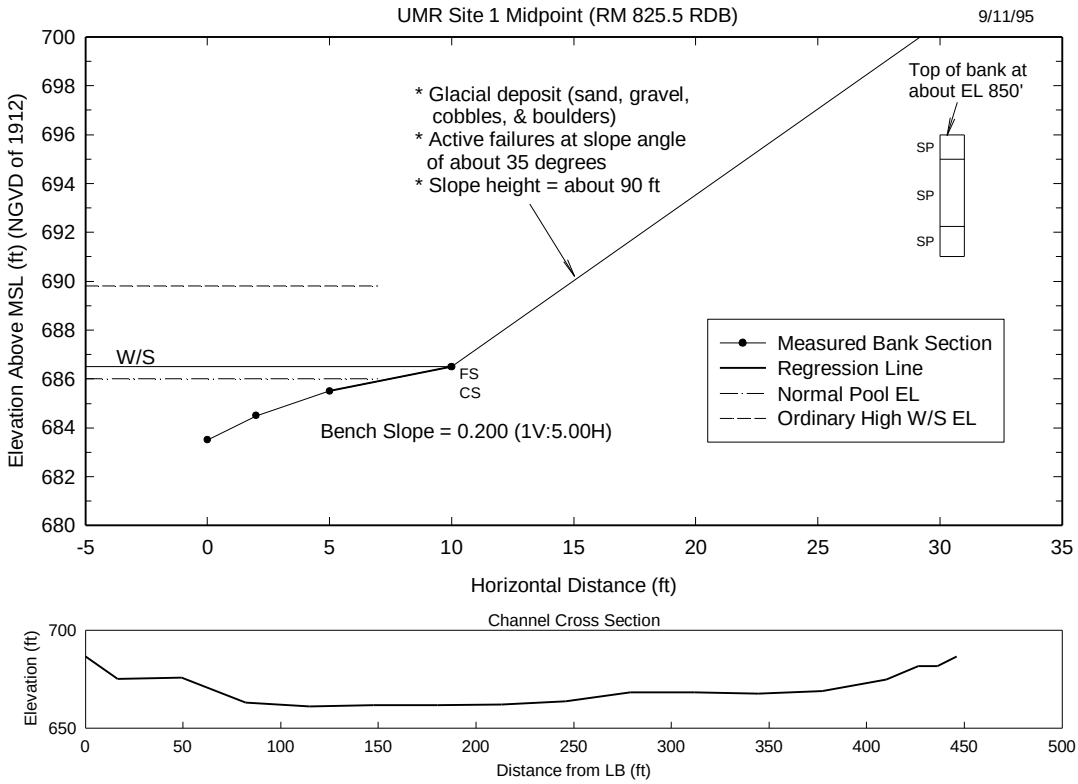

Figure 7-7 Bank section and channel cross section measured at Site 1 midpoint

Table 7-3 Sediment grade scale

Size Range (mm)	Class Name	Class Name Abbreviation
64-32	Very Coarse Gravel	**VCG**
32-16	Coarse Gravel	**CG**
16-8	Medium Gravel	**MG**
8-4	Fine Gravel	**FG**
4-2	Very Fine Gravel	**VFG**
2.000-1.000	Very Coarse Sand	**VCS**
1.000-0.500	Coarse Sand	**CS**
0.500-0.250	Medium Sand	**MS**
0.250-0.125	Fine Sand	**FS**
0.125-0.062	Very Fine Sand	**VFS**
0.062-0.031	Coarse Silt	**CST**
0.031-0.016	Medium Silt	**MST**
0.016-0.008	Fine Silt	**FST**
0.008-0.004	Very Fine Silt	**VFST**
0.004-0.002	Coarse Clay	**CC**
0.0020-0.0010	Medium Clay	**MC**
0.0010-0.0005	Fine Clay	**FC**
0.0005-0.00024	Very Fine Clay	**VFC**

Table 7-4 Unified soil classification system adopted from PLATE 5 Appendix G - Demonstration projects on other streams, nationwide, Vol. 2 of 2, U.S. Army Corps of Engineers, December 1981

Major Divisions			Group Symbols	Typical Names
COARSE GRAINED SOILS - 50% or more retained on the No. 200 sieve	GRAVELS - More than half of coarse fraction retained on the No. 4 sieve	Clean sands	**GW**	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines	**GM**	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS - More than half of coarse fraction passing the No. 4 sieve	Clean sands	**SW**	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sands, little or no fines
		Sands with fines	**SM**	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS - More than 50% passing the No. 200 sieve	SILTS AND CLAYS	Liquid limit below 50%	**ML**	Inorganic silts and very fine sands, rock flour, silty fine sands or silts - plastically below "A" line
			CL	Inorganic clays, gravelly clays, sandy clays, lean clays - plastically above "A" line
			OL	Organic silts and organic clays - plastically below "A" line
		Liquid limit 50% and above	**MH**	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts - plastically below "A" line
			CH	Inorganic fat clays - plastically above "A" line
			OH	Organic clays or organic silts - plastically below "A" line
Highly organic soils			**PT**	Peat, organic content greater than 60%

Table 7-5a A summary of bank-erosion study sites and their characteristics

No.	Site No.	Date	RM (mi)	Pool No.	Location Identification	Site Characteristics (Close to Sailing Line?: Y/N)	W/S EL (ft)	Bench Slope	OHWL (ft)	NPL (ft)	Erosion Type
1	1	9/11/95	825.5R	2	Midpt	Outside Bend/Glacial Deposit/(Y)	686.5	0.200	689.8	686.0	F
2	2	9/11/95	791.7R	4	U/S Pt		669.5	0.222	671.3	666.6	E
3	2	9/11/95	791.7R	4	Midpt	Outside Bend/Displaced Riprap/(N)	669.5	0.130	671.3	666.6	E
4	2	9/11/95	791.5R	4	D/S Pt		669.5	0.150	671.2	666.6	E
5	3	9/12/95	763.4L	4	U/S Pt		667.5	0.127	668.2	665.3	E & F
6	3	9/12/95	763.4L	4	Midpt	Straight/D.S. of Chippewa/Dredge/(N)	667.5	0.100	668.2	665.3	F
7	3	9/12/95	763.4L	4	D/S Pt		667.5	0.153	668.2	665.3	E & F
8	4	9/12/95	751.1L	5	U/S Pt	Less than 2 miles downstream from L&D 4	660.8	0.217	661.8	658.7	E
9	4	9/12/95	751.1L	5	Midpt	Outside Bend/Mooring Facilities/(Y)	660.8	0.200	661.8	658.7	E
10	4	9/12/95	751.1L	5	D/S Pt		660.8	0.106	661.8	658.7	E
11	5	9/13/95	746.5L	5	U/S Pt		660.4	0.313	661.1	658.5	F
12	5	9/13/95	746.4L	5	Midpt	Outside Bend/Island/Dredge/(Y)	660.4	0.183	661.1	658.5	F
13	5	9/13/95	746.3L	5	D/S Pt		660.4	0.139	661.1	658.5	F
14	6	9/13/95	727.4R	6	U/S Pt	Only 1 mile downstream from L&D 5A	646.4	0.164	647.8	643.8	E
15	6	9/13/95	727.4R	6	Mid Pt	Outside Bend/Island/(Y)	646.4	0.196	647.8	643.8	E
16	6	9/13/95	727.4R	6	D/S Pt		646.4	0.132	647.8	643.8	E
17	7	9/13/95	727.4L	6	Midpt	Inside Bend/Island/1 mile D.S. from L&D 5A/(N)	646.4	0.136	647.8	643.8	E
18	8	9/14/95	677.7R	9	U/S Pt	Only 1.7 mi downstream of L&D 8	622.6	0.204	625.1	619.9	C
19	8	9/14/95	677.5R	9	Midpt	Outside Bend/Channel Erosion/(Y)	622.6	0.161	625.1	619.9	C
20	8	9/14/95	677.5R	9	D/S Pt		622.6	0.176	625.0	619.9	C
21	9	9/14/95	677.5L	9	Midpt	Inside Bend/Island/1.7 mile D.S. of L&D 8/(N)	622.6	0.161	625.0	619.9	E & F
22	10	9/15/95	669.5R	9	U/S Pt		622.0	0.081	623.7	619.5	D & E
23	10	9/15/95	669.5R	9	Midpt	Outside Bend/Dredge Spoil/(Y)	622.0	0.111	623.6	619.5	D & E
24	10	9/15/95	669.5R	9	D/S Pt		622.0	0.122	623.6	619.5	D & E
25	11	9/16/95	620.5L	10	U/S Pt	5.5 mi upstream from L&D 10	610.2	0.081	612.3	609.1	D & E
26	11	9/16/95	620.5L	10	Midpt	Crossover/Island/U.S. of Wing Dam/(N)	610.2	0.148	612.3	609.1	D & E
27	11	9/16/95	620.5L	10	D/S Pt		610.2	0.078	612.3	609.1	D & E
28	12	9/16/95	613.6L	11	U/S Pt	Only 1.5 mi downstream from L&D 10	605.8	0.012	608.0	602.7	E & F
29	12	9/16/95	613.6L	11	Midpt	Outside Bank/Island/Dredge/(Y)	605.8	0.033	608.0	602.7	E & F
30	12	9/16/95	613.4L	11	D/S Pt	D.S. of Ackerman's Cut	605.8	0.131	608.0	602.7	E & F
31	13	9/16/95	613.6R	11	Midpt	Inside Bend/Island/Wing-Dam Field/(N)	605.8	0.125	608.0	602.7	E
32	14	9/16/95	607.5R	11	U/S Pt		604.8	0.109	606.8	602.5	A & B

Table 7-5b A summary of bank-erosion study sites and their characteristics

No.	Site No.	Date	RM (mi)	Pool No.	Location Identification	Site Characteristics (Close to Sailing Line?: Y/N)	W/S EL (ft)	Bench Slope	OHWL (ft)	NPL (ft)	Erosion Type
33	14	9/16/95	607.5R	11	Midpt	Inside Bend/Fleeting Area/(N)	604.8	0.145	606.8	602.5	A & B
34	14	9/16/95	607.5R	11	D/S Pt		604.8	0.075	606.8	602.5	A & B
35	15	9/17/95	576.0L	12	U/S Pt		593.7	0.086	595.5	590.5	C
36	15	9/17/95	576.0L	12	Midpt	Inside Bend/Island/Fleeting/Riprap Protection/(N)	593.7	0.160	595.5	590.5	C
37	15	9/17/95	576.0L	12	D/S Pt		593.7	0.059	595.5	590.5	C
38	16	9/17/95	551.9L	13	U/S Pt		585.5	0.286	588.0	582.9	C
39	16	9/17/95	551.9L	13	Midpt	Inside Bend/Island/Channel Erosion/(Y)	585.5	0.358	588.0	582.9	C
40	16	9/17/95	551.9L	13	D/S Pt		585.5	0.096	588.0	582.9	C
41	17	9/18/95	512.7L	14	U/S Limit		573.2	0.105	575.9	571.3	D
42	17	9/18/95	512.7L	14	U/S 1/4 Pt		573.2	0.056	575.9	571.3	D
43	17	9/18/95	512.7L	14	Back Chan U/S 1/3 Pt		573.2	0.145	575.9	571.3	D & E
44	17	9/18/95	512.7L	14	Midpt	Straight/Island/Wing-Dam Field/(N)	573.2	0.059	575.9	571.3	D & E
45	17	9/18/95	512.7L	14	D/S 1/4 Pt		573.2	0.188	575.9	571.3	E
46	17	9/18/95	512.7L	14	Back Chan D/S 1/3 Pt		573.2	0.066	575.9	571.3	E
47	17	9/18/95	512.7L	14	D/S Limit		573.2	0.054	575.9	571.3	E
48	18	9/18/95	509.2R	14	U/S Pt		572.6	0.182	574.5	571.0	D, E, & F
49	18	9/18/95	509.2R	14	Midpt	Straight/Island/Channel Erosion/(Y)	572.6	0.133	574.5	571.0	D, E, & F
50	18	9/18/95	509.2R	14	D/S Pt		572.6	0.117	574.5	571.0	D, E, & F
51	19	9/18/95	509.2L	14	Midpt	Straight/Glacial Deposit/(N)	572.6	0.134	574.5	571.0	F
52	19	9/18/95	509.2L	14	D/S Pt		572.6	0.174	574.5	571.0	F
53	21	10/2/95	466.9L	16	U/S Tip of Island		545.8	0.295	546.8	541.8	C & D
54	21	10/2/95	466.7L	16	U/S Pt		545.8	0.090	546.8	541.8	D
55	21	10/2/95	466.8L	16	Back Chan U/S 1/3 Pt		545.8	0.069	546.8	541.8	D
56	21	10/2/95	466.7L	16	Midpt	Straight/Island/(Y)	545.8	0.051	546.8	541.8	C
57	21	10/2/95	466.5L	16	D/S 1/4 Pt		545.8	0.068	546.8	541.8	C
58	21	10/2/95	466.7L	16	Back Chan D/S 1/3 Pt		545.8	0.094	546.8	541.8	C
59	21	10/3/95	466.3L	16	D/S Toe of Island		545.8	0.077	546.8	541.8	C
60	22	10/3/95	436.4L	18	U/S Limit		531.0	0.116	535.4	527.0	C
61	22	10/3/95	436.4L	18	U/S 1/4 Pt		531.0	0.146	535.4	527.0	C
62	22	10/3/95	436.4L	18	Midpt	Straight/D.S. of L&D 17/(Y)	531.0	0.106	535.4	527.0	C
63	22	10/3/95	436.4L	18	D/S 1/4 Pt		531.0	0.417	535.4	527.0	C
64	22	10/3/95	436.4L	18	D/S Limit		531.0	0.207	535.4	527.0	C

Table 7-5c A summary of bank-erosion study sites and their characteristics

No.	Site No.	Date	RM (mi)	Pool No.	Location Identification	Site Characteristics (Close to Sailing Line?: Y/N)	W/S EL (ft)	Bench Slope	OHWL (ft)	NPL (ft)	Erosion Type
65	23	10/3/95	436.4R	18	U/S Pt	Straight/Island/Failed Riprap/(N)	531.0	0.068	535.4	527.0	C
66	23	10/3/95	436.4R	18	D/S pt		531.0	0.145	535.4	527.0	C
67	24	10/3/95	432.3L	18	U/S Pt		530.0	0.159	535.4	527.0	F
68	24	10/3/95	432.3L	18	Midpt	Outside Bank/(Y)	530.0	0.151	535.4	527.0	F
69	24	10/3/95	432.3L	18	D/S Pt		530.0	0.192	535.4	527.0	F
70	25	10/3/95	432.3R	18	Midpt	Inside Bank/Island/Channel Erosion/(N)	530.0	0.336	535.4	527.0	C & D
71	26	10/3/95	420.0R	18	U/S Pt		528.5	0.130	530.7	526.6	E & F
72	26	10/3/95	420.0R	18	Midpt	Straight/Island/Wing-Dam Field/(Y)	528.5	0.105	530.7	526.6	E & F
73	26	10/3/95	420.0R	18	D/S Pt		528.5	0.200	530.7	526.6	E & F
74	27	10/4/95	360.0R	20	Midpt	Straight/Wing Dams/D.S. of Des Moines Conf./(N)	481.5	0.119	485.0	478.0	A
75	28	10/4/95	357.6R	20	Midpt	Crossover/Island/(Y)	481.2	0.168	484.5	477.7	A
76	29	10/5/95	339.4L	21	U/S Pt		471.8	0.143	475.2	469.5	A, B, & C
77	29	10/5/95	339.3L	21	Midpt	Straight/Island/Wing Dams/(N)	471.8	0.136	475.2	469.5	A, B, & C
78	29	10/5/95	339.3L	21	D/S Pt		471.8	0.073	475.2	469.5	A, B, & C
79	30	10/5/95	339.3R	21	Midpt	Straight/(Y)	471.8	0.106	475.2	469.5	C
80	31	10/6/95	293.0L	24	Midpt	Inside Bend/Island/Wing Dams/(N)	450.8	0.092	459.0	449.8	D & E
81	32	10/11/95	275.3R	24	Midpt	Inside Bend/U.S. of L&D 24/Mooring Site/(Y)	449.0	0.159	452.0	449.0	A
82	33	10/12/95	266.5L	25	Midpt	Crossover/Island/(N)	436.6	0.144	447.5	435.6	A
83	34	10/13/95	232.2R	26	Midpt	Straight/Chute Outlet/(Y)	421.0	0.113	432.0	420.3	A
84	35	10/13/95	222.1R	26	U/S Pt		419.4	0.129	428.5	419.9	A
85	35	10/13/95	222.1R	26	Midpt	Straight/Island/(Y)	419.4	0.119	428.5	419.9	A
86	35	10/13/95	222.1R	26	D/S Pt		419.4	0.097	428.5	419.9	A
87	36	10/13/95	217.5R	26	Midpt	Straight/Confluence of ILWW/(N)	419.4	0.076	427.5	419.4	C
88	37	10/14/95	197.6R	27	Midpt	Inside Bank/U.S. of Missouri River/Mooring/(N)	403.6	0.115	423.0	401.1	C
89	38	10/14/95	175.2L	Open	Midpt	Straight/Fleeting Area/(Y)	389.6	0.141	390.6	386.8	A, B, & C
90	39	10/15/95	112.4L	Open	Midpt	Inside Bend/Island/Wing-Dam Field/(N)	352.9	0.172	359.7	355.9	A, B, & C
91	40	10/16/95	94.2R	Open	U/S Pt	Outside Bank/Wing-Dam Field/(Y)	347.6	0.488	349.6	345.9	C
92	40	10/16/95	94.1R	Open	D/S Pt		347.6	0.068	349.6	345.8	C
93	41	10/16/95	77.2R	Open	Midpt	Outside Bank/Pleistocene Terracette Failure/(Y)	338.2	0.172	340.1	336.5	E & F
94	42	10/17/95	53.2L	Open	U/S Pt		321.8	0.135	326.3	322.7	A
95	42	10/17/95	53.2L	Open	Midpt	Outside Bend/Riprap Failure/(Y)	321.8	0.092	326.3	322.7	A
96	42	10/17/95	53.2L	Open	D/S Pt		321.8	0.170	326.3	322.7	A
97	43	10/17/95	45.3L	Open	Midpt	Straight/Shale Rock Beach/(Y)	317.4	0.186	322.3	318.8	A
98	44	10/17/95	26.0R	Open	Midpt	Inside Bank/Island/Wing Dams/(Y)	306.9	0.132	311.5	308.1	B

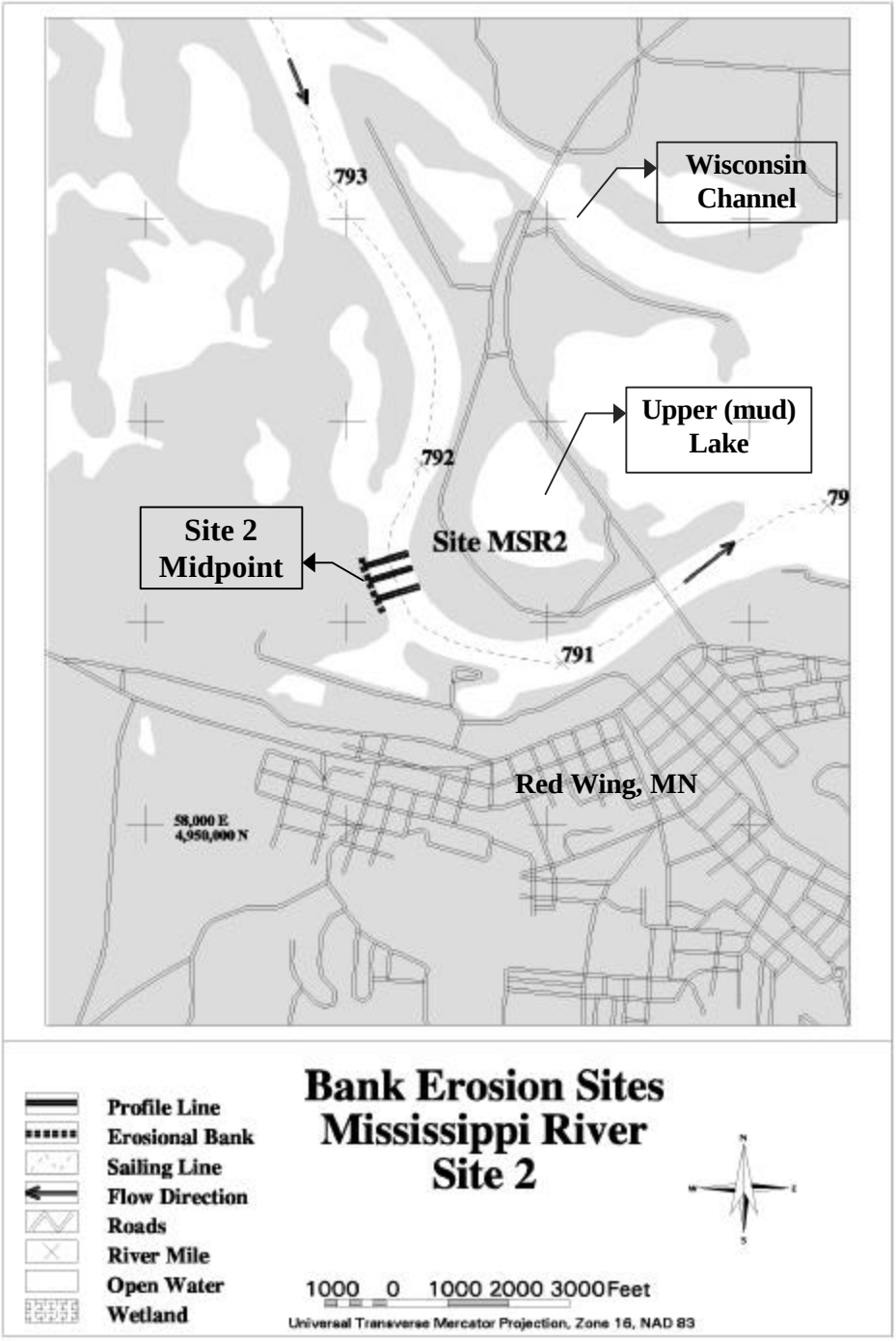

Figure 7-8 A map showing Mississippi River Site 2

Photo 7-13 An upstream view of Site 2 midpoint

Photo 7-14 A downstream view of Site 2 midpoint

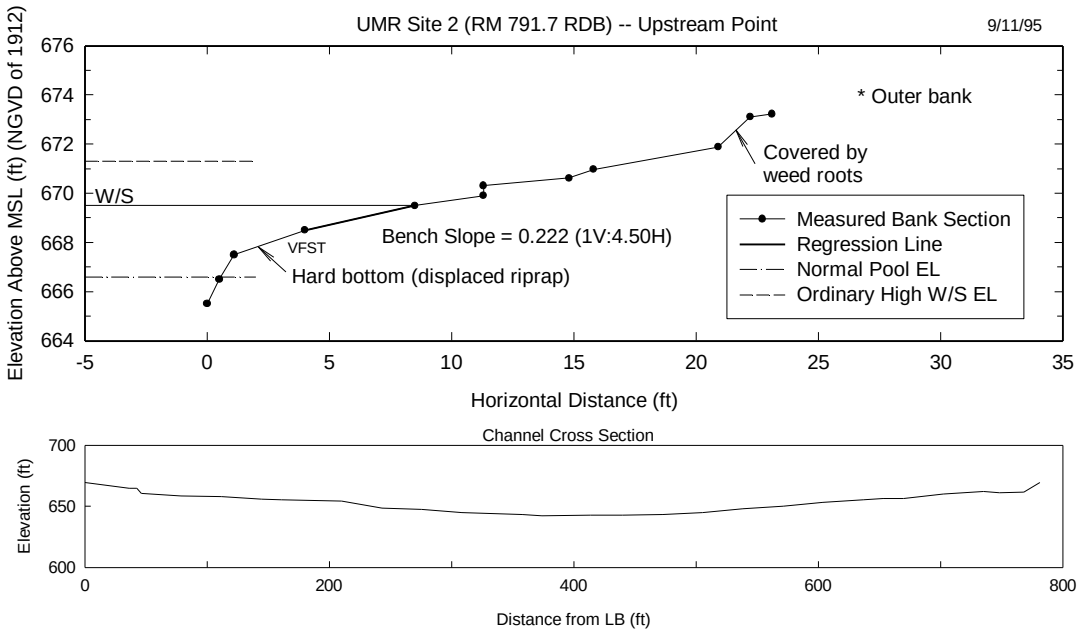

Figure 7-9 Bank section and channel cross section measured at Site 2 upstream point

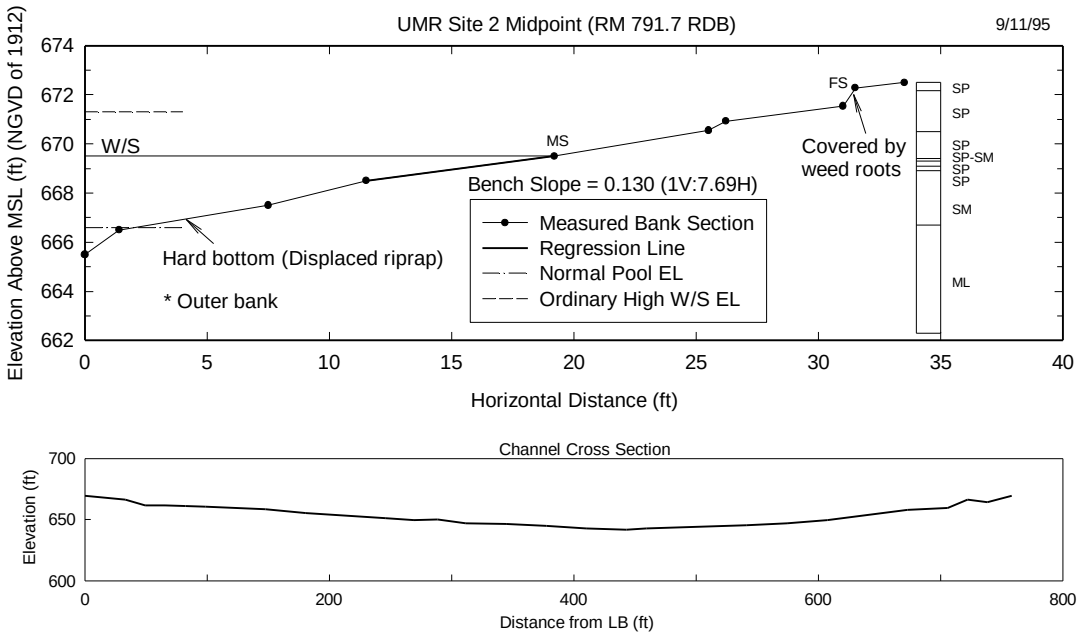

Figure 7-10 Bank section and channel cross section measured at Site 2 midpoint

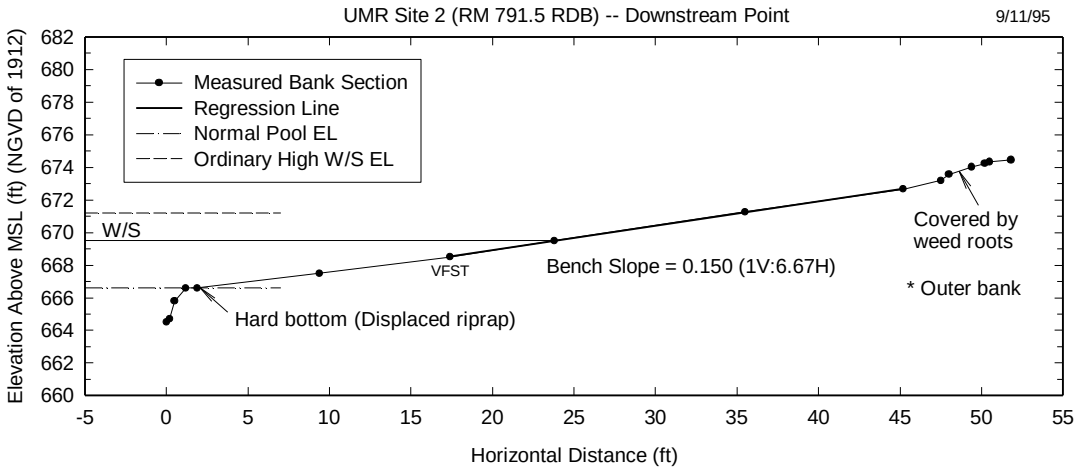

Figure 7-11 Bank section measured at Site 2 downstream point

sand (FS) to medium sand (MS); the stone slope-protection revetment apparently had failed. Subaqueous soil is very fine silt (VFST). Figure 7-9 exhibits a typical rework-transport bank-section pattern which is illustrated in figure 7-5. Several subaerial parallel benches seen in figures 7-9 and 7-10 are considered to be formed at different river stages within a range of stage between NPL and OHWL. Those parallel benches formed at different bank elevations were observed at many other sites investigated.

The tube-core samples showed that the thickness of recent historical alluvial deposits varies greatly at this site, ranging from 0.3 ft to greater than 5.0 ft. Young and very late Holocene deposits lie below historical soils. A weak, thin buried AC horizon is recorded at about 3.1 ft below the surface. Below that horizon are calcareous flood laminae containing partially decomposed gastropod shells and charcoal.

Causative factors for bank retreat at this site include wave and rework-transport of failed soil, and flood-period failure and erosion. Sandy sediment mantles the bench. This site can be classified as Type E.

3. Site 3 at RM 763.4 LDB (Pool 4)

This straight-channel dredged-material disposal site, shown in figure 7-12, is immediately downstream from the mouth of the Chippewa River. A downstream view of

the site is shown in Photo 7-15 and dredged-material layers are shown in Photo 7-16. Three bank sections obtained here are shown in figures 7-13 through 7-15. The river water depth along the left bank is extremely shallow, only 2 to 3 ft deep, and the main

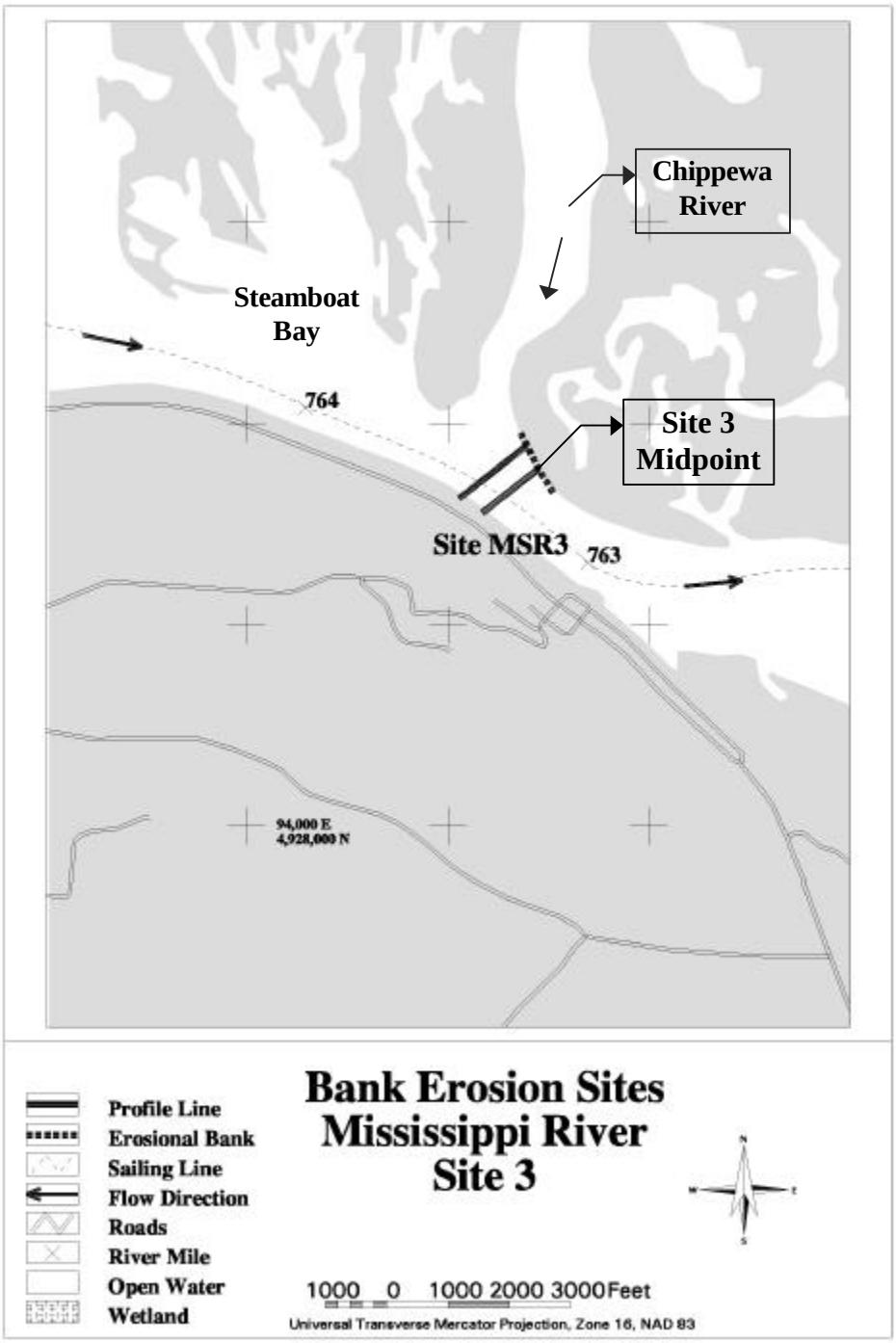

Figure 7-12 A map showing Mississippi River Site 3

channel is located about 600 ft to 800 ft away from the left bank. The dredged bank material consists primarily of medium sand (MS). Subaqueous soil is sand (MS-CS). At the midpoint section, the bank slope was found to be approximately 32°, typical of the angle of shearing resistance of medium dense sand.

Site 3 is located at the distal end of the historical portion of a Chippewa alluvial fan complex. Numerous abandoned tributary channels (former fan outlets) were observed. Two sampling tube cores, taken at this site, indicate that sandy dredged material caps recent historical flood laminae. The native pre-settlement (before ca. 1830) soil was not encountered.

Because there is no erosion protection at this site, dredged material was reworked and transported to the river. The bank-section bench area can be seen clearly in figure 7-14 at the midpoint section. Dredged material at this site is prone to current and wave erosion. The bank sections at the upstream and downstream points are classified as a combination of bank Type E and Type F, and the midpoint section as Type F.

Photo 7-15 A downstream view of Site 3 midpoint

Photo 7-16 Detailed bank-soil structure of Site 3 midpoint

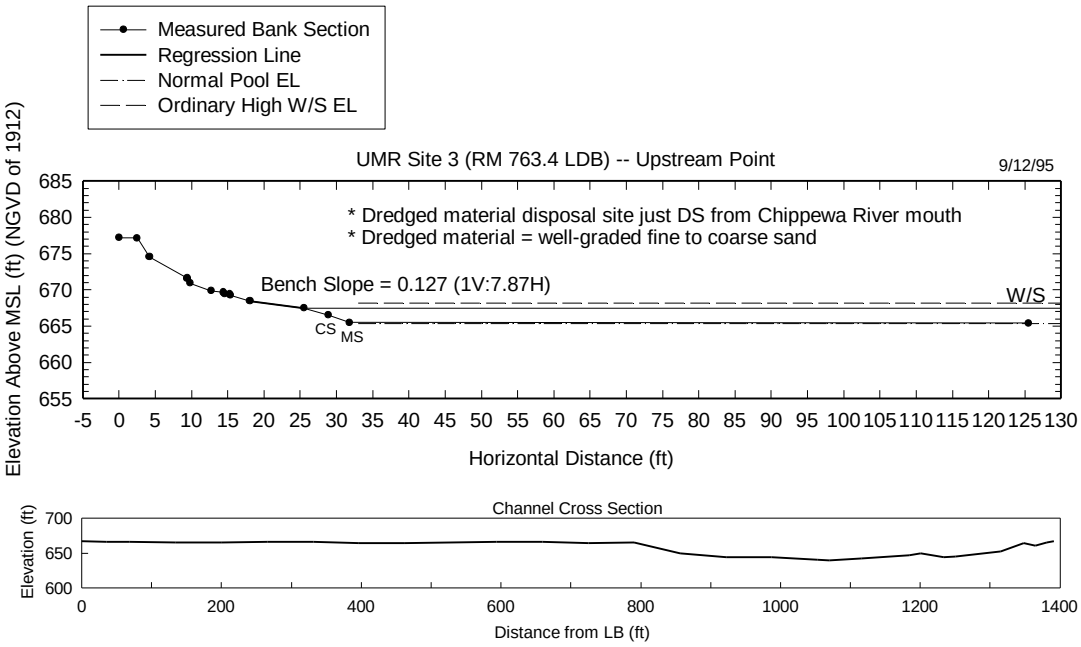

Figure 7-13 Bank section and channel cross section measured at Site 3 upstream point

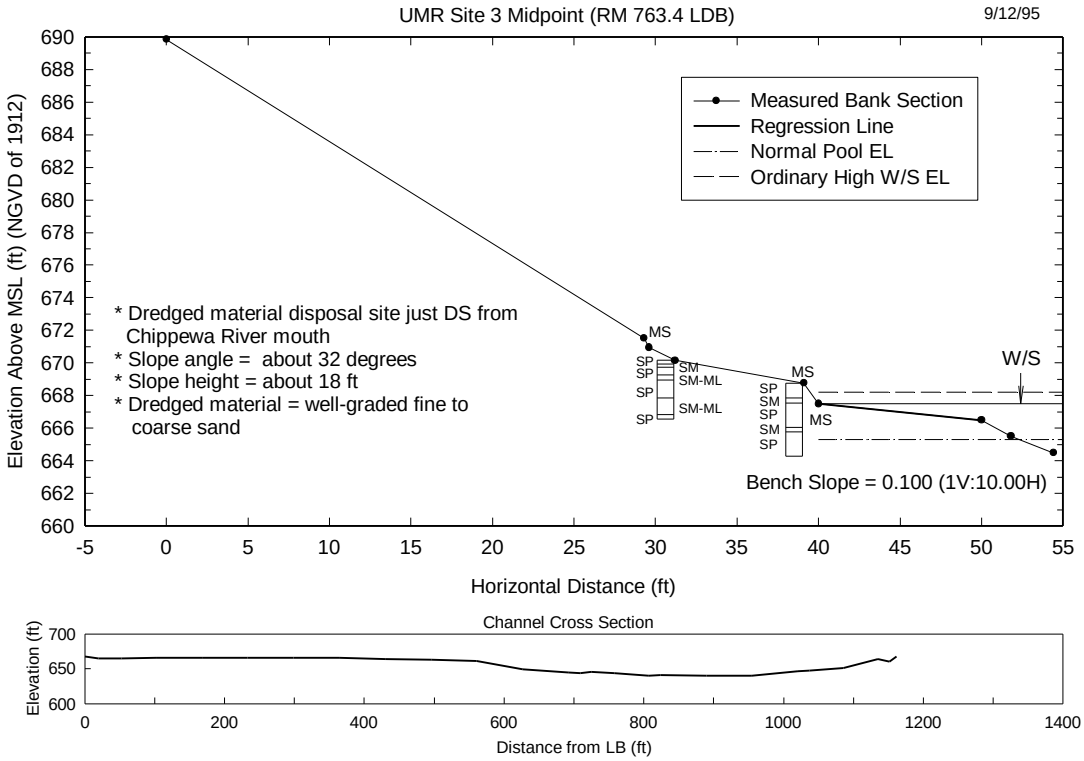

Figure 7-14 Bank section and channel cross section measured at Site 3 midpoint

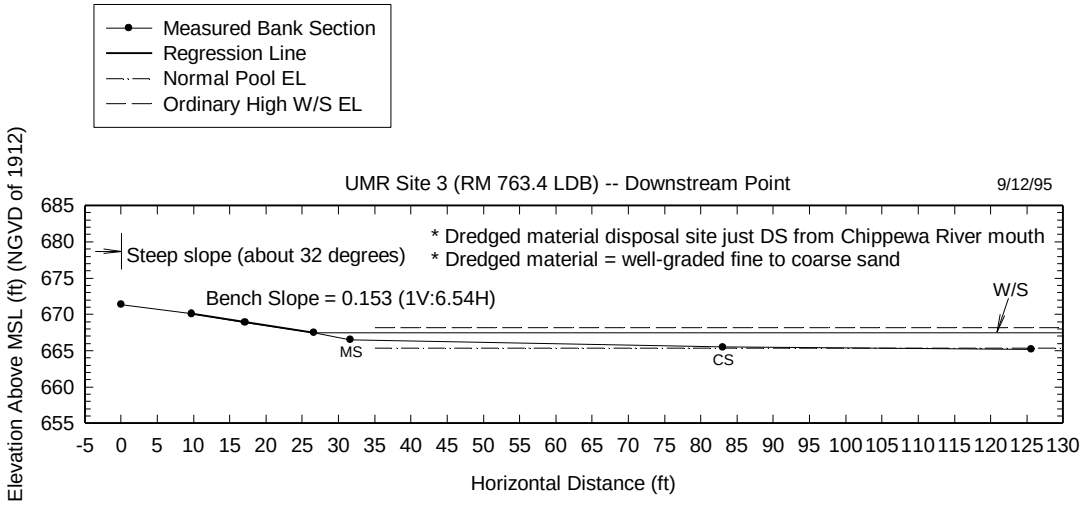

Figure 7-15 Bank section measured at Site 3 downstream point

4. Site 4 at RM 751.1 LDB (Pool 5)

This left-bank site, shown in figure 7-16, is located only about 2 miles downstream from Lock & Dam No. 4, and is adjacent to mooring facilities used by two nearby power plants. A downstream view of the site is shown in Photo 7-17. As shown in figures 7-17 through 7-19, very steep subaqueous slopes exist at this site, which is indicative of in-channel erosion. At the downstream section, evidence of failed revetment was found near the water's edge (see figure 7-19). The bank soils are primarily FS. The soil core sample, taken at the bank and shown in figure 7-18, show multiple layers of SP-ML (see table 7-4) which are judged to be historical deposits due to a series of flood events.

A narrow Holocene meander belt occurs along this reach of the UMR. A deflated outwash terrace and paleochannel system was observed along the western portion of the valley. The Mississippi River Holocene meander belt lies along the eastern portion of the valley where this site is located. Western lateral stream migration has produced a ridge and swale topography from the study site east to the valley wall. Apparent channel stability for several thousand years has produced natural levee deposits at this site. The core sample showed multiple paleosols of late Holocene age. At least six paleosols were recognized below a thin surficial unit of historical alluvium, ranging in age from very late Holocene/early historic, to middle or early late Holocene. Because Archaeological site 47BF160 is nearby at RM 753.0, and because of the existence of multiple paleosols, a high potential exists for buried archaeological material at this study site.

Causative factors for bank retreat at this site include flood erosion and rapid recessional loading and failure, and wave and rework-transport of failed soil and recently deposited sediments. Because of the closeness to the thalweg sailing line and mooring activities, this bench area cover is eroded by waves. All three bank sections are classified as bank Type E.

5. Site 5 at RM 746.4 LDB (Pool 5)

This left-bank, outside-of-bend island site, shown in figure 7-20, is an old dredged material disposal site located about 8 miles upstream from Lock & Dam No. 5. Upstream and downstream views of the site are shown in Photos 7-18 and 7-19, respectively. Three bank sections are plotted in figures 7-21 through 7-23. The subaerial bank as well as the

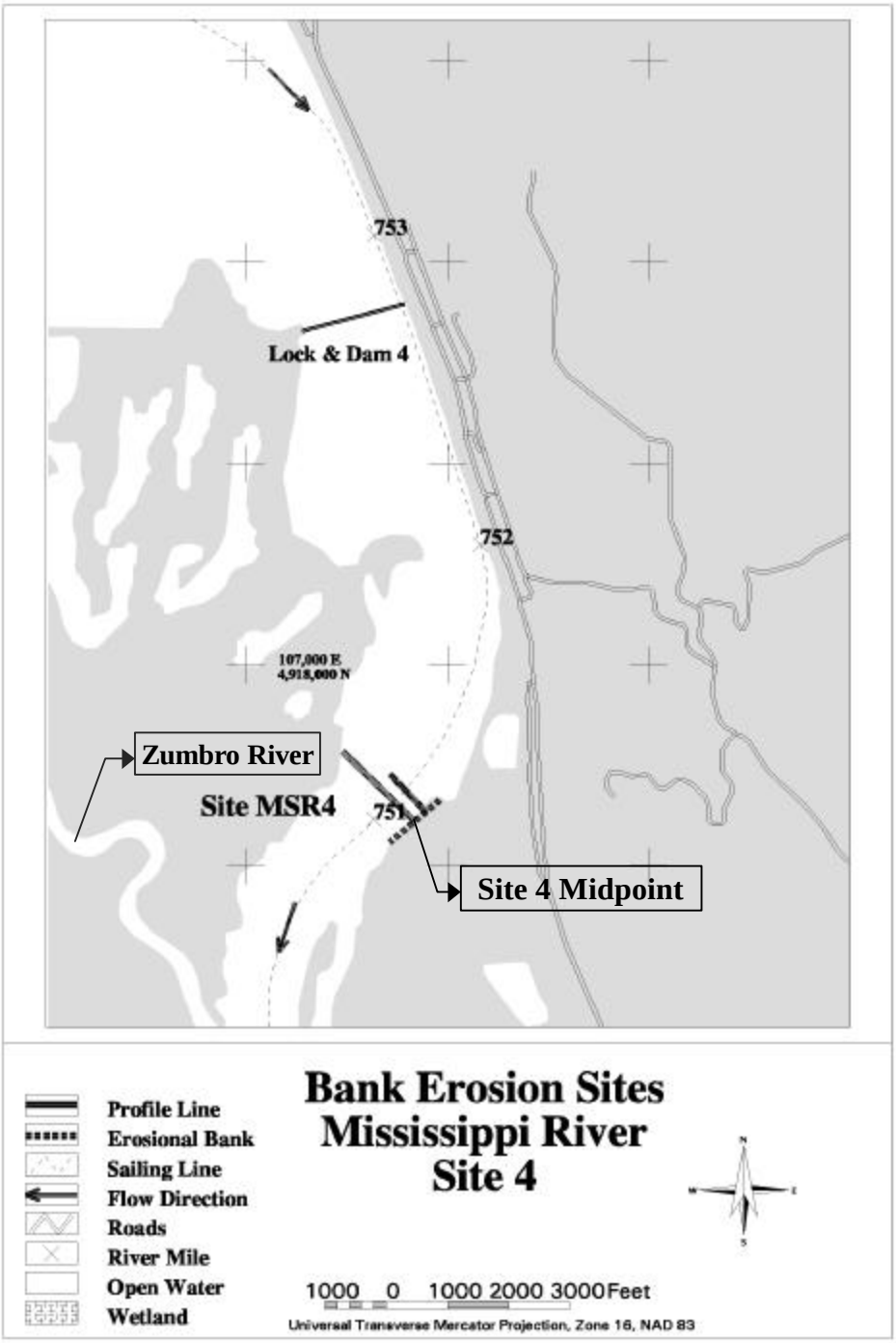

Figure 7-16 A map showing Mississippi River Site 4

Photo 7-17 A downstream view of Site 4 midpoint

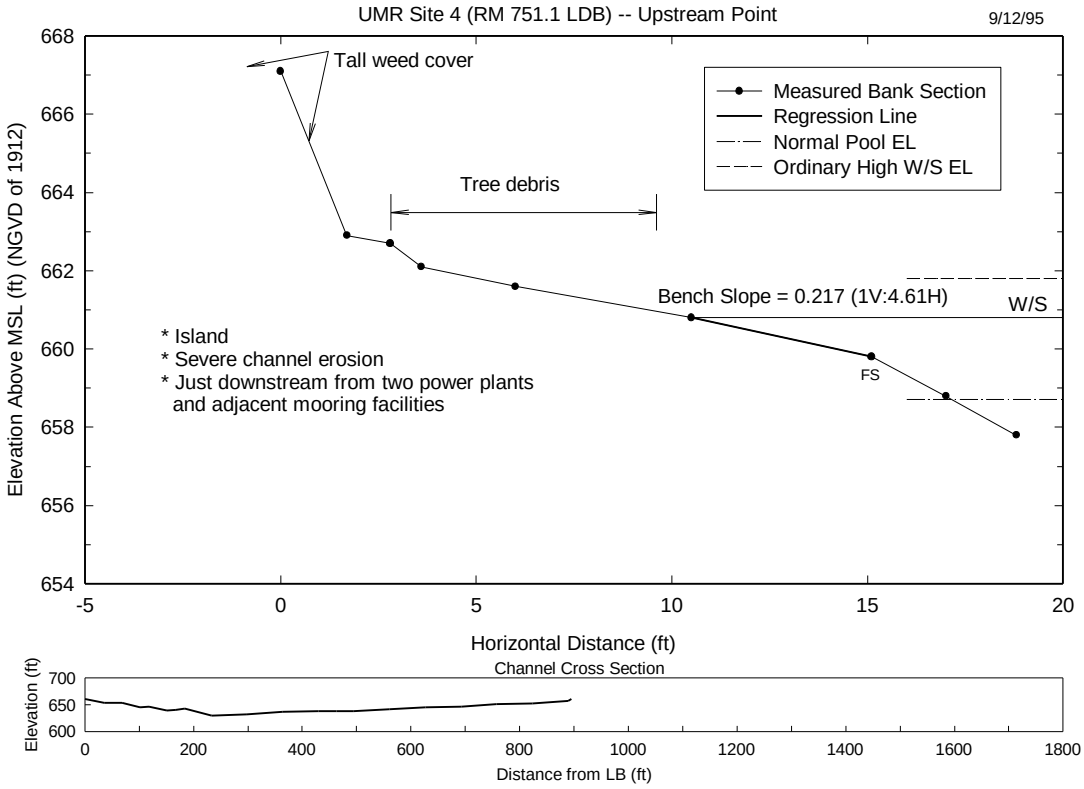

Figure 7-17 Bank section and channel cross section measured at Site 4 upstream point

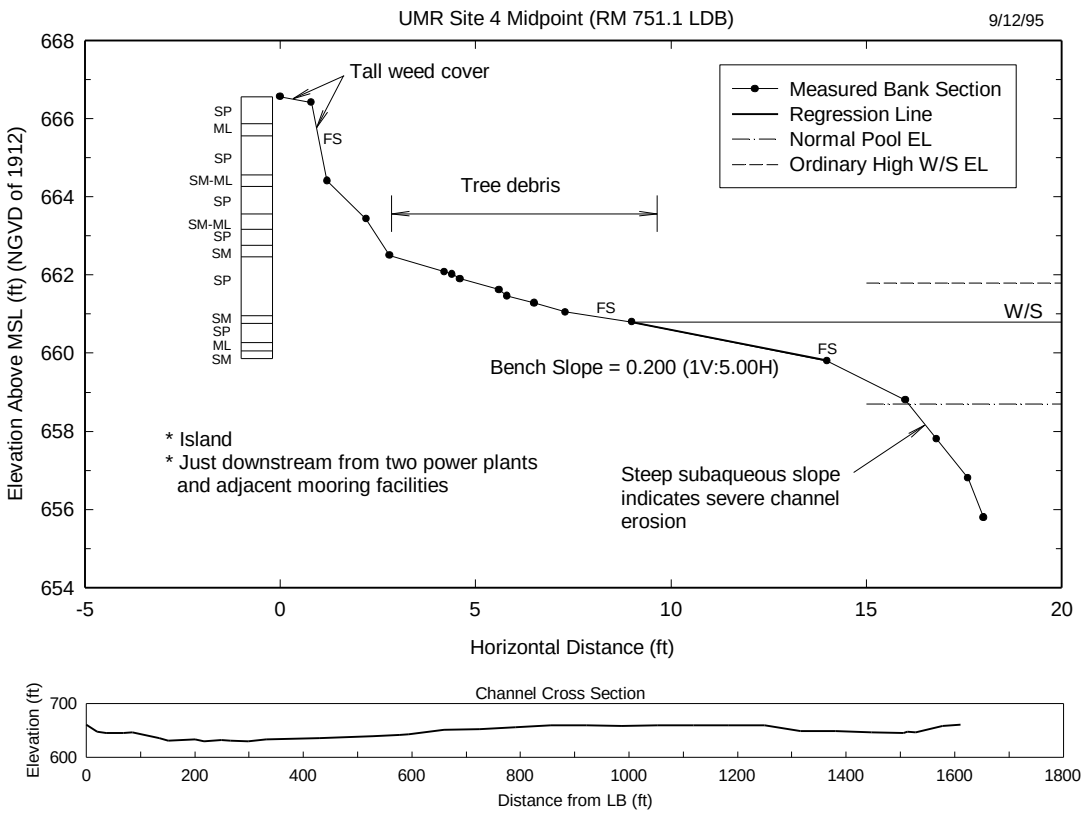

Figure 7-18 Bank section and channel cross section measured at Site 4 midpoint

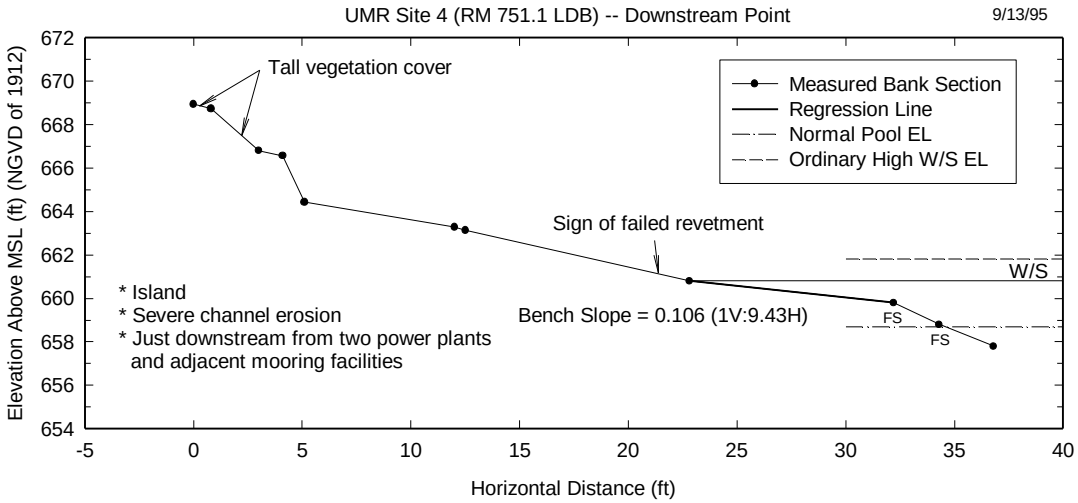

Figure 7-19 Bank section measured at Site 4 downstream point

near-bank subaqueous area are covered by FS, and the site is very close to the thalweg sailing line. As indicated in these figures, bed elevation drops off sharply toward the

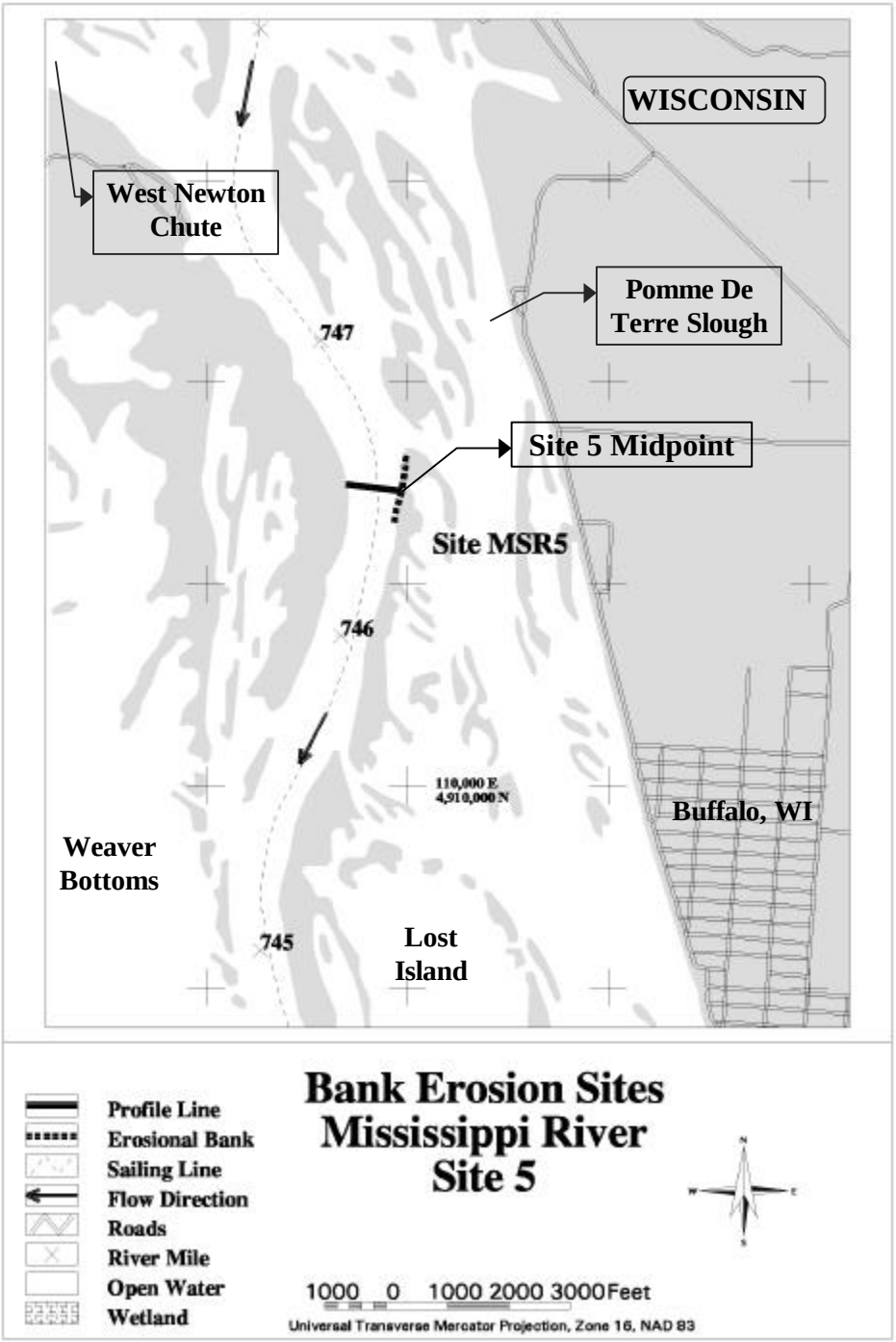

Figure 7-20 A map showing Mississippi River Site 5

Photo 7-18 An upstream view of Site 5 upstream point (see in-channel erosion)

Photo 7-19 A downstream view of Site 5 midpoint

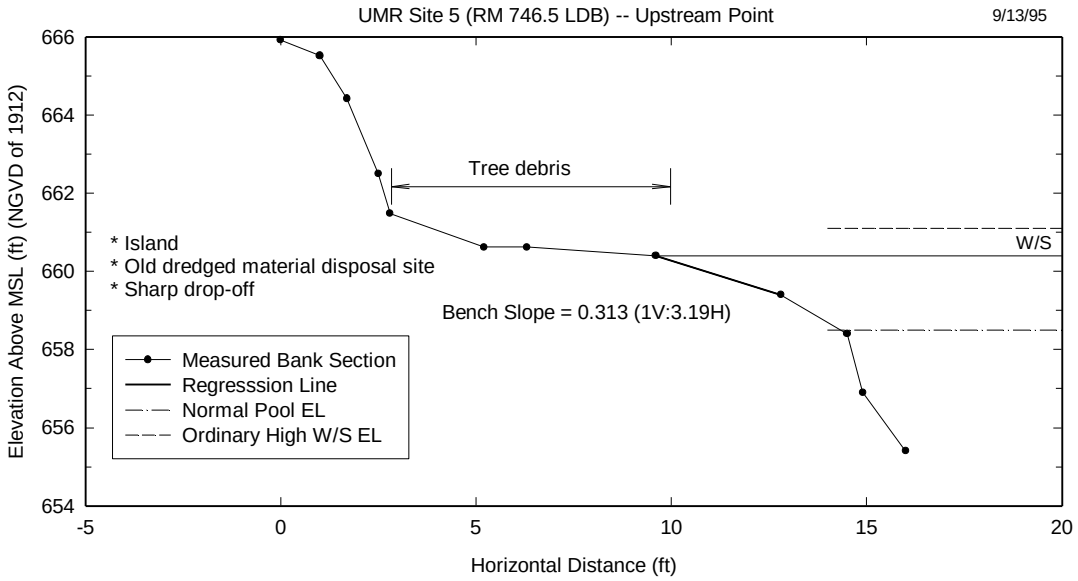

Figure 7-21 Bank section measured at Site 5 upstream point

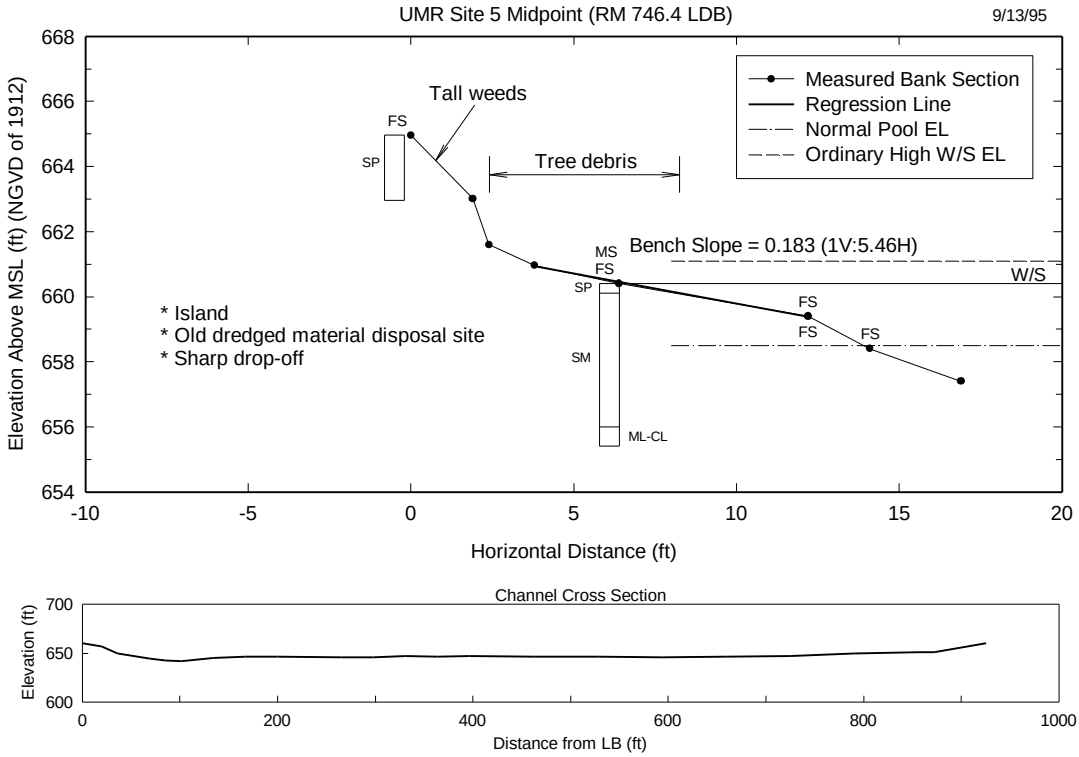

Figure 7-22 Bank section and channel cross section measured at Site 5 midpoint

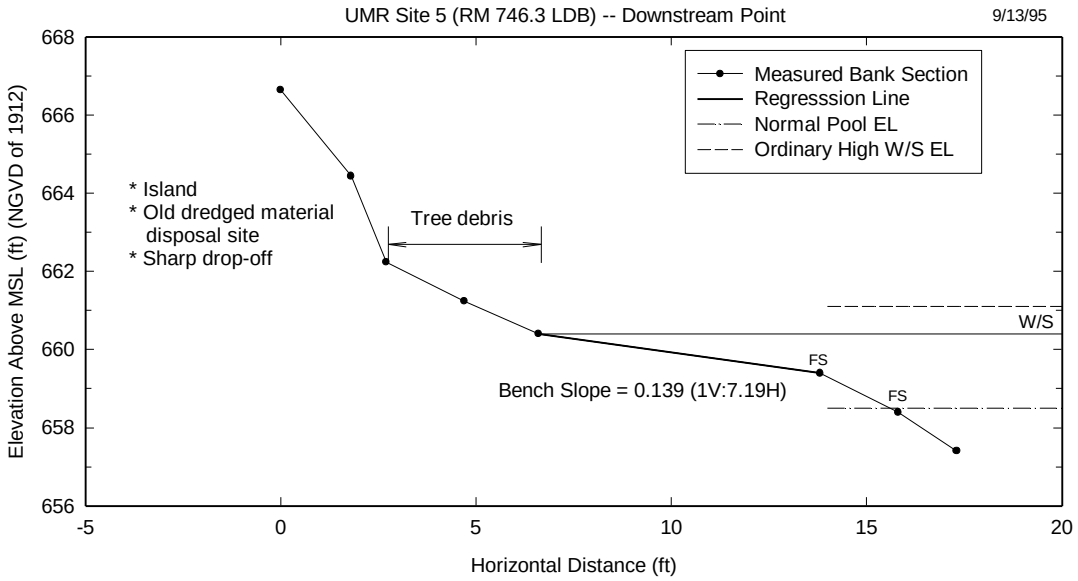

Figure 7-23 Bank section measured at Site 5 downstream point

channel. The bench slope gradually decreased from 0.313 at the upstream point to 0.183 at the midpoint, and to 0.139 at the downstream point along the island. These eroded island banks exhibit steep bench topography near the tip of the island and the bench slope decreases toward the toe of the island. These morphological characteristics were observed at other island sites.

Most of the Holocene surfaces are inundated. An approximately 4.4-ft deep dredge-spoil layer was found in the core sample. The core sample also showed historical alluvium overlying a very poorly drained late Holocene to historical soil.

Causative factors for bank retreat at this site include wave and rework-transport of failed soil and recently deposited sediments and flood erosion. Wave erosion within berm and bench areas appear to be significant at this site. The bank section for this site is classified as Type F.

6. Site 6 at RM 727.4 RDB (Pool 6)

This site was on the right outer bank of a minor river bend, shown in figure 7-24, only about 1 mile downstream from Lock & Dam No. 5A, and the bank is close to the thalweg sailing line. Photos 7-20 and 7-21 show a downstream view and scarp at this site,

respectively. The three bank sections obtained at this site are depicted in figures 7-25 through 7-27. The river cross section in figure 7-26 shows the thalweg near the right

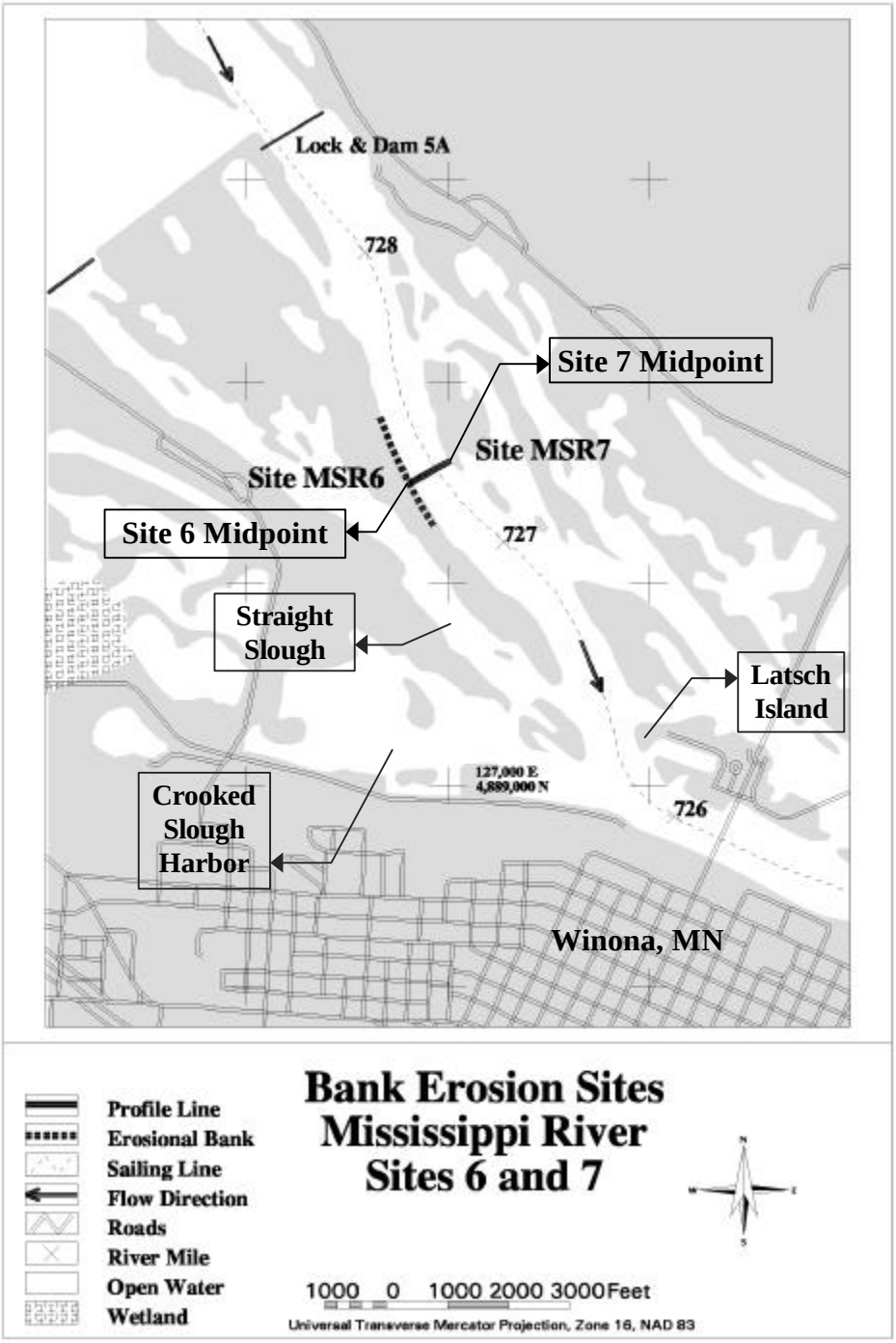

Figure 7-24 A map showing Mississippi River Sites 6 and 7

bank. The bank soil is primarily sand (VFS-MS) and subaqueous sediment is sand (FS-MS). The scarp was covered by grass roots and tree debris.

Photo 7-20 A downstream view of Site 6 midpoint

Photo 7-21 A close-up view of scarp at Site 6 midpoint

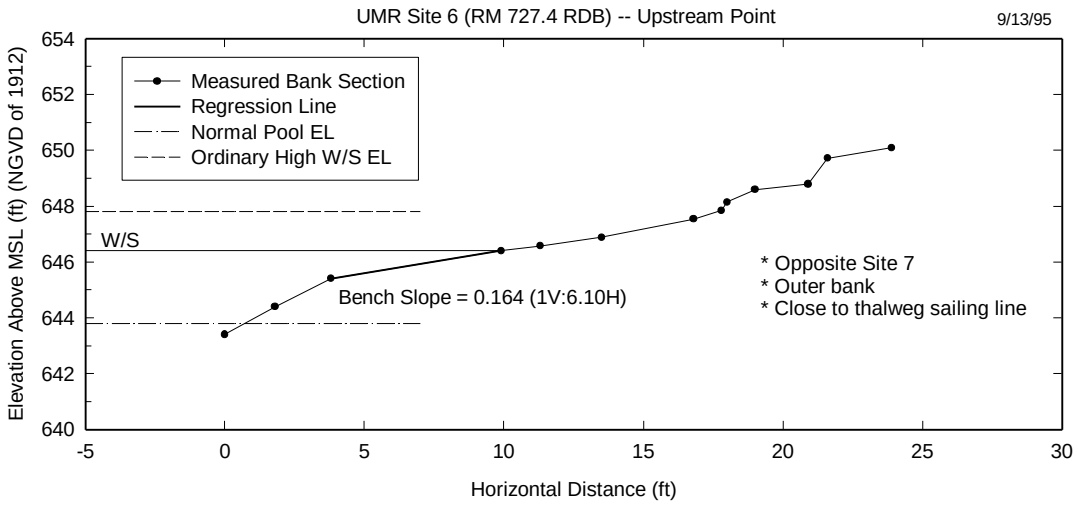

Figure 7-25 Bank section measured at Site 6 upstream point

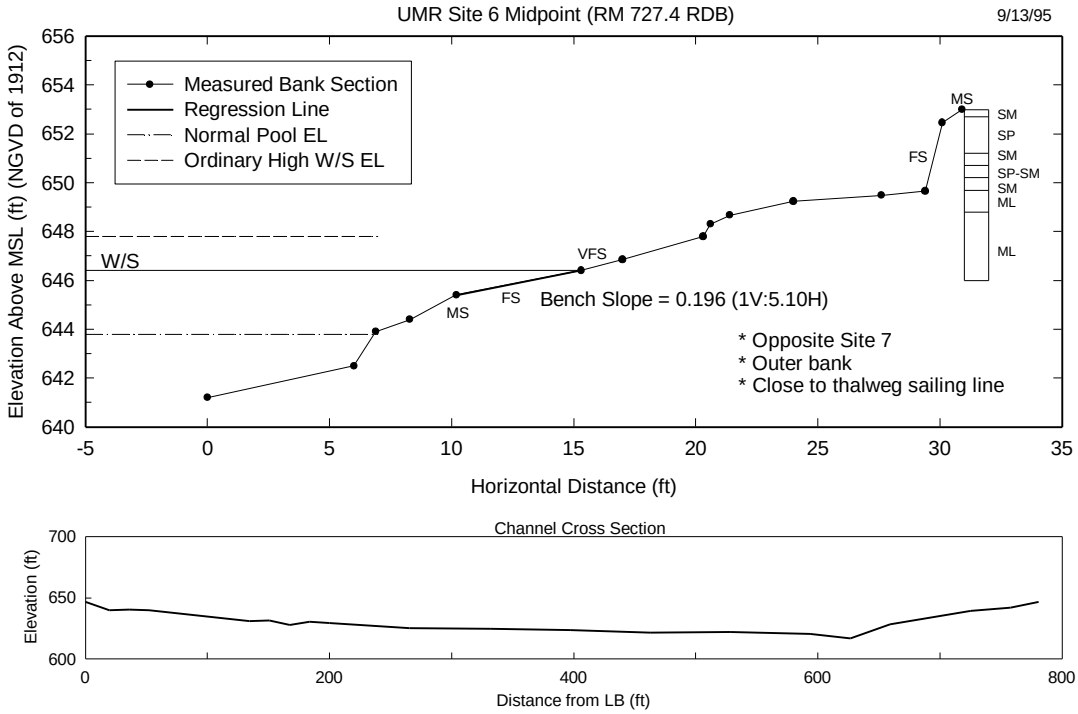

Figure 7-26 Bank section and channel cross section measured at Site 6 midpoint

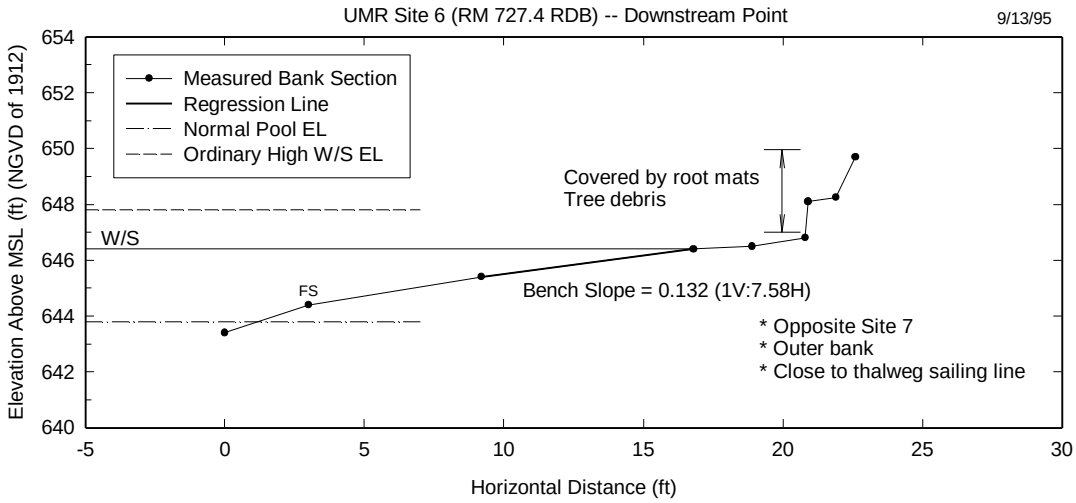

Figure 7-27 Bank section measured at Site 6 downstream point

Observations indicate lateral bank erosion with minor surface erosion. No historical deposits were found in the core sample. Three paleosols were observed in the profile, developed in levee deposits, and they appear to be of late Holocene age. It should be noted that the buried soils occur in a MR natural levee deposit. Because of the buried soils and location in the upper pool, there is potential for buried archaeological material although there are no recorded archaeological sites nearby.

Primary causative factors for bank retreat at this site include flood-flow erosion and rapid recessional loading and failure, wave and rework-transport of failed soils and recently deposited sediments, and minor piping. Wave erosion of sand cover occurs within bench areas at this site. This site is classified as Type E.

7. Site 7 at RM 727.4 LDB (Pool 6)

This site on the left bank of a minor bend, located on island opposite Site 6, is only about 1 mile downstream from Lock & Dam No. 5A (see figure 7-24). The site includes a wing-dam field. Upstream and downstream views of the site are shown in Photos 7-22 and 7-23, respectively. The measured bank section is shown in figure 7-28. The scarp was covered by a grass-root mat. Both the subaerial bank and the subaqueous bench consisted primarily of sand (FS-CS). When the mat was lifted, sand ran freely from the