ASSESSMENT OF DREDGING SEDIMENT FROM NEWNANS LAKE TO IMPROVE WATER QUALITY

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Alachua County Environmental Protection Department
May 14, 2015

2012 aerial photo of 6,600-acre Newnans Lake and surrounding land.

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PURPOSE

The purpose of this assessment is to examine available literature and data to determine if dredging sediments from part or all of Newnans Lake would:

- result in long-term improvements to water quality,
- be justified based on data on Newnans Lake sediments and nutrients,
- be logistically feasible in terms of sediment disposal,
- be cost-effective, and
- be permittable,

and to offer alternatives to sediment dredging that could contribute to improved water quality.

BACKGROUND

Water Quality in Newnans Lake

Newnans Lake is a shallow 6,600-acre lake in Alachua County, Florida. Newnans Lake was naturally nutrient-rich for thousands of years, perhaps due to the rich source of phosphorus in the Hawthorn Group, a geologic layer at or near the surface in much of the lake's watershed (Odum 1953; Brenner & Whitmore 1998; Di et al. 2012). Over the last several decades, however, water quality in Newnans Lake has significantly declined, and the naturally clear tea-colored lake has turned turbid and green with microscopic algae.

The State of Florida considers Newnans Lake to be a Class III water body whose designated uses are recreation and propagation and maintenance of healthy well-balanced fish and wildlife populations. Water quality in Newnans Lake does not meet state standards due to excessive nitrogen and phosphorus that feed growth of microscopic algae in the lake water (Gao & Gilbert 2003). From 1995 through 2013, concentrations in Newnans Lake of total nitrogen (TN), total phosphorus (TP), and chlorophyll - a measure of algae in the water - were 3 to 4 times higher than state standards (FDEP 2014).

Current Sources of Nutrients

Degraded water quality in Newnans Lake is due to ongoing runoff of nutrients and sediments from the watershed into the lake, and perhaps to nutrient release from lake sediments.

According to FDEP's 2003 analysis of Total Maximum Daily Loads (TMDLs) for Newnans Lake, release of nutrients from lake sediments accounts for most of the nutrients in the lake - 72% of TN and 52% of TP (Gao & Gilbert 2003), while external nutrient loads from the watershed and a point source (Brittany Estates) account for only 26% of the TN and 35% of TP. FDEP assumed that sediment nutrient release was occurring in Newnans Lake from 1996-2000 (a period of record drought) because concentrations of TN and TP in water flowing into the lake were significantly lower than concentrations in flows out of the lake. Since there was no data at the time on TN and TP release from sediments in Newnans Lake, FDEP nutrient models were based on estimates of nutrient release from Lake Okeechobee sediments.

FDEPS's TMDL report recommended that watershed nutrient loads be significantly reduced – by 74% for TN and 59% for TP (Gao & Gilbert 2003). The FDEP TMDL report also recommended studies to determine if control or removal of release of TN and TP from lake sediments would significantly decrease the time it would take for Newnans Lake to meet state water quality standards.

Six years later the St. Johns River Water Management District (SJRWMD) published an analysis of Pollutant Load Reduction Goals for Newnans Lake, which included a longer period of data as well as baseflow and stormflow data from previously unsampled sites (Di et al. 2009). SJRWMD agreed with FDEP on the target trophic state for Newnans Lake and that external nutrient loads (which include the point–source of Brittany Estates) need to be significantly reduced - by 66% for total nitrogen and 48% for total phosphorus.

There was a significant difference, however, between FDEP's TMDL analysis and SJRWMD's PLRG analysis for Newnans Lake. FDEP models assumed that net nutrient release from sediments accounted for most of the TN and TP loading (72% and 52%). SJRWMD's PLRG analysis did not provide evidence of net nutrient release from lake sediments, instead finding that lake sediments were a net sink. The PLRG analysis indicated that all of the TP and 48% of the TN entered Newnans Lake from the watershed, and assumed that the remaining 52% of the TN load was from atmospheric nitrogen-fixation by microscopic algae in the lake.

The difference between the two above analysis of sources of nutrients to Newnans Lake has significant consequences for decisions on how to improve the lake's water quality. If the TMDL analysis is more correct and lake sediments are a significant net source of nutrients to the lake, then sediment dredging might be a reasonable method to pursue. If however the PLRG analysis is more correct and sediments are not a significant net source of nutrients to the lake, then sediment dredging would not be a logical method to pursue. To resolve this discrepancy and guide informed decision-making, it is hoped that FDEP will revise the Newnans Lake TMDL, since the iterative approach of the Basin Rotation Cycle allows for revising TMDLs as warranted by new scientific findings. As part of the TMDL update, FDEP will have the advantage of studies of Newnans Lake and its sediments conducted over the 12 years since the TMDL was originally developed, and of 12^{+} years of additional water quality and hydrologic data.

Nutrients of concern in Newnans Lake are both phosphorus and nitrogen. FDEP's TMDL analysis indicated that growth of microscopic algae in Newnans Lake had gradually shifted from being co-limited by both nitrogen and phosphorus, to being limited only by phosphorus (Gao and Gilbert 2003). SJRWMD's PLRG analysis also indicated nitrogen and phosphorus co-limitation of algae growth in Newnans Lake, but with nitrogen limitation during some periods (Di et al. 2009). Therefore, both nitrogen and phosphorus need to be reduced in Newnans Lake to reduce the growth of algae and improve water quality.

Previous Sources of Nutrients

Large-scale land use conversion began in the Newnans Lake watershed in the 1950s. Those new land uses likely contributed to elevated nutrients in the lake's water and sediments. Two of those early land uses, described below, are no longer in operation but may have left a legacy of nutrients stored in Newnans Lake sediments.

Nessler's Dairy operated in the 1950s adjacent to Newnans Lake, west of County Road 234 near Windsor. This dairy likely contributed significant amounts of nutrient in cow manure to Newnans Lake through surface runoff (DRMP 2003; Dale Crider, personal communication). Although the dairy is now a blueberry farm, the manure holding tank for the former dairy milking barn still exists, with a ditch draining to a tributary of Newnans Lake (Lippincott 2011).

A chicken processing plant operated for about 20 years about 3 miles east of Newnans Lake at 3540 SE Hawthorne Rd - historic aerial photos show the plant in 1956 and 1974 (Dale Crider, personal communication). This was prior to the federal Clean Water Act, which prohibits discharge of untreated effluent to surface waters, and the plant appears to have discharged processing by-product effluent to a ditch that flows to Lake Forest Creek, a tributary of Newnans Lake.

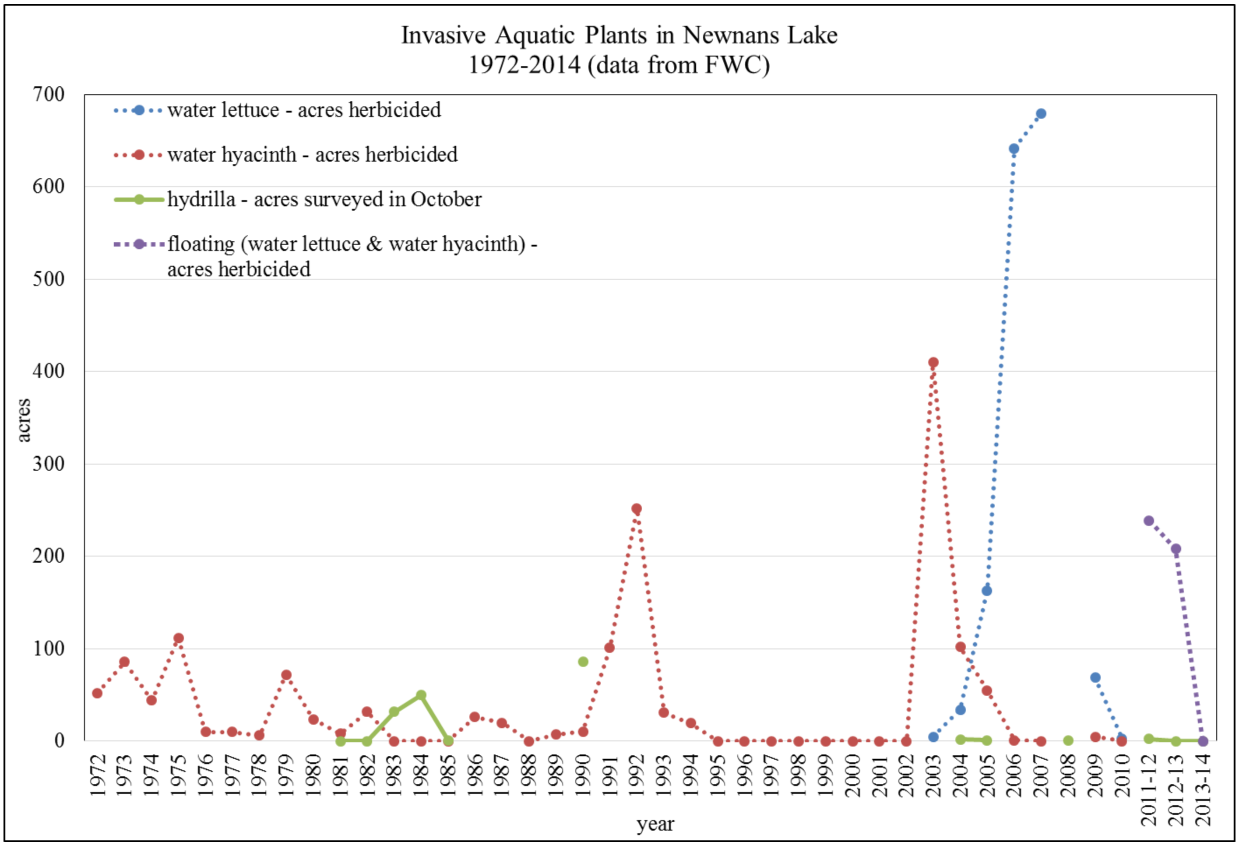
The former Sunland Training Center on Waldo Road about 3.5 miles east of Newnans Lake (now Tacachale, a state-run community for people with developmental disabilities) operated a 0.3 MGD sewage treatment plant from at least 1956 through at least 1971, until they connected to GRU's municipal wastewater treatment system. Aerial photos suggest that the plant may have discharged treated wastewater to a ditch that flowed to a creek system that flows to the east side of Newnans Lake.

Additionally, it has been speculated that draining large tracts of natural forest and conversion to silvicultural pine plantation may have resulted in accelerated runoff of phosphorus to Newnan Lake where phosphorus-rich Hawthorn materials (clays, sandy clays, clayey sands, and carbonates) were disturbed at or near the ground surface by ditching to increase runoff, bedding for new pine plantings, and pine tree harvest activities (Cohen 2008).

Potential Sources of Nutrients

Aquatic Plant Management - Large-scale simultaneous herbicide treatment of hundreds to thousands of acres of aquatic plants in lakes can release nutrients into the lake as the vegetation decays, overwhelming the lake's short-term capacity to assimilate nutrients, resulting in long-term degradation of water quality and increase in lake sediments. Large-scale herbicide treatment of aquatic plants may have contributed to degraded water quality in Lochloosa and Orange lakes (Lippincott 2011). To prevent this potential source of large-scale sudden nutrient release in Newnans Lake, it has been recommended that FWC (the state agency tasked with control of aquatic plants) prevent invasive aquatic plants from covering large areas in Newnans Lake. This could be done by regular plant surveys with application of contact herbicides to small infestations so that they do not expand. This preventative approach eliminates the need to treat large areas of aquatic vegetation at one time (Lippincott 2011).

Records of aquatic plant management on Newnans Lake over the past 42 years indicate that during some years hundreds of acres of water lettuce and water hyacinth – both floating invasive aquatic plants – have been treated with herbicide on Newnans Lake, as shown in the following chart. Hydrilla surveys in the fall showed small areas of coverage. Hydrilla in Newnans Lake is resistant to Fluridone (Sonar), a systemic herbicide used in large-scale treatments.



Newnans Lake Sediments

Newnans Lake contains approximately 20 million cubic meters of organic sediment, about half the lake volume above the sandy substrate beneath the organic sediments, with an estimated solid mass of 2 million metric tons (ECT 2002; Jain et al. 2005).

Outlet Weir and Lake Flushing - Sediment accumulation in Newnans Lake may have increased after 1966 when a concrete weir was constructed on Prairie Creek at State Road 20, reducing flushing from the lake. The weir was used in 1989 to conduct an experimental 90-day drawdown of Newnans Lake, which resulted in some nutrient removal from the lake due to flushing during pulsed discharges (Gottgens & Crisman 1992). Boards in the notch of the weir were permanently removed in 1991 to allow more natural lake level fluctuations. The Florida Department of Transportation removed the weir during construction of a new SR 20 bridge in 1999. An interagency group convened in 2007 to evaluate a request to dredge a channel through Prairie Creek and into the deeper-water portion of Newnans unanimously (which would have increased lake flushing) agreed that dedicating public funding to dredge Prairie Creek into Newnans Lake did not provide sufficient public benefits to offset potential environmental impacts and agency resources required to address permitting issues.

Sediment and Nutrient Accumulation - Before decisions are made to remove lake sediments, it would be useful to understand the rate at which sediments are accumulating due to watershed loading, which could eventually negate the effects of dredging. As background, sedimentation in lakes is a natural process that leads to the slow accumulation of material on the lake bottom. Lake sediment cores are a source of information about the watershed, such as vegetation type, geology, and changes in land use over time. For example, pollen in Newnans Lake sediments indicate that the lake began as a grassy marsh and is 5,000–8,000 years old (Holly 1976).

As lake sediments build up they accumulate and store nutrients in organic matter, and are typically net sinks for nutrients when undisturbed. Sediment nutrient accumulation rate is proportional to and most strongly influenced by nutrient concentration in the overlying lake water (Brenner and Whitmore 1998).

A study of historical sediment and nutrient accumulate rates in Newnans Lake indicate that surface sediments in Newnans Lake are richer in organic matter than most Florida lakes (Brenner & Whitmore 1998). Sediment and nutrient accumulation rates were highest in Newnans Lake about 1900, followed by a decline over the next several decades, and then a rise to much higher rates in the late 1900s (Brenner & Whitmore 1998).
The mass sedimentation rate in Newnans Lake rose through the 20th century, with highest rate in the late-1990s (just prior to the study), when it averaged 0.056 g/cm^2/yr. Over the 20th century the average net linear sedimentation rate in Newnans Lake was 0.57 cm/yr. Based on this estimate, 20 years after dredging the entire lake, Newnans Lake could have re-accumulated at least 5 inches of new sediment weighing about 300,000 metric tons.

A 2010 study of phosphorus release and settling in Newnans Lake sediments was an intriguing yet inconclusive initial examination (Cohen et al. 2010). Net release of phosphorus from sediments was highly variable across the lake. Models predicted that phosphorus accumulation in sediments (settling from lake water) to be extremely low in Newnans Lake. The authors speculated several reasons for an unusually low phosphorus accumulation rate: sediment disturbance by fish feeding; large post-drought release of a phosphorus deposit that resulted when the lake was stabilized by an outlet weir; and weathering of Hawthorn-derived materials that either eroded into the lake from the watershed or lie just beneath the lake. These findings do not provide compelling evidence that dredging sediments will reduce nutrient release to the lake.

Sediment Resuspension and Nutrient Release – Undisturbed organic sediments in lakes are typically a net sink for nutrients, storing nutrients that are largely unavailable to the lake water. If lake sediments are resuspended by wind, feeding by fish and other aquatic animals, or human activities, nutrients may be released to the lake water.

To determine if wind and waves cause significant sediment suspension and nutrient release in Newnans Lake, data were collected for 9 months in 2004, during which 2 tropical storms passed over Newnans Lake (Jain et al 2005). A temporary platform was installed in the lake to collect data on wind speed and direction, sediment suspension, and water quality. Data indicated that wave action in Newnans Lake is limited by shallow depth and short wind fetch. This investigation concluded that suspended sediment in the water column consisted mostly of fine organic material with a density close to water, derived from the upper 1 mm or less of the sediment layer. The data indicated little interaction between the remaining 2 meters of lake sediment and the water column. The study concluded that wind speed was not correlated to nutrient concentration in Newnans Lake – that sediment resuspension was not a significant cause of water quality degradation, providing evidence that dredging sediments may not be necessary to improve water quality.

Resuspension of lake sediment by fish and other aquatic organisms can result in release of nutrients from disturbed sediments that are immediately assimilated by microscopic algae in the lake water, stimulating growth of the algae. Because large numbers of bottom-feeding gizzard shad were harvested in sampling nets in 2009, shad disturbance of sediments was speculated to be a contributor to growth of algae in Newnans Lake. As a result, the St. Johns River Water Management District in 2010 conducted the first year of a planned 3-year experiment to reduce the number of gizzard shad in Newnans Lake. The goal was to improve lake water quality by reducing resuspension of lake sediments due to gizzard shad feeding, reducing release and recycling of nutrients from disturbed surface sediments. While 205,188 pounds of fish were harvested that year, effect of the shad harvest on water quality could not be estimated until after 3 years of fish harvest. Due to budget and staffing cuts, the shad harvest project was discontinued after year 1.

Newnans Lake Archeological Resources

When extreme drought in spring & summer 2000 exposed the bottom of Newnans Lake (formerly known as Lake Pithlachocco), 93 prehistoric dugout canoes and associated artifacts were found in the lake sediments - the largest collection of prehistoric watercraft ever discovered in North America. The 53 canoes excavated and studied by archeologists with the Florida Division of Historical Resources indicated that the canoe builders used a variety of construction techniques. Radiocarbon dates of 52 canoes ranged from 500 to 5,000 years old, placing them in the Middle and Late Archaic and Alachua Periods. The Florida Division of Historical Resources believes it is very likely that additional canoes and other cultural resources exist throughout Newnans Lake.

As a result of this significant archeological discovery, in 2001 the Florida Division of Historical Resources determined that all of Newnans Lake is eligible for nomination for the National Register of Historic Places. In March 2001, the “Lake Pithlachocco Canoe Site” was listed on the National Register (file # 8AL4792), warranted because the site yields important information about prehistoric fishing and maritime practices and people since the canoes were built over a 4,500- year period. As well, few other prehistoric canoes in Florida have been recorded in situ, so Newnans Lake affords the opportunity to study prehistoric watercraft in the context in which they were built and used. The Seminole Tribe of Florida actively and strongly supported the National Register nomination.

Concurrent with the canoe discovery in 2000, the Florida Department of Environmental Protection issued a permit for a private company to drag sunken logs from Newnans Lake’s exposed lake bottom using heavy equipment, referred to as “deadhead logging”. This activity destroyed at least 7 of the prehistoric dugout canoes and was strongly opposed by the Seminole Tribe of Florida. In 2002 the Governor and Cabinet unanimously voted to prohibit deadhead logging on Newnans Lake.

Also during the 2000 drought, the Florida Fish and Wildlife Conservation Commission (FWC) proposed to scrape exposed organic sediments along the Newnans Lake shoreline from Powers Park to Prairie Creek, and to deposit them in piles in the same area of the lake. The desired outcome was to prevent formation of vegetated floating tussocks as the lake refilled. The Florida Division of Historical Resources reviewed FWC’s proposal as part of the state permitting process, and recommended that FWC withdraw the project because of the possibility of adverse impacts to ancient canoes and other buried archeological resources. The Seminole Tribe of Florida also objected for the same reasons. FWC withdrew the project proposal.

Management Plans for Newnans Lake

There are 3 current plans to improve water quality and aquatic habitats in Newnans Lake, all developed with input from stakeholders. In accordance with the Florida Watershed Restoration Act, the Florida Department of Environmental Protection (FDEP) convened the multi-stakeholder Orange Creek Basin Working Group, which developed a management action plan to restore water quality in Newnans Lake and other impaired water bodies to state standards (FDEP 2008). The 2008 Orange Creek Basin Management Plan (OCBMAP) contains several projects that broadly address release of nutrients from Newnans Lake sediments.

The second plan, the Orange Creek Basin Surface Water Improvement and Management (SWIM) Plan, was developed in 2011 by SJRWMD with input from various stakeholders (Lippincott 2011). This plan contains projects to reduce watershed nutrient loads to Newnans Lake and does not contain any projects addressing Newnans Lake sediments.

The third plan, Phase 2 of the OCBMAP, is an update to the 2008 OCBMAP and was prepared by the FDEP-convened Orange Creek Basin Working Group. Phase 2 of the OCBMAP says that the discrepancy between the FDEP TMDL and SJRWMD PLRG regarding nutrient release from sediments will be resolved during the second BMAP cycle. This is critical so that limited lake management funds are spent where they will improve water quality.

The Phase 2 OCBMAP also says that "Dredging is one mechanism to remove nutrients stored in sediment that contribute to internal recycling, but because of significant cultural resources (wooden dugout canoes) buried in the bottom of the lake, dredging is not a feasible option. Additionally, without eliminating the sources of excess nutrients, dredging becomes a temporary solution" (FDEP 2014).

None of the above 3 plans recommend lake-sediment dredging as a tool for improving water quality in Newnans Lake. This assessment is intended to familiarize stakeholders with information and studies of Newnans Lake and similar Florida lakes to help them address any future recommendations regarding sediment dredging in Newnans Lake to improve water quality.

ASSESSMENT

Potential for Sediment Dredging to Improve Water Quality

As shallow lakes naturally age, they accumulate organic sediments containing nutrients. Human activities such as sewage discharge and stormwater runoff accelerate lake aging by increasing the rate of deposition of sediments in the lake bottom. In lakes with extensive deep layers of nutrient-rich sediments, release of nutrients from sediments can, under certain circumstances, be a significant source of nutrients to the lake. Sediments nutrient release can either be a source of internal nutrient loading to the lake or a source of internal nutrient recycling in the lake (see text box for definitions).

An extensive review of dredging as a restoration tool for lake water-quality improvement concluded that reducing external (watershed) nutrient loading prior to dredging is the most important factor associated with success of dredging to improve water quality (Mactec 2007). In cases where dredging was done without prior significant reduction in external nutrient load, water quality benefits of dredging were temporary or non-existent.

Dredging of lake-bottom sediments has been done in lakes around the world for various reasons – to improve depth for navigation and recreation, increase flushing, improve aquatic habitats, remove contaminated sediments, and/or improve water quality. Dredging to reduce release of nutrients from sediments has been attempted in lakes with mixed results. During dredging, temporary resuspension of sediments and degradation of water quality often occurs, and can be reduced with selection of appropriate dredging equipment used by a skilled operator.

Success of dredging at reducing nutrient release from sediments requires that prior to dredging, the potential for success is objectively evaluated based on lake-specific data. Pre-dredging feasibility analyses should include:

- sedimentation rates,
- water residence time (flushing rate),
- sediment distribution and depth,
- sediment particle size, organic content, bulk density,
- nutrient release rates at various depths,
- toxic contaminants in sediments, and
- external nutrient loading sources and rates.

Problems inherent in dredging include nutrient release from dredged sediments, liberation of toxic materials such as trace elements and organic pesticides, oxygen depletion, and impacts to fish and wildlife habitats and benthic fauna. Another major uncertainty pertains to redistribution of loose and nearshore sediments from undredged areas into dredged areas.

There are few case studies of lakes where sediment dredging alone or prior to reduction in watershed nutrient loading resulted in significant and long-term water-quality improvements. A 1988 analysis by the North American Lake Management Society of dredging projects showed a high potential for negative impacts during and for a period after dredging due to re-suspension of sediments (Moore & Thornton 1988).

Failure of dredging to provide long-term improvement in lake water quality has been the result of inadequate pre-dredging feasibility studies, continuation of external (watershed) nutrient loading, high sediment resuspension during dredging, and the misunderstanding that dredging alone can restore water quality.

Feasibility studies for sediment dredging from the two largest lakes in Florida - Lake Apopka and Lake Okeechobee - resulted in decisions not to dredge (Pollman et al 1998; Reddy et al. 2002). For Lake Okeechobee, a 470,000-acre lake in south Florida, a scientific and engineering study evaluated options to reduce phosphorus in sediments. Dredging was rejected as a management option because removal of all sediments was prohibitively expensive (~ $3 billion), and dredging of only a portion of the sediments would allow phosphorus to continue to be released to the water column from remaining sediments (Reddy et al. 2002).

For Lake Apopka, a 30,800-acre lake in central Florida, a thorough feasibility analysis was conducted on dredging to improve degraded water quality (Pollman et al 1998). Dredging costs for Lake Apopka were based on removing much of the loose upper sediment layer - approximately 25,700 acres with a volume of 121 million cubic meters of sediment, a full-time operation that would take 6 years to complete. Total dredging costs, not including purchase and clearing of a disposal and storage site, was estimated at $868,800,000 or $7/m^3$ of dredged sediment. If Lake Apopka sediment could be sold as a potting medium for the ornamental horticulture industry, then total project cost might be reduced to $771,400,000. A significant uncertainty in dredging of Lake Apopka pertained to redistribution of loose and nearshore sediments from undredged areas into dredged areas. Over multi-year span of the project, redistribution was considered very likely, negating much of the water-quality benefits of dredging.

The FWC dredging project on Lake Panasoffkee in central Florida is sometimes cited as an example of success. From 2004-2008 FWC removed 8 million cubic yards of sediment at the cost of $26 million. The project goal, however, was not water quality improvement, and water quality did not improve as a result of dredging. The goal of the Lake Panasoffkee dredging was improve to fisheries habitat and navigation.

Sediment Dewatering and Disposal

Lake sediment removal involves dredging sediments followed by sediment dewatering and disposal of dried sediment. Sediment dewatering and disposal require purchase or lease of land near the dredging site.

In dredging projects to improve lake water quality, the goal is to permanently remove sediment-bound nutrients from the lake. The process of dredging disturbs sediments, releasing nutrients to water in the dredged slurry. Permanently removing nutrients from the lake therefore means removing the dredged sediments as well as the nutrient-enriched slurry water, allowing neither to return to the lake.

One method for permanently removing sediments and slurry water from a lake as part of a dredging project is to construct large lined and bermed evaporation ponds. Dredged material is transported, often by pumping depending on dredging equipment used, to the nearby evaporation ponds, where fine sediment slowly settles. The lined ponds contain the nutrient-rich slurry water (supernatant) until it evaporates, so that the nutrient-rich water is not discharged back to the lake or allowed to seep into groundwater. When dredging is complete, the dried sediment is trucked to other locations or used on-site for beneficial purposes. Finally, the disposal site is often rehabilitated to some other land use according to permit conditions.

A challenge in the technical feasibility of dredging part or all of Newnans Lake may be availability of a suitable and sufficiently large sediment dewatering and disposal site near the lake shore.

Costs of Sediment Dredging

Dredging project costs include:

- pre-dredging feasibility analysis and data collection;
- planning of dredging techniques;
- designing a sediment disposal site;
- purchasing or leasing a sediment disposal site;
- constructing a sediment disposal site;
- project permitting;
- purchase or lease of dredge equipment, pumps and other equipment;
- labor, fuel, and monitoring during and after dredging;
- and rehabilitation of the sediment disposal site after dredging is completed.

Cost is primarily governed by amount of sediment to be dredged, sediment characteristics, and distance to the sediment disposal site. Dredging cost increases in larger lakes are non-linear because of increased transportation or pumping costs as a result of increased distance from the dredge site to the disposal site.

Costs of dredging Florida lakes have varied widely because of differences in type of dredging equipment, skill of dredge operators, productivity rate, type and amount of sediment, dredging depth, ecological considerations, method of transport to the disposal site, and type of sediment disposal. Cost estimates made by the U.S. Environmental Protection Agency 22 years ago for dredging uncontaminated sediments ranged from \$1 to \$25/m^3.

Using 1998 cost estimates of dredging Lake Apopka, it would cost \$140 million to dredge all of the 20 million cubic meters of sediment from Newnans Lake, plus the cost of purchasing or leasing and constructing a disposal site (Pollman et al. 1998).

Permits

Federal, state and Alachua County permits would be required to remove sediments from Newnans Lake, dewater sediments on adjacent land, and dispose of dewatered sediments.

Removing sediments from Newnans Lake would require a US Army Corps of Engineers (Corps) dredge-and-fill permit. Section 106 of the National Historic Preservation Act requires that the Corps and the Florida Division of Historical Resources assess the project's potential to adversely affect (damage) significant historic resources that are eligible for or listed on the National Register of Historic Places. In order for a permit to be issued, the benefits of sediment dredging would have to outweigh potential damage to archaeological resources. In addition, any Native American tribe with a geographic interest in the area, such as the Seminole Tribe of Florida, has a legal right to participate in the Corps permit review process.

CONCLUSIONS

Several lines of evidence - the 1998 University of Florida study of historical sediment and nutrient accumulate rates, the 2005 University of Florida report on sediment suspension and nutrient loading, and the 2009 SJRWMD PLRG analysis - indicate that net release of nutrients from sediments is not a significant component of the Newnans Lake nutrient budget. This argues against sediment dredging to improve water quality.

Dredging is not a proven tool to improve lake water quality. The most important proven management tool for improving lake water quality in Newnans Lake is to reduce external (watershed) loading of nutrients.

Dredging part or all of Newnans Lake sediments would be extremely or prohibitively expensive. A suitable nearby sediment disposal site is not likely to be found because most of the lake is surrounded by cypress wetlands, conservation lands, upland archeological sites, and residential properties.

Dredging of sediments from any portion of Newnans Lake would likely disturb or destroy archeological resources – primitive dugout canoes and associated relics – and would likely be strongly opposed by the Seminole Tribe of Florida and other stakeholders.

ALTERNATIVES TO SEDIMENT DREDGING

There are several alternatives to sediment dredging that could be investigated in order to improve water quality in Newnans Lake.

1. Reduce External Nutrient Loading –External nutrient loading has inarguably contributed to degraded water quality in Newnans Lake. Reducing external nutrient loading can only be beneficial, although it may be more effective when combined with other water-quality improvement projects.

2. Prevent Expansion of Invasive Aquatic Plants - To avoid sudden release of large quantities of nutrient into Newnans Lake due to large-scale decay of vegetation treated with herbicide, FWC should continue their management of water lettuce and water hyacinth at the lowest feasible level, and should attempt to control hydrilla in Newnans Lake, when it appears, at the lowest feasible level using the regular surveys and early spot treatment.

3. Reduce Sediment Disturbance by Fish – If sampling shows that there are large numbers of gizzard shad in Newnans Lake, it may be worthwhile to conduct a shad harvest, prior to start of other water-quality improvement projects, to determine if water quality improves during the shad harvest.

4. Reduce Water Residence Time – Increasing the rate at which Newnans Lake flushes may have a positive impact on water quality, although it would lower average lake stage. Current water residence time in Newnans Lake is estimated to be 0.69 year (Di 2009; Lin 2009). Flushing might be increased by dredging to remove the sand sill at Prairie Creek (the outlet of Newnans Lake), combined with confirming that all of the concrete weir in Prairie Creek is actually removed. Obstacles are significant and include public acceptance of lower lake level resulting from removal of the sand sill, disturbance of archeological resources in the lake sediments, high cost of dredging, negative impacts to water quality, and logistics and cost of dewatering and disposal of dredged sediment.

   Consultation (~ $10,000 or less) with an expert in fluid and sediment dynamics who has worked on Newnans Lake sediments, such as Dr. Ashish Mehta at University of Florida, might provide a professional opinion (with minimal data collection or modelling) on whether limited dredging to increase lake flushing would be likely to provide long-term improvements to water quality. If so, the next step needed to justify the project would be a full-scale feasibility assessment, with substantial data collection and modeling, to determine if increased flushing had a high likelihood of providing long-term improvements to lake water quality.

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