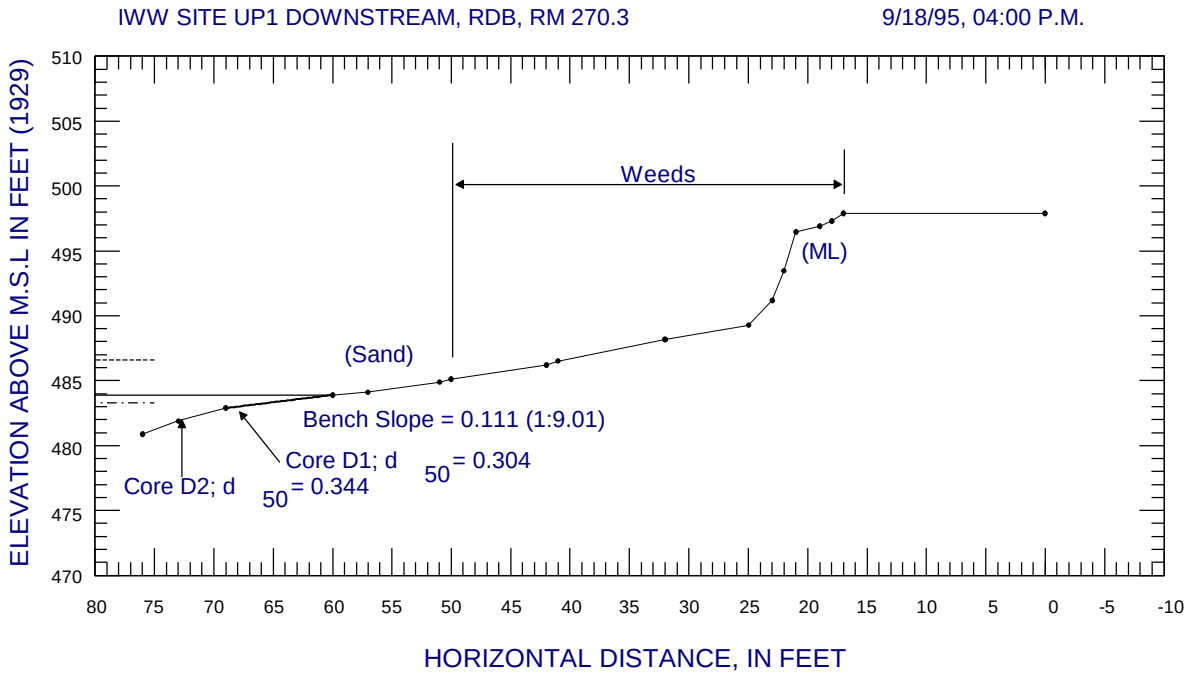

Figure 6-35. Bank sections at site UP1 (concluded)

The gradation plots of bank soils and nearshore sediment are presented in appendix F. At the midsection, the d_{50} varies from 0.009 mm at the top surface of the bank to 0.379 mm at the upper part of a core sample at a depth of about 2 feet of water.

The bench slope varied from 1V:6.8H to 1V:9.H. The bank at this site can be classified as a combination of types 1 and 3 (figure 6-18, 6-20, table 6-4). Floods and high water stages could be the major cause of bank erosion. There was a collapsed bank section. Failure could be due to erosional oversteeping. Several holes were observed on bank face indicating that piping could also be a factor in bank failure.

Site UP2, Marseilles Pool, 9/18/95. This site is located on the Left Descending Bank (LDB) at RM 270.8, opposite site UP1. Figure 6-33 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-36 shows one photograph of the site.

The site is about 280 feet from the sailing line and no major tributary enters the IWW at this location. In Bhowmik and Schicht's (1980) note, this side was marked as a dredge material displacement site. Trees and grass covered an obvious scarp approximately 3 feet in height 100

feet from the water's edge. The bench was composed of coarse sand, gravel, and boulders. More boulders were encountered between the scarp face and the bench.

Figure 6-37 shows the plot of the bank sections and a cross section. Only one river cross section and one bank section were measured at this site. The OHW is the same as site UP1 at 486.6 feet above msl, and NP at 483.3 feet above msl. On this side of the river, the OHW is on the bench area and only stages exceeding 10% occurrence level (table 6-7) can reach to the base of the minor scarp face at about 494 feet above msl.

Table 6-6. Site UP1

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	484.2	• Bench (slope varied from 1V:9H to 1V:6.8H)	• d_{50} (core) @ 2' of water varied (0.017-0.379)
75	484.6	• Bench	• d_{50} @ 1' of water varied (0.042-0.304)
50	485.5	• Bench	
25	487.3	• Toe of berm	
10	489.9	• Berm • Berm (slopes varied from 1V:1.05H to 1V:5H)	• d_{50} = 0.016
0-9	>490.0	• Toe of scarp • Scarp (slope varied from 1V:1.05H to 1V:0.38H)	• d_{50} = 0.009

Note: Tail water gage of Dresden Island @ RM 271.5 was used for stage histogram; WSE = 483.9'; OHW = 486.6'; NP = 483.3'.

Table 6-7. Site UP2

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	484.2	• Bench	• d_{50} = 0.617
75	484.6	• Bench	• d_{50} (core) @ 1' of water varied (0.239-0.589)
50	485.5	• Bench	• d_{50} (core) @ 2' of water = 0.429
25	487.3	• Bench	
10	489.9	• Bench (slope = !v:11H)	
0-9	>490.0	• Scarp (slope = 1V:9.2H)	• d_{50} varied (0.013-0.138)

Note: Tail water gage of Dresden Island @ RM 271.5 was used for stage histogram; WSE = 483.9'; OHW = 486.6'; NP = 483.3'.

Figure 6-36. Site UP2 on the Illinois Waterway

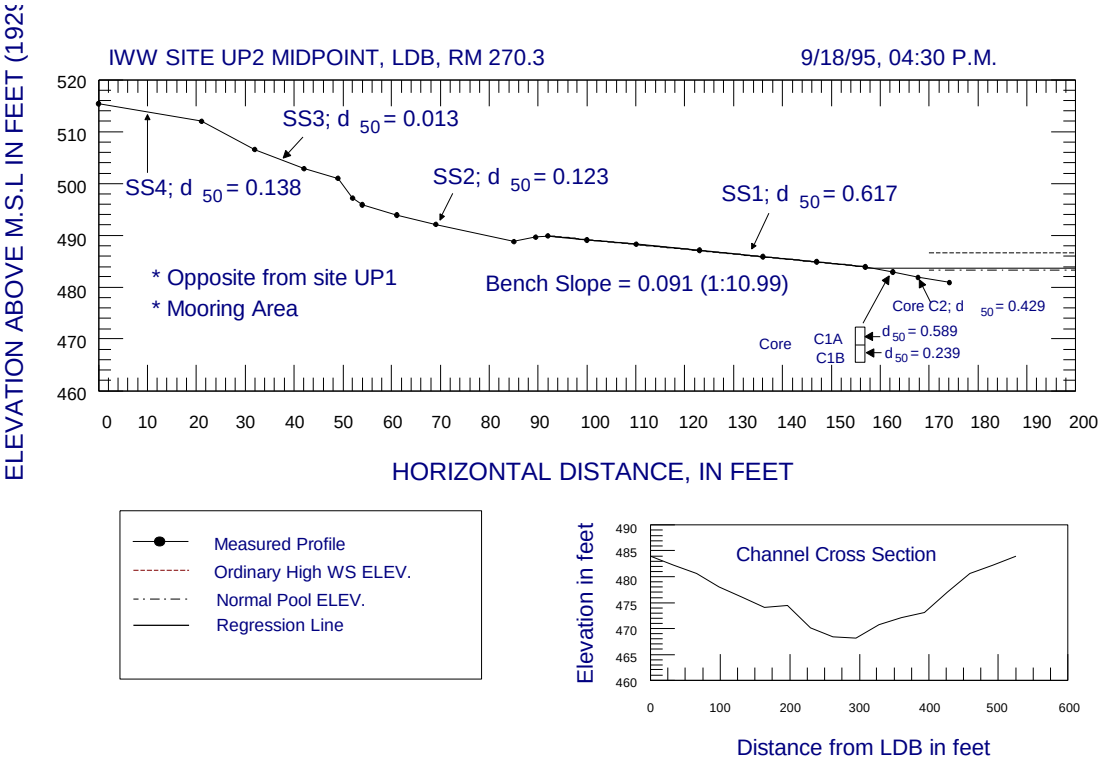

Figure 6-37. Bank section at site UP2, midsection

The d_{50} varied from 0.138 mm at the top surface of the bank to 0.429 mm for a core sample at a depth of about 2 feet of water. Another core sample at 1 foot of water showed coarse sand (d_{50} = 0.589 mm) on top and fine sand (d_{50} = 0.239) at the bottom. Gradation plots of bank soils and nearshore sediment are presented in appendix F. The detailed cross section and coordinates are shown in appendix G.

The bench slope was 1V:11.H, and the bench was covered with noncohesive sandy soil. This site can be classified as type 5 (see figure 6-22 and table 6-4). The scarp was above OHW stage. Erosion could have occurred during flood stages. The base of the scarp showed sand deposits indicating that seepage at the base could weaken the bank. Waves and currents could remove/transport failed soils that mantle the bench.

Site UP3, Marseilles Pool, 9/19/95. This site is located on the LDB at RM 264.3; the reach is fairly straight. The Morris Boat Club Dock and Vogler Gravel Company are located across the river at RM 264.5. No major tributary enters this site. Figure 6-38 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-39 shows one photograph of the site.

The site is about 250 feet from the sailing line as measured from the navigation chart. Both Bhowmik and Schicht (1980) and Hagerty (1988) indicated the existence of a significantly long stretch of bank erosion on the LDB. The site is currently used as a trailer park located at the top of the bank, and boat docks were installed. An abandoned boat ramp was found at the upstream end of the site. Quite a few boulders were found in the nearshore area. When taking core samples, the crew noted that sediments showed a very high level of oil staining, and oil emerged when the crew split samples.

An obvious scarp approximately 5 to 10 feet high was present at this site. Erosion of the bench area, if not retreat of the bank line, could be described as significant when compared with a 1988 photo. Figure 6-40 shows the three measured bank sections and a reduced cross section. At the downstream section, a concave bank face was observed. The OHW is at 485.7 feet and NP is at 483.3 feet above msl. The NP elevation corresponds to a break in the subaqueous bench slope. The OHW reaches to the upper part of the bench and corresponded well with the lower end of the weed zone. The bank top is relatively high and only high stages exceeding the 10% occurrence frequency (at 488 feet, see table 6-8) can reach the berm or the scarp.

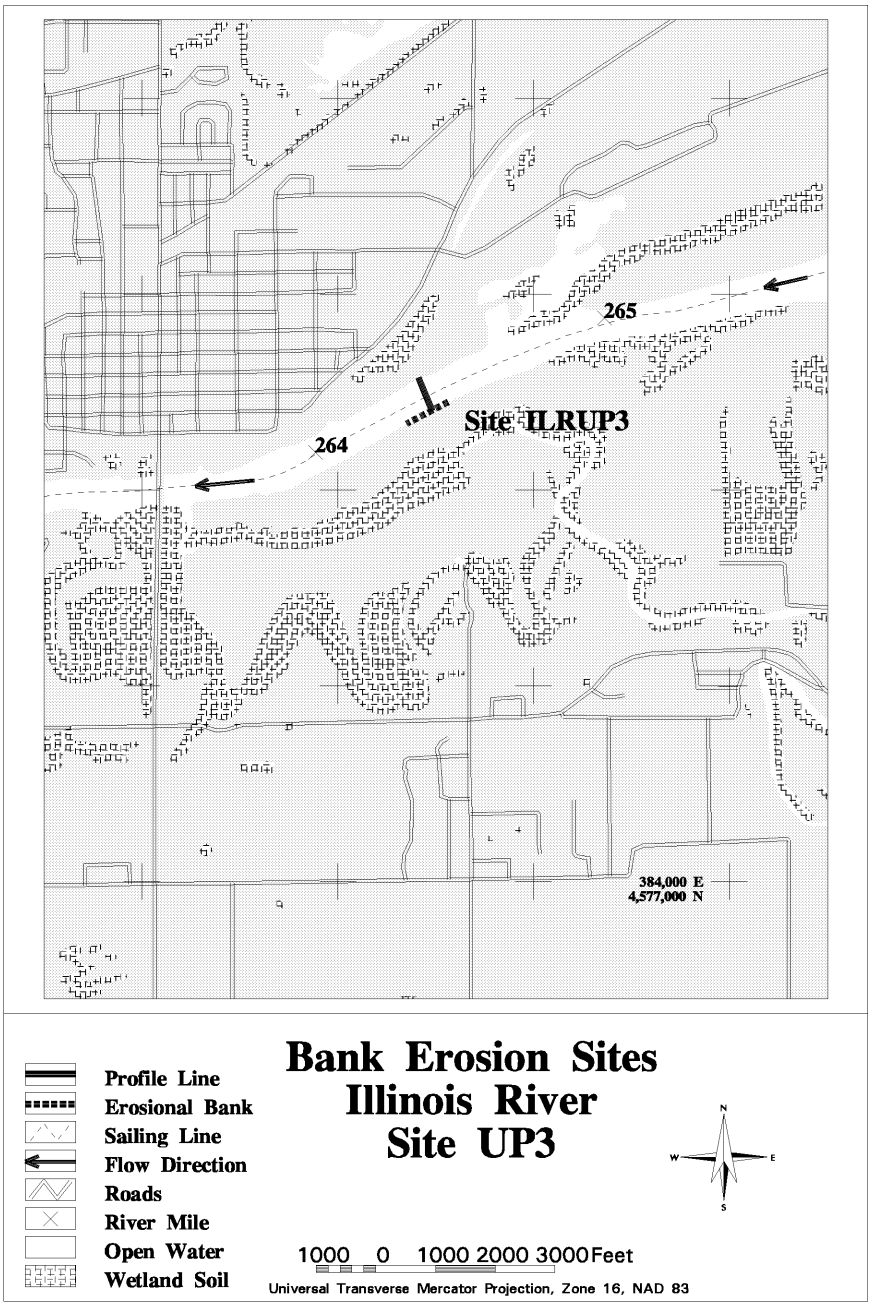

Figure 6-38. Location of site UP3 on the Illinois Waterway

Figure 6-39. Site UP3 on the Illinois Waterway

At the midsection, the d_{50} varies from 0.023 mm at the top surface of the bank to 0.419 mm for a core sample at a depth of about 2 feet of water. Gradation plots of bank soils and nearshore sediment cores are presented in appendix F. The detailed cross section and coordinates are shown in appendix G.

Bench slopes varied only slightly from 1V:21.7H, and the bench was covered with noncohesive sandy materials. This site can be classified as type 3 (see figure 6-20 and table 6-4). Erosional undercutting, rework and transport by waves and currents at high stages or during floods could be major causes of erosion at this site. After the flood receded, the bank soil may slip and fall as blocks, as shown in the downstream section. Land use as a trailer park can be a factor at this site too. Seepage at the recession stage of a flood could also play a significant role in bank failure. Waves and disturbances created by local boating activities can cause entrainment of recently deposited sediments from bench areas.

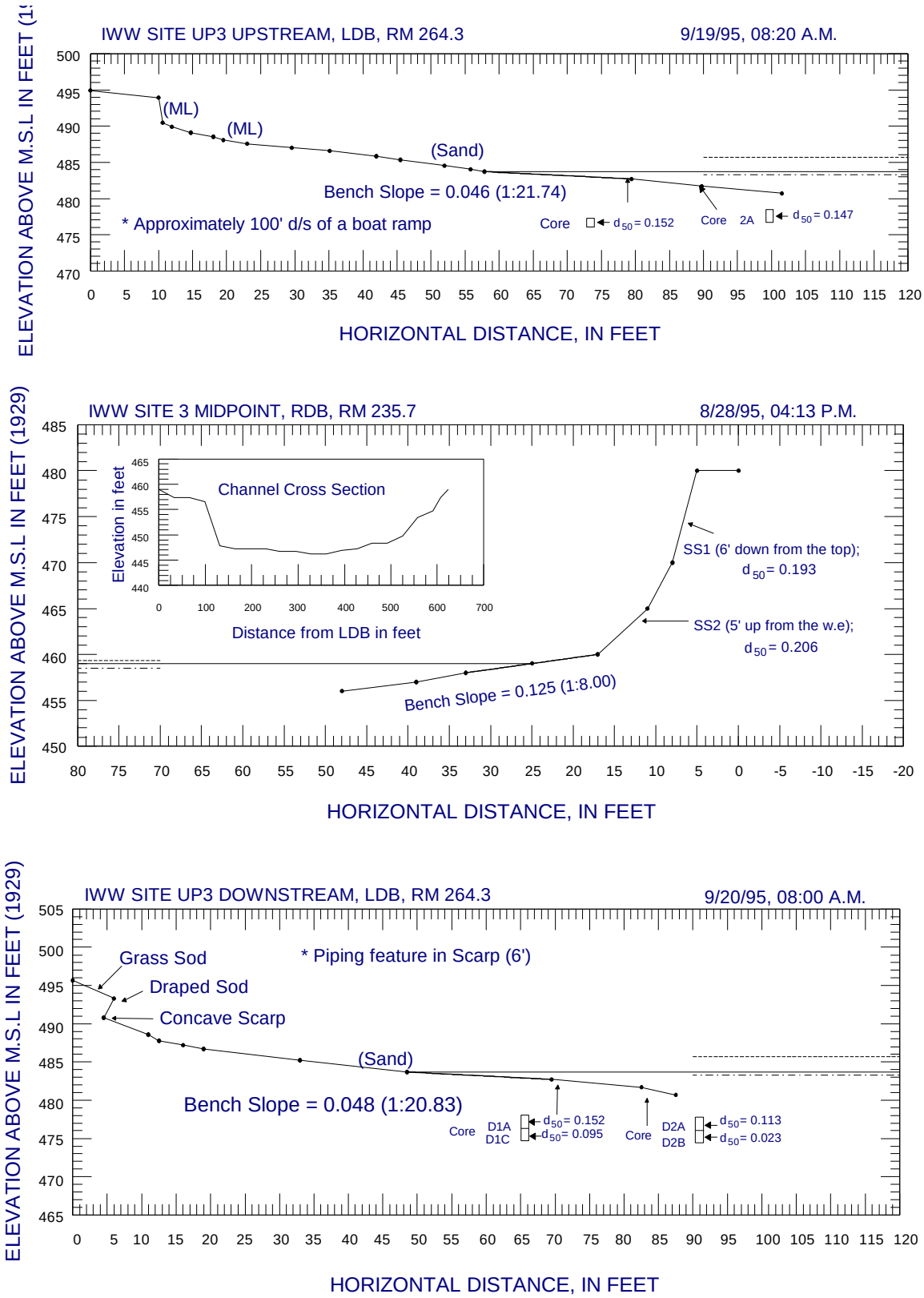

Figure 6-40. Bank sections at site UP3

Table 6-8. Site UP3

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	483.7	• Bench (slopes varied from 1V:21.7H to 1V:20.8H)	• d_{50} (core) @ 1' of water varied (0.095-0.152)
75	484.0	• Bench	• d_{50} (core) @ 2' of water varied (0.023-0.419)
50	484.6	• Bench	
25	486.0	• Bench	
10	488.0	• Bench	
0-9	>488.0	• Berm • Berm (slopes varied from 1V:3.8H to 1V:1.6H) • Scarp (slopes varied from 1V:0.85H to 1V:0.17H)	• d_{50} varied (0.059-0.062) • d_{50} (top of bank) = 0.023

Note: Gage on the Illinois River near Morris, IL @ RM 263.1 was used for stage histogram. WSE = 483.7'; OHW = 485.7'; NP = 483.3'.

Site UP4, Marseilles Pool, 9/20/95. This site is located on the LDB at RM 262.1. Figure 6-41 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-42 shows one photograph of the site. Higher velocity can be expected on this side as it is in a straight reach downstream from a mild bend. Hagerty (1988) indicated erosion on the LDB but also marked a long stretch of erosion on the opposite bank. Bhowmik and Schicht (1980) marked this as an erosion site.

Site UP4 is in a fleeting area where the distance to a red buoy marking the navigation channel was less than 50 feet from shore. Land use on top of the bank was agriculture (corn), and tall weeds were encountered on the bank crest. A scarp 5 to 10 feet high had its top portion covered with exposed roots and its lower portion had piping holes. The lower bank was a narrow sand bench. Failed riprap existed downstream of the site at an entrance channel to a gravel pit. Local tow traffic at this reach can be very frequent. Figure 6-43 shows the three measured bank sections and a reduced cross section. A slumped bank face was observed at the downstream section. The OHW is at 485.5 feet and NP is at 483.3 feet above msl. Except at the downstream section, the base of the scarp is slightly higher than the OHW level. At higher stages (10% occurrence frequency, 488 feet, see table 6-9) wave and current can have a direct contact on the scarp.

At the midsection, the d_{50} varied from 0.035 mm at the top of the bank to 0.185 mm for the top portion of a core sample at a water depth of about 2 feet. The bank scarp consisted of

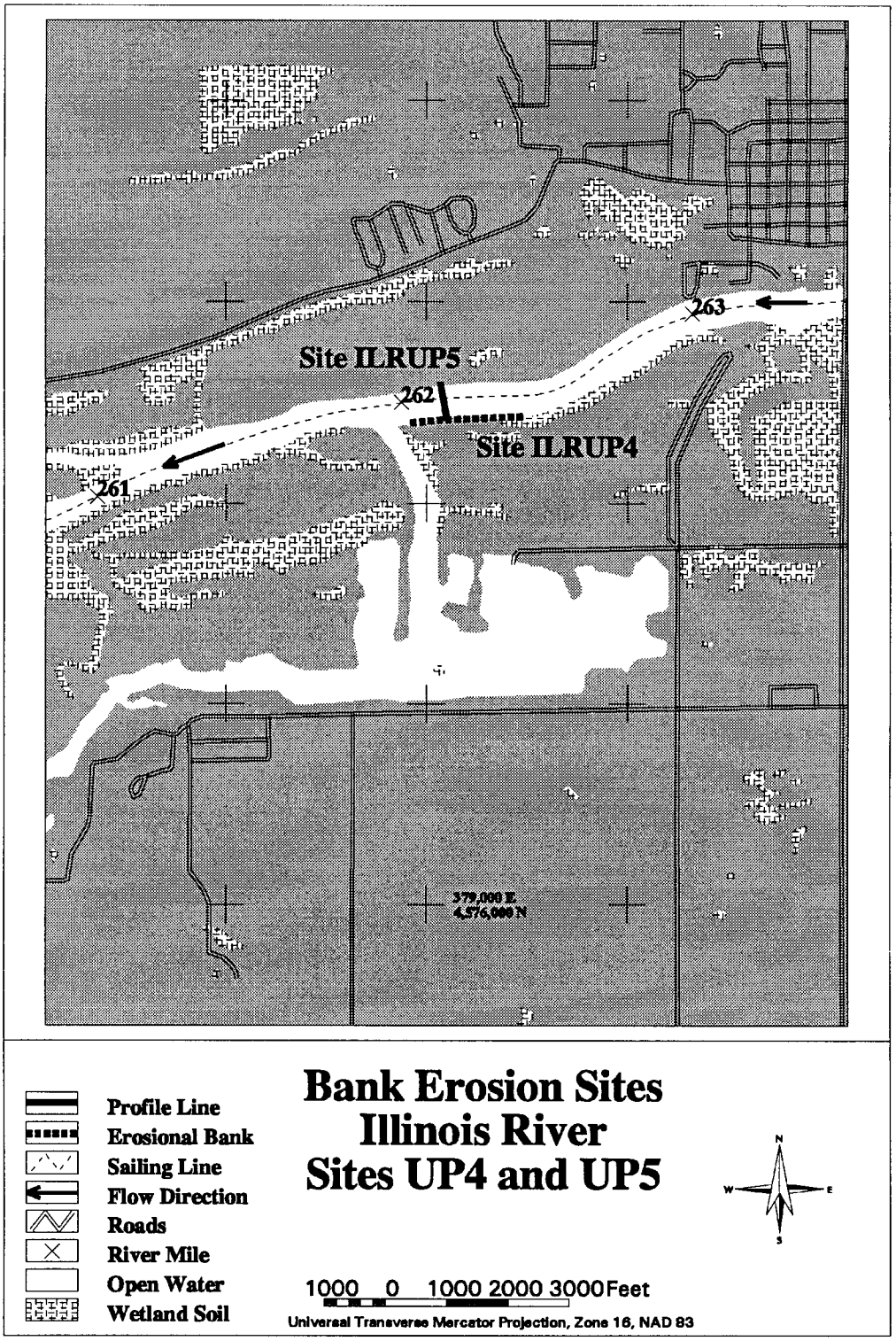

Figure 6-41. Locations of sites UP4 and UP5 on the Illinois Waterway

cohesive materials and the sediments are of fine sand fairly consistently at three sections. Gradation plots of bank soils and nearshore sediment are presented in appendix F. The detailed cross section and coordinates are shown in appendix G.

Figure 6-42. Site UP4 on the Illinois Waterway

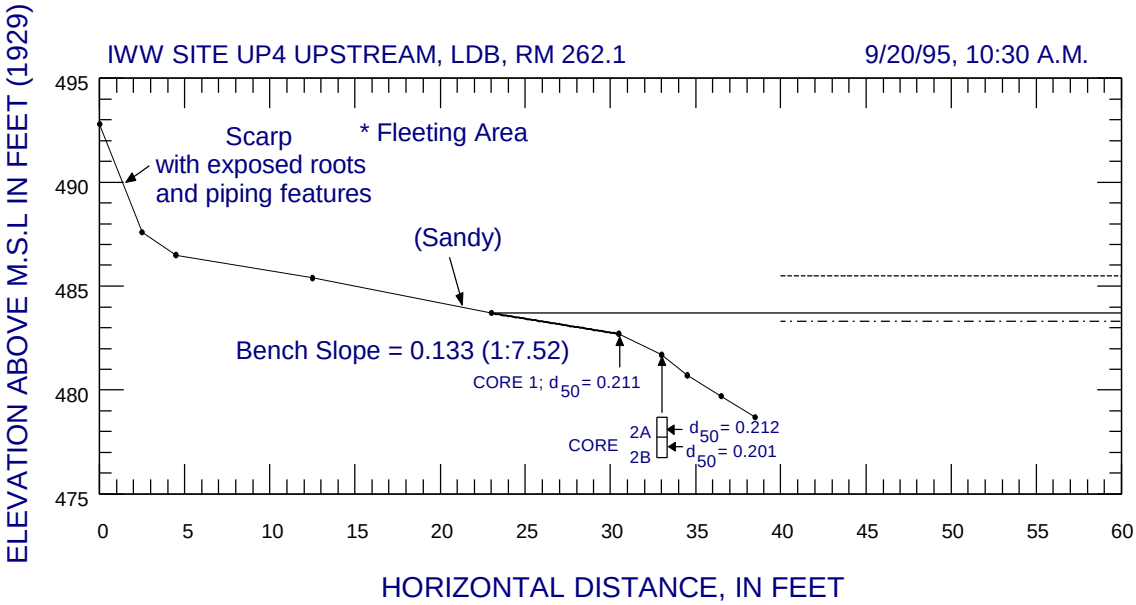

Figure 6-43. Bank sections at site UP4

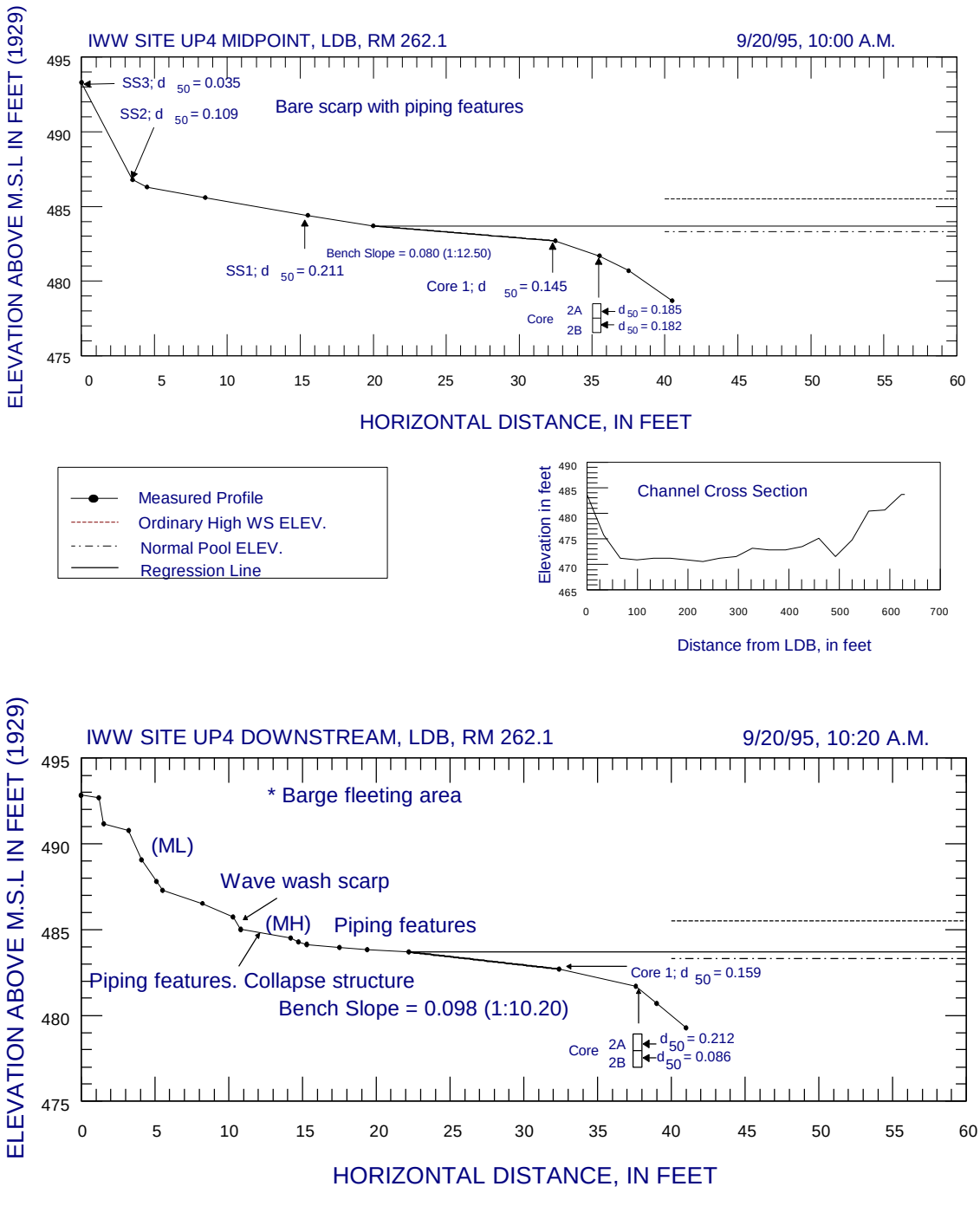

Figure 6-43. Bank sections at site UP4 (concluded)

Table 6-9. Site UP4

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	483.7	• Bench (slopes varied from 1V:12.5H to 1V:7.5H)	• d_{50} (core) @ 1' of water varied (0.145-0.211)
75	484.0	• Bench	• d_{50} (core) @ 2' of water varied (0.086-0.212)
50	484.6	• Bench	• d_{50} = 0.211
25	486.0	• Berm/bench • Berm (slopes varied from 1V:3H to 1V:1.8H)	• d_{50} = 0.109
10	488.0	• Scarp base	
0-9	>488.0	• Scarp • Scarp (slopes varied from 1V:0.8H to 1V:0.5H)	• d_{50} = 0.035 (T.O.B.)

Note: Gage on the Illinois River near Morris, IL @ RM 263.1 was used for stage histogram. WSE = 483.7'; OHW = 485.7'; NP = 483.3'.

Bench slopes varied from 1V:12.5H to 1V:7.5H, and the subaqueous bench becomes steeper. Piping holes at the scarp and moist soils on the lower portion of the bank were noted. This site can be classified as a combination of types 2 and 3 (see figures 6-19, 6-20, and table 6-4). The bank soils appeared to be cohesive, but the bench was sandy with several clay outcrops. Seepage could weaken the base support and cause the bank to slip, as shown at the downstream section. Failed soils and/or recently deposited sediment on the bench are reworked and transported by wind or tow-generated waves. The steep dropoff in subaqueous benches is indicative of effects of direct vessel contact or traffic-induced velocities.

Site UP5, Marseilles Pool, 9/20/95. This is at the bank opposite site UP4. Figure 6-41 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-44 shows one photograph of the site. Site UP5, is in a straight reach downstream from a mild bend. Bhowmik and Schicht (1980) marked this site as an erosion site and also indicated dredge material displacement on this bank. A 1 by 1 loaded barge passed in the upstream direction while the team was on the bank. Although the barge slowed down at the site, the drawdown induced by this traffic event was approximately 1.5 feet vertically. Four to five large waves with crests approximately 0.9 feet higher than pool level came in after the drawdown.

The site is about 300 feet from the sailing line and there is no major tributary at this location. The bank section has a scarp with exposed roots and piping holes. However, the bench was wet and did not have heavy sand deposition as on the opposite bank. A subaqueous scarp was found at the water's edge. Figure 6-45 shows one measured bank section and a reduced cross section. The OHW is at 485.5 feet and NP is at 483.3 feet above msl. The subaqueous bench extends at least about 100 feet from the water's edge. A 10-year stage data analysis (table 6-10) shows that stages higher than 25% recurrence frequency (the OHW) would submerge the base of the scarp; those higher than 10% recurrence frequency (above 490 feet) will overtop the bank.

At the midsection, the d_{50} varies from 0.129 mm at the top surface of the bank to 0.279 mm for the top portion of a core sample at a water depth of about 2 feet. Core samples are similar to those at site UP4. Gradation plots of bank soils and nearshore sediment are presented in appendix F. The detailed river cross section and coordinates are shown in appendix G.

The bench slope was 1V:26H. Some algae were observed on the subaerial bench. This site is classified as a combination of types 4 and 5 (see figures 6-21 and 6-22 and table 6-4). Banks are susceptible to erosion by tractive forces from flows at OHW or during floods. Piping, seepage, and weathering could loosen the bank soils which are then subject to removal by currents and waves. At this site, traffic-induced currents and waves can erode failed soils and recently deposited sediments within bench areas during periods of normal pool stages.

Figure 6-44. Site UP5 on the Illinois Waterway

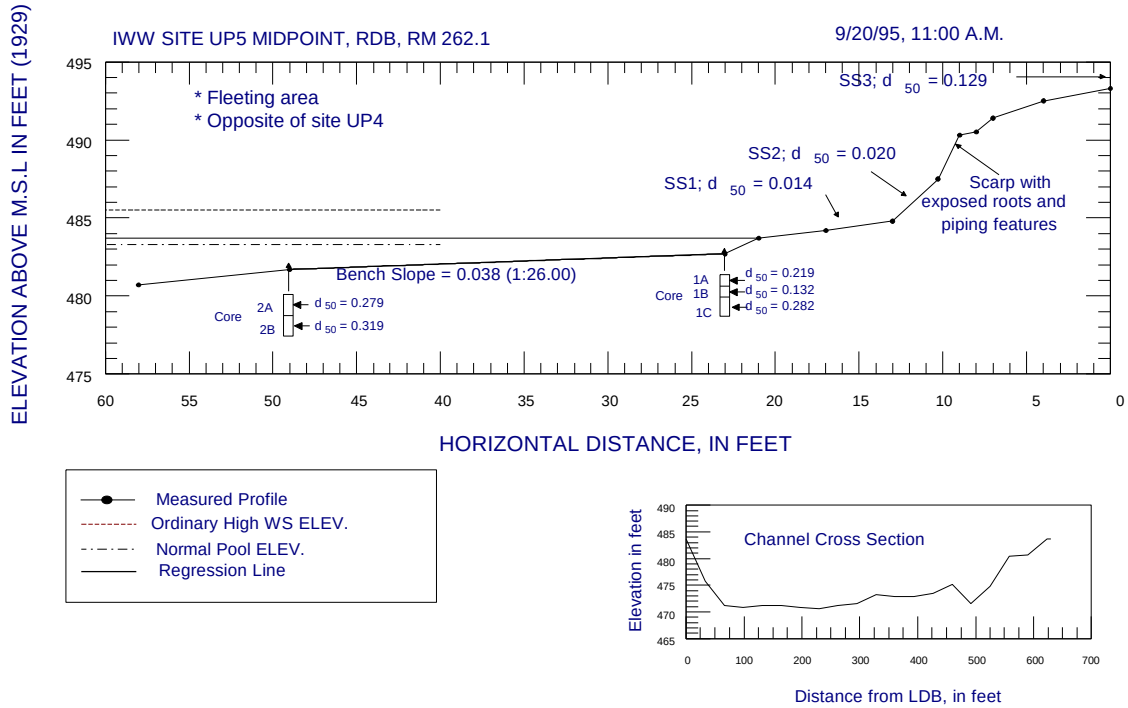

Figure 6-45. Bank section at site UP5

Table 6-10. Site UP5

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
>90	<483.7	• Bench (underwater) • Slope = 0.038	• d_{50} (core) @ 2' of water varied (0.28-0.32)
90	483.7	• Berm • Slope = 1V:2.6H	• d_{50} = 0.014
75	484.0	• Berm	
50	484.6	• Toe of scarp	
25	486.0	• Scarp • Slope = 1V:2.6H	• d_{50} = 0.020
10	488.0	• Scarp	
0-9	>490.0	• Top of the bank	• d_{50} = 0.129 • d_{50} (core) @ 1' of water varied (0.132-0.282)

Note: Gage on the Illinois River near Morris, IL @ RM 263.1 was used for stage histogram. WSE = 483.7'; OHW = 485.7'; NP = 483.3'.

Site 1, Starved Rock Pool, 8/28/95. This site is located on the LDB at RM 242.9, on the outside of a sharp bend. Figure 6-46 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-47 shows one photograph of the site. The site is about 400 feet from the sailing line, and Moores Creek enters the IWW downstream of this site.

Neither Bhowmik and Schicht (1980) nor Hagerty (1988) observed erosion at this site. Hagerty (1988) noted rock instead. During this survey a near vertical scarp about 8 feet high was encountered. Exposed tree and grass roots covered the top of the scarp, and some leaning tall trees were found on the scarp. Flat slabs or rocks approximately 1 to 2 inches in length and only about quarter inch in thickness were found on the bench at the foot of the scarp. Rocks increased in size to about 4 or 5 inches long near the waters edge. Rock crops out along the Moores Creek. Figure 6-48 shows the two measured bank sections and a reduced cross section. Available stage data from the Marseilles Lock and Dam is used for interpolating stage information at this site (table 6-11). The OHW is at 460 feet and NP is at 458.5 feet above msl. Stages higher than 461.8 feet will submerge the scarp.

At the midsection, the d_{50} varies from 0.010 mm at the surface of the bank to 0.696 mm at the edge of water to 0.025 mm for a core sample at a depth of about 1 foot of water. Gradation plots of bank soils, and nearshore sediment are presented in appendix F. The detailed cross section and coordinates are shown in appendix G.

Bench slopes varied from 1V:6.1H to 1V:17.2H. This site can be classified as type 1 (figure 6-18 and table 6-4). Surficial bank materials slake and are loosened by weathering with subsequent collapse. Reworking and transport of failed materials and recently deposited sediments occurs within bench areas during high flows.

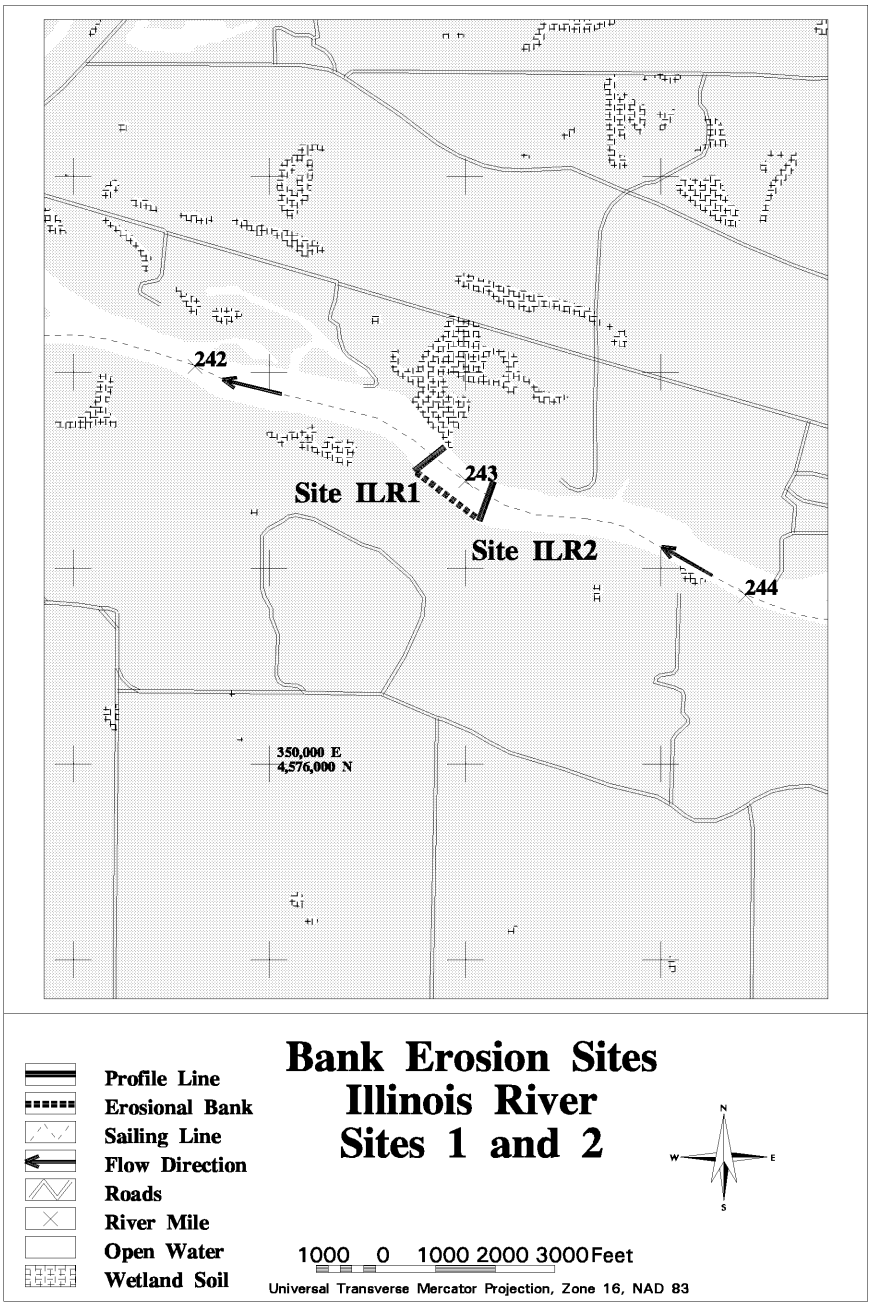

Figure 6-46. Locations of sites 1 and 2 on the Illinois Waterway

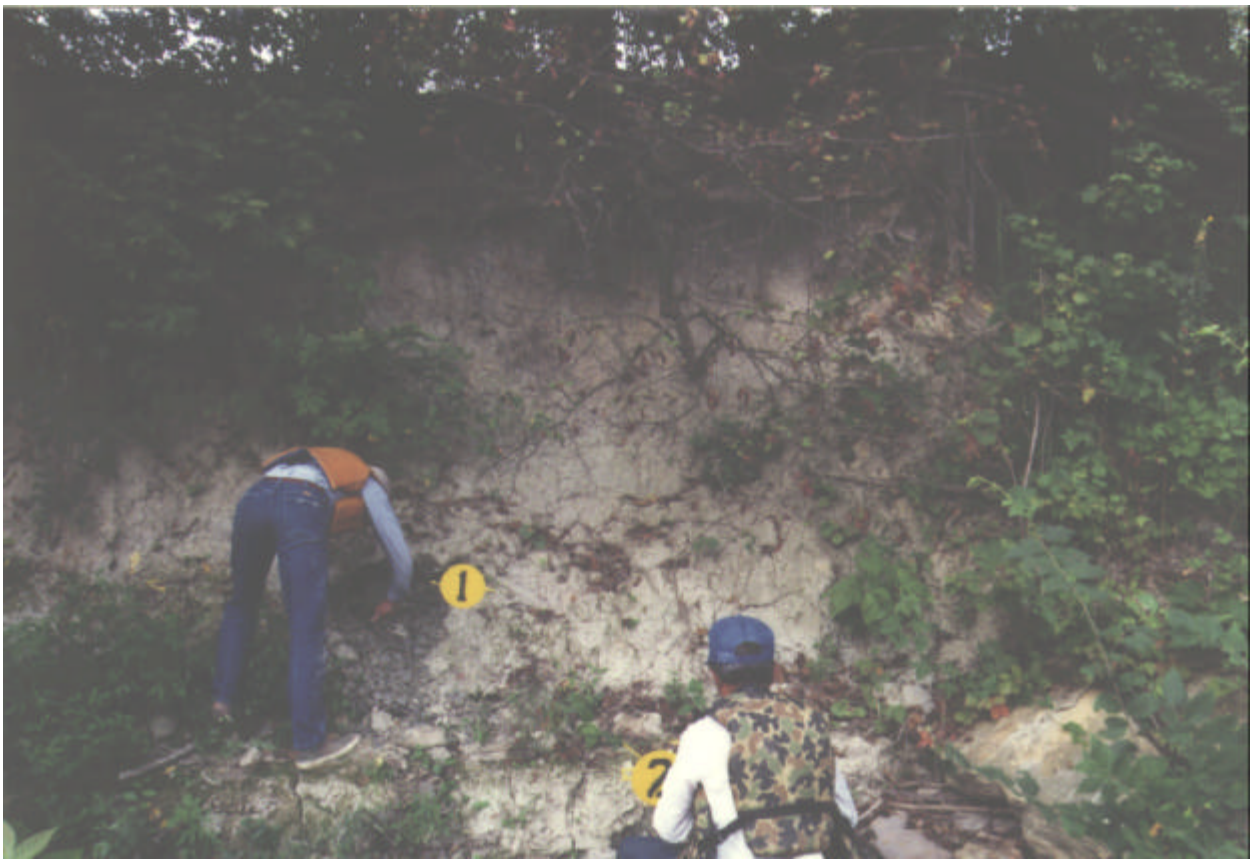

Figure 6-47. Site 1 on the Illinois Waterway

Table 6-11. Site 1

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	459.0	• Bench (slopes varied from 1V:40H to 1V:6.1H)	
75	459.2	• Bench	
50	459.6	• Bench	
25	460.4	• Bench	
10	461.8	• Bench/toe of scarp	• d_{50} varied (0.014-0.696)
0-9	>461.8	• Scarp (slopes varied from 1V:0.8H to 1V:0.53H)	• d_{50} = 0.010

Note: Tail water gage of Marseilles Pool @ RM 244.6 was used for stage histogram. WSE = 458.8'; OHW = 460.1'; NP = 458.5'.

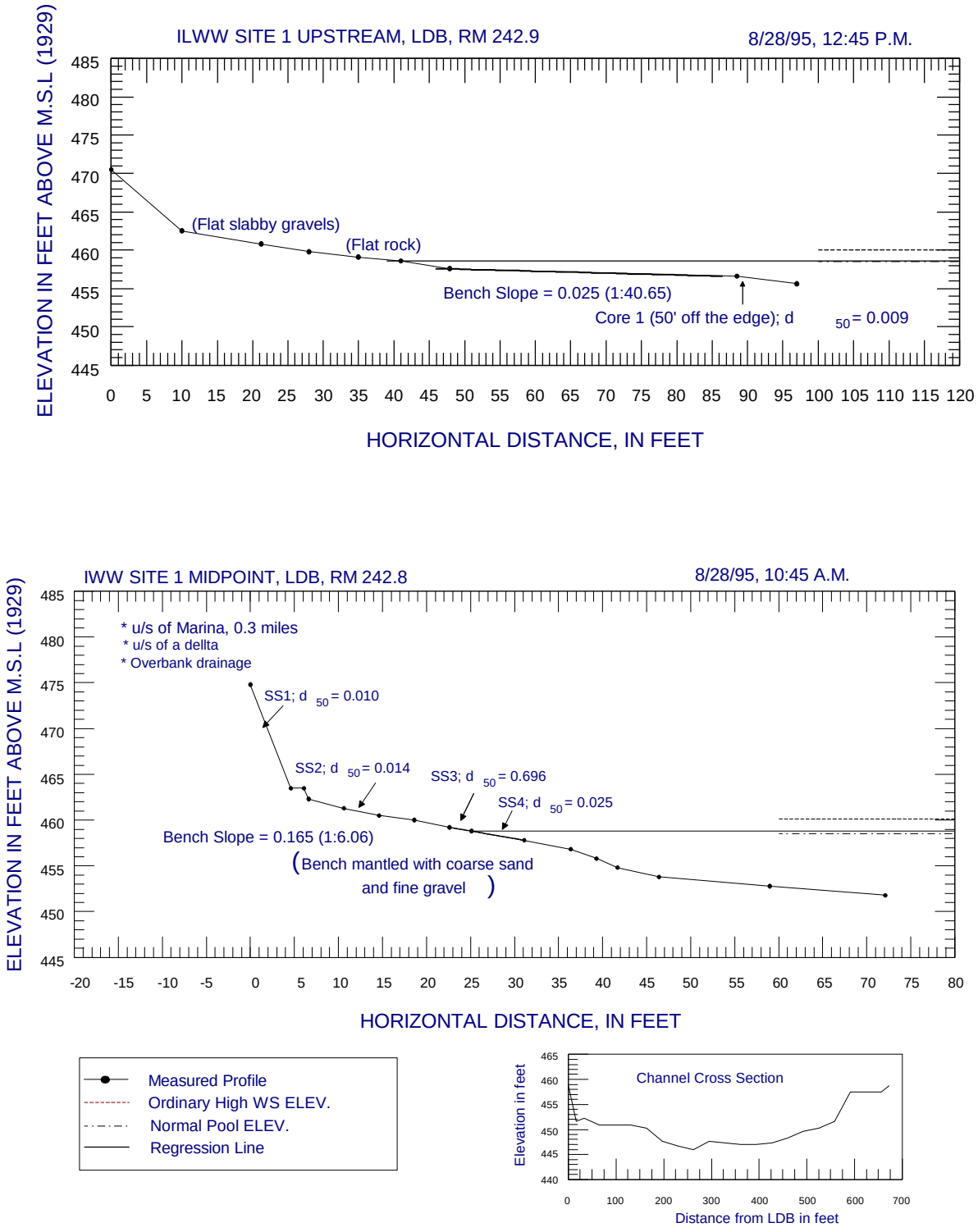

Figure 6-48. Bank sections at site 1

Site 2, Starved Rock Pool, 8/28/95. This site is located on the LDB at RM 243.4 upstream of site 1. The entrance to the Marseilles Canal is at RM 244.6. Figure 6-46 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-49 shows one photograph of the site. The bank at this site is about 250 feet from the sailing line. No tributary enters the IWW at this location.

Hagerty (1988) noted erosion, but Bhowmik and Schicht (1980) indicated riprap at this site. During the survey there was a fairly long stretch of eroded bank with a nearly vertical scarp about 6 to 7 feet in height. Trees of 6 inch diameter stood at the edge of the scarp, some with extensive root exposure on the bank face, and some downed trees were lying on the bench. The relatively narrow bench was covered with fine sand. Nearshore materials were mostly fine sand on soft silt.

Figure 6-50 shows the measured bank section and a reduced cross section. The OHW is 459.5 feet and NP is 458.5 feet above msl. According to 10-year stage data (Table 6-12), stages with 25% or less exceedence frequencies will reach the base of the scarp, and any stage higher than OHW elevation will be on the scarp.

Figure 6-49. Site 2 on the Illinois Waterway

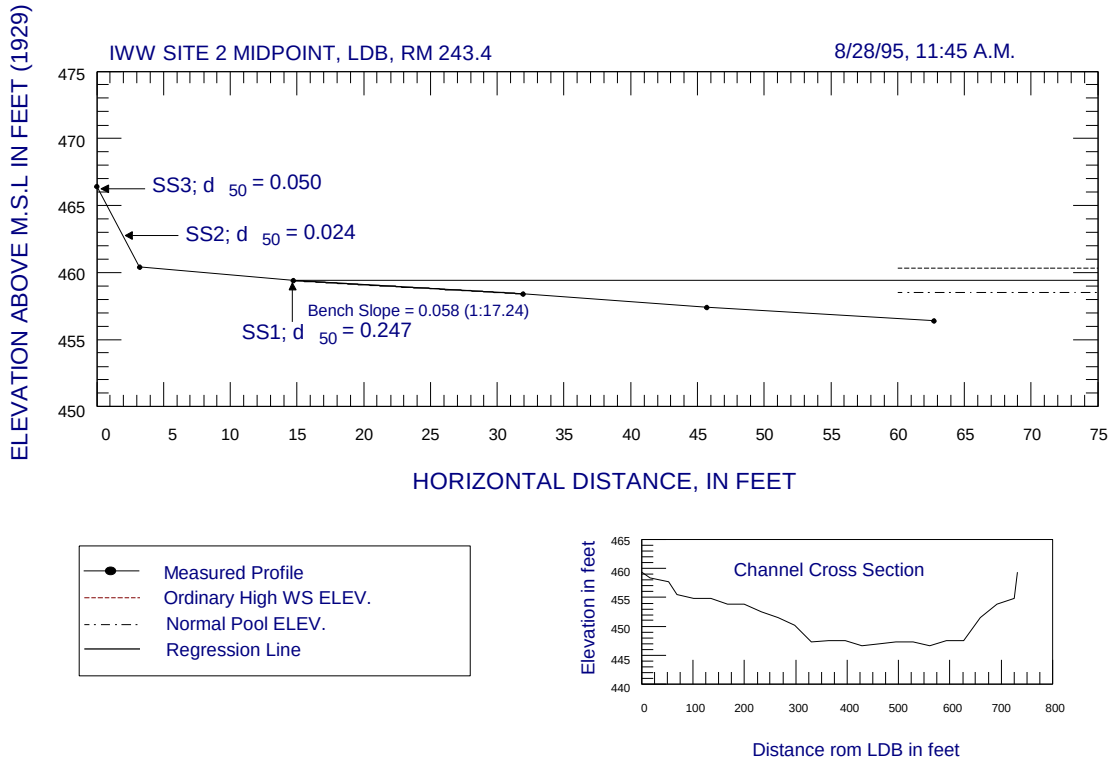

Figure 6-50. Bank section at site 2

Table 6-12. Site 2

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	459.0	• Bench (underwater)	• d_{50} = 0.247
75	459.2	• Bench	
50	459.6	• Bench	
25	460.4	• Scarp toe	
10	461.8	• Scarp	• d_{50} varied (0.024-0.050)
0-9	>462.0	• Scarp	

Note: Tail water gage of Marseilles Pool @ RM 244.6 was used for stage histogram. WSE = 459.4'; OHW = 460.3'; NP = 458.5'.

The d_{50} varied from 0.050 mm at the top of the bank face to 0.247 mm for a core sample at the edge of water. Gradation plots of bank soils and nearshore sediment are presented in appendix F. the detailed cross section and coordinates are shown in appendix G.

The bench slope was 1V:17.2H, and the bench was covered with noncohesive sandy materials. This site was considered as the combination of types 2 and 6 (figures 6-18 and 6-23,

and table 6-4). The scarp was nearly vertical and covered with fine roots. There was a moist layer at the base of the scarp and the subaerial bench was narrow and covered with sand. Several factors contribute to bank failure: tractive forces during floods, wave and current actions at stages above OHW, and seepage at the base of scarp could all contribute to the rework and erosion of failed bank soils and recently deposited sediment.

Site 3, Starved Rock Pool, 8/28/95. This site is located on the RDB at RM 235.8. The reach is fairly straight, and the site is on Sheehan Island. Behind this bank is a lake and the top width of the levee is only 5 to 6 feet. The levee appeared to be wider on the navigation chart that Bhowmik and Schicht (1980) used. However, the navigation chart that Hagerty (1988) used in 1988 showed a very thin levee. Figure 6-51 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-52 shows one photograph of the site.

Site 3 is about 550 feet from the sailing line, and no major tributary enters the IWW at this location. Bhowmik and Schicht (1980) noted erosion along RM 235.4 of the LDB, while Hagerty (1988) noted erosion at RM 235.8.

The bank consisted of a bare face approximately 15 to 20 feet high. Toppled trees halfway up the bank face supported stems re-grown to upright directions. Fine sand and gravel were found at the water's edge. Although the reach is straight, the three sections surveyed all were measured from locally concave banklines. These concavities were about 50 feet wide, and all had either gravel or trees at the water's edge, at the upstream end. Several mass failures had occurred at the downstream ends, which indicated the concave sections were widening.

Figure 6-53 shows the three measured bank sections and a reduced cross section. The bank slopes were steeper towards the downstream limit. The OHW is 459.3 feet and NP is 458.5 feet above msl. This range of fluctuation is within the bench area. Ten-year stage data (table 6-13) shows that only stages with less than 10% recurrence frequency can reach the base of the bank face.

At the midsection, the d_{50} varied from 0.193 mm at the upper part of bank surface to 0.206 mm at the base of the bank. A core sample at 2 feet of depth on the upstream section had d_{50} of 0.202 mm. Gradation plots of bank soils and nearshore sediment are presented in appendix F. The detailed cross section and coordinates are shown in appendix G.

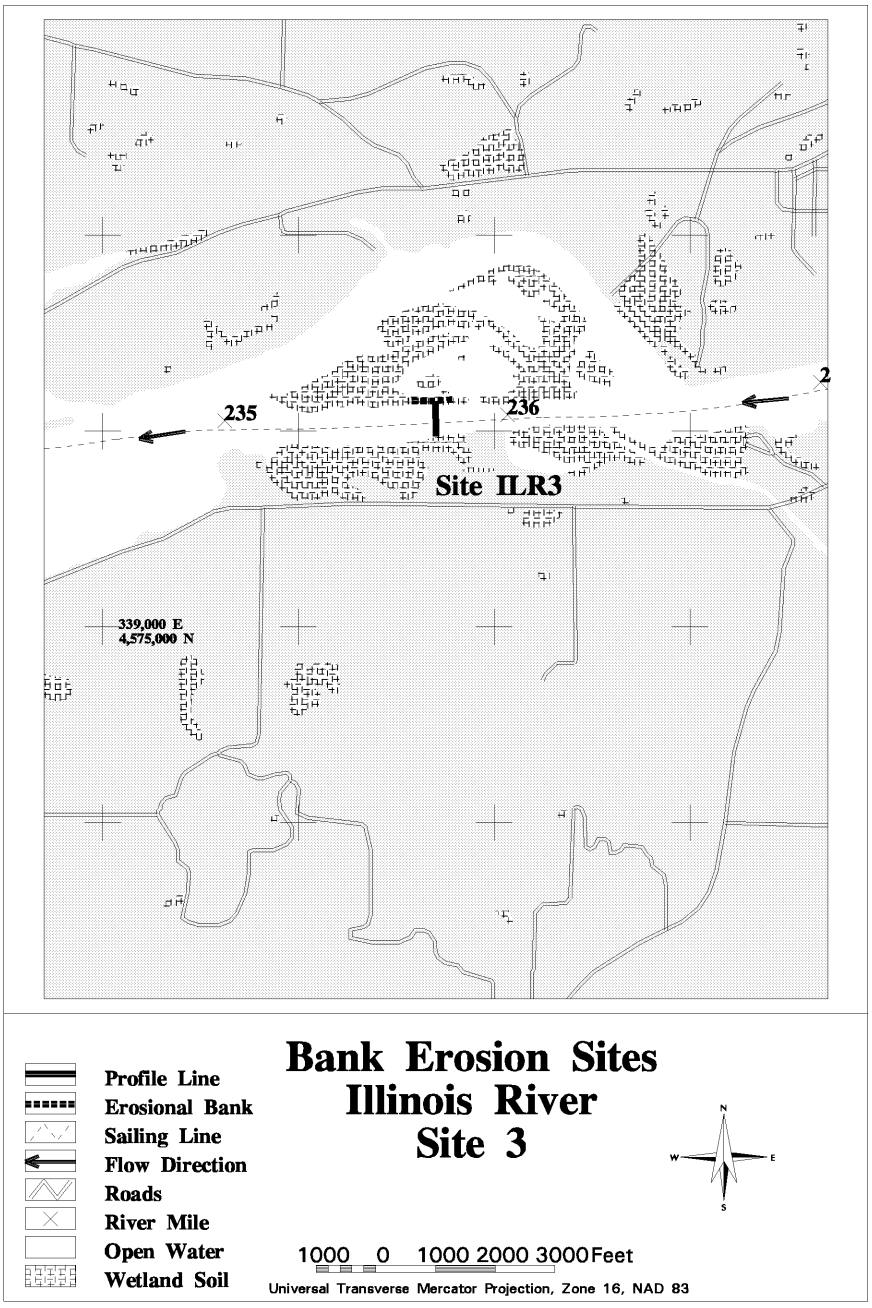

Figure 6-51. Location of site 3 on the Illinois Waterway

Figure 6-52. Site 3 on the Illinois Waterway

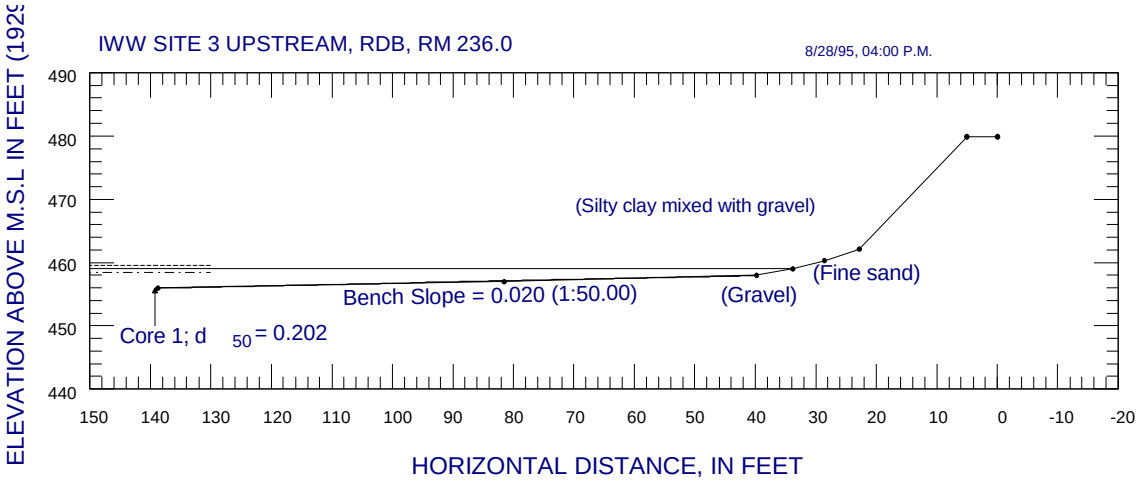

Figure 6-53. Bank sections at site 3

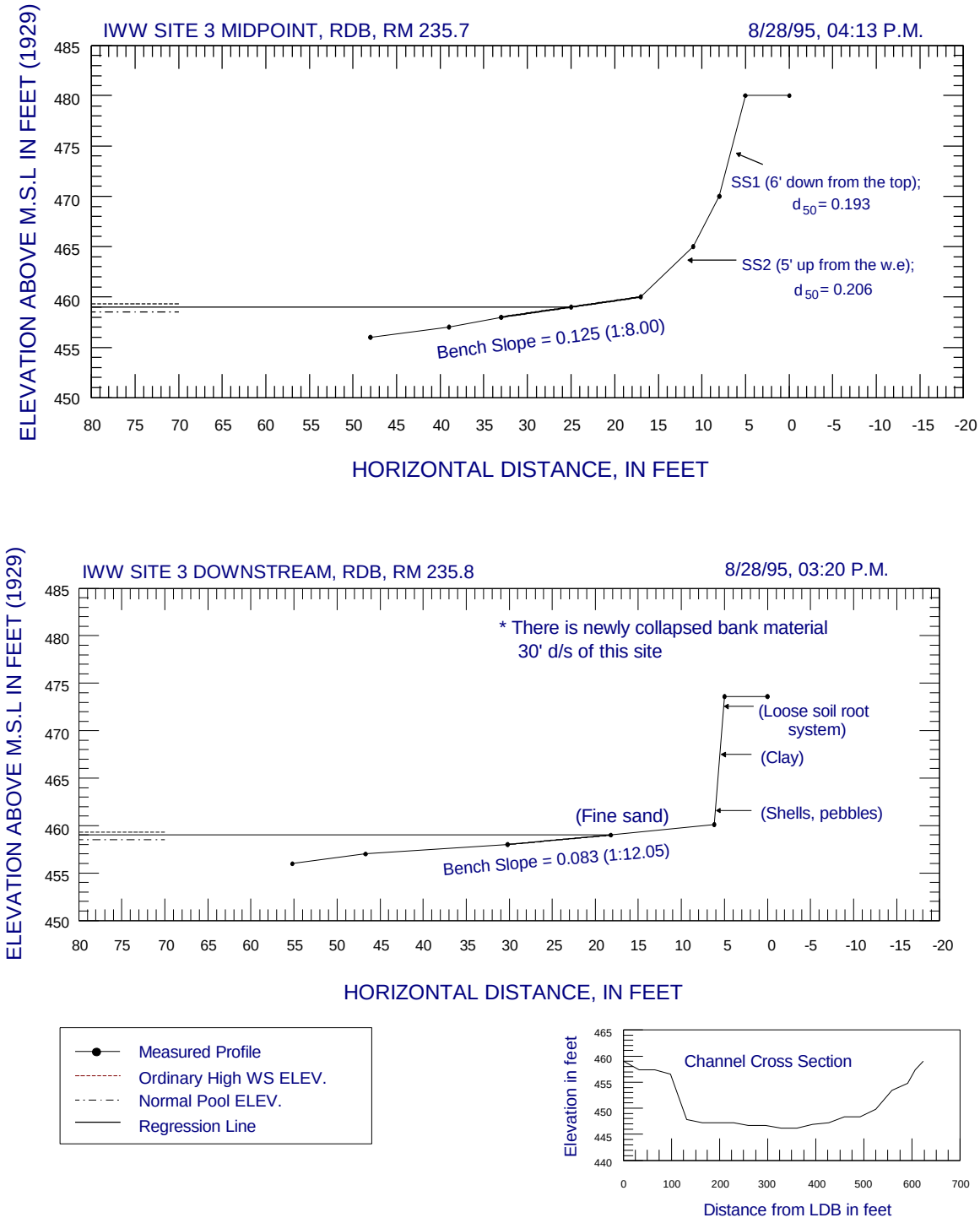

Figure 6-53. Bank sections at site 3 (concluded)

Table 6-13. Site 3

Percentage of occurrence	*Stage above msl, in ft*	*Topographical features*	*Bank/bed material, mm*
90	458.7	• Bench (underwater) • Bench (slopes varied from 1V:5H to 1V:8H)	• d_{50} (core) @ 1' of water = 0.202
75	458.8	• Bench (underwater)	
50	458.8	• Bench (underwater)	
25	458.9	• Bench (underwater)	
10	458.9	• Berm/bench (1V:1.2H) • Berm slope	• d_{50} = 0.206
0-9	>459.0	• Scarp	• d_{50} = 0.193

Note: Pool gage of Starved Rock Pool @ RM 231.0 was used for stage histogram. WSE = 459.0'; OHW = 459.3'; NP = 458.8'.

Bench slopes varied from 1V:50H at the upstream section to 1V:8H at the midsection. The bank consisted mostly of noncohesive sandy materials. The three sections can be classified as a combination of types 1 and 6 because of the extended subaqueous bench width (figures 6-18 and 6-23, and table 6-4). Rework and transport of failed soils and recently deposited sediment occur during floods. Eddy currents induced by the trees or gravel upstream of concave sections can cause bank failure and eddies are generated at stages when the flows are disturbed by trees or gravel.

Site 4, Peoria Pool, 8/28/95. This site is located on the LDB at RM 228.1 in a long, straight reach downstream from the Starved Rock L&D (RM 231). Figure 6-54 shows the position of the site on a GIS-based map of the Illinois navigation chart, and figure 6-55 shows one photograph of the site.

Site 4 is about 360 feet from the sailing line. No major tributary enters the IWW at this location, but a state highway bridge crosses the river at RM 229.6. Bhowmik and Schicht (1980) selected both banks as erosion sites (sites 18 and 19) with surveys completed on the RDB and one survey on the LDB (site 20). Erosion of these two sites was indicated on Hagerty's (1988) chart also. At site 4, a mildly sloped bench lies under a small scarp, with mature trees growing behind the scarp. The bench was very wide, sandy, and mostly covered with tall weeds. Tall trees survive in an area between the weed zone and scarps with roots exposed to the air. The root crown is approximately at the same level as the top of the bank. The bench is clay mantled with sand mixed with shells.