SECTION 6

Dredging, Disposal, and Beneficial Reuse Analysis

The management of dredged material is a major consideration in the evaluation of selected alternatives for further E&D. Previous studies have discussed methods for the dredging and reuse of dredged material, and at this point in the evaluation, it is assumed that a large-scale dredging program would be possible. A dredging program, depending on its extent, can have significant impacts on the cost and schedule of the project. The most fundamental aspects driving the viability and cost of a dredging program will be the volume of dredged material and the options available for ultimate disposal or reuse.

Evaluation of a potential dredging program were limited mostly to volume determination as presented in Section 3 of this report. Overall project alternatives were screened to a smaller number as described in this Phase 1 Design Report, and the dredge volume estimates per reach of the bayou will be refined during the 30 percent design.

Refinement of the project alternatives in later phases of design will require ongoing development of many of the following key issues related to a dredging program:

- Channel design, including slope, dredge depth, and dredge volume
- Physical characteristics of dredged material, including debris
- Chemical characteristics of dredged material
- Permit requirements
- Dredging methods and equipment
- Transport of dredged sediments
- Interim storage and dewatering of dredged sediments
- Final disposal or reuse of dredged materials
- Public perception and involvement

The Phase 1 design effort focused on the key issues associated with dredging. These issues are presented in the following sections.

6.1 Dredge Volumes

The channel capacity evaluation described in Section 3 generated detailed estimates of dredging volumes and measures of dredged material distributed along the channel for each given dredge template. The reaches were differentiated by reviewing the existing bottom invert profile, and separating the overall route into four reasonably uniform slope segments and additional subreaches within those segments with similar bottom widths and geometry along the bayou. The HEC-RAS program has a feature that compares two cross sections within its data input and computes the difference in area. The difference in area was then used to compute a prismatic volume for the different dredge alternatives. Dredging and bypass channel excavation calculations are presented in Appendix D. The total dredge volume for the conveyance alternatives were listed in Table 3-6.

Volumes of dredged material, average dredging depth, and volumes per linear foot were determined for each alternative by design reaches identified in Section 3. A summary of the unit volume of dredge material for the bayou dredge templates is presented in Table 6-1. For the Smoke Bend alternatives, dredging begins at RM 3.4, just downstream of the Palo Alto Bridge.

TABLE 6-1
Dredge Quantity Summary
Mississippi River Reintroduction into Bayou Lafourche – Phase 1 Design Report

		Dredge Quantity	
Route	**Dredge Template**	**(mcy)**	**(cy/ft)**
BL	2-0@RM3.4	0.23	12.8
BL	2-0@RM29	2.85	18.6
BL	8-0@RM29	4.34	28.3
BL	2	4.77	16.1
BL	8-2@RM3.4	4.93	16.7
BL	8-2@RM29	6.73	22.7
BL	8	8.62	29.1
SB	2-0@RM29	2.63	17.2
SB	2	4.55	15.3
SB	8-2@RM29	6.35	21.4
SB	8	8.24	27.7

Notes:

BL = Bayou Lafourche
cy/ft = cubic yards per foot
SB = Smoke Bend

In general, dredging volumes would be the greatest from Palo Alto Bridge to RM 12.0. Large volumes of dredge material would also need to be dredged in the 10 miles of bayou immediately upstream of the weir in Thibodaux. For alternatives that include dredging down to Lockport, almost half the dredged material would come from the reach of the bayou beginning upstream of Thibodaux (RM 29.0) to Lockport, despite an average dredging depth of only 2 feet. This is because of the increased cross section width of the bayou downstream of Thibodaux. Thus, the depth might be shallow but the width of the dredge template might increase considerably.

6.2 Sediment Quality

6.2.1 Sediment Study Overview

Sediment quality parameters of interest include the soil's physical and chemical composition. CH2M HILL studied the Bayou Lafourche sediments (Sediment Study) (EPA, 2004) for EPA to support the analysis of alternatives for this project by characterizing the sediments that might be removed. The Sediment Study investigated the suitability of sediments for open water disposal in the Mississippi River, placement in an upland facility, and placement on adjacent agricultural fields. In addition, potential impacts on water quality at the dredging site (i.e., Bayou Lafourche) during dredging operations were evaluated.

The bulk sediment samples from 50 stations in Bayou Lafourche were chemically characterized for the Sediment Study. Samples for chemical characterization were collected within the top 3 feet and analyzed for the following parameters:

- Trace metals
- Chlorinated pesticides
- Polychlorinated biphenyls
- Semivolatile organic chemicals
- Other general chemistry parameters

To meet the Sediment Study objectives, five sample reaches, designated A through E, were identified. These reaches extend from Donaldsonville (RM 0.0) to Company Canal at Lockport (RM 55.8). The reaches were selected to represent specific areas of interest in the study area as determined by application of a stratified sampling approach, which considered factors such as anticipated dredging depth (based on then-current data), potential disposal options, known or suspected contaminant sources, physical composition of sediments, and water quality. The Sediment Study reaches do not necessarily correspond to those developed in this analysis because the Sediment Study was conducted before the Phase 1 design. Figure 6-1 identifies sediment sampling locations.

A screening-level evaluation was conducted for each of the disposal options and beneficial reuse options listed in this Phase 1 Design Report. This screening-level evaluation is intended to be a preliminary screening evaluation to identify issues associated with each sediment disposal/reuse alternative to confirm that they are viable options for further consideration.

According to this screening-level evaluation, no limitations were identified for the disposal and beneficial dredged material reuse options. Each of the disposal and beneficial reuse options listed in this Phase 1 Design Report appear to be acceptable according to existing information and should be carried forward for further consideration.

Additional investigations, including additional field sampling, might be necessary to make a final determination that the dredged material and dredging alternatives meet the regulatory requirements for the disposal and reuse options being considered.

The suitability of dredged material for specific disposal/reuse options will ultimately include other non-technical considerations associated with the project, such as public perception and community acceptance.

6.2.2 Sediment Quality Relative to Beneficial Agricultural Reuse

The Sediment Study supports the analysis of alternatives for the project by characterizing the sediments that would potentially be removed. Section 7 of the Sediment Study discussed the physical and chemical characteristics of sediments and how they might impact the potential beneficial reuse alternative of applying dredged sediments from Bayou Lafourche on the adjacent agricultural fields adjacent to the bayou.

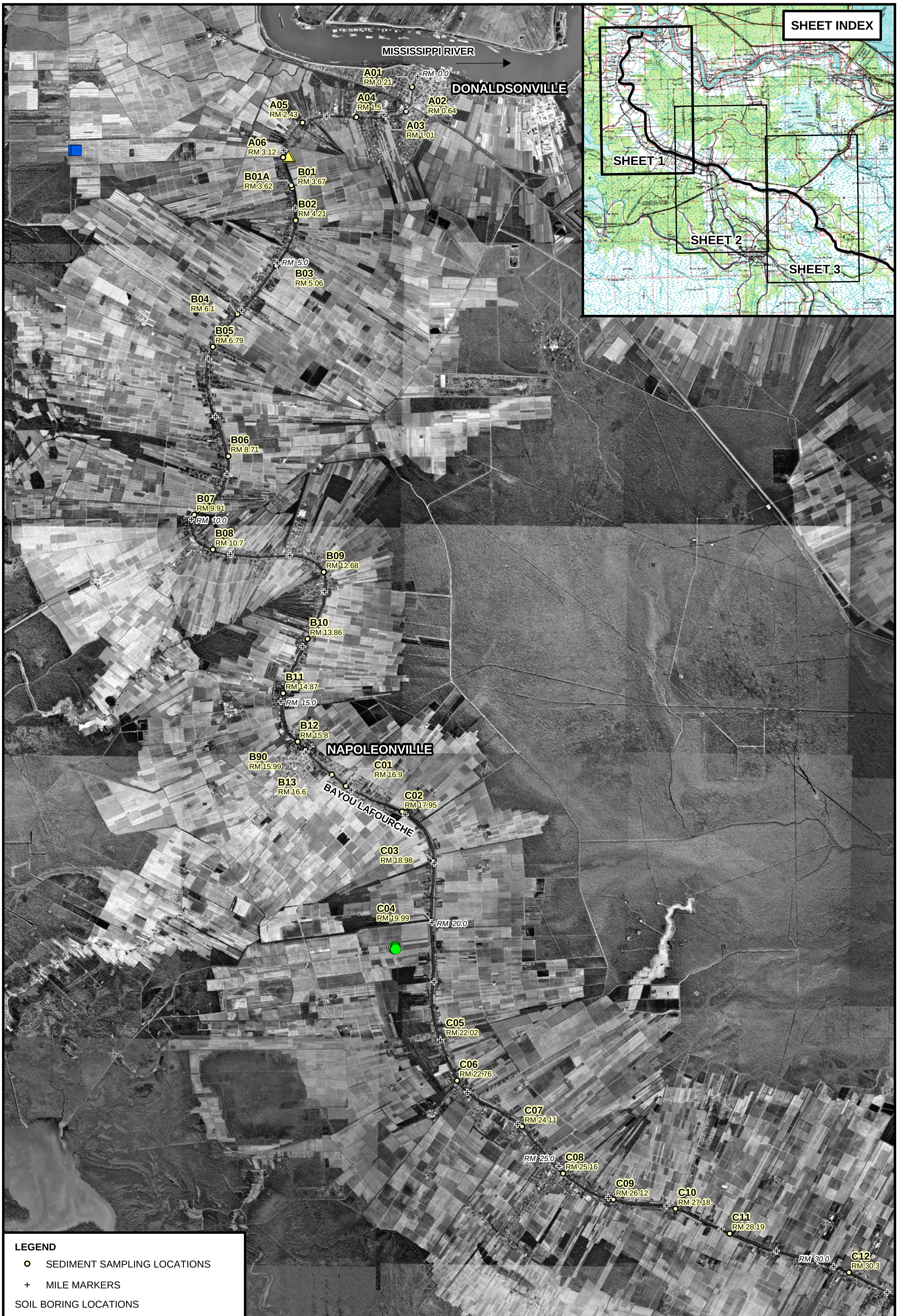

FIGURE 6-1
BAYOU LAFOURCHE SEDIMENT SAMPLING LOCATIONS (SHEET 1 OF 3)
MISSISSIPPI RIVER REINTRODUCTION INTO BAYOU LAFOURCHE
LOUISIANA DEPARTMENT OF NATURAL RESOURCES
PHASE 1 DESIGN REPORT

CH2MHILL

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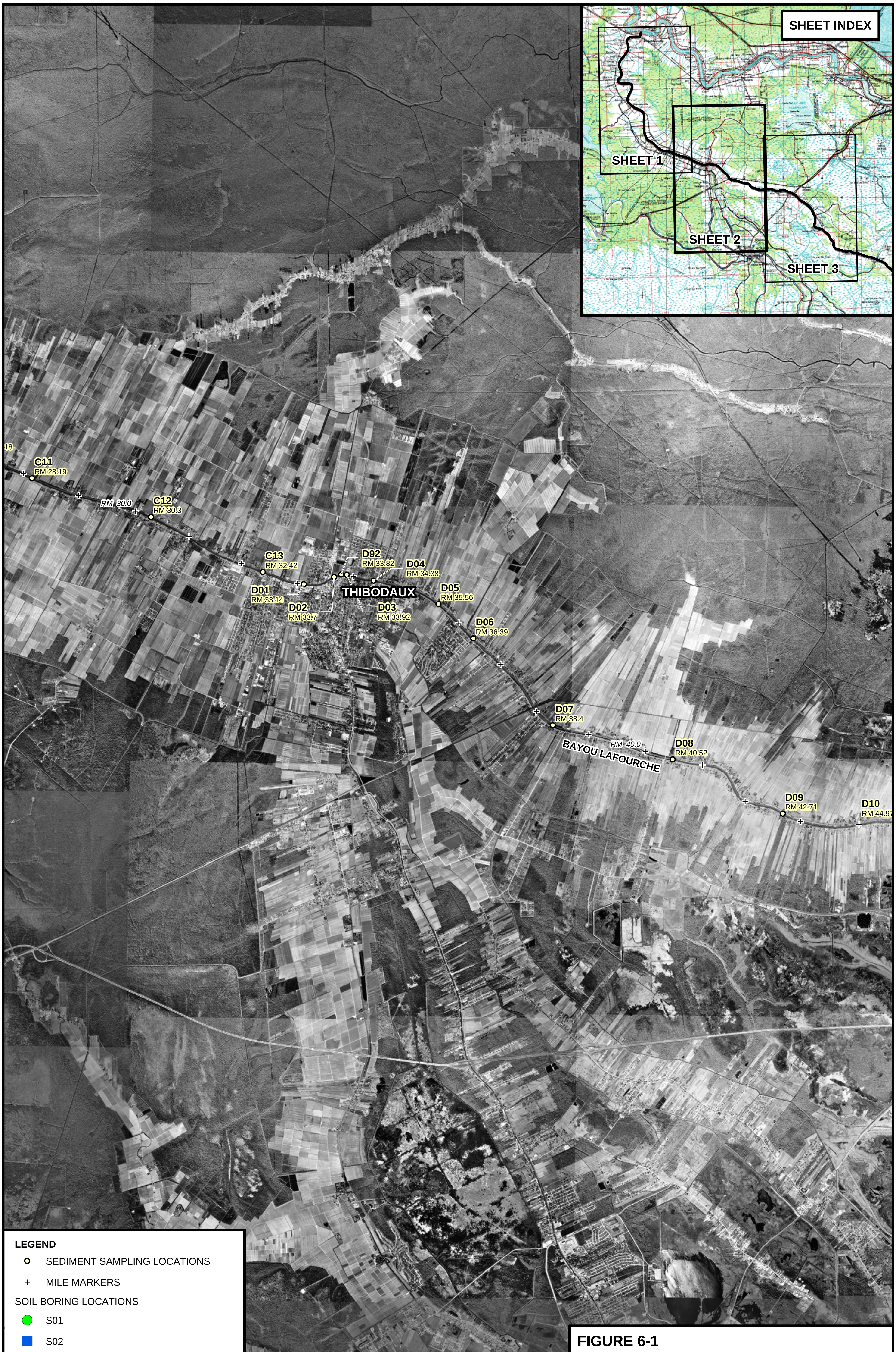

FIGURE 6-1
BAYOU LAFOURCHE SEDIMENT SAMPLING LOCATIONS (SHEET 2 OF 3)
MISSISSIPPI RIVER REINTRODUCTION INTO BAYOU LAFOURCHE
LOUISIANA DEPARTMENT OF NATURAL RESOURCES
PHASE 1 DESIGN REPORT

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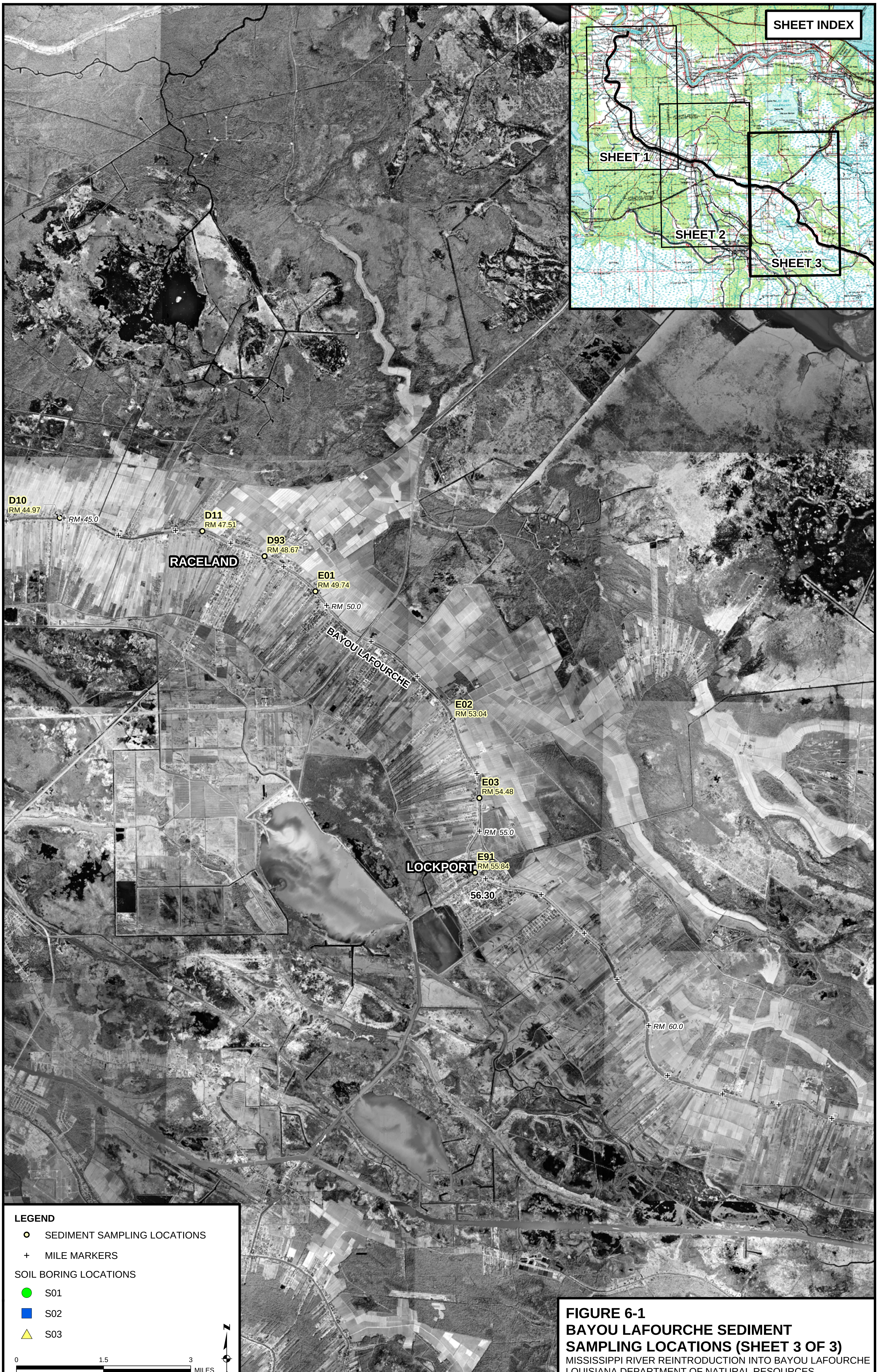

FIGURE 6-1
BAYOU LAFOURCHE SEDIMENT SAMPLING LOCATIONS (SHEET 3 OF 3)
MISSISSIPPI RIVER REINTRODUCTION INTO BAYOU LAFOURCHE
LOUISIANA DEPARTMENT OF NATURAL RESOURCES
PHASE 1 DESIGN REPORT

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Laboratory testing of collected soil samples included grain-size distribution, identification of the soil classification group according to the Unified Soil Classification System, percent moisture, permeability, percent organic matter, pH, sodium adsorption ratio, cation exchange capacity (CEC), electrical conductivity, total Kjeldahl nitrogen, and total phosphorus. Results from samples collected in four combined reaches along the bayou were compared to those from samples collected on upland soil areas in sugarcane fields.

According to the Sediment Study, possible limitations of the sediments used as agricultural topsoil included grain size that was too sandy and high pH in Reach A compared to the results found in the upland soils. Reach A is the area at the beginning of the bayou in Donaldsonville to the Palo Alto Bridge. The difference between the sediment in that reach and those soils tested in an upland area are not necessarily a problem. The addition of a sandier textured soil from the Reach A sediments to the more fine-textured, existing topsoil could be a beneficial amendment to agricultural topsoil that would improve soil permeability. Although changes in soil texture might be minimal, mixing sandy sediments with the finer textured upland soils might produce a loam texture (U.S. Department of Agriculture soil classification terminology) that would benefit plant growth.

The relatively higher soil pH in the bayou sediments would quickly leach because of the abundant rainfall in the area. Raising the pH slightly in the existing upland soils might also be beneficial. The tested upland soils had a mean pH of 6.1; therefore, it would not affect the agricultural value of the soil if the pH were raised by a few tenths. Good plant growth is typically expected along with favorable conditions for nutrient uptake in soils when the soil pH ranges from 6.0 to 7.0. The nitrogen fertilizers typically used to grow sugarcane tend to lower soil pH; therefore, the addition of a more basic soil pH from the dredged material improves existing soil conditions.

The sampled bayou sediments became finer with higher percentages of clay proceeding down the bayou. The clay- and silty-clay-textured soils are similar to those already found in the topsoil of the upland soil samples. It appears that the texture of the dredged material will have little potential change to existing soils except in Reach A.

The CEC levels in all soil test results indicated that salinity levels are low. CECs typically show results between 20 and 25, which is strictly related to the clay mineralogy of the soil. Soils in Reach A showed slightly lower CECs, but the magnitude of the differences will not effect or impact the potential use of dredged spoil material to be added to existing upland soils. Sodium adsorption ratio test results show no problems associated with sodium accumulation. Nutrient levels (total phosphorous and nitrogen) are low but of little concern because fertilizers are added to crops being grown anyway.

In summary, the existing data provided in the Sediment Study indicate little potential impact if dredged material is added to existing upland soils. One issue to consider is how much land is required for soil spreading. Currently, it is assumed that more than 2 to 4 inches of soil in any one area might impact local drainage based on the natural slope of the field. As an example, if a low area of a field were filled with dredged sediments, the surface water runoff that might have naturally accumulated will be forced to drain elsewhere. This might be desired by some farmers in some of their fields; however, until additional information is gathered and areas better identified, modifying drainage patterns in the sugarcane fields might not be a widespread benefit but, rather, an impact to be avoided.

6.3 Disposal and Reuse Options

This section reviews the potential options for disposal or beneficial reuse if material is dredged from Bayou Lafourche. The ultimate spoil material disposal or reuse solution must be identified before an overall dredging program can be defined. The ultimate disposal and reuse options will vary, depending on proximity to disposal or reuse site, sediment quality, permit conditions, and dredging methods selected by contractors. The following disposal and reuse options are considered to be the likely range of alternatives available:

- Open water placement in the Mississippi River
- Placement into a confined disposal facility (CDF)
- Placement in an upland environment
- Disposal into a solid waste landfill
- Beneficial reuse as agricultural soil
- Beneficial reuse as construction fill for residential or industrial use

These options are discussed in the following subsections and grouped into either disposal or reuse categories.

6.3.1 Disposal Options

It is assumed that beneficial reuse of most of the dredged material is preferable to pure disposal options. However, there will probably be a combination of solutions as the project is constructed and operated.

Open Water Placement in the Mississippi River

Open water disposal might be desired for limited quantities of material or maintenance dredging in the future (e.g., forebay maintenance). Open water disposal would require pipeline conveyance and the pumping capacity to overcome a 30-foot levee. Dredged materials proposed for open water disposal must meet Clean Water Act 404(b)(1) guidelines, which are substantive environmental criteria established by the EPA. These guidelines provide the basis for factual determinations with regard to dredged material activities.

The Sediment Study evaluated sediments proposed for open water disposal with regard to the application of exclusionary criteria and the need for further testing. For the Sediment Study, only sediments from Reach A, the portion of Bayou Lafourche through Donaldsonville to Palo Alto Bridge (RM 0.0 to 3.4), were considered viable for open water placement in the Mississippi River because of the proximity of this reach to the river.

The Sediment Study analysis consisted of a comparison between the proposed dredged material (bayou) and disposal site (river) sediments to determine whether they have the same general characteristics. Sediments were considered substantially similar if they showed no significant statistical difference in chemical or physical composition. Six sediment samples from Reach A and one sediment sample from the proposed Mississippi River open water disposal site were analyzed for chemical and physical parameters. The mean concentrations of detected parameters from the six samples in Reach A were then statistically compared with the results from the Mississippi River sediment sample using a statistical approach.

The results of the comparative analysis demonstrated that deposited sediments within Reach A are substantially similar in both physical and chemical characteristics to the Mississippi River disposal site. In accordance with this analysis, the Sediment Study concluded that sediments from Reach A would meet the exclusionary criteria, as outlined in Section 230.60(c).

On the basis of the Sediment Study results, and consistent with the conclusions in that document, it is assumed for this screening-level evaluation that open water placement into the Mississippi River is a viable alternative for sediments from Donaldsonville to Palo Alto Bridge, and a pump station forebay, if selected. Final regulatory approval and permitting will be required during the final design phase.

Upland Confined Disposal

The USACE and EPA define a CDF as "an engineered structure consisting of dikes or other structures that extend above any adjacent water surface and enclose a disposal area for containment of dredged material, isolating the dredged materials from adjacent waters or land" (USACE and EPA, 1992). The isolation of the sediments from adjacent waters or land during and following disposal distinguishes a CDF from other forms of disposal such as unconfined upland or open water. CDFs are not solid waste landfills, but are designed and constructed specifically for disposal of dredged sediments and their unique properties such as high initial water content and the drainage of excess water to surface waters. Soil placed in a CDF is essentially not available for other uses. It is assumed that beneficial reuse options would be preferable to a CDF facility and that such a facility would only be used for relatively small quantities of dredged sediments.

The Sediment Study evaluated the potential for using CDFs as an ultimate disposal option for dredged sediments from Bayou Lafourche and concluded that sediment quality issues did not exclude their use as an option.

Upland Placement/Containment

According to the 1998 Summary Report, upland placement was expected to be performed in 25- to 30-acre containment areas within 1 mile of the bayou. The containment areas would be surrounded by dikes on each of the four sides with an inlet at one end and a weir at the other end for water discharge. The water will be discharged from the containment area into drainage ditches near the outlet. After the dredged material is dewatered, it would be beneficially used as agricultural soil or construction fill.

Design of upland containment areas will require proper sizing to allow for sufficient retention time of the dredged material for settling. A weir/decanter system would likely be constructed to allow for water to be decanted off the top, but underdrains would also need to be installed to fully dewater the soil. Decant water might be directed into nearby drainage ditches.

Following initial discussions with several landowners near the bayou, placement of dredged material in containment areas within 1 mile of the bayou appears to be a viable option. The siting of these facilities would be subject to both landowner acceptance and the amount of material at any given location along the bayou. A more comprehensive screening evaluation will be required as the design progresses. Regulatory approval and permits will also be required during the design phase.

Landfill

Disposal of soils or debris that are not considered suitable for any other reuse option might require disposal in a solid waste landfill. Sections within the bayou might contain material considered suitable only for landfill disposal, although no areas were identified in the Sediment Study. Landfill disposal will consist of mechanical dredging and transfer into a truck for transport to a local landfill. Landfill disposal typically requires certain limits on free water in the waste; therefore, the material will most likely need to be dewatered to a certain level before being taken to a landfill.

Because of the high costs for placement of dredged material in a landfill, it is not a viable option for large volumes. However, it is expected that some degree of landfilling will be required with any extensive dredging program in the bayou.

6.3.2 Reuse Options

The following beneficial uses of the spoil material were evaluated after upland placement:

- Agricultural use
- Construction fill

Agricultural Use

One consideration for reuse of dredged sediments is placing them on the surrounding sugarcane fields, either after the sediments have been dewatered, or directly on the sugarcane fields while wet. Because of the method of farming sugarcane, this might provide some opportunities and difficulties.

Typically, sugarcane is grown in the same field for 4 consecutive years. Sugarcane is planted using good-quality seed cane that is harvested and then planted in furrows that have been benched up from the surrounding soil to provide better drainage. Typically, the cane is planted mid-August through September. The cane is referred to as “plant cane” that will be harvested the next fall from late-September until the end of the year. The same field of cane will then be cared for and harvested for 3 more years with the cane being referred to as first-, second-, and third-year stubble. Often weeds, disease, and insect damage will injure the cane and its sugar yield to the point that, after the second or third year of the crop, the field will be plowed up for replanting.

After the last harvesting in the fall of that normally fourth year of cane, and before replanting the next August or September, the field is left fallow. There are some alternatives to this but, typically, the field lies fallow with some weed control measures. At any one time on a typical sugarcane operation, 20 to 25 percent of the fields are fallow for 9 to 11 months.

These fallow fields provide an opportunity to directly apply dredged sediments to fields. The location of these fields change each year on a rotation basis. It is expected that the farmers would require demonstration that the spoil material are as follows:

- Not contaminated in any way
- Compatible in nutrients and texture
- Ready for farming by the next planting season

It is expected that under no circumstances would farmers allow sediments to be applied to cane fields during its normal 4-year growth cycle where potential crop injury would be likely. However, this would be a discussion point with the cooperating farmers.

As alternatives to increase flow into Bayou Lafourche are narrowed and potential areas of dredging are better identified, discussions with local sugarcane farmers are recommended to address this option. For this option to be considered, it will be vital for the design team to interface with the American Sugarcane League (located in Thibodaux) to reach consensus on the idea and concept. Without the approval of the local agronomists, it is unlikely that any local sugarcane farmers will accept dredged sediment material on their land.

Construction Fill

Initial discussions with other local interests and the screening-level evaluation of sediment quality indicated that beneficial reuse of the dredged material as construction fill might be possible. Because of the nature of the low-lying lands, most home lots must be built-up before construction can begin. Additionally, USACE or local levee districts might have a need for the material for levee maintenance. Discussions with local contractors that haul and sell soil products might determine that the dredged materials have value that can be used to reduce the overall costs of the dredging program.

Dredged material would be temporarily stored in upland cells immediately after dredging. After the dredged material is dewatered, containment dikes can be removed and the dredged material can be loaded into trucks to be placed for construction fill.

The bioaccumulation tests performed in the Sediment Study were meant to address the potential for exposure of receptors (i.e., ecological and human health) to sediment contaminants used for agricultural soil. Although the use of the dredged material as construction fill was not directly addressed, the potential exposure concerns identified for use in an agricultural setting are applicable here. If the dredged material is sold for general purpose use as construction fill, control of its use is not realistic. The material must be permitted for unrestricted use that is acceptable in an industrial or residential setting. Regulatory acceptance and permitting requirements will be assessed in later phases of design.

Marsh Creation

Marsh creation/nourishment opportunities were not investigated in this Phase 1 design effort, but will be evaluated in the 30 percent design.

6.4 Dredging Method Options

The mechanics of dredging Bayou Lafourche have been addressed in previous studies. This section provides an overview of the most viable methods. Dredging equipment options include a hydraulic dredge, a mechanical dredge, or a combination of both. Mechanical dredging could be performed from the bank or from a barge. Hydraulic dredging would be performed from a barge.

Conveyance of mechanically dredged material could be achieved by truck or by adding make-up water in a slurry processing unit for pipeline conveyance. Conveyance of hydraulically dredged material would be through a pipeline. Pipeline conveyance might require the use of booster pump(s) located on the shoreline, depending on the distance to the disposal location.

The location of utilities, bridges, and structures will be incorporated into the dredging management plan later in the design process. Other programmatic and logistical considerations, including construction easements, site access, work schedule, coordination of multiple dredges, and potential impacts to traffic will be incorporated into the dredging management plan.

6.4.1 Dredging Equipment

Dredging equipment will be a key consideration during implementation of the dredging program. Selection of the equipment will depend on the type of dredging, volume of dredged material, amount of debris, and equipment availability. The following subsections describe dredging equipment likely to be used for the project.

Hydraulic Dredging

Hydraulic dredges remove and transport sediments in a slurry through a pipeline for placement at an upland or in-water location. If placed in an upland location, the dredged material is settled out. The percent of solids in the slurry is dependent on the dredge, the operator, and the type of material. Most hydraulic dredges are not self-propelled, but instead use spuds and swing winches (a type of walking mechanism) to move through a sediment removal area. Some hydraulic dredges rely solely on suction to remove sediments and are effective at preventing resuspension of sediments. Other dredges have a cutter head, high-pressure water jets, or a rotating auger to loosen sediment for subsequent suction into the hydraulic portion of the dredge. The selection of these dredges will be dependent on the consolidation of the sediments and contractor preference.

Compared to other types of dredges, hydraulic dredges can remove large volumes of material and offer advantages of flexibility, high production rates, and low cost. However, the amount of water that is generated with the spoil material must be managed, and disposal storage cells of adequate size to allow for necessary detention times to separate the solids must be available. Discharge of return water from the storage cells will likely require special permitting and water quality compliance. In those instances where the sediment particles are extremely fine, managing the dredged water and settling of solids could require a substantial effort.

Mechanical Dredging

Mechanical dredging equipment, such as clamshells and backhoes, are used to directly remove sediment by excavation. In contrast to hydraulic dredging, sediment can be removed with a minimum of added water mixing with the material. Therefore, the volume of dredged material is minimized, and there is less water to manage for disposal. Disadvantages of mechanical methods include the potential for a higher rate of sediment resuspension because of the physical disturbance of the bottom, increased cost, and lower production rate. Mechanical dredging allows for removal of sediments containing debris.

Recent advances in dredging technology have minimized resuspension of sediments with the advent of the Cable Arm™ or similar closed clamshell dredges. The design of the Cable Arm™ provides an ability to control the vertical cut in the sediments and minimize resuspension during dredging.

Mechanical dredges require either a supporting barge to contain the material for transport and disposal or dump truck access (this is not considered feasible in most areas along the bayou). If a mechanical dredge were used in Bayou Lafourche, the dredged sediment material would be off-loaded from the barge using a separate excavator and then trucked to the disposal site or mixed with water to create a slurry for pumping to the disposal site.

Selection of Dredging Equipment

Selection of the different dredging equipment will be evaluated according to implementability, effectiveness, and cost. Mechanical dredges operate at a slower production rate compared with hydraulic dredges. However, mechanical dredges produce less water that needs management (as compared to hydraulic dredges) and can process debris easier. One dredging method might not be sufficient to remove the proposed magnitude of material volume because of the variability of dredging volume and depth, the distance to disposal sites, and the limitations created by debris and existing utilities and structures. The preferred dredging equipment might include both mechanical and hydraulic. Further analysis will be performed as the design progresses.

6.4.2 Conveyance/Transport

The conveyance method of dredged material will depend on dredging equipment. Conveyance of mechanically dredged material could be achieved by truck or by adding make-up water in a slurry processing unit for pipeline conveyance. Conveyance of hydraulically dredged material would be through a pipeline.

Mechanical Dredge

This method assumes that a barge will likely be used to transport the spoil material along the bayou. Off-loading sites are required to relocate mechanically dredged material from a barge to trucks. Sites will be required at multiple locations along the bayou to avoid long transport times of the material barge and spoil material. Off-loading will likely be performed by land-based equipment. Significant truck traffic will occur for this option.

Dredged material that is mechanically dredged could be slurried for pipeline conveyance, but it will require additional make-up water. The slurried material will be hydraulically pumped to a disposal site for dewatering, similar to a hydraulically dredged material.

Hydraulic Dredge

Pipeline conveyance might require the use of booster pump(s), depending on the distance to the disposal location. Disposal locations that are less than approximately 1 mile from the bayou will not likely require a booster pump. As the design progresses, disposal sites will be identified for each reach, which will determine the need for booster pumps.

Culverts are available throughout the bayou to temporarily place dredge pipelines for the conveyance of dredged material across adjacent highways.

Conveyance of dredged material by pipeline is preferred. However, if dredged material is required to be disposed of in a landfill, or if mechanical dredging is the preferred equipment without a slurry processing unit, truck transport will be required.

6.5 Cost Development

Numerous factors will affect the overall cost of the dredging program for the bayou. Cost-related factors and the recommended planning-level cost for dredging are described in Section 7.2.

6.6 Permitting and Public Involvement

Permits identified in previous studies necessary for the dredging program might include the following:

- Water Quality Certification – Louisiana Department of Environmental Quality
- Section 404 Permit – USACE

The above permits will not be the sole permitting issues to be resolved related to the dredging program. During later design phases, a regulatory matrix will be constructed detailing possible regulatory concerns and associated actions to resolve the issues or obtain the permits. A key concern of regulatory agencies will be the potential of contaminated sediments being present in the dredged materials. The Sediment Study provides initial indication that contaminated sediments are not a significant consideration. However, more extensive sampling is required to provide a definitive understanding of the sediment composition. Discussions with the USACE and Louisiana Department of Environmental Quality will be initiated at the start of the 30 percent phase to verify additional data needs.