

**Port Sedimentation Solutions for the
Tennessee-Tombigbee Waterway in Mississippi
Report 1: Preliminary Evaluation**

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EXECUTIVE SUMMARY

Sedimentation of the navigation channel and ports on the Tennessee-Tombigbee Waterway has averaged over 800,000 yd³ per year since completion of the Waterway. The standard solution for the past 17 years has been to dredge the accumulated sediment and place it in upland confined disposal sites. That solution has become less effective as dredging costs have risen and dredging contracts have become more difficult to obtain.

Sedimentation of waterways is a natural and ubiquitous phenomenon, and artificially deepened navigation facilities often accumulate sediment faster than waterways of natural depth. Engineering solutions that reduce or eliminate the excess sedimentation are available, and, if they can be designed to be economical, effective, and environmentally sustainable, may offer viable alternatives to dredging. Design of engineering solutions tends to be unique to each site's characteristics – facilities' size and layout, waterway hydrography, flows, and sediment supply and characteristics, but they can be classified by the basic mechanisms that they employ into three methods: those that keep sediment out, those that keep sediment moving, and those that remove sediment after it has deposited.

Sediment supply to the Divide Cut and Canal sections is relatively low, but the Waterway bed continues to be a source for resuspension and movement, which can cause port sedimentation problems. Sediment supply to the River section is sufficient to cause port and waterway sedimentation problems at any location where the capacity to transport sediment is smaller than the depositable sediment supply.

Five of the six public ports on the Waterway have experienced sedimentation problems. The sixth port, Yellow Creek, has not experienced excessive sedimentation at its primary location.

Based on the limited available data, sedimentation sources and mechanisms acting in the Waterway ports can be preliminarily categorized as:

- Vessel-resuspended bed sediment from the Waterway and port approaches moves into the port and deposits.
- Sediment transported from upstream into and through the port during high flow events deposits.
- Other mechanisms contribute sediment (slumping, piping, etc.).

The engineering solutions with the greatest likelihood of success for reducing sedimentation from vessel resuspension include:

- Methods that keep sediment out.
 - Stabilizing sediment sources.
 - Blocking sediment entry.

Port Sedimentation Solutions

- Methods that keep sediment moving.
 - Devices that increase tractive forces on the bed.
- Methods that remove deposited sediment
 - Dredging.
 - Agitation of deposits.

The engineering solutions with the greatest likelihood of success for reducing sedimentation from transportation from upstream include:

- Methods that keep sediment out.
 - Stabilizing sediment sources.
 - Diverting sediment-laden flows.
 - Trapping sediment before it enters.
- Methods that keep sediment moving.
 - Structural elements that train natural flows.
 - Designs that reduce cohesive sediment flocculation.
- Methods that remove deposited sediment.
 - Dredging.
 - Agitation of deposits.

It is recommended that:

- Task II of the Scope of Work be performed
- Data collection and analyses be focused on two or three ports, one in the Canal section and one or two in the River section of the Waterway.
- Findings from those two or three ports be extrapolated to the other Waterway ports.

PREFACE

The work described here was performed by the Civil Engineering Department of Mississippi State University with funding and guidance from the Mississippi Department of Transportation (MDOT) under the Engineering Services Master Agreement.

Mr. Wayne Parrish served as MDOT proponent and liaison during the performance of Task I and preparation of this report. Messrs. Marlin Collier, Randy Beatty, and James Moak provided valuable advice, guidance and reviews.

We express our thanks to the port officials and others who provided invaluable data and observations – Messrs John Hardy, Perry Lucas, William Tisdale, Louis Burroughs, Thomas Griffith, Frank Peeler, Timothy Weston, Eugene Bishop, and Kirby McRae. Special thanks go to Messrs. Al Wise, Allan Brewer and staff of the Corps of Engineers Tenn-Tom Waterway Management Center and Doug Otto and Maurice James of the Corps of Engineers Mobile District for their expert advice and information.

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CHAPTER 1. INTRODUCTION

Purpose

The purpose of this work is to determine if there are feasible, affordable engineering solutions to reduce or eliminate dredging requirements at docks and mooring areas at the Mississippi public ports on the Tennessee-Tombigbee Waterway.

This report presents a brief description of the Tennessee-Tombigbee Waterway; a description of some engineering alternatives to sedimentation problems; a preliminary evaluation of the six public ports, including a history of sedimentation and dredging; an assessment of sedimentation processes affecting each port; and a preliminary assessment of whether engineering alternatives may be viable options for relief of sedimentation at each port.

The purpose of this report is to provide information that can be used to select ports for further examination in Task II of the Scope of Work (see Appendix).

Background

The Tennessee-Tombigbee Waterway (Tenn-Tom), shown in Figure 1, was completed in 1984, and both public and private organizations have built ports and terminals along the Waterway. Six publicly owned ports – Yellow Creek Port, Port Itawamba, Port of Amory, Port of Aberdeen, Clay County Port, and Lowndes County Port – are located on the Waterway. Sedimentation near the docks and mooring areas of these ports hinders barge access and sometimes requires that barges be only partially loaded. While the U.S. Army Corps of Engineers has responsibility for dredging of the navigation channel, the Corps does not dredge the docks or mooring areas. Each port authority (city, county, or state) must acquire its own dredging services. Small dredging jobs are often difficult or expensive to acquire. Sometimes the port authority can add port-funded dredging to a Corps contract, but not always. Even the Corps has experienced difficulty in recent years in acquiring dredging services at reasonable rates.

One possible alternative to the port dredging challenge is for the Mississippi Department of Transportation (MDOT) or other organization to take the lead in the purchase of a dredge, with the purchase, operation, and maintenance cost shared by the port authorities, and determination of cost/benefits of that alternative are part of this work which will be reported later.

Scope

This report covers Task I of the Scope of Work — a brief review of the extent and nature of sedimentation problems in the ports and a preliminary evaluation of possible engineering solutions to those problems.



Figure 1. The Tennessee-Tombigbee Waterway (Courtesy of the Tennessee-Tombigbee Waterway Development Authority)

CHAPTER 2. TENNESSEE-TOMBIGBEE WATERWAY

The Tennessee-Tombigbee Waterway is a 234-mile-long inland waterway providing a navigation connection between the Tennessee River (and thus the Cumberland, Ohio, and Mississippi Rivers) and the Gulf of Mexico via the Black Warrior-Tombigbee Waterway and Mobile Bay. It passes through Mississippi and Alabama as shown in Figure 1. Constructed by the U. S. Army Corps of Engineers, it was completed in 1984¹.

The Waterway consists of three distinct sections — River, Canal, and Divide Cut — as shown in Figure 2. The River portion extends upstream from Mile 217, where the Waterway connects to the Black Warrior River, to Mile 356 near Amory, Mississippi, generally following the course of the Tombigbee River. The Canal section starts at Mile 356 and departs from the Tombigbee River course to trend generally northward to Jamie Whitten (Bay Springs) Lock and Dam at Mile 412. The Divide Cut section connects the Canal section to the Tennessee River at Pickwick Lake near the Mississippi-Tennessee boundary.

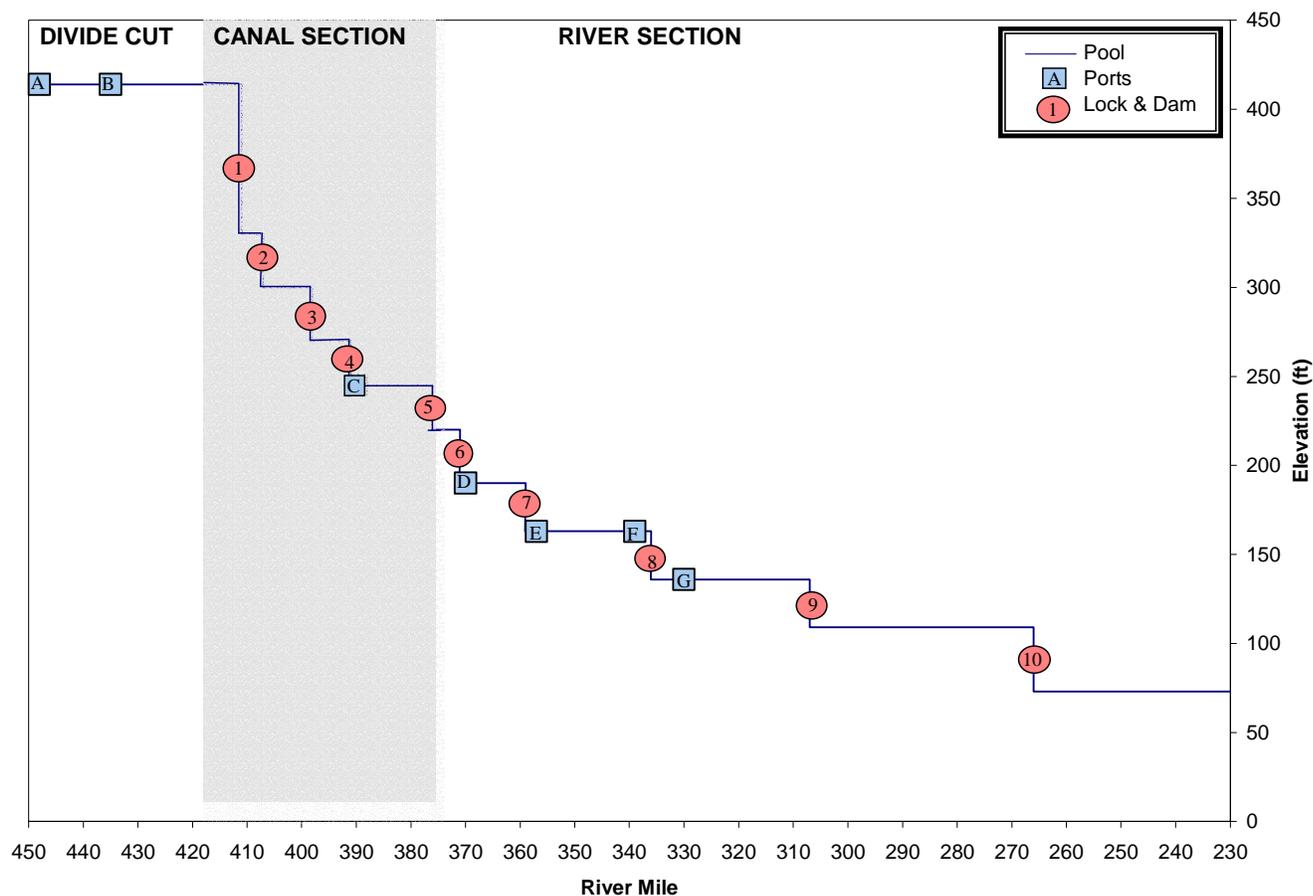
The 149-mile-long River section lies within the Tombigbee River flood plain and generally follows the course of the river. A number of river meanders have been cut off, leaving 71 miles of meander loops that are still connected to the Waterway. Four lock and dam structures raise the water level a total of 117 ft. The navigation channel has a bottom width of 300 ft and dredged depths of 9 or 12 ft plus 1 ft of allowable overdepth dredging. Numerous tributaries drain into the River section, bringing significant quantities of sediment.

The 46-mile-long Canal section is located near the eastern edge of the Tombigbee River floodplain and was formed by constructing a levee to serve as the western boundary of the section while natural high ground serves as the eastern boundary. Five pools result in a chain-of-lakes configuration to provide navigable depths with a 300-ft-wide by 12-ft-deep channel. Inflow to the Canal section is limited to discharges from Whitten Lock and Dam and small tributaries on the eastern edge of the floodplain.

The Divide Cut section connects the separate river basins by a excavated cut through the basin divide and extends 39 miles from Bay Springs Dam to Pickwick Lake. The navigation channel has a bottom width of 280 ft and a depth of 12 ft during minimum (winter) pool on Pickwick Lake. Inflows to the section consist of minor local inflows and flow from Pickwick Lake to replace water released downstream at Bay Springs Dam.

Table 1 lists the pools and structures of the Waterway and their dimensions. Each dam forms an upstream pool, which in some cases has the same name as the dam. Annual water flow through the Waterway consisting of natural flows plus an estimated 11 lockages per day are shown in Table 2.

¹ Information in this section was drawn from materials of the Corps of Engineers and the Tennessee-Tombigbee Waterway Development Authority and from a special issue of *Environmental Geology and Water Sciences*, Vol 7, Nos. 1/2, 1985. A partial list of source materials is shown in the Bibliography.



PUBLIC PORTS (River Mile)

- A. Yellow Creek Port (448)
- B. Burnsville Port (435)
- C. Port Itawamba (390)
- D. Amory Port (370)
- E. Aberdeen Port (357)
- F. Clay County Port (339)
- G. Lowndes County Port (330)

LOCK AND DAM

- 1. Jamie Whitten (Bay Springs)
- 2. GV 'Sonny' Montgomery (Lock E)
- 3. John Rankin (Lock D)
- 4. Fulton (Lock C)
- 5. Glover Wilkins (Lock B)
- 6. Amory (Lock A)
- 7. Aberdeen
- 8. John C. Stennis (Columbus)
- 9. Tom Bevill (Aliceville)
- 10. Howell Heflin (Gainesville)

Figure 2. Structures, Public Ports, and Pool Elevations on the Tennessee-Tombigbee Waterway

Prior to construction of the Waterway, the Tombigbee River carried an estimated 2.39 tons of sediment per year at Gainesville, Alabama.² Table 3 shows 50 percent suspended sediment concentration exceedance levels (half the time concentrations were lower and half the time concentrations were higher) at several measurement stations on the Tombigbee River before construction of the Waterway.

Total maintenance dredging quantities for the Waterway from 1985 through 2001 are given in Table 4 and Figure 3. These figures do not include port and terminal dredging quantities.

Table 1. Tennessee-Tombigbee Waterway Navigation Components

Section	Total Length (mi)	Channel Width (ft)	Channel Depth (ft)	Locks (Pool) 110 ft. wide x 600 ft. long each	Lift (ft)	Normal Pool (ft)	Water Surface (acres)
River	149	300	9	Gainesville Lock and Dam (Gainesville)	36	109	6,400
				Bevill Lock and Dam (Aliceville)	27	136	8,300
				Stennis Lock and Dam (Columbus)	27	163	8,900
				Aberdeen Lock and Dam (Aberdeen)	27	190	4,121
Canal	46	300	12	Amory Lock (Pool A)	30	220	914
				Lock B (Pool B)	25	245	2,718
				Fulton Lock (Pool C)	25	270	1,642
				Rankin Lock (Pool D)	30	300	1,992
				Montgomery Lock (Pool E)	3	330	851
Divide	39	280	12	Whitten Lock (Bay Springs)	84	414	7,645
Total	234				341		43,483

² Flow and sediment data cited here and in Tables 2 and 3 were taken from Hydrology, Hydraulic, and Sediment Considerations of the Tennessee-Tombigbee Waterway. Underwood, Kenneth D. (US Army Corps of Engineers, Mobile, AL, USA); Source: *Environmental Geology and Water Sciences*, v 7, n 1-2, 1985, p 69-90.

Table 2. Average Annual Flows, 1000 acre-ft

Pool	Upstream Inflow	Local Inflow	Discharge outside the Waterway
Bay Springs	301	270	0
Pool E	571	70	51
Pool D	590	32	15
Pool C	607	40	0
Pool B	647	447	163
Pool A	931	23	7
Aberdeen	2,744	2,494	0
Columbus	5,238	1,586	0
Aliceville	6,824	689	0
Gainesville	7,315	—	0

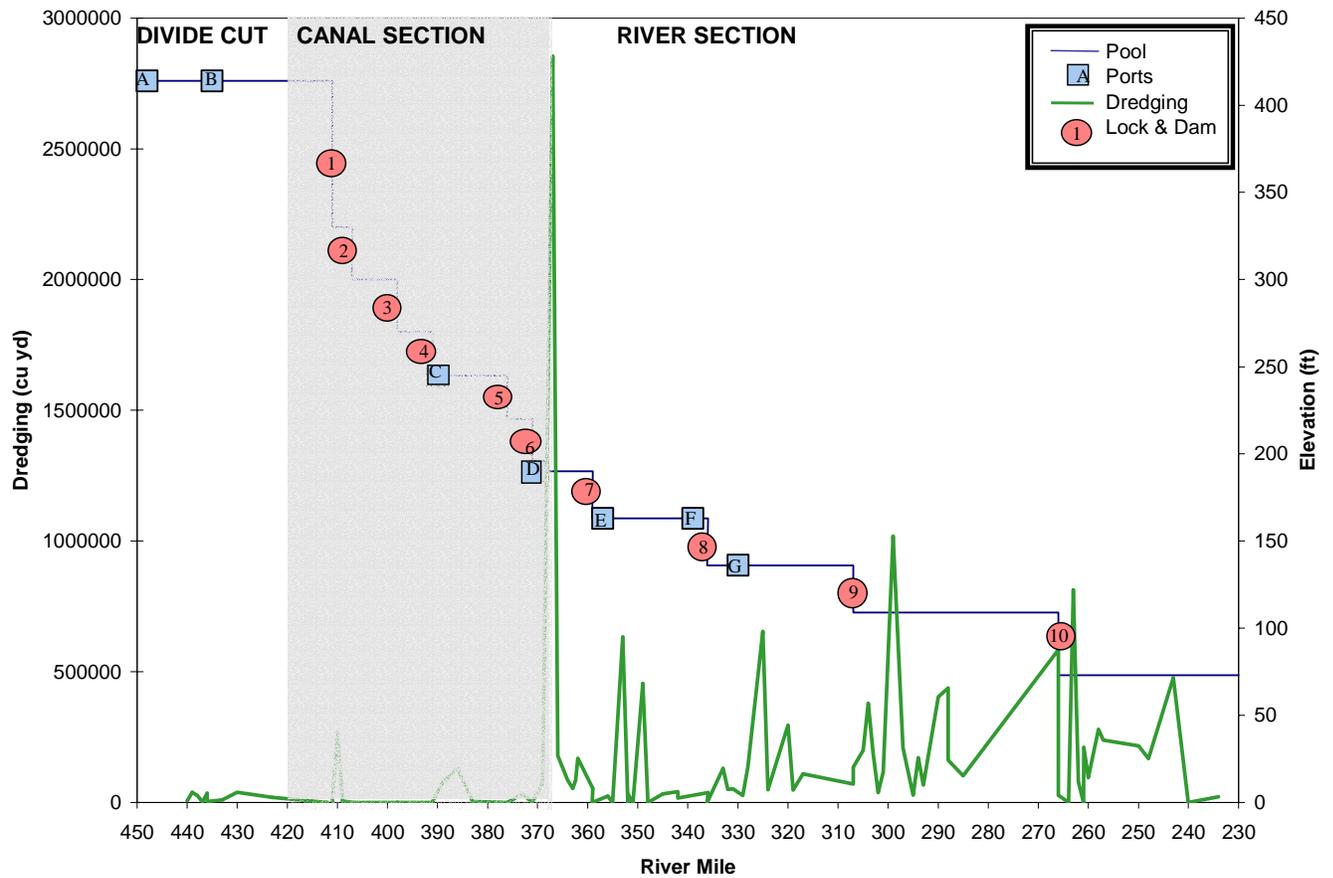
Table 3. 50 Percent Exceedance Suspended Sediment

Location	Concentration (mg/l)	Load (tons/day)
Fulton	129	129
Amory	81	252
Aberdeen	78	258
Columbus	66	400
Aliceville	74	620
Gainesville	37	447

Table 4. Dredged Quantities 1985 through 2001

Pool	Dredged Volume (yd ³)
Aliceville	1,619,807
Columbus	1,269,829
Aberdeen	3,550,085
A	30,652
B	209,216
C	0
D	0
E	275,393
Bay Springs	177,132
Total	14,028,705

Port Sedimentation Solutions



PUBLIC PORTS (River Mile)

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Figure 3. Pools and Dredged Volumes for Tennessee-Tombigbee Waterway

CHAPTER 3. SEDIMENTATION AND ENGINEERING SOLUTIONS

Sediment and Sediment Behavior

Sediment, consisting of rock, mineral, and shell fragments plus organic materials, is naturally present in streams, rivers, lakes, estuaries, and ocean waters. It makes up the bed and banks of those water bodies, and flowing water transports it from place to place until it deposits. Some waters contain small amounts of sediment that are nearly invisible, while others contain so much sediment that the water becomes a chocolate brown. Visibility of the sediment also depends on how the water transports it. The nature and amount of the sediment and the flow determine whether the sediment is transported along the bed or suspended higher in the water.

Waterborne sediment is a valuable resource. Deposited on a river's floodplain, it forms rich farmland such as the Mississippi Delta between Memphis and Vicksburg. Sand and gravel deposits in rivers and ancient river courses provide construction materials. Some aquatic species, ranging from tiny daphnia to sturgeon, thrive in high levels of suspended sediment. Along coastlines, sediment deposits build land and marshes that protect against flooding and offer productive habitat for aquatic species. Having too little sediment in a waterbody can be both economically and environmentally damaging. The most dramatic example of such damages is coastal Louisiana, where several square miles of land are lost each year because of diminished sediment supply from the Mississippi River.

Despite its resource value, too much sediment or the wrong kind of sediment can also cause economic and environmental damage. For example, muddy deposits on gravel bars can kill mussels and fish eggs, and floodborne sediment can bury farms and damage homes. Of particular interest here, sediment deposited in ports and navigation channels reduces the water depth available for commercial and recreational vessels, increasing costs, decreasing profits, and making waterways less safe.

Waterborne sediment can be classified by size of the primary grains, from largest to smallest, into boulders, cobbles, gravel, sand, silt, and clay. Larger sizes move mainly by rolling, sliding, or hopping along the bottom only when the water is moving swiftly; whereas, finer sizes and organic materials move in suspension throughout the water column. Sizes in the middle may move in either or both modes, depending on the water flow and bottom configuration. Sand-sized (grain diameter greater than 0.062 mm) and larger particles are noncohesive, so they move nearly independently of other particles. Because they are relatively large, they settle very rapidly to the bottom when flow slows down or stops. Clay particles are tiny (grain size 0.004 mm and smaller), so they tend to stick together (flocculate) and move as aggregates of many individual grains. They may settle very slowly, even in quiet water. Silt, falling between sand and clay in size, may behave either like sand or like clay. Organic materials include plant and animal detritus. They settle very slowly and may help bind sediment grains together.

Cohesion of sediment particles influences bed behavior also. New clay deposits are usually porous and easily resuspended. With time and overburden pressure clay deposits consolidate and become denser and more resistant to erosion.

Sediment Transport

Sediment is transported from one place to another by flowing water. Depending on the size and degree of cohesion of the sediment grains and intensity of the flow, the amount transported may be proportional to the speed of the flow or proportional to the speed squared, cubed, etc. So a doubling of flow speed may increase sediment transport as much as eight-fold. In some cases more sediment is transported in one storm event than in all the rest of the year.

The proportionality effect described above can also cause substantial sediment deposition. If a waterway's cross-section is suddenly increased by increased depth or width, the flow speed drops and the capacity to transport sediment falls even faster, so sediment will tend to deposit. This effect is a common cause of sedimentation in navigation channels and ports, and is sometimes used to force sediment deposition in a particular location, such as sediment trap.

Vessel traffic can suspend sediment from the bed and banks of a waterway through:

- Flow under and around the vessel as water moves from the front end of the vessel to the back.
- Pressure fluctuations beneath the vessel.
- Propwash striking the bed.
- Bow and stern waves agitating the bed and breaking against the bank.

Sediment suspended by vessel traffic can either quickly settle out (if the sediment consists of sand-sized material) or remain in suspension (if the sediment consists of very fine silts or clay-sized material). A fine sediment suspension has greater density than the surrounding water, so it can flow as a density current away from the point of suspension. The latter process can move sediment from the waterway centerline into relatively quiet berthing areas, where it settles out.

Eddies, circular flow patterns formed by flow past an obstruction or in front of an opening like a port slip, have a complex three-dimensional circular structure with flow inward near the bottom and outward near the surface with a quieter zone in the middle. Sediment passing near an eddy is drawn into the eddy and pushed toward the center, like loose tea leaves in a stirred cup, where it tends to deposit. This phenomenon is a common cause of sedimentation in slips, side channels and berthing areas.

Sedimentation in Ports

Commercial vessels — deep water ships and shallow water tows — require navigable water depths that are equal to or greater than the sum of the draft of the vessel plus allowances for vessel motion, water level fluctuations, and under-keel clearance. If available water depth in a port is less than navigable depth for a commercial vessel, the vessel must light-load (load less than a full cargo) to reduce draft if it is to use the port.

Natural waterways exhibit shallow areas and deep areas that may shift as flows change, sediment supply changes, or features migrate. They may naturally be deep enough in some locations to accommodate navigation, but often have at least some areas shallower than navigable depth. Ports are usually built close to shorelines where water is naturally shallow and so they tend to suffer sediment deposition that reduces the depth available for navigation.

Some few ports have no significant sediment deposition, either because they are built in water naturally deeper than needed for navigability, because the sediment supply is very small, or because the waterway's currents sweep the sediment away. An example on the Tenn-Tom Waterway is Yellow Creek Port on the Pickwick Lake section. Sediment inflow to the lake is relatively low and most of that deposits at the mouths of streams or in the deep sections of the lake, and lake currents themselves are small enough that they do not deliver sediment to the port area, so the port experiences minor or no deposition and has never required maintenance dredging.

Engineering Solutions

When ports experience sediment deposition that will ultimately lead to unacceptable loss of water depth, solutions are needed to maintain navigability. Solutions can be complete — eliminating sediment deposition — or partial — reducing sediment deposition.

A variety of engineered solution approaches to reduce deposition problems are available. Solutions tend to be unique to each port, for a successful design depends on port layout, waterway configuration, flow conditions, and sediment type and supply; however, all solutions can be placed in three categories — methods that keep sediment out of the port, methods that keep sediment that enters the port moving (and prevents net deposition), and methods that remove sediment after it has deposited in the port. The following lists some of these solutions.

Methods that keep sediment out

Keeping excess sediment out of the port that might otherwise enter and deposit can be accomplished by:

- Stabilizing sediment sources.
- Diverting sediment-laden flows.
- Trapping sediment before it enters.
- Blocking sediment entry.

Methods that keep sediment moving

If very fine, slow-settling sediment can be kept suspended while the flow passes through the port, or if the flow maintains high enough tractive force (usually expressed as shear stress, or drag force per unit area) to keep coarser particles moving, sediment can enter the port and pass on through without depositing. Methods to keep sediment moving include:

- Structural elements that train natural flows.
- Devices that increase tractive forces on the bed.
- Designs and equipment that increase sediment mobility.
- Designs that reduce cohesive sediment flocculation.

Methods that remove deposited sediment

Sediment can be removed after it deposits. Methods include:

- Dredging and disposal.
- Agitation of deposits so that the sediment becomes mobile again.

These methods and their applicability to Waterway ports will be described further in Task II of the Scope of Work.

CHAPTER 4. MISSISSIPPI'S PUBLIC PORTS ON THE TENN-TOM

This chapter describes preliminary findings on each of the six public ports on the Waterway. The sedimentation assessment concepts and engineering solutions listed here are described in Chapter 3.

Yellow Creek Port

Description

Yellow Creek Port is located at Waterway mile 448 on Pickwick Lake near Iuka, MS. The port is operated under the supervision of the Yellow Creek State Inland Port Authority. Mr. Eugene Bishop is Port Executive Director.

The primary port is in the lake created by Pickwick Dam in Tennessee and the Bay Springs Lock and Dam in the Divide Cut of the Waterway. Located on a peninsula in Pickwick Lake, the primary Yellow Creek Port has the ability to accommodate river barges at berths 1000 ft long at 9 ft draft and 400 ft long at 9 ft draft. The Yellow Creek Port Authority is planning an expansion at the primary port site. Figure 4 shows the port.

Recently the Port Authority has opened a barge terminal in the Divide Cut near Burnsville, MS, at mile 435. It consists of a notch parallel to the Waterway.

Sedimentation and Dredging History

Yellow Creek Port has experienced no sedimentation problems and has never required maintenance dredging. The only depth problems have consisted of barges bumping high spots in the lake bottom during low lake level periods. A small creek flows into a debris basin on port property and drains into an arm of Pickwick Lake on the southeast side of the port. A substantial quantity of sand and gravel has accumulated in the debris basin in the last two years.

The new terminal at Burnsville has not yet experienced sedimentation problems. Kirby McRae of Dean and McRae Engineers noted some soft sediment accumulating on the bottom near the outer boundary of the notch shortly after construction, but no noticeable loss of depth has occurred¹. Corps of Engineers dredging records show no maintenance dredging in the vicinity of the terminal.

¹ This observation and others in this section were made by Mr. Kirby or Mr. Bishop during a meeting at the port on 19 June 2002.

Sedimentation Assessment

With no present sedimentation problems, no action is recommended for Yellow Creek Port. However, items of possible future concern are noted:

- If expansion of the primary port extends berthing facilities to or across the small creek discharging into the lake, the sediment discharge of the creek might deposit in the berthing area unless the debris basin is regularly cleaned out.
- Aerial photos of the port show suspended sediment plumes behind tugs operating in the port, indicating soft sediment deposits in the maneuvering area. Since no significant sedimentation accumulation has been observed, none is expected unless the port experiences a period of inactivity or if substantial construction in the areas tributary to the lake greatly increases land erosion.
- The Burnsville barge terminal may experience sediment accumulation from fine sediments resuspended by vessel traffic in the Waterway.

Environmental Issues

There are no known sediment-related environmental issues for either site of Yellow Creek Port.

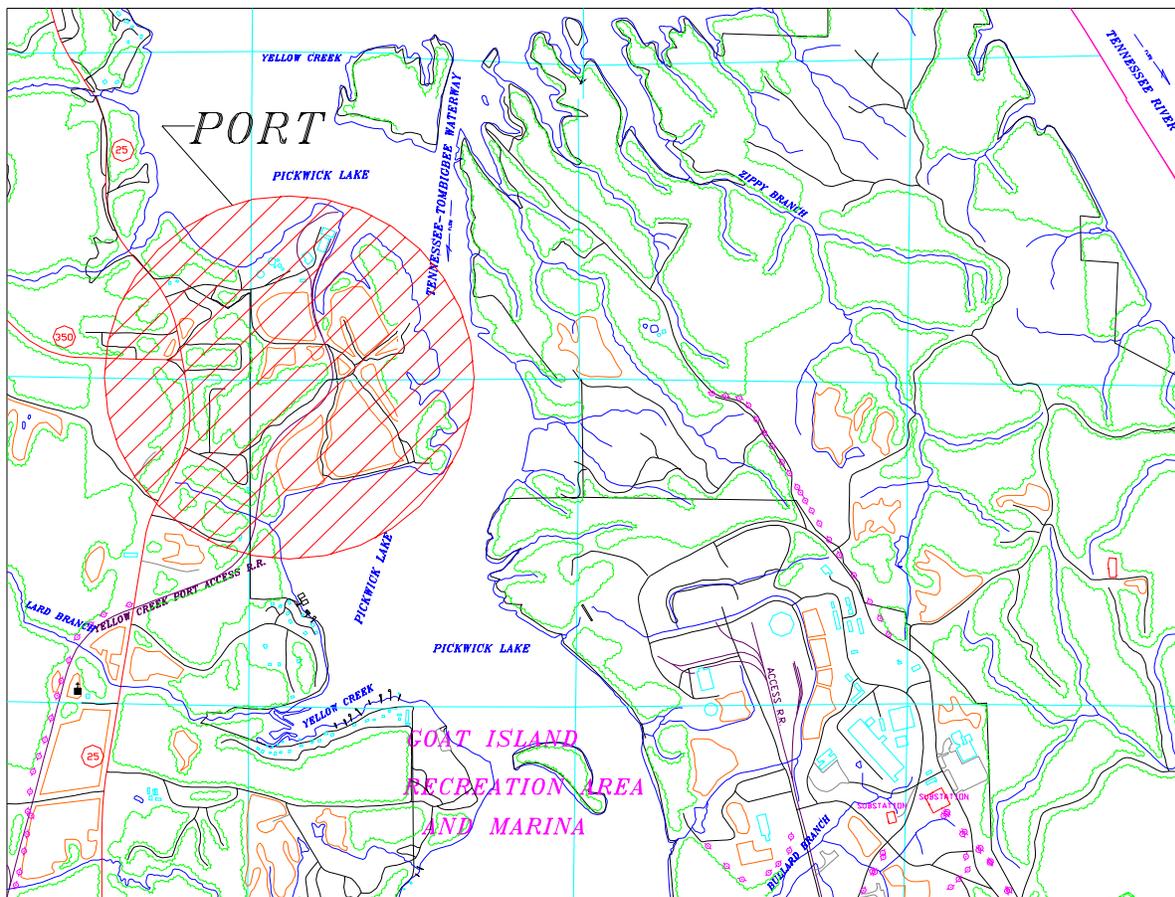
Engineering Solutions

Regular removal of accumulated sand and gravel from the debris basin at the primary port location will prevent future sedimentation problems from that source.

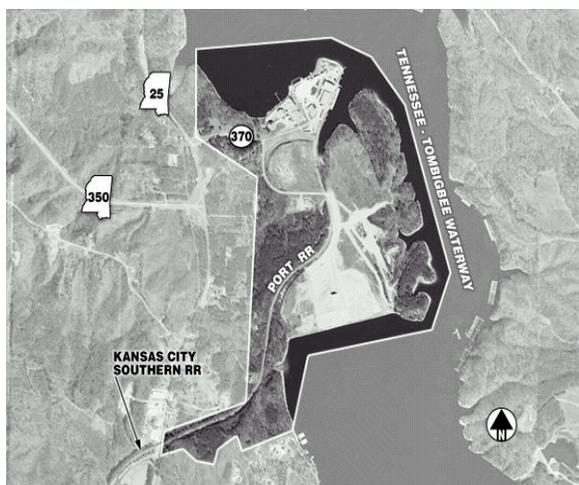
Monitoring of water depths in the Burnsville terminal is advised. If sediment accumulation occurs in the terminal or approach, engineering solutions that may be appropriate include:

- A barrier to prevent sediment entry, such as a bubble screen.
- A narrow trap dredged parallel to the waterway, deeper than the berthing area so as to intercept the resuspended sediment plume. (Dredging of the trap will be required, but can be accomplished by fixed plant.)
- Regular agitation of the bed sediments by propwash or raking to resuspend them.

Port Sedimentation Solutions



a. Port Location (adapted from US Army Corps of Engineers Basemaps)



b. Aerial Map (courtesy of MDOT)



c. Photo (courtesy of Tennessee-Tombigbee Waterway Authority)

Figure 4. Yellow Creek Port

Port Itawamba

Description

Port Itawamba is located at Fulton, Mississippi at Waterway Mile 390.6. Port Director is Mr. Timothy Weston.

The port is in the Canal Section, in the pool formed by Glover Wilkins Lock and Dam (Lock B). As shown in Figure 5 the port has two berthing areas – the main slip, perpendicular to the waterway, is about 1100 ft long and 260 ft wide, and a notch parallel to the Waterway is 900 ft long. Both have nominal depths of 10.5 ft but have reported the critical working areas seeming to have less than 9 ft of depth.

Barge loading and unloading occurs in the main slip, but the notch slip previously has been used for barge fleetings. Ongoing expansion of the port is expected to put the notch slip into use for loading and unloading.

Sedimentation and Dredging History

Mr. Weston reported² that sedimentation occurs throughout the year without noticeable seasonal variation. The port was dredged in 1995 (amount unknown) and material placed on port property. It needs dredging again, but mainly for efficiency, since loss of depth has not yet become a severe problem. The port has no room on port property for dredged material, but might acquire rights to adjacent land or use a nearby Corps of Engineers disposal site.

Tug maneuvers create noticeable sediment plumes, according to Mr. Weston, and may be a cause of port sedimentation. In the past tugs agitated the sediment so as to clear the port, but they could affect only the middle of the main slip, while sediment continued to deposit in the area around and behind the dolphins.

The Waterway reach below the port, near Mile 389, has required maintenance dredging several times, with the most recent dredging removing 8,932 yd³ in 1998.

Sedimentation Assessment

The Canal Section of the waterway has very low current speeds and little sediment in transport. Resuspension of bed sediment by vessel traffic and subsequent deposition in the port is the most probable cause of sedimentation problems.

² This comment and others in this section by Mr. Weston occurred in a 17 June 2002 email and during a meeting in Fulton on 21 June 2002.

Environmental Issues

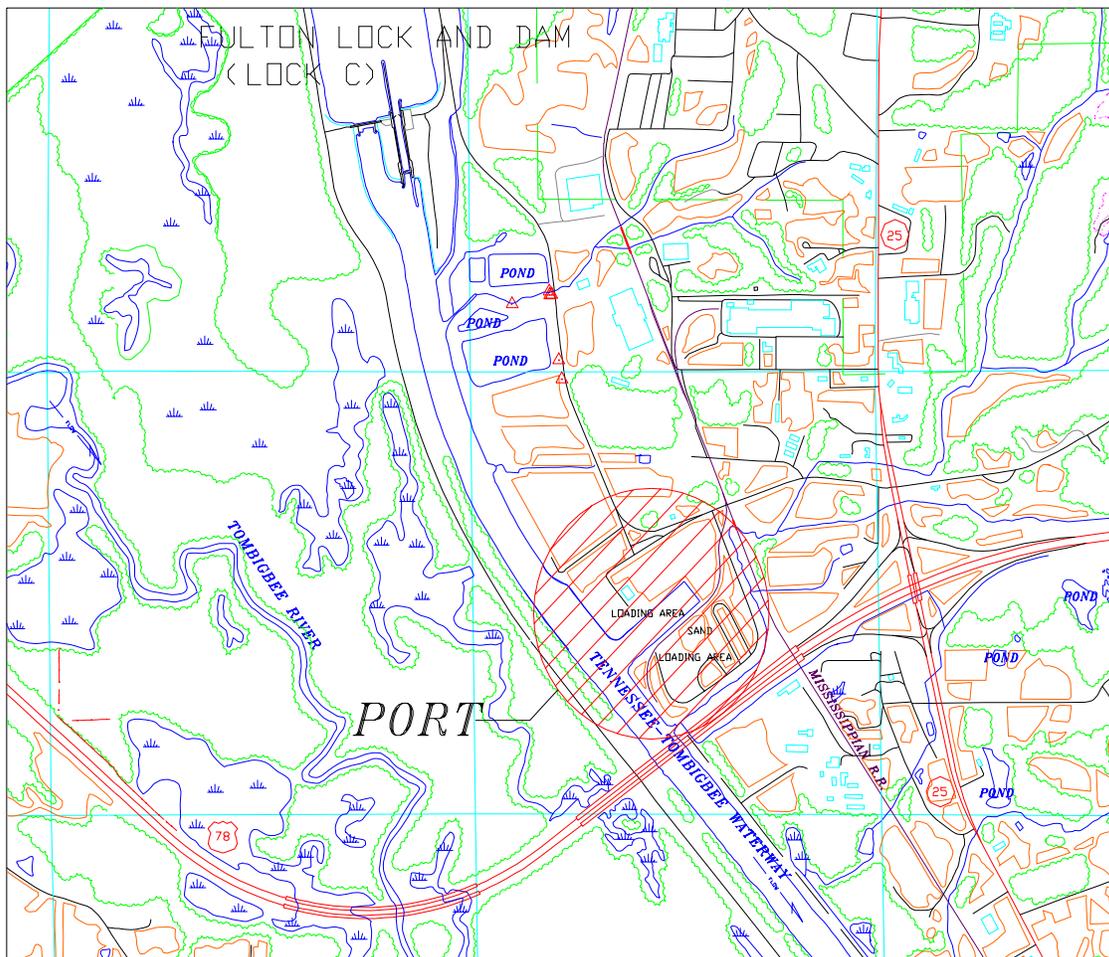
There are no known sediment-related environmental issues at Port Itawamba.

Engineering Solutions

If vessel resuspension is the primary cause of sedimentation in the port, possible engineering solutions include:

- A barrier to prevent sediment entry, such as a bubble screen.
- A narrow trap dredged parallel to the waterway, deeper than the berthing area so as to intercept the resuspended sediment plume. (Dredging of the trap will be required, but can be accomplished by fixed plant.)
- Regular agitation of the bed sediments by propwash or raking to resuspend them.

Port Sedimentation Solutions



a. Port Location (adapted from US Army Corps of Engineers Basemaps)



b. Aerial Map (courtesy of MDOT)



c. Photo (courtesy Tennessee-Tombigbee Waterway Authority)

Figure 5. Port Itawamba

Port of Amory

Description

Port of Amory is located at river mile 369.5 in Amory, MS. Mr. Frank Peeler, the City Planner for Amory, manages the port under the direction of Amory Mayor Thomas Griffith.

The port is in the Canal Section of the Waterway, in the Aberdeen Pool created by the Aberdeen Lock and Dam. The barge berthing area, shown in Figure 6, is 834 ft long at 9 ft draft. The Port of Amory has no present users/tenants. Immediately adjacent to Amory's dock is a Weyerhaeuser facility that operates a wood chipping mill and its own dock. Both berthing areas share the same notch cut in the Waterway bank.

Sedimentation and Dredging History

The Port obtained a Corps' dredging permit in June 1999 for up to 10,000 yd³ but did not dredge. The Amory side of the berthing area has never been dredged, and barges report that that cannot get close to the dock because of a shoal. Mayor Griffith believes that the Weyerhaeuser berth has been dredged in the last few years.

The port has an option to place dredged material on top of a Corps-owned dredge fill created during waterway construction.

Corps of Engineers records show that the Waterway reach at the port has required maintenance dredging several times, with 19,355 yd³ in 1997 and 52,734 yd³ in 1993.

A recent survey of the berthing area showed about 3 ft of sediment accumulated above the 9 ft nominal depth next to the berth wall, tapering down to nominal depth toward the Waterway over a distance of about 1000 ft.

Sedimentation Assessment

The berth wall along the Amory dock consists of H-beam piles with stoplogs between the piles. According to design plans, the stoplogs have a bottom elevation of 178 ft, 12 ft below the Normal pool elevation of 190 ft. The wall has experienced some movement toward the waterway and slumping of soil between it and the concrete dock surface, which is supported on H-beam pilings. One dock cleat has moved about 10 inches toward the water, leaving a crack in the soil behind it. Several large cracks in the earth indicated block failure of the soil behind the quay wall. Slumping of soil under the quay wall, piping, or washing of fines between the stoplogs may be contributing to loss of depth at the berth.

Mayor Griffith³ believes that settling of sediment suspended from the main waterway channel by tow traffic causes port shoaling. He notes that a noticeable turbidity plume occurs behind every tow.

Although the port is in the Canal section of the Waterway, it is in Aberdeen Pool and the River section begins just two miles below the port. The Waterway dredging quantities profile peaks in the mile 366-367 reach where the River section begins, and fine sediments brought into the Waterway by the Tombigbee River are a potential sources of shoaling material for the port.

Environmental Issues

There are no known sediment-related environmental issues at the Port of Amory.

Engineering Solutions

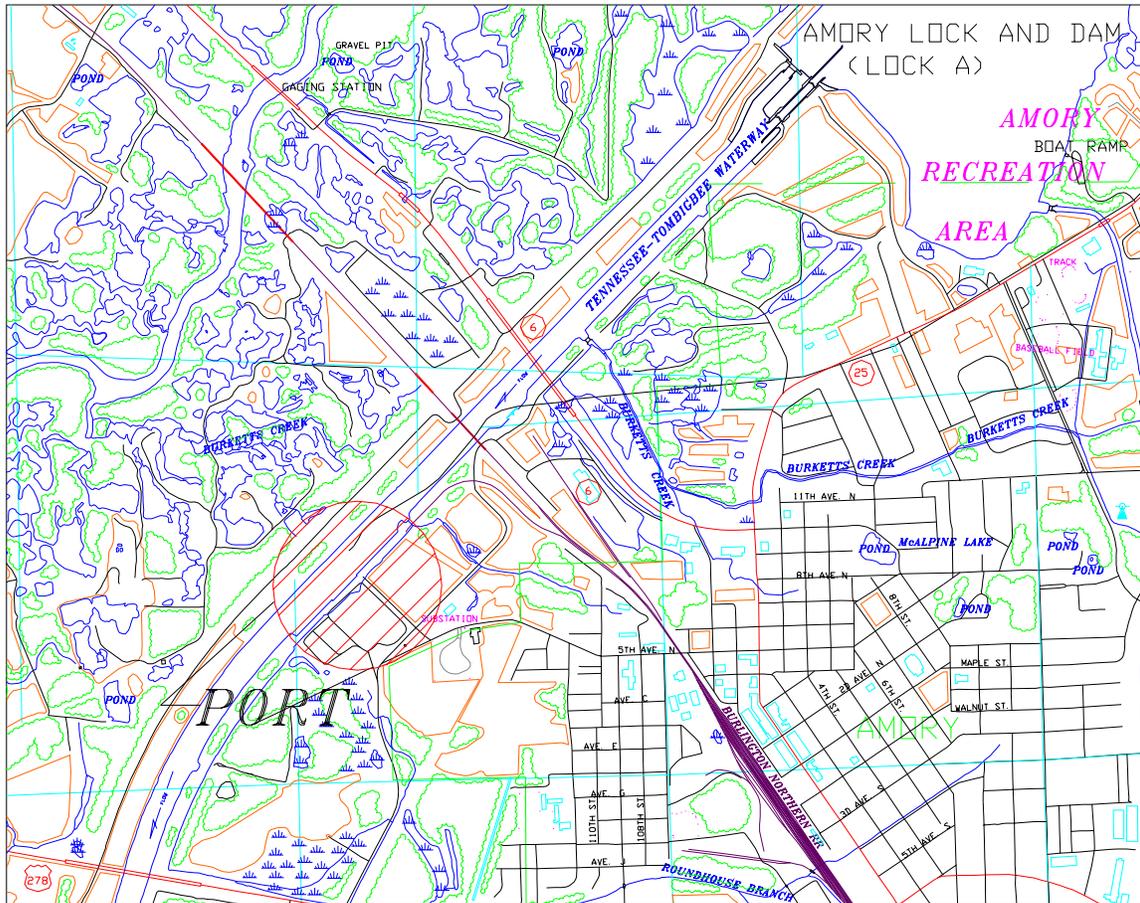
Slumping of soil fill behind the berth wall should be corrected. A geotechnical analysis will reveal whether the slumping or piping is pushing material under the bottom of the wall, and if so, what repairs are needed, Repair of the wall can be accompanied by sealing it to prevent washing out of fines, backfilling, and sealing the surface to prevent surface water percolation behind the wall.

Deposition of vessel-resuspended bottom sediment in the port can be ameliorated or prevented by measures such as:

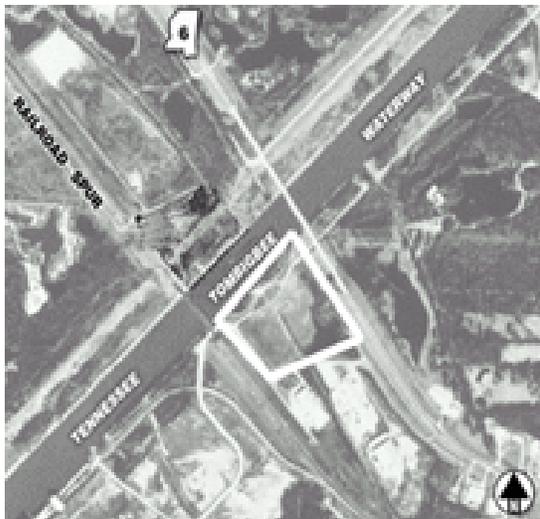
- A barrier to prevent sediment entry, such as a bubble screen.
- A narrow trap dredged parallel to the waterway, deeper than the berthing area so as to intercept the resuspended sediment plume. (Dredging of the trap will be required, but can be accomplished by fixed plant.)
- Regular agitation of the bed sediments by propwash or raking to resuspend them.

³ This comment and others in this section by Mayor Griffith and Mr. Peeler occurred during a meeting in Amory on 14 June 2002.

Port Sedimentation Solutions



a. Location Map (adapted from US Army Corps of Engineers Basemaps)



b. Aerial Map (courtesy of MDOT)



c. Photo (courtesy Tennessee-Tombigbee Waterway Authority)

Figure 6. Port of Amory

Port of Aberdeen

Description

Port of Aberdeen is located in Aberdeen, MS, at river mile 357. Mr. Perry Lucas manages the Port under the direction of Mayor William Tisdale of Aberdeen and Mr. Louis Burroughs of the Public Works Department.

The port is in the River Section of the Waterway, in the Columbus Pool, just below the Aberdeen Lock and Dam. Port Aberdeen is a notch cut port on the main channel of the Waterway as shown in Figure 7. Its barge berthing area is 1000 ft long at 9 ft draft.

Sedimentation and Dredging History

The port has been dredged 5 times since 1987. The most recent dredging was in October of 2001 at a cost of approximately \$75,000, but only 3 months later a barge hit bottom while loading. Since then some larger deposits were removed with a clamshell. The port is again in need of dredging.

The current disposal site is owned by an outside party that wants the area filled. Two permanent pipes run from the port under the road to the spoil area.

Corps of Engineers records show no Waterway dredging requirement in the immediate vicinity of the port, but 23,724 yd³ were removed from the reach downstream near Mile 356 in 1991.

Sedimentation Assessment

Mayor Tisdale and Mr. Burroughs believe⁴ erosion along several streams and creeks located to the north of the port, notably Mattubby Creek, are a major source of the sediment depositing in the port. Mattubby Creek is deeply incised and displays evidence of historical and recent bank caving. Near Williams' Store on Meridian Street rubble and concrete mix have been placed on an eroding 50- to 60-ft-high bank in an attempt to stabilize it and save the store's parking lot. Below the Meridian Street bridge the channel appears more stable at present. Signs of erosion were also visible on the Waterway bank opposite the Port.

Mayor Tisdale believes that an eddy formed within the port during high flow events is the mechanism by which the port shoals, and that it might be remedied by cutting the upstream corner at a shallower angle. Mr. Lucas agrees with that assessment and also suggests that cutting back the downstream corner of the notch might help, also.

⁴ This comment and others in this section by Mayor Tisdale and Messrs. Burroughs and Lucas occurred during meetings in Clay County and Aberdeen on 17 June 2002.

High sediment inflows to the Waterway from west bank tributaries, including James Creek, is the most probable source of material shoaling in the port. Once in the Waterway, sediment is probably moved into the port by eddies, as cited by port officials; although deposition of sediment resuspended by vessel traffic may also be a factor.

Even without eddies, widening a waterway as the Port notch does, reduces velocity, and thus sediment transport capacity of flow in the waterway, so deposition is likely to occur at the widened cross section.

Environmental Issues

There are no known sediment-related environmental issues at the Port of Aberdeen.

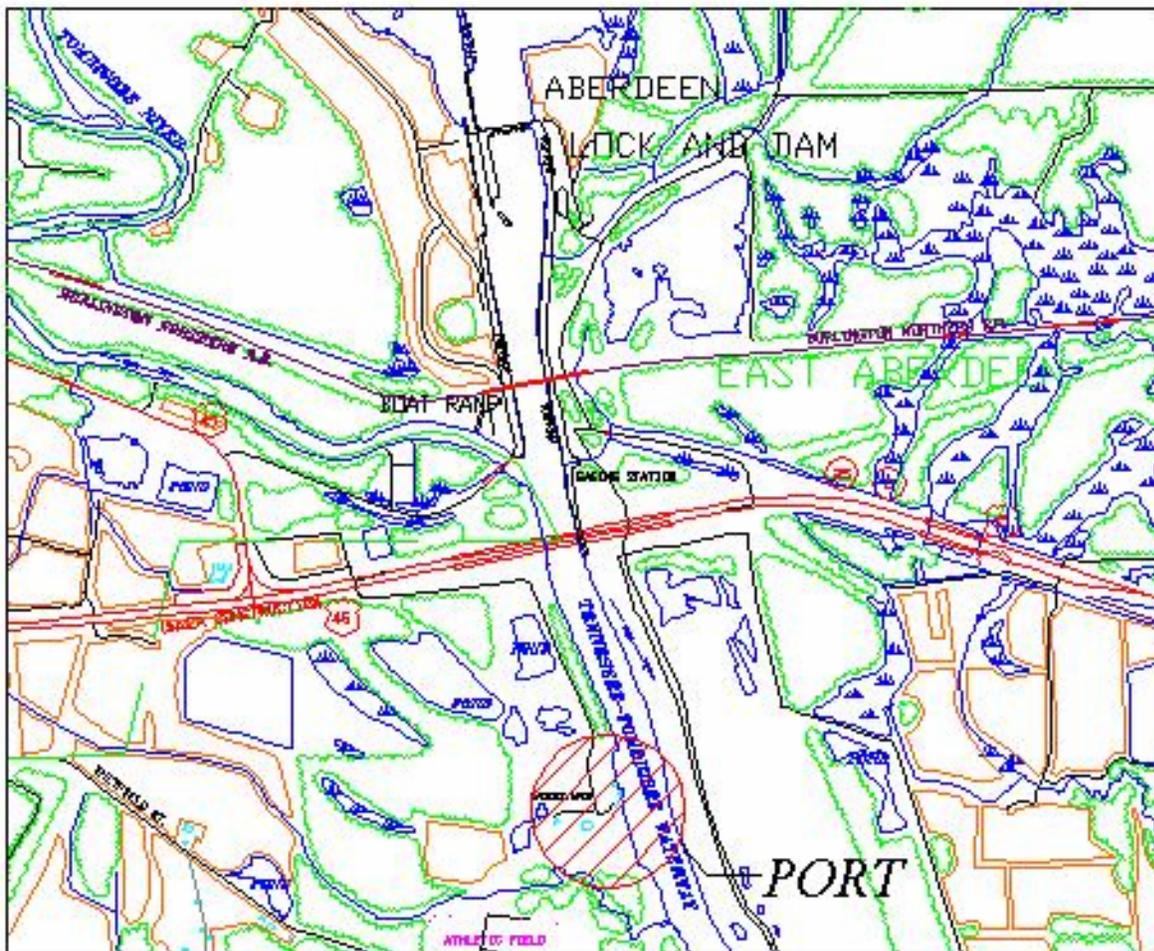
Engineering Solutions

For the most probable cause of port sedimentation, entrainment and deposition by eddies during high flow events, several structural solutions can be considered:

- Streamlining the notch to minimize eddy formation
- Addition of a flow training structure on the upstream end of the notch to break up the eddy and fill the notch with water containing less sediment.

Deposition of vessel-resuspended bottom sediment in the port can be reduced or prevented by measures such as:

- A barrier to prevent sediment entry, such as a bubble screen.
- A narrow trap dredged parallel to the waterway, deeper than the berthing area so as to intercept the resuspended sediment plume. (Dredging of the trap will be required, but can be accomplished by fixed plant.)
- Regular agitation of the bed sediments by propwash or raking to resuspend them.



a. Port Location (adapted from US Army Corps of Engineers Basemaps)



b. Aerial Map (courtesy of MDOT)



c. Photo (courtesy of Tennessee-Tombigbee Waterway Authority)

Figure 7. Port of Aberdeen

Port of Clay County

Description

Port of Clay County is located near West Point, MS, at river mile 338.8. The General Manager of the port is Mr. Perry Lucas.

The port is in the River Section of the Waterway, in the Columbus Pool formed by the John C. Stennis Lock and Dam. Located at the crossing of a Tombigbee River cutoff channel and the Waterway as shown in Figure 8, the port consists of a notch on the waterway and berthing areas in the cutoff channel, where the port and a Tom Soya terminal operate. The port uses a portion of a former highway bridge approach to dock barges. The port has the ability to berth 2 - 195 ft barges at 12 ft draft and 3 - 195 ft barges at 9 ft draft.

Sedimentation and Dredging History

Barges presently cannot reach the port notch dock because of shoaling and must park in the channel.

Mr. Lucas⁵ reported that when the Waterway was dredged depth of the river cutoff was approximately 28 ft. That depth is now reduced to about 8 ft. Most sedimentation occurs from January to May.

Corps of Engineers dredging records show no Waterway maintenance dredging within a mile of the port.

Sedimentation Assessment

Port of Clay County has one of the most complex set of sedimentation processes in the Waterway, so it is difficult to identify a specific primary sedimentation process responsible for the problem. It may be caused by several separate processes.

High sediment inflows to the Waterway from tributaries and from Aberdeen Pool upstream are probable sources of material shoaling in the port. With its location in the River portion of the Waterway, the port experiences the high winter runoff and accompanying sediment inflow typical of that section. The cutoff-Waterway crossing configuration at the port will create complex flow patterns conducive to sedimentation problems, also. From Mr. Lucas' description of the river cutoff channel infilling, it seems probable that flow down the river cutoff channel now carries substantial quantities of sediment that tends to deposit where the cross-section widens at the port.

⁵ This comment and others in this section by Mr. Lucas occurred during a meeting at the port on 17 June 2002.

Docking of barges at the old bridge site probably alters local flow and sedimentation patterns. When high runoff events push water through the cutoff, flow will pass under barges docked there, which may scour deposited sediment that then deposits in the adjacent notch berth. A bed sample from the berth at the bridge (provided by Mr. Lucas) in June 2002 (low flow period) consisted of a black organic mud with mostly fine-grained sediment particles.

Visible sediment plumes from tug prop wash are reported by tug pilots in the vicinity of the port and other locations in the Waterway, so during low flow seasons vessel resuspension of sediment may be contributing to deposition in the port.

Environmental Issues

There are no known sediment-related environmental issues at Clay County Port.

Engineering Solutions

Since identifying a specific sedimentation process is difficult for Clay County Port, it is therefore difficult to identify a specific solution. Possible solutions include:

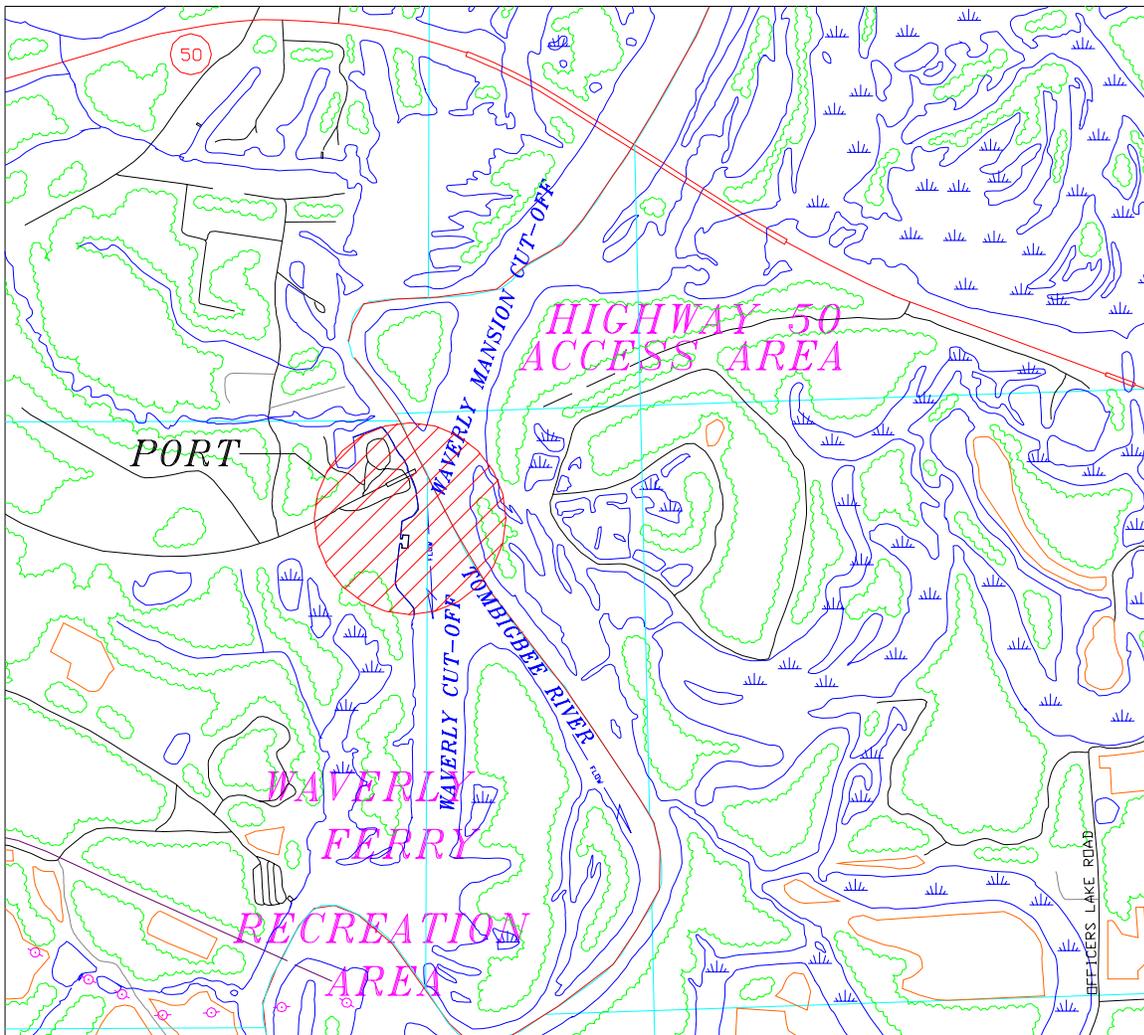
- A barrier at the upper end of the river cutoff to reduce flow and thus transport through the cutoff and into the port.
- A sediment trap in the cutoff channel above the port to intercept sediment
- A flow training structure at the confluence of the cutoff channel and Waterway to reduce eddy formation.

Deposition of vessel-resuspended bottom sediment in the port can be reduced or prevented by measures such as:

- A barrier to prevent sediment entry, such as a bubble screen.
- A sediment trap dredged parallel to the waterway, deeper than the berthing area so as to intercept the resuspended sediment plume.
- Regular agitation of the bed sediments by propwash or raking to resuspend them.

Dredging of sediment traps cited above will be required, but can be accomplished more economically than port dredging.

Port Sedimentation Solutions



a. Port Location (adapted from US Army Corps of Engineers Basemaps)



b. Aerial Map (courtesy of MDOT)



c. Photo (courtesy of Tennessee-Tombigbee Waterway Authority)

Figure 8. Port of Clay County

Lowndes County Port

Description

Lowndes County Port is located at Columbus, Mississippi at Waterway Mile 330. Port Director is Mr. John Hardy.

The port is in the River Section, in the Aliceville Pool formed by Tom Bevill Lock and Dam. A Federal channel connects the port to the Waterway (see Figure 9). Two public slips parallel with the channel can serve two 600 ft barges at 9 ft draft. The port has a 200 ft by 120 ft turning basin. Private terminals within the port are operated by Southern Ionics and Southern Wood Fibre.

Sedimentation and Dredging History

The port has been dredged several times. According to port records:

- Combined new work and maintenance dredging in 1993 of about 8000 yd³ did not provide a complete harbor prism, but was halted when the maximum allowable funding was exhausted. Unexpected trees and debris in the new work area (near Southern Ionics' terminal) were cited as the cause of delays.
- In 1994 the embankment at the Southern Ionics' terminal was repaired after sloughing occurred.
- In 1999 required dredging was estimated at 17,000 yd³, but funding limited the actual dredging quantity at only 7,867 yd³.
- In the fall of 2002 the Southern Wood Fibre port was dredged removing gravel, wood chips, sand, and brick. The Logistics Services North dock, as well as the Southern Ionics pier, was also dredged removing mud and fine sand.
- The USACE dredges the federally maintained channel into Lowndes County Port, as well as the turning basin.

Recently some tow operators have report bumping bottom as they try to place barges close and parallel to the docking facilities. The port has submitted a permit request for dredging 1000 cu yd at the Southern Wood terminal, taking a 50 ft by 500 ft area to depth 12 ft plus 1 ft overdepth at Normal Pool (136 ft).

The port uses an on-site confined dredged material placement area. Dredged material (from the 1999 dredging) in the disposal area consisted of sandy silt with a significant fraction of large gravel near the disposal discharge point and organic mud at the far end of the disposal site.

Corps of Engineers' dredging records show some maintenance dredging of the Waterway above and below the port channel in 1991 and 1993, but no dredging of the access channel itself.

Sedimentation Assessment

Mr. Hardy believes that most shoaling occurs during the high water season of January-April, and that dryer years produce less shoaling⁶. During high flows on the Waterway, strong currents can be observed in the cutoff river channel.

Grab samples from the bed of the port area in October 2002 consisted of very soft organic black mud with a small fraction of fine sand.

The location of the port and its dredging history suggest that the primary source of sediment depositing in the port is transport through the cutoff channel. That channel has a maximum depth of 15 to 20 ft over much of its length, but is shallow (less than 5 ft) at its upstream junction with the Waterway. During high flow events sand may be moved through the cutoff channel, depositing when it reaches the enlarged cross-section of the port area. At other times a weak flow can move vessel- or flow-resuspended fine sediments into the port area from either upstream or downstream.

Environmental Issues

There are no known sediment-related environmental issues for Lowndes County Port. A 1998 letter from the Mississippi Department of Environmental Quality stipulated that there were no water quality problems associated with proposed dredging.

Engineering Solutions

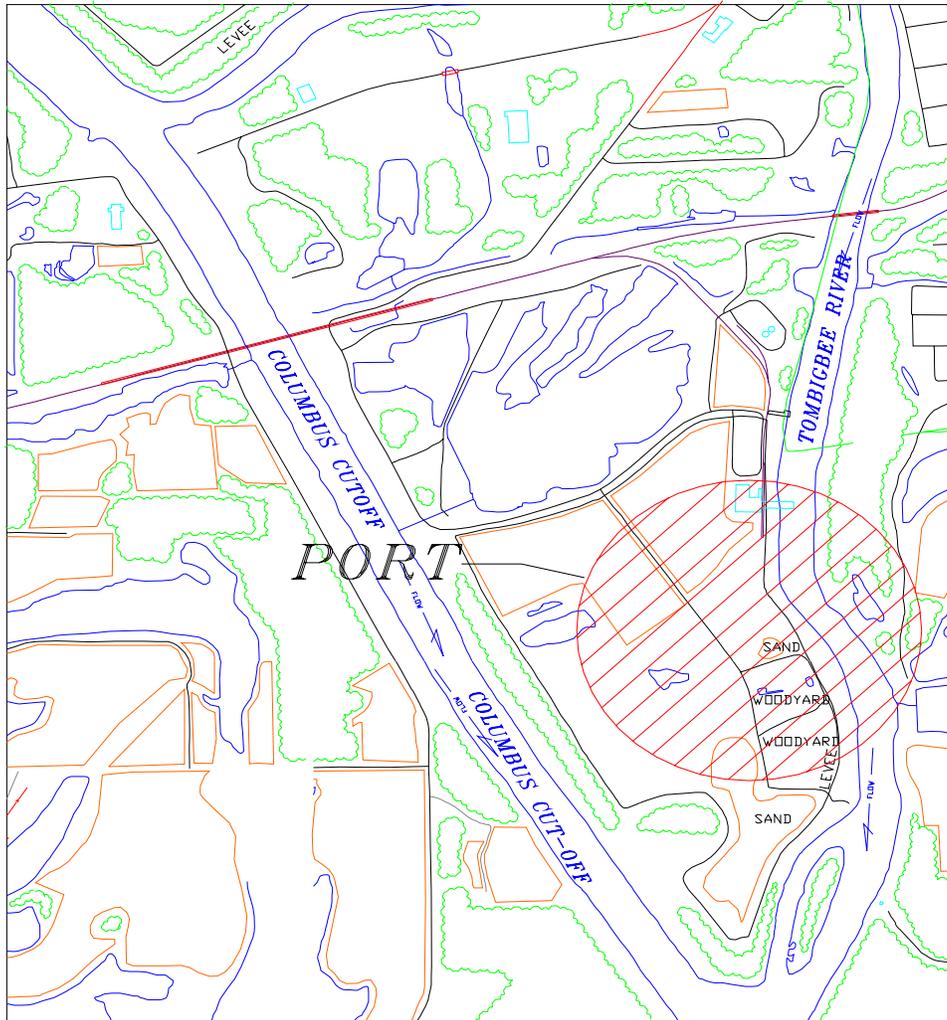
If transport through the cutoff channel is the only substantial source of shoaling material, then three approaches might reduce port sedimentation:

- Restricting the upstream entrance to a smaller opening (large enough to permit some through-flow for maintaining water quality and recreational boat passage) to reduce transport into the port area.
- Constructing a barrier in the cutoff channel at the upstream end of the port similar to that above.
- Creating a narrow transport channel against the bank opposite the port with a training structure to concentrate flow and convey sediment past the port area.
- Dredging a sediment trap at the upstream end of the cutoff or the port.

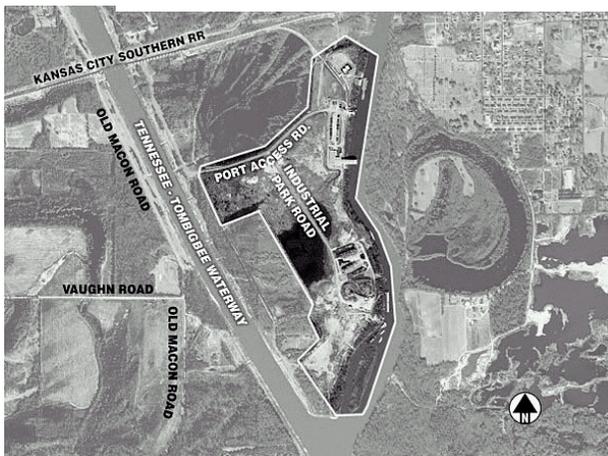
The last approach will still require dredging to maintain the sediment trap, but will localize the dredging outside the berthing areas, making it less expensive, less disruptive, and more amenable to permanent plant to accomplish the removal of accumulated sediment.

⁶ This observation and others in this section were expressed by Mr. Hardy during at meeting in Columbus on 12 June 2002.

Port Sedimentation Solutions



a. Port Location (adapted from US Army Corps of Engineers Basemaps)



b. Aerial Map (courtesy of MDOT)



c. Photo (courtesy of Tennessee-Tombigbee Waterway Authority)

Figure 9. Lowndes County Port

CHAPTER 5. SUMMARY AND DISCUSSION

Sedimentation of the navigation channel and ports on the Tennessee-Tombigbee Waterway has averaged over 800,000 yd³ per year since completion of the Waterway. The standard solution for the past 17 years has been to dredge the accumulated sediment and place it in upland confined disposal sites. That solution has become less effective as dredging costs have risen and dredging contracts more difficult to obtain.

Sedimentation of waterways is a natural and ubiquitous phenomenon, and artificially deepened navigation facilities often accumulate sediment faster than waterways of natural depth. Engineering solutions that reduce or eliminate the excess sedimentation are available, and, if they can be designed to be economical, effective, and environmentally sustainable, offer viable alternatives to dredging. Design of engineering solutions tends to be unique to each site – the shape and layout of facilities, hydrography of the waterway, flows, and sediment supply and characteristics, but they can be classified by the basic mechanisms that they employ into methods that keep sediment out, those that keep sediment moving, and those that remove sediment after it has deposited.

Sediment supply to the Divide Cut and Canal sections is relatively low, as evidenced by the small maintenance dredging quantities shown there in Figure 3. However, the small sediment inflow from local sources and upstream releases is enough to replenish the equally small amounts dredged and released downstream, so that the bed can continue to be a source for resuspension and movement, which can cause port sedimentation problems.

Sediment supply to the River section is sufficient to cause port and waterway sedimentation problems at any location where the capacity to transport sediment is smaller than the sediment supply.

Five of the six public ports on the Waterway have experienced sedimentation problems. The sixth port, Yellow Creek, has not experienced excessive sedimentation and can probably expect that to continue at the primary site on Pickwick Lake. The new Yellow Creek barge terminal near Burnsville is too new to have had problems, but may experience future sedimentation problems, so it is included in the discussion below.

Based on the limited available data, sedimentation sources and mechanisms acting in the Waterway ports can be preliminarily categorized as these processes:

- Vessel-resuspended bed sediment from the Waterway and port approaches moves into the port and deposits.
- Sediment transported into and through the port during flow events deposits.
- Other mechanisms contribute sediment (slumping, piping, etc.).

Dispersion of sediment resuspended by vessels occurs as tows and recreational boats disturb fine sediment (fine sand, silt, clay and organic material) on bed and banks of the waterway. The sediment plumes raised by vessels spread by diffusion, weak density currents, and natural currents slowly re-deposit over minutes to hours. Sediment re-depositing near the Waterway centerline are available for resuspension by the next vessel. Sediment depositing in the relatively quieter water in the ports may be resuspended or may consolidate to become erosion resistant. Tugs maneuvering in the port may resuspend some of the deposits, but leave behind sediment close to piers and walls. These processes are probably the primary cause of sedimentation at Port Itawamba and Port of Amory, and may be a cause of future sediment problems at the Yellow Creek Port barge terminal at Burnsville.

Transport from upstream occurs primarily during the high flow period of January through April, but can occur during any high flow event caused by local rainfall-runoff events or upstream releases that exceed the threshold for sediment transport. The delivery mechanism may be simple through-flow of water and sediment, as at the Lowndes County Port and part of Clay County Port, or by eddy formation as in the Port of Aberdeen.

These two processes appear to be the primary ones operating in the Waterway ports. Based on available data, observations by port officials, and experience, their relative contributions to each port are estimated in Figure 10.

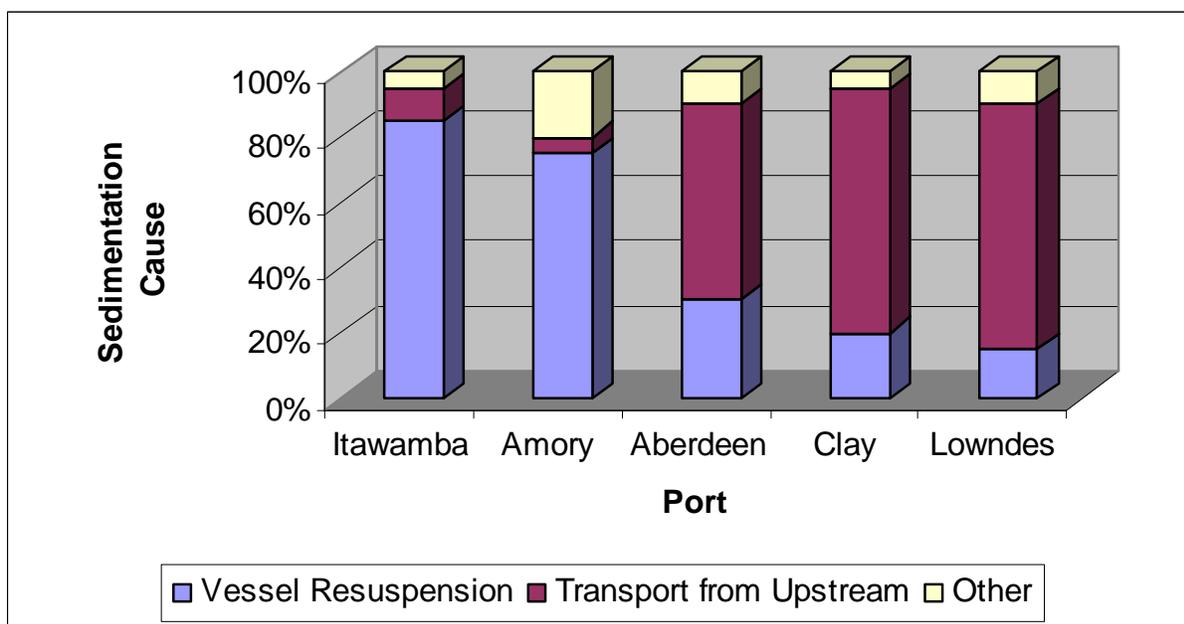


Figure 10. Estimates of relative sedimentation contribution from various processes.

The Yellow Creek barge terminal near Burnsville is closest in circumstances to Itawamba, so the relative magnitude of the processes, if sedimentation becomes a problem, is estimated to be similar to Itawamba's.

The engineering solutions with the greatest likelihood of success for vessel resuspension are a subset of those listed in Chapter 3 and include:

- Methods that keep sediment out.
 - Stabilizing sediment sources.
 - Blocking sediment entry.
- Methods that keep sediment moving.
 - Devices that increase tractive forces on the bed.
- Methods that remove deposited sediment
 - Dredging
 - Agitation of deposits

The engineering solutions with the greatest likelihood of success for transportation from upstream are a subset of those listed in Chapter 3 and include:

- Methods that keep sediment out.
 - Stabilizing sediment sources.
 - Diverting sediment-laden flows
 - Trapping sediment before it enters
- Methods that keep sediment moving.
 - Structural elements that train natural flows
 - Designs that reduce cohesive sediment flocculation
- Methods that remove deposited sediment
 - Dredging
 - Agitation of deposits

Refinement of the estimates in Figure 10 can be accomplished by further data collection, calculations and analyses. Definitive diagnoses will require sophisticated modeling beyond the scope of this work, but may be unnecessary. If a most probable diagnosis of sedimentation processes can be established, and a solution with the greatest chance of success and best environmental effects can be identified in Task II, it can be recommended for implementation or further investigation at the discretion of the respective port authorities.

Selection of the best engineering solution from the range of alternatives can be accomplished using the diagnosis of causes followed by an assessment of each solution's likelihood of success for the circumstances of each port.

Traditional dredging and disposal remain an option for the ports, provided that it can be done expeditiously and economically. Task III of this work will examine that option in more detail and in comparison to the non-dredging solutions.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Sedimentation is a significant problem for five of the six public ports on the Mississippi section of the Tennessee-Tombigbee Waterway. Port Itawamba, Port of Amory, Port of Aberdeen, Port of Clay County, and Lowndes County Port all experience sedimentation that at least reduces efficiency of operations. Yellow Creek Port has not experienced sedimentation problems. A new barge terminal at Burnsville has been open too short a period to determine if sedimentation will be a problem.

Dredging and disposal are traditional solution for port sedimentation, but has become more expensive and more difficult to obtain.

Alternative engineering solutions to excess sedimentation problems are available and may prove to be viable alternatives to traditional dredging; therefore, they should be examined for feasibility.

The degree and causes of sedimentation problems vary among the ports. As a first estimate, two processes appear to dominate – vessel resuspension of bed sediments and dispersion into port facilities, which dominates in the Canal section, and transport from upstream during flow events, which dominates in the River section of the Waterway.

Further data collection and analyses as described in Task II of the Scope of Work will lead to more refined and reliable diagnoses of sedimentation causes and recommendations for the engineering solutions to excessive sedimentation.

Recommendations

Based on the findings presented here, it is recommended that:

- Task II of the Scope of Work be performed
- Data collection and analyses focus on two or three ports, one in the Canal section and one or two in the River section of the Waterway.
- Extrapolate findings from those two or three ports to the other Waterway ports.

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APPENDIX: SCOPE OF WORK

Appendix A: Task Descriptions for Proposed Research Project: Port Sedimentation Solutions

To Be Conducted as a Work Assignment
Under the Master Contract
Between the Mississippi State University
And
The Mississippi Department of Transportation

Purpose: To determine if there are feasible, affordable engineering solutions to reduce or eliminate dredging requirements at docks and mooring areas at the Mississippi public ports on the Tennessee-Tombigbee Waterway.

Principal Investigator: Dr. William H. McAnally, P.E.

MSU Project Manager: Dr. Thomas D. White, P.E.

PROBLEM: Sedimentation near the docks and mooring areas of the six public ports on the Tennessee-Tombigbee Waterway (TTW) hinders barge access. While the US Army Corps of Engineers has responsibility and does the dredging of the navigation channel, the Corps does not dredge near the docks or mooring areas. The port authority (City, County, or State) must acquire their own dredging services. Sometimes the port authority can “piggy-back” on a Corps contract, but not always. Small dredging jobs are becoming increasingly difficult/expensive to acquire. Even the Corp has experienced difficulty in recent years in acquiring dredging services at reasonable rates.

Several port directors have proposed that the Mississippi Department of Transportation (MDOT) take the lead in the purchase of a dredge, with the cost shared by MDOT and the port authorities, but the issues of purchase cost, operation, and maintenance over the long term have not been fully developed. A determination of cost/benefits is a desirable product of this research project.

SCOPE OF WORK: The Civil Engineering Department of Mississippi State University (MSU), in accordance with the terms of this work assignment, and for the agreed price, will accomplish the necessary work for the following tasks:

Task I. Preliminary Evaluation

Conduct an analysis of each of the six publicly owned ports on the Tennessee-Tombigbee Waterway to determine the extent of sedimentation in the docking and mooring areas. The initial assessment will include interviews with port directors or other port personnel, coordination with the Corps of Engineers, the Tenn-Tom Development Authority, the office of Land and Water Resources of the MDEQ, and agencies as appropriate, collection of existing data, and analyses. The work product of the initial assessment will be a draft technical memorandum, which, for each port, will include as a minimum:

- A history of sedimentation problems
- A dredging history including
 - Intervals between dredging necessity
 - Cost
 - Environmental issues of spoils disposal
- An assessment of current sedimentation
- A preliminary assessment of whether engineering alternatives may be viable options for relief of sedimentation at the port.

Engineering alternatives may include waterway and port training structures, reconfiguration of port waterside facilities, and/or specialized equipment such as jet arrays to prevent sediment from depositing or consolidating.

This first task may result in a conclusion that engineering alternatives to dredging are not feasible or practical at some of the ports, and these ports should be excluded from the work in Task II. Therefore, it includes a Decision Point Briefing to summarize preliminary conclusions for the MDOT and reach a decision on which ports to include in Task II.

Subtasks and deliverables for Task I are described in Appendix A.

Task II. Engineering Alternatives

Those ports, identified in Task I as viable candidates for engineering alternatives to dredging, will be thoroughly analyzed in Task II. Recommended engineering alternatives will be developed for each port, to at least a conceptual design level, including drawings of the port with alternative design features superimposed. Cost estimates commensurate with the conceptual design level will be developed for all recommended alternatives.

The work products of Task II will include a technical report for each port, or a single report with chapters or sections addressing each port. The report(s) will include as a minimum:

- Concept level plans for the recommended engineering alternative(s)
- Cost estimates for the alternative(s) commensurate with the conceptual design level
- A cursory examination of the environmental impact of the alternative(s). “Cursory” is used to describe a level of analysis sufficient to identify environmental impacts that could be potential “show-stopper” issues for the alternative

- Evidence of coordination with the Corps of Engineers and the Tenn-Tom Development Authority which reflects that the alternative is at least acceptable for pursuit to a final planning/design stage
- An analysis of the projected long-term effectiveness of the proposed alternative compared to dredging.

Subtasks and deliverables for Task II are described in Appendix A.

Task III. Comparison of the Dredge Purchase Option

Task III will include an economic analysis that compares the costs and benefits of the engineering alternatives to the purchase, operation, and maintenance of a dredge dedicated to the Mississippi Tenn-Tom Waterway public ports. The analysis will consider a sufficient time period to make the comparison meaningful, but not less than a ten-year period. The analysis must consider projected dredging costs at any ports not addressed in the Task II work in the comparison.

The product of Task III will consist of a report (or report chapter) and a presentation that describe the costs and expected benefits of a state-owned dredge, compare them with the costs and expected benefits of any recommended engineered alternatives, and recommend a course of action for MDOT and the appropriate ports.

Subtasks and deliverables for Task III are described in Appendix A.

Task IV. Final Reviews and Presentation

Following completion of Tasks I-III, clarifications to the findings will be made as necessary and a project summary will be presented to the Inland Water Transportation Committee of the Transportation Research Board at the summer 2003 meeting.

APPENDIX: SUBTASK AND DELIVERABLE DESCRIPTIONS

Details of the Tasks are presented below as numbered subtasks and a list of deliverable items.

I. Preliminary Evaluation

A. Interviews. The MSU principal investigator and/or associates will visit the Tenn-Tom Waterway (TTW) Development Authority, each of the 6 public TTW ports in Mississippi, the Corps of Engineers, and MDOT to explain the research project, solicit views on potential solutions and anticipated problems, and begin acquiring data for analyses.

B. Data compilation. Gather data from the ports, Corps, and other sources such as U. S. Geological Survey and compile them into a form susceptible to analysis and display. Conduct follow-up visits to further obtain and clarify data and metadata. Screen data for quality assurance and to determine if they meet minimum study requirements.

C. Data Analysis. Analyze data to characterize flows and sediment loads in the TTW and appropriate tributary streams. Define the characteristics of sediments in transport and in the bed. Calculate volume and timing of sediment deposition in the port facilities and correlate those with measured flows, sediment loads, and other forcings. Identify data gaps that limit the analysis and recommend additional data collection as necessary. Create graphical displays.

D. Evaluation. For each port, identify probable primary causes for port sedimentation and engineering alternatives that may remedy them.

E. Report. Prepare a technical memorandum and briefing materials describing Task I findings as listed in the Task description, including appropriate maps. Supply 2 paper copies and digital copy of draft memorandum and presentation materials to MDOT for review. Meet with MDOT to decide on which ports will be examined in Task II. Revise drafts according to review comments and submit final versions to MDOT.

II. Engineering Alternatives

A. Data collection. Fill data gaps identified in Task I by acquiring data from others or collecting data directly. Expected data gaps consist of some suspended sediment measurements in the vicinity of ports and characteristics of sediment that deposits in each port. MSU will recommend to MDOT additional data collection beyond the scope of this effort, if necessary.

B. Engineering design. Prepare feasibility level designs, consisting of structure and facility layout drawings, overall dimensions, and equipment descriptions, for recommended engineering alternatives to reduce or eliminate sedimentation problems for each port selected for Task II evaluation. Estimate benefits and costs to construct, operate, and maintain the alternatives.

C. Environmental Assessment. Assess the probable effects of the recommended engineering alternatives on water quality and biota. Identify those environmental effects that might prevent implementation of the alternatives and procedures (permitting, etc.) that will be necessary if the alternatives are implemented.

D. Report. Prepare a draft technical report and briefing materials describing Task II findings as listed in the Task description for each port. Provide 2 paper copies and digital copy of all draft reports and presentation materials to MDOT and two paper copies of each port's report to the respective port director for review. Present findings to MDOT and port representatives. Revise drafts according to review comments and MDOT consultation and submit final versions to MDOT and ports.

III. Comparison of the Dredge Purchase Option

E. Identify dredge requirements. Use Task I findings on volume and nature of deposited sediments and port needs to estimate frequency and volume of required dredging. Identify dredged material placement options. Select a dredge type and size that will best provide the required capabilities. Estimate benefits and costs to purchase, operate, and maintain the selected dredging equipment.

F. Environmental Assessment. Assess the probable effects of the dredge purchase option on water quality and biota. Identify those environmental effects that might limit implementation of the option and procedures (permitting, etc.) that will be necessary if the alternatives are implemented.

G. Report. Prepare a summary report and briefing materials combining all Task II port findings plus Task III findings. Brief MDOT and ports on overall recommendations.

Deliverables

Task I:

- Introductory briefing on research study. One paper and one digital copy of slides.
- Technical Memorandum. 10 paper copies and one digital copy.
- Decision briefing. One paper and one digital copy of slides.

Task II:

- Report on recommended engineering alternatives for each port selected. 2 paper copies and one digital copy for each port, 10 paper copies and one digital copy for MDOT.
- Recommendations Briefing. One paper copy and one digital copy of slides for each port.

Task III:

- Summary Report. 20 paper copies and one digital copy.
- Summary Briefing. One paper copy and one digital copy of slides.