PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

YEAR 1 (2009) REPORT

Channel Geomorphology and In-Channel Vegetation Monitoring of the Central Platte River

Prepared for:
Executive Directors Office
Platte River Recovery Implementation Program
Headwaters Corporation
3710 Central Avenue, Suite E
Kearney, NE 68847

Prepared by:

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PLAT12-T.DOC

and

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February 2010

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ACKNOWLEDGMENTS

A number of Ayres Associates and Olsson Associates personnel were involved in conducting various aspects of this project. Dr. James Schall, VP Ayres Associates, is the Principal-in-Charge and provided overall oversight of the project. Mr. William Spitz, Senior Geomorphologist for Ayres Associates, is the overall Project Manager. Dr. Joan Darling, Environmental Sciences Team Leader for Olsson Associates, is the Olsson Project Manager. Mr. Spitz and Dr. Darling provided oversight and guidance in conducting the geomorphology and vegetation monitoring aspects of the project. Mr. Anthony Alvarado, Geomatics Project Manager for Ayres, provided oversight and guidance in conducting the longitudinal profile and transect surveys and performed the suspended sediment transport analysis. Dr. E.V. Richardson, a Senior Associate with Ayres, provided QA/QC and oversight on the suspended sediment transport analysis. Mr. Nate Van Meter, an Associate Scientist with Olsson conducted the vegetation monitoring activities and was assisted by Ben Schiltz, Deanna Pulse, and Caroline Hinkelman, also of Olsson. Survey control setup, the survey of the longitudinal profile and transects, and the suspended sediment sampling effort were overseen by Mr. Joe Robinson, Survey Crew Chief for Ayres, who also assisted in the collection of bed, bank, and bar sediment samples. The ground survey and suspended sediment sampling were performed by Mr. Pete Paulus and Mr. Darby Schock of Ayres. Mr. Andrew Phillips, at Olsson's geotechnical lab in Lincoln, conducted the grain size analysis of all sediment samples collected for the project.

Dr. Jerry Kenny, Headwaters Corporation, is the Executive Director for the Platte River Recovery Implementation Program (PRRIP). He is assisted by Mr. Chad Smith, Director of Natural Resources for the Headwaters Corporation, who is the Program's Technical Point of Contact for this project. They are also assisted by Mr. Jason Farnsworth from Headwaters Corporation. Mr. Smith and Mr. Farnsworth have provided guidance and invaluable assistance in conducting this project. Other Program/Headwaters Corporation personnel that have provided invaluable assistance include Mr. Justin Brei and Mr. Tim Tunnell. Mr. Brei provided assistance in issues related to the Program's geodatabase and the acquisition of the LiDAR data, and Mr. Tunnell provided assistance in dealing with access issues and coordination with landowners.

1. PURPOSE

Per the protocol, the purpose of geomorphology monitoring is to document trends in channel geomorphology parameters in the full program reach of interest during the thirteen-year First Increment (2007-2019) of the Platte River Recovery Implementation Program (Program). Monitoring includes documenting channel shape (including width), channel plan form, channel degradation or aggradation, grain sizes, and sediment loads.

The purpose of the in-channel vegetation survey is to provide system-wide status information on trends in extent and elevation range of vegetation species of interest. This information is designed for use in the annual and long-term planning for implementation of the Program's Adaptive Management Plan (AMP) and use of water in the Environmental Account (EA). Specifically this information will be usedto evaluate the extent of existing native and non-native invasive species infestations, to provide information in evaluating the effects of program activities, and to serve as a mechanism for identification of new invasive species populations before infestations become widespread.

Several priority hypotheses identified in the AMP are directly linked to river morphology and are also influenced by in-channel vegetation. Data collected through this monitoring protocol will be utilized to determine effects and relationships that relate back to these priority hypotheses, the two management strategies identified in the AMP, and overall AMP implementation. Several priority hypotheses related to system form and function, physical processes, and habitat features for least tern, piping plover, whooping crane, and pallid sturgeon, (AMP, Table 2) are linked to aspects of geomorphology.

2. BACKGROUND

Much of the following section is taken from the monitoring protocol document and is replicated here to provide background for this report.

2.1 Area of Interest

The area of interest for geomorphology and vegetation monitoring consists of channels within an area of approximately 0.5-mile on either side of the centerline of the Platte River, beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington, Nebraska, and extending eastward to Chapman, Nebraska (approximately 100 miles). **Figure 2.1** shows the project reach and relevant geographic features. Certain areas within this stretch of the central Platte will be prioritized for monitoring based on key priority hypotheses, ecological need, and Program actions undertaken during the First Increment.

2.2 Channel Geomorphology Monitoring

Program geomorphology monitoring is designed to document trends in channel morphology within the entire study area throughout the First Increment. In addition, the data will provide information on trends at specific sites or groups of sites within the entire study area. Monitoring is focused on measuring and tracking changes in river planform, river cross-section geometry (including bed elevation and channel width), longitudinal bed profile, streamflow, sediment loads, and grain size distribution. The monitoring data is collected through aerial photographs, airborne terrestrial LiDAR, topographic ground surveys, bed material sampling, ground photography, flow measurements at gaging stations, and sediment transport measurements. The overall strategy is focused on a randomized scheme, but there is some sampling stratification (e.g., grain size) to reduce variability and improve future comparisons.

2.3 Anchor Points

A systematic sample of points along the river are "anchors" for data collection. These anchor points are systematically placed along the centerline of the main channel of the river. The anchor points are spaced at approximately 4,000 meter (2.5 mile) intervals along the centerline, and each point has been labeled with a UTM (Universal Transverse Mercator coordinate system) location and a U.S. Army Corps of Engineers (USACE) river mile (using USACE river mile shape file obtained from the Bureau of Reclamation). The anchor points are listed by river mile in **Table 2.1**. The locations of anchor points can vary up to 800 meters (0.5 mile) from the 4,000 meter spacing to accommodate previously established cross sections within the historical database, and to accommodate some land access issues. Three cross sections at an anchor point entail the basic sampling unit for geomorphology data collection and analyses. The anchor point cross sections extend laterally across the historic flood plain and incorporate the current main channel as well as all primary split flow channels (i.e., those channels separated from the main channel by islands). Although the south channel (Reach 2) and north channel (Reach 1) of Jeffrey Island share the same anchor points, these two channels are treated as separate reaches of river for monitoring, measuring, and analysis.

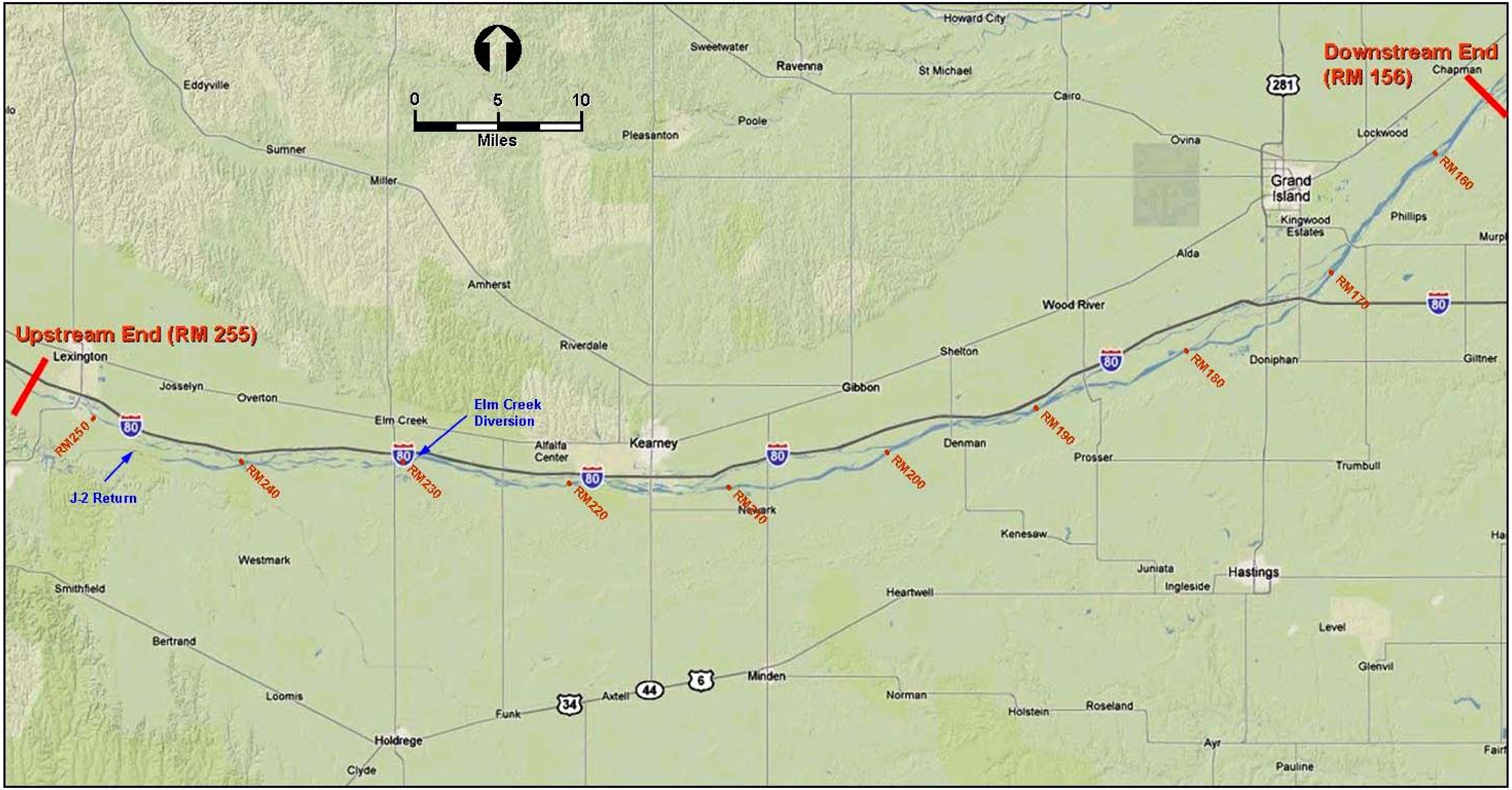


Figure 2.1. Location map showing the project reach for the Channel Geomorphology and In-Channel Vegetation Monitoring.

Table 2.1. Anchor Point Locations per the Monitoring Protocol.

Anchor Point No.	Systematic Point at 4000 m (2.5 miles) (River Mile)	Closest Existing Cross Section	Recommended Anchor Point (River Mile)	Pure (P) or Rotating (R) Panel	Location
40	254	254.4	254.4	**R1**	Lexington
39	251.5 Bridge	250.5	250.8	**P**	Lexington bridge (Hwy 283)
38	249	249.5	249.0	**R2**	
37	246.5	246.5 N & 246.0 S	246.5 N & S	**P**	J2 Return - Jeffrey Island
36	244	244.0 N & S	244.0 N & S	**R3**	
35	241.5		241.5 N & S	**P**	
34	239	239.1	239.1	**R4**	d/s Overton bridge (Rd. 444)
33	236.5	237.3	236.4	**P**	Cottonwood Ranch transects
32	234	233.9	234.1 Main, N, S	**R1**	
31	231.5	231.5	231.5	**P**	u/s Elm Creek bridge (Hwy 183)
30	229	228.6	228.6	**R2**	d/s Kearney Diversion
29	226.5	226.4	226.4	**P**	
28	224 Bridge	224.3	224.3	**R3**	Odessa Rd. Bridge
27	221.5	222.0	221.9	**P**	
26	219	219.8	219.0	**R4**	
25	216.5		216.5	**P**	
24	214		214.0	**R1**	d/s Kearney bridge (Hwy 44)
23	211.5	210.6	211.5 Main & N1,N2	**P**	
22	209	208.4	208.4 Main & N1	**R2**	u/s 32 Rd. bridge (Hwy 10)
21	206.5	206.7 (no N)	206.7 Main & N1	**P**	
20	204	203.3 N&S	204.0 Main & N1	**R3**	
19	201.5	201.1 N maybe S	201.1 Main & N1	**P**	d/s Lowell Rd. bridge (Hwy 10C)
18	199	199.5	199.5	**R4**	
17	196.5	196.4	196.4	**P**	u/s Shelton Rd. bridge (Hwy 10D)
16	194	193.9	193.8	**R1**	
15	191.5	190.9	190.7	**P**	
14	189	189.3	189.3	**R2**	
13	186.5	187.0	186.7 Main & N1	**P**	d/s S. Nebraska Hwy 11 bridge
12	184	183.1	184.0 Main & N1	**R3**	
11	181.5	181.8 S	181.8 Main & N1	**P**	d/s S. Alda Rd. bridge
10	179	178.38 & 178.4 M & N	179.0 Main & N1,N2,N3	**R4**	
9	176.5	177.1	176.5 Main & N1,N2,N3	**P**	u/s SR 34/281 bridge (Doniphan)
8	174	174.6	174 Main & N1,N2,N3	**R1**	Grand Island
7	171.5	172.1 S & SM & N & NM	171.5 Main & N1,N2,N3	**P**	d/s I-80 bridge
6	169	168.7 N & S	169.1 Main & N1	**R2**	
5	166.5	166.9	166.9	**P**	d/s SR 34/Hwy 2 bridge
4	164	164.6	164.0	**R3**	
3	161.5	162.1	161.8	**P**	Phillips
2	159	158.7	158.7	**R4**	
1	156.5	157.3	156.6	**P**	d/s Bader Park Rd. br (Chapman)

New survey at systematic point

Use existing site (Holburn et al. 2008)

Use existing site if new transect can be aligned to match existing site using metal pins or coordinates

2.4 Pure and Rotating Panels

The anchor points sampled each year under this protocol are components of a “pure panel” subset and a “rotating panel” subset. A panel is made up of a group of sampling sites that are always visited at the same time. The pure panel consists of a group of sites that are visited annually. The rotating panel consists of four groups of sites, with only one group visited annually and each group revisited once every four years.

There are 25 sample sites that will be surveyed each year - 20 pure panel anchor points (3 geomorphology transects per anchor point) and five rotating panel anchor points (3 geomorphology transects per anchor point). The sample sites in the pure panel are to be surveyed each year while the sample sites in the rotating panel are to be surveyed every four years (rotating between R1-R4 sites as denoted in Table 2.1). Each site in the rotating panel are to be surveyed three times in the First Increment. We have completed the first survey of all of the pure panel anchor points and the first set of rotating panel anchor points.

2.5 In-Channel Vegetation Monitoring

The system-level vegetation survey is designed to document the areal extent of species of interest within the Vegetation Survey Zone (as defined in protocol) between the historic high banks. The system-wide anchor points are used to locate the data collection in order to obtain estimates that are representative of the entire study area. The vegetation survey utilizes the topography survey conducted as part of the annual geomorphology monitoring. Since the objective of this monitoring is to identify trends in extent and elevation, the in-channel vegetation monitoring design is conducted at the same pure panel and rotating panel anchor points as the geomorphology survey.

One fixed width (belt) transect is used to estimate the area of the channel with vegetation of interest present at each anchor point. The belt transect is centered on an anchor point and is generally oriented perpendicular to the flow. The length of each belt transect is the length of the Vegetation Survey Zone within the historic high banks. The width of each belt transect is approximately 300 meters (1,000 feet), extending for approximately 150 meters (500 feet) upstream and downstream of the anchor point. Within the belt transect, seven linear vegetation transects spaced approximately 50 meters (165 feet) apart were established perpendicular to flow and generally parallel to or overlapping the geomorphology transects. Three of the vegetation transects correspond to and overlap the three geomorphology transects. On each transect, sample points were assessed for species composition and percent cover, and elevation. Sample points were spaced on each linear transect at approximately 15-meter (50-foot) intervals within the Vegetation Survey Zone. This sampling interval was evaluated during this first year for appropriateness and it was determined that it may not provide sufficient data to obtain an accurate representation of the vegetation within each belt transect.

Current vegetation species of interest include woody vegetation less than 1.5 meters tall, including willows, cottonwood, false indigo, saltcedar (all heights), and Russian olive, as well as purple loosestrife, phragmites, river bulrush, and cattails. The monitoring identifies vegetation, including the above species of interest, at sampling sites located within the Vegetation Survey Zone.

2.6 Airborne Mapping of Topography (LiDAR)

Vegetation on the floodplain and on islands within the outer historic banks makes ground surveys laborious and costly outside the active channel or disked ground. Therefore, topographic information in the form of contour base mapping is to be developed from airborne terrestrial LiDAR. Airborne terrestrial LiDAR flights for mapping are to be flown at the beginning (baseline conditions) and end of the First Increment. Mapping with a plus or minus 6-inch vertical accuracy and one-foot contours (vertical accuracy) covering the area between the historic outer banks (approximately one mile in width) will provide baseline topographic information from Lexington to Chapman for monitoring channel changes. The LiDAR mapping has been completed for the first year.

The current LiDAR mapping is providing data for: planform mapping; topography for extending transects to cross sections; basic input to 1-D and 2-D flow, sediment, and vegetation modeling; and data for base mapping for designing sediment and planform (flow consolidation and other mechanical actions) management actions. Topographic information within the active channel has been obtained from the GPS ground surveys of the transects, which will be extended to the full width of the floodplain (i.e., cross sections) and to the outer historic banks through the use of the LiDAR topography.

3. LONGITUDINAL PROFILE AND TRANSECT SURVEYS

Surveys of the longitudinal thalweg profile and the ground transects were conducted per Section III.B of the protocol. Sample sites were surveyed according to the schedule for pure and rotating panels, while the longitudinal survey, which occurs once at the start-up of the program and a second time one year before the end of the First Increment, was also completed this year.

The locations of established control points and permanent benchmarks were identified prior to conducting the surveys. Where control points or benchmarks had been destroyed, damaged, or displaced, those points were reestablished. In areas where there was insufficient survey control, new control points or permanent benchmarks were established for use in conducting the transect and longitudinal profile surveys. All new or reestablished benchmarks and control points were established and monumented using standard survey techniques and criteria and as defined in the monitoring protocol.

3.1 Survey Control

The horizontal reference datum for all surveys is the North American Datum of 1983 (NAD83) and the vertical reference datum is the North American Vertical Datum of 1988 (NAVD88). Primary control was set for the project reach at roughly 12 mile intervals. Each control point was measured with GPS static observations for approximately 4 hours. Raw observations for each were sent to National Geodetic Survey (NGS) Online Positioning User Service (OPUS). OPUS horizontal and vertical coordinates in NAD83 Geographic and NAD83 State Plane Nebraska systems were used to correct values for each monument. Secondary control was set for the project reach in between the primary control point locations. These monuments were measured with RTK GPS from each adjacent primary control point and then the coordinates were derived from the mean of those two measurements. This control survey was not performed in compliance with the Protocol, but deemed necessary in order to complete both the longitudinal profile as well as the transects survey in a high quality and timely manner.

3.2 Landowner Contact

A protocol for obtaining landowner permission was established by Program and Ayres/Olsson staff prior to conducting the field survey work. Program staff made the initial contact with the landowners and obtained written permission forms allowing access to their properties. Program staff also created a geodatabase that included landowner contact information for each anchor point. The signed permission forms and the geodatabase were provided to Ayres/Olsson staff prior to the start of field work. The landowner permission forms indicated that a phone call would be made to the landowner prior to Program or Ayres/Olsson staff entering the property. During the project kickoff meeting it was determined that Ayres/Olsson staff would be responsible for making the phone call to landowners.

Ayres/Olsson staff's protocol was to make calls to landowners at least one day prior to entering their property. In cases where a phone message was left with a landowner, a contact phone number for a member of the field crew (typically Nate Van Meter of Olsson) was given and the landowner was asked to return the call if they had any questions or concerns. In addition, significant coordination was also conducted between Ayres/Olsson and Program staff during the field work to ensure proper property access protocols were followed. A memo documenting field staff's contacts with landowners was provided to the program in the 8-29-09 Progress Report.

3.3 Longitudinal Profile Survey

The longitudinal profile of the main channel thalweg will be monitored to provide data on irregularities in slope that may affect channel planform and cross section, and to evaluate trends in aggradation and degradation. The longitudinal profile was measured with a hydrographic survey this year and will be measured again in Year Twelve of the Program. The survey included thalweg measurements in the main channel of the river between Lexington (RM 255) and Chapman (RM 156) and the south channel at Jeffrey Island between the Johnson-2 (J2) Return (RM 237) and the confluence with the main channel (RM 230). The longitudinal thalweg profile survey was conducted per Section III.B.4 of the monitoring protocol.

3.3.1 Methodology

The protocol initially indicated that the longitudinal profile survey should be conducted at higher flows, preferably during spring runoff, to allow for the use of survey-grade, boat-mounted, GPS-based, depth-sounding equipment (e.g., fathometer). However, as discussed below, high flows may not be a necessary or even desirable prerequisite to conducting the hydrographic survey. Regardless of the flows, a GPS-based hydrographic survey is preferential because it is less time consuming and easier to conduct (i.e., using a boat versus physically walking the channel), is less costly (fewer man-hours and lower equipment costs), and provides significantly more topographic data.

Prior to conducting the survey, the principal flow path within the main channel that contains the primary thalweg was identified from the most current georeferenced aerial imagery and the flow path was used to guide the hydrographic survey. Since there are multiple flow paths within and outside of the main active channel, the identified flow path that contains the primary thalweg provided an accurate boundary within which the hydrographic survey could be conducted.

The profile survey was conducted using a boat-mounted, survey grade, GPS-based fathometer. The horizontal and vertical accuracy of the survey was within 0.1 feet using NAD83 as the horizontal reference datum and NAVD88 as the vertical reference datum. Where possible, the profile survey was performed in a relatively tight diagonal cross-channel zigzag pattern in order to accurately define the position of the thalweg while minimizing the distance between thalweg points. A maximum spacing between cross-channel survey lines of no more than 150 meters (500 feet) was used. However, the presence of numerous islands, high bars, and locally dense vegetation, as well as areas where flow was very wide, shallow, and braided often precluded the use of the zigzag pattern. In those instances, the survey boat was driven along the apparent thalweg path of the primary braid channel.

3.3.2 Results

The longitudinal survey was performed from April 21 to April 24 and from August 23 to August 28, 2009. A 16' jet boat was used for the reach from river mile 154 to river mile 205 and a 14' airboat was used to survey river mile 205 to river mile 255 as well as the J-2 Return (south) channel. Each survey vessel was equipped with Leica 1200 GPS systems, a Getac rugged laptop utilizing HYPACK data acquisition and processing software, and an Innerspace 455 depth sounder with an Airmar survey grade 8 degree transducer. The survey was conducted moving in the upstream direction. Positions were collected at a rate of one point per second with the boat speed averaging about 10 mph. Repeater radios were used to boost the RTK radio signal because of the density of the riverine vegetation along the river corridor.

The first 2.2 miles of the survey were conducted using an experimental transducer setup that included a 1.5 foot long by 6 inch diameter tube filled with water with a clear Lexan plate at the bottom. The transducer was mounted at the top of the tube and was submerged in the water. Since the transducer does not always perform well in less than 6 inches of water, it was determined that a longer column of water might produce more optimal results in shallow water. This method has been used on other projects by other agencies including the USGS. However, it was determined that the base of the tube creates cavitation (i.e., air bubbles) when the boat is moving which, in turn, produces a double signal – one off the air bubbles below the clear Lexan plate at the bottom of the tube and one off the bottom of the river. The return signals are then averaged automatically by the equipment, producing a depth profile that is shallower that the actual profile. Therefore, this experimental method was abandoned and the standard method for mounting the transducer was used. The first 2.2 miles of the thalweg profile elevation data, which is much smoother than the remaining surveyed profile, was revised to account for the double signal and is included with the final surveyed profile data.

The flows under which the profile survey was conducted ranged from about 3,300 cfs to 1,000 cfs for April 21-24 while the flow ranged from about 250 cfs to 125 cfs for August 23-28. This is one complete survey with just under half of the survey conducted in April and the remainder conducted in August. The April dates were chosen because of the SDHF pilot test flows that were planned for that time period. The remainder of the profile survey was not completed until August because of boat issues. The first part of the survey was completed using a jet boat, which proved to be problematic. Attempts were made to complete the survey after the April pilot test flows and prior to the transect survey in July, but the shallow, sediment laden flows of the river created problems for our jet boat motor that could not be overcome. Therefore, an airboat was purchased and the profile survey was completed following completion of the transect survey. The longitudinal profile was not surveyed prior to or during the transect survey work. The period prior to the transect survey work encompassed the bird nesting period, which precluded us from conducting any boat and/or survey work during that period. The transect surveys took place between mid July and late August, which was the period defined by the Protocol. We compiled and evaluated the two portions of the profile survey where they overlapped and found no inconsistencies. A comparison of the thalweg elevations from the profile survey with the thalweg elevations from the ground transects showed a good match.

All survey point data has been downloaded and compiled electronically into a spreadsheet and defined by NAD83 State Plane Nebraska easting and northing coordinate pairs and elevation. Raw stationing for the profile is based on the straight line point-to-point distance upstream of the Chapman bridge (Bader Park Rd.). To generate a profile based on the USACE river mile markers, the hydrographic survey points were projected to the USACE river mile marker stationing and then thinned and refined by extracting the minimum point every 50 feet. This method removes the sinuosity from the data and projects the data onto a common reference line along the river. These thinned points were then used to develop the longitudinal thalweg profile for the project reach. The formatted thalweg survey point data and attributes will also be electronically uploaded and seamlessly incorporated into the Program database.

The raw hydrographic survey data is provided in CSV and GIS shapefile format while the projected stationing thalweg data is provided in Excel files on the attached DVD. A graphical representation of the projected longitudinal thalweg profile is presented in **Sheet 1** through **Sheet 5** in **Appendix A**. A comparison of the main river channel profile versus the J-2 Return channel profile within the reach from RM 239 to RM 247 is also provided as **Sheet 6** in Appendix A.

3.3.3 Recommendations for Protocol Revisions

Ayres recommends that when the longitudinal survey is performed again, that the same pathway corridor be utilized when attempting to define the thalweg. This will allow for a more useful comparison of the data both in using the same flow path as well as determining how the channel profile has changed over the intervening time period. Additionally, although the profile survey is best performed at flows greater than 1,000 cfs, sustained flows at that level are unreliable and can often fluctuate above and below that level during the course of a day. Therefore, an airboat is the most suitable vessel to complete the hydrographic survey, regardless of the flow. Given the wide range of flows that can occur during any given day and at any time in the summertime, we would recommend that the identification of a specific flow range for conducting the survey work be removed from the protocol.

The protocol also states that the hydrographic survey boat be driven in a rectangular or zigzag pattern of a certain spacing back and forth across the channel in order to capture the thalweg. This method works well when flows are sufficiently deep to preclude the accurate identification of the main thalweg within the river. However, this method does not work well under shallow braided conditions, especially where there are numerous exposed braid bars. Under shallow or braided flow conditions, it is relatively easy to identify and follow the main thalweg with the survey boat. Therefore, we would recommend that the protocol be modified to allow for the use of both methods.

3.4 Ground Survey of Channel Geomorphology Transects

The protocol states that the transect surveys are to occur during an annual low flow [ideally between 250 and 500 cubic feet per second (cfs)] between July 1 and August 31 to track changes in measures of channel shape and slope. The ground survey of the channel geomorphology transects were conducted per Section III.B.2 of the monitoring protocol. Per the protocol, a group of three transects at 150 meter (500 feet) spacing, with the middle transect centered at the anchor point, were measured at each anchor point selected for sampling. Each transect represents the surveyed active channel portion of a cross section at an anchor point. Each cross section extends across all channels and islands of the Platte River in the 100-year flood plain, or between outer historic banks. The cross sections are generally oriented perpendicular to average flow direction and high flow direction in the main channel. The survey was started at the upstream end of the reach, at Anchor Point 40, and progressed downstream to Anchor Point 1.

3.4.1 Methodology

The ground surveys are used to provide transect data within the active channel (accretion zone), while LiDAR mapping is used to extend transects across the full width of the flood plain (i.e., translate transects to full cross sections). Ground-surveyed transects only extended along the cross sections where the ground has been inundated since the previous survey and includes areas where the ground has been disturbed by anthropogenic activities (i.e., areas that have been disked or mowed), where natural processes have created significant topographic changes (i.e., channels and islands where sediment could have deposited or been eroded), or locations where new dikes or other river training structures have been placed or removed by landowners (described and recorded in survey notes). The transect survey includes the channels, banks, and small islands within the accretion zone, but not the upland portions of the cross section beyond the potential bank erosion/deposition zone. Because of the presence of multiple active channels separated by large islands, ground surveys between Kearney and Grand Island were also conducted on the split flow channels relative to the associated anchor point. The surveys included sets of transect measurements with two marker pins per transect, to record measurements of all the active channels in a cross section.

The transects were surveyed using a Leica survey-grade global positioning system (GPS) per the requirements defined in the monitoring protocol. Each transect within each cross section is generally oriented perpendicular to the principal flow direction and extends through all channels at the anchor point. In some instances, dog-legs in the cross section line were needed to remain perpendicular to flows in major side channels. The location of the cross section has been delineated on both historic outer banks with a permanent metal marker (pin) set above the flood elevation and far enough from the active channel to avoid all but the most severe erosion effects.

The location of cross-section marker pins, their monumentation, and the extent of the survey beyond the pins was dependent on accessibility and private property requirements and restrictions. The marker pins are composed of 1/2-inch (#4) rebar, approximately 18-inch long, driven flush with the ground surface, and topped with an aluminum cap that is stamped with the anchor point and transect identifier. The geographic coordinates and elevation of each marker pin was established with vertical and horizontal accuracies of 0.1 feet or less using standard survey techniques and criteria, and a detailed description of the location of each pin was documented in the surveyor's notes. Depending on the type, location, and extent of Program activities and other potential natural or man-made disturbances, marker pins may be lost, damaged, or displaced over time and will need to be reestablished as necessary during annual surveys.

The surveyors took GPS readings and appropriately identified the following in the data recorder:

- Top and toe of bank
- Bed or ground elevation
- Left and right edge of water
- Main and secondary channel thalwegs
- Water surface at exposed bars and islands
- Edge of canopy of permanent woody vegetation > 1.5m tall
- Edge of vegetation (green line)
- Any other significant geomorphic feature in the transect

When surveying topography in vegetated areas, a maximum height of vegetation was recorded with the topography point to compute height of vegetation blocking observation view. In order to adequately define the channel bed, GPS readings were taken at significant breaks in slope. If the channel bed or a portion of the channel bed was flat with no breaks in slope, a GPS survey point was recorded every fifteen meters (50 feet).

3.4.2 Results

The primary control that was set as part of the longitudinal profile survey (Section 3.2.2) was also utilized in the survey of the transects. The transect surveys were performed from July 14 to July 21, July 30 to August 13, and were completed between August 18 and August 28, 2009. Two teams, each with an Ayres survey technician and an Olsson biologist, worked to complete the surveys. Monuments were set on the historic high bank at or behind the tree line. Vegetation sample point data was collected on a 15 meter interval along each cross section beginning at the edge of the permanent woody vegetation line for each Year 1 anchor point. The 15 meter interval was determined using the Leica Line Stakeout program within the Leica 1200 GPS system to calculate and find the vegetation sample point locations. At each sample point location, the survey technician collected the location data via RTK GPS and the biologist performed a visual analysis of all vegetation species within a square meter grid and documented the results on field data sheets. Topographic data was also collected for the top and toe of bank, grade breaks, green lines, water's edge, and the channel thalweg.

The transect survey data was downloaded and compiled electronically into spreadsheets. The actual survey data is differentiated as such in the spreadsheets. The final LiDAR data has been merged with the transect survey data to extend each anchor point's cross sections and is identified in the spreadsheet as LiDAR data. The LiDAR LAS data was clipped into individual LAS files for each anchor point area using Global Mapper 11. Then, using Bentley Microstation and InRoads v8i, a LiDAR digital terrain model (DTM) was generated for each anchor point. For each DTM the LiDAR data in the area of the transect survey was erased and the survey transect data was merged with the LiDAR data into one hybrid surface for every anchor point. The extended transects were then cut from the merged DTMs and exported to spreadsheets at a point every 0.25 feet. This section data was thinned horizontally keeping a point every 50 feet if the vertical difference remained less than 0.5 feet. Vertically, the points were thinned using a parameter of differences of less than 0.2. This reduced the size of the transect files by 15% on average for the final transect.

Individual spreadsheets have been developed for each anchor point and include both the survey data for each transect and the LiDAR data for each cross section at that anchor point. Both the LiDAR and survey points for each cross section are documented in the spreadsheet by their NAD83 State Plane Nebraska easting and northing coordinate pair, elevation, and stationing from the left descending bank marker pin. The State Plane zone, point identifiers, and comments are also included. Where the cross section is extended across the floodplain on the left bank, the stationing will be documented as a negative value. Since it is extremely difficult to precisely follow a pre-defined survey line for each transect, the stationing for each survey point has been defined by projecting a line perpendicular to the transect line from the surveyed point and where it intersects the transect line, that is the point at which stationing is calculated based on its distance from the left bank marker pin. **Figure 3.1** shows a typical cross section (Anchor Point 39, Transect 7) based on transect survey and LiDAR data.

The ground survey data are provided in Excel files on the attached DVD. The final full cross sections (survey plus LiDAR data) for all anchor points have been submitted to the ED Office for review.

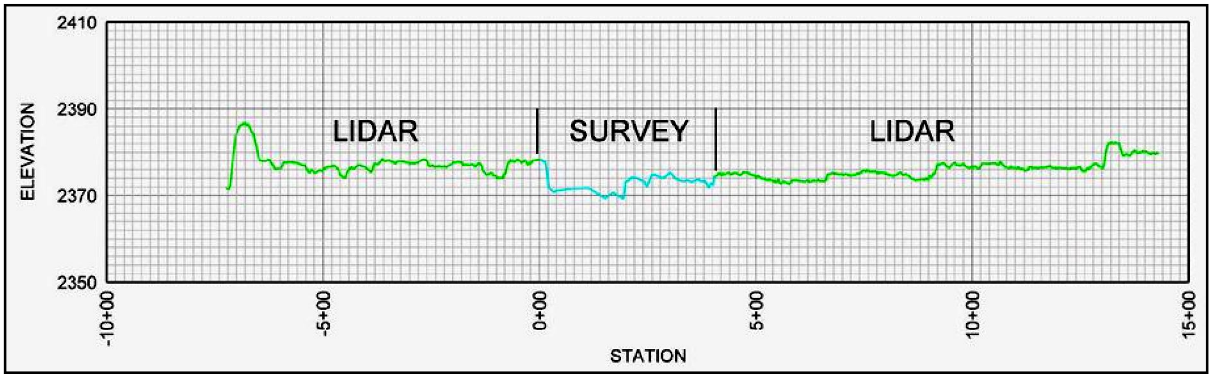


Figure 3.1. Typical cross section (looking downstream) compiled from transect survey and LiDAR data.

3.4.3 Recommendations for Protocol Revisions

The protocol requires that the location of the geomorphology transects be delineated on both historic outer banks with a permanent metal marker (pin) set above the flood elevation and far enough from the active channel to avoid all but the most severe erosion effects. In many cases, this location falls within a riparian corridor with a canopy sufficiently dense to preclude acquisition of a good GPS satellite signal. In these cases, it was necessary for the surveyors to monument the ends of the transects outside of the obstruction created by the riparian canopy. In most cases, the riparian corridor was sufficiently wide and dense that placement of the monument away from the river was not practical. However, in almost every case, there was either a sufficient amount of intervening land between the active river bank and the riparian corridor to allow for placement of the monument riverward of the riparian canopy or an open area within the corridor was found that allowed for placement of the monument well back from the high bank. Therefore, we would recommend that the protocol be revised such that some latitude is allowed in placement of the transect monumentation.

Another principal revision to the protocol is related to obtaining ground photography at the surveyed geomorphology transects and is described in Section 5 below. Also, given the wide range of flows that can occur during any given day and at any time in the summertime, we would recommend that the identification of a specific flow range for conducting the survey work be removed from the protocol.

3.5 Ground Survey of In-Channel Vegetation Transects

The vegetation survey for 2009 was conducted between the dates of July 13 and August 22, starting at the upstream end of the reach, at Anchor Point 40, and progressing downstream to Anchor Point 1. The ground survey of the in-channel vegetation transects were conducted per Section III.C of the monitoring protocol. Three hundred meter wide belt transects (approximately 150 meters on either side of the anchor point) at each anchor point in the pure panel as well as that year's rotating panel were visited to document vegetation within the Vegetation Survey Zone. Within the belt transect, 7 linear vegetation transects were established perpendicular to the flow at approximately 50 meter (165 feet) intervals. Three of the linear vegetation transects were at the same locations as the geomorphology transects.   Vegetation sample points were taken along the linear transects within the Vegetation Survey Zone at the same time as the geomorphology survey.

3.5.1 Methodology

The start and end locations of the Vegetation Survey Zone(s) along each transect were determined in the field by analyzing the vegetation and topography at the site. In general, areas with mature woody vegetation, areas that appeared to have been mechanically cleared of mature woody vegetation, or areas that appeared to be outside the active channel were determined to be outside the Vegetation Survey Zone and therefore were not surveyed. In addition, at several of the anchor point locations surveyed in 2009, there were small side channels or sloughs that were not surveyed. Some of these side channels had minimal or no flow during the survey period, and were considered outside the main channel and major secondary channels.

In general, the vegetation sample points were established at intervals spaced approximately 15 meters (50 feet) apart within the Vegetation Survey Zone along each transect. As a result of site visits prior to the start of monitoring, and due to the initial concern that the 15 meter spacing may not be adequate to provide a representative survey, it was determined that it may be necessary or beneficial to add sample points in areas that would be missed by the 15 meter spacing. As a result, some of the sample points were shifted and some locations were added along the transects. This deviation was not added to the protocol and it is Olsson's opinion that the practice of selecting points may not be beneficial and can skew data (discussed further in Section 3.5.3).

A plot canopy coverage method was used to collect vegetation data. At each sample point, a meter-square quadrat was placed and all the plant species within the square meter sample point were identified. For unknown species a sample was collected for later identification. Data collected at each sample point included:

- GPS coordinates of the sample point
- Elevation of the sample point
- List of the species occurring within the quadrat
- Percent cover of each species (actual percent cover as cover classes were not used in field)
- Estimate of the average height of the woody vegetation
- Estimate of the average height of the herbaceous vegetation

The vegetation data listed above along with (in most instances) transect notes and photo numbers was recorded in the field on a modified Daubenmire form. Data from each transect was recorded separately. Each sample point was assigned an ID in the field which was recorded with the survey equipment and included the anchor point, transect, and sample location number.

The data at each anchor point was collected using two survey teams with each team consisting of one surveyor and one biologist. In general, one team collected the data on transects 1, 4, and 7 (geomorphology + vegetation transects) and another team collected the data on transects 2, 3, 5, and 6 (vegetation only transects). The two teams used a slightly different method for numbering the sample locations. In general, the team collecting the data on transects 1, 4, and 7 would skip numbers when they were crossing an area outside of the Vegetation Survey Zone (based on how they set up the sample locations at the start of the transect) while the team collecting data on transects 2, 3, 5, and 6 ran the sample location numbers sequentially. In addition, it is important to note that for areas within the Vegetation Survey Zone that lacked vegetation (i.e., an unvegetated bar or wetted channel) the location was still recorded as a vegetation sample location. In many cases, these areas were noted on the modified Daubenmire form, but in some cases the vegetation data was simply left blank.

In addition to the vegetation sample points, a data point documenting GPS coordinate and elevation was taken at:

- Each edge of the Vegetation Survey Zone (if it was not located at a vegetation sample point)
- "Green line" at the edge of vegetated sand bars and wetted channel

3.5.2 Results

More than 4,200 vegetation sample points were collected. The vegetation data collected in the field at each sample location included, among other things, a list of species present, the percent cover of each species, and the total number of sample locations per transect. Section III.C.2 of the protocol specified the basic analyses to be conducted on the data, including:

- Frequency of occurrence for each species of interest (defined on the following page) at each belt transect. Calculated by dividing the number of sample locations in which a species of interest was found by the total number of sample locations.

- Percent cover for each species of interest at each belt transect. Calculated by averaging the percent cover for each species of interest at all sample points per belt transect.
- Average elevation for each species of interest at each belt transect.
- Weighted average elevation above base flow for each species of interest at each belt transect.
- Estimate of areal coverage for each species of interest at each belt transect. Calculated by dividing the percent canopy cover by 100 and then multiplying by the total estimate acres surveyed at each belt transect.
- Vegetation sample location shapefile with an attribute table that includes the presence or absence for each species of interest.

Data analysis focused on the extent and elevation of species of interest, which are the species that currently thought to have the most influence on in-channel habitat in the Central Platte River. Although the species of interest may change over time, the data collection method was designed to allow for comparison of any species in the future. For 2009 the species of interest were defined in Section II.B of the protocol and included the following:

- The following woody species less than 1.5 meters high:
    - Willows
    - Cottonwood
    - False indigo
    - Saltcedar (all heights)
    - Russian olive

- The following herbaceous species:
    - Purple loosestrife
    - Common reed (*Phragmites*)
    - Cattails
    - River bulrush (not in monitoring protocol, but added prior to 2009 field surveys)

Following the field data collection, the first step to be completed in the data analysis was to review the field data sheets and vegetation samples collected and identify any unknown species. Several plant samples have yet to be identified, but we have been able to exclude them as species of interest. We plan to continue to attempt to identify the remaining unknown species for future reference.

The next step was to convert the percent canopy for each species of interest at each sample location to a cover class using the Daubenmire system and compiling that data into a modified Daubenmire summary spreadsheets for each belt transect. The total number of vegetation sample locations for each belt transect was also compiled and entered into the spreadsheets. For anchor points that had multiple channels, each of these channels were kept separate and then a combined Daubenmire summary spreadsheet for the anchor point was completed.

The modified Daubenmire summary spreadsheets were used to calculate frequency, percent cover, and an acreage estimate for each species of interest at each belt transect.

The spreadsheets were also used to calculate species composition. Although not part of the monitoring protocol, species composition is useful as it compares the total canopy cover for each species of interest with the total canopy for all species. **Figure 3.2** shows the Daubenmire summary spreadsheet for Anchor Point 1. **Figures 3.3** and **3.4** graph the overall frequency and percent canopy coverage, respectively, for each species of interest for all the data collected in 2009.

The presence or absence of each species of interest at each sample point location was entered into a second spreadsheet. This spreadsheet was created from the survey data recorded in the field and listed all vegetation sample locations surveyed with GPS coordinates and elevation data. Columns for each species of interest were added to this spreadsheet and a "Yes" was entered for each location where a species of interest was found. This spreadsheet was then used to create a vegetation sample location point shapefile with all spreadsheet data in the attribute table. This spreadsheet was also used to calculate the average elevation for each species of interest at each anchor point.

Modified Daubenmire Summary																					
Project Name: Platte River Recovery Implementation Program In-Channel Vegetation Monitoring									Date: 8-22-09		Anchor Point: 1										
Number of Quadrats:		184	Estimated Acreage:		26.8	Examiner(s): Nate Van Meter and Ben Schiltz					Company: Olsson Associates - Lincoln, NE										
		Species		Species		Species		Species		Species		Species		Species		Species		Species		Species	
Cover Class	Mid Point	Cattail species		Common reed		Purple loosestrife		River bulrush		Eastern cottonwood - <1.5m tall		False indigo - <1.5m tall		Peach leaf willow - <1.5m tall		Russian olive - <1.5m tall		Sandbar willow - <1.5m tall		Saltcedar - all heights	
1. 1-5%	2.5	0	0	1	2.5	17	42.5	2	5	9	22.5	1	2.5	0	0	0	0	5	12.5	0	0
2. 6-25%	15	0	0	8	120	22	330	9	135	0	0	0	0	0	0	0	0	3	45	0	0
3. 26-50%	37.5	0	0	9	337.5	8	300	1	37.5	0	0	0	0	0	0	0	0	0	0	0	0
4. 51-75%	62.5	0	0	2	125	3	187.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. 76-95%	85	0	0	5	425	3	255	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6. 96-100%	97.5	0	0	13	1267.5	1	97.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Canopy			0.0		2277.5		1212.5		177.5		22.5		2.5		0.0		0.0		57.5		0.0
Number of Samples			184		184		184		184		184		184		184		184		184		184
% Canopy Cover			0.0		12.4		6.6		1.0		0.1		0.0		0.0		0.0		0.3		0.0
Species Composition			0.0		18.0		9.6		1.4		0.2		0.0		0.0		0.0		0.5		0.0
Frequency			0.0		20.7		29.3		6.5		4.9		0.5		0.0		0.0		4.3		0.0
Estimated Acreage			0.0		3.3		1.8		0.3		0.0		0.0		0.0		0.0		0.1		0.0

Figure 3.2. Daubenmire Sheet for Anchor Point 1.

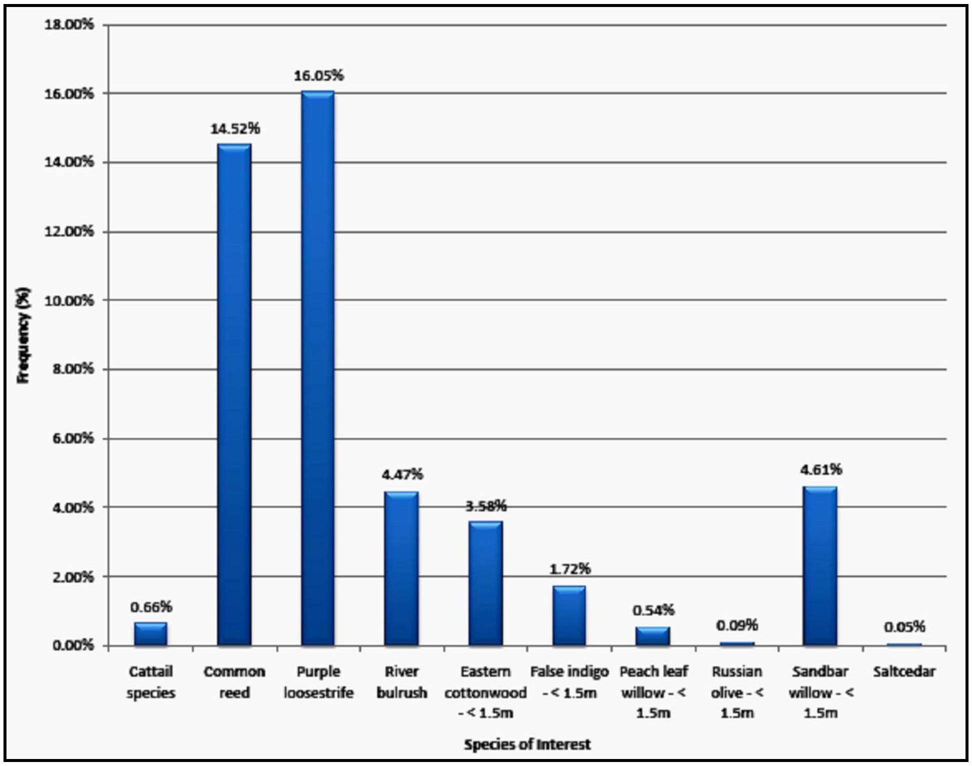


Figure 3.3. Frequency of each Species of Interest across all 2009 sample locations.

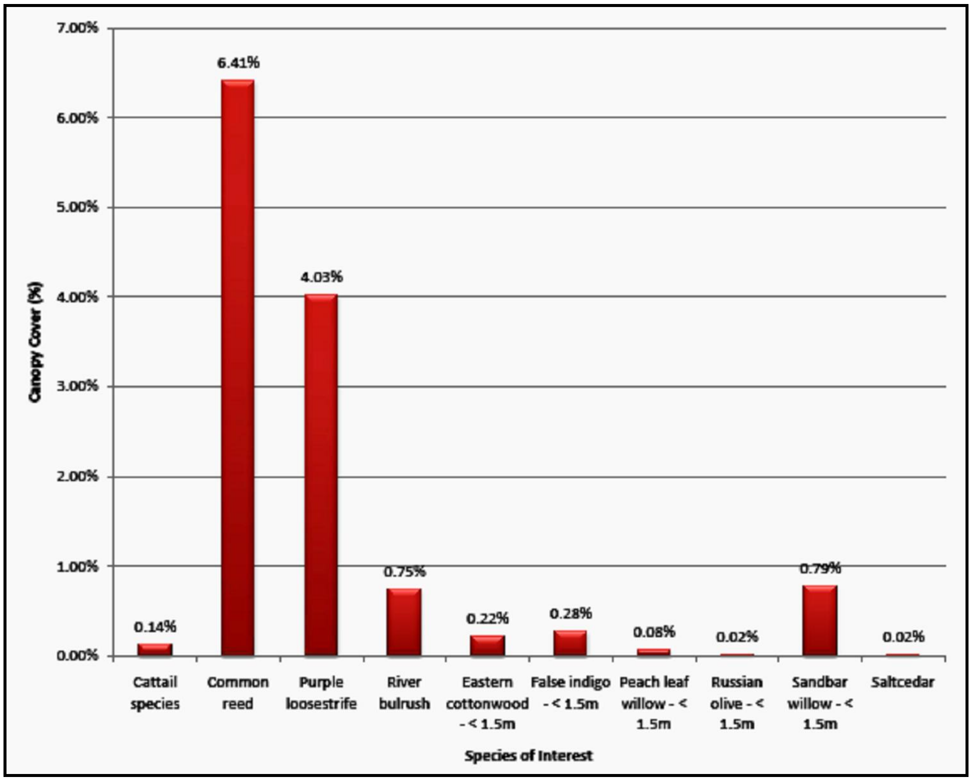


Figure 3.4. Percent canopy cover of each Species of Interest across all 2009 sample locations.

One of the analyses that is defined in the monitoring protocol has not been completed at this point, weighted elevation above base flow. The weighted elevation above base flow calculation will be performed after a method to define base flow at each anchor point or transect has been established. The Program will be developing a protocol for calculating the base flow elevation at each anchor point over the next year. Once base flow data is available it will be provided to Olsson for completing this analysis.

Throughout the analysis process, staff who had not been involved in data collection performed a QA/QC review of the data. The review process compared the spreadsheet of the vegetation survey location with the data on the field data sheets, among other items. Olsson and Ayres staff coordinated closely while compiling the survey data and the vegetation data and information.

3.5.3 Recommendations for Protocol Revisions

The interim protocol was developed to minimize observer error and improve the reliability of comparable data collection from one location to another and from one year to another. However, field testing and original data analysis often reveal inconsistencies or ambiguities and provide suggestions for additional improvements. The vegetation monitoring data collection and analysis for the first year of field work resulted in several suggestions for ways to improve the efficiency of data collection and further increase the objectivity and comparability of data. These suggestions are detailed as follows:

- There is a need to better define the Vegetation Survey Zone (i.e., transect start and stop points). The interim protocol attempted to define this in a replicable way, but a significant amount of field interpretation was required during data collection. One possible option would be to define the Vegetation Survey Zones prior to conducting the field work by using aerial photography and topography data.
- As discussed in the Methods section above, some vegetation sample locations were added or shifted in an effort to capture areas that would have been missed by the 15 meter sampling interval. After data analysis, this method of selecting the location of certain points will skew (maybe not significantly) the frequency and percent cover data. For this reason we recommend not doing this in future monitoring.

- The adequacy of the 2009 vegetation data was reviewed as part of the data analysis process. Olsson tested the 2009 data by artificially removing some of the data and then re-calculating frequency and percent cover values. The thought is that if too much data is being collected then the frequency and percent cover values should change very little. Our data tests revealed that the data changed more than expected and therefore we concluded that we were likely not collecting too much data and maybe collecting too little. Daubenmire (1959) suggests sampling approximately 40 1/10th square meter plots per vegetation community is typically adequate. Many of our anchor points have two or three vegetation communities within the Vegetation Survey Zone and therefore this also suggests that we may be collecting too little data. As a result we are proposing to collect vegetation data along the transect every 10 meters in 2010. To offset the increase in data collection effort we are proposing to not collect data annually at some of the side and secondary channels, focusing our data collection instead on higher priority areas.

- Propose to record canopy coverage for each species using the Daubenmire (1959) cover class system in the field. In 2009 we recorded actual percent cover for each species and then converted the field data into cover classes in the office. The use of cover classes in the field should reduce the amount of variability between observers and it will eliminate one data processing step which should reduce error and increase efficiency. Not recording actual canopy cover in the field does dilute the data collected somewhat but we feel that this is offset by a reduction in error.

- Record a community type classification code at each sample point to aid in future data analysis. Currently we are proposing to use the classification code outlined in Terrestrial Natural Communities of Nebraska (2003).

- Establish a standard sample ID naming system where sample points along a transect are numbered sequentially by all data collectors. This will reduce the amount of data interpretation in the office and therefore aid in increasing efficiency and reducing data processing error.

4. BED, BAR, AND BANK MATERIAL SAMPLING

Bed, bar, and bank material samples were collected and analyzed per the methodology defined in Section III.D of the monitoring protocol. Per the protocol, the bed, bar, and bank material samples will be taken at locations along the geomorphology transects at each anchor point. Bed material samples will be used to track changes in measures of bed material grain size distribution. Changes in grain size distribution over time will indicate coarsening or fining of the sediment at the system level.

4.1 Bank Material Sampling

Bank material will be documented in the first year of the topographic surveys using stratigraphy and grain size distribution of the bank material; however, the bank material sampling does not have to be repeated at successive topographic surveys. The bank material sampling will only be repeated during the final year of the First Increment. One drawing, accompanied by ground photography, is to be created for a left bank and a right bank in the main channel at each pure panel anchor point. Since the bank material sampling occurs on the main channel, the samples are to be collected from one or both outer banks or from the bank of an island, depending on the location of the main channel. There will be one sediment sample taken from the same site of each drawing.

4.1.1 Methodology

At each bank, the sediment stratigraphy was described using sketches and notes in a waterproof field notebook. The stratigraphic documentation included the color and texture of each major stratigraphic horizon (using Munsell Soil Color Charts where appropriate), the average grain size or range of sizes of each major horizon, and the thickness of each major horizon along the vertical axis of the bank. In addition, photographs were taken at each bank to provide additional documentation of bank stratigraphy at the sampling sites. Photographs of bank stratigraphy included an appropriate photo scale with visible measurement increments. The location of the bank material sampling was georeferenced using GPS.

Although Section III.D.2 of the protocol required the use of a steel cylinder sampler/sediment corer to take a representative composite sample of the bank material, this proved to be extremely difficult and impractical. Because of the density of the bank vegetation and root zone characteristics, it was extremely difficult or nearly impossible to drive the corer sample into the ground. Therefore, an alternative method was required to obtain a representative sample. This was accomplished by clearing the bank face of vegetation and debris where possible and then defining a sampling width down the bank face. The width was usually about 6" since that was the length of the trowel that was used to conduct the sampling. Then the trowel was used to excavate the bank face to a depth of about 1 to 2 inches. The 1 to 2-inch depth was maintained all the way down the bank face within the 6" width. This allowed for a uniform sampling of the bank material from the bank face.

The composite bank material samples were transferred to sample bags that were labeled with the sampled anchor point, transect ID, sample number, and the date the sample was taken. The locations of all samples were georeferenced using the Trimble GeoXT handheld GPS unit. All samples were transferred to the Olsson geotechnical lab and analyzed for grain size distributions using the same procedures, sieve sizes, and results reporting as described in the protocol.

4.1.2 Results

A total of 45 bank material samples were collected. The grain size distribution analyses of all bank material samples conducted by Olsson were provided as individual sheets (PDFs) that included all pertinent distribution data and a distribution plot as required by the protocol. This data is also compiled in an Excel file that contains all the sediment data (bed, bar, and bank) for all anchor points. The Excel file is included on the attached DVD. In addition, the grain size distribution data along with the stratigraphic descriptions, field drawings, and ground photos for both banks for each pure panel anchor point have been compiled in individual Excel files and PDFs (by anchor point), which are also included on the attached DVD. **Figure 4.1** shows a typical data spreadsheet that is representative of the stratigraphic data compiled for each pure panel anchor point.

Figures 4.2 and **4.3** show the D16, D50, and D84 distributions by river mile for the composite left and right bank samples, respectively, collected at each pure panel anchor point. As expected, there appears to be little difference in grain size distributions between banks and that there is a gradual fining in the downstream direction.

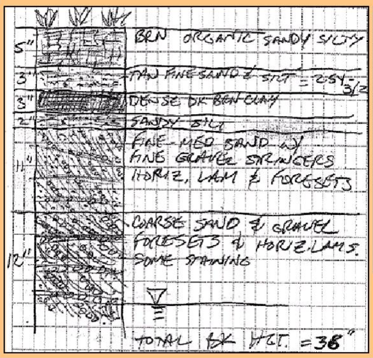
4.1.3 Recommendations for Protocol Revisions

The current methodology of using a hand corer to collect bank material samples does not work well. It is recommended that a better method of sampling be identified. We believe that the one used for this year's sampling effort was both accurate and effective. However, the method for collection of the sample needs to be revised and refined. The method of sediment collection during this year's sampling included excavating a continuous volume of material from the face of the bank and holding the sample bag or bucket under the excavation point to collect the material. Another possible method would be to construct a long rectangular metal box of a predefined depth, say 24" long by 6" wide by 3" deep. The open face of the box could be placed against the face and pushed into and flush with the bank face. The box could then be excavated and the material placed in the sample bag. This would be done over the entire height of the bank to collect a uniform volume of sediment that is representative of the bank material.

In addition, there are numerous areas where wide, high bars and/or low benches or berms separate the channel from the true bankline. Because of the protection to the bankline afforded by these sedimentary features, they are often overgrown with vegetation, making sampling nearly impossible. Instead, we sampled the exposed face of the berm/bench/low island/high bar which may be more representative of the material that would have to be eroded before reaching the true bankline. Therefore, it may be necessary to revise the protocol such that, where these features are identified and potentially provide protection to the true bankline, the face of those features are what is to be sampled.

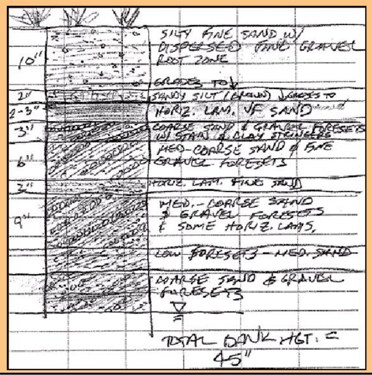
ANCHOR POINT 27

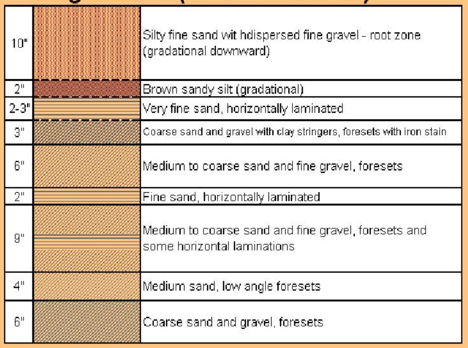
Left Bank (AP27-T5-Bank1)



5"	Brown organic sandy silt
3"	Tan fine sand and silt
3"	Dense dark brown clay = 2.5Y-3/2
2"	Sandy silt
11"	Fine to medium sand with fine gravel stingers, horizontally laminated and foresets
12"	Coarse sand and gravel, foresets and horizontal laminations, some iron staining

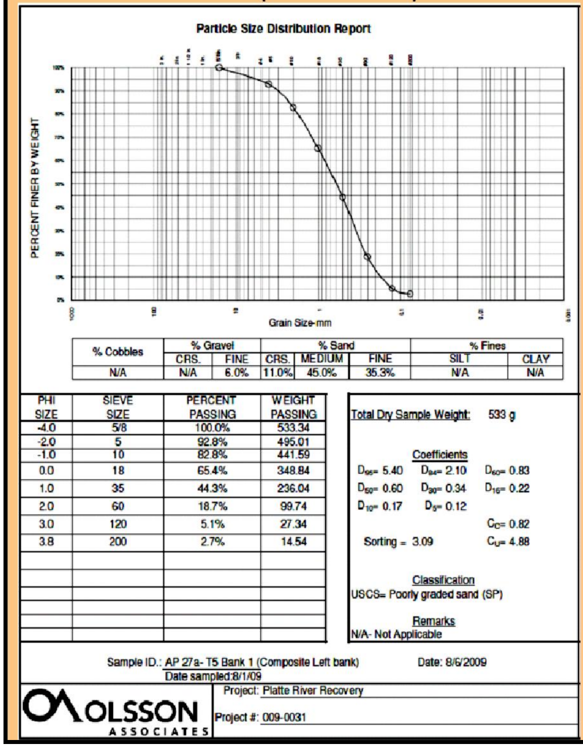
Right Bank (AP27-T7-Bank2)





10"	Silty fine sand wit hdispersed fine gravel - root zone (gradational downward)
2"	Brown sandy silt (gradational)
2-3"	Very fine sand, horizontally laminated
3"	Coarse sand and gravel with clay stringers, foresets with iron stain
6"	Medium to coarse sand and fine gravel, foresets
2"	Fine sand, horizontally laminated
9"	Medium to coarse sand and fine gravel, foresets and some horizontal laminations
4"	Medium sand, low angle foresets
6"	Coarse sand and gravel, foresets

Left Bank (AP27-T5-Bank1)



Particle Size Distribution Report

% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	N/A	6.0%	11.0%	45.0%	35.3%	N/A	N/A

PHI SIZE	SIEVE SIZE	PERCENT PASSING	WEIGHT PASSING
-4.0	5/8	100.0%	533.34
-2.0	5	92.8%	495.01
-1.0	10	82.8%	441.59
0.0	18	65.4%	348.84
1.0	35	44.3%	236.04
2.0	60	18.7%	99.74
3.0	120	5.1%	27.34
3.8	200	2.7%	14.54

Total Dry Sample Weight: 533 g

Coefficients

D_{95}= 5.40 D_{84}= 2.10 D_{60}= 0.83

D_{50}= 0.60 D_{30}= 0.34 D_{16}= 0.22

D_{10}= 0.17 D_{5}= 0.12

C_C= 0.82

Sorting = 3.09 C_U= 4.88

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: AP 27a- T5 Bank 1 (Composite Left bank) Date: 8/6/2009

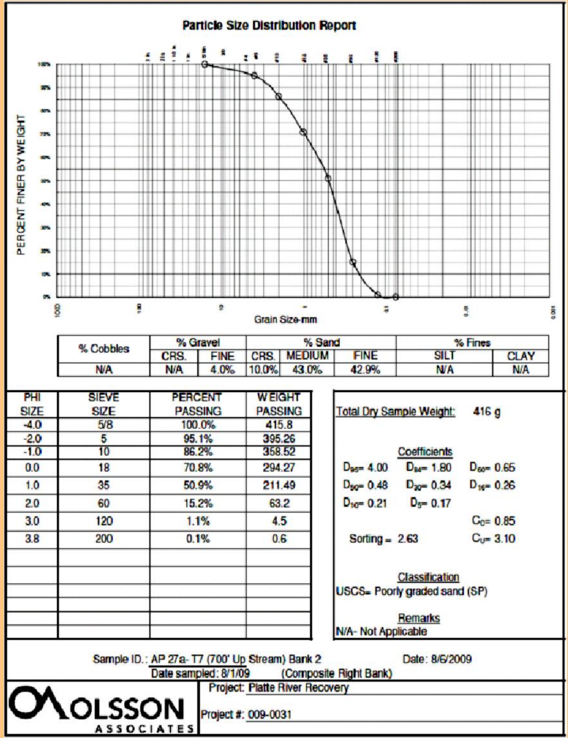
Date sampled:8/1/09

OLSSON ASSOCIATES

Project: Platte River Recovery

Project #: 009-0031

Right Bank (AP27-T7-Bank2)



Particle Size Distribution Report

% Cobbles	% Gravel		% Sand			% Fines	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
N/A	N/A	4.0%	10.0%	43.0%	42.9%	N/A	N/A

PHI SIZE	SIEVE SIZE	PERCENT PASSING	WEIGHT PASSING
-4.0	5/8	100.0%	415.8
-2.0	5	95.1%	395.26
-1.0	10	86.2%	358.52
0.0	18	70.8%	294.27
1.0	35	50.9%	211.49
2.0	60	15.2%	63.2
3.0	120	1.1%	4.5
3.8	200	0.1%	0.6

Total Dry Sample Weight: 416 g

Coefficients

D_{95}= 4.00 D_{84}= 1.80 D_{60}= 0.65

D_{50}= 0.48 D_{30}= 0.34 D_{16}= 0.26

D_{10}= 0.21 D_{5}= 0.17

C_C= 0.85

Sorting = 2.63 C_U= 3.10

Classification

USCS= Poorly graded sand (SP)

Remarks

N/A- Not Applicable

Sample ID.: AP 27a- T7 (700' Up Stream) Bank 2 Date: 8/6/2009

Date sampled: 8/1/09 (Composite Right Bank)

OLSSON ASSOCIATES

Project: Platte River Recovery

Project #: 009-0031

Figure 4.1. Example bank stratigraphy data collected at each pure panel anchor point.

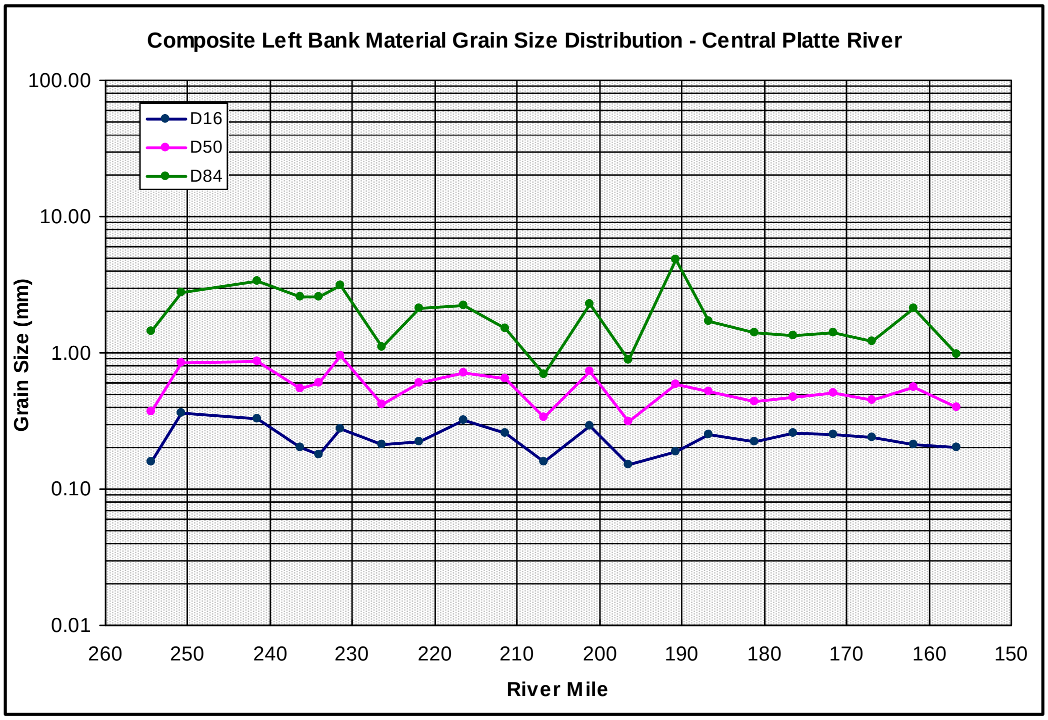


Figure 4.2. Grain size distribution of composite left bank samples by river mile.

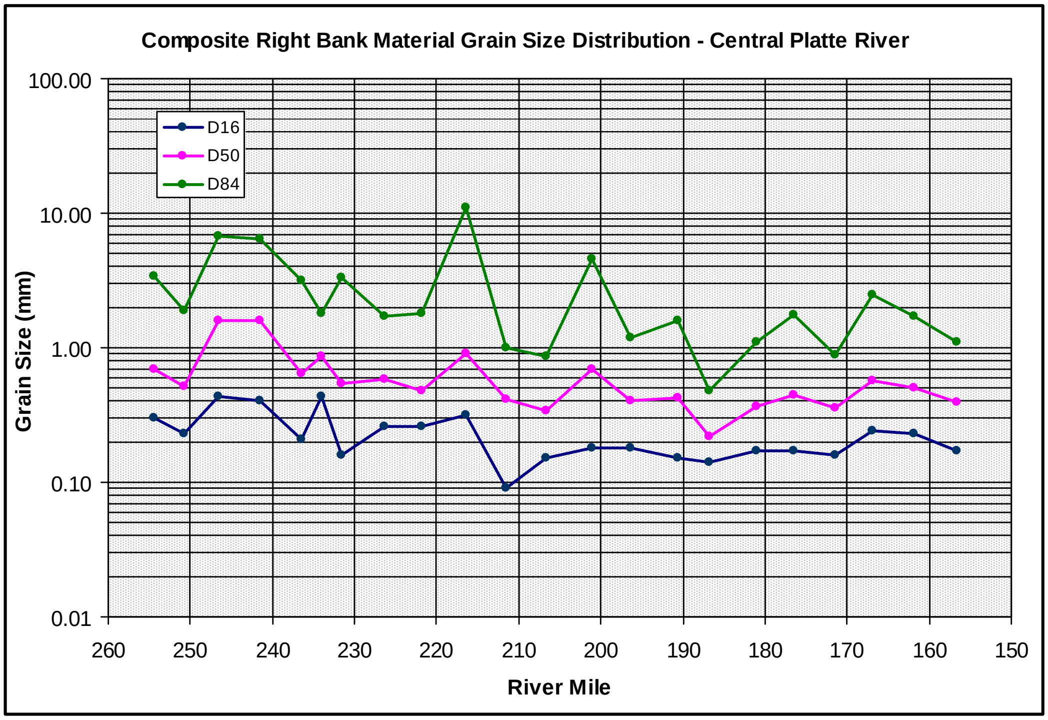


Figure 4.3. Grain size distribution of composite right bank samples by river mile.

4.2 Bed and Bar Material Sampling

Bed and bar material sampling and analysis were conducted per Section III.D.1 of the monitoring protocol. Bed and bar material will be documented using grain size distributions of samples collected during each successive annual topographic survey. Up to 13 bed material samples and one bar material sample will be collected annually at each of the 25 surveyed anchor points. The bed and bar material samples will be collected as follows:

- Main and Secondary Channel Bed Samples - Three main channel samples were collected from each of the three geomorphology transects at each anchor point. Each transect was divided into three equally-spaced increments with one sample from the thalweg in the increment that contains the thalweg and a representative dry or wet bed sample from the other two increments. If additional smaller channels separate from the main channel were present, one sample was collected from the thalweg of the middle transect on the second largest channel at the anchor point. The locations of each of the samples were georeferenced using GPS.

- Sand Bars in Main Channel - Samples were collected from natural high flow sand bars. No mechanically created sand bars were present at the surveyed anchor points. Natural bar sites were selected for sampling from anywhere in the main channel at the anchor point. One set of three samples representing materials found on the sampled sand bars was collected. The three individual samples were collected in close proximity to each other at the head of the bar and were representative of the materials that comprise the bar. The three samples were combined to form a composite sample. The central location of the composite sample was georeferenced. Any surface armor layer or coarse surface lag was noted and removed prior to sampling.

4.2.1 Methodology

Based on the protocol, bed sediment samples were to be collected using a steel cylinder core sampler. However, because of the coarseness of the material, it became evident that using the steel cylinder core sampler defined in the protocol was both difficult and impractical. It was extremely difficult to push or drive the core sampler into the bed and bar material and often the amount of material retrieved was small, thus requiring the need to conduct multiple samplings at the sample site. Instead, it was determined that a 5-gallon bucket would be more practical for collecting bed material samples and would likely provide the same results. The bucket was pushed 10 to 12 inches deep at an angle into the bed of the channel with the opening facing upstream. This allowed all the material in the bed at the sample point to be collected by the bucket with minimal loss of material. The water was decanted off, the material was well mixed to avoid artificial stratification or sorting of the material, and the sample was then poured into the sample bag. All bed samples taken from the main channel and any secondary channels were transferred to individual sample bags that were labeled with the sampled anchor point, transect ID, sample number, and the date the sample was taken per the protocol. All sample locations were georeferenced using the Trimble GeoXT handheld GPS unit.

Bar material samples were generally collected at the head of a high bar in the area where the coarsest material was deposited. Samples were taken at 3 different spots on the bar, generally in relatively close proximity to each other such that the zone that was being sampled was generally the same. The samples were collected with a shovel after noting and removing any armor or coarse lag. An approximately equal volume of bar materials was collected at each of the three sites. The composite bar material samples were transferred to sample bags that were labeled with the sampled anchor point, transect ID, sample number, and the date the sample was taken. A single georeference point was taken at a location that was central to all the samples using the Trimble GeoXT handheld GPS unit.

All samples were transferred to the Olsson geotechnical lab and analyzed for grain size distributions using the same procedures, sieve sizes, and results reporting as described in the protocol.

4.2.2 Results

A total of 267 bed and 25 bar material samples were collected at all the anchor points. The grain size data and other information for the samples are provided in an Excel file on the attached DVD.

Figure 4.4 shows the D16, D50, and D84 distributions by river mile for the bar samples collected at each anchor point. Although the bar sample gradations are fairly variable, the figure shows little or no fining in the downstream direction.

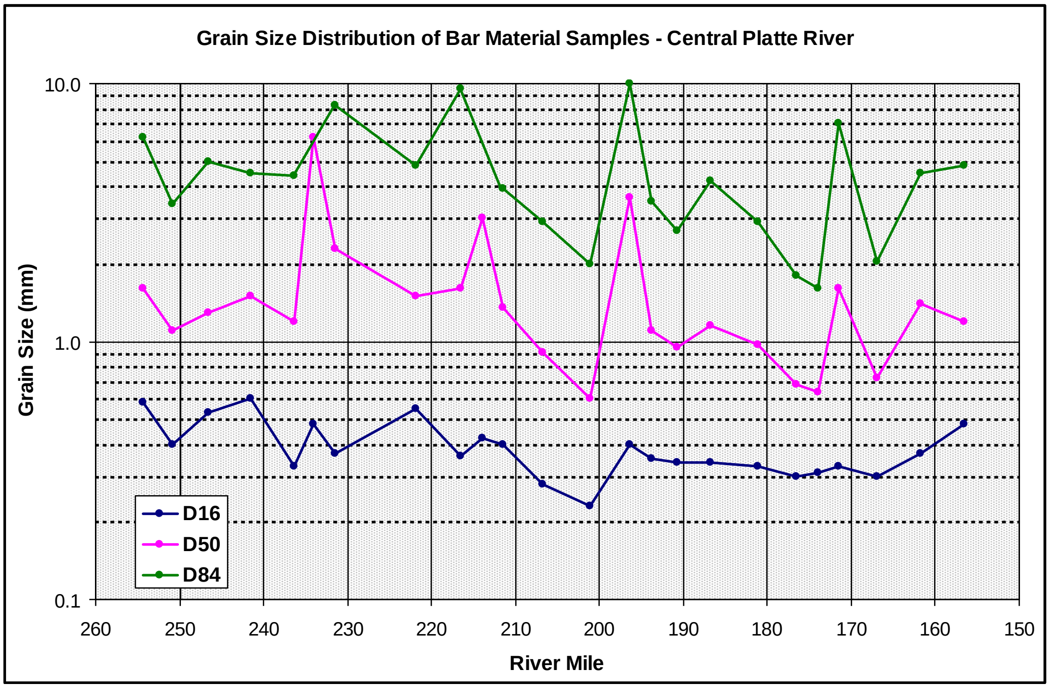


Figure 4.4. Grain size distribution of composite bar samples by river mile.

The bed material sample data is compiled as both individual data and as composited data for each anchor point. **Figure 4.5** shows the D16, D50, and D84 distributions by river mile for the composited bed material samples collected at each anchor point. A comparison with the bar material gradations shown in Figure 4.4 would suggest that there is little difference between the bed material and bar material. In addition, the distributions for the bed material samples collected by the USBR in 1989 are shown in **Figure 4.6** for comparison. The comparison with the 2009 bed material shown in Figure 4.5 suggests that the bed material for this reach of the Central Platte River has coarsened significantly over time.

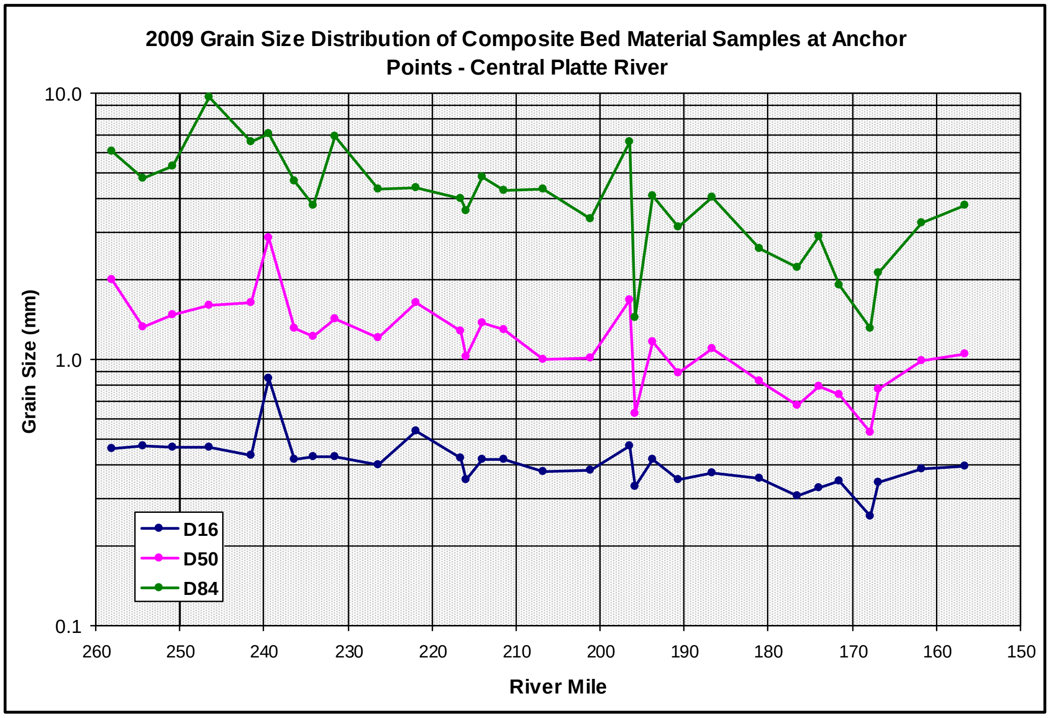


Figure 4.5. Grain size distribution of 2009 bed material samples by river mile.

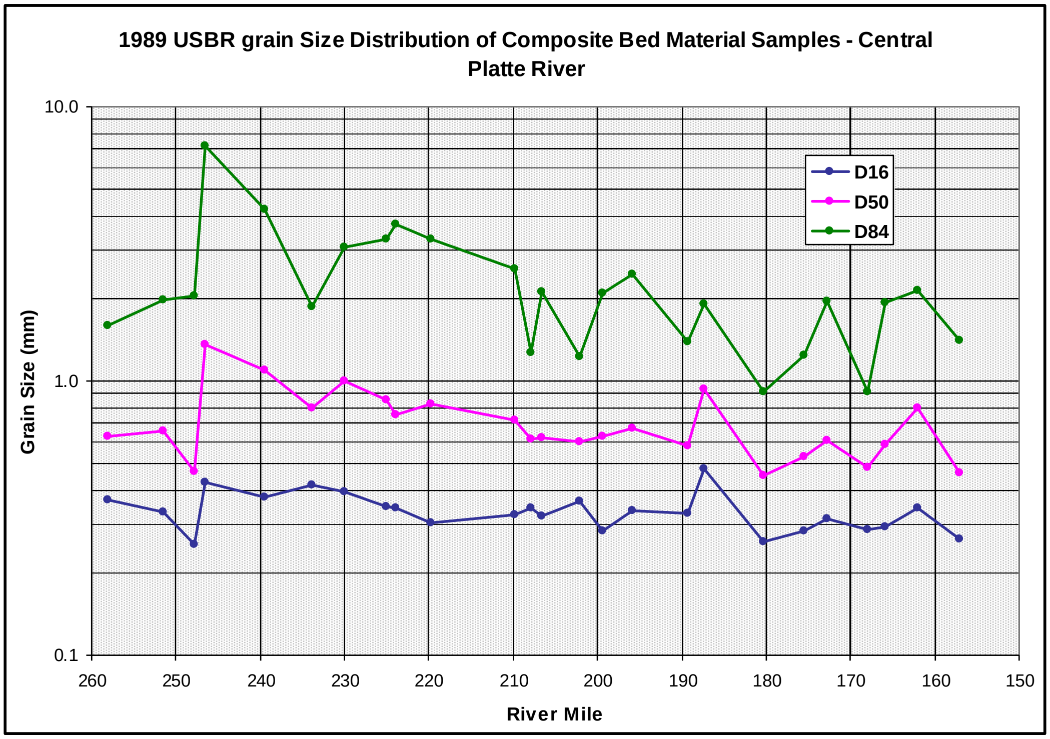


Figure 4.6. Grain size distribution of 1989 USBR bed material samples by river mile.

In addition, **Figure 4.7** shows a comparison of the grain size distributions for the bed material in the J-2 Return (South) channel at river mile 246.5 (AP37). This figure suggests that the bed material in the J-2 Return channel has coarsened significantly over time as well.

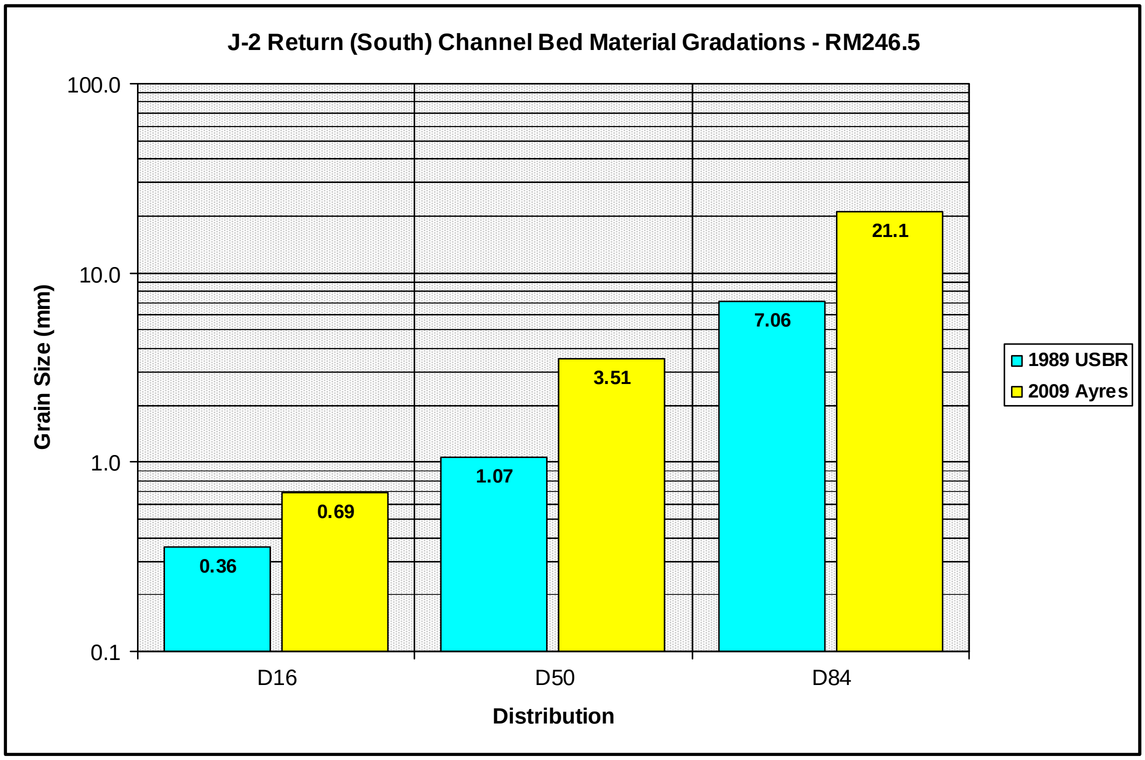


Figure 4.7. Comparison of grain size distribution for the 1989 USBR and 2009 Ayres composite bed material samples at river mile 246.5 on the J-2 Return (South) channel.

4.2.3 Recommendations for Protocol Revisions

Most of the bed material samples that were obtained this year were collected under water at flows that were not within the range defined by the protocol (e.g., 250 to 500 cfs). Flows during the sampling period in July and August often were above this range and often fluctuated over a wide range during the course of a day. Therefore, it may be necessary to revise the protocol to reflect that samples may have to be obtained during higher than expected flows. Although the 5-gallon bucket method we used generally worked well, it may be that the Technical/Scientific Advisory Committees may identify another, more suitable methodology. However, we would recommend whichever methodology is chosen, it should not require any more effort to perform than the method we used for this year's sampling because of cost and time constraints.

5. PHOTOGRAPHIC DOCUMENTATION

5.1 Channel, Bank, and Vegetation Features

Per Section III.F of the monitoring protocol, ground photography will be conducted on each transect survey to document and describe bank stability and composition, vegetation type and structure, and the location of the main channel.

5.1.1 Methodology

Three photographs will be taken on each bank of the main channel from the survey point. These photographs will be archived by the Program for use in clarifying changes detected by the topography survey. The vegetation delineations will also be documented with photographs for use in the interpretation of aerial photographs.

Ground photography stations on each bank adjacent to the topography survey point are be taken with a good quality digital camera that maintains a time and date stamp, a 3X or greater optical zoom lens, and an effective image capture size of five megapixels or greater. Photographs were to be taken from the transect pin looking upstream (with bank in center of the frame), downstream (with bank in center of the frame), and across stream (with the pin of the other bank in the center of the frame). Additional photographs are to be used to document other banks of multi-channel sections. Transect and point identification, photo number, and azimuth are to be recorded for each photograph. Photographs are to be cataloged after field work is completed and all data/photos will be stored in the Program database. Software that georeferences digital ground photography will be used to facilitate incorporation of the ground photos into the Program database.

5.1.2 Results

Although the protocol calls for numerous ground photos to be obtained at each transect, the orientation of the photos and the features they are to document were difficult if not impossible to obtain. Often, dense vegetation precluded obtaining photos of bankline and overbank features. In addition, some transects cross wide expanses of braided channels that are so wide and flat that it is difficult to identify any significant features in the channel or on the opposite bank in the photo. Therefore, ground photos were only obtained at the edge of bank looking toward the opposite bank at each transect for both banks. In some cases, photos were obtained looking upstream and/or downstream and of specific geomorphic features of interest.

With regard to the vegetation surveys, ground photographs were taken at each vegetation sample location to document site conditions at the time of field survey. These photographs were generally oriented towards the ground to show the vegetation conditions within the 1 meter square quadrat. Landscape views at each vegetation sample location were not specified in the protocol and were not taken in the field.

Separate cameras and handheld sub-meter GPS units were used in the field to allow each photo to be georeferenced. A shapefile containing the georeferenced locations of all geomorphology and vegetation survey photos is included on the attached DVD.

5.1.3 Recommendations for Protocol Revisions

Given the difficulty in obtaining photos of geomorphic features in areas of extremely dense vegetation, it may be more useful to obtain ground photos of the reach upstream and downstream of the transect from the approximate middle of the active channel, views of the bank and vegetation as viewed over a short distance from the channel toward the bank, and any other significant geomorphic features within close proximity to the transect such as islands, high bars, man-made bars, bank revetment, etc.

6. SEDIMENT TRANSPORT MEASUREMENTS

The total sediment load in a channel is the sum of the bed load and suspended load. Bed load is the material that moves (rolls, slides, or bounces) along the bed. Suspended load is that material in full suspension throughout its motion and can consist of materials that are found in the bed along with the finer materials (silts and clays) that are derived primarily from the watershed. The finer materials are often referred to as the wash load as they are easily transported by the river, even at low flows, and tend to "wash" through the system. Wash load is commonly defined as sediment finer than 0.0625 mm (division between sand and silt).

Suspended sediment measurement is relatively easy, but bedload measurements on an easily deformable bed like the Platte River make accurate sampling difficult. Therefore, the protocol called for using a well-established calculation procedure, the Modified Einstein method, to estimate total sediment load based only on suspended sediment measurements and bed material size analysis. Specifically, the protocol called for standard U.S. Geological Survey (USGS) depth-integrated suspended sediment sampling based on equal width intervals at five gaged bridge sites throughout a range of flows. Estimates of total sediment load based on the Modified Einstein method combined with volume of aggradation and degradation measured with topographic ground surveys provides the necessary information to monitor the sediment budget between Lexington and Chapman.

6.1 Depth-Integrated Suspended Sediment Sampling and Total Load Computations

Suspended sediment is to be monitored throughout the year at bridge crossings near Lexington (SH-L24A/Rd 755), at Overton (SH-L24B/Rd 444), at Kearney (SH-44/S. 2nd Ave.), at Shelton (SH-L10D/Shelton Road), and near Grand Island (US-34/Schimmer Drive). Suspended sediment are to be measured using procedures from Edwards and Glysson (1999) and Thomas and Lewis (1993) and analyzed by a certified geotechnical lab.

6.1.1 Methodology

Samples are to be collected using USGS standards for a depth-integrated sampler at 20 equally spaced locations (20 verticals) in the river cross section along the bridge face. This will allow inclusion of historical suspended sediment measures from USGS and others in the data set. Per the protocol, samples are to be collected at each site 12 times annually with the sampling schedule extending throughout the year so that samples represent different seasons. Ideally sampling should include four samples obtained from each of three different flow increments: 1,000 to 3,000 cfs; 3,000 to 5,000 cfs; and flows greater than 5,000 cfs. However, given that discharges never exceeded 3,400 cfs during the year, sampling was never conducted under the largest incremental flow. Per the protocol, no more than four samples were to be collected at a single high flow event, such as the managed pulse flow, to allow data representation from all seasons.

The samples were collected using a DH-40 suspended by cable from hand winch mounted on a portable, lightweight, wheeled frame (**Figure 6.1**). The wheeled frame allows the sampler to be easily moved from vertical to vertical. The winch has an audible counter and, when combined with a small metronome, can be raised and lowered at a constant rate.

Figure 6.1. View of DH-40 suspended by cable from hand winch mounted on a portable, lightweight, wheeled frame.

The 20 vertical suspended sediment samples collected at a bridge site during each sampling effort were collected in small pint bottles and then combined into a larger container to make a single composite sample for that bridge site. The composite samples were delivered to and analyzed by the Olsson geotechnical lab. The sediment samples were analyzed by dry sieving per the methodology defined in the protocol to determine their grain size distribution. The total load computation (based on suspended sediment measurements) was then calculated using the modified Einstein method.

6.1.2 Results

Depth-integrated suspended sediment sampling was completed on April 17-20, June 16-20, and July 6, 2009. The instantaneous flows in cubic feet per second (cfs) for each sample at each bridge (as obtained from gages at those bridges) along with the calculated concentration are shown in **Table 6.1**. During the first sampling effort on April 17 at the Lexington bridge (283/Plum Creek Pkwy), a traffic control crew was in place for USGS work being conducted at that location. However, the use of a traffic control crew during our sampling efforts would be prohibitively expensive and would require considerable coordination. However, without a traffic control crew, this bridge was deemed to be too unsafe to perform our suspended sediment sampling effort. Therefore, the sampling location was moved from the Lexington bridge to the immediate upstream bridge at Darr (SH-L24A/Rd 755). Since there are no flow diversions or inputs between the bridges, it was deemed that the Darr bridge site would likely produce similar results.

Table 6.1. Depth-Integrated suspended sampling flows and concentrations for Year 1 (2009).

Bridge		April 17	April 19-21	June 16-17	June 18-20	July 6
Lexington	Flow (cfs)	1180	---	---	---	---
	Concentration (ppm)	1308*	---	---	---	---
Darr	Flow (cfs)	---	1000	1230	1230	NA
	Concentration (ppm)	---	263	1708*	369	NA
Overton	Flow (cfs)	1790	3530	1730	1920	1070
	Concentration (ppm)	209	429	145	129	183
Kearney	Flow (cfs)	1250	3000	1490	2130	1000
	Concentration (ppm)	150	1334*	231	290	311
Shelton	Flow (cfs)	1370	3000	1490	2060	1340
	Concentration (ppm)	134	333	231	338	303
Grand Island	Flow (cfs)	1920	3200	1520	1690	1240
	Concentration (ppm)	177	563	317	376	292

*Anomalous

A single bulk bed material sample was obtained at each bridge on July 29-30, 2009. The bed material gradation at each bridge is shown in **Table 6.2**. The bed material samples were collected from the exposed low flow braid bars in the main channel downstream of the bridges. The bridge cross section was surveyed at this time as well. The bridge cross section surveys were not included within the Protocol but were necessary for the hydraulic analysis at each bridge which was needed for the total load computations. An attempt was made to directly measure bed load transport at the Darr bridge using a Helley-Smith bed load sampler during the transects survey in August, but the flow was too low and the sampling effort was unsuccessful.

Table 6.2. Bed Material Gradation Analysis at the Bridges (collected July 29-30, 2009).

Bridge	D16 (mm)	D50 (mm)	D84 (mm)	USCS Class
Darr	0.4	2.0	7.5	SP
Overton	0.9	2.8	9.3	SW
Kearney	0.3	1.0	3.6	SP
Shelton	0.3	0.6	1.4	SP
Grand Island	0.3	0.5	1.3	SP

The results of the suspended sediment sampling effort reveal multiple conclusions. First, at the flows that were measured, very little of the bed material is in suspension and, therefore, the suspended sediment is more likely wash load. This is demonstrated by comparing the bed sample gradations (Table 6.2) with the gradation data shown in **Table 6.3** for the suspended sediment, which shows very minimal overlap between the gradation sizes. Second, the suspended sediment concentrations, shown in Table 6.1, are consistently lower than 1,000 parts per million (ppm) with only 3 samples being the exception. The average suspended sediment concentration at the flows above 3,000 cfs is still only 700 ppm. These are very low concentrations and indicate that not enough bed material is being suspended at these flows and the only material in suspension is the finer wash load material. By wash load we mean only the fine sediment in the bed material was transported and not in large concentrations. At bankfull and higher flow conditions, such as what happened in May, 2008, the bed is very likely mobilized and sediment concentrations would be much larger and include the larger sediment sizes found in the bed material.

Table 6.3. Average Suspended Sample Gradation Analysis at the Bridges.

Bridge	D16 (mm)	D50 (mm)	D84 (mm)
Darr	0.22	0.44	0.77
Overton	0.11	0.21	0.43
Kearney	0.19	0.25	0.68
Shelton	NA	0.14	0.28
Grand Island	0.08	0.13	0.32

Dr. Everett Richardson (Professor Emeritus, Civil Engineering, Colorado State University) provided QA/QC as part of the suspended sediment sampling and analysis. Dr. Richardson examined the data and it is his opinion that the high concentration of the Lexington sample is an anomaly. It is our opinion that, when compared with all the acquired data, all 3 of the samples with concentrations above 1,000 ppm are likely anomalous. Those samples with concentrations below 500 ppm are more consistent when compared to the general trend, which is that the samples collected at the higher flows have higher concentrations. The flow during the first sampling event was between 1,000 and 2,000 cfs, whereas the flow during the second sampling event was between 3,000 and 3,500 cfs.

As a result of the disconnect between the bed material sample gradations and the suspended sediment gradations, the calculation of the total load using the modified Einstein approach (Holmquist-Johnson and Raff, 2006) and the Bureau of Reclamation Automated Modified Einstein Program (BORAMEP) was not feasible. The bed material is simply not being suspended at flows in the 1,000 to 3,500 cfs range. With the bed gradation showing average sizes of coarse sand and gravel, either dune bed forms or a plane bed form in the upper flow regime are needed to launch the sediment into suspension. A dune bed form will have large boils on the water surface and a dip sample of the flow would have sand particles in it. A plane bed would produce streaming flow and potentially low, hard to detect, standing waves.

6.1.3 Recommendations for Protocol Revisions

Based on the results of the first year, it is recommended that suspended sediment sampling should not be performed at flows lower than 5,000 cfs. We recommend that bedload sampling be performed for incremental flows less than 5,000 cfs. For example, 3 bedload samplings could be performed in the 1,000-3,000 cfs increment, 2 could be performed at the 3,000-5,000 cfs increment, and a single bedload sampling could be performed during a flow greater than 5,000 cfs. We would recommend that a suspended sediment sampling also be conducted in conjunction with the bedload sampling for the flow event greater than 5,000 cfs. At flows over 5,000 cfs, the sampling crew should also note the following:

- What is the condition of the water surface? Are there strong boils? Is the water surface placid? Is the water surface streaming with low long standing waves?
- Depending on visibility, what is the bed condition? Are there 1 to 3 feet or higher dunes that are 6 to 10 feet long? Is the bed plane and hard or plane and soft? Plane and hard is upper flow regime.

If there are dunes, the flow will have large suspended bed material more uniformly distributed in the vertical column, and the modified Einstein method can be used to compute total sediment load. If the river is in the upper flow regime bed form, the flow will have most of the suspended sediment in the unsampled zone (extending about 3 inches off of the bed). Under this condition, both suspended sediment samples and bedload samples should be obtained.

Additionally, it is recommended that a bed sample should be taken at the bridge locations once every year. This can continue to be done after the high flows during the transect surveys. This should be performed even if there is no suspended sediment sampling for the year.

7. DELIVERABLES

Deliverables to be included with the final annual report will include any raw data (including survey and parametric data), survey and mapping data, UTM locations of monitoring and sampling sites, ground photographs and field documentation of project activities, and other documents or materials collected and/or developed as a part of annual monitoring activities. Where appropriate, all data will be compiled in Excel spreadsheet format and incorporated into the Program database. Data will be reported in accordance with guidelines outlined in the Program's AMP and the Program's Database

7.1 Longitudinal Profile Survey Data

The following deliverables pertaining to the longitudinal profile survey are included on the submitted DVD:

- Spreadsheets containing the processed, but un-projected thalweg profile survey data for both the main Platte River channel and the J-2 Return channel
- Spreadsheets containing the processed thalweg profile survey data project onto USACE river miles for both the main Platte River channel and the J-2 Return channel
- Profile plots (PDF) of the projected thalweg profile at 10-mile increments for the main river channel and the J-2 Return

7.2 Transect Survey and LiDAR Data

The following deliverables pertaining to the channel geomorphology transect surveys are included on the submitted DVD:

- Shapefiles and ground survey data for all surveyed geomorphology and vegetation transects
- Shapefiles of cross sections for all anchor points compiled from transect survey data and LiDAR data

7.3 In-Channel Vegetation Data

The following deliverables pertaining to the in-channel vegetation surveys are included on the submitted DVD:

- Copies of original vegetation field data sheets on modified Daubenmire forms in PDF format.
- Shapefile with attribute table documenting the presence or absence of each species of interest at each vegetation sample location.
- Excel format spreadsheet with elevation data for each species of interest.
- Daubenmire summary spreadsheets in Excel format which document the frequency,percent cover, and acreage for each species of interest at each belt transect

and anchor point. The spreadsheets also include the acreage data in graph format at each anchor point.

- Excel graphs of the estimated acreage for each species of interest per anchor point.
- Excel and PDF graphs that show the overall 2009 frequency and percent cover for all data collected in 2009.

7.4 Bed, Bar, and Bank Sediment Sampling Data

The following deliverables pertaining to the bed, bar, and bank material sampling and analysis and the bank stratigraphy documentation are included on the submitted DVD:

- Grain size analysis data for all bed, bar, and bank samples by anchor point
- Spreadsheets compiling all pertinent data relating to the samples
- Spreadsheets and plots (PDFs) of bank stratigraphy and bank material sample analyses
- Shapefiles containing the locations of all sediment sample collection points

7.5 Suspended Sediment Sampling Data and Sediment Transport Results

The following deliverables pertaining to the suspended sediment sampling/analysis are included on the submitted DVD:

- Spreadsheet compiling the suspended sediment sample data
- Summary spreadsheet of suspended sediment concentrations
- Suspended sediment grain size analysis sheets
- Spreadsheets with bridge cross section survey data

It should be noted that because the total load analysis did not yield any useful results, the total load calculations are not included with the deliverables.

7.6 Ground Photography

The following deliverables pertaining to the location of ground photography are included on the submitted DVD:

- Shapefiles of all georeferenced ground photography for bank stratigraphy, and geomorphology transects
- All ground photos obtained during all profile and transect surveys and sediment sampling work

8. SUMMARY

This Draft Report represents a summary of the work that was conducted this year (2009) under the Channel Geomorphology and In-Channel Vegetation Monitoring protocol. Included with this report is a DVD with all the raw and processed survey and vegetation data, photos, sediment samples, and other information acquired during the survey and sampling effort.

We believe that the Year 1 (2009) survey and sampling effort went relatively smooth considering the extensive amount of data that were collected and the conditions under which the data were collected. The suspended sediment sampling, survey control setup, and longitudinal thalweg profile survey began early in the year. The start of these efforts was timed to coincide with the SDHF Test Flow that was performed in April. The duration of the test flow allowed for several suspended samplings and the start of the thalweg profile survey.

The profile was not completed until the end of the transect survey work because of boat problems. The original boat used was a flat bottom boat with a jet motor that allows for bathymetric surveying during higher flows. As flows receded, however, the jet motor became plugged with sediment and required that the boat be taken out of service. The remaining profile survey was then postponed until an airboat could be obtained. An airboat was purchased in late July and proved extremely useful in conducting the remainder of both the transect surveys and the thalweg profile survey. Up until that point access to the anchor points and the survey and sampling work had been conducted using a combination of 4-wheel drive trucks, ATVs, and on foot. The airboat allowed us to access the anchor points and move around much more quickly.

Although the transect surveys and bed, bar, and bank material sampling were to be conducted under low flows, spring runoff in the mountains in Colorado and Wyoming coupled with an extremely wet early summer resulted in inordinately high flows in June and July. This resulted in conducting the survey and sampling work in somewhat deeper and faster flow conditions than defined in the protocol. However, flows had receded by August, allowing the remainder of the work to be conducted under more manageable conditions.

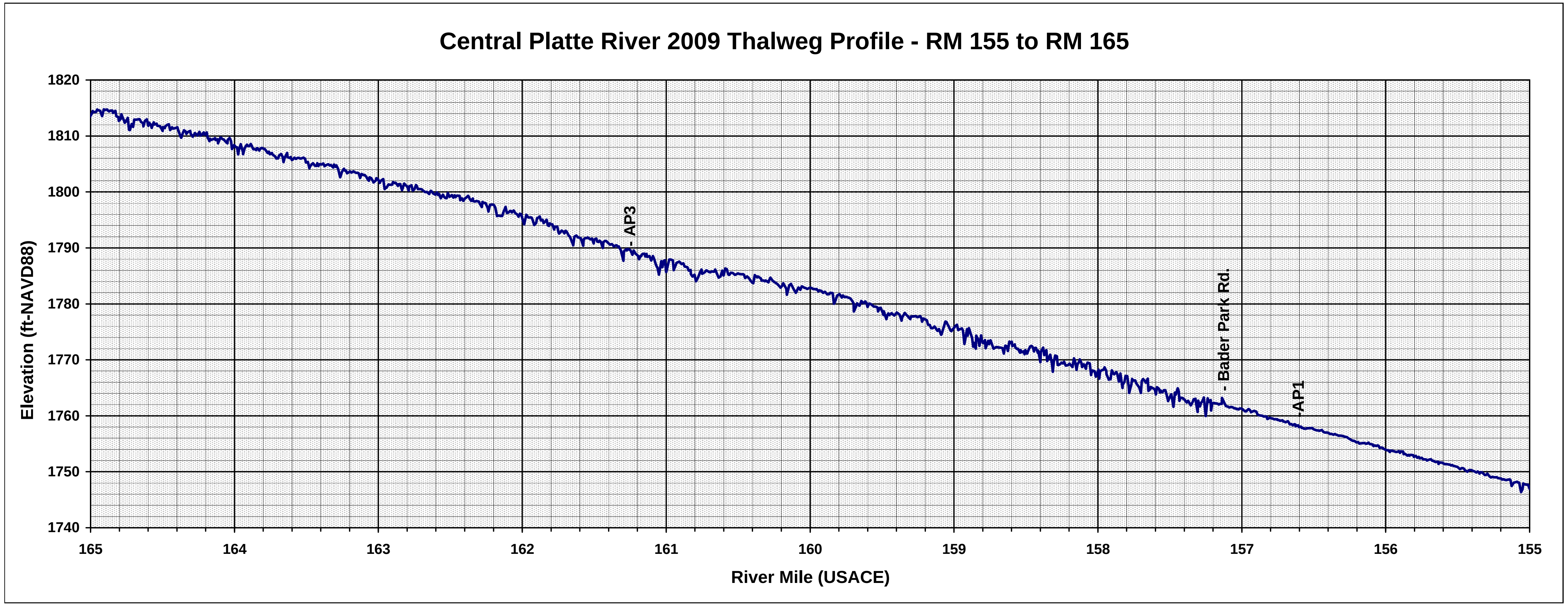
In late September, the Program's Director of Natural Resources asked if we could compile one page descriptions of the work that was conducted at each anchor point for use during an informal meeting with landowners to be conducted in December 2009. We complied with the request and submitted the one-pagers to the ED Office in early October.

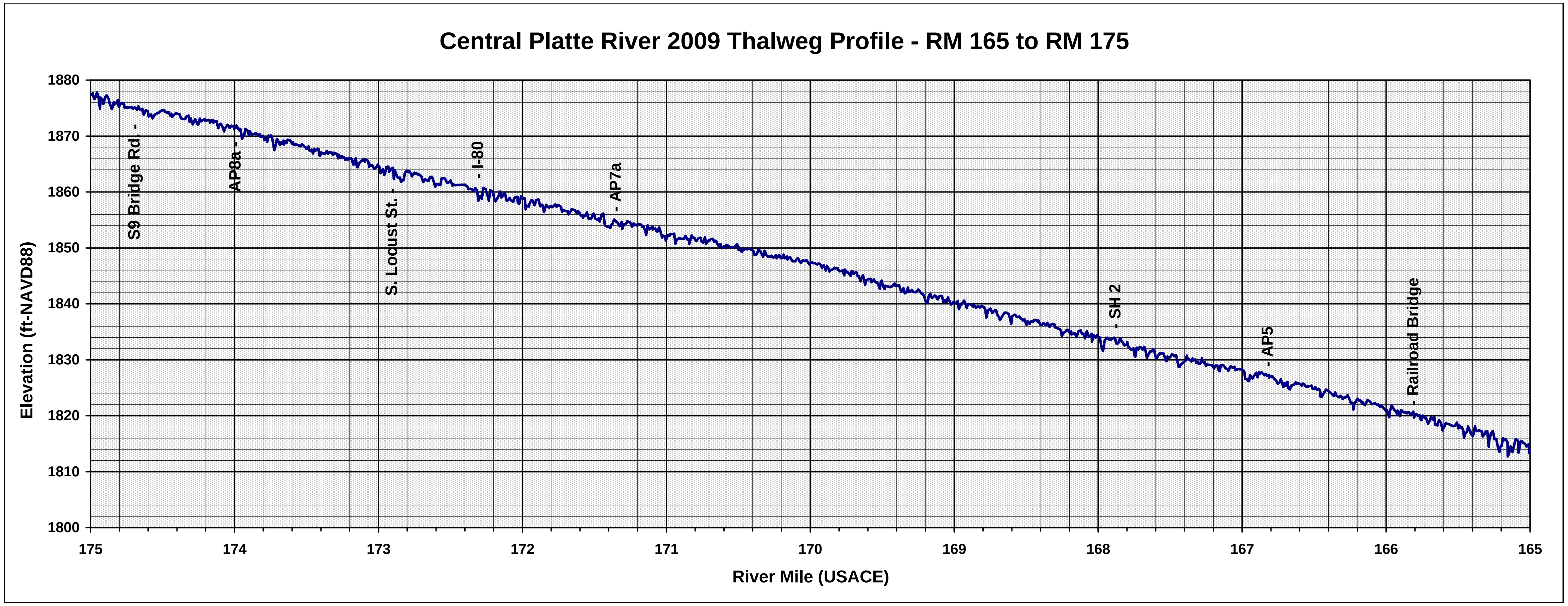
Subsequently, all of the data collected for this project has been processed and compiled into the appropriate formats requested by the ED Office. The final LiDAR was received and has been used to compile the cross sections for all anchor points. The anchor point cross sections have been submitted to the ED Office for review.

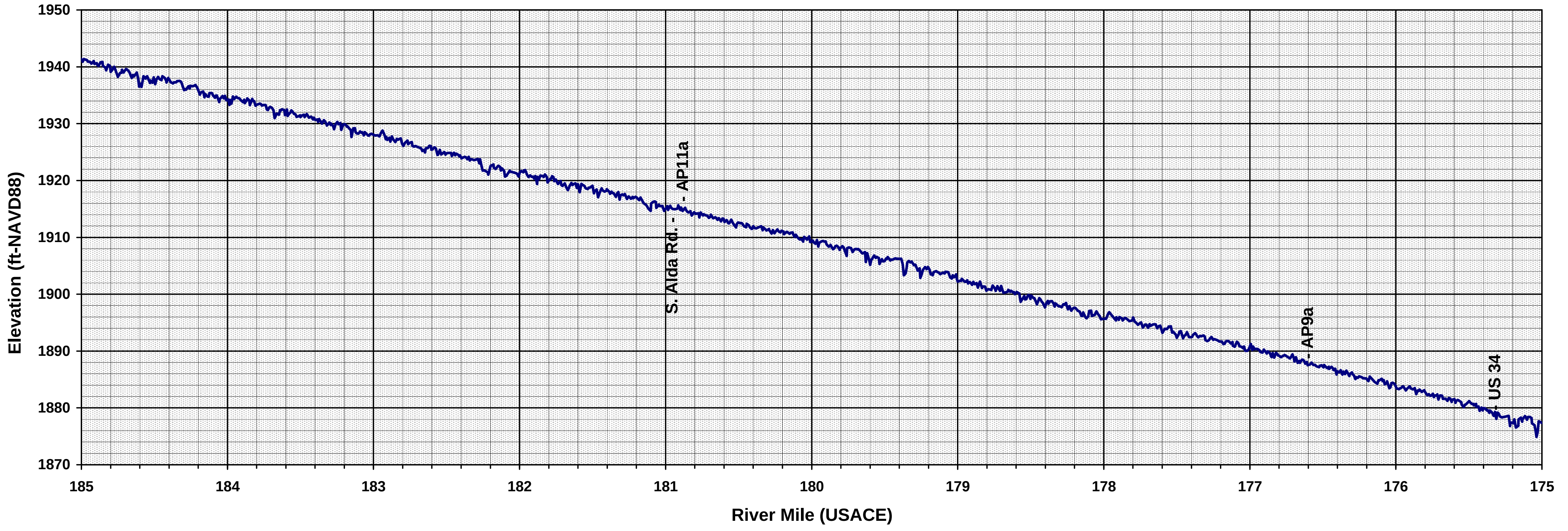
The ED Office and its Technical Advisory Committee (TAC) have reviewed the draft report and all review comments have been addressed and incorporated into this final Year 1 report. In addition, agreed upon revisions to the protocol that have been identified by the ED Office, its advisory committee(s), and us have been incorporated into the protocol and submitted for finalization.

APPENDIX A

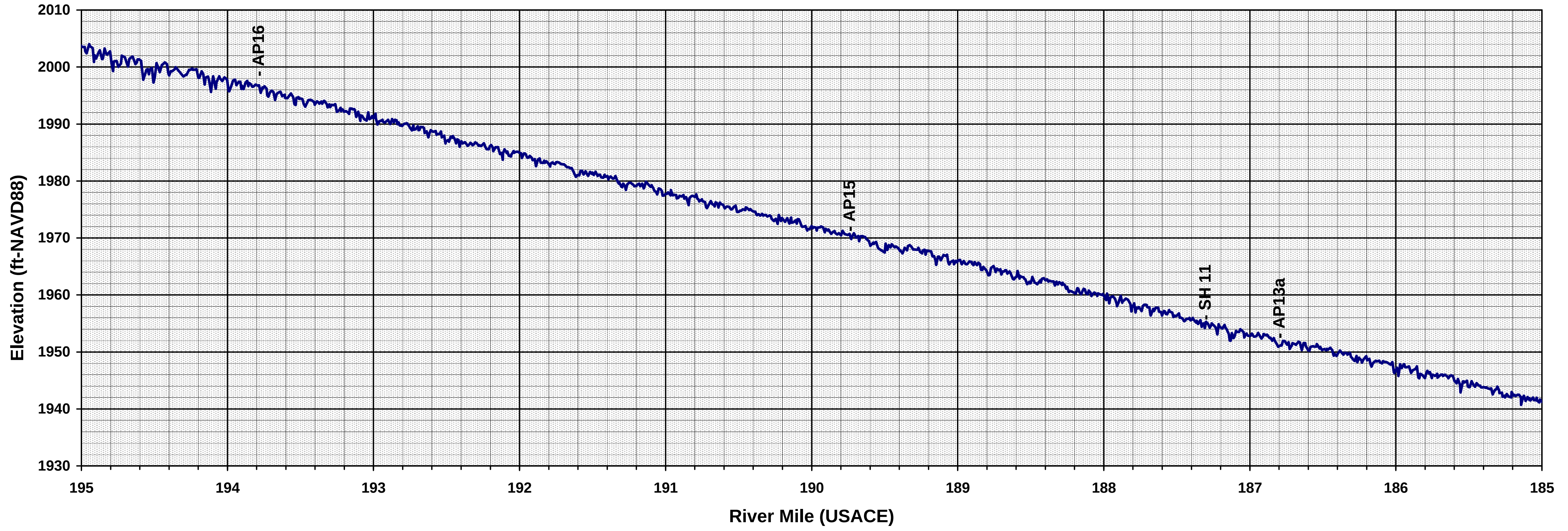
Longitudinal Thalweg Profiles


Central Platte River 2009 Thalweg Profile - RM 155 to RM 165


Central Platte River 2009 Thalweg Profile - RM 165 to RM 175

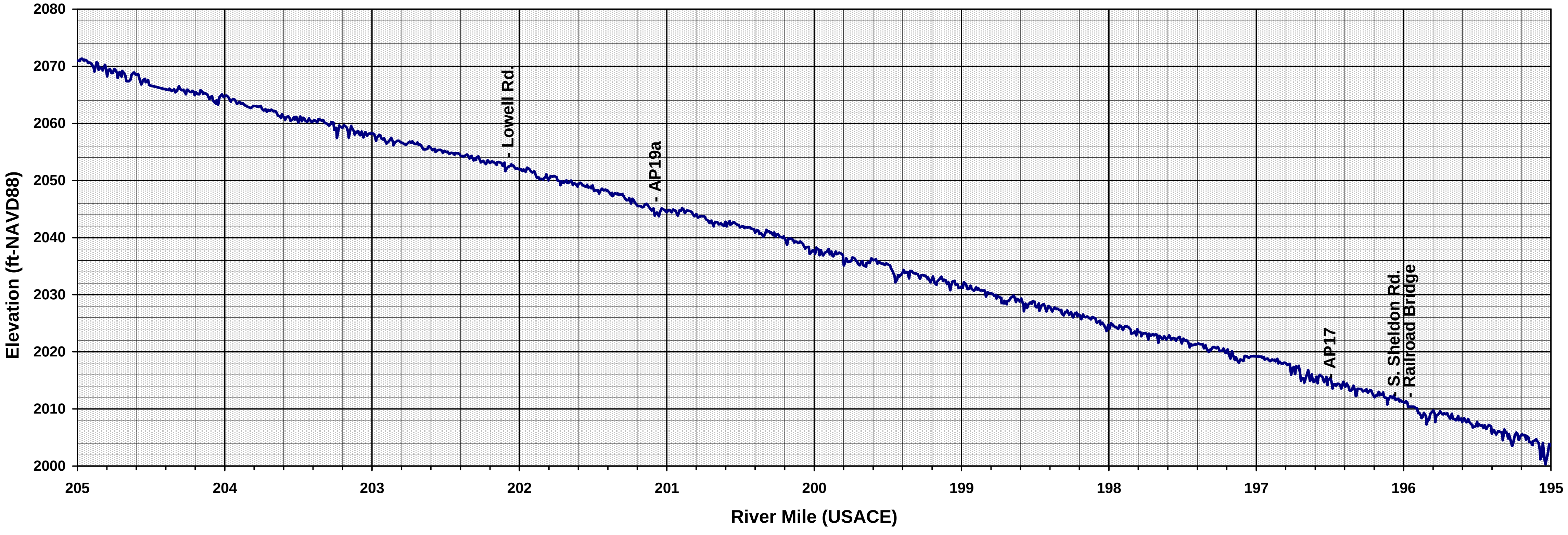


Central Platte River 2009 Thalweg Profile - RM 175 to RM 185

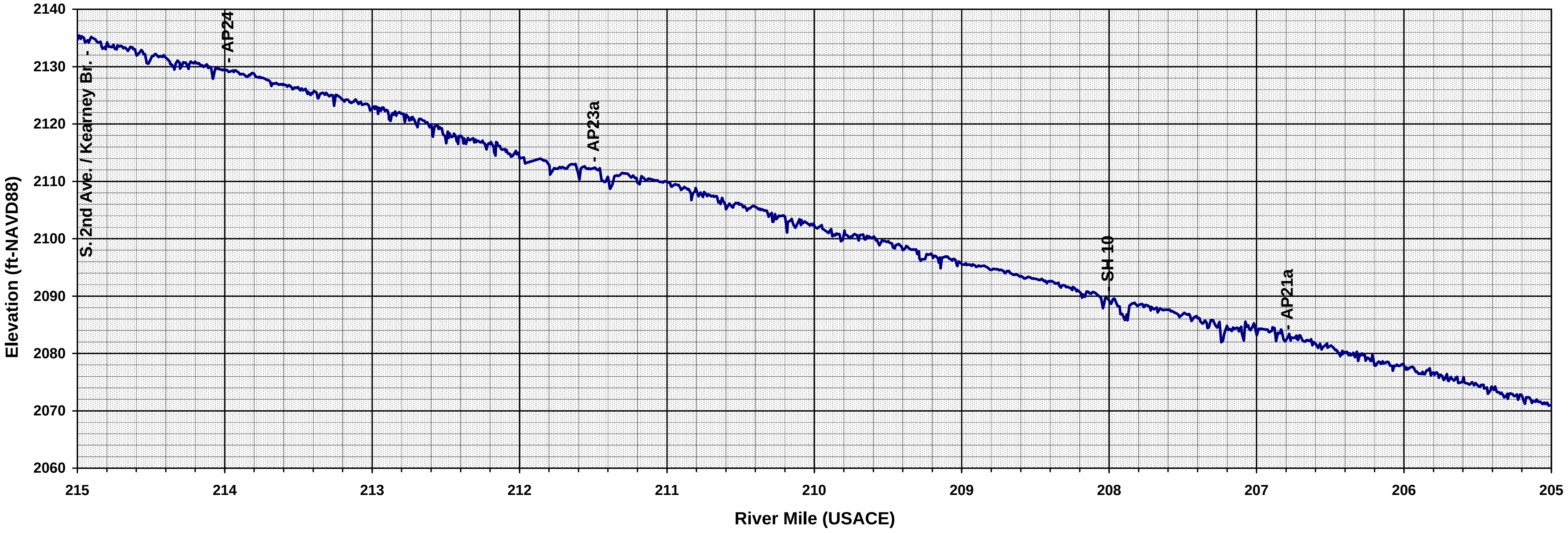


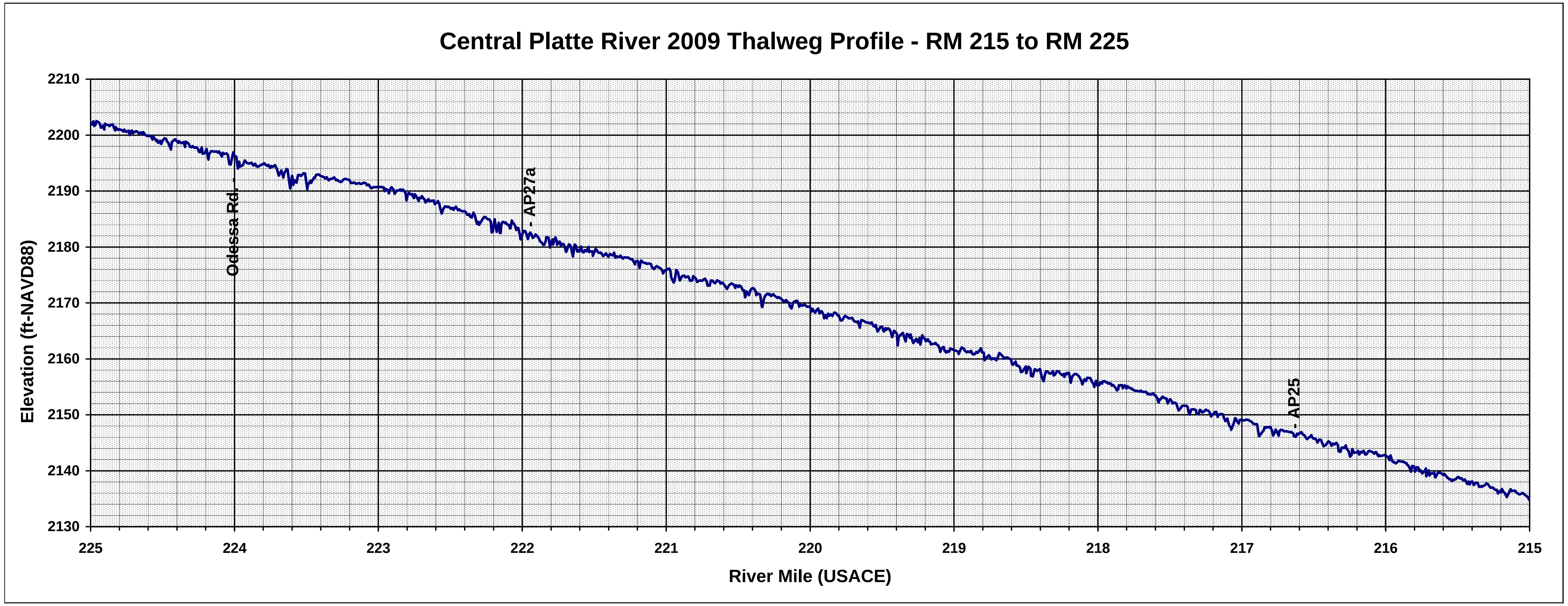
Central Platte River 2009 Thalweg Profile - RM 185 to RM 195

Central Platte River 2009 Thalweg Profile - RM 195 to RM 205

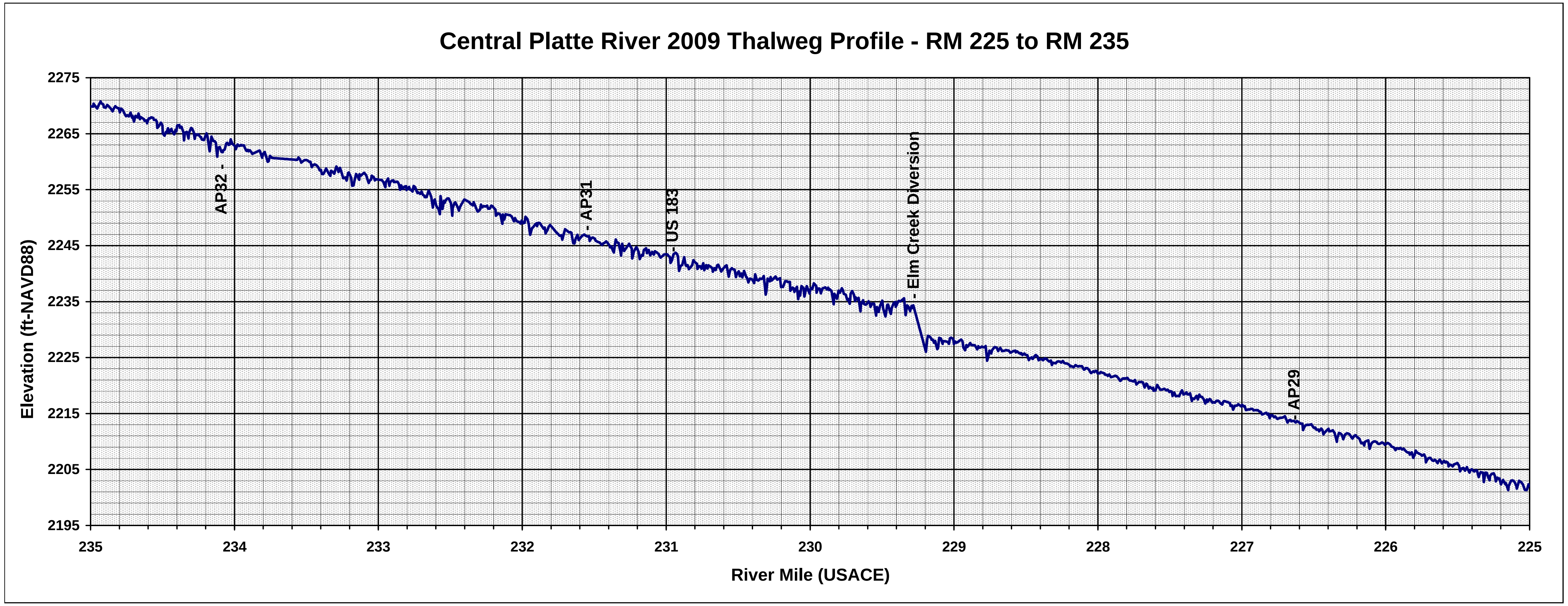


Central Platte River 2009 Thalweg Profile - RM 205 to RM 215

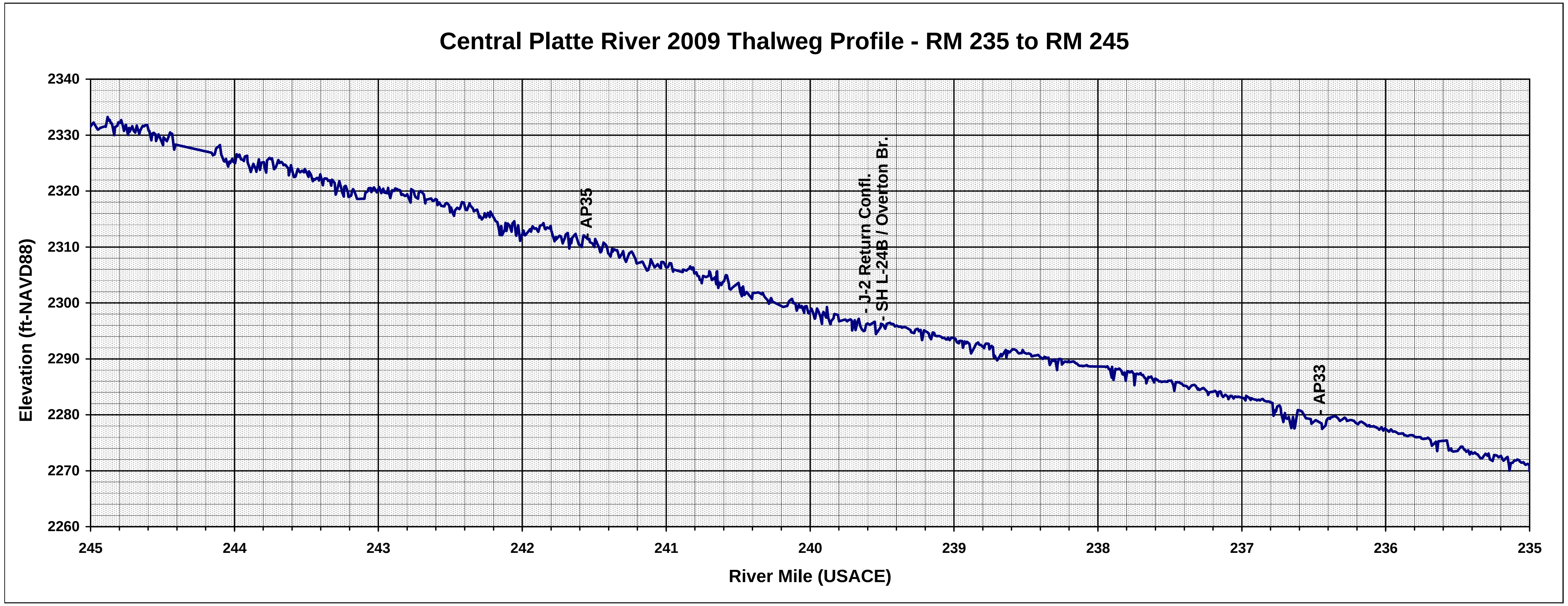




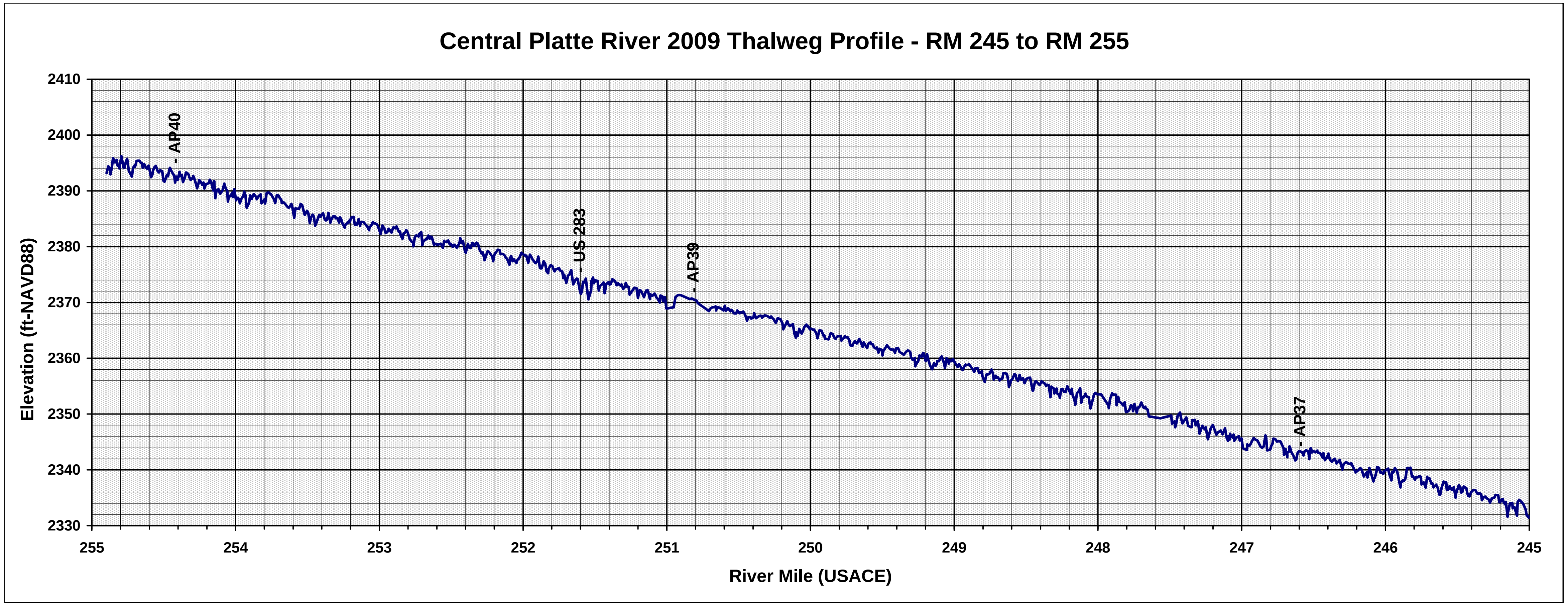
Central Platte River 2009 Thalweg Profile - RM 215 to RM 225



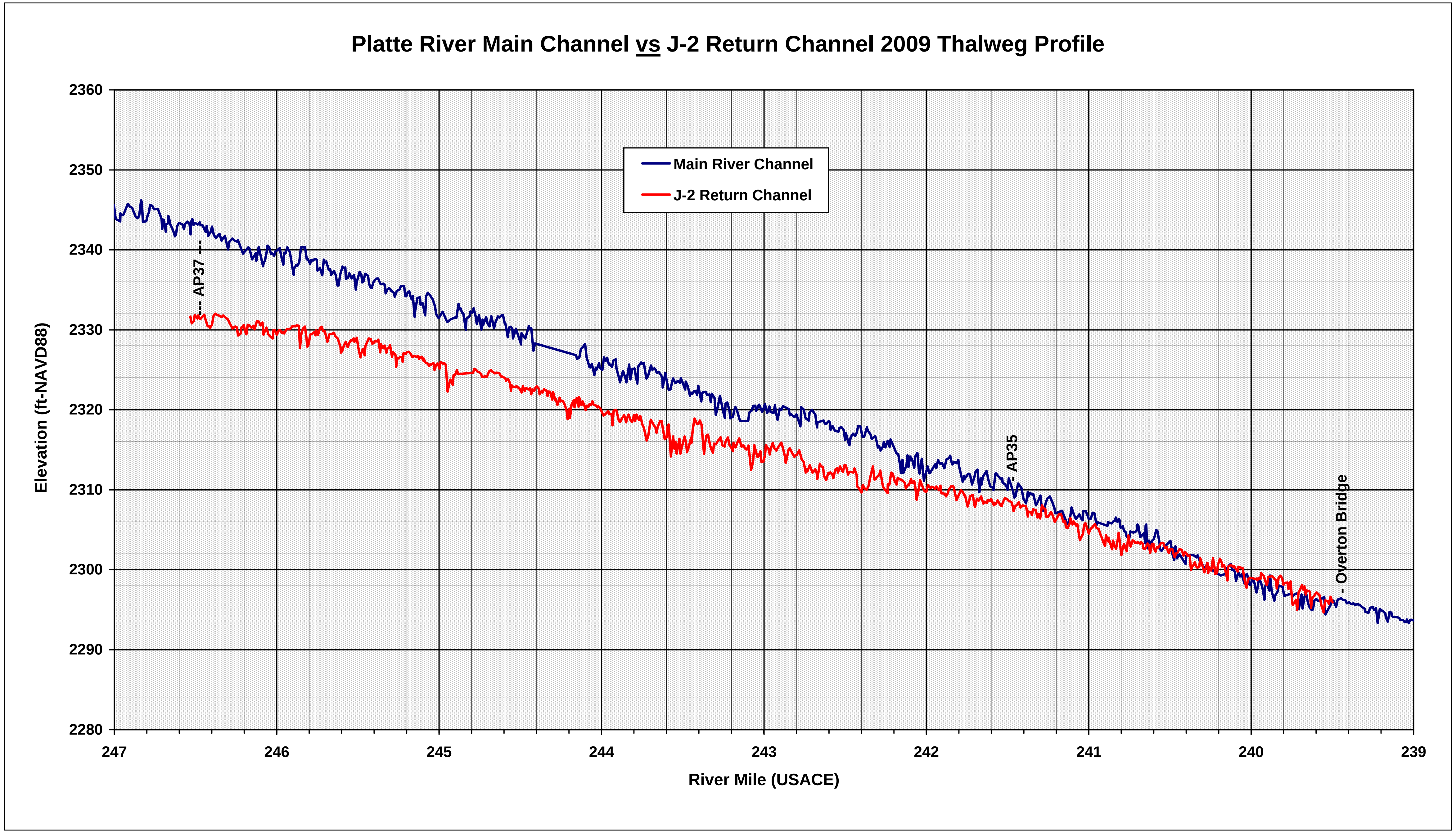
Central Platte River 2009 Thalweg Profile - RM 225 to RM 235



Central Platte River 2009 Thalweg Profile - RM 235 to RM 245



Central Platte River 2009 Thalweg Profile - RM 245 to RM 255


Platte River Main Channel vs J-2 Return Channel 2009 Thalweg Profile
Main River Channel
J-2 Return Channel
Elevation (ft-NAVD88)
2360
2350
2340
2330
2320
2310
2300
2290
2280
River Mile (USACE)
247
246
245
244
243
242
241
240
239
AP37
AP35
Overton Bridge