Deposition **Dilemma**

Hydraulic dredging of sediment from a Pennsylvania lake

By Stephen N. Zeller & Archis Ambulkar

Sediment accumulation at the bottom of waterways can affect water quality, navigation, recreation or any other intended use of the water body. Sediment removal, therefore, is practiced to restore the water bodies' original quality, nature and appearance.

Various ongoing and proposed studies refer to the use of dredging processes for sediment removal and lake cleaning. The following is a case study of hydraulic dredging of sediment from Lake Henrietta in Lower Mifflin Township, Pa.

Sediment Situation

Lake Henrietta, a 4-acre lake on the property of the Doubling Gap Center Yolijwa campground, is used for boating, fishing and other recreational purposes. The lake sits on Doubling Gap Creek, a coldwater fishery that flows through the Doubling Gap Valley.

Doubling Gap State Park, directly upstream from Lake Henrietta, has its own lake on the same creek. The state park cleaned out its lake every two or three years to maintain its swimming areas and keep the sand beach clean—an indication of the amount of deposition occurring from the creek and surrounding areas. The sediment comprised primarily leaf material and sand from erosion of area geology.

A proposed project involved removing sediment material that had accumulated in the upper reaches of Lake Henrietta, along the west side of the lake. The pros and cons of taking no action at the lake were analyzed, and it was determined that ignoring the problem would result in additional deposition of material into the lake: Amounts were estimated to increase 30% to 40% every 10 years.

This continued deposition of sediment most likely would result in part of the lake becoming unsuitable for boating and fishing. The deposited material buildup had provided a habitat for breeding of mosquitoes and other vectors, and odor issues and septic conditions were anticipated. The sediment removal option, therefore, was pursued.

Using pumps and filter bags, workers hydraulically dredged approximately 7,000 cu yd of material from the bottom of Lake Henrietta.

Initial Analysis

Prior to the beginning of the project, an initial analysis looked at the sediment deposition depth, approximate sediment volume to be excavated and the area of lake that needed to be cleaned. This analysis indicated a sediment deposition depth of approximately 1.5 ft to 5 ft. The dredge depths were measured to estimate the depth of deposition material for the lake area, then material volume was estimated using conventional engineering estimating practices for volumetric calculations and these depth measurements. The area of the lake was estimated from a topographic survey and existing survey data for the property.

Project Prep Work

Brinjac Eng. initiated the cleanup project, and its staff conducted a preliminary assessment of the depth of material deposited onto the lake bottom. Samples of the material also were collected and analyzed.

Results indicated that the deposits were very high in organic material and low in inorganics. The deposition sampling provided a basis by which to evaluate and estimate the amount of material to be excavated in order to return the lake to its original contours. It also proved helpful in developing a scope of work for contractors who could provide this dredging service.

Based on the measurements, Brinjac calculated that more than 10,000 cu yd of material would have to be removed from the lake to return it to its original contours. Conversations with experienced dredging contractors indicated that material less than 1.5 ft in depth would not warrant the cost of removal. Revised estimates,

HYDRAULIC DREDGING

Dredging is the process of removing sediment material from waterway beds. Some of the common methods for removing sediment from a lake include:

- Draining and excavating the lake;
- Mechanical dredging; and
- Hydraulic dredging.

Hydraulic dredging involves the removal and transportation of waterway materials via sediment/water slurry. It does not require water drawdown in the lake. Rather, the dredging equipment floats on the water surface and "sucks up" sediment/water slurry from the lake with the help of centrifugal pumps, conveying it to an offsite location. The process mainly involves a barge that floats on water, a dredge unit, pumps and a discharge line. Sediment removal can be performed over an entire lake or at a specific location within the lake.

Because water is used as a medium for transportation of sediments during the dredging process, it needs to be separated from sediments at the offsite location prior to final disposal of sediment material. The various methods for separation of sediments and water include the use of a settling basin, filter bags, geotextile tubes and mechanical dewatering, for example.

After separation, the dredged sediment material needs to be disposed of. Potential options for disposal of dredged material include open-water disposal sites, upland confined disposal facilities, disposal pits and contaminated areas. Some of the options for use of dredged material include beach nourishment, habitat development, construction material, agriculture and capping open-water disposal sites.

therefore, indicated that depths greater than this amounted to approximately 7,000 cu yd of material to be removed from the lake. This volume included an island that had formed at the head of the lake as a result of sedimentation.

Discussion with the Department of Environmental Protection (DEP) and the Fish and Boat Commission indicated that the island could be removed if desired because wetlands that form within a lake due to sediment deposition were not considered jurisdictionally covered waters of the commonwealth. Regulatory agency permitting for the work in the lake was under a single waiver in accordance with Section 105.12 (A).14 of the Pennsylvania code that addressed the construction activity within a state water.

Dredging Decisions

While reviewing options for sediment removal, Brinjac focused on cost-effective dredging alternatives with minimal environmental impact. The estimated cost for hydraulic dredging work was $117,500, which included bags, pumping equipment, workers and associated equipment.

This cost was compared with that of conventional dredging of the lake by a crew of contractors with digging equipment and trucks once the lake was drained:

$180,000, not including erosion and sedimentation that was expected to drive the total up an additional $100,000 to $300,000.

The pricier conventional method would create ponds some 5 ft to 7 ft deep, which could take months or years to dewater, posing a liability to a facility that serves many thousands of able-bodied youths each year. This method also would require months of clearing woods and building a retention area and roads, then weeks to use trucks and loaders to remove sediment and transport it to a loading area for dewatering by evaporation. For these reasons, further evaluation of the conventional dredging alternatives was not pursued.

Due to the size of the lake and the drainage basin, dredging in Lake Henrietta qualified for Section 105 permit exclusion. A report needed to be submitted to the DEP for the work, but approval was four to five weeks using hydraulic dredging compared to four months for the conventional dredging permitting. Additionally, the cost for the permit application was less than that of a conventional dredging permit application.

An erosion and sedimentation control plan also was filed, showing the area in which the bags and filter fence were located. A county conservation district officer visited the site and approved the plan quickly because the bags were simply large filter bags that trap all sediment and protect the coldwater fishery creek.

Hydraulic Application

About 7,000 cu yd of material from the lake bottom was dredged, primarily in the area at the upper end and around boat docks on the west side of the lake. The hydraulic dredging technique utilized a pump to lift the material deposited on the lake bottom and transfer it to large polypropylene filter bags up to 30 ft in diameter and more than 100 ft long.

The bags contained solids while water was filtered out under pressure. Within a week or two, the material in the bags generally reached a concentration comparable to wet topsoil and was moved by backhoe and dump truck. Project design placed the bags along the lake banks so that as they dewatered the drained water flowed back into the lake.

The dredged material was expected to be compacted to less than half of its original volume. The contractor had the ability to pump the material to any location within an elevation of less than 25 vertical ft of the lake bottom at no additional cost. SWS

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