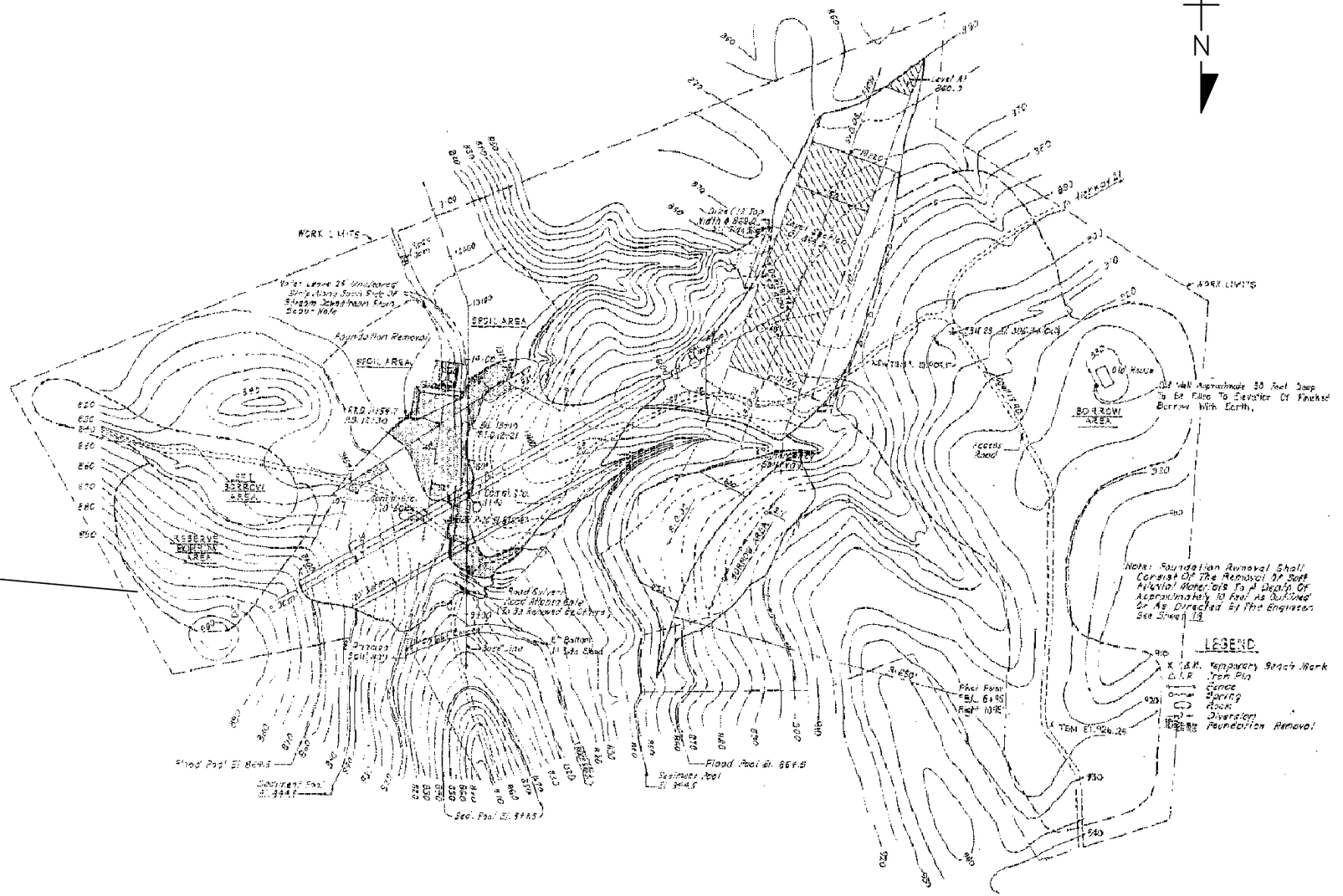
The subject dam, Upper Mulberry River Watershed Dam Number 8 (Upper Mulberry River 08), is located approximately 3-½ miles northwest of Braselton, Georgia in Hall County. More specifically, the dam is located on Cooper Creek about ⅔ miles east of the intersection of Howington Road and Georgia State Route 211.

The existing dam was designed in 1977 and constructed in 1979. As designed, the dam had a crest elevation of 869.0 feet and impounded a reservoir that had a surface area of approximately 21 acres at a normal pool elevation of 844.5 feet. The crest of the emergency spillway was designed to be at elevation 864.5 feet. According to the Soil Conservation Service (SCS), now known as the Natural Resources Conservation Service (NRCS), Dam Inventory sheet, the dam was originally designed and constructed as a Class 'A' or low-hazard dam. The state Safe Dams program classifies the existing dam as a Category 2 structure. When designed, the emergency spillway (now referred to as an auxiliary spillway) had a 3 percent chance of operating in any given year. This results in the auxiliary spillway operating during storm events equal to and greater than the 33-year event. Not including engineering, land acquisition, or project administration, the dam was completed for a cost of approximately $310,000.



HALL COUNTY

N.T.S.



EXISTING SITE PLAN

0 100' 100'

Schnabel Engineering	NRCS WATERSHED DAM ASSESSMENT UPPER MULBERRY RIVER DAM NO. 8	SITE LOCATION MAP PROJECT NO. 07170030.01 FIGURE 1

NEEDS AND DEMAND EVALUATION

Population projections through the year 2025 were obtained from the Gainesville/Hall County Comprehensive Plan (Amended in May 2005). Projections to 2057 were extrapolated based on the assumption of the same constant growth rate that was shown in the Comprehensive Plan. These projections can be seen in Table 1.

Table 1
Population Projection

Year	Population Projection
2000	139,277
2005	180,970
2010	237,332
2015	307,089
2020	376,329
2025	437,609
2030*	495,028
2035*	549,972
2040*	602,014
2045*	641,123
2050*	674,689
2055*	703,026
2057*	714,837

Data Source: from Gainesville/Hall County Comprehensive Plan
**Population calculated based on yearly % growth from 2000-2025*

Water demand projections were calculated based on population projections and water withdrawal data for Hall County in 2000. According to the US Census, the population of Hall County was 139,277 in 2000, while the water withdrawal was 23 million gallons per day (MGD) based on the document "Water Use in Georgia by County for 2000", (Information Circular 106, Julia Fanning, USGS, Atlanta, 2003). Hall County currently holds a surface water withdrawal permit of 20 MGD from the North Oconee River, and a 2.0 MGD permit from the Cedar Creek Reservoir. The City of Gainesville and the City of Buford hold surface water permits from Lake Lanier for 30 MGD and 2.0 MGD, respectively. In addition to the surface water permits, the City of Flowery Branch holds a groundwater withdrawal permit for 0.367 MGD. All totaled, water withdrawal permitted for public use in Hall County is 54.367 MGD (all numbers are reported in permitted monthly average).

The overall usage was calculated to be 168 gallons per day (gpd) per person. This number was used as a constant through 2057 to create water withdrawal projections. The water withdrawal projection for 2057 was calculated to be approximately 120 MGD. This figure includes all unaccounted for water (UAW), and the assumption that industrial usage would increase with the increase in Hall County population. Water withdrawal projections are shown in Table 2.

Table 2
Water Withdrawal Projection

Year	Water Withdrawal Projection (MGD)
2000	23
2005	30
2010	40
2015	52
2020	63
2025	74
2030	83
2035	92
2040	101
2045	108
2050	113
2055	118
2057	120

Proximity to Surface Water Intakes

Based on the GIS database developed for this project, the closest downstream surface water intake structure is 12.8 miles downstream of the dam on the Mulberry River. This structure is operated by the City of Winder. The Mulberry River is approximately 0.4 miles from the dam along Cooper Creek. The remaining 12.4 miles is along the Mulberry River. The Figure 2 illustrates the location of the nearest surface water intake to Upper Mulberry River 08.

Figure 2
Distance to Nearest Intake

ENGINEERING FACTORS

Proposed Dam

The proposed dam, which will incorporate the existing dam, has a crest elevation of 920 feet, an auxiliary spillway elevation of 910 feet, and a normal pool elevation of 905 feet. The proposed dam will impound a reservoir that has a surface area of approximately 193 acres and storage volume of approximately 1,930 million gallons (MG). A plan view of the proposed reservoir is shown in Figure 3.

Several engineering assumptions were made pertaining to spillway configuration. The spillway system for the proposed dam was assumed to consist of a principal spillway in the form of a 2'-6" by 7'-6" interior dimension reinforced concrete riser with a 30-inch diameter reinforced concrete low-level outlet pipe and an auxiliary spillway in the form of a 180-foot wide reinforced concrete chute spillway with ogee crest. The intent of the proposed principal spillway is to approximate the flows that are being discharged by the current spillway system during the two through 100-year storm events. The size of the auxiliary spillway was approximated by estimating the peak inflow that would occur during the Probable Maximum Precipitation (PMP) event and computing the spillway width that would be required to pass the estimated inflow with a given amount of hydraulic head. The available hydraulic head was determined by comparing the drainage basin area to lake surface area. The structures that had a drainage basin area to lake surface area ratio equal to or in excess of ten were allotted 15 feet of hydraulic head to pass the PMP inflows, while the structures that had a ratio of less than ten where allotted ten feet of hydraulic head to pass the PMP inflows. The assumption that the dam would be required to pass the inflow resulting from the PMP storm event is based on the history of the Georgia Department of Natural Resources Environmental Protection Division Safe Dams Program (Safe Dams) reviewing plans for water supply reservoir dams regardless of classification. As such, the dam would generally be required to comply with the engineering guidelines established by Safe Dams. Based upon the height of the dam (approximately 100 feet), the dam would be required to store and/or pass the inflows from the full PMP event safely. Additionally, the proposed dam would have a relatively high likelihood of being classified as high-hazard or Class 'C' by the NRCS, as well as Safe Dams.

The proposed dam and flood pool will:

- Impact two structures
- Require the purchase of 289 acres from 13 parcels
- Require the purchase of 92 acres of easement area for state required buffer
- Impact four local/county roads
- Impact the Atlanta Speedway

Figure 4 displays the proposed reservoir area as well as the buffer and affected parcels. The two affected structures were identified from aerial photographs. The types of structures were not identified on the ground and could be houses, barns, trailers, etc. A more detailed ground survey will be required to determine the type of each structure and the corresponding purchase price of each structure.

Figure 3
Proposed Reservoir Area Map

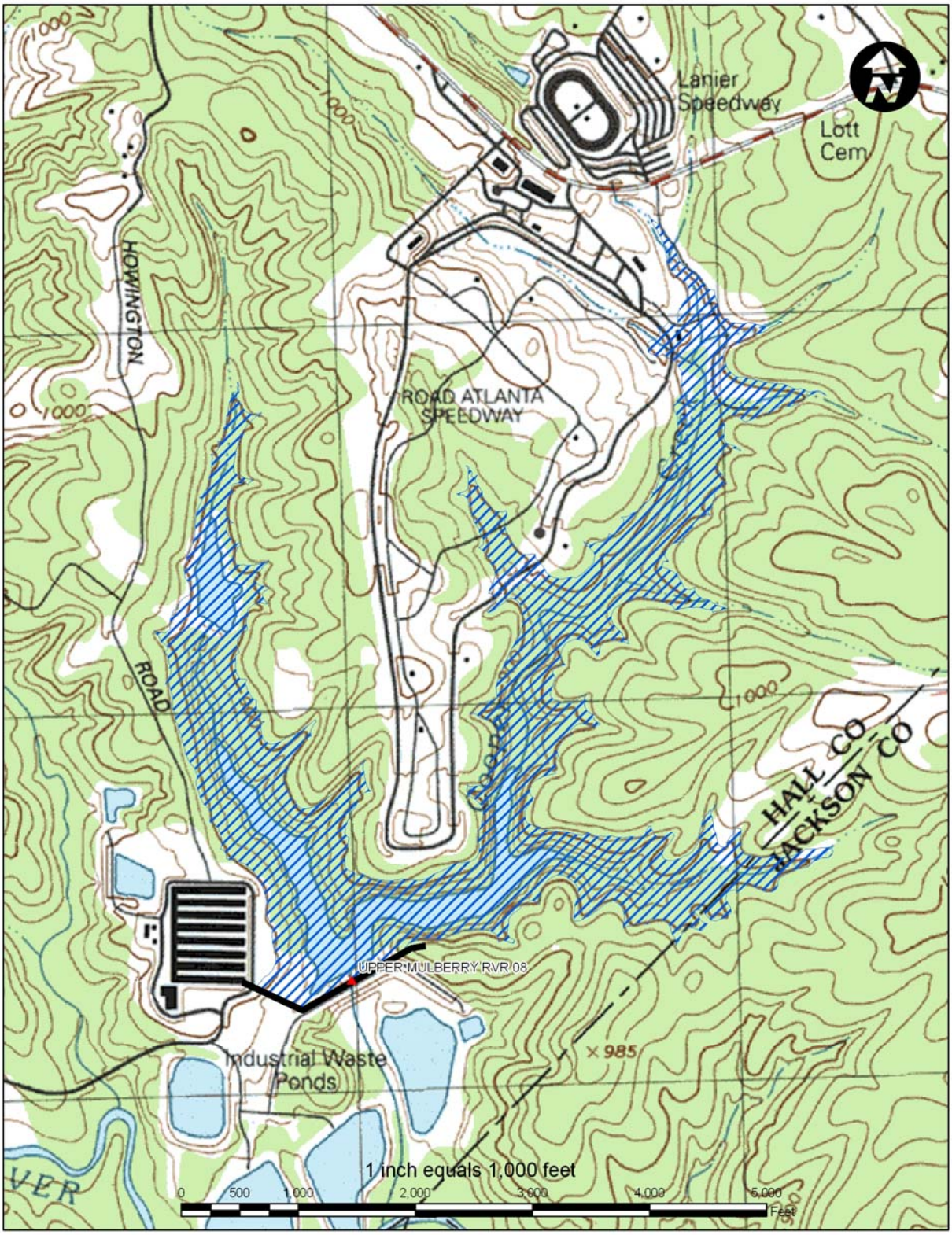
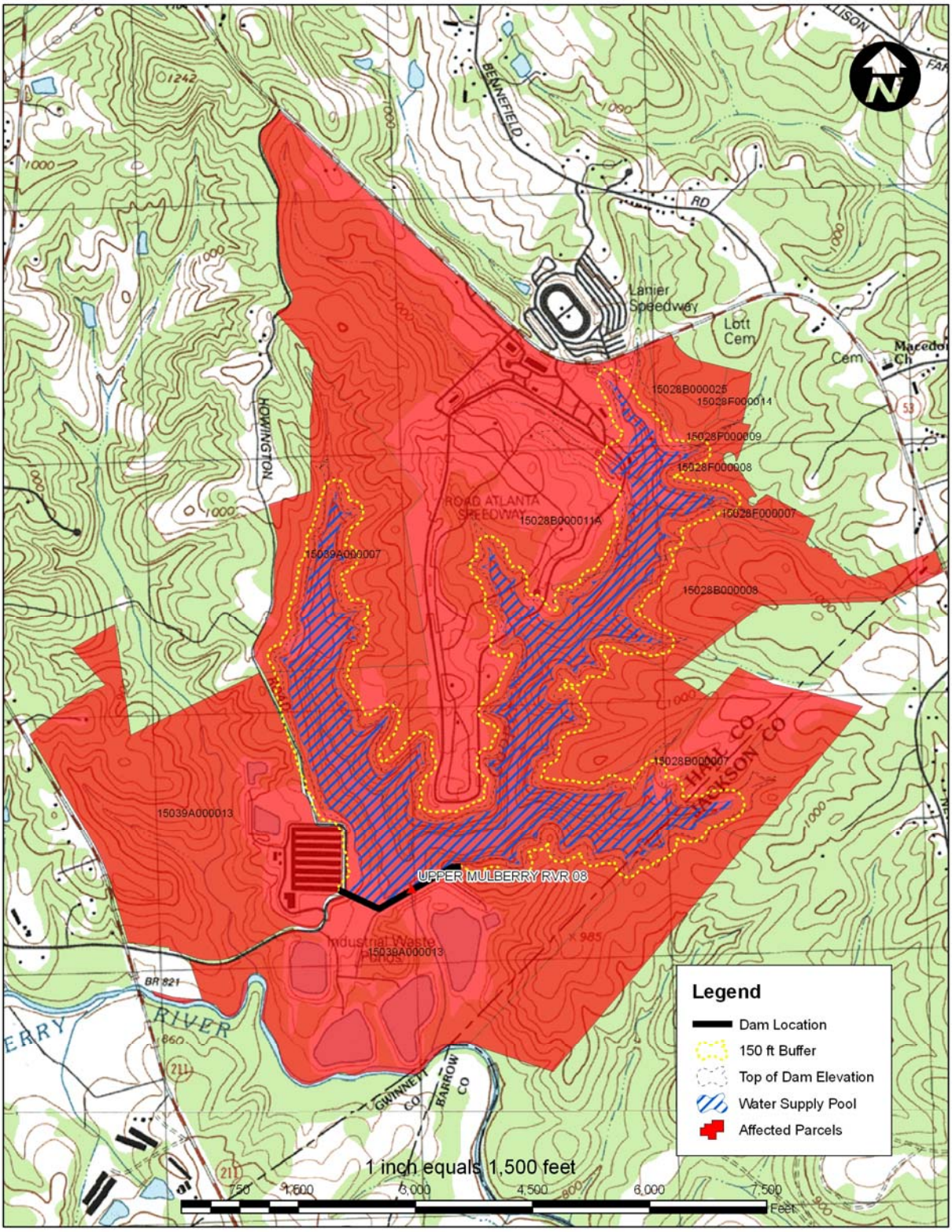


Figure 4
Land Acquisition and Buffer Areas



SAFE YIELD ANALYSIS

Definition

Reservoir safe yield is generally defined as the reliable withdrawal rate of water with acceptable quality that can be provided by reservoir storage through the critical drought period. The critical drought period in the State of Georgia is defined as the drought of record and in any given drainage basin can vary depending on reservoir size and other factors. This study was based on the critical drought period from 1999-2002; however, the current drought could possibly exceed the existing drought of record. If this were to occur, the computed yields detailed herein would be reduced. Safe yield in this study was simulated using a constant average annual demand. The justification for this is that while total water demands after declaration of a drought condition are usually less than normal, this situation is typically offset by higher than average demands prior to declaration of the drought condition. Safe yield is dependent upon the storage and hydrologic (rainfall/runoff/evaporation) characteristics of the source and source facilities, the selected critical drought, upstream and downstream permitted withdrawals, and the minimum in-stream flow requirements.

The proposed reservoir is a "pumped-storage" reservoir, where natural inflow into the reservoir is supplemented with pumped diversions from a nearby larger stream or river. Water is pumped from a larger river when runoff is plentiful, and is stored in the reservoir for times of drought. Pumped diversions increase safe yield, and generally result in fewer environmental impacts compared with reservoirs on main-stem rivers.

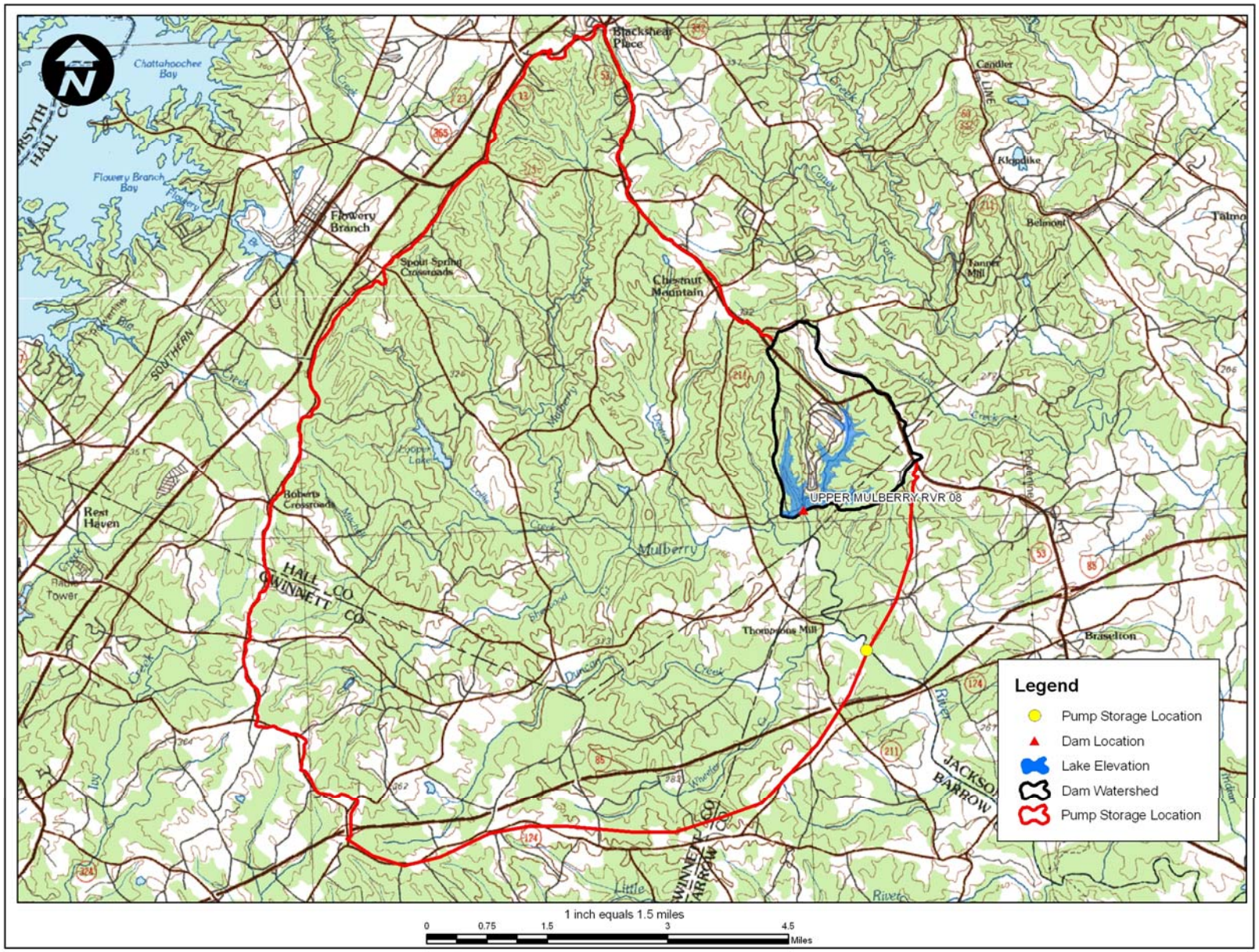
Analysis Method

The Allen Creek at Talmo (USGS 02217000) and the Middle Oconee River near Arcade (USGS 02217475) gages were selected for use in this analysis. The flows were then used to simulate streamflows in Cooper Creek and Mulberry River basins. The modeled periods for the Allen Creek and Middle Oconee River gages extend from July 1951 to September 1971 and March 1987 to present, respectively, and collectively includes three major droughts (1954-56, 1986-88, 1999-2002), plus the current drought. The diversion pump station was assumed to be located downstream of the confluence of Duncan Creek with the Mulberry River. The straight line pipe distance between the dam and diversion location was estimated at 2.0 miles. The following drainage area was used in the analysis:

- Dam Site (Cooper Creek): 2.84 mi^2
- Diversion (Mulberry River): 51 mi^2

The pumped diversion location and watershed is shown in Figure 5. The maximum estimated pool level at top of dam was selected during the initial screening phase based on USGS topographic mapping. Subsequently more detailed GIS topographic data was obtained for calculation of reservoir storage. A freeboard allowance of 10 feet between the top of dam and the auxiliary spillway was incorporated to pass the spillway design flood (assumed to be the probable maximum flood).

Figure 5
Watershed Location Map

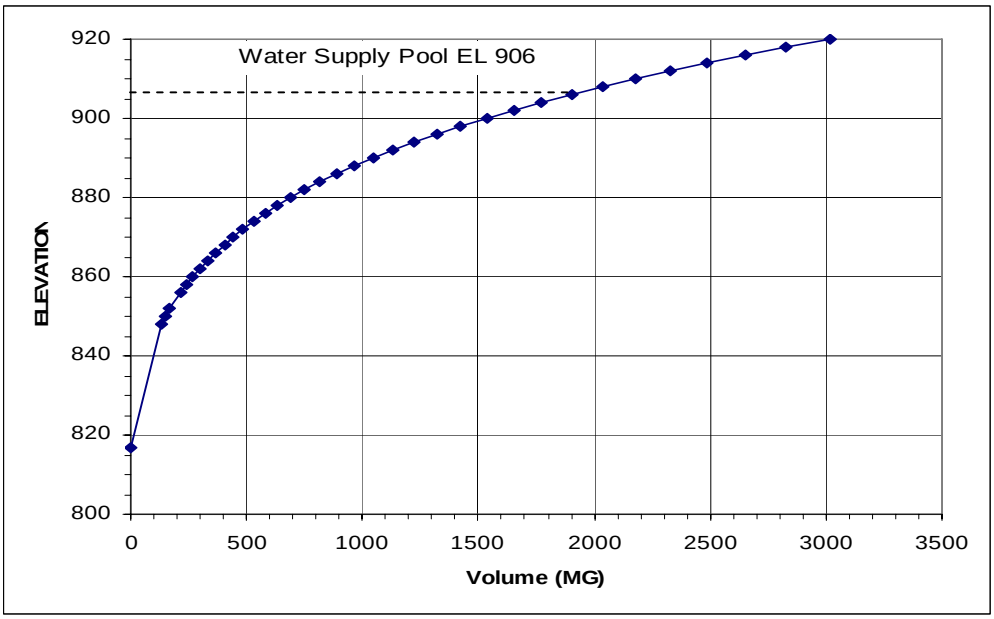


Additional depth to maintain existing flood storage volume (939 Ac-ft, or 306 MG) was subtracted from the auxiliary spillway elevation to compute the water supply pool elevation used in the analysis of safe yield. Table 3 summarizes the various reservoir elevations and approximate storage volumes. Calculation of stage-area and stage-storage curves is presented as Figures A-1a and A-1b in the Appendix. Figure 6 below is the stage-storage curve for the reservoir.

Table 3
Summary of Reservoir Data

Stage	Elevation	Volume (Million Gallons)
Maximum Pool (Top of Dam)	920	3,000
Flood Pool (Auxiliary Spillway Crest)	910	2,200
Water Supply Pool	906	1,900

Figure 6
Stage-Storage Curve



A reservoir operations model was developed to incorporate daily gage data from the selected USGS gage and reservoir shape parameters for estimation of evaporation. The following assumptions were incorporated into the analysis for the estimation of safe yield:

Assumptions:

1. Dead storage of 20% of gross reservoir storage was incorporated to allow for sediment storage and poor water quality in lower reservoir strata.
2. Usable water supply storage was assumed to be the water supply pool storage (calculated as noted above) less dead storage.
3. Pump station diversions were assumed to be from the Mulberry River at the

location previously described. Diversions were assumed to occur whenever the reservoir level fell below full water supply pool. Pumped diversions were assumed to be bounded by pumping capacity and by flow restrictions on the Mulberry River (noted below).

4. A minimum in-stream flow (MIF) of 30% AAF at the diversion pump station (Mulberry River) was used.
5. Allowance for downstream withdrawals would reduce available flow in the stream. In addition to the MIF, the model provided for a prorated let-bys with the following characteristics:

Permittee:	City of Winder	Upper Oconee Basin Water Authority	Athens-Clarke County
Downstream Withdrawal:	5.1 mgd	60 mgd	16 mgd
Drainage Area:	109 mi^2	351 mi^2	388 mi^2
Prorated Let-by:	2.39 mgd	8.72 mgd	2.10 mgd

6. No upstream withdrawals were identified.
7. For the dam site, minimum in-stream flow of 30/60/40 percent average annual flow (AAF) was used. This MIF applies as follows: 30% AAF for July through November; 60% AAF for January through April; and 40% AAF for May, June and December.
8. Return flow from wastewater discharges or septic systems was not considered in the analysis.
9. Evaporation loss was based upon net historical evaporation rates (one standard deviation above average monthly values) as recorded at the University of Georgia in Athens. Lake evaporation was assumed to be equal to 70% of pan evaporation during each month. Surface area was approximated by a regression equation relating storage to surface area (Figure A-2, Appendix).
10. Streamflow data from the USGS gages was applied in direct proportion of drainage areas to simulate flow into the reservoir and at the diversion location.
11. Total seepage losses would be less than the MIF requirements and, therefore, did not need to be separately considered.
12. Safe yield is that quantity of water that can be provided to meet water demands during the critical drought period.

The attainable safe yield during the analyzed period was found by iteration of the daily mass balance equation:

Ending Storage = (Beginning Storage) + (Natural Inflow) + (Pumped Inflow) – (Water Supply) – (Evaporation) – (MIF)

The trial safe yield value was varied until the reservoir level just reached the dead storage value, and recovery of the reservoir was computed.

RESULTS

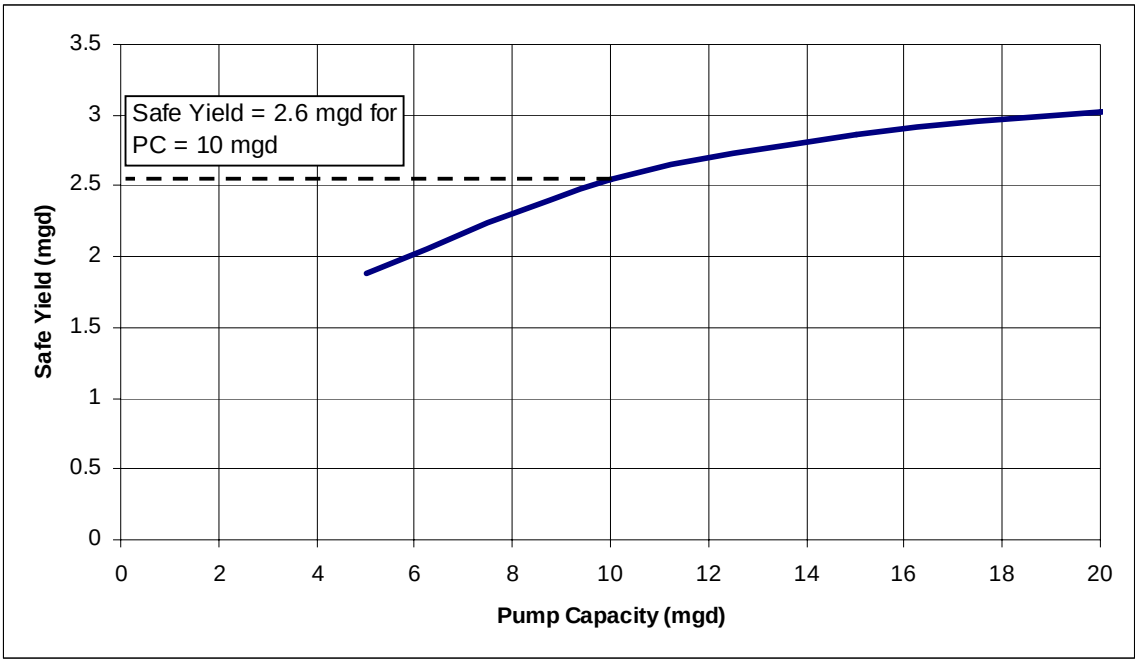
Incorporating the above assumptions, the estimated safe yield of the site was computed. The results of the safe yield analysis are presented in Table 4 and Figure 7. These estimated safe yield values are based on GIS topographic mapping. The table below presents the estimated safe yield and refill time for a range of pump capacities. We have assumed a refill time of 4 to 5 years is the maximum refill duration for selection of pump capacity (PC).

Table 4
Safe Yield Summary

Pump Capacity (MGD)	Estimated Safe Yield (mgd)	Refill Time* (years)
5	1.9	6
10	2.6	4
15	2.9	4
20	3.0	4

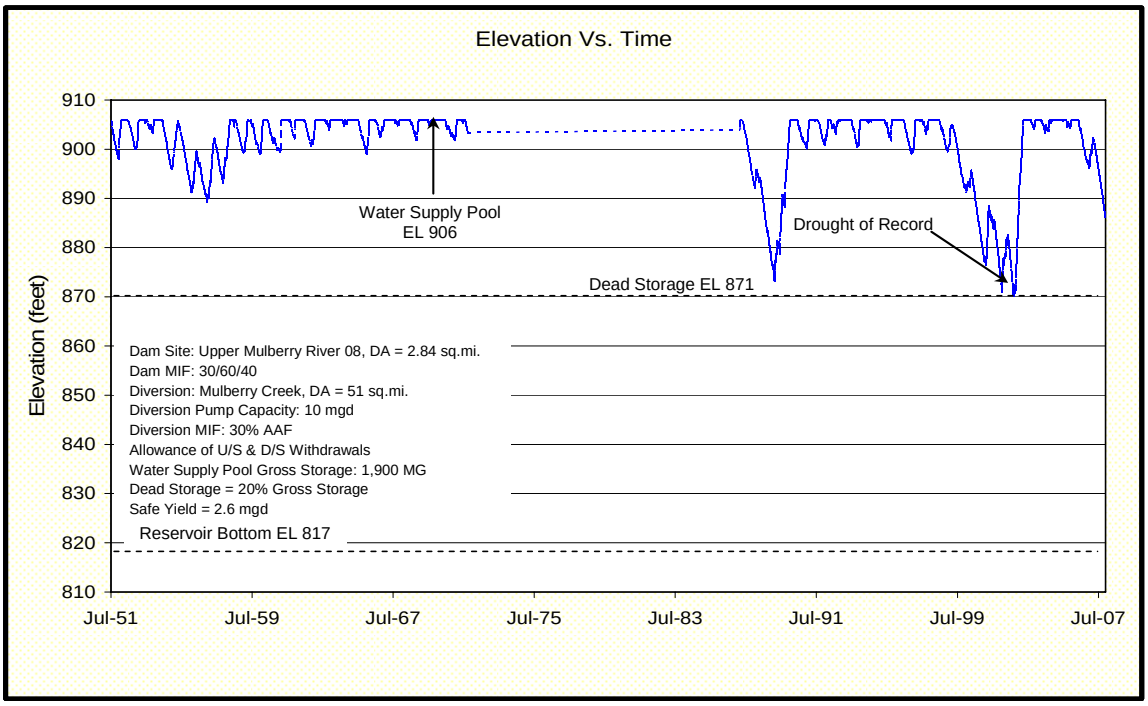
*Refill time is the time from start of drawdown until complete refill to water supply pool

Figure 7
Estimated Safe Yield vs. Pump Capacity



As presented in Figure 7, there is diminishing return (safe yield) with increasing pump capacity (reflecting pump station and pipeline cost). For the purposes of this analysis, an estimated economical safe yield & pump capacity combination were selected from the above graph. The estimated safe yield for this project is approximately 2.6 mgd for a pump capacity of 10 mgd. These values were used to size and cost out the diversion facilities detailed later in this report. The variation of reservoir elevation over time for the above assumed safe yield and pump capacity is reflected in Figure 8.

Figure 8
Reservoir Elevation vs. Time



ENVIRONMENTAL CONSIDERATIONS

Preliminary Studies

To evaluate the potential environmental impacts, permitting and compensatory mitigation associated with Upper Mulberry River 08, preliminary ecological studies were conducted by JJG. These studies consisted of a desktop survey and wetland approximation field surveys to estimate wetlands and streams occurring within the project area. While this evaluation is not sufficient for Clean Water Act Section 404 permitting, field surveys add increased confidence to the desktop evaluation. All estimates of jurisdictional waters, permitting requirements, and compensatory mitigation requirements/cost estimates presented herein are very general and preliminary in nature. Detailed studies would be necessary to definitively determine permitting requirements.

Prior to conducting field surveys, desktop evaluations were performed with available data resources including the U.S. Geological Survey 7.5-minute topographic maps and U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps. JJG ecologists then performed a reconnaissance-level site visit to Upper Mulberry River 08 site to verify and supplement the desktop evaluation. Subsequent to field surveys, observations were transcribed into an ArcView GIS database for analysis. Preliminary estimates of jurisdictional waters (i.e., wetlands, streams, open waters) occurring within the Upper Mulberry River 08 project area are provided below.

Wetlands

The *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin Classification System) defines the Palustrine System as all nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity is less than 0.5 percent. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: 1) area less than 20-acres; 2) the lack of active wave-formed or bedrock shoreline; 3) water depth in the deepest part of basin less than 6.6 feet at low water; and 4) salinity due to ocean-derived salts less than 0.5 percent.

The Lacustrine System includes wetlands and deepwater habitats with all of the following characteristics: 1) situated in a topographic depression or a dammed river channel; 2) lacking trees, shrubs, persistent emergent vegetation, emergent mosses or lichens with greater than 30-percent areal coverage; and 3) total area exceeds 20 acres. Wetlands and deepwater habitats less than 20-acres are also included in this system if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 6.6 feet at low water.

Office and field reviews determined that approximately 0.5 acres of palustrine wetlands and approximately 28 acres of lacustrine/palustrine open waters exist within the Upper Mulberry River 08 project area. Cowardin classifications of the wetland systems range from palustrine forested to palustrine emergent with hydrologic regimes ranging from saturated to seasonally flooded.

Streams

The Cowardin Classification System defines lower perennial streams as low gradient streams with slow water velocities and substrates comprised mainly of sand and mud. Intermittent streams are defined as streams flowing for only part of the year. When water is not flowing, it may remain in isolated pools or surface water may be absent. Ephemeral streams flow only in direct response to precipitation and do not receive groundwater contributions.

Office and field reviews indicate that approximately 21,630 linear feet of lower perennial streams and approximately 1,184 linear feet of intermittent streams are located within the maximum reservoir pool limits of Upper Mulberry River 08. Ephemeral streams were not identified due to the preliminary nature of the studies. Refer to Figure 9 for locations of these jurisdictional features.

Cultural Resources

Review of existing cultural resources information did not indicate any identified cultural resources within the maximum reservoir pool limits of Upper Mulberry River 08. It should be noted that the absence of recorded Cultural Resources does not mean that they do not exist; in fact, a Phase I Cultural Resources Survey (conducted to the standards of Section 106 of the National Historic Preservation Act) would be required to determine the presence or absence of Cultural Resources as part of permitting for any proposed reservoir project.

Threatened and Endangered Species

Review of existing threatened and endangered species information identified nine protected species documented from Jackson and Hall counties, Georgia. These species consist of three faunal and six floral species. The Georgia Department of Natural Resources – Non-game Conservation Section lists the occurrence of three federally protected species, pool sprite (*Amphianthus pusillus*), black-spored quillwort (*Isoetes melanospora*), and mat-forming quillwort (*Isoetes tegetiformans*), within the maximum reservoir pool limits of Upper Mulberry River 08. Specialized surveys would be required to definitively determine the presence/absence of this species within the project area. Refer to Table 5 for a summary of protected species located in these counties and potential habitat for these species within the maximum reservoir pool limits.

Figure 9
Jurisdictional Areas Location Map

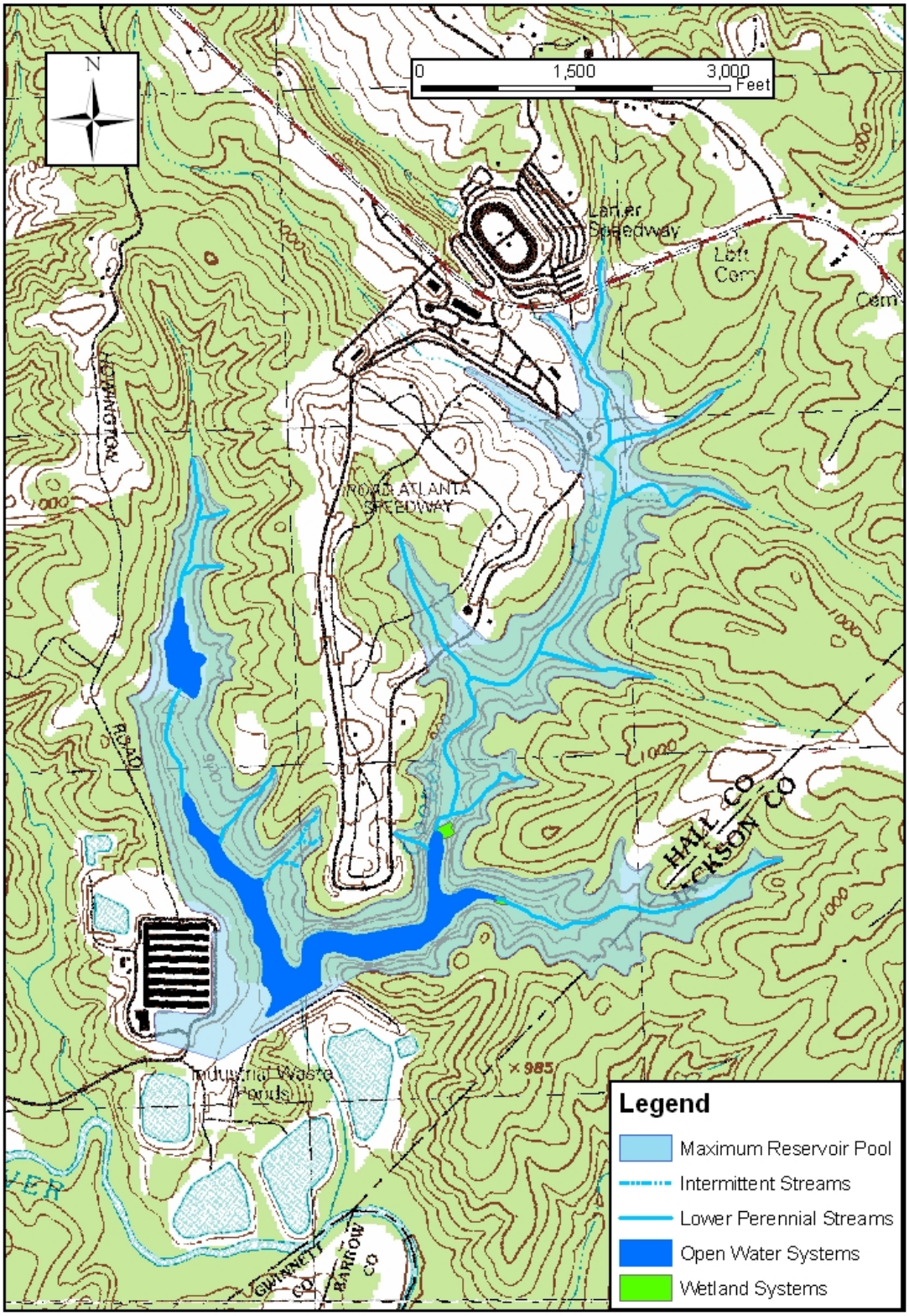


Table 5
Summary of Protected Species for Jackson and Hall counties, Georgia

Scientific Name	Vernacular Name	Federal Status	State Status	Habitat Present (Yes/No)	Preferred Habitat
Faunal					
Cyprinella xaenura	Altamaha shiner	NA	E	Yes	medium sized streams in runs or pools over sand to gravel substrates
Haliaeetus leucocephalus	bald eagle	D	T	No	forages along rivers, estuaries, and impoundments
Cambarus howardi	Chattahoochee crayfish	NA	T	No	moderate to swiftly flowing streams with rocky or rubble substrate
Floral					
Amphianthus pusillus	pool sprite	T	T	No	shallow pools (>1 feet deep) on granite outcrops, where water collects after a rain
Isoetes melanospora	black-spored quillwort	E	E	No	shallow pools (> 1 ft deep) on granite outcrops, where water collects after a rain
Isoetes tegetiformans	mat-forming quillwort	E	E	No	vernal pools on granite outcrops; shallow, flat-bottomed pools that form in depressions granite outcrops
Hydrastis canadensis	goldenseal	NA	E	Yes	rich woods in circumneutral soil
Monotropsis odorata	sweet pinesap	NA	T	Yes	upland forests
Symphyotrichum georgianum	Georgia aster	C	T	Yes	upland oak-hickory-pine forests and openings; sometimes with *Echinacea laevigata* or over amphibolite

D = recently delisted, E= endangered, R = rare, T= threatened, NA= not applicable

Trout Streams

Review of available resources did not indicate any primary or secondary trout streams within the maximum reservoir pool limits of Upper Mulberry River 08.

303(d) and 305(b) Listed Streams

Review of available resources did not indicate any 303(d) or 305(b) listed streams within the maximum reservoir pool limits of Upper Mulberry River 08.

Section 404/401 Permitting

The U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged or fill material into the Nation's Waters under Section 404 of the Clean Water Act. Construction of an impoundment and flooding jurisdictional streams/wetlands is regulated by the USACE. Two types of permits are available through the USACE: Nationwide and Individual Permits. Nationwide Permits (NWP) have been established previously by the Chief of Engineers for projects that have minimal cumulative impacts to the Nation's Waters. Examples of the most commonly used NWPs include site development, minor road crossings, maintenance activities, and utility line discharges. Specific criteria and conditions were established that must be satisfied prior to obtaining authorization of a NWP from the USACE. In addition, the Savannah District of the USACE issued Final Nationwide Permit Regional Conditions effective May 11, 2007.

Individual Permits (IP) are required for projects having more than minimal cumulative adverse impacts on the Nation's waters. The development of a water supply reservoir would typically require an IP. IPs involve significantly more information, documentation, and coordination with regulatory agencies and are considerably more difficult to acquire than a NWP. Prior to coordination with the USACE regarding the construction of an impoundment, required information would consist of, but not be limited to, the following information:

- Justification of Purpose and Need for the project
- Alternatives analysis of other water supply options evaluated to meet the need
- Wetland delineation with surveyed boundaries of USACE jurisdictional waters
- Phase I cultural resources and protected species surveys
- Detailed description of proposed project and proposed impacts to jurisdictional waters
- Detailed analysis of flow releases documented with population analysis and system modeling
- Avoidance and minimization of jurisdictional waters analysis
- Identification of adjacent property owners
- Development of a conceptual compensatory mitigation plan

Following completion of these items, a complex project meeting would typically be scheduled with the USACE Northern Area Section Office (Morrow, GA) to present the proposed project. Subsequent to the meeting, and if a project is tentatively accepted by the regulatory agencies, formal application and preparation of an IP would start. Following submittal of an IP, the application must be advertised for public comment. The USACE prepares the public notice,

which includes detailed applicant information such as site location, proposed impacts, cultural resources, protected species, and proposed mitigation. The public notice would be advertised for 30 days and is also submitted to regulatory agencies including the Environmental Protection Agency (EPA) and USFWS, adjacent property owners, and to the USACE general mailing list. Applicants will be required to respond to inquiries received during the public notice process. Public hearings could be required if substantial adverse comments are received from the coordinating agencies or the public. Additional information and permitting required would consist of a Section 401 Water Quality Certification from the Georgia Environmental Protection Division (EPD). This certification must be issued for an IP to be valid. Depending on the level of impacts associated with the proposed reservoir, an Environmental Assessment or Environmental Impact Statement could be required by the USACE as well. Based on previous project experience, the level of controversy and environmental issues raised during agency and public review, a typical new reservoir project may require permitting times of 5 years or more.

The expansion of an existing reservoir could potentially facilitate the Section 404 permitting process when compared to the construction of a new impoundment. This is especially true for issues such as alternatives analysis, avoidance and minimization, and aquatic organism passage in that many or most potential impacts have already occurred. However, the steps of the overall Section 404 permitting process would still need to be followed, and historically reservoirs have encountered significant regulatory and public challenges, regardless of the presence/absence of an existing impoundment.

Compensatory Mitigation

To determine the amount mitigation potentially required for jurisdictional impacts within the Upper Mulberry River 08, the USACE's Standard Operating Procedure (SOP) for Compensatory Mitigation (March 2004) was utilized. The SOP uses a series of factors such as location, type, existing condition, type of impact, etc. to generate a multiplying "factor." That factor is then multiplied by the impact area (acreage or linear footage) to calculate the required mitigation credits. To determine an average factor for jurisdictional areas associated with the Upper Mulberry River 08, various conditions observed during the field surveys were utilized. *However, it is imperative to note that this document only serves as a guideline if impacts do not exceed 5,000 linear feet of stream or ten acres of wetland impacts.* Potential impacts for the Upper Mulberry River 08 would significantly exceed this threshold and actual compensatory mitigation requirements would likely be substantially different from SOP estimates. Currently, the USACE Savannah District Office is developing a new SOP for large-scale projects focused on reservoirs. It is anticipated that this SOP would be issued mid-2008.

Utilizing the 2004 SOP and the approximated acreage and linear feet of jurisdictional waters located within the Upper Mulberry River 08 project area, an estimate of compensatory mitigation credits can be determined. Multiplying factors used for this analysis include: 6.7 for wetland systems, 5.7 for open waters, 12.7 for lower perennial streams, and 7.6 for intermittent streams. This factor was then multiplied by the acreage/ linear footage to determine an estimated number of mitigation credits required. The number of credits was then multiplied by an average credit price to estimate the final estimated compensatory mitigation cost associated with the Upper Mulberry River 08. Refer to Table 6 in the following section entitled "Project Construction Cost Estimate Narrative" for estimated impacts to jurisdictional waters and an estimate of mitigation credits required and associated costs.

Stream Buffer Variance

The Georgia Erosion and Sedimentation Act of 1975 (GESA), as amended, requires that a 25-foot vegetated buffer be maintained along all state waters. Any land disturbing activities within the buffer would require obtaining a stream buffer variance from the EPD. The local issuing authority is responsible for determining if state waters are on-site and is responsible for determining if a stream buffer variance is required.

The GESA has a number of activities that are considered for stream buffer variances, including public water system reservoirs. Based on current regulations, reservoir construction would likely qualify for a variance. Attendant features such as pipelines and roadways, would likely be exempt from GESA regulations if stream crossings are constructed nearly perpendicular.

EPD Water Withdrawal Permit

Georgia EPD requires a permit for withdrawal of 100,000 gallons per day or more of either surface water or ground water. In addition to justification of need for water for up to 50 years in the future, water withdrawal permits typically require the preparation of water conservation, drought contingency, water supply/watershed protection, and reservoir management plans. A public hearing may be required as part of the withdrawal permitting process. EPD requires that its comments on the component plans be addressed before moving forward with issuing the water withdrawal permit. Based on previous permitting experience, a water withdrawal permit can be obtained within 5 to 7 months, depending on EPD's review time and the extent of their comments.

Source Water Protection Plan

Amendments to the Federal Safe Drinking Water Act (SDWA) have brought about a new approach for ensuring clean and safe drinking water served by public water supplies in the United States. Management of a drinking water source now requires a Source Water Protection Plan. This plan basically defines watershed management strategies for ensuring that the water supply is not compromised by potential pollutant sources. Typically these sources are unmanaged development, but they can also include industrial sources that can potentially contaminate the water supply. The entity that operates this reservoir for water supply would be required to produce and implement the Plan. The Plan should also address any source water from outside the reservoir watershed that would be used to fill the reservoir, i.e., pumped/storage sources. The cost and schedule for producing a Source Water Assessment and the corresponding Source Water Protection Plan have not been included in any of the estimates presented in the report.

PROJECT CONSTRUCTION COST ESTIMATE NARRATIVE

Dam and Reservoir

The construction cost estimate for the proposed dam was based upon the general description provided in the background section of the report. Additionally, the following assumptions were made regarding the geometry of the dam.

- Upstream slope of 3H to 1V
- Downstream slope of 3H to 1V
- Upstream slope wave action protection in the form of riprap from 30 feet below the crest of the dam to 5 feet below the crest of the dam. Riprap supported by a berm located 30 feet below top of dam.
- Downstream slope having nearly horizontal 12-foot wide berms at 30-foot vertical intervals to control surface water runoff and erosion
- Crest of dam having a width of 25-feet

In addition to the above geometric considerations, the following internal drainage configurations were also considered in the estimation of construction costs.

- Chimney drain located at the downstream edge of the crest
- Trench drain located at 1/3 the distance from the downstream toe to the crest

A plan view and cross section of the proposed dam is provided in Figures 10 and 11.

Contained below are the items estimated to develop the construction cost estimate. We caution that the quantities and associated prices are based upon limited engineering evaluation and will likely change as the project proceeds into detailed evaluation and design.

Mobilization and Demobilization

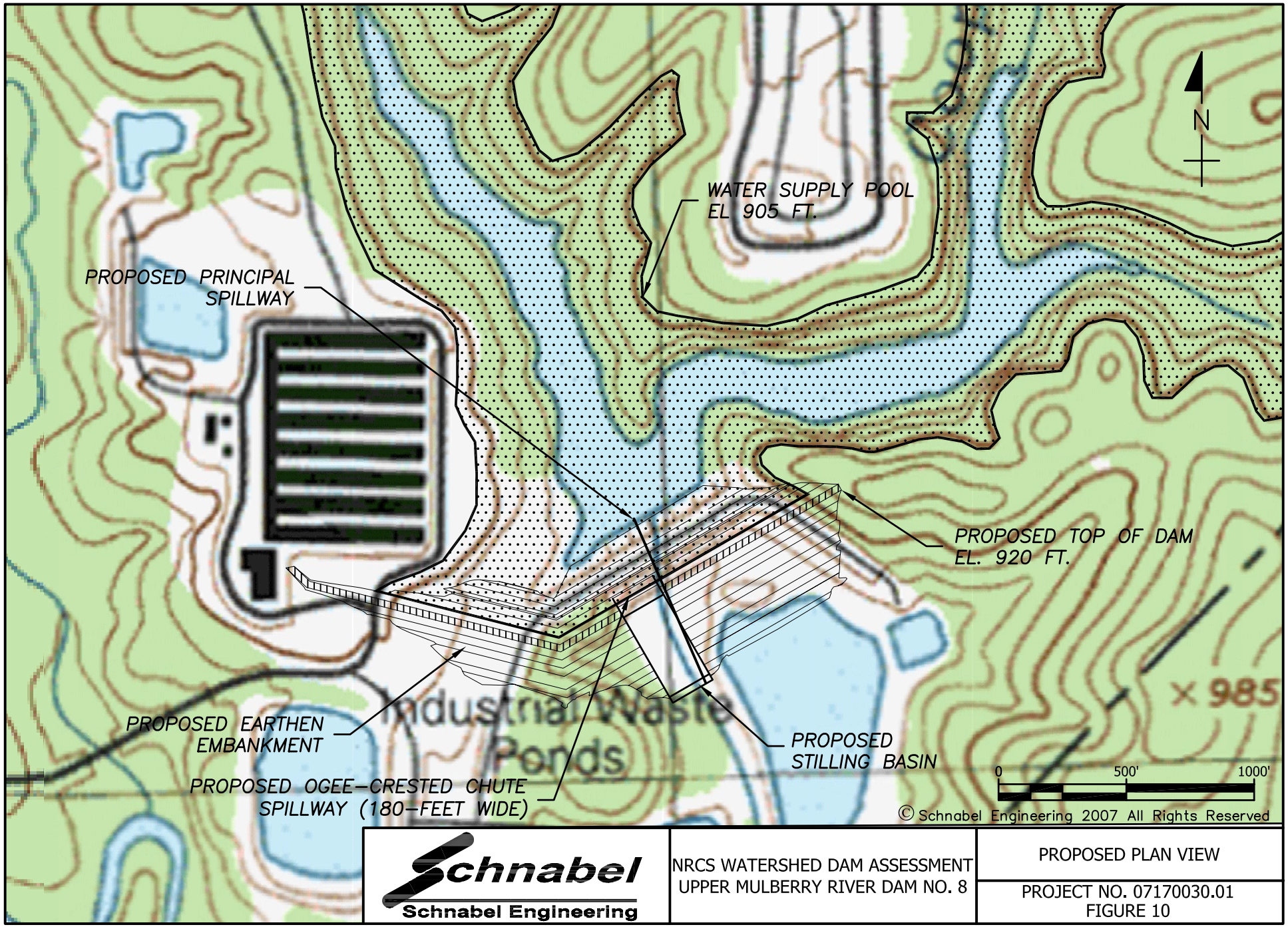
Mobilization and demobilization is a lump sum item estimated at 6 percent of the unit rate sum of the construction items.

Erosion and Sedimentation Control

Erosion and sedimentation control is a lump sum item estimated at 2 percent of the sum of unit rate construction items.

Control of Water

Control of water is a lump sum item estimated at 3 percent of the sum of unit rate construction items. This item includes the control of both surface water and groundwater and will likely consist of stream diversion, cofferdam construction and maintenance, pumping, and well points, as well as any other means of controlling water during construction.

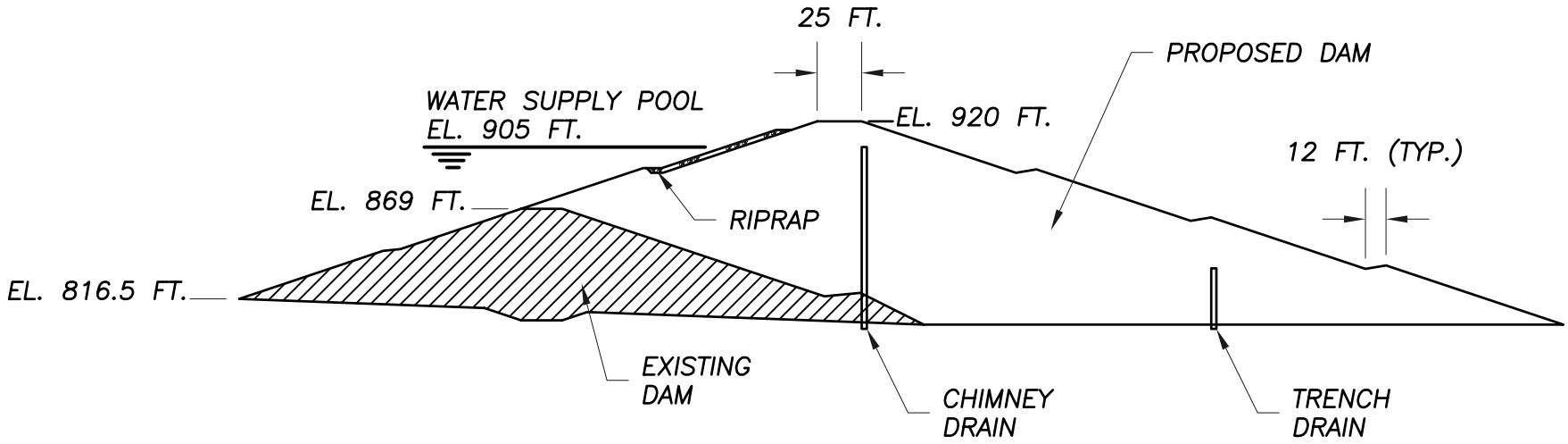


Schnabel Engineering

NRCS WATERSHED DAM ASSESSMENT
UPPER MULBERRY RIVER DAM NO. 8

PROPOSED PLAN VIEW

PROJECT NO. 07170030.01
FIGURE 10



0 100' 200'

Schnabel Engineering

NRCS WATERSHED DAM ASSESSMENT
UPPER MULBERRY RIVER DAM NO. 8

TYPICAL SECTION

PROJECT NO. 07170030.01
FIGURE 11

Clearing

Clearing is a unit rate item measured in acres associated with the removal of trees and other vegetation from the reservoir. The estimated area of clearing was assumed to be equal to the surface area of the reservoir at the normal pool elevation.

Clearing and Grubbing

Clearing and grubbing is a unit rate item measured in acres associated with the removal of trees, other vegetation, and associated root mats in the areas to receive structural fill or concrete. The estimated area of clearing and grubbing was assumed to be equal to the footprint of the proposed dam plus an additional 50-foot perimeter around the proposed dam.

Earth Fill

Earth Fill is a unit rate item measured in cubic yards. The computed volume of earth fill represents the estimated quantity required to construct the dam as described herein. The estimated quantity was computed using an AutoCad Civil 3D computer model based on the proposed grading and existing topography. In addition to the proposed embankment earth fill, foundation excavation backfill was calculated (see Excavation, Common for details) and added to the embankment earth fill to determine the total quantity of earth fill.

Drain Fill

Drain Fill is a unit rate item measured in cubic yards. The computed volume of drain fill represents the estimated quantity of fine and coarse-grained drain material required to construct the internal drainage system as described herein. For the purposes of this study, no differentiation was made between fine and coarse drain fill. In addition, the quantity for the trench drain was assumed to be equal to half of the chimney drain quantity. The chimney drain was assumed to have a top elevation equal to the proposed normal pool elevation and a bottom elevation approximated at the limits of the foundation excavation. The chimney drain was assumed to have a width of three feet and run the length of the dam from one abutment, into the floodplain, and up the other abutment tying into residual soils.

Excavation, Common

Excavation, Common is a unit rate item measured in cubic yards associated with the removal of unsuitable material (soils) within and adjacent to the footprint of the proposed dam. The volume of common excavation was calculated by approximating the surface area of the floodplain within the limits of clearing and grubbing as well as the depth of excavation within the same area. The surface area of the floodplain was approximated using available topographic maps. The depth of excavation was estimated from the boring data included in the design plans for the existing dam.

Riprap

Riprap is a unit rate item measured in tons. The computed weight of riprap represents the estimated quantity required to construct the wave-action berm as described herein. Riprap was assumed to be placed on the upstream slope of the dam. The section of riprap was assumed to extend 30 vertical feet, have a thickness of about 2-¾ feet, and traverse the length of the proposed dam.

Permanent Turf Establishment

Permanent Turf Establishment is a unit rate item measured in acres associated with the establishment of a permanent turf at the conclusion of construction activities for the proposed dam. The estimated area of permanent turf establishment was assumed to be equal to the estimated area of clearing and grubbing.

Concrete, Class 4000

Concrete, Class 4000 is a unit rate item measured in cubic yards associated with the construction of the reinforced concrete auxiliary chute spillway. The volume of concrete was estimated by comparing the proposed auxiliary spillway drop in elevation and width to the drops in elevation and widths of constructed reinforced concrete chute spillways. A relationship was developed between the drop in elevation and width of the constructed spillways and the required quantity of concrete. This relationship was applied to the proposed dam to estimate the quantity of concrete.

Principal Spillway Reinforced Concrete Pressure Pipe

Reinforced Concrete Pressure Pipe (RCPP) is a unit rate item measured in feet. The computed length of RCPP represents the estimated quantity required to construct the principal spillway conduit described herein. The RCPP was assumed to be placed through the base of the proposed dam from the upstream toe to the downstream toe. The diameter of the pipe was assumed to be equal to the diameter of the pipe in the existing dam.

Concrete, Class 3000 (mass)

Concrete, Class 3000 is a unit rate item measured in cubic yards associated with the construction of the concrete cradle beneath the principal spillway pipe. The concrete cradle was assumed to be designed as a Soil Conservation Service Type A2 cradle and run the length of the principal spillway pipe minus ten feet.

Reinforced Concrete Riser

The Reinforced Concrete Riser is a lump sum item associated with the construction of the reinforced concrete principal spillway structure. The cost was estimated by comparing the proposed principal spillway riser height to the heights of constructed reinforced concrete riser structures. A relationship was developed between the height of the constructed spillways and the cost to construct them. This relationship was utilized to estimate the cost of the proposed riser structure.

Land Acquisition

The costs associated with land acquisitions are unit rate items based upon the number of acres that will need to be purchased at the top-of-dam elevation, the number of acres that will need to be managed for a 150-foot buffer around the normal pool, and the number of houses that will need to be purchased. For the purposes of the buffer management, only the portions of the buffer above top-of-dam elevation were considered. The costs to purchase the land were estimated based upon available records of recent land sales. The cost to manage the buffer was assumed to be 60 percent of the land purchase cost. The cost of each structure impacted was assumed to be $200,000.

Roadway Relocation

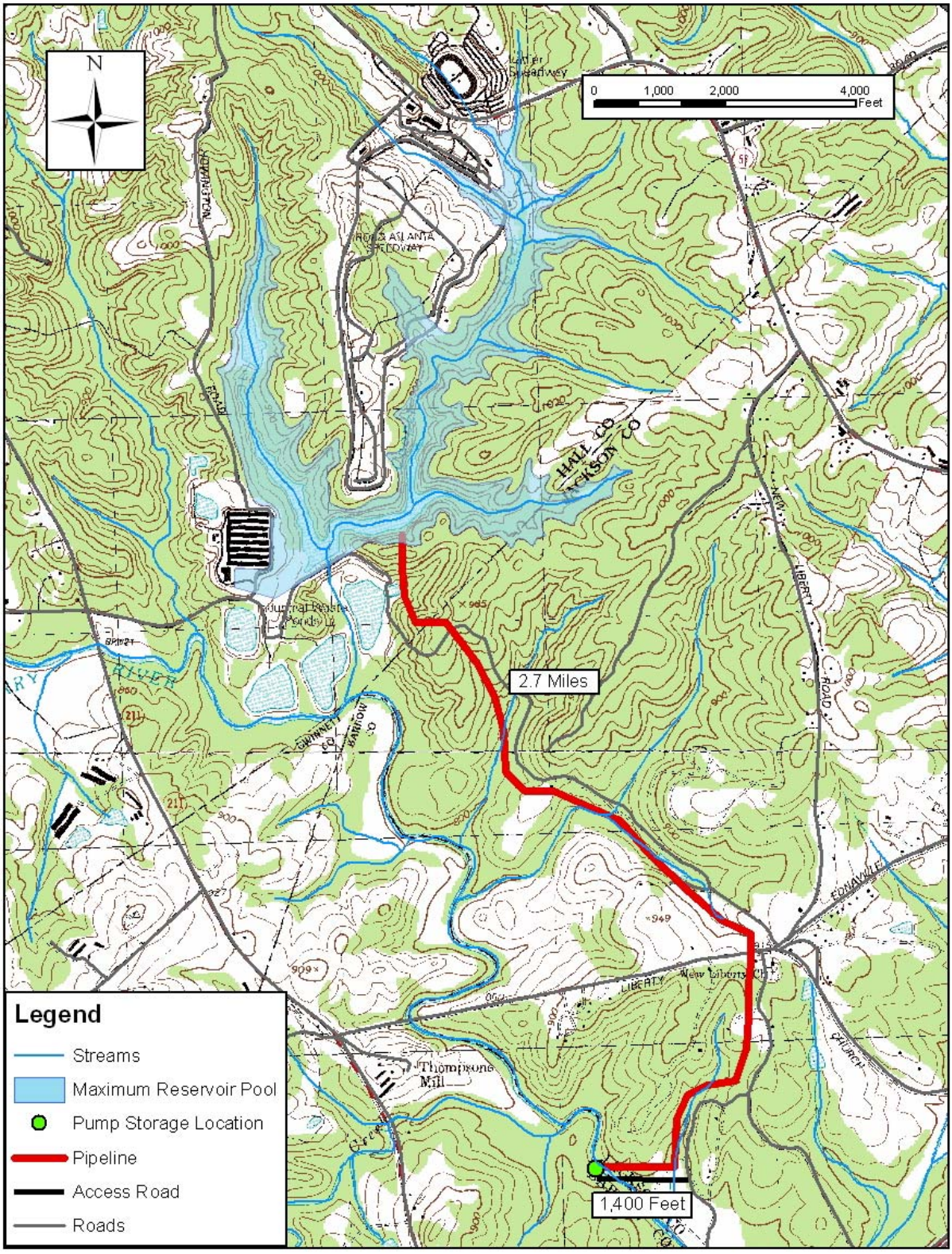
To construct the proposed project, four roads will be impacted. These roads may need to be raised, relocated, or modified to accommodate the new reservoir; however, no consideration was given to the relocation of roads in this study. A more detailed evaluation would need to be performed to evaluate the impact on existing roadways and the associated cost.

Pump Station and Pipeline Cost Estimation

The pump storage location for the Upper Mulberry River Reservoir 08 is located on the Mulberry River, just downstream of its confluence with Duncan Creek. The reservoir is located along Cooper Creek, approximately 0.4 miles upstream of the confluence with the Mulberry River. With a water supply pool elevation of 906 feet, Reservoir 08 has an average day yield of approximately 2.6 MGD. A 24-inch ductile iron pipe (DIP) was selected to carry water from the pump storage location to the reservoir. This pipeline is approximately 2.7 miles in length and will pump water from the storage location elevation of 850 feet, to the 906 feet height of the reservoir water surface. A cascading structure will need to be constructed where the pipe comes into the reservoir to provide aeration and erosion control.

Three 5-MGD pumps were selected at the pump storage location to pump water to the reservoir. This gives a firm pumping capacity of 10-MGD, which is a little more than twice the daily yield of the reservoir, the standard assumption for pump capacity. This pumping capacity will allow the reservoir to remain stable during times of peak water demand, as well as give redundancy in the case of failure in one of the pumps. An access road will need to be constructed in order to construct and maintain the pumping station on the Mulberry River. This road, shown on Figure 12, will run approximately 0.25 miles from Charlie Smith Road. The cost opinion for these components is found in the appendix.

Figure 12
Project Location Map



Compensatory Mitigation

The simplest mitigation option is typically purchasing credits from a bank. Compensatory mitigation credits may be purchased from an approved mitigation bank or through the Georgia Land Trust Service Center if a bank is not available within the project area. Based on recent projects, wetland credits range from $7,000-$10,000 per credit and stream credits range from $70-$110 per credit. An option to purchasing credits is to obtain credits by conducting on-site restoration or preservation of jurisdictional waters.

Table 6
Upper Mulberry River 08 Estimated Impacts and Overall Mitigation Banking Cost Analysis

Impact Type	Estimated Impact Acres/Linear Feet	Projected Credits Needed	Projected Cost* $90/stream credit $7,500/wetland credit
Wetland	0.55 A.	4	$30,000
Intermittent Stream	1,184.0 l.f.	8,998	$809,820
Lower Perennial Stream	21,630 l.f.	274,701	$24,723,090
Open Water	27.90 A.	159	$1,192,500
Total	**28.45 acres / 22,814 lf**	**163 wetland / 283,699 stream****	**$26,755,410**

*Cost is based on recent quotes from banks within the Upper Oconee River Basin. Actual banking price may be higher or lower than estimated depending on the date of purchase and credit availability.**Total required credits calculated using the March 2004 Standard Operating Procedure mitigating guidelines established by the US Army Corps of Engineers.

Estimated Project Construction Cost

The total project cost is estimated at $113,000,000. Table A-5, located in the appendix, shows an itemized breakdown of the costs associated with enlarging the existing dam and reservoir. These costs are estimates and are based on multiple assumptions.

APPENDIX

FIGURES

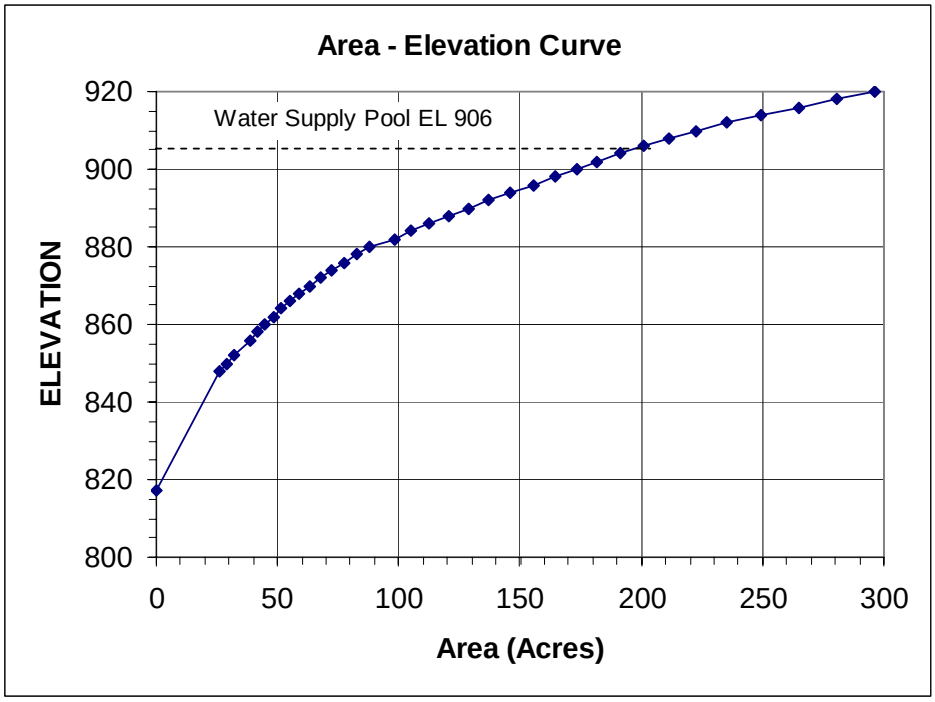
TABLES

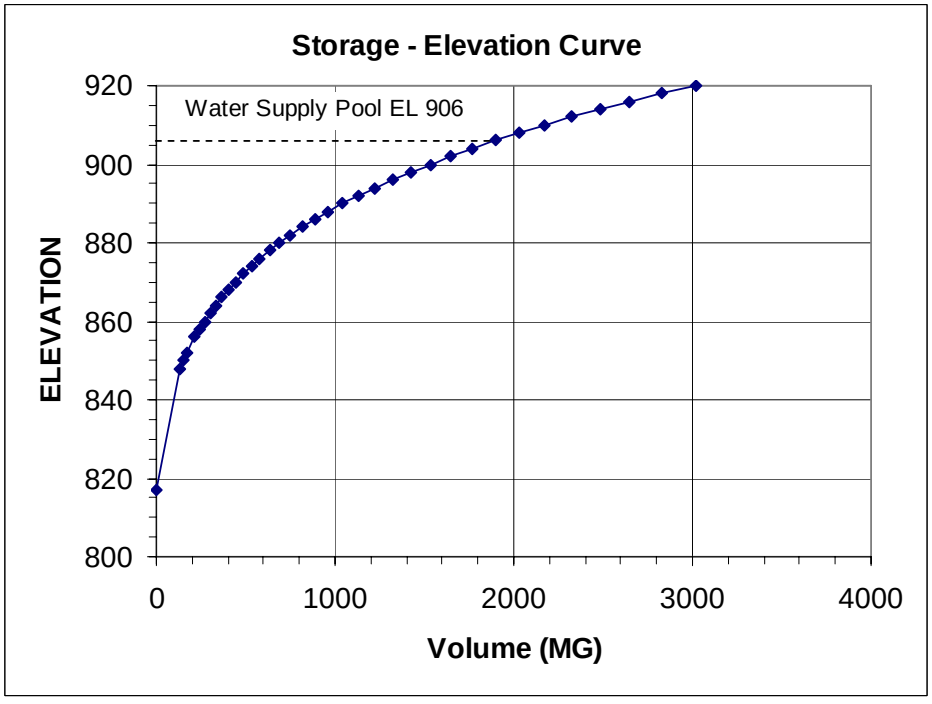
Figure A-1a

Upper Mulberry Creek 08
Area and Storage Curves

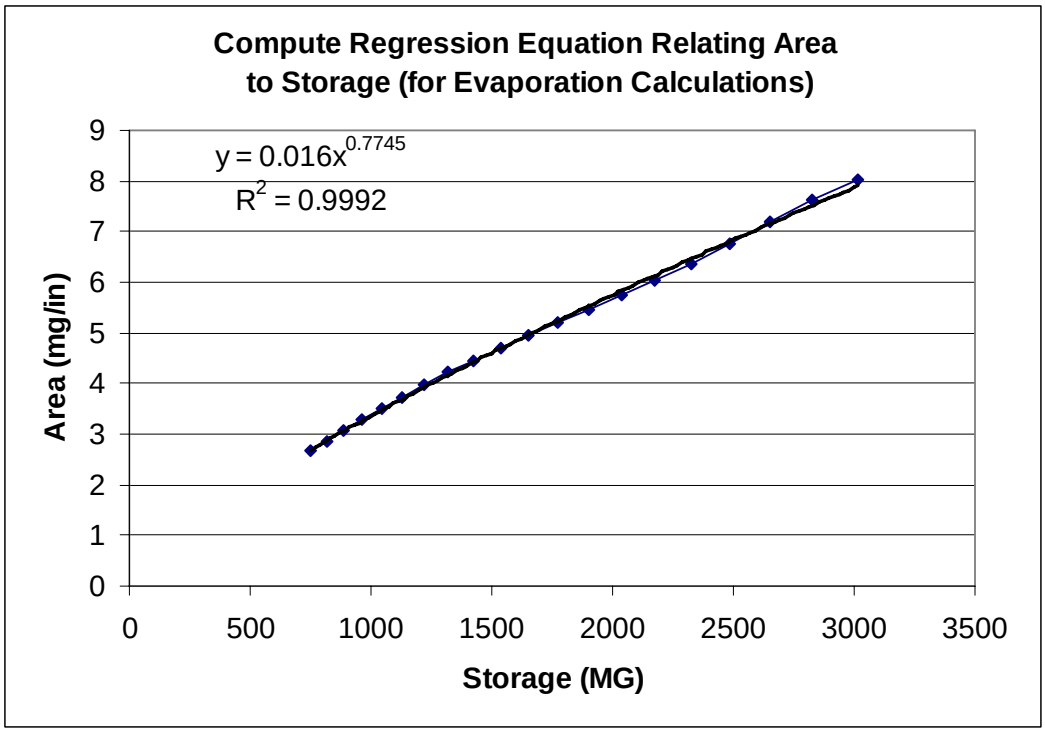
Elev.	Area Acres	Area mg/in	Inc. Vol. A-FT	Cumulative Vol A-FT	Cumulative Vol M Gal.
817	0.00	0	0	0	0
848	25.84	1	400	400	131
850	29.04	1	55	455	148
852	32.17	1	61	517	168
856	38.68	1	142	658	215
858	41.67	1	80	739	241
860	44.87	1	87	825	269
862	48.12	1	93	918	299
864	51.64	1	100	1018	332
866	55.24	1	107	1125	367
868	58.91	2	114	1239	404
870	63.09	2	122	1361	444
872	67.79	2	131	1492	486
874	72.20	2	140	1632	532
876	77.23	2	149	1781	581
878	82.40	2	160	1941	633
880	88.02	2	170	2111	688
882	98.25	3	186	2298	749
884	104.93	3	203	2501	815
886	112.61	3	218	2718	886
888	120.96	3	234	2952	962
890	128.84	3	250	3202	1043
892	137.25	4	266	3468	1130
894	145.94	4	283	3751	1222
896	155.22	4	301	4052	1321
898	164.35	4	320	4372	1425
900	173.16	5	338	4709	1535
902	181.89	5	355	5064	1650
904	191.32	5	373	5437	1772
906	201.22	5	393	5830	1900
908	211.73	6	413	6243	2035
910	222.83	6	435	6678	2176
912	234.97	6	458	7135	2325
914	249.66	7	485	7620	2483
916	265.06	7	515	8135	2651
918	280.51	8	546	8680	2829
920	296.00	8	577	9257	3017

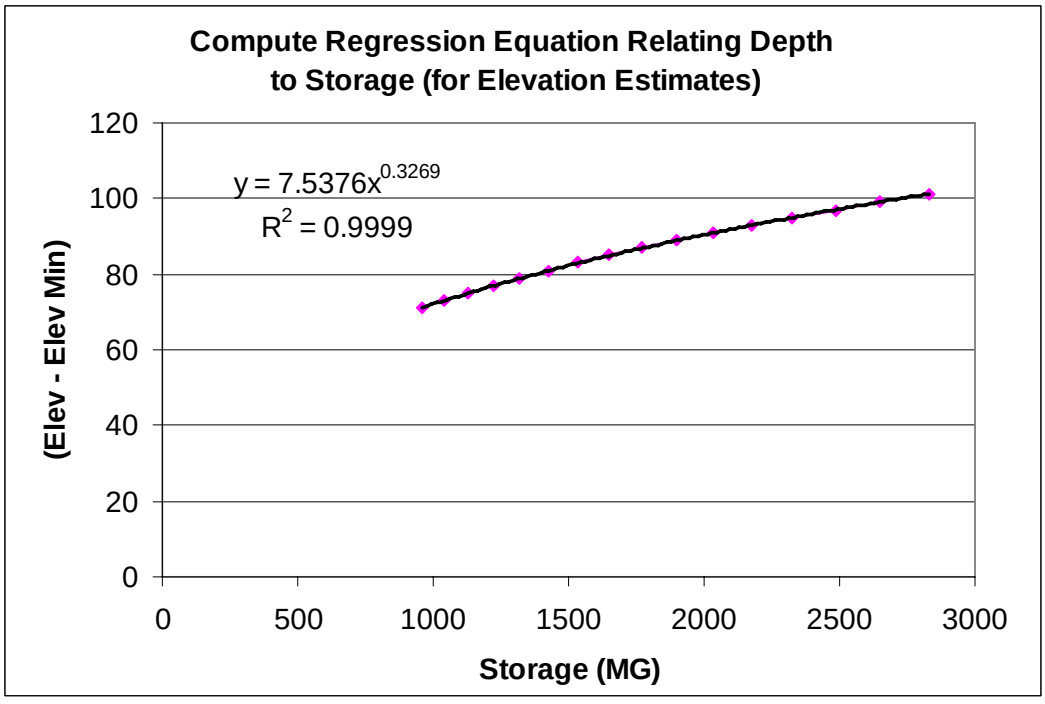
Figure A-1b


Area - Elevation Curve
Water Supply Pool EL 906
ELEVATION
920
900
880
860
840
820
800
0
50
100
150
200
250
300
Area (Acres)

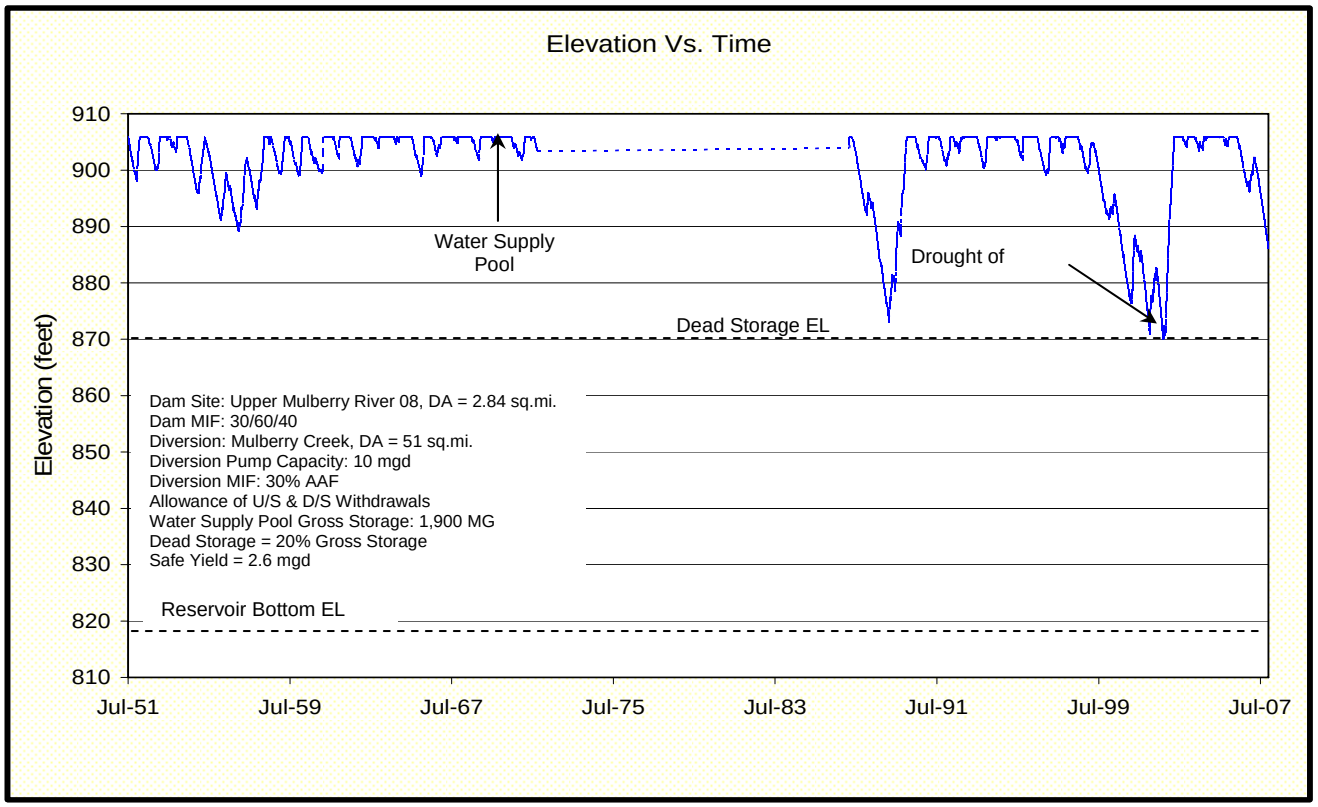

Storage - Elevation Curve
Water Supply Pool EL 906
ELEVATION
920
900
880
860
840
820
800
0
1000
2000
3000
4000
Volume (MG)

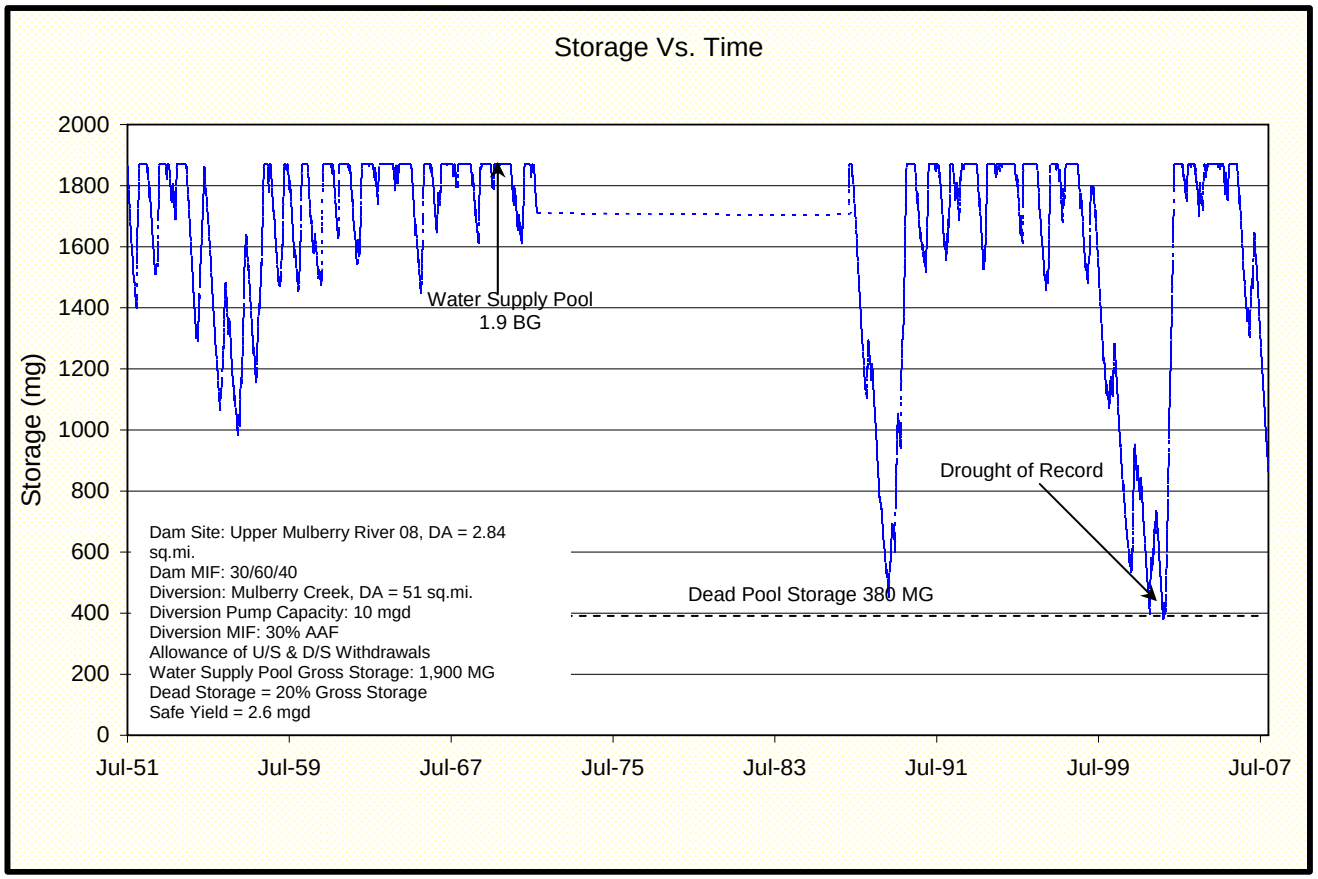
Upper Mulberry River 08 Figure A-2





Upper Mulberry River 08 Figure A-3





WATERSHED DAM ASSESSMENT - UPPER MULBERRY RIVER 08

Hall County, Georgia (7194-001)

OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE - CONCEPTUAL LEVEL

Summary by Division

TABLE A-1

Division	01 - River Intake and Pump Station and Access Road	02 - 24 - inch Raw Water Force Main and Venturi Vault	03 - Reservoir Inlet Structure	TOTAL	% of Total
1	$0.51	$0.17	$0.05	$0.72	8.79%
2	$0.80	$0.00	$0.04	$0.84	10.25%
3	$0.67	$0.01	$0.27	$0.96	11.67%
4	$0.06	$0.00	$0.00	$0.06	0.74%
5	$0.02	$0.00	$0.00	$0.02	0.27%
6	$0.00	$0.00	$0.00	$0.00	0.00%
7	$0.01	$0.00	$0.00	$0.01	0.17%
8	$0.03	$0.00	$0.00	$0.03	0.37%
9	$0.05	$0.00	$0.00	$0.05	0.61%
10	$0.00	$0.00	$0.00	$0.00	0.00%
11	$0.82	$0.00	$0.06	$0.88	10.66%
12	$0.00	$0.00	$0.00	$0.00	0.00%
13	$0.00	$0.00	$0.00	$0.00	0.00%
14	$0.09	$0.00	$0.00	$0.09	1.11%
15	$0.39	$1.64	$0.01	$2.04	24.79%
16	$0.69	$0.06	$0.00	$0.74	9.00%
17	$0.14	$0.02	$0.00	$0.15	1.85%
Structure Contingency	$0.43	$0.00	$0.00	$0.43	5.20%
Markup	$0.78	$0.32	$0.09	$1.19	14.50%
Structure Total (without Contingency)	$5.49	$2.21	$0.53	$8.22	100.00%
Project Contingency	**$1.65**	**$0.66**	**$0.16**	**$2.47**	**30.00%**
Structure Total (with Contingency)	**$7.14**	**$2.87**	**$0.68**		

All Figures are in Millions

PROJECT TOTAL $10.69 M

UPPER MULBERRY RIVER 08:

Maximum Safe Reservoir Yield:

2.6 MGD

RWPS Firm Pumping Capacity:

10.0 MGD

RWFM Pipe Diameter: 24-inches

WATERSHED DAM ASSESSMENT - UPPER MULBERY RIVER 08
Hall County, Georgia (7194-001)
OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE - CONCEPTUAL LEVEL
01 - River Intake and PS

01
DECEMBER 2007

TABLE A-2

No.	Spec. Sect.	Description	Unit	Qty	Labor $$		Material $$		Equipment $$		Subcontractor $$		Total
					Unit	Total	Unit	Total	Unit	Total	Unit	Total	
01 - Upper Mulberry River 08: River Intake and Pump Station					**3 - Channel Intake Pump Station**				**Pump Station Firm Capacity is 10MGD**				
		Div 1											
1	1000	General Conditions	LS	1		$181,000		$143,500		$181,200		$0	$505,700
		Div 2											
2	2200	Earth Work	LS	1	$13,600.00	$13,600	$8,400.00	$8,400	$3,479.00	$3,480	$252,800.00	$252,800	$278,280
3		Access Road	LF	1300		$0		$0		$0	$110.00	$143,000	$143,000
4		Creek Crossing	EA	2		$0		$0		$0	$50,000.00	$100,000	$100,000
5	2831	10' Galv. Chain Link Fence	LF	2600		$0		$0		$0	$30.00	$78,000	$78,000
6	2831	Dewatering / Pre-Excavation Preparation	LS	1	$50,000.00	$50,000	$20,000.00	$20,000	$100,000.00	$100,000	$30,000.00	$30,000	$200,000
		Div 3											
7	3250	Water Stop	LF	500	$1.25	$630	$2.00	$1,000		$0		$0	$1,630
8	3300	Concrete Bridge	SF		$2.00	$0		$0	$3.50	$0	$20.00	$0	$0
9	3300	Concrete	LS	1	$212,885.00	$212,890	$394,527.00	$394,530	$65,650.00	$65,650	$0.00	$0	$673,070
		Div 4											
10	4210	Brick Veneer	SF	2800		$0		$0		$0	$14.50	$40,600	$40,600
11	4220	Concrete Masonry Unit - Reinforced	SF	2800		$0		$0		$0	$7.25	$20,300	$20,300
		Div 5											
10	5524	Aluminum Handrail	LF	200	$6.00	$1,200	$35.00	$7,000	$2.90	$580		$0	$8,780
11		Ladder	VF	20	$50.00	$1,000	$150.00	$3,000	$15.00	$300		$0	$4,300
12	5530	Aluminum Grating Landing	SF	32	$10.00	$320	$45.00	$1,440	$10.00	$320		$0	$2,080
13	5530	Aluminum Grating	SF	240	$10.00	$2,400	$20.00	$4,800		$0		$0	$7,200
		Div 6											
		Div 7											
14		Membrane Roofing	SF	1500		$0		$0		$0	$5.00	$7,500	$7,500
15		Dampproofing - Walls	SF	2800		$0		$0		$0	$0.56	$1,570	$1,570
16		1" Rigid Insulation - Walls	SF	2800		$0		$0		$0	$1.07	$3,000	$3,000
17	7210	Walls - Core Fill Foam Insulation (12" CMU)	SF	2800		$0		$0		$0	$0.61	$1,710	$1,710
		Div 8											
18	8120	Hollow Metal Doors, Hardware, and Frames - Single	EA	10	$150.00	$1,500	$400.00	$4,000		$0		$0	$5,500
19	8120	Hollow Metal Doors, Hardware, and Frames - Double	EA	2	$150.00	$300	$800.00	$1,600		$0		$0	$1,900
20		Windows	LS	1	$3,000.00	$3,000	$8,000.00	$8,000	$1,000.00	$1,000		$0	$12,000
21	8331	Roll Up Aluminum Door (10'x12')	EA	2	$800.00	$1,600	$4,500.00	$9,000	$50.00	$100		$0	$10,700
		Div 9											
22	9900	Painting	LS	1		$0		$0		$0	$50,000.00	$50,000	$50,000
		Div 10											
		Div 11											
23		Screens	EA	3	$3,500.00	$10,500	$200,000.00	$600,000	$500.00	$1,500		$0	$612,000
24		Eductors	EA	15	$200.00	$3,000	$2,500.00	$37,500	$50.00	$750		$0	$41,250
25		Pumps (5 MGD, 145 Feet Static Head)	EA	3	$3,500.00	$10,500	$51,000.00	$153,000	$1,000.00	$3,000		$0	$166,500
		Div 12											
		Div 13											
		Div 14											
26		Bridge Crane	LS	1	$5,000.00	$5,000	$85,000.00	$85,000	$1,500.00	$1,500		$0	$91,500
		Div 15											
27	15062	Ductile Iron Pipe	LS	1	$11,195.00	$11,200	$197,359.83	$197,360	$2,840.00	$2,840	$0.00	$0	$211,400
28		PVC Piping	LS	1	$1,250.00	$1,250	$8,000.00	$8,000	$750.00	$750		$0	$10,000
29		Valves	LS	1	$10,000.00	$10,000	$100,000.00	$100,000	$2,000.00	$2,000	$0.00	$0	$112,000
30		HVAC and Plumbing	LS	1		$0		$0		$0	$60,000.00	$60,000	$60,000
		Div 16											
31	16000	Electrical	LS	1		$0		$0		$0	$415,000.00	$415,000	$415,000
32		CCTV Allowance	LS	0		$0		$0		$0		$0	$0
33		Ductbank	LF	1800		$0		$0		$0	$150.00	$270,000	$270,000
		Div 17											
34	17000	Instrumentation	LS	1		$0		$0		$0	$135,000.00	$135,000	$135,000
		Contingency	LS	10%		$52,000		$179,000		$36,000		$161,000	$428,000
		Subtotals				$572,890		$1,966,130		$400,970		$1,769,480	$4,709,470

Sales Tax @	**7.0%**	$137,600
Labor Burden @	**30.0%**	$171,900
Bonds On Subs @	**1.5%**	$26,500
Subtotal		$5,045,470
Fee @	**7.0%**	$353,200
Insurance & Bonds @	**1.7%**	$91,800
Estimated Construction Cost		**$5,490,470**

Assumptions:
Assumes that EPD will allow withdrawal from this source
15 foot wide Asphalt access road with 10-foot high fence
Pump Station firm capacity is 10MGD
Pump Station has a 3 channel intake
Pump Station footprint is approximately 100 feet by 40 feet
Pump Station main building footprint is approximately 35 feet by 35 feet
Pump Station main building also houses the electrical room and is made of brick and block
A Transformer is being provided by the Utility Company at the access road entrance
Estimate DOES NOT include easements acquisitions, land acquisitions, withdrawal permits or mitigations required to build the pump station

WATERSHED DAM ASSESSMENT - (7194-001)
UPPER MULBERRY RIVER 08

OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE - CONCEPTUAL LEVEL

02 - 24-inch Raw Water Line

TABLE A-3

No.	Spec. Sect.	Description	Unit	Qty	Labor $$		Material $$		Equipment $$		Subcontractor $$		Total
					Unit	Total	Unit	Total	Unit	Total	Unit	Total	
02 - 24-inch Raw Water Line with Venturi Vault													
		Div 1											
1	1000	General Conditions	LS	1		$61,000		$44,300		$61,400		$0	$166,700
		Div 2											
2	2125	Erosion and Sedimentation Control Maintenance - with Unit Bid	MTH			$0		$0		$0		$0	$0
3		Dewatering	LS			$0		$0		$0		$0	$0
4	2510	Asphalt Concrete Pavement - with Unit Bid	LS			$0		$0		$0		$0	$0
5	2523	Concrete Sidewalk and Curbs - with Unit Bid	LS			$0		$0		$0		$0	$0
		Div 3											
6	3300	Miscellaneous Concrete (Venturi Vault)	LS	1	$1,200.00	$1,200	$12,500.00	$12,500	$1,000.00	$1,000	$0.00	$0	$14,700
		Div 4											
		Div 5											
		Div 6											
		Div 7											
		Div 8											
		Div 9											
		Div 10											
		Div 11											
		Div 12											
		Div 13											
		Div 14											
		Div 15											
7		**24" DIP**	**Depth**	**6**		**Depth of Cover**	**4**						
8		24" Pipe Excavation - Earth (compacted volume)	CY	11917	$0.75	$8,938		$0	$3.00	$35,750		$0	$44,688
9		24" Pipe Excavation - Trench Rock (compacted volume)	CY	3972		$0		$0		$0	$35.00	$139,028	$139,028
10		Trench Box	LF	14,300		$0	$1.00	$14,300		$0		$0	$14,300
11		24" DIP Pressure Class 250	LF	11,300	$6.00	$67,800	$58.99	$666,610	$2.50	$28,250		$0	$762,660
12		24" Pipe Bedding (compacted volume)	CY	2,648	$1.00	$2,648	$13.00	$34,426	$1.00	$2,648		$0	$39,722
13		24" Pipe Backfill (compacted volume)	CY	11,577	$1.00	$11,577		$0	$4.00	$46,307		$0	$57,884
14		Import Backfill Materials (loose volume, assume 10% swell)	CY	374		$0	$13.00	$4,859		$0		$0	$4,859
15		Haul off Rock (assume 15% swell) - with Unit Bid	CY	4,568		$0		$0		$0	$15.00	$68,521	$68,521
16		24" 90-degree Bend	EA	2	$127.20	$254	$3,398.04	$6,796	$50.00	$100		$0	$7,150
17		24" 45-degree Bend	EA	10	$127.20	$1,272	$1,737.81	$17,378	$50.00	$500		$0	$19,150
18		24" 22.5-degree Bend	EA	6	$127.20	$763	$1,815.65	$10,894	$50.00	$300		$0	$11,957
19		24" 11.25-degree Bend	EA	2	$127.20	$254	$2,746.39	$5,493	$50.00	$100		$0	$5,847
20		24" DIP Pressure Class 250 RJ	LF	3000	$9.17	$27,498	$81.17	$243,504	$2.50	$7,500		$0	$278,502
21													
22		Earthwork Calculations				$0		$0		$0		$0	$0
23		Pipe Excavation - Total Compacted Volume	CY	15889		$0		$0		$0		$0	$0
24		Rock - Total Compacted Volume (assume 25% of excavation)	CY	3972		$0		$0		$0	$37.00	$146,972	$146,972
25		Pipe Bedding - Total Compacted Volume	CY	2648		$0		$0		$0		$0	$0
26		Pipe Backfill - Total Compacted Volume Needed	CY	11577		$0		$0		$0		$0	$0
27		On-Site Backfill Material Available - Compacted Volume	CY	11917		$0		$0		$0		$0	$0
28		Materials for Disposal - Compacted Volume	CY	340	$5.00	$1,699		$0	$5.00	$1,699		$0	$3,398
29													
30		Air Release Valve and Manhole (3 each)	LS	1	$2,200.00	$2,200	$26,400.00	$26,400	$1,800.00	$1,800	$0.00	$0	$30,400
31													
		Div 16											
32	16000	Electrical	LS	1		$0		$0		$0	$55,000.00	$55,000	$55,000
		Div 17											
33	17000	Venturi Meter	LS	1	$1,000.00	$1,000	$8,500.00	$8,500	$500.00	$500		$0	$10,000
34	17000	Instrumentation	LS	1		$0		$0		$0	$7,500.00	$7,500	$7,500
		Contingency	LS	0%		$0		$0		$0		$0	$0
		Subtotals				$188,104		$1,095,960		$187,855		$417,021	$1,888,939

Sales Tax @	**7.0%**	$76,700
Labor Burden @	**30.0%**	$56,400
Bonds On Subs @	**1.5%**	$6,300
Subtotal		$2,028,339
Fee @	**7.0%**	$142,000
Insurance & Bonds @	**1.7%**	$36,900
Estimated Construction Cost		**$2,207,239**

Assumptions:

Estimate DOES NOT include easements acquisitions, land acquisitions or mitigations required to build the pump station

Assumed 25% of the excavated material is rock

$154 per LF

WATERSHED DAM ASSESSMENT - (7194-001)
UPPER MULBERRY RIVER 08

OPINION OF PROBABLE CONSTRUCTION COST - CONCEPTUAL LEVEL

03 - Reservoir Inlet Structure

TABLE A-4

No.	Spec. Sect.	Description	Unit	Qty	Labor $$		Material $$		Equipment $$		Subcontractor $$		Total
					Unit	Total	Unit	Total	Unit	Total	Unit	Total	
03 - Reservoir Inlet Structure													
		Div 1											
1	1000	General Conditions	LS	1		$18,000		$14,500		$18,300		$0	$50,800
		Div 2											
2	2200	Earth Work	LS	1	$5,000.00	$5,000	$2,639.00	$2,640	$4,926.00	$4,930	$31,300.00	$31,300	$43,870
		Div 3											
3	3250	Water Stop	LF	500	$1.25	$630	$2.00	$1,000		$0		$0	$1,630
4	3300	Concrete	LS	1	$82,952.00	$82,950	$159,839.00	$159,840	$26,200.00	$26,200	$0.00	$0	$268,990
		Div 4											
		Div 5											
7	5524	Aluminum Handrail	LF		$6.00	$0	$35.00	$0	$2.90	$0		$0	$0
8		Ladder	VF		$50.00	$0	$150.00	$0	$15.00	$0		$0	$0
9	5530	Aluminum Grating Landing	SF		$10.00	$0	$45.00	$0	$10.00	$0		$0	$0
10	5530	Aluminum Grating	SF		$10.00	$0	$20.00	$0		$0		$0	$0
		Div 6											
		Div 7											
		Div 8											
		Div 9											
10	9900	Painting	LS			$0		$0		$0		$0	$0
		Div 10											
		Div 11											
11		Sluice Gates and Operators	EA	2	$2,500.00	$5,000	$25,000.00	$50,000	$1,000.00	$2,000		$0	$57,000
		Div 12											
		Div 13											
		Div 14											
		Div 15											
12	15062	Ductile Iron Pipe	LS	1	$1,000.00	$1,000	$8,500.00	$8,500	$500.00	$500		$0	$10,000
		Div 16											
13	16000	Electrical	LS			$0		$0		$0	$70,000.00	$0	$0
		Div 17											
14	17000	Instrumentation	LS			$0		$0		$0	$25,000.00	$0	$0
		Contingency	LS	0%		$0		$0		$0		$0	$0
		Subtotals				$112,580		$236,480		$51,930		$31,300	$432,290

Sales Tax @	**7.0%**	$16,600
Labor Burden @	**30.0%**	$33,800
Bonds On Subs @	**1.5%**	$500
Subtotal		$483,190
Fee @	**7.0%**	$33,800
Insurance & Bonds @	**1.7%**	$8,800
Estimated Construction Cost		**$525,790**

Table A-5

Upper Mulberry River No. 8

TOTAL PROJECT OPINION OF COST

Item . No.	Description of Work	Estimated Quantity	Unit	Lump Sum Price	Amount
1.	Mobilization and Demobilization	1	Job	Lump Sum	$1,050,160
2.	Erosion & Sediment Control	1	Job	Lump Sum	$350,053
3.	Control of Water	1	Job	Lump Sum	$525,080
4.	Clearing	193	Ac	$2,500	$482,500
5.	Clearing & Grubbing	29	Ac	$5,000	$145,000
6.	Earth Fill	1,288,466	Cu-Yd	$4	$5,153,864
7.	Drain Fill	20,155	Cu-Yd	$75	$1,511,625
8.	Excavation, Common	79,931	Cu-Yd	$5	$399,655
9.	Riprap	20,629	Ton	$75	$1,547,175
10.	Permanent Turf Establishment	29	Ac	$2,000	$58,000
11.	Concrete, Class 4000 (reinforced)	8,997	Cu-Yd	$850	$7,647,450
12.	Concrete, Class 3000 (mass)	131	Cu-Yd	$400	$52,400
13.	30-Inch RCP	700	Feet	$400	$280,000
14.	Principal Spillway Riser	1	Lump Sum	$225,000	$225,000
	Dam Construction Cost Estimate				**$19,427,963**
15.	24-Inch Pipeline	1	Lump Sum	$2,210,000	$2,210,000
16.	Cascading Structure	1	Lump Sum	$530,000	$530,000

17.	Pumping Station (Including Raw Water Pumps and Access Road)	1	Lump Sum	$5,490,000	$5,490,000
	Pump Station and Pipeline Cost Estimate				**$8,230,000**
18.	Land Acquisition	289	Ac	$75,000	$21,675,000
19.	Easement Acquisition	92	Ac	$45,000	$4,140,000
20.	Building Acquisition	2	Buildings	$200,000	$400,000
	Land Acquisition Cost Estimate				**$26,215,000**
21.	Wetland	4	Credits	$7,500	$30,000
22.	Intermittent Stream	8,998	Credits	$90	$809,820
23.	Lower Perennial Stream	274,701	Credits	$90	$24,723,090
24.	Open Water	159	Credits	$7,500	$1,192,500
	Impacts and Overall Mitigation Cost Estimate				**$26,755,410**
	Construction, Land Acquisition, Mitigation Estimate				**$80,628,373**
	Contingency at 25%				**$20,157,093**
	Professional Services at 15% *				**$12,094,256**
	Total Project Estimate				**$112,879,722**
	Suggested Project Estimate				**$113,000,000**

*Professional services include but are not limited to engineering, construction management legal, appraisals, and environmental consulting.