ENVIRONMENTAL AND HYDRAULIC DESIGN ISSUES FOR THE CITY OF DALTON'S WATER STORAGE RESERVOIR

Jeff Beriswill[1] and Steve Bach[2]

AUTHORS: [1]P.E., Project Engineer; and [2]Senior Environmental Scientist, Golder Associates Inc., 3730 Chamblee Tucker Road, Atlanta, Georgia 30034.
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INTRODUCTION

Golder Associates Inc. was retained by the City of Dalton to provide engineering services for the design and construction of a 1,100 million gallon off-stream storage water reservoir. The design of the reservoir incorporates a blend of environmental, wetlands, and hydraulic issues.

The proposed reservoir is located adjacent to the Conasauga River, approximately 10 miles upstream of the City of Dalton's water treatment facilities (Figure 1). The reservoir is the second of a series of reservoirs to be constructed for Dalton Utilities to supplement the city's public and industrial water supply. An additional off-stream reservoir, the Conasauga Reservoir, is located approximately 6 miles downstream of the proposed reservoir. The Conasauga Reservoir was constructed in 1990 and has a maximum storage capacity of 500 million gallons.

During seasonal high flows of the Conasauga River, water will be pumped into the reservoir. During seasonal low flows, or at other times as needed, water from the reservoir will be released back into the river to augment flow to the water treatment plant. Environmental design concerns include (1) impacts on aquatic life in the river, including two federally endangered fish species, the amber darter (*Percina antesella*) and the Conasauga log perch (*Percina jenkinsi*); and (2) creation of wetlands habitat within the proposed borrow area between the reservoir and the river. The two objectives of the hydraulic design were to re-route surficial drainage at the project site and to reduce impacts on the river flow during flood events.

METHODS

Impacts on Endangered Fish

A variety of issues have been identified concerning potential impacts of the proposed facility on protected fish species. These issues include: (1) potential entrainment impacts; (2) potential effects of water withdrawal on habitat availability; and (3) potential effects of water releases, including changes in flow, temperature and dissolved oxygen levels.

Entrainment of Fish. Entrainment of fish at the intake will be minimized by limiting intake velocities to less than 0.5 feet per second (fps) and constructing a travelling fish screen to return trapped fish to the river. The fish screen system will consist of a 3/8-inch mesh to present fish entrainment in the intake pumps and a travelling screen fish basket system which gently directs stray fish back into the main river channel.

Water Withdrawal Schedule. To maintain habitat availability, a water withdrawal schedule has been developed based on minimum flow requirements recommended by the United States Fish and Wildlife Service (USFWS). Minimum flows for aquatic species based on a percentage of the mean annual daily streamflow, are as follows:

- July to November - 20 percent of mean annual daily streamflow (MADS);
- January to April - 40 percent of MADS; and
- May, June, and December - 30 percent MADS.

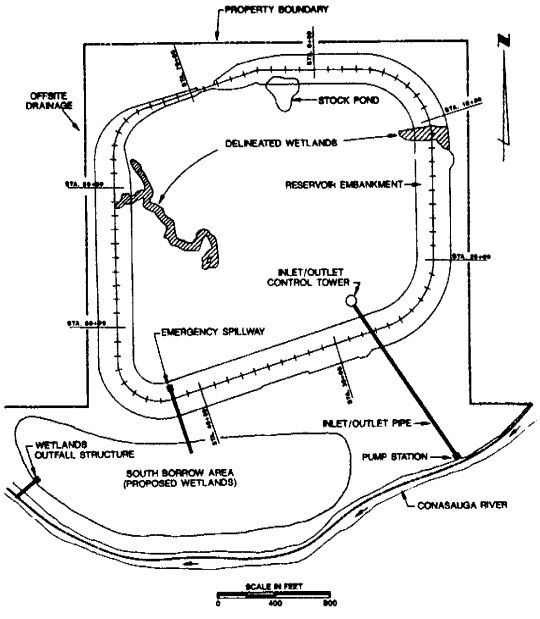

Figure 1. Site Location Plan

No water will be withdrawn from the river when streamflows are below the recommended minimum flows. In addition, the intake weir elevation will be set so that no withdrawals will occur when the river approaches the 7Q10 flow rate (the minimum average flow rate over 7 consecutive days within a 10-year period).

Water Release. Impacts of water release on the aquatic life in the river will be controlled by maintaining discharge temperature and dissolved oxygen (DO) within specified limits and by initiating a fish monitoring plan.

Water temperature and dissolved oxygen levels in releases from the reservoir into the river will be controlled by a special water release tower (Figure 2). The tower consists of an inner and outer vertical column. The outer column will collect water at selected depths via a series of butterfly valves to allow control of discharge water temperature. Discharge water will flow through the chamber between the two columns and cascade over a series of baffles within the inner column, becoming thoroughly mixed and aerated.

A baseline temperature and DO study within the river indicated daily temperature variations of 6°F over a twelve-hour period and a maximum monthly deviation in DO content of 4.5 mg/l. To stay within the natural range of temperature and DO variation of the river, a maximum deviation in temperature and DO levels between the river water and released water of 6°F and 4.5 mg/l, respectively, is suggested over a minimum twelve-hour time period. Ongoing studies may further reduce the proposed deviations.

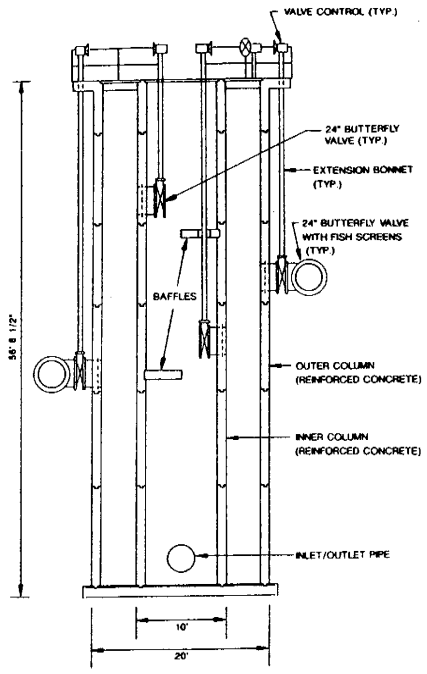

Figure 2. Inlet/outlet tower cross section showing intake points and inner column with aeration baffles.

Temperature and DO are to be measured continuously in the discharge pipe and at two specified locations above and below the discharge pipe. The exact locations are currently being negotiated with the regulatory agencies, but are being selected based on the need to protect endangered species of fish.

Fish Monitoring Plan. A fish monitoring plan has been developed and submitted to the USFWS. The approach of the plan is to compare data upstream and downstream of the reservoir before construction with similar data collected for a three-year period during operation. The data will include temperature, dissolved oxygen, fish abundance, and fish habitat characteristics. Fish will be monitored annually during the summer using seizing and controlled electro-shocking techniques. Both riffle and pool habitats will be sampled. All federally listed species will be released. Temperature and DO data will be continually assessed and used as the basis to assess potential effects on endangered fish.

Creation of Wetlands Habitat

Investigations at the project site indicated that less than one acre of wetlands would be displaced for the construction of the proposed reservoir. As a result, no impact mitigation is required under current U.S. Army Corps of Engineers (Corps) guidelines. However, high quality wetland habitats could be created within the proposed approximately 25 acre south borrow area (see Figure 1) at a minimal expenditure of cost and effort.

The overall concept would be to trap flood waters within the borrow pit area for a sufficient period of time to produce shallow seasonal inundation and saturation. Some water would also be obtained from seepage from the reservoir and runoff from the watershed. Wetland communities would then develop in the borrow pit area over the years as hydrology is maintained. Emergent herbaceous and woody species of trees and shrubs would also be conducted.

The overall plan will be accomplished by connecting the borrow pit area to the main channel of the River via a flood distribution channel, and by careful grading of the entire borrow pit area to effectively trap water behind the existing natural levee. The borrow pit area will be designed to include islands and shallow water areas in order to produce an extensive "edge" habitat and variations in elevation which would produce a diverse plant and animal community. Water will be returned to the river via a gradually sloped and vegetated swale system in order to minimize erosion and to maximize the extent and types of wetland habitat produced. The primary benefits of the created wetlands will be to improve the floodplain ecological values, trap and filter sediments, and protect aquatic life of the river. A small improvement in flood retention for the Conasauga River watershed will also be provided.

Control of Surficial Drainage

Site drainage presently consists of intermittent flow through several small, meandering channels and remnant agricultural drainage ditches. The site receives additional surface water flow from a 700-acre area located northwest of the property via a small creek. Runoff from the reservoir embankment will be controlled by a series of collection ditches located adjacent to the embankment toe road (see Figure 1). Off-site runoff will flow into a large channel on the west side of the reservoir. The channel will have both a low-flow section and a high-flow section with a maximum crest width of 45 feet.

The collection ditches and the large channel will drain to a stilling basin located on the north side of the south borrow area, flow into the proposed wetlands area, and eventually be released into the Conasauga River.

Flood Plain Study

Since the project site is located within the Conasauga River flood plain, a study was conducted to assess the effects of the proposed reservoir on water surface levels upstream of the facility during storm events. Water surface profiles developed for various storm durations were compiled using the HEC-2 computer program developed by the Corps of Engineers. Several descriptive parameters were necessary to adequately model the river during flooding including channel and bridge cross sections, storm flow rates, stream channel roughness coefficients, and overbank roughness coefficients. Results of the analysis included water surface elevations, stream and overbank flow rates, and flood plain top widths calculated at several surveyed stream cross sections.

Water surface elevations were calculated for storms with return periods of 2, 5, 25, 50, and 100 years for both pre- and post-construction conditions. A plot of the maximum increase in flood water levels upstream of the reservoir for the various storm return periods is provided on Figure 3.

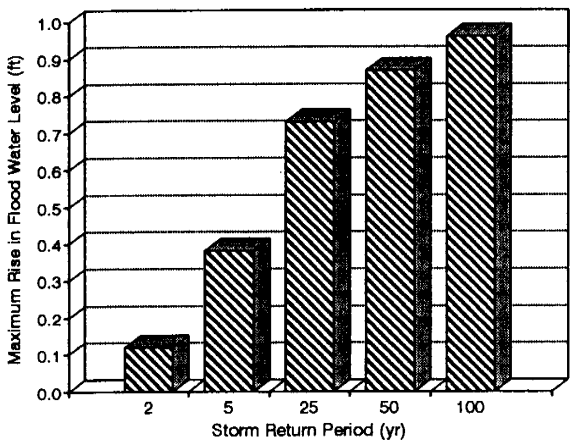

Figure 3. Estimated increase in flood water levels for various storm return periods.

Based on this analysis the increase in water elevations is predicted to be less than 1 foot for up to a 100-year flood. Therefore, construction of the reservoir will not significantly effect flooding conditions near the impoundment, nor notably increase the flood hazard to upstream property owners.

SUMMARY

The proposed water storage reservoir has been designed to minimize impacts to the aquatic life and hydraulic characteristics of the Conasauga River. Impacts will be reduced by the following:

- Careful design and construction of the reservoir and its associated structures;
- Control of water withdrawal rates and discharge water quality during operation; and
- Initiation of a monitoring plan prior to construction and during operation of the facility.
- Creation of wetlands by grading the South Borrow Area.

The overall project has, therefore, been designed to meet the water supply needs of the area in an environmentally compatible manner.

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