3 Sediment Characterization

Data Collection Strategy

Sediment data were needed at a high resolution for selected areas in which sediment transport modeling was conducted and at a lower resolution for the systemic analysis of navigation impacts. Within the selected areas for sediment transport modeling, modelers selected locations based on the model needs. All of these sediments were analyzed in detail for particle size distribution.

The systemic sampling was conducted along transects spaced at 8-km (5-mile) intervals in the study reach of the UMRS. The study reach was from Pool 3 to Pool 26 on the Upper Mississippi River and Brandon Road Pool to Alton Pool on the Illinois Waterway. Along each transect, sampling locations were selected laterally as follows: (a) in the center of the navigation channel, (b) at the location of 1.0 m at low-water conditions on both sides of the channel, (c) at the location halfway between the 1.0-m location and the shoreline on both sides of the channel, (d) at both shorelines at low-water conditions, and (e) at a terrestrial site 0.5 m above low-water conditions on both shores. Samples at the terrestrial location and the location halfway between the 1.0-m depth and the shoreline were not taken if the locations were within 10 m of other sampling sites. A maximum of nine locations and a minimum of five locations were sampled along each transect.

Although a sample of the sediment was retained at all systemic sampling locations, only sediments for every other transect (16-km (10-mile) intervals) were sent to the laboratory for analysis. All samples were classified by visual/tactile techniques in the field. The visual classification was to be used to extrapolate to the transects for which no laboratory analysis on the sediments was performed. The classification system included estimates of the dominant particle size for samples containing all sediments larger than silt (>63 µm). Those samples containing particles of size less than fine sand (<63 µm) were classified by both dominant and subdominant particle size. All sediments less than 63 µm were grouped into a silt/clay class because distinguishing between silt and clay was not possible using the visual/tactile techniques.

Sediments containing silt/clay were also classified into consolidated or unconsolidated sediments. This distinction was included because the systemic sampling was to be used for sediment resuspension predictions, and both particle size and cohesive properties determine the potential for resuspension of fine sediments. Several of the sites with consolidated cohesive sediments were selected for obtaining large amounts of sediments for laboratory testing of the potential for resuspension.

Sediment Collection

For the systemic transects, surficial sediment (top 10 cm) was obtained with a Wildco KB Sediment Core Sampler (Wildco Wildlife Supply Company) containing a plastic core liner (with approximate 5-cm inside diameter and 50-cm length) at the nearshore sites. A 23- × 23-cm (0.052-m^2) standard Ponar grab sampler (Wildlife Supply Company) was used to obtain sediment in the navigation channel. Nearshore sites were found based on the depth criteria described previously. This required obtaining an estimate of the water surface elevation by interpolating between elevation gauging stations prior to field sampling. The difference in the estimated water surface elevation on the day of the survey and the low-water condition of flat pool elevation in Table 1 was used to adjust water depths on the day of the survey. The sediments obtained were homogenized by mixing thoroughly. The sediment was subjectively classified by visual/tactile techniques into classes as previously described and listed in detail in Table 2.

Table 2
Classes used for Visual/Tactile Classification

Class	Description
1	Consolidated silt and clay
2	Predominantly consolidated silt and clay with some sand
3	Predominantly sand with some consolidated silt and clay
4	Silt and clay
5	Predominantly silt and clay with some sand
6	Predominantly sand with some silt and clay
7	Predominantly fine sand
8	Predominantly medium sand
9	Predominantly coarse sand
10	Predominantly gravel
11	Predominantly boulder
12	No sample obtained

A sample of the homogenized sediment from each sampling location was placed in a 0.5-L (16-oz) bag. The vertical depth of sediment sent for laboratory analysis differed for the nearshore sites (10 cm) and main channel sites (depth of sediment depended on the depth of the Ponar grab). Sediment from every other transect was sent to the laboratory for analysis and the remaining sediment retained for analysis in the future, if needed. Geographical coordinates were obtained with a real-time differential GPS unit for all sampling locations. A GIS coverage of the sampling locations was generated from the coordinates obtained and attributed with sediment characteristics.

Laboratory Analysis

All laboratory analyses performed by the U.S. Army Engineer Waterways Experiment Station (WES) were completed using modifications to published methodologies. Moisture content and bulk density were determined using gravimetric methods; organic content was determined as the loss of sediment mass on combustion at 550 °C; and particle size distribution for most samples was determined by hydrometer methods. Detailed procedures, including references, for analytical methods used by WES are included in Appendix B.

More detailed particle size analysis on some samples was performed by the St. Louis District using ASTM methods. Standards used include the following:

a. ASTM C117-95 (ASTM 1995)

b. ASTM C136-96a (ASTM 1996)

c. ASTM D422-63(R1998) (ASTM 1963b)

d. ASTM D2487-93 (ASTM 1993a).

The standard procedure ASTM C136-96a was used on the entire sample for about half the samples. The standard procedure ASTM C117-95 was used on the other samples based on the visual observation of the amount of sediment passing through a No. 230 sieve. The gradation of the sediment retained on the No. 230 sieve after washing was then determined by the ASTM C136-96a procedure. The exception was the use of the ASTM D422-63(R1998) procedure for a few samples. When the ASTM D422-63(R1998) procedure was used, the materials retained by a No. 10 sieve were sieved using the ASTM C136-96a procedure and included in the hydrometer results.