

# FLOOD PROTECTION

By Garnet Daus

## Feasibility Study Proposes *Inflatable Dam*

The Wyoming Valley (Pa.) Inflatable Dam Feasibility Study recently received a National Honor Award in the studies, research and consulting engineering services category at the ACEC Engineering Excellence Awards Competition. The annual event celebrates engineering achievements that demonstrate the highest degree of merit and ingenuity.

From the start, the viability of this project was in question due to the significant envi-

ronmental issues, technical problems and limited financial resources. However, the study team was able to address these challenges by incorporating state-of-the-art dam technology, unconventional dam alignment and a revolutionary fish passage concept.

### Study Team

Gannett Fleming, an international consulting engineering and construction management firm, served as the prime consultant for the study. This firm joined with the Greeley-Polhemus Group,

Borton-Lawson Engineering and the Wilkes University Geographical Information System Center to prepare and execute a work plan that maximized the use of the Luzerne County Flood Protection Authority's \$520,000 budget for the study.

### The Feasibility Study

The feasibility study proposes revitalizing the economy and improving recreation opportunities in Wilkes-Barre, Pa., by constructing a \$14 million inflatable dam. The project would create a 400-acre seasonal lake and establish a destination for recreation and tourism.

In addition to promoting public use of the Susquehanna River, the proposed project would create permanent economic benefits for the region. Potential economic benefits include 400,000 new visitors annually, 320 new jobs, \$41.8 million in additional annual state revenue and \$24.5 million in annual county revenue.

### Technology

State-of-the art inflatable dam technology was utilized in this project. The dam would be constructed of inflatable rubber sections that can be fully or partially lowered to create the seasonal recreational lake. A migratory fish passage also would be enabled through the use of a unique fish ladder concept. Four water-filled rubber dams that stair-step in height from tailwater to headwater elevations would be used. This new concept has several advantages over conventional fish ladders.

### History

The Susquehanna River always has been an important part of the Wyoming Valley's economy. Unfortunately, the river also has

## Dam Site Selection

The project team conducted a thorough review of potential sites between Nanticoke and Pittston. They considered engineering, economic, environmental and recreational factors. In November 1998, a site reconnaissance of the study area was made and included a boat survey of the Susquehanna River. Other data used to evaluate potential sites included the locations of existing and proposed parks, property ownership along both sides of the river, population demographics, avoidance of sensitive environmental areas such as large islands, foundation conditions, river morphology, site access and reservoir geometry. The primary dam site selection objectives are as follows.

- Improve public access and enjoyment of the Susquehanna River.
- Take advantage of existing facilities.
- Minimize construction costs.
- Optimize reservoir conditions.
- Minimize environmental impacts.

- Minimize impacts to cultural resources.
- Minimize impacts to drainage structures.
- Maximize economic development.
- Maximize proximity to public lands.
- Should not increase flood levels.

Although other dam sites are possible, the best dam site considering all factors is upstream of Richards Island and the Delaware & Hudson Railroad Bridge. At this site the Susquehanna River is about 1,000 feet wide. A dam at this location would create a lake extending upstream along a large portion of the metropolitan area, border most of the existing river parks and avoid impacting the large islands in the river. This site also has the most favorable reservoir conditions and would produce the deepest and largest lake. Access for construction is excellent, and sufficient public land is available for developing recreation areas.



▲ Four water-filled rubber dams that stair-step in height from tailwater to headwater elevations would be used to enable migratory fish passage.

made the surrounding areas susceptible to flooding. In 1936, the U.S. Army Corps of Engineers constructed a levee system in an effort to protect area communities. The Corps currently is constructing the \$175 million Wyoming Valley Levee Raising Project. While raising the levees will improve flood protection, it also will further isolate communities from the river's resources.

The Luzerne County Flood Protection Authority and the U.S. Army Corps of Engineers authorized the Wyoming Valley Inflatable Dam Feasibility Study as the key mitigation component of the Levee Raising Project.

### Environmental Impact

The Authority is using the proposed project as a catalyst to address long-term water pollution problems affecting the Susquehanna River. The recreational lake would emphasize the need for cleaning the river. The river has a long history of problems resulting from com-

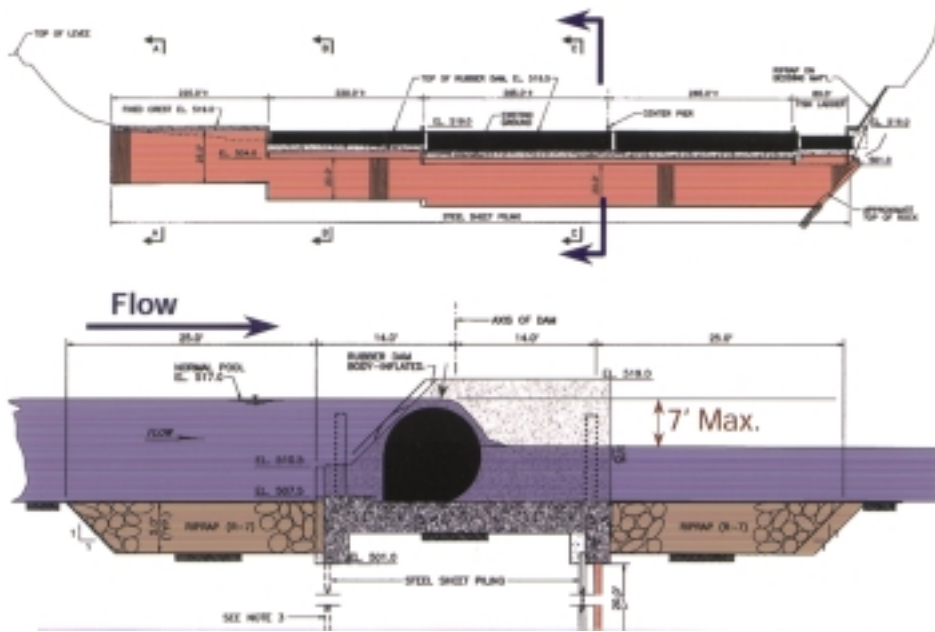
## Inflatable Dam Description

Inflatable dams have been constructed worldwide. The world's longest rubber dam was constructed in 1970 on the Susquehanna River at Sunbury, Pa. This dam has a total length of 2,100 feet and consists of six rubber tubes each 300 feet in length and one tube 175 feet in length. The dam creates a seasonal recreational pool for boating and other water sports.

The most recent inflatable dam project in the United States to create a recreational lake is the Rio Salado project located on the Salt River in Tempe, Ariz. Two inflatable dams will be constructed within an existing flood-control project to create a two-mile-long recreation lake in the heart of downtown Tempe. The inflatable dams are part of a \$1.2 billion effort to revitalize and expand development of the area.

The components of an inflatable dam include the rubber dam body or tube, a

foundation and clamping system and a control system. The rubber tube is made of a thick laminated rubber and nylon combination. A fin structure is located on the top of the rubber dam body to act as a spoiler to assure an even break of cresting water without oscillation. The reinforced concrete foundation extends from the upstream side of the dam to the downstream side a sufficient distance to support the deflated rubber tube. For wide streams and rivers, the foundation includes intermediate concrete piers separating several rubber tubes. The rubber tube is inflated with an air compressor to impound water. Internal air pressure is adjusted automatically to maintain a constant upstream water level. The dam is deflated automatically to pass flood flows or to drain the recreation pool. When fully deflated, the rubber tube lies flat on the concrete foundation.



Proposed inflatable dam profile and cross section.

bined sewer outfalls, acid mine drainage and hazardous waste effluents from mines.

**Challenges**

The study team managed to overcome issues that initially threatened the project. The end result is an award-winning feasibility study that defines a project that is financially feasible and compatible with the existing flood control project. Most importantly, the proposed project poses no significant adverse environmental impacts and would revitalize the economy in the Wyoming Valley.

**About the Author:**  
Garnet Daus is the public relations coordinator for Gannett Fleming, Inc., Harrisburg, Pa.

For more information on this subject, circle 867 on the reader service card.

## Dam Height and Proposed Configuration of the Recreation Lake

**Dam Height**

Once the location of the dam was established, the next step involved determining the footprint and height of the dam. In the Corps' 1991 Reconnaissance Report, dam heights ranging between 6.5 feet and 11.0 feet were judged to be feasible. The 15-foot-high option was dropped from further consideration early in the Corps' study because of its adverse impacts on existing drainage structures, its high construction cost, the adverse impacts it would have on adjacent lands and the relatively small incremental increase in usable lake area over the 11-foot-high plan.

In order to determine the optimal height of the dam, several recreation, engineering and environmental factors were considered. Factors that tend to favor raising the height of the dam include maximizing the extent and area of the recreation lake, providing adequate draft for boats and simplifying the automated operation of the dam. Factors that tend to lower the height of the dam are construction costs, fish passage mitiga-

tion requirements, impacts to wetlands and local habitats and impacts to the existing flood control project. After a careful evaluation of these primary factors, it was determined that an inflatable dam with a fully inflated height of 9.5 feet would provide the optimal recreation lake. With a dam of this size, the recreation lake would be confined within the natural channel banks of the river and inundation of overbank areas and wetlands would be minimal. Impacts to the existing flood control project, including the pumping stations and drainage structures, would be easily mitigated.

**Recreation Lake**

At a height of 9.5 feet, the proposed inflatable dam will maintain the level of the recreation lake near Elevation 517 feet. This elevation corresponds to gage height five feet at the Market Street Bridge, a well know datum to local residents who monitor flood conditions in the river. On average, the water surface elevation of the river in the vicinity of Market Street will be raised approximately four feet higher than

normal when the dam is inflated. The dam will be equipped with automatic controls so that the lake level will be maintained within approximately three inches of the desired elevation.

The recreation lake will extend approximately 4.5 miles from the dam along the waterfronts of Wilkes-Barre and Kingston to a point on the river near the Wilkes-Barre/Wyoming Valley Airport in Forty Fort. The surface area of the lake will be approximately 400 acres. The width of the lake will vary between 500 and 1,100 feet and encompass one small island just upstream of Pierce Street. The average depth of the lake will be approximately 8-10 feet with the deepest area more than 25 feet deep. Five public parks will abut the shoreline including Kirby Park, River Common Park, Nesbitt Park, Riverbend Park and the downstream end of the Luzerne County Recreational Facility. Although most of the shoreline property is publicly owned, there are portions of privately owned land at the downstream and upstream ends of the lake.