DATA ANALYSIS SUMMARY REPORT

For

MAY 2008 NATURAL HIGH FLOW EVENT

Flooding Near Stream Gage at Cottonwood Ranch
Photo Credit: Jim Jenniges, NPPD

Prepared for:
Governance Committee of the
Platte River Recovery Implementation Program

By:
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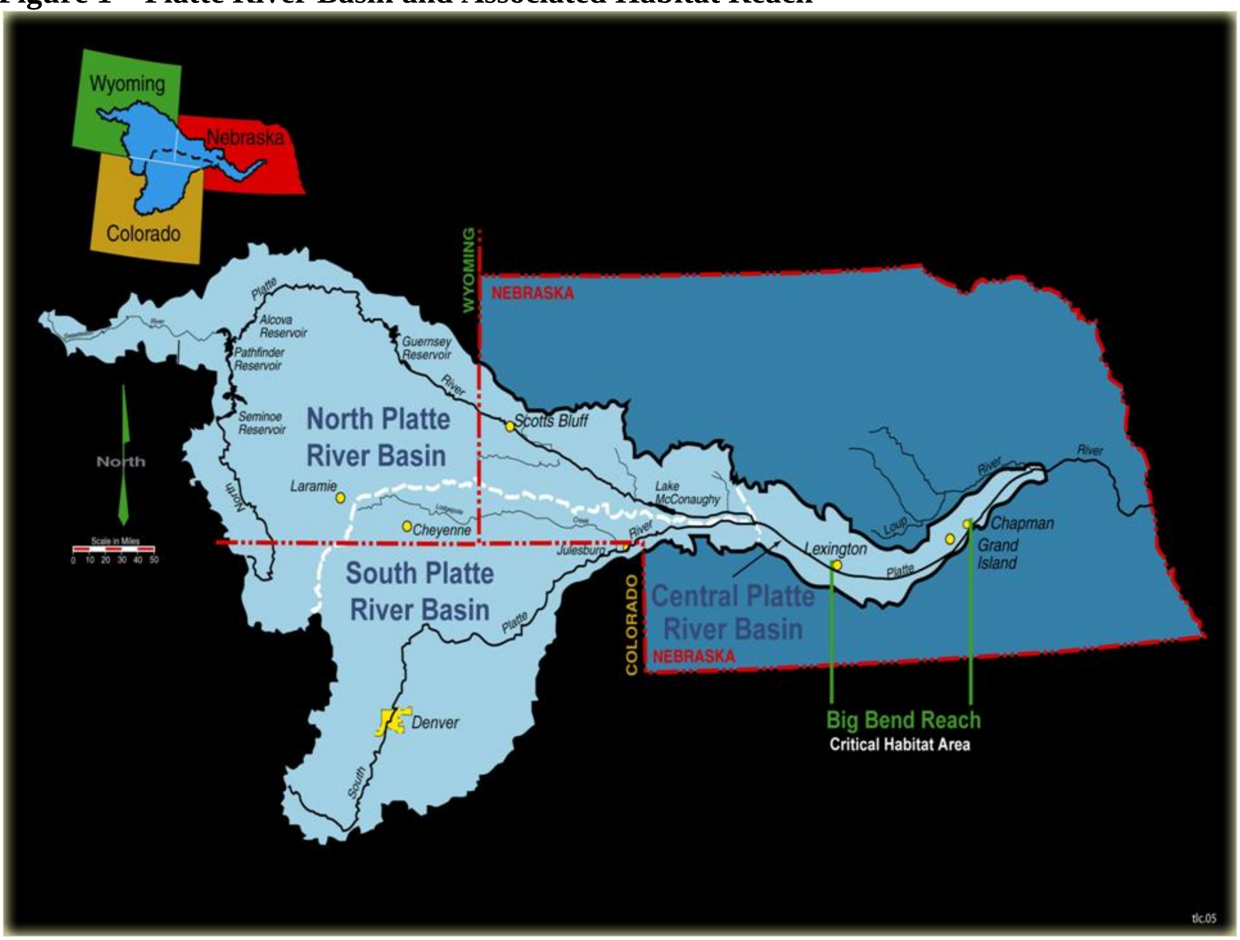
I. INTRODUCTION

In late May 2008, intense rainfall events in south central Nebraska produced a natural high flow event on the Platte River throughout Platte River Recovery Implementation Program's central Platte habitat reach (habitat reach) (Figure 1). Following the event, the Program's Governance Committee (GC) approved an Executive Director's Office (ED Office) proposal to collect and analyze event-related hydrologic and geomorphic data. Data was collected throughout the month of June by Program staff, Program cooperators, and contractors. Program staff conducted data analysis and compiled this summary report. Section II of this report presents a hydrologic analysis of the high flow event. Subsequent sections present physical data collection methods, results, and conclusions.

Figure 1 – Platte River Basin and Associated Habitat Reach



II. HYDROLOGY SUMMARY

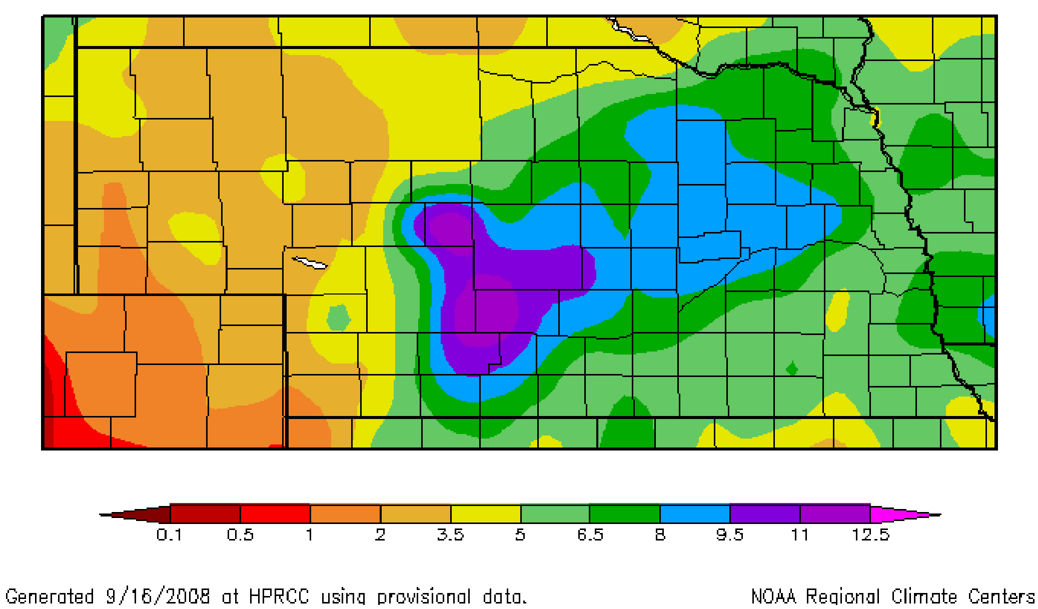
In late May 2008, intense rainfall events in south central Nebraska produced a natural high flow event on the Platte River throughout the habitat reach. The crest of this high flow event exceeded National Weather Service (NWS) Flood Stage at all three Platte River United States Geologic Survey (USGS) stream gages in the reach and produced moderate flooding throughout the area. This section of the report presents a general discussion of the timing, duration, and magnitude of this high flow event and provides a comparison to the expected timing, duration, and magnitude of Program pulse flows.

A. Precipitation

The high flow event in the associated habitats was produced by a wide-spread high-intensity rainfall event that occurred on May 23rd and 24th, 2008 in south central Nebraska. The greatest amount of rainfall occurred along the Platte River valley between Gothenburg and Cozad, with depths totaling six to seven inches. Rainfall depths of this magnitude in central Nebraska exceed a 100-year return period.

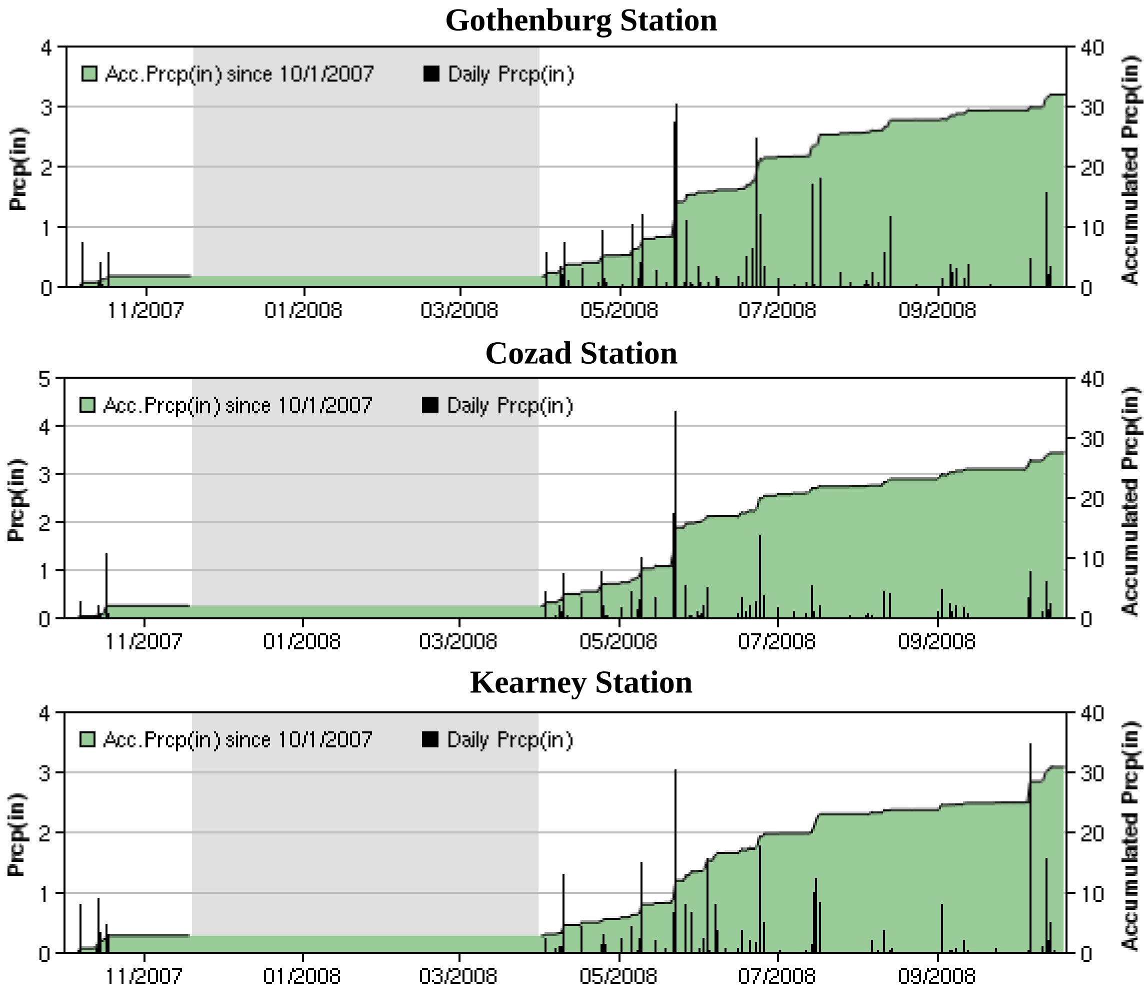
This rainfall event was also preceded by several lesser events producing a May precipitation total on the order of ten to twelve inches at the west end of the habitat reach. Average May precipitation in this area is slightly less than four inches. Figure 2 presents total precipitation for the month of May. Figure 3 presents daily and cumulative precipitation records for the Gothenburg, Cozad, and Kearney automated weather stations.

Figure 2 – Nebraska Precipitation in Inches 05/01/2008 to 06/01/2008



Courtesy of High Plains Regional Climate Center, University of Nebraska, Lincoln

Figure 3 – Daily and Cumulative Precipitation for Gothenburg, Cozad and Kearney Weather Stations



Note: Precipitation data not collected during winter months (gray bands in figures)

Courtesy of High Plains Regional Climate Center, University of Nebraska, Lincoln

B. Platte River Flow Magnitude and Duration

The combination of saturated soils due to above average rainfall and the large storm event on May 23rd and 24th resulted in a peak Platte River flow of 13,400 cfs in the habitat reach. This flow was recorded on May 26th at the USGS gage near Kearney, NE (06770200), near the midpoint of the reach. The peak flow at the upstream end of the reach was 11,200 cfs, recorded on May 25th at the USGS gage near Overton, NE (06768000). The peak flow at the downstream end of the reach was 12,900 cfs, recorded on May 27th at the USGS gage near Grand Island, NE (06770500).

The USGS and NWS use different stage-discharge relationships at each gage location so NWS flood stage exceedance is presented independent of discharge. At the Overton gage, peak gage height exceeded the NWS flood stage of 7.0 feet on three consecutive days. At the Kearney gage, the flood stage of 6.0 feet was exceeded on three consecutive days. At the Grand Island gage, the flood stage of 6.5 feet was exceeded on one day. Figures 4 – 6 present the provisional gage records for the Overton, Kearney, and Grand Island stream gages. Please note that discharge and gage height do not correspond.

Figure 4 – Provisional Daily Peak Discharge and Gage Height 15/15/2008 to 06/15/2008, Platte River near Overton Nebraska (USGS Gage 06768000)

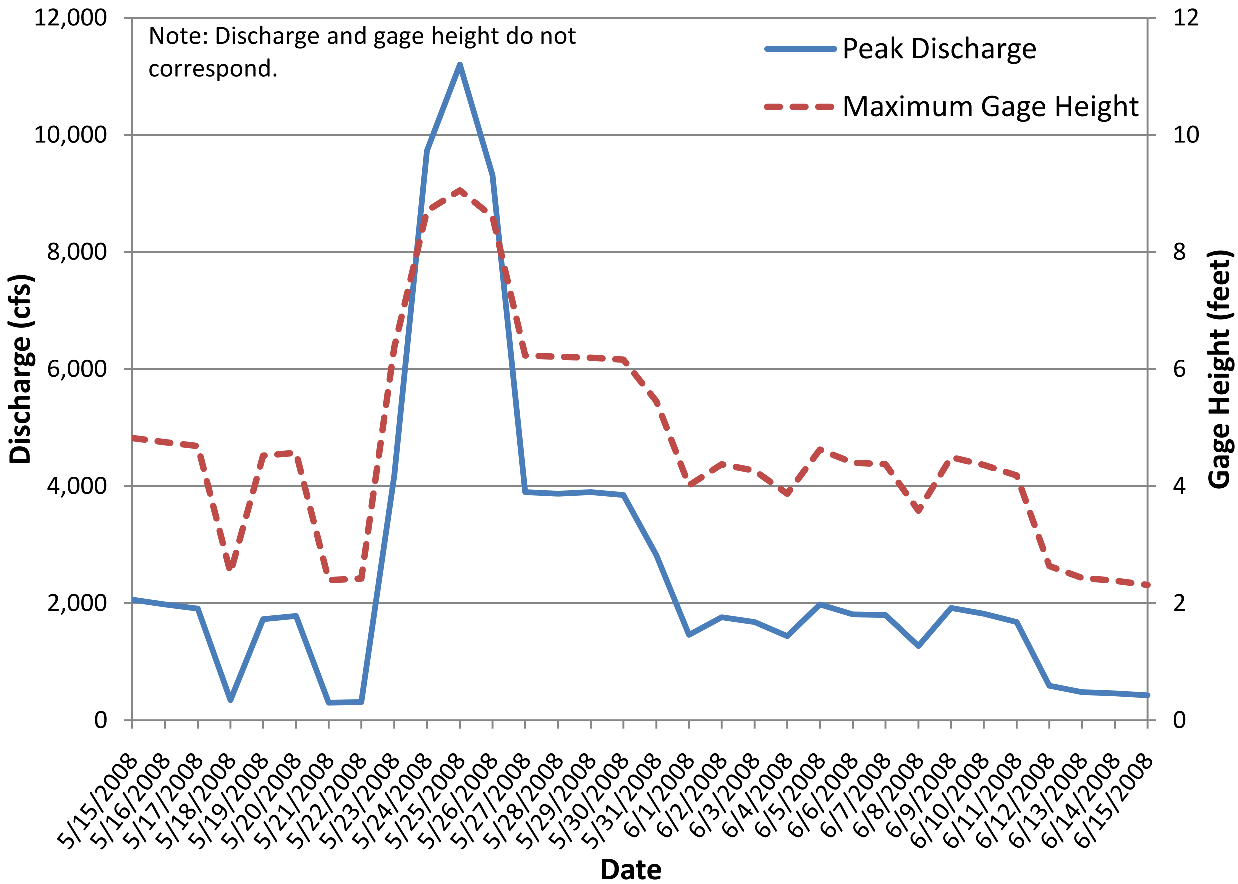


Figure 5 – Provisional Daily Peak Discharge and Gage Height 15/15/2008 to 06/15/2008, Platte River near Kearney Nebraska (USGS Gage 06770200)

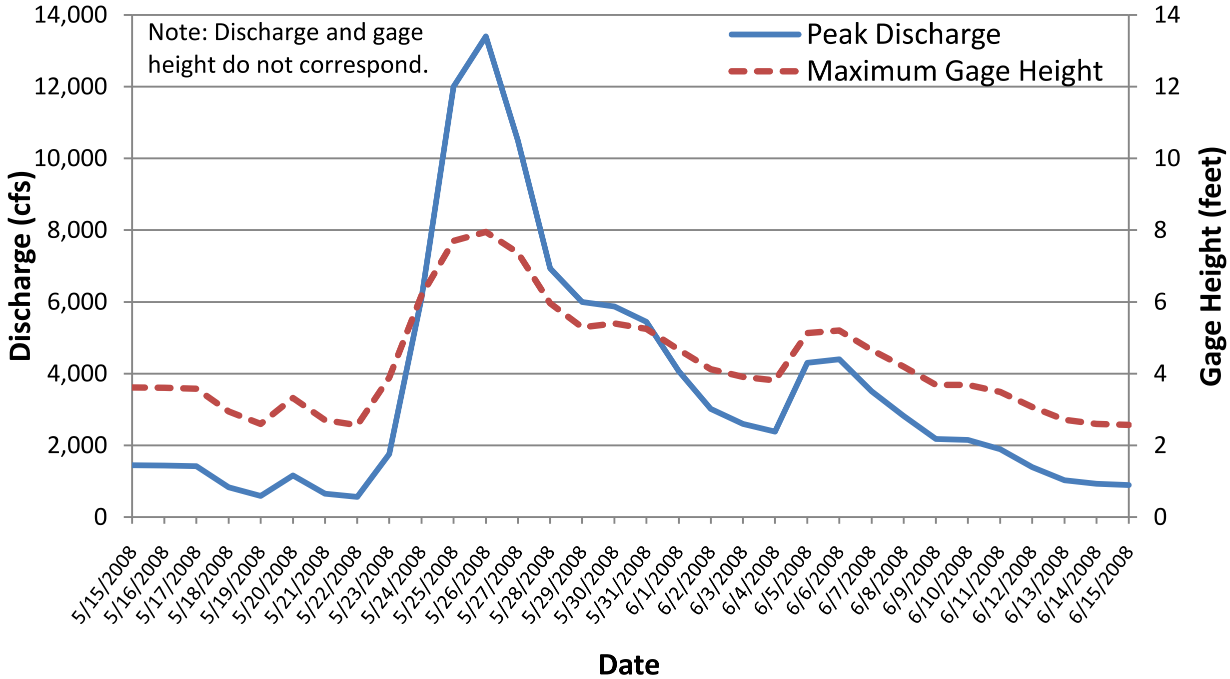
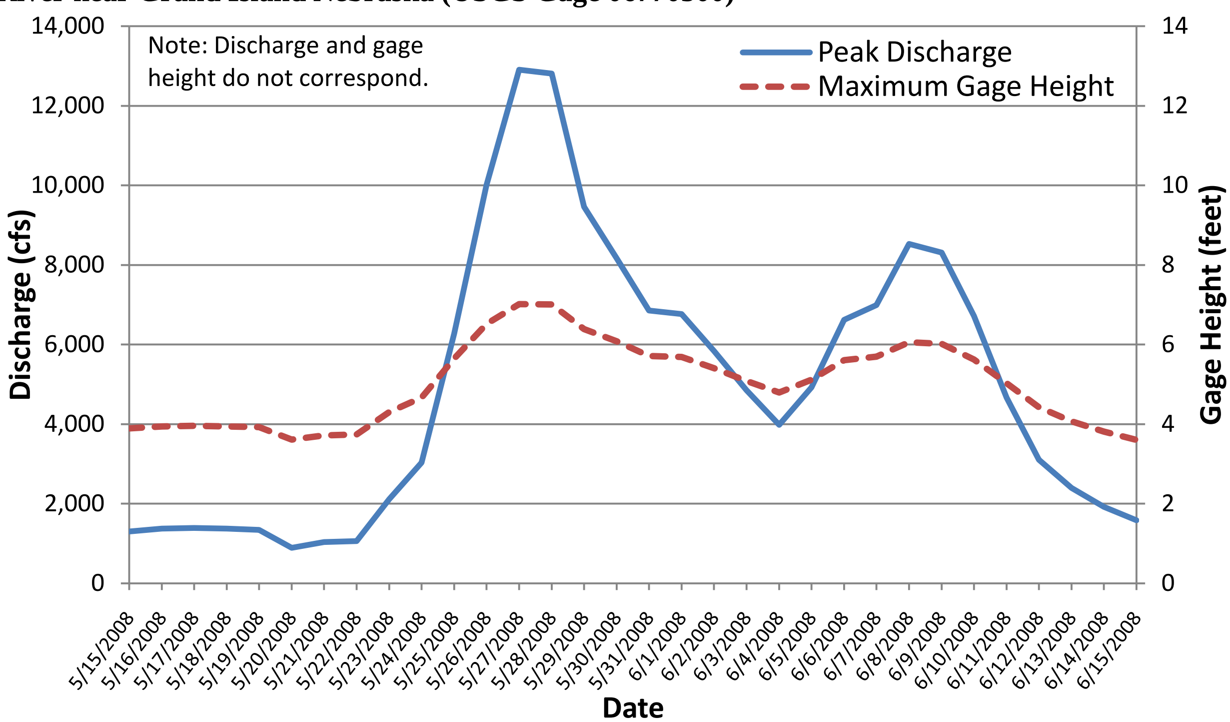


Figure 6 – Provisional Daily Peak Discharge and Gage Height 15/15/2008 to 06/15/2008, Platte River near Grand Island Nebraska (USGS Gage 06770500)



C. Flood Flow Frequency

The flood flow return frequency for the May event was calculated at each gage location utilizing the USGS gage data for the period of record and following the procedures in Bulletin 17B of The Interagency Committee on Water Data titled "Guidelines for Determining Flood Flow Frequency" (Interagency Advisory Committee on Water Data, 1982). The analysis did not include separation of pre and post-Kingsley Dam flow records. Doing so would have slightly lowered the exceedance probabilities.

The calculated flow exceedance probability for the peak flow of 11,200 cfs at the Overton gage is on the order of 24%, which equates approximately to a four year return period. The calculated flow exceedance probability for the peak flow of 13,400 cfs at the Kearney gage is on the order of 15%, which equates to approximately a seven year return period. The calculated flow exceedance probability for the peak flow of 12,900 cfs at the Grand Island gage is on the order of 19%, which equates to approximately a five year return period. Figures 7 – 9 present Platte River flow exceedance probability curves at the three gage locations.

Figure 7 – Flow Exceedance Probability Curve, Platte River near Overton Nebraska 1915-2008 (USGS Gage 06768000)

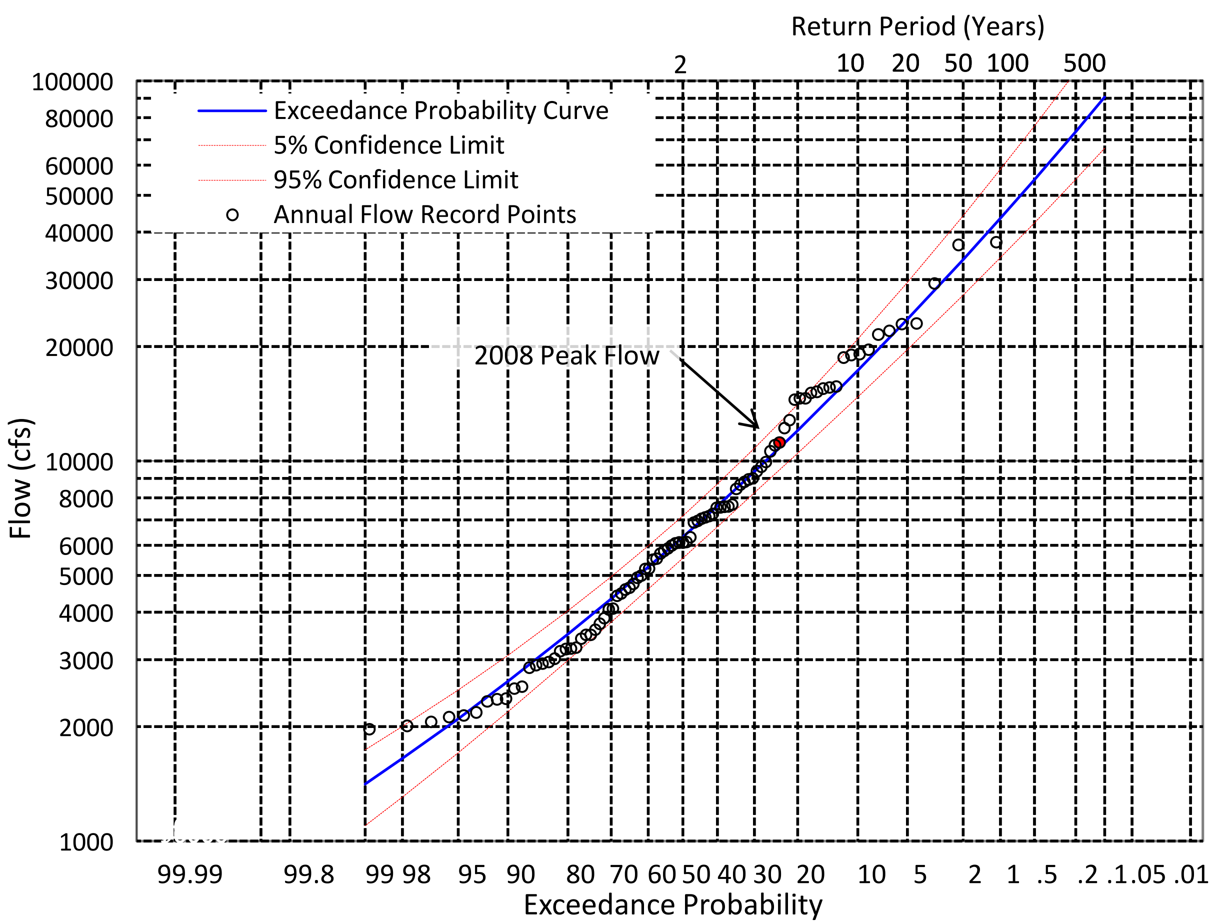


Figure 8 – Flow Exceedance Probability Curve, Platte River near Kearney Nebraska 1982-2008 (USGS Gage 06770200)

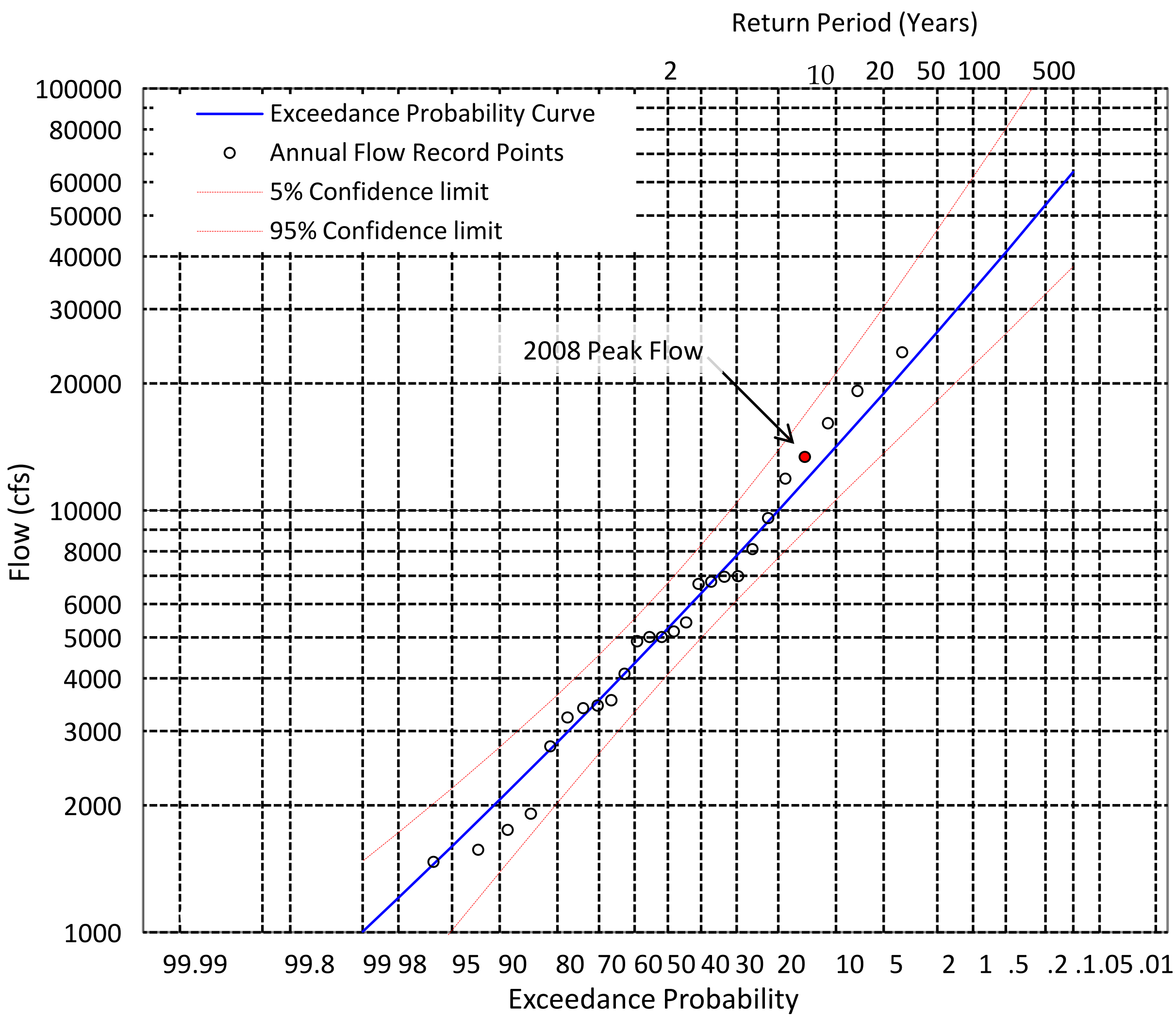
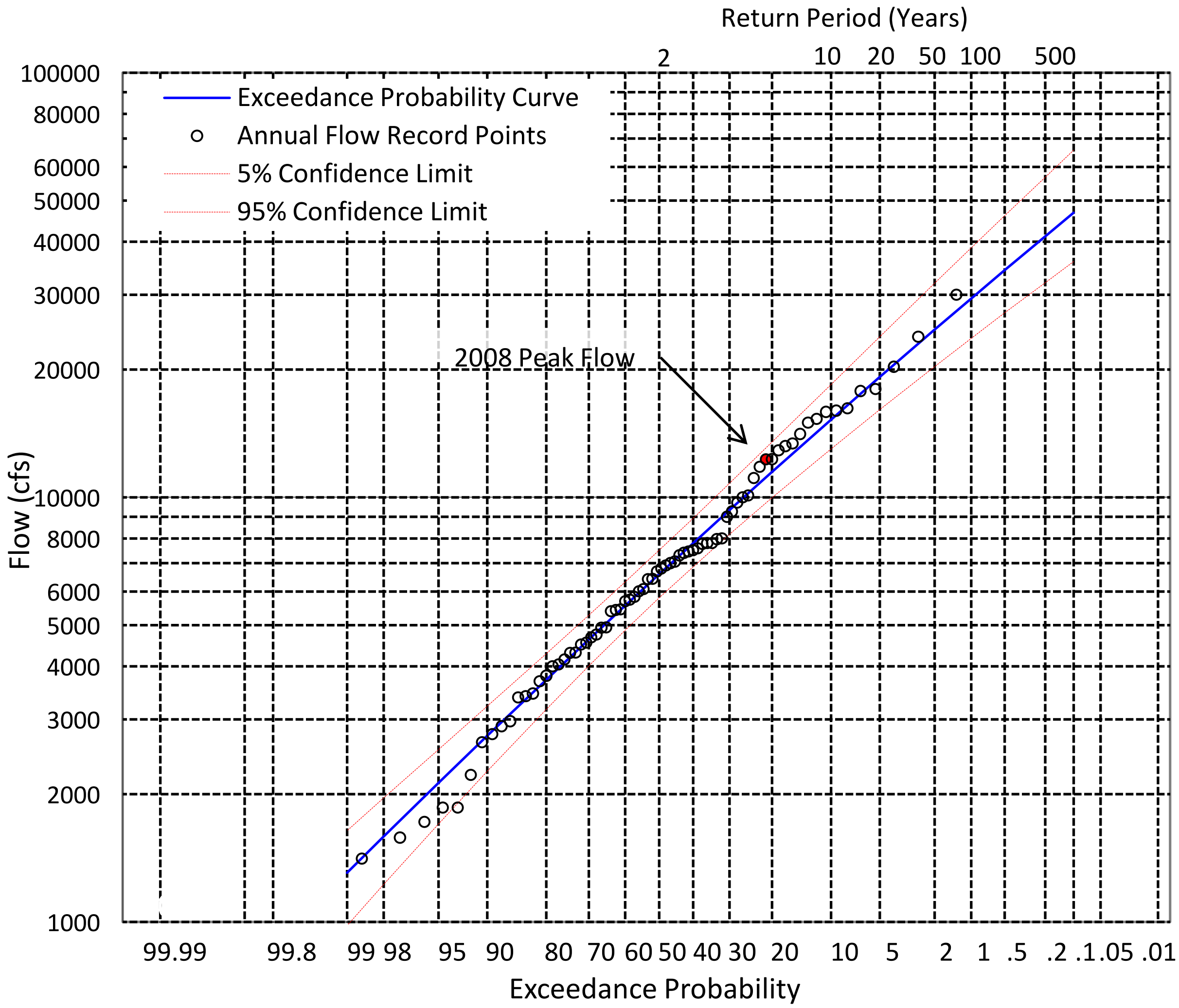
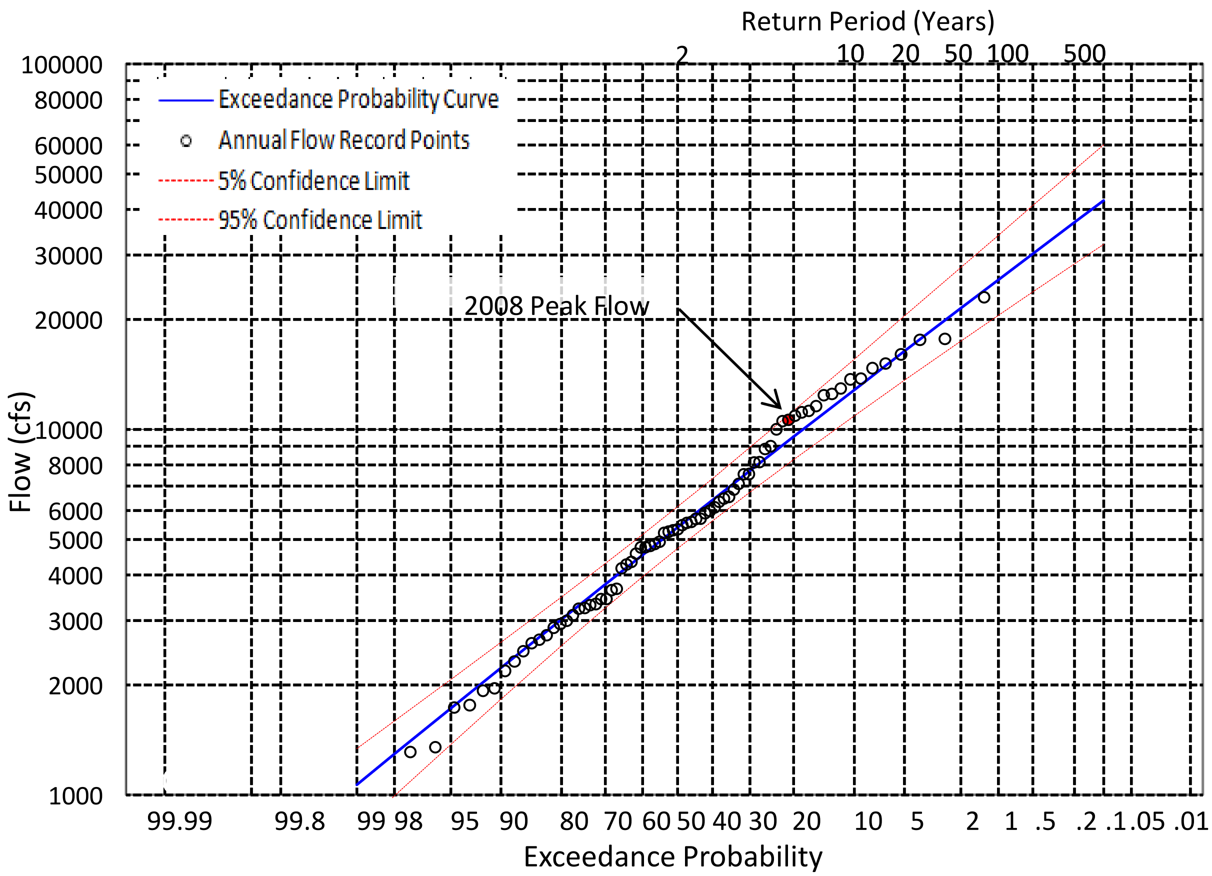


Figure 9 – Flow Exceedance Probability Curve, Platte River near Grand Island Nebraska 1934-2008 (USGS Gage 06770500)



The three-day mean peak flow return frequency for the May event was also calculated at the Grand Island gage using annual three-day mean peak flows for the period of record. The three-day mean peak flow for the three highest flow days during the May event was 10,553 cfs. The calculated flow exceedance probability this mean peak flow is on the order of 23%, which equates approximately to a four year return period. The three-day mean peak exceedance probability is similar to the single day peak exceedance probability of 19% at the Grand Island gage. This indicates that the flood flow duration during the May event is similar to historic flows of approximately the same magnitude. Figure 10 presents the three-day mean peak Platte River flow exceedance probability curves at the Grand Island Gage.

Figure 10 – Three-Day Mean Peak Flow Exceedance Probability Curve, Platte River near Grand Island Nebraska 1934-2008 (USGS Gage 06770500)



D. Program Pulse Flow Comparison

Table 1 presents a high flow event discharge and volume comparison for the three consecutive days with the highest recorded flow at each of the gage locations. This event likely exceeds the magnitude and duration of any expected Program pulse flow during the First Increment, especially considering that the NWS flood stage was exceeded at all three gages.

Table 1 –High Flow Event Discharge and Volume Comparison at the Overton, Kearney and Grand Island Gages

	Flow Dates	Approx. NWS Discharge at NWS Flood Stage (cfs)	Three Day Minimum Discharge (cfs)	Three Day Maximum Discharge (cfs)	Three Day Mean Discharge (cfs)	Three Day Flow Volume (Ac-Ft)
Overton Gage	May 24 - 26	7,400	3,710	11,200	7,597	45,205
Kearney Gage	May 25 - 27	8,900	6,110	13,400	9,667	57,522
Grand Island Gage	May 26 - 28	12,500	6,270	12,900	10,533	62,675

III. PHYSICAL DATA COLLECTION AND ANALYSIS METHODOLOGIES

Following the May 2008 event, Program staff, cooperators, and contractors collected qualitative and quantitative physical data in an effort to evaluate the effects of the high flow event on channel morphology and the quantity and distribution of bare sand in the channel. Data collection began during the event and concluded during the first week of July. Data collection activities included:

- Visual observations of the flow event.
- False-color infrared aerial photography for the entire habitat reach.
- Re-survey of existing Bureau of Reclamation (Bureau) and USGS river cross sections.
- Airboat survey of sandbar features at accessible Program geomorphology anchor point locations.

The remainder of this section of the report presents methodologies for collection and analysis of physical data.

A. Visual Observation of High Flow Event

Program staff conducted pedestrian observation of the high flow event at the Wyoming Property, located south of Kearney. A photo log documenting conditions at the property before, during, and after the event is included in Appendix A. The photo log includes two series of images. The first was taken at the west edge of the property from the north bank of the north channel looking south. The second was taken near the center of the property from the north bank of the north channel looking southeast toward managed tern and plover nesting islands. The two-image series includes photographs taken prior to the flow event, photographs taken during the receding limb of the hydrograph, and photographs taken after flood water had completely receded. Program staff attempted to access the site as the river was cresting but could not reach the photograph locations due to impassible flooding in normally dry side channels.

Nebraska Public Power District (NPPD) personnel conducted airboat observation of the high flow event at the Cottonwood Ranch property, located between Elm Creek and Overton. The observation was conducted on May 25, and the airboat was able to traverse both the active channel and normally dry overbank areas. Photographs from the airboat observation are included in Appendix A. The photo log also includes a set of reference photographs taken in November 2008.

B. Aerial Photography

The Program contracted with Cornerstone Mapping to acquire aerial imagery following the high flow event. Acquisition of two-foot pixel resolution false-color infrared (CIR) imagery for the entire habitat reach took place on June 22, 2008. The acquisition was scheduled such that river flow conditions were similar to those during the acquisition of 2007 CIR photography.

Program staff used Definiens Developer 7.0 automated image recognition software to create a classified polygon map from the imagery. The software creates polygons around groups of pixels with similar spectral and textural characteristics. These polygons were then classified into three categories: vegetation, sand, and water. The classified polygon files were then used to generate total area for each of the categories in each habitat reach bridge segment.

Program staff also manually extracted sand polygons located in the channel and surrounded by water. Total area (by bridge segment) was calculated for these polygons in order to better approximate the total sand area that could function as island sand bar nesting habitat for terns and plovers. Sand polygons attached to either bank or part of a large or mostly vegetated island/sandbar were not included in these calculations.

Program staff also attempted to process August/September 2007 and August/September 2008 CIR imagery flown by the Central Platte Natural Resources District (CPNRD) in order to develop a year-to-year sand area comparison. Processing and analysis was not completed due to significant flow variation within and between the two sets of imagery. The CPNRD annual CIR imagery was acquired for the entire district over the course of several weeks and acquisition was not tied to Platte River reference flows. As a result, river flows were highly variable within each imagery set due to precipitation and CNPPID hydropower operations during the acquisition period. Flows also varied from year to year for any given reach of the river. This combination made it impossible to develop a meaningful year-to-year area comparison.

C. Transect Surveys

Following the high flow event, the Program contracted with Olsson Associates and Tagge Engineering to re-survey twelve existing Bureau transects (located in pairs) at six sites in the habitat reach. The transects were last surveyed for the Bureau in 2005 by Eisenbraun and Associates. Tagge Engineering surveyed the three transect pairs in the west half of the reach. Olsson Associates was only able to complete the survey on two of the remaining three transect pairs due to high water downstream of Grand Island.

The Bureau provided the Program with Nebraska State Plane coordinates in NAD83 and elevations in NAVD88 at left and right bank headpins at each of the transects. The contractors recovered the headpins utilizing the Bureau coordinates and completed the surveys with RTK GPS units. Points were captured at the headpins, grade breaks, and edge of water. The contractors provided the Program with processed survey data consisting of spreadsheets with transect stations and corresponding elevations.

The Program also provided funds for the USGS to re-survey three USGS research transect sets. One of those transect sets, located at NPPD's Cottonwood Ranch property, was last surveyed in March of 2008. The remaining two sets, located in the east half of the habitat reach, were last surveyed in August of 2007. A USGS survey crew conducted the survey and provided the Program with pre- and post-high flow survey data as raw points in spreadsheet form. Each of the USGS transect sets include multiple (up to 30) transects located at approximately 60 meter intervals. In order to reduce the volume of data processing, only half of the transects (odd numbered) were processed and used in this analysis. Program staff processed the point data utilizing a Euclidian distance equation to compute the distance to each survey point along transects relative to the left bank headpin coordinates.

The Bureau transect data was surveyed in Imperial units (feet) and the USGS data was surveyed in Metric units (meters). For the sake of consistency, the Bureau transect data was converted to Metric units before proceeding with transect analysis. The first exercise in transect analysis was the development of comparison plots of the pre and post-high flow event transect surveys. Plots of the Bureau transects are located in Appendix B. Plots of the USGS transects are located in Appendix C. Each transect was also analyzed to determine change in minimum, mean, and maximum in-channel elevation as well as difference in total cross section area flow area (difference = pre-event area – post-event area). The results of these analyses are presented in Section IV of this report. The Bureau comparisons are presented numerically due to the small number of transects. The USGS comparisons are presented in graphical form as quartile plots due to the larger number of transects at each transect set location. Please note that the USGS identifies all transects as cross sections and they are referenced by cross section number.

D. Sandbar Surveys

On June 24th through the 26th, Program staff and cooperators conducted an airboat-based sandbar survey within a 300 meter band around accessible Program geomorphology anchor point locations in the habitat reach. At each point, the maximum length, width, and elevation of sandbars with less than 25% vegetative cover were recorded. Photographs were also taken and a temporary benchmark was established for future survey reference. Due to the fact that pre-high flow sandbar survey data is not available and permanent benchmarks with reference elevations have not yet been established at these sites, the value of the sandbar survey is primarily qualitative in nature. Summary sheets for each anchor point survey are presented in Appendix D.

IV. RESULTS

This section of the report presents the results of the observations, data analysis, and comparisons discussed in the previous section. Portions of the analysis like the aerial photography processing and transect survey comparisons have quantitative value. Others, like the visual observations and sandbar survey primarily have quantitative value.

A. Visual Observations of High Flow Event

A photo log documenting channel conditions at the Wyoming Property before, during, and after the May high flow event is included in Appendix A. Visual observations following the event indicate that the high flows increased the areal extent of bare sand on the property. However, the majority of this additional area is in the form of large longitudinal and point bars connected to either the north or south channel bank. An example of a large post-high flow event point bar can be seen along the opposite (south) bank in Photo Log Photograph #4, taken from the airboat ramp.

The managed tern and plover nesting islands on the property were completely or partially inundated for several days during the high flow event. No nests were initiated on the islands prior to or following the event and the inundation did not significantly alter the size or elevation of the islands. New material was deposited around the periphery of the islands but quickly disappeared as the result of lateral erosion.

A photo log of NPPD observation of the high flow event at the Cottonwood Ranch property is included in Appendix A. The observation was conducted on May 25th, 2008 by airboat and November 2008 photos are also included in the photo log for comparison purposes. As the photos demonstrate, flood flows inundated large areas of riparian forest and grassland adjacent to the active channel.

B. Aerial Photography

Bare sand area analysis results for the June 22, 2008 CIR imagery are presented by bridge segment in Table 2. During aerial photography collection, mean Platte River flow was 288 cfs at the Overton gage, 649 cfs at the Kearney gage, and 1,160 cfs at the Grand Island gage. The number and minimum, mean, and maximum area of in-channel sandbars surrounded by water are presented by bridge segment in Table 3. The ratio of in-channel sand bar area to total bare sand within individual bridge segments ranged from 0.03 to 0.47. The highest ratios occurred in bridge segments like Minden to Gibbon and Alda to Highway 281 where in-channel vegetation is mechanically removed on an annual or biennial basis.

The number of in-channel sand bars surrounded by water increases downstream through the habitat reach, with a significantly greater number of bars in the bridge segments downstream of Kearney. The segment with the greatest number of bars is the farthest downstream bridge segment (Highway 34 to Chapman). The segment with the least number of bars is the farthest upstream segment (Lexington to the J-2 Return). Mean bar size in most segments ranged between 1.0 and 1.5 acres. Median bar area was on the order of one acre for most bridge segments.

Table 2 – June 22, 2008 CIR Imagery Bare Sand Analysis by Bridge Segment

Bridge Segment	Approx. Bridge Segment Length (river miles)	Total Bare Sand Area (ac)	Acres of Bare Sand per River Mile	Total Area of In-Channel Bars Surrounded by Water (ac)	Acres of In-Channel Bare Sand per River Mile	Ratio of In-Channel Bar Area to Total Sand Area
Lexington to J-2 Return	4	32.9	8	4.6	1.2	0.14
J-2 Return to Overton	8	200.3	25	5.5	0.7	0.03
Overton to Elm Creek	9	157.7	18	32.1	3.6	0.20
Elm Creek to Odessa	8	213.0	27	54.3	6.8	0.25
Odessa to Kearney	9	215.6	25	25.3	3.0	0.12
Kearney to Minden	8	276.7	37	24.6	3.3	0.09
Minden to Gibbon	6	216.9	36	101.5	16.9	0.47
Gibbon to Shelton	7	224.9	32	81.9	11.7	0.36
Shelton to Wood River	9	239.3	27	39.4	4.4	0.16
Wood River to Alda	5	233.8	47	89.0	17.8	0.38
Alda to Highway 281	7	280.1	40	103.0	14.7	0.37
Highway 281 to Highway 34	7	269.8	39	35.1	5.0	0.13
Highway 34 to Chapman	11	478.3	43	147.5	13.4	0.31

Note: Overton gage flow = 288 cfs, Kearney gage flow = 649 cfs, and Grand Island gage flow = 1,160 cfs

Table 3 – June 22, 2008 CIR Imagery Minimum, Mean, and Maximum In-Channel Sand Bar Area by Bridge Segment

Bridge Segment	Bridge Segment Number	Number of In-Channel Bars Surrounded by Water	Minimum Sand Bar Area (ac)	Mean Sand Bar Area (ac)	Maximum Sand Bar Area (ac)
Lexington to J-2 Return	13	3	0.42	1.54	2.40
J-2 Return to Overton	12	12	0.00	0.46	1.59
Overton to Elm Creek	11	27	0.10	1.19	9.17
Elm Creek to Odessa	10	36	0.06	1.51	7.04
Odessa to Kearney	9	27	0.07	0.94	3.41
Kearney to Minden	8	23	0.19	1.07	3.00
Minden to Gibbon	7	45	0.14	2.26	10.18
Gibbon to Shelton	6	44	0.16	1.86	14.87
Shelton to Wood River	5	35	0.01	1.12	4.04
Wood River to Alda	4	50	0.08	1.78	21.20
Alda to Highway 281	3	71	0.14	1.45	7.66
Highway 281 to Highway 34	2	29	0.08	1.21	4.67
Highway 34 to Chapman	1	106	0.03	1.41	9.25

Note: Overton gage flow = 288 cfs, Kearney gage flow = 649 cfs, and Grand Island gage flow = 1,160 cfs

C. Transect Surveys

1. Bureau of Reclamation Transects

A comparison of September 2005 and June 2008 Bureau transect surveys is presented in Table 4. Transect location figures and plots are located in Appendix B. The 2008 to 2005 transect survey comparison indicates reach-wide thalweg deepening as evidenced by negative changes in minimum channel elevation for seven out of ten transects. In contrast, general increases in average and maximum channel elevations were recorded along with a generally positive difference (difference = 2005 area - 2008 area) in cross sectional flow area. Long-term average annual difference in cross-sectional area of plus or minus approximately one m^2 can be categorized as either aggradational (+) or degradational (-) given that a channel in equilibrium may fluctuate more than one m^2 within a single year and maintain stability (Holburn et al. 2006). Thalweg deepening would be consistent with channel degredation while the positive differences in survey cross section area indicate a stable to aggradational channel.

Table 4 – Bureau of Reclamation Transect Survey Comparison, September 2005 to June 2008

Transect Number	River Mile	Bridge Segment	Change in Minimum Channel Elevation (m)	Change in Average Channel Elevation (m)	Change in Maximum Channel Elevation (m)	Change in Channel Cross Section Area (m^2)
4A-3	227.4	Elm Creek - Odessa	-0.24	0.12	0.21	11.5
4A-2	227.25	Elm Creek – Odessa	0.22	0.03	0.34	2.8
6-4	206.4	Minden – Gibbon	-0.02	0.00	0.00	17.4
6-3	206.2	Minden - Gibbon	-0.13	-0.01	0.05	2.8
8B-3	191.1	Shelton – Wood Riv	-0.15	0.05	-0.01	14.4
8B-2	191.0	Shelton – Wood Riv	0.25	0.20	0.10	24.3
9BW-4	178.32	Alda – Grand Island	-0.29	0.01	0.11	-9.8
9BW-2	178.23	Alda – Grand Island	-0.35	0.06	0.09	-6.9
9BE-7	177.4	Alda – Grand Island	0.07	0.18	-0.15	4.6
9BE-2	177.15	Alda – Grand Island	-0.62	0.06	-0.07	2.3

2. United States Geological Survey Transects

The USGS transects have been divided into five subsets located in a total of three geographic locations. The first three subsets are located within the NPPD Cottonwood Ranch property in the Overton to Elm Creek bridge segment. NPPD is actively widening the channel and augmenting sediment in the central portion of the property. The first USGS transect subset, labeled Cottonwood Input, is located upstream of the widening and augmentation activities. The second subset, labeled Cottonwood Managed, is located in the area being widened and where site-specific sediment augmentation is occurring. The third subset, Cottonwood Output, is located downstream of the widening and augmentation activities. The fourth set is located within Audubon Rowe Sanctuary in the Minden to Gibbon bridge segment. The fifth is located on the Platte River Whooping Crane Maintenance Trust Uridil Property in the Shelton to Wood River bridge segment.

The general transect survey dates for the Cottonwood Ranch transect comparison are March 2008 and June 2008. The general transect survey dates for the Rowe and Uridil transect comparison are August 2007 and June 2008. A comparison of the transect surveys is presented below in Figures 11 -14. Transect location figures and plots are located in Appendix C. The comparison results for all transect subsets are presented as quartile plots that include minimum, 25th percentile, median, 75th percentile, and maximum values of individual cross section comparisons within the subset. With the exception of the Cottonwood Downstream subset, the comparison indicates thalweg deepening as evidenced by generally negative changes in minimum channel elevation. In contrast, general increases in average and maximum channel elevations were recorded along with a generally positive difference (difference = 2007 area - 2008 area) in cross sectional flow area. Long-term average annual difference in cross-sectional area of plus or minus approximately one m^2 can be categorized as either aggradational (+) or degradational (-) given that a channel in equilibrium may fluctuate more than one m^2 within a single year and maintain stability (Holburn et al. 2006). Thalweg deepening would be consistent with channel degredation while the positive difference in survey cross section areas indicates a stable to aggradational channel.

Figure 11 – USGS Transect Survey Comparison - Change in Minimum Transect Elevation

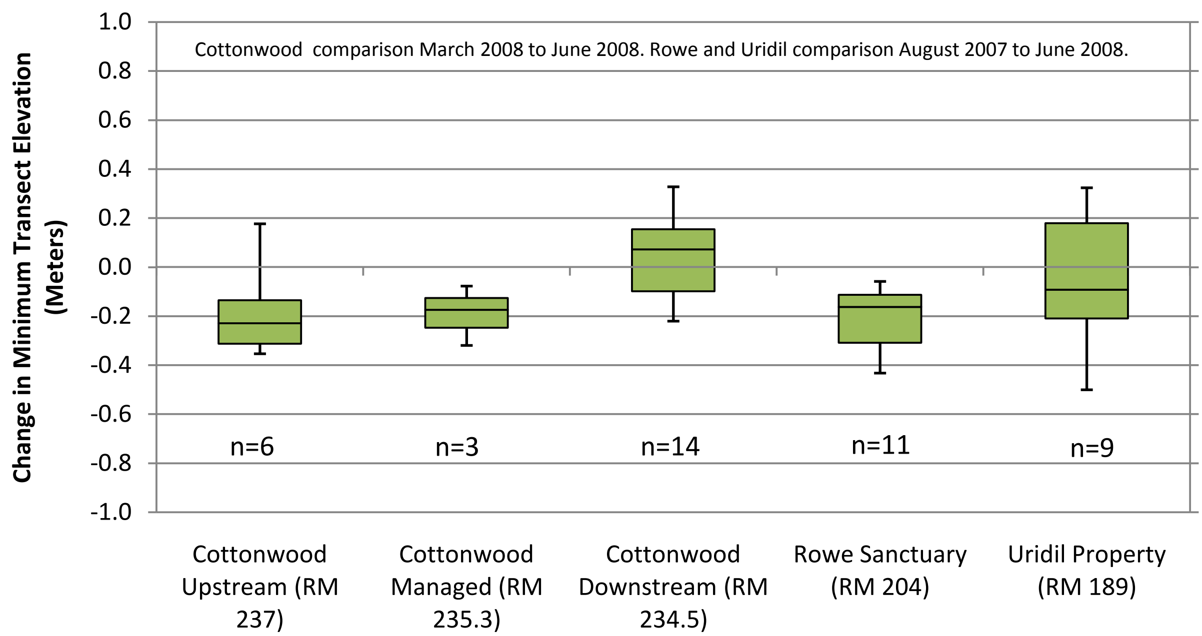


Figure 12 – USGS Transect Survey Comparison - Change in Mean Transect Elevation

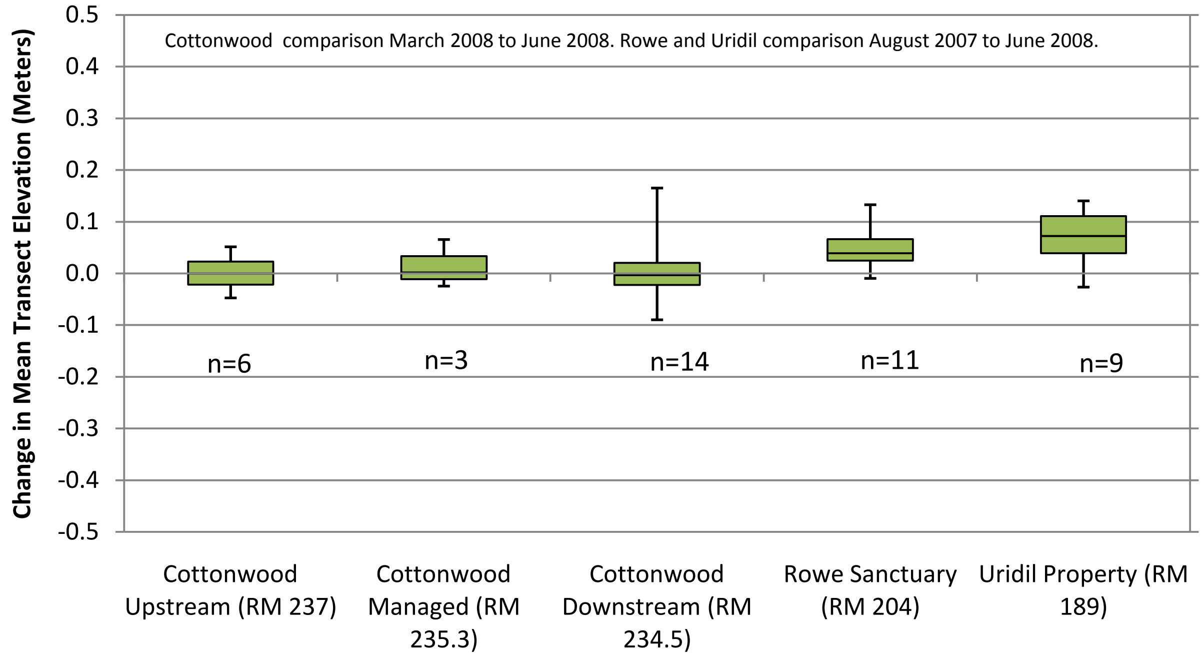


Figure 13 – USGS Transect Survey Comparison - Change in Maximum Transect Elevation

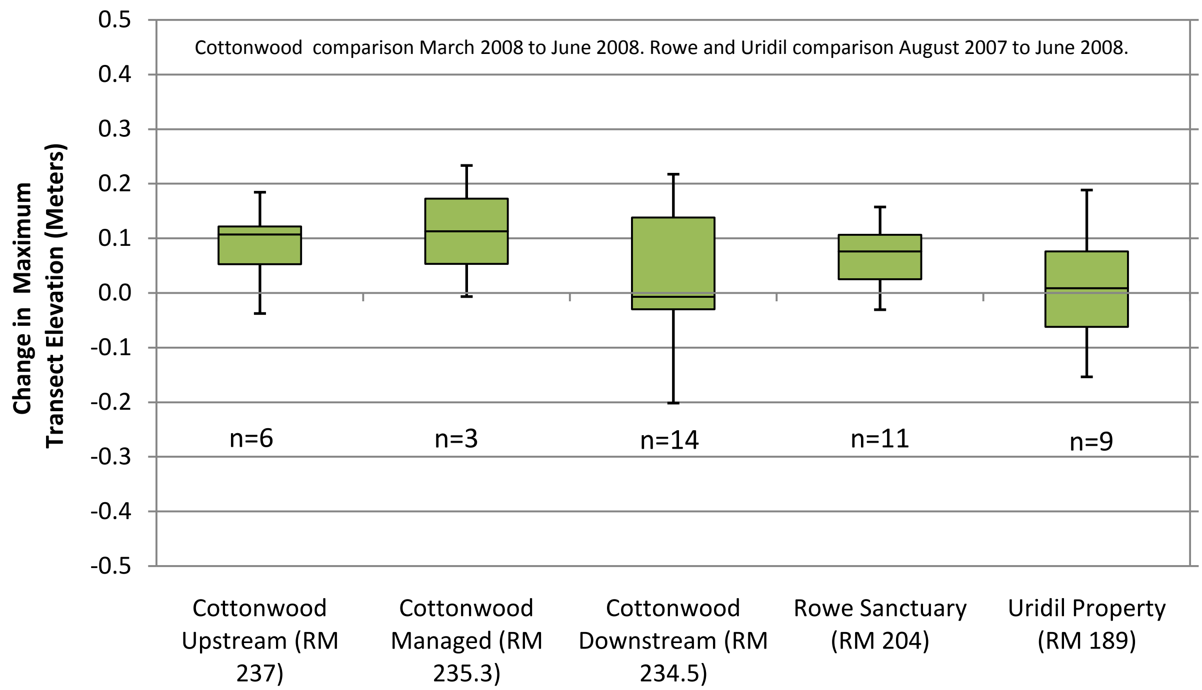
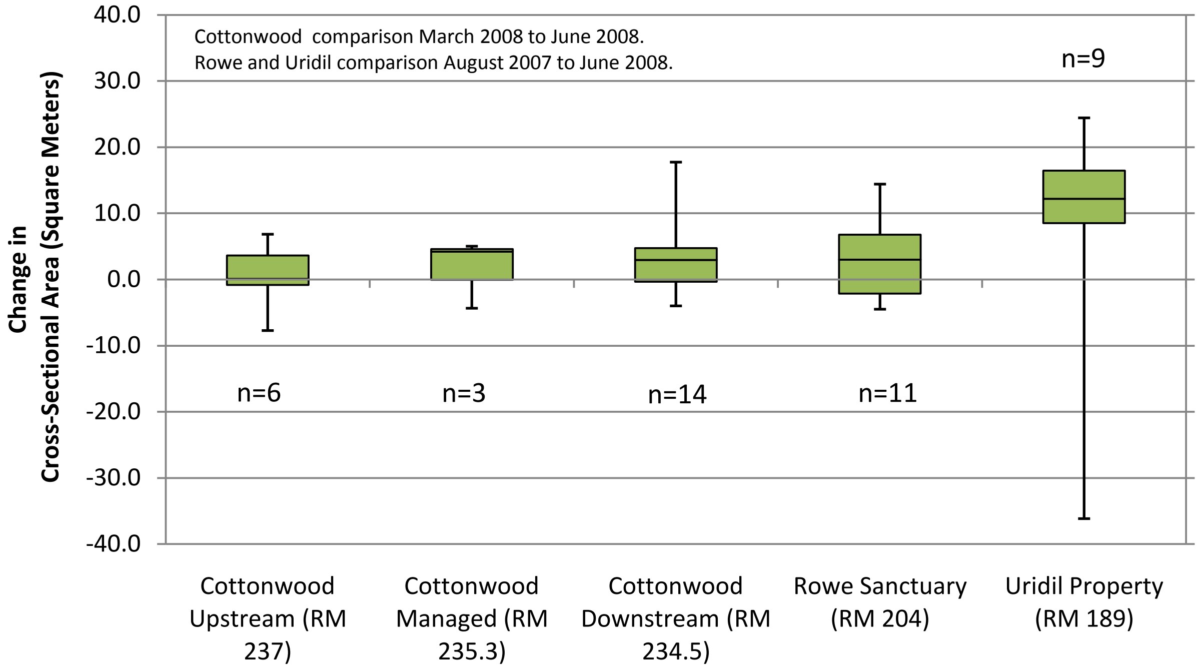


Figure 14 – USGS Transect Survey Comparison - Change in Transect Cross-Sectional Area



D. Sandbar Surveys

Summary sheets for each anchor point survey are located in Appendix D. In general, personnel conducting the surveys observed more and larger sandbars as they moved east down the river through the habitat reach. This corresponded with intermittently wider channel widths in the eastern half of the habitat reach, especially where organizations like the Audubon Society and Platte River Whooping Crane Maintenance Trust actively manage the channel through mechanical vegetation removal.

V. CONCLUSIONS AND RECOMMENDATIONS

This high flow event data collection and analysis effort has been instructive in reinforcing the need for collection of baseline data and continual evaluation of data collection protocols to ensure that they are appropriate and the data is useful. It has also highlighted the potential for data analysis to produce seemingly contradictory results, especially when working with highly variable data represented by spatially or temporally limited data sets. The following conclusions highlight these challenges and the recommendations look to translate the "lessons learned" into more focused future data collection efforts.

A. Conclusions

The May natural high flow event occurred during the preferred USFWS channel maintenance pulse flow date range and exceeded the NWS flood stage throughout the habitat reach. This leads us to conclude that, although appropriately timed, this event exceeds the maximum pulse flow release that could be accomplished by the Program during the First Increment. Accordingly, it provides an indication of the upper limit of the Program's ability to influence channel morphology and in-channel bare sand area via pulse flows under existing river conditions and in the absence of larger-scale sediment augmentation and flow consolidation actions.

As discussed in Section IV, the transect survey analysis indicates post-event reach-wide thalweg deepening. This contrasts with a stable to aggrading general channel cross section as indicated by positive changes in average channel elevation, maximum channel elevation, and cross section area. For most transects, these channel changes were not significant enough to be easily observable on-site or in a 2007-to-2008 comparison of aerial photography. Though this dataset is limited in scope, the lack of significant cross section changes (like island scouring and building of new in-channel bar features) related to this magnitude of flow appears to reinforce the need for the clearing and leveling component of the flow-sediment-mechanical management strategy.

It is difficult to develop conclusions about the effects of the high flow event based on the aerial photography analysis or sandbar surveys given the lack of usable pre-event data. In the case of sandbar surveys, the Program's geomorphology and in-channel vegetation monitoring is expected to serve as a baseline for future analysis of system-scale effects of pulse flows on channel form and in-channel vegetation. The attempt to compare annual CPNRD CIR imagery series to Program CIR imagery flown after the high flow event uncovered several limitations in the usefulness of the CPNRD dataset for Program analysis of in-channel bare sand area. These limitations were not related to data quality but were a by-product of collection duration and timing. The Program post-high flow event CIR imagery proved to be very valuable and could serve as a baseline for analysis of future imagery collected during the tern and plover nesting season.

Although we are not able to develop conclusions, we can present general observations relating to the sandbar surveys and aerial photography analysis. In general, post-high flow event bare sand area increased downstream through the upper half of the habitat reach and was fairly consistent through the lower portion of the habitat reach. The proportion of the total bare sand area in the form of islands or bars surrounded by water was highest in bridge segments like Minden to Gibbon and Alda to Highway 281 where in-channel vegetation is mechanically removed on an annual or biennial basis.

B. Recommendations

The high flow event data gathering and analysis provides valuable to the Program as we look toward refining existing monitoring protocols and initiating annual in-channel geomorphology and vegetation monitoring. The following recommendations were developed based on issues and opportunities that were identified during this effort:

- Permanent, recoverable benchmarks and transect headpins need to be established at each anchor point location. Without them, it will be difficult to produce accurate and repeatable survey results.
- The in-channel geomorphology and vegetation monitoring protocol needs to address the effects of varying river flow (during annual monitoring) in monitoring results and the ability to compare yearly monitoring data.
- The Cottonwood Ranch USGS pre and post-high flow event surveys were conducted immediately before and after the high flow event. As such, this dataset may have additional value for sediment transport modeling analysis.
- The collection of CIR imagery in June was relatively inexpensive ($15,000) and allowed for a comprehensive evaluation of the area of bare sand in the river during the tern and plover nesting season. Collecting this data series annually would be valuable for estimation of available in-channel tern and plover nesting habitat on a yearly basis and for documenting long-term trends. This is also consistent with recent discussions within the Technical Advisory Committee about data needs for use in Program ecological models and relating monitoring data to progress toward meeting management objectives in the Adaptive Management Plan.
- Comparative analysis of annual aerial photography series is complicated by flow variations between individual images in a yearly data set. Aerial photography collection for Program purposes needs to occur during a one or two consecutive day time period.
- Landowners were more likely to allow access for channel surveys if those surveys were conducted by airboat and did not involve traversing private property by truck or all-terrain vehicle. The final geomorphology and vegetation monitoring protocol should take this into account.
- The locations (spatial and temporal) of both Program and non-Program in-channel maintenance and management activities need to be documented on an annual basis in order to be able to separate the effects of mechanical and flow-related channel and/or vegetation changes at Program anchor points.

REFERENCES

Adaptive Management Plan. 2006. Final Platte River Recovery Implementation Program. U.S. Department of the Interior, State of Wyoming, State of Nebraska, State of Colorado.

Holburn, E.R., L.M. Fotherby, T.J. Randle and D. Carlson. 2006. "Trends of aggradation and degradation along the central Platte River: 1985 – 2005". Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group. Denver, Colorado.

Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood-flow frequency: Bulletin 17B of the Hydrology Subcommittee, Office of Water Data Coordination, U.S. Geological Survey, Reston,Va.

Water Plan. 2006. Final Platte River Recovery Implementation Program. U.S. Department of the Interior, State of Wyoming, State of Nebraska, State of Colorado.

APPENDIX A – HIGH FLOW EVENT PHOTO LOGS

Photograph 1 – May 5, 2008 looking south from airboat ramp at west edge of property (650 cfs).

Photograph 2 – May 27, 2008 looking south from airboat ramp at west edge of property (7,770 cfs).

Photograph 3 – June 4, 2008 looking south from airboat ramp at west edge of property (2,840 cfs).

Photograph 4 – June 16, 2008 looking south from airboat ramp at west edge of property (870 cfs).

Photograph 5 – May 2, 2008 looking southeast at managed tern and plover nesting habitat.

Photograph 6 – May 27, 2008 looking southeast managed tern and plover nesting habitat.

Photograph 7 – June 2, 2008 looking southeast at managed tern and plover nesting habitat.

Photograph 8 – June 4, 2008 looking southeast at managed tern and plover nesting habitat.

Photograph 9 – June 16, 2008 looking southeast at managed tern and plover nesting habitat.

North channel of the NPPD Cottonwood Ranch Property, photos taken from the gate on the north side looking south. The total flow at Overton on May 25 was 11,200 cfs with a peak stage of 9.62, flow on the middle channel at Cottonwood Ranch was 7,290 cfs with a peak stage of 8.38. this channel at low flows is actually Spring Creek but connects to the river at higher flows. Max flow of Spring Creek on May 25, 2008 was 475 cfs with a pak stage of 9.62. Peak flows on November 4, 2008 were Overton 636 cfs (stage 3.25), Cottonwood Ranch 548 cfs (stage 4.23) and Spring Creek 36 cfs (stage 3.97). No obvious changes in vegetation, channel width or depth were noted in this channel.

Photograph 1 – May 25, 2008.

Photograph 2 – November 4, 2008.

Main channel Cottonwood Ranch Property River Mile 235 looking west, May 25, 2008 flow 7290 cfs (stage 8.38), November 4, 2008 flow 518cfs (stage 4.23) gauge 0.9 miles downstream. No sandbars were formed that would be exposed at 1200 cfs. No scour of islands with vegetation. Significant bank erosion on north bank that was mechanically modified to be vegetation free and verticle, little or no erosion on south bank, which has not been modified. Picture 4 shows small island that is patch of phragmites roots that was less then 10 feet from bank prior to flow, approximately 40 feet from bank.

Photograph 3 – Main Channel Cottonwood Ranch Property May 25, 2008

Photograph 4 – Main Channel Cottonwood Ranch Property November 4, 2008

Main channel Cottonwood Ranch Property River Mile 234.5 looking west, May 25, 2008 flow 7290 cfs (stage 8.38), November 4, 2008 flow 518cfs (stage 4.23) gauge 0.4 miles downstream. No sandbars were formed that would be exposed at 1200 cfs. No scour of vegetation. May flow totally innudated the east tern and plover island. This island was free of vegetation but suffered no sigficant erosion. Did vegetate within one month of flow. Tern and plover island seen in upper portion of photograph 6 has been disked in October 2008.

Photograph 5 – May 25, 2008.

Photograph 6 – November 4, 2008.

Main channel Cottonwood Ranch Property River Mile 234 looking west, May 25, 2008 flow 7290 cfs (stage 8.38), November 4, 2008 flow 518cfs (stage 4.23) gauge 0.2 miles upstream. No sandbars were formed that would be exposed at 1200 cfs. No scour of vegetation. Did deposit sand on vegetated bars and terraces raising the elevation of those land forms, but not enough to form barren bar.

Photograph 7 – May 25, 2008

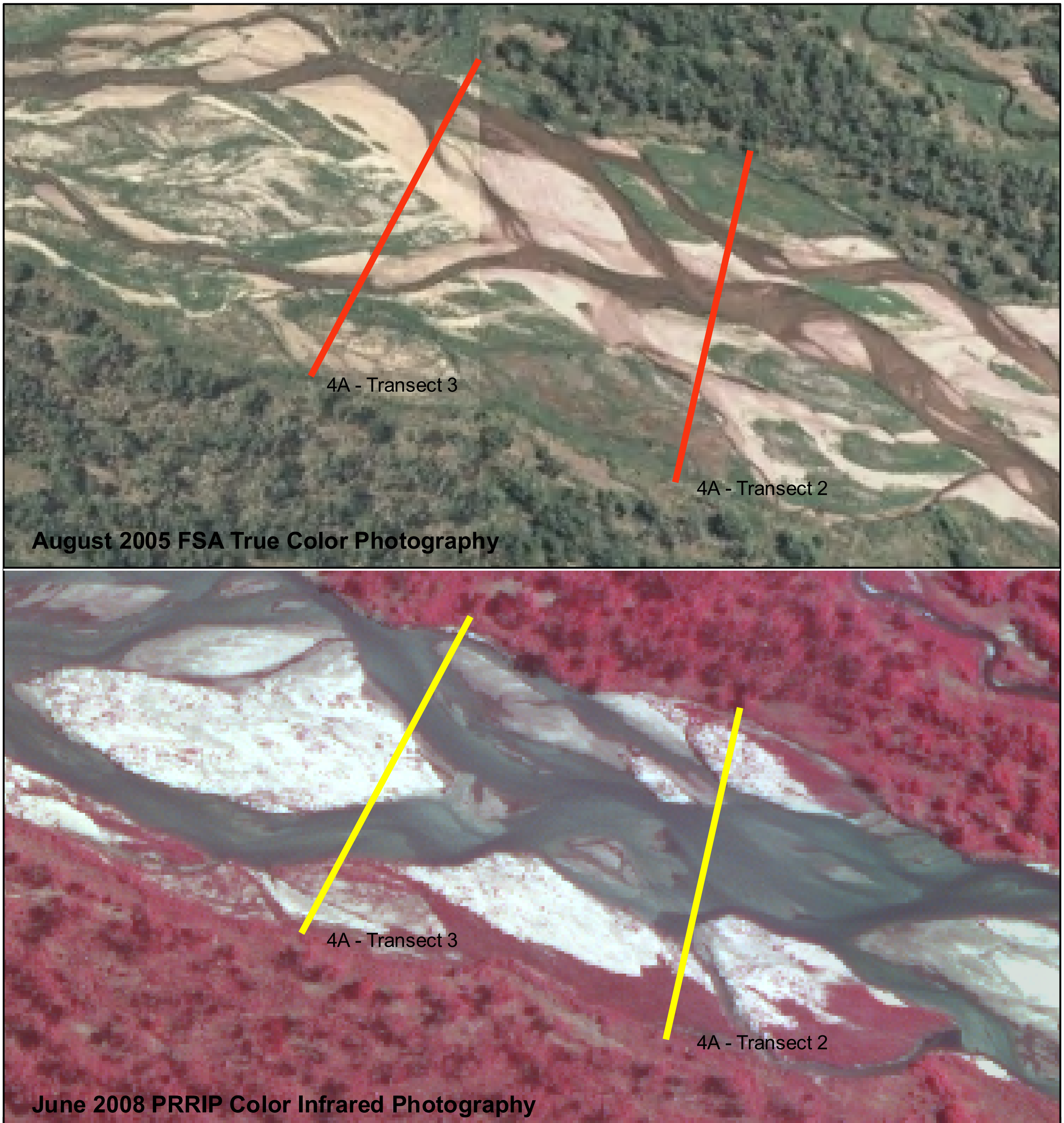
Photograph 8 – November 4, 2008

Man-made channel Cottonwood Ranch Property River Mile 236 looking northwest, May 25, 2008 total flow main channel 7290 cfs (stage 8.38), November 4, 2008 flow 518cfs (stage 4.23) gauge 1.9 miles downstream. Sand from channel was stock piles on banks thinking high flow would erode banks and mobilize sand. Some erosion occurred but much of the material remains and is now vegetated.

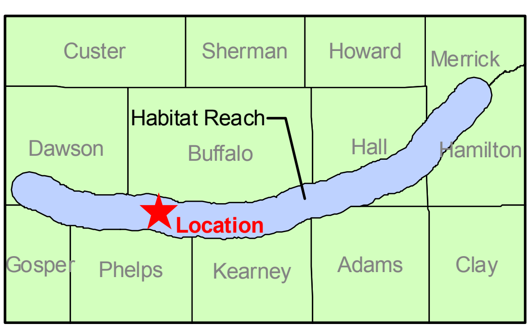
Photograph 9 – May 25, 2008

Photograph 10 – November 4, 2008 looking….

APPENDIX B – BUREAU OF RECLAMATION TRANSECT LOCATION MAPS AND SURVEY PLOTS



PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



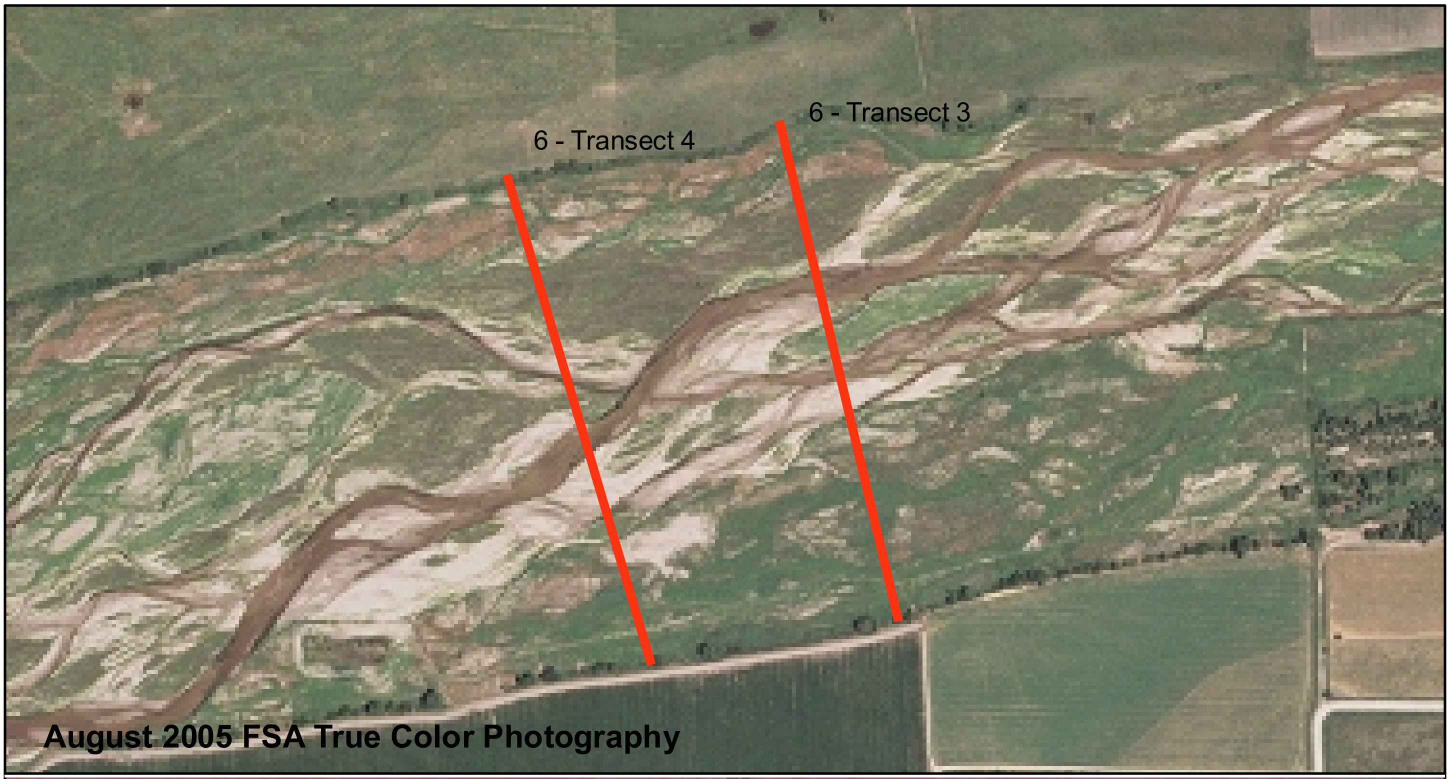
N

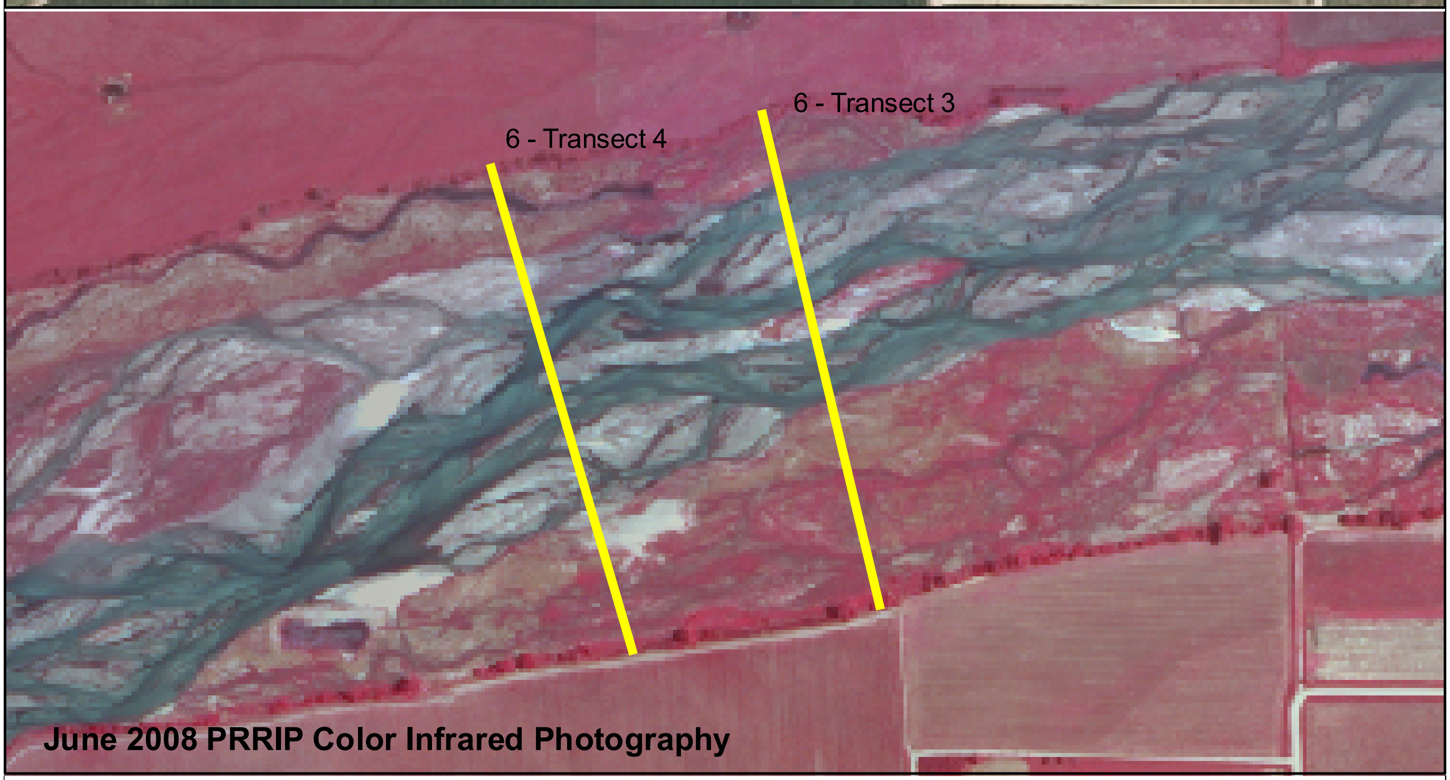
Meters
100

STUDY SITE 4A
TRANSECT LOCATIONS

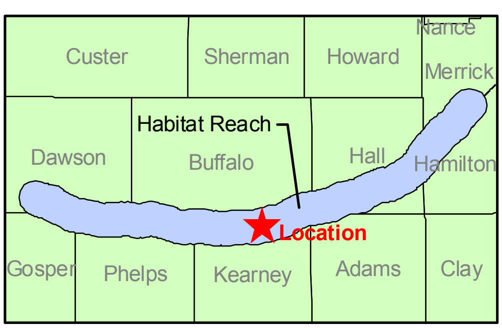
Date: 10/29/08
By: JMF

Figure B-1





PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



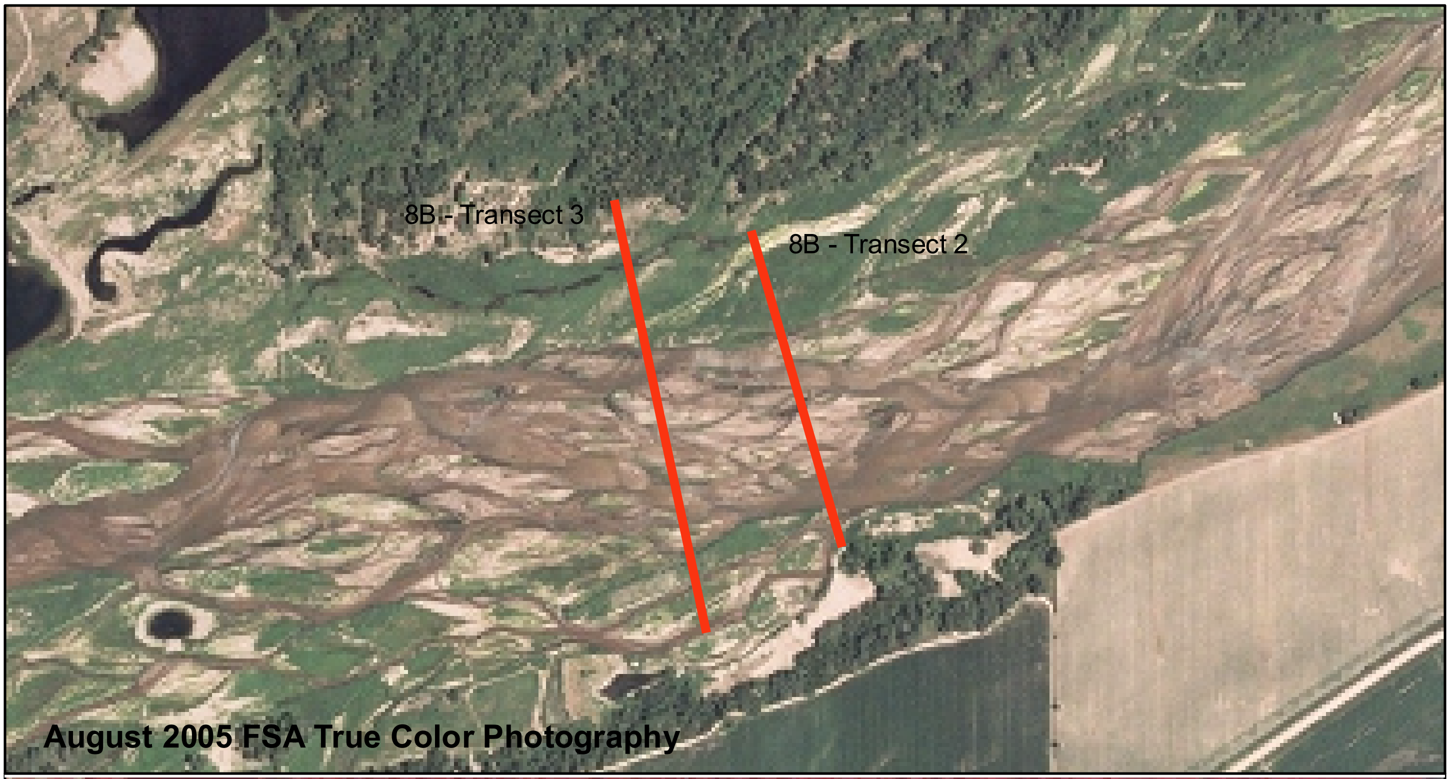
N

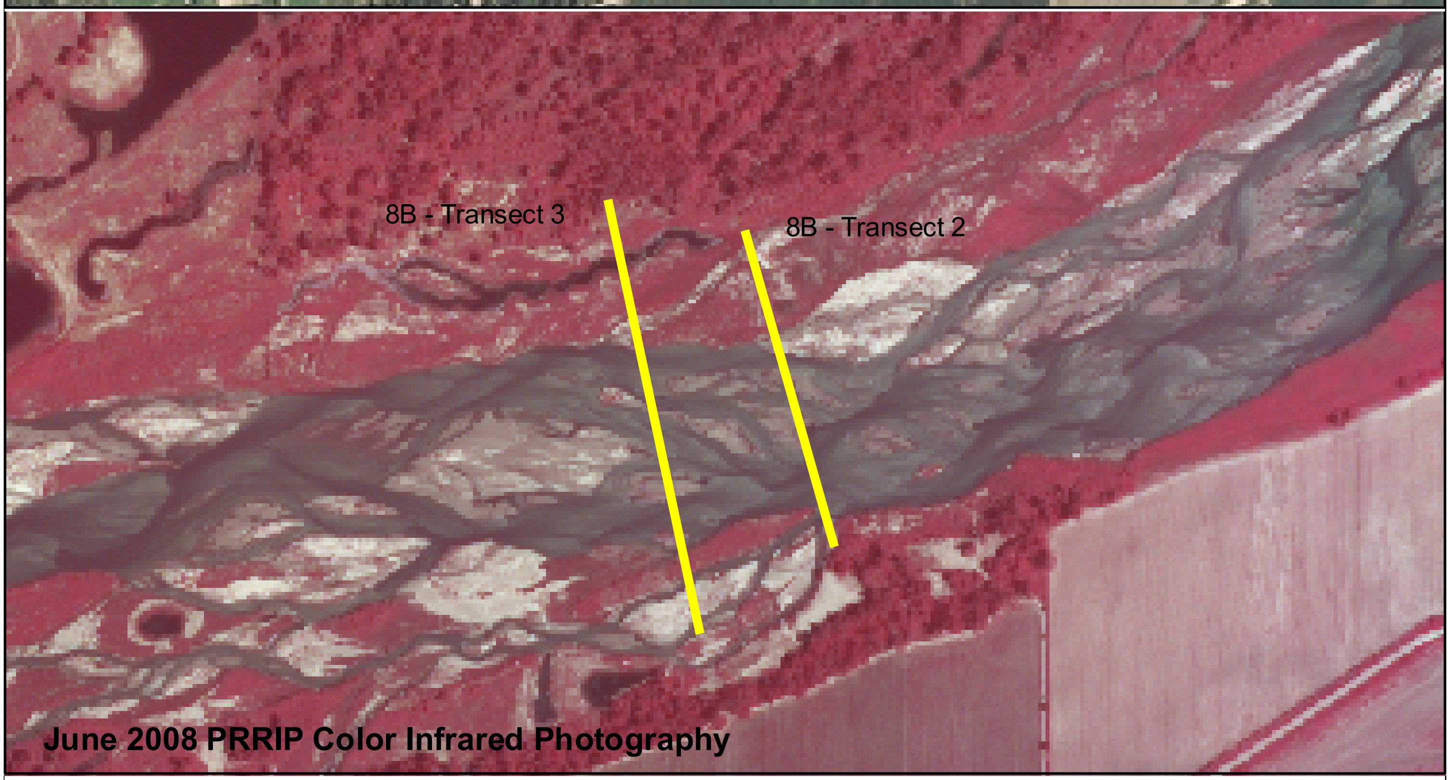
Meters
200

STUDY SITE 6
TRANSECT LOCATIONS

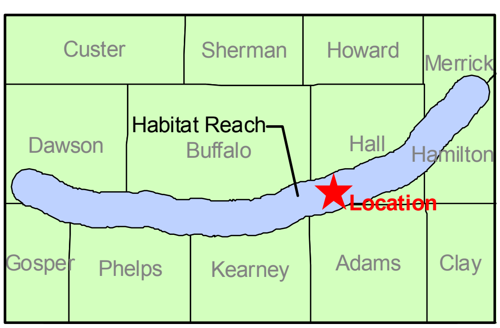
Date: 10/29/08
By: JMF

Figure B-2





PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



N

Meters
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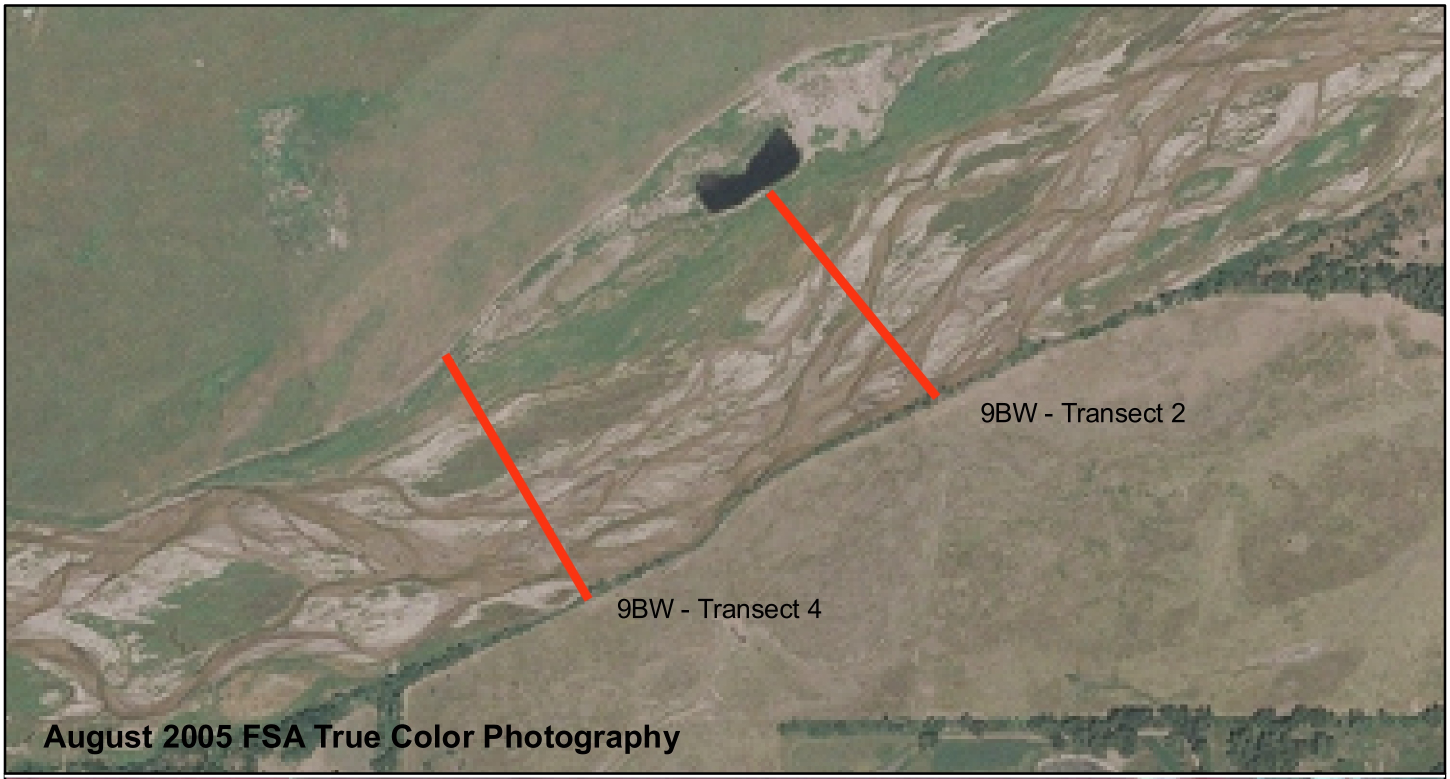
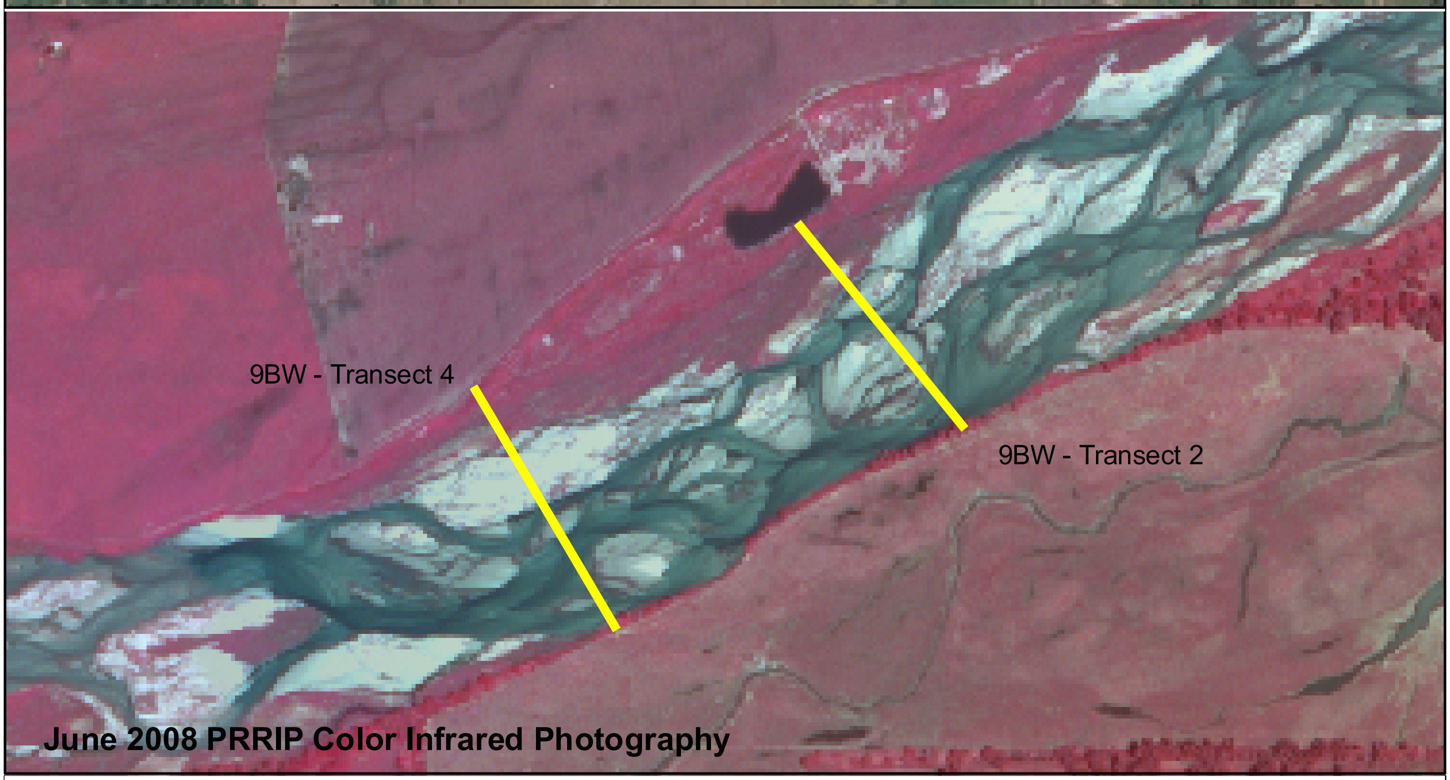
STUDY SITE 8B
TRANSECT LOCATIONS

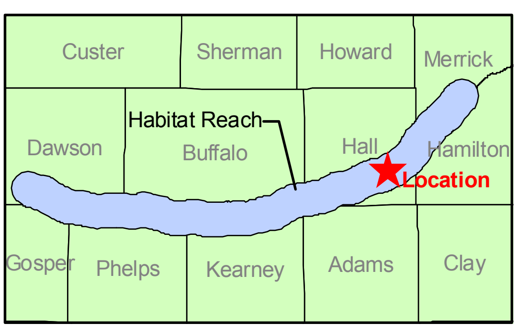
Date: 10/29/08
By: JMF

Figure B-3





PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



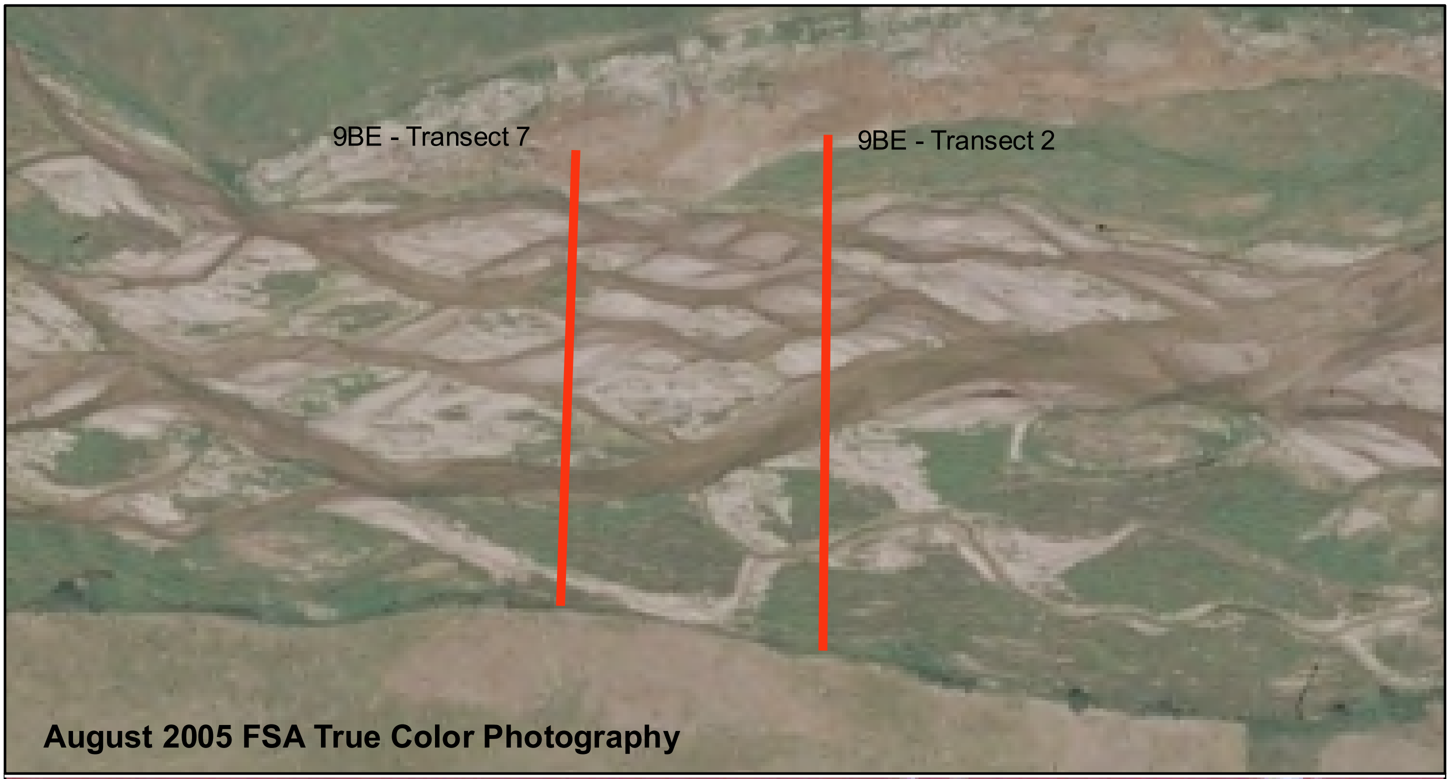
N

Meters
200

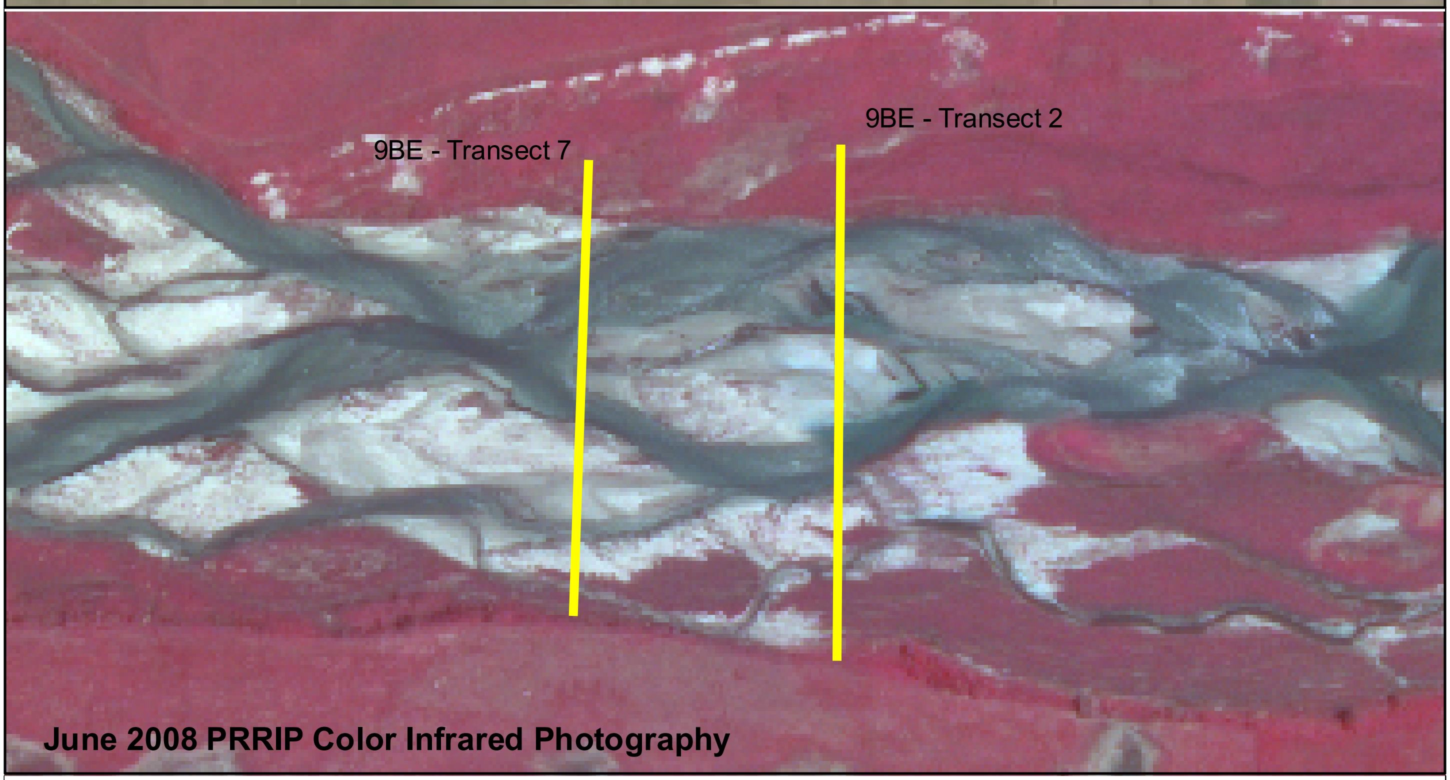
STUDY SITE 9BW
TRANSECT LOCATIONS

Date: 10/29/08
By: JMF

Figure B-4

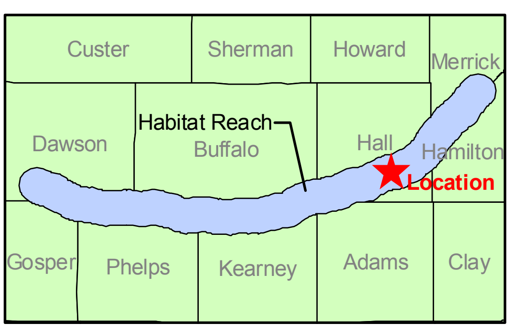


August 2005 FSA True Color Photography



June 2008 PRRIP Color Infrared Photography

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



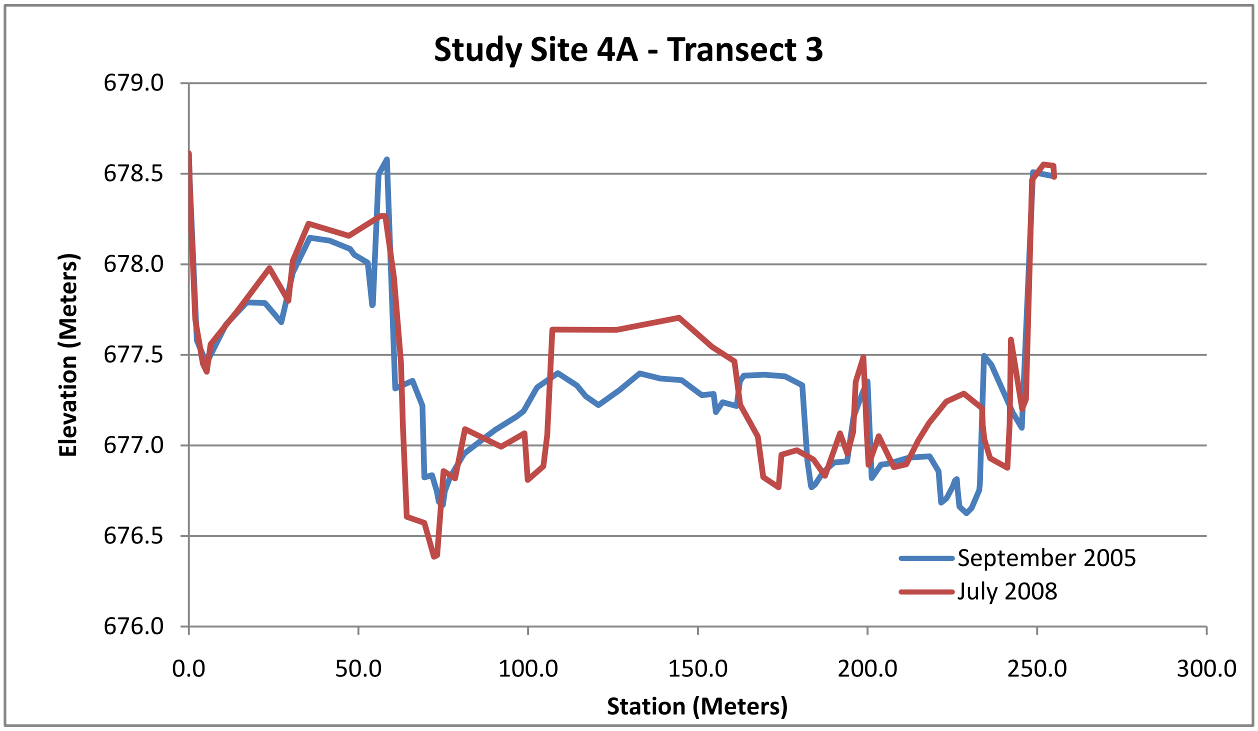
N

100 Meters

STUDY SITE 9BE
TRANSECT LOCATIONS

Date: 10/29/08
By: JMF

Figure B-5



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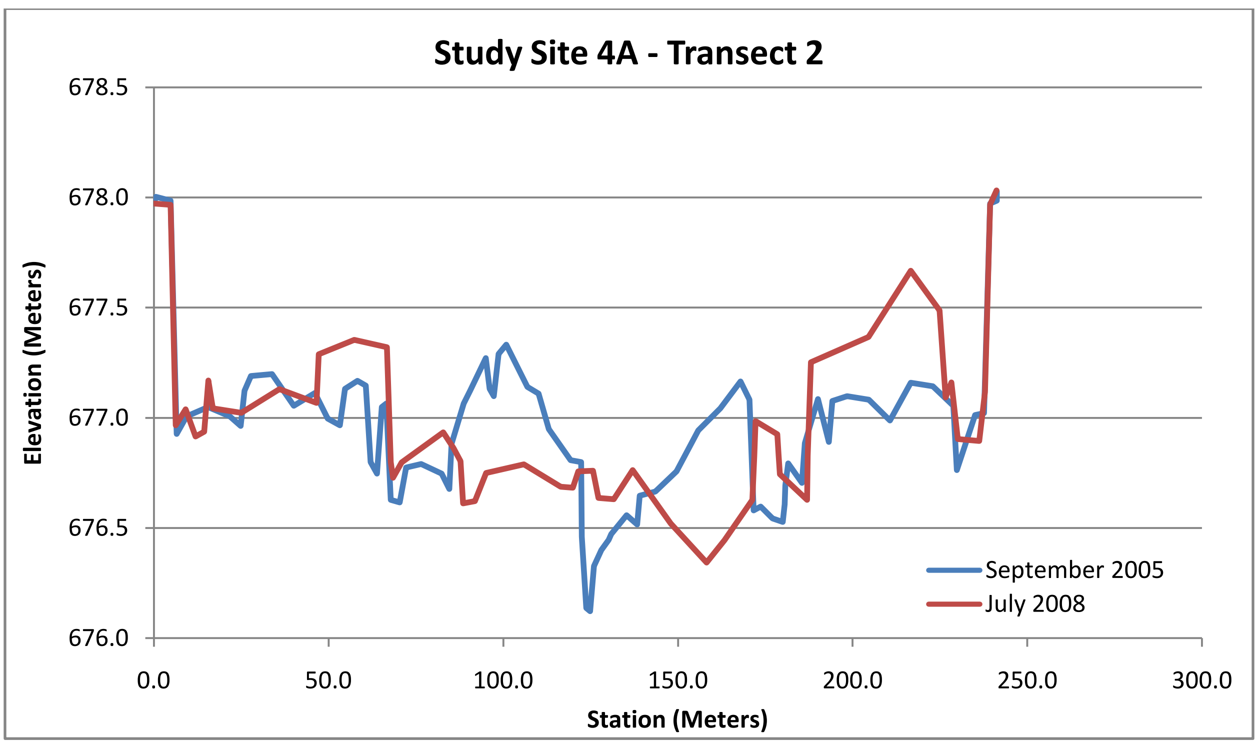
679.0
678.5
678.0
677.5
677.0
676.5
676.0
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Station (Meters)
September 2005
July 2008



Study Site 4A - Transect 2
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678.0
677.5
677.0
676.5
676.0
Elevation (Meters)
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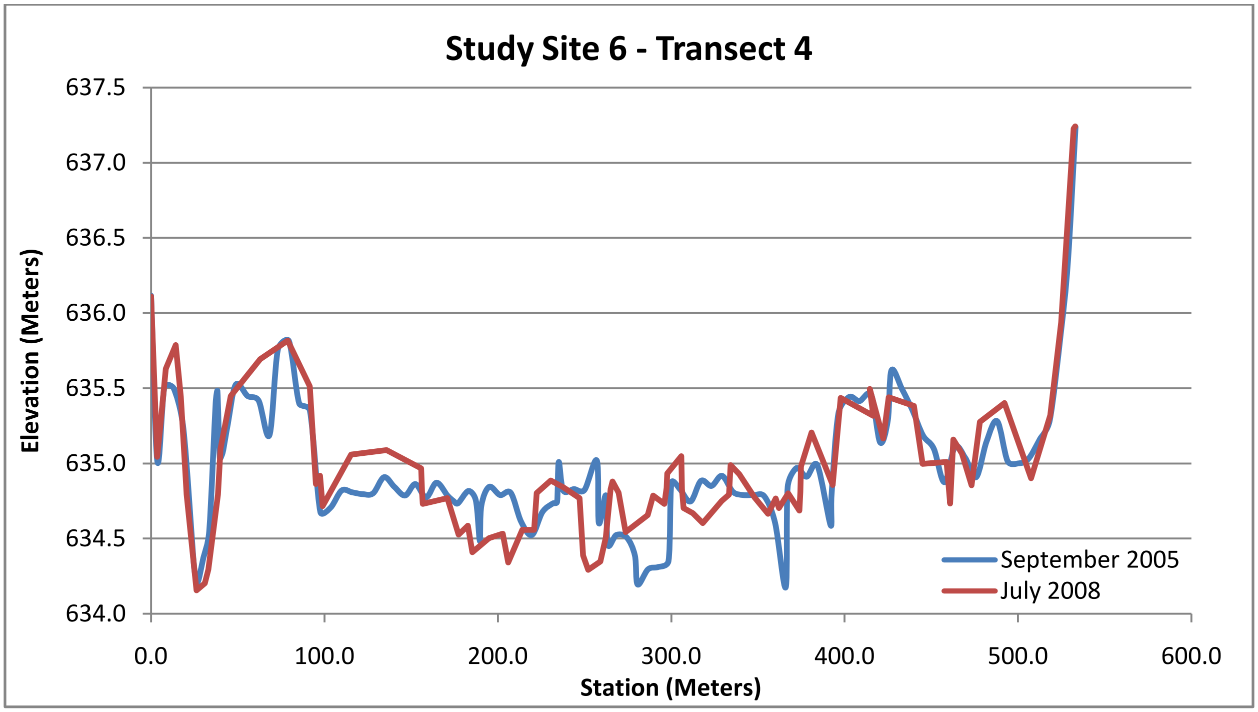
100.0
150.0
200.0
250.0
300.0
Station (Meters)
September 2005
July 2008


Study Site 6 - Transect 4
Elevation (Meters)
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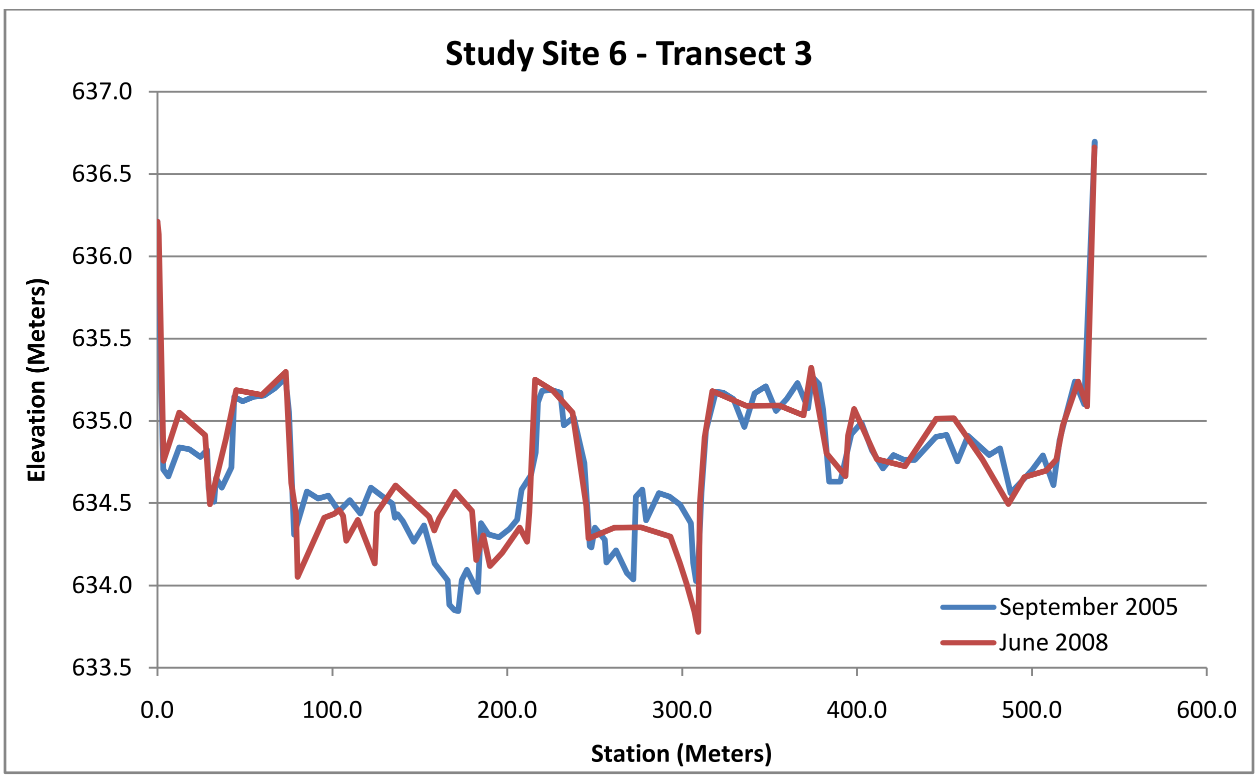
637.0
636.5
636.0
635.5
635.0
634.5
634.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Station (Meters)
September 2005
July 2008


Study Site 6 - Transect 3
Elevation (Meters)
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636.0
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635.0
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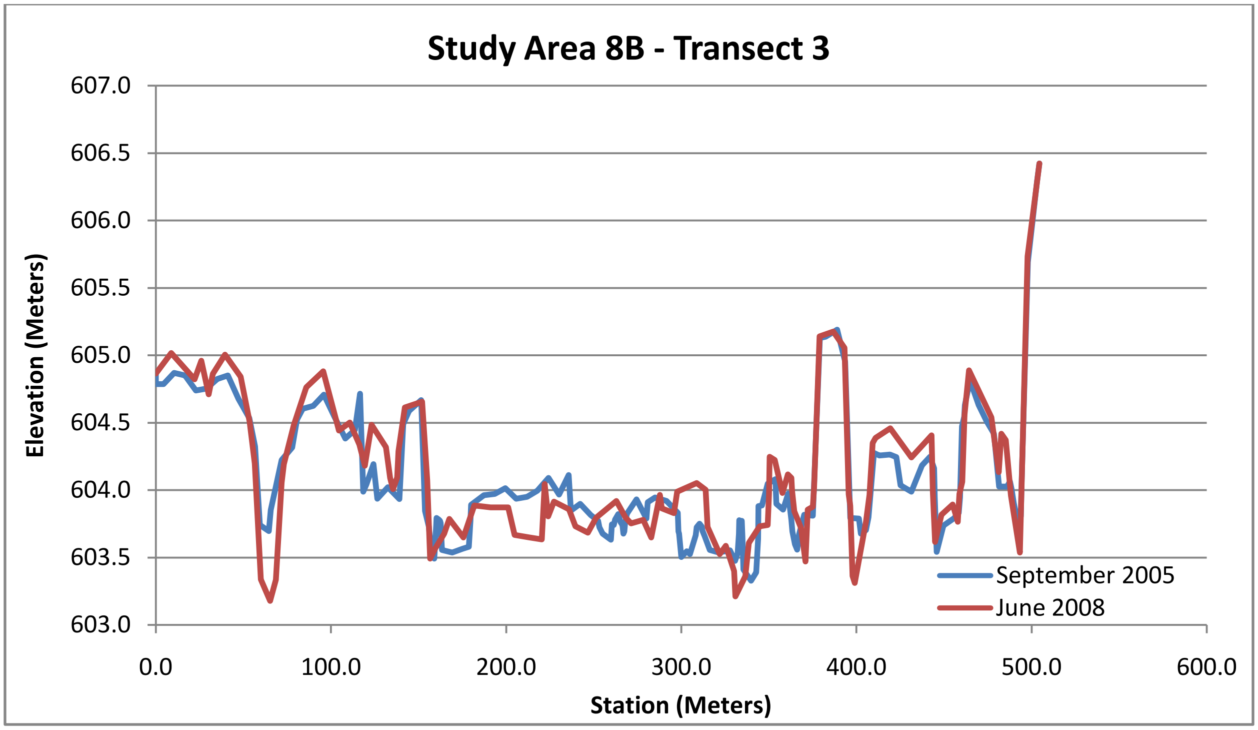
200.0
300.0
400.0
500.0
600.0
Station (Meters)
September 2005
June 2008


Study Area 8B - Transect 3
Elevation (Meters)
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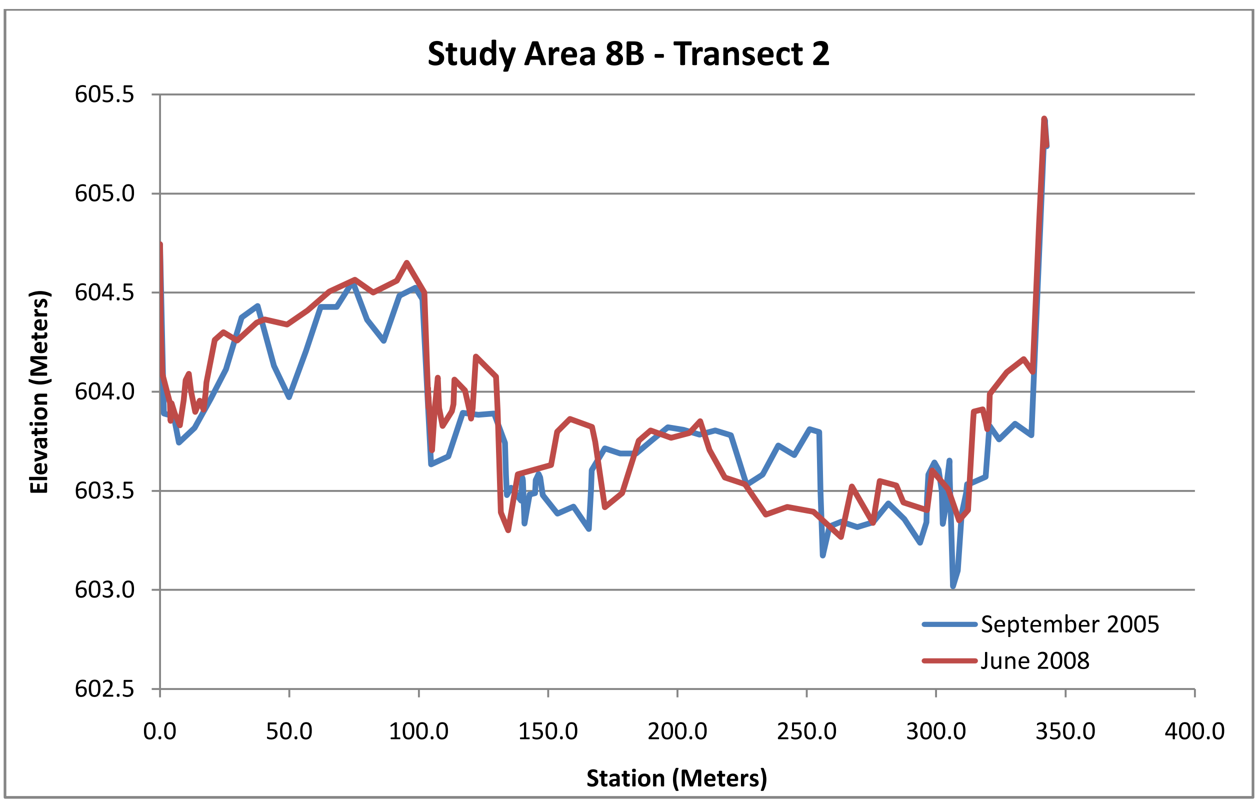
606.5
606.0
605.5
605.0
604.5
604.0
603.5
603.0
0.0
100.0
200.0
300.0
400.0
500.0
600.0
Station (Meters)
September 2005
June 2008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Elevation (Meters)
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604.5
604.0
603.5
603.0
602.5
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100.0
150.0
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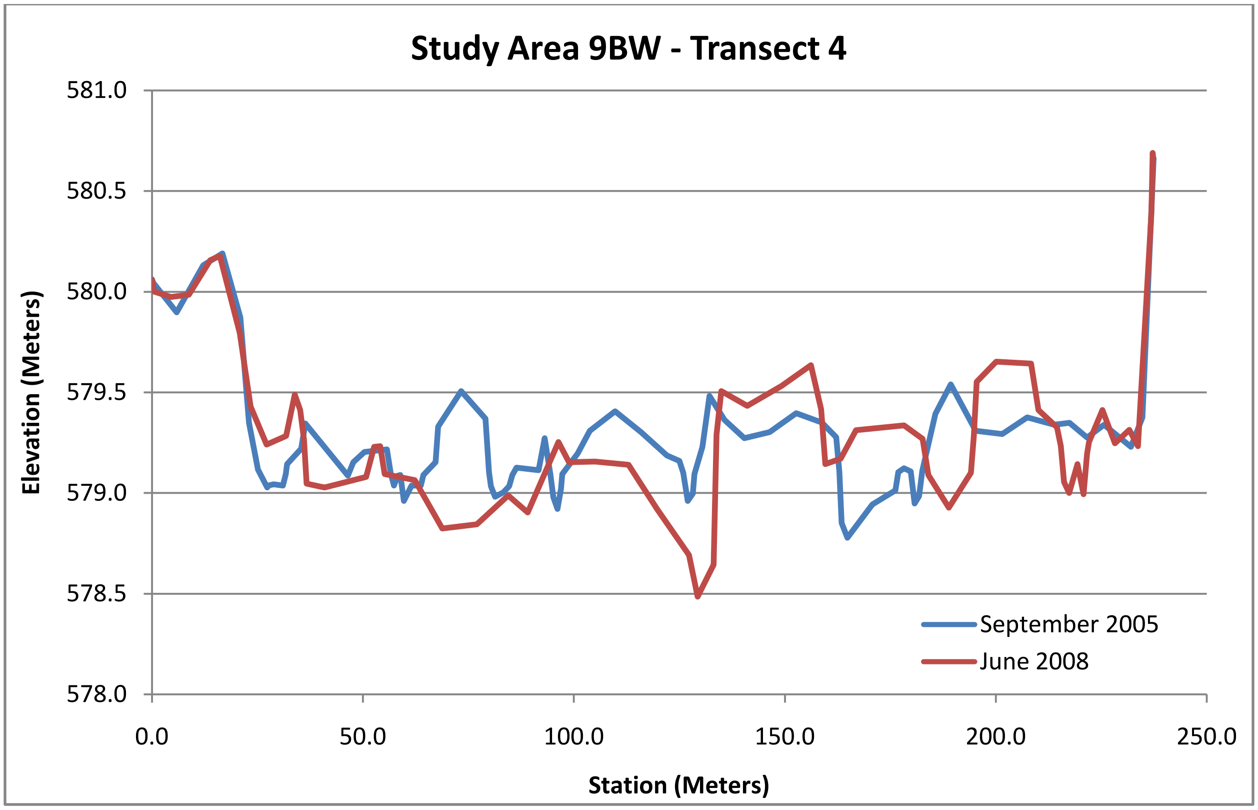
250.0
300.0
350.0
400.0
Station (Meters)
September 2005
June 2008


Study Area 9BW - Transect 4
Elevation (Meters)
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580.0
579.5
579.0
578.5
578.0
0.0
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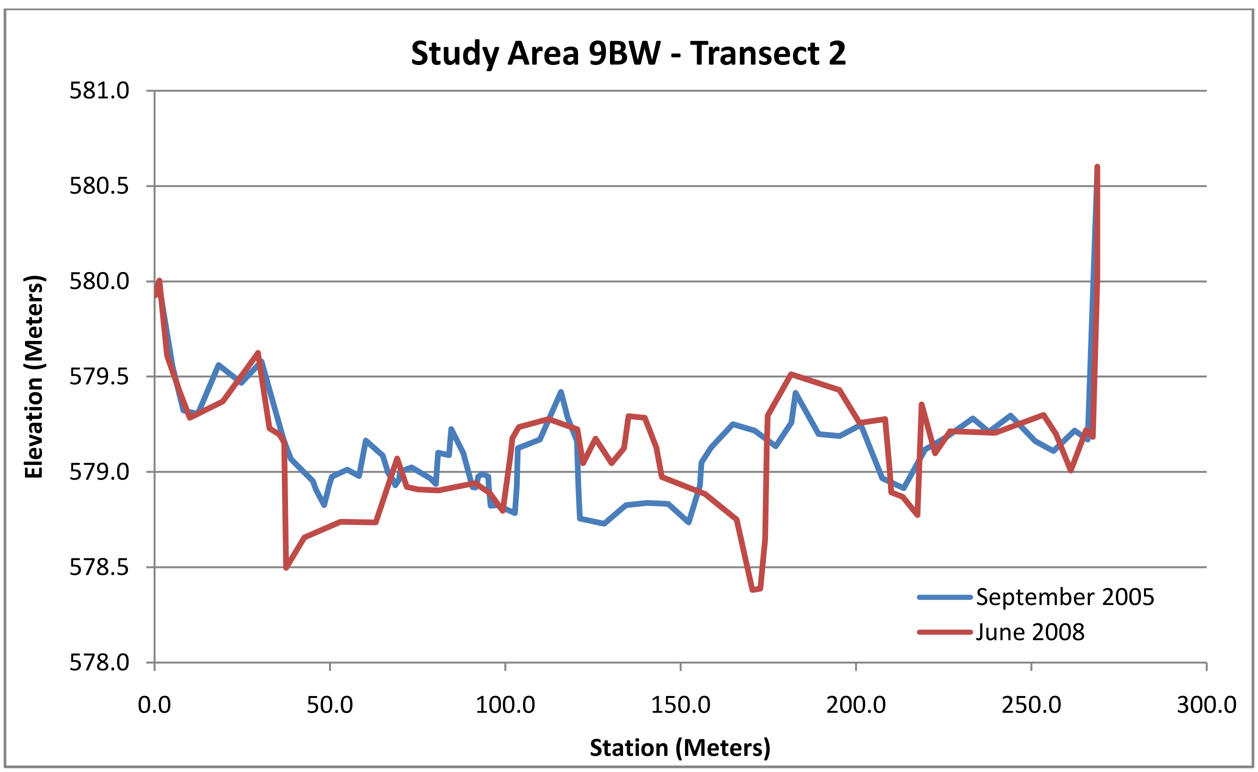
100.0
150.0
200.0
250.0
Station (Meters)
September 2005
June 2008


Study Area 9BW - Transect 2
Elevation (Meters)
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580.0
579.5
579.0
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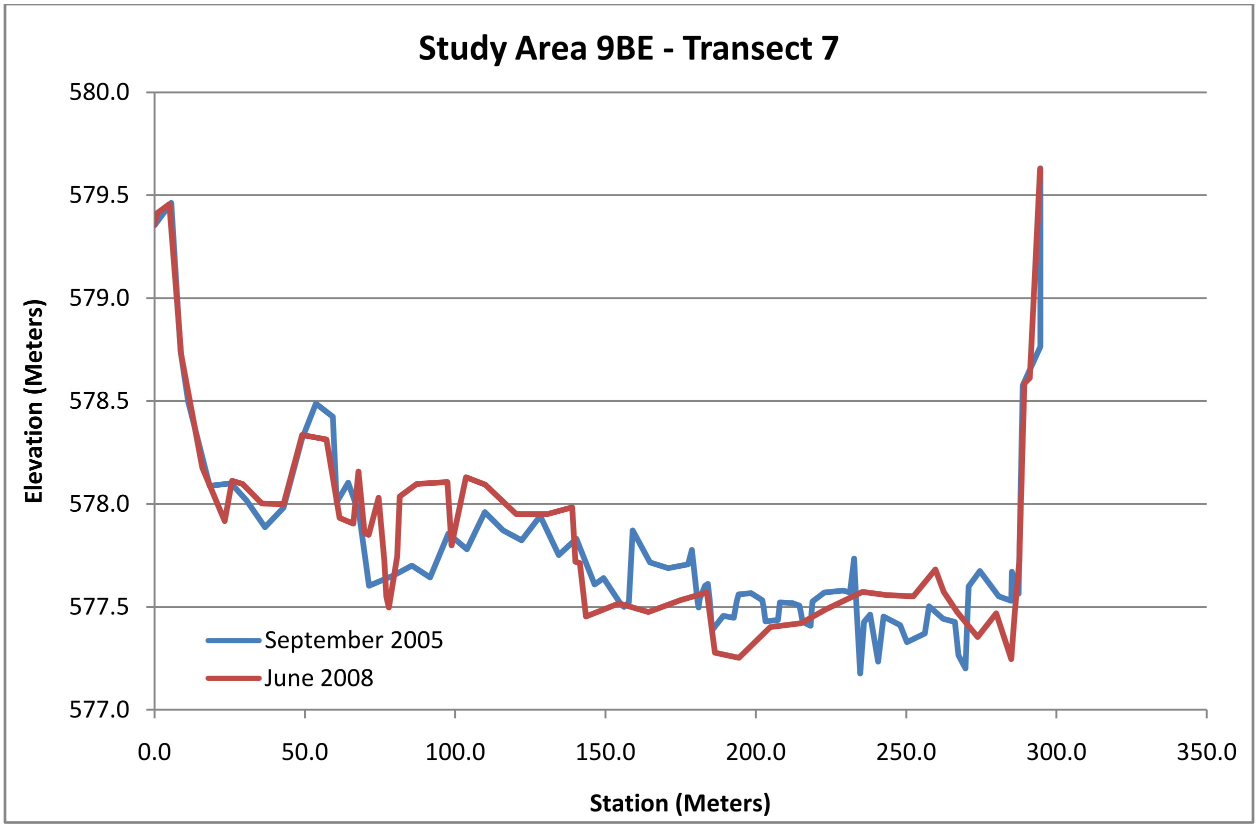
150.0
200.0
250.0
300.0
Station (Meters)
September 2005
June 2008


Study Area 9BE - Transect 7
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579.0
578.5
578.0
577.5
577.0
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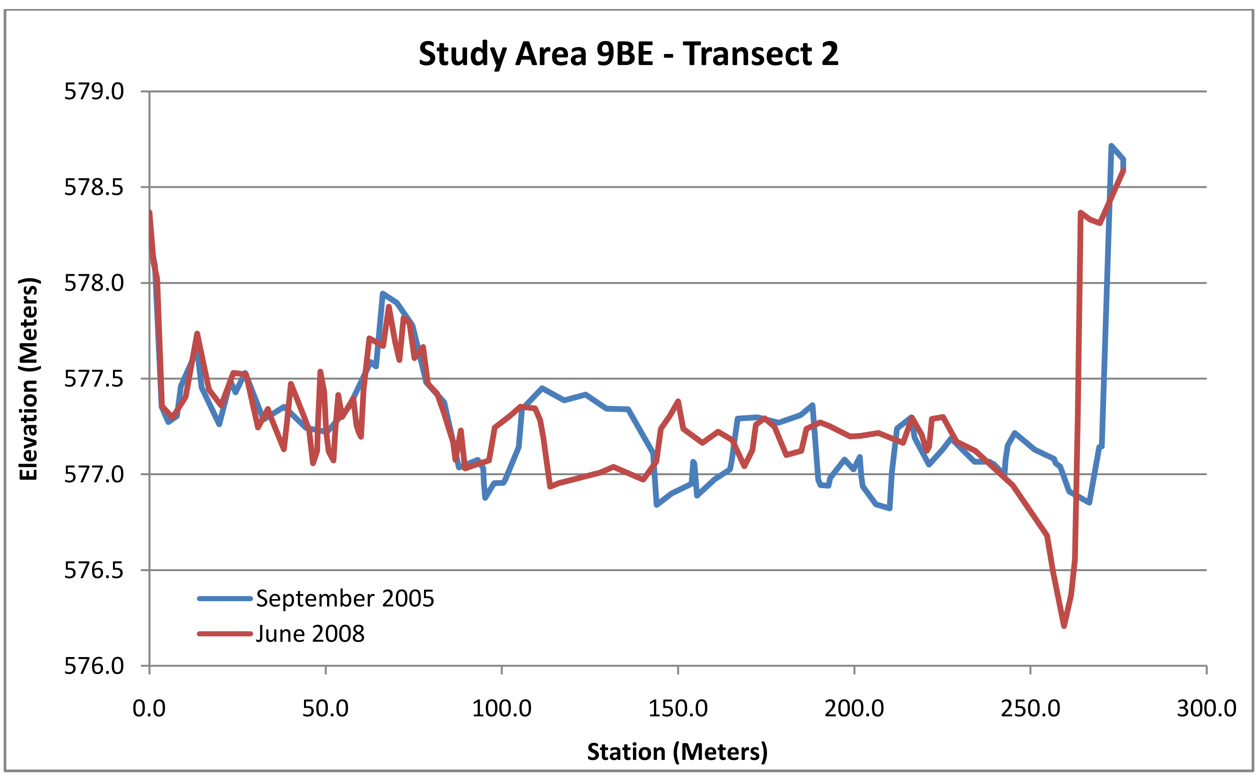
100.0
150.0
200.0
250.0
300.0
350.0
Station (Meters)
September 2005
June 2008


Study Area 9BE - Transect 2
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578.5
578.0
577.5
577.0
576.5
576.0
Elevation (Meters)
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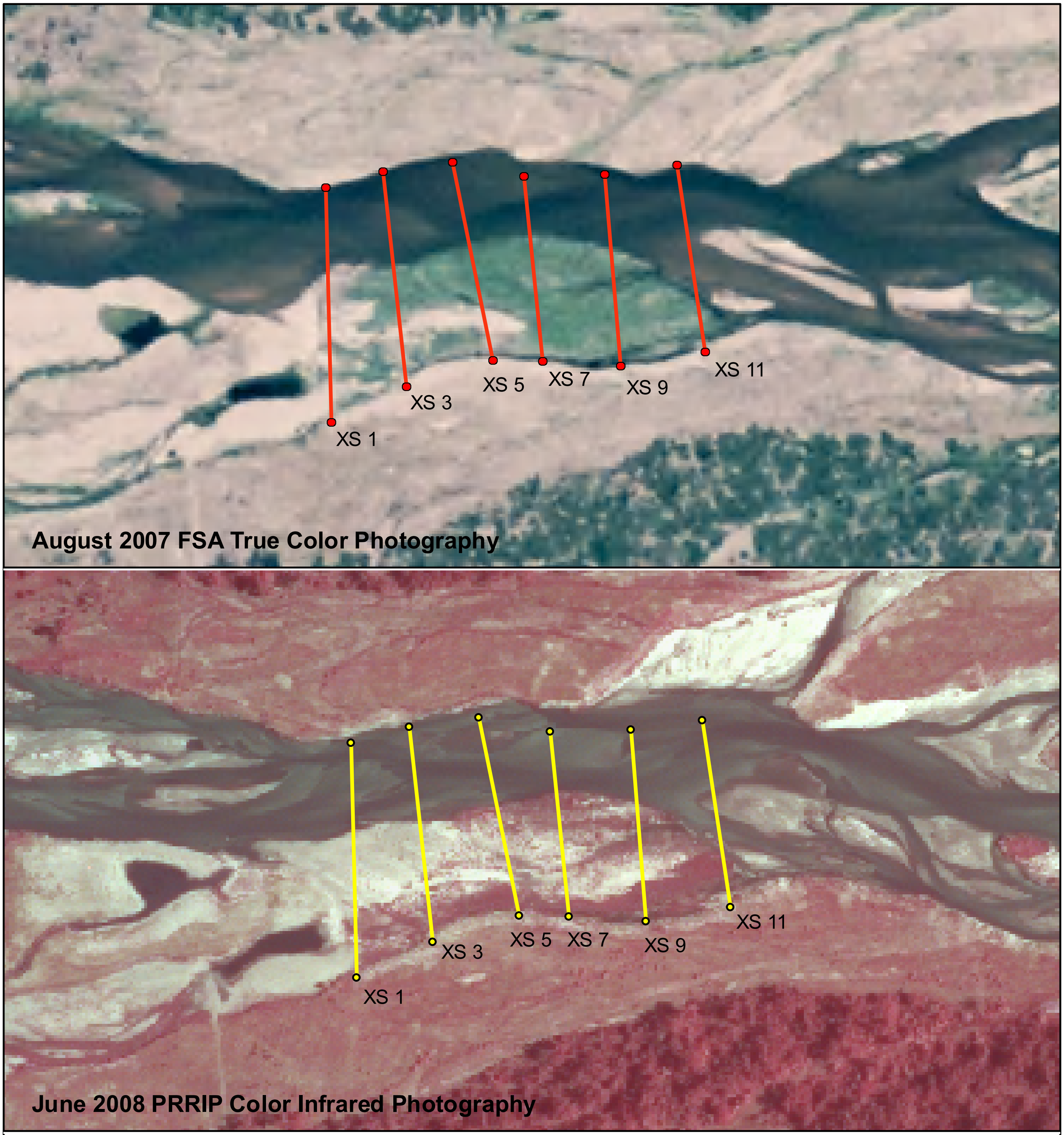
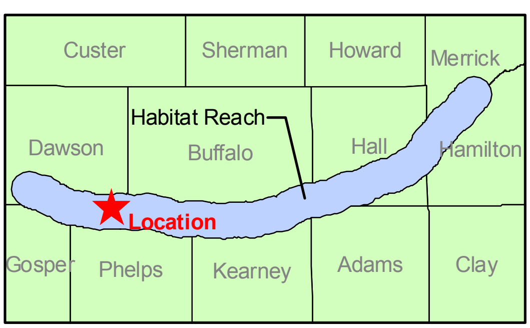
50.0
100.0
150.0
200.0
250.0
300.0
Station (Meters)
September 2005
June 2008

APPENDIX C – USGS TRANSECT LOCATION MAPS AND SURVEY PLOTS



PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



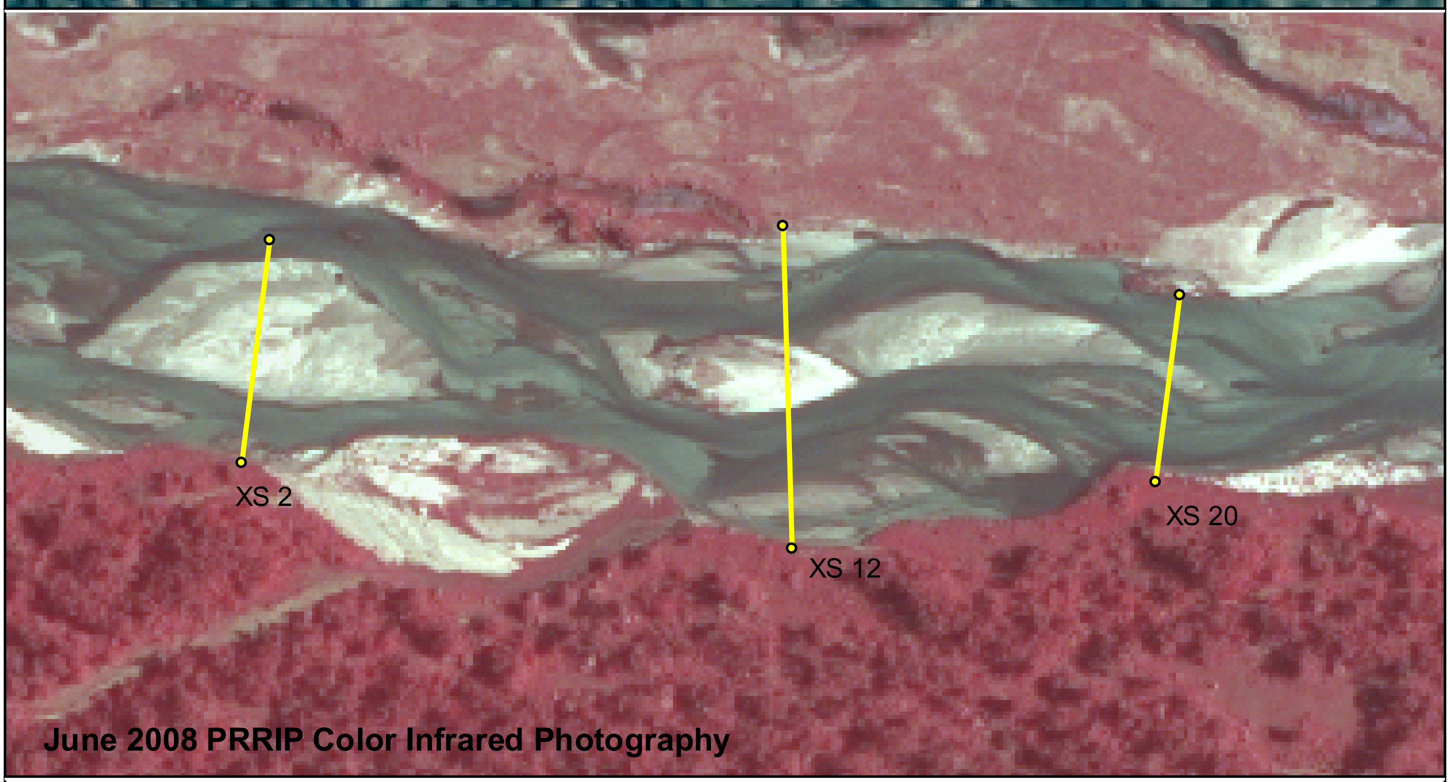
N

Meters
100

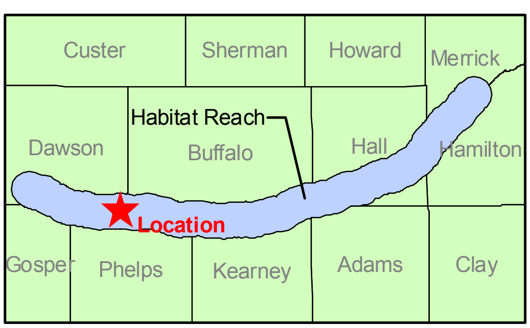
COTTONWOOD RANCH
INPUT REACH
TRANSECT LOCATIONS

Date: 10/29/08
By: JMF

Figure C-1



PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



N

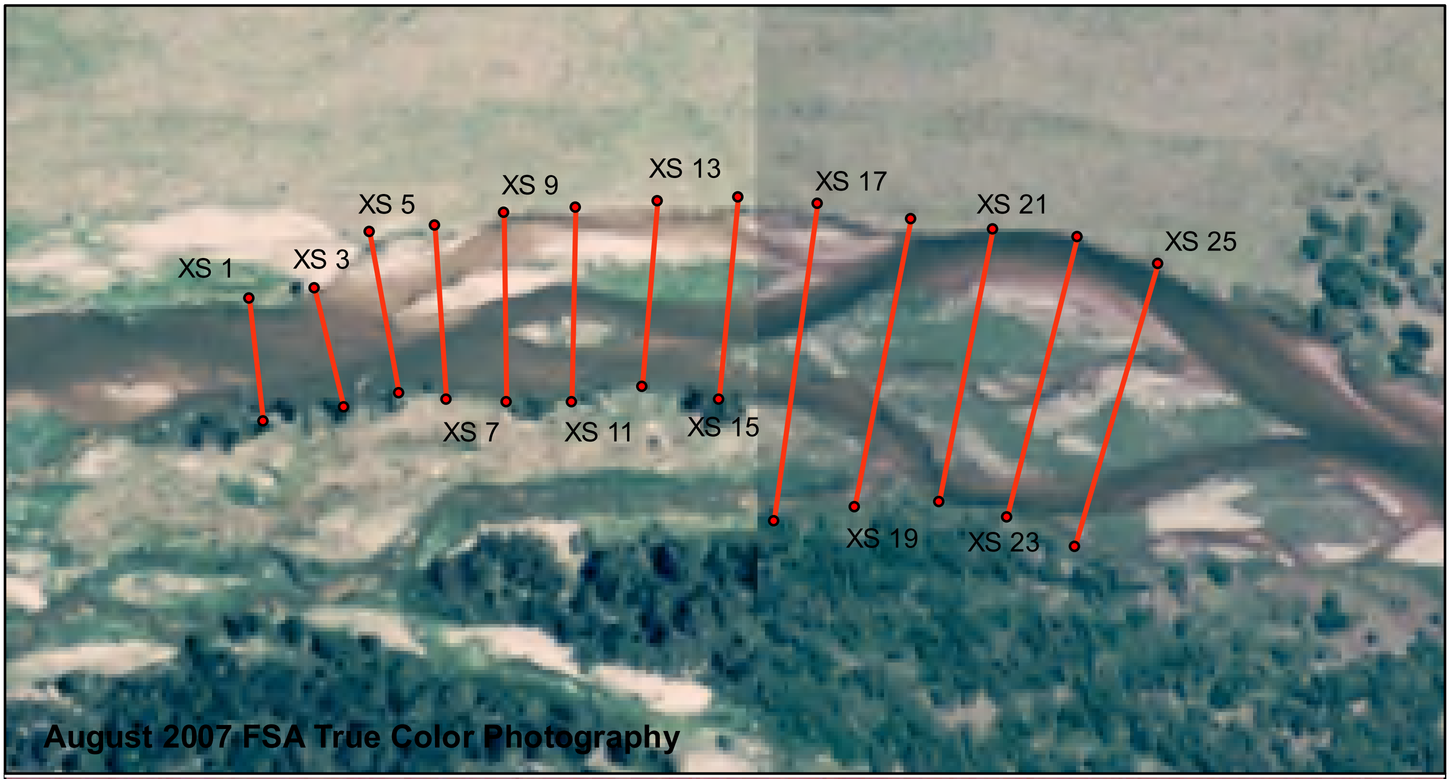
Meters
100

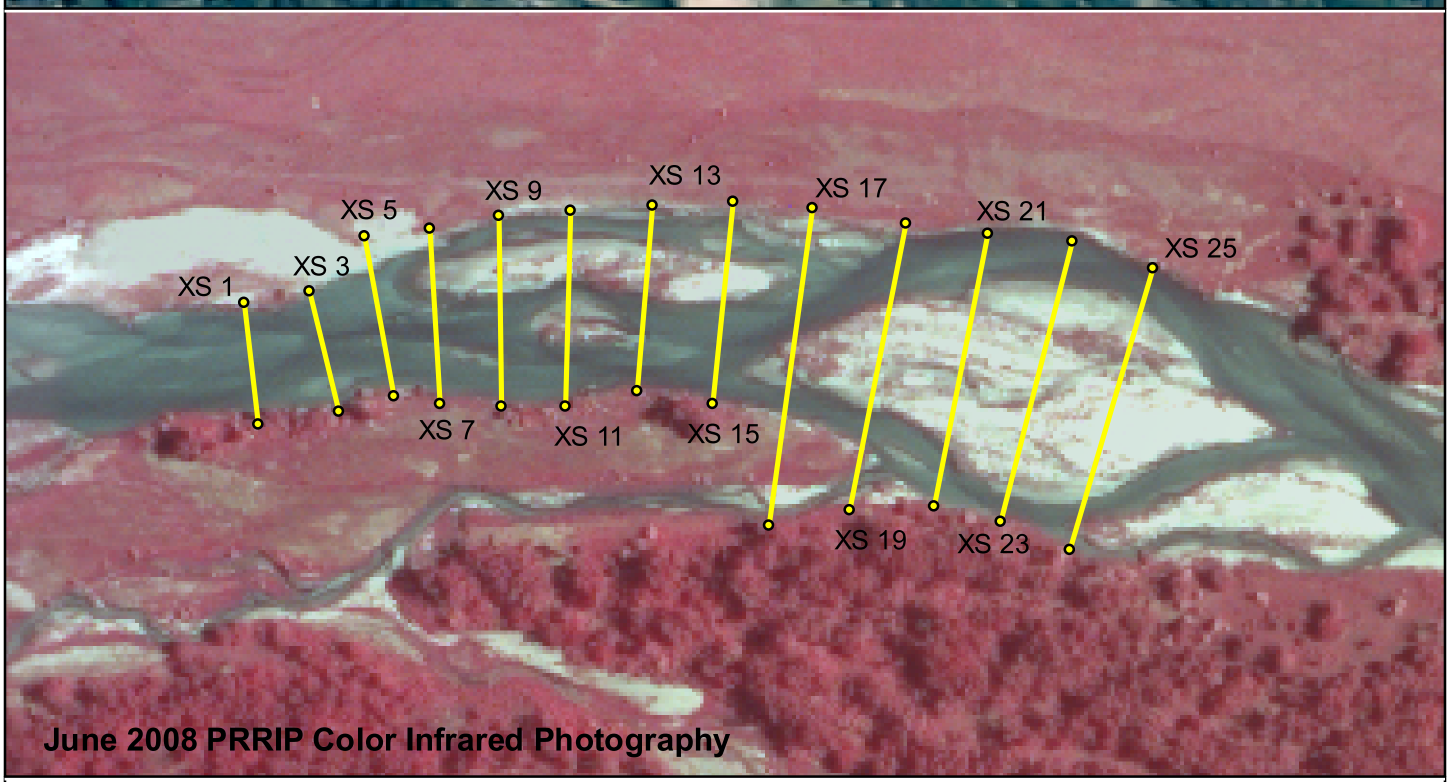
COTTONWOOD RANCH MANAGED REACH TRANSECT LOCATIONS

Date: 10/29/08

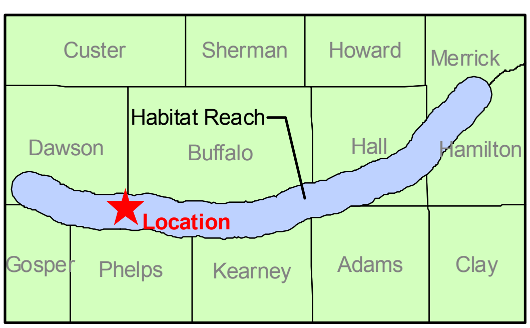
By: JMF

Figure C-2





PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



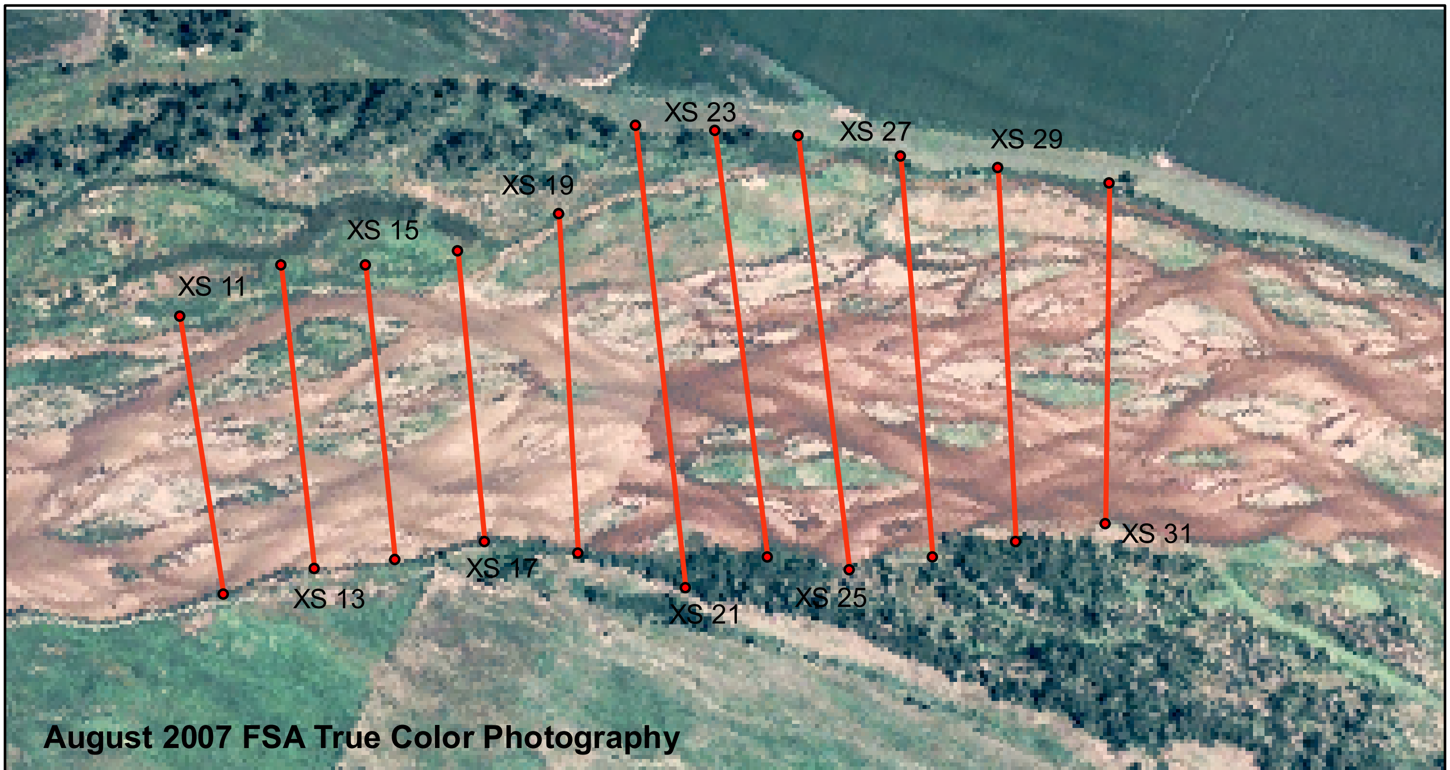
N

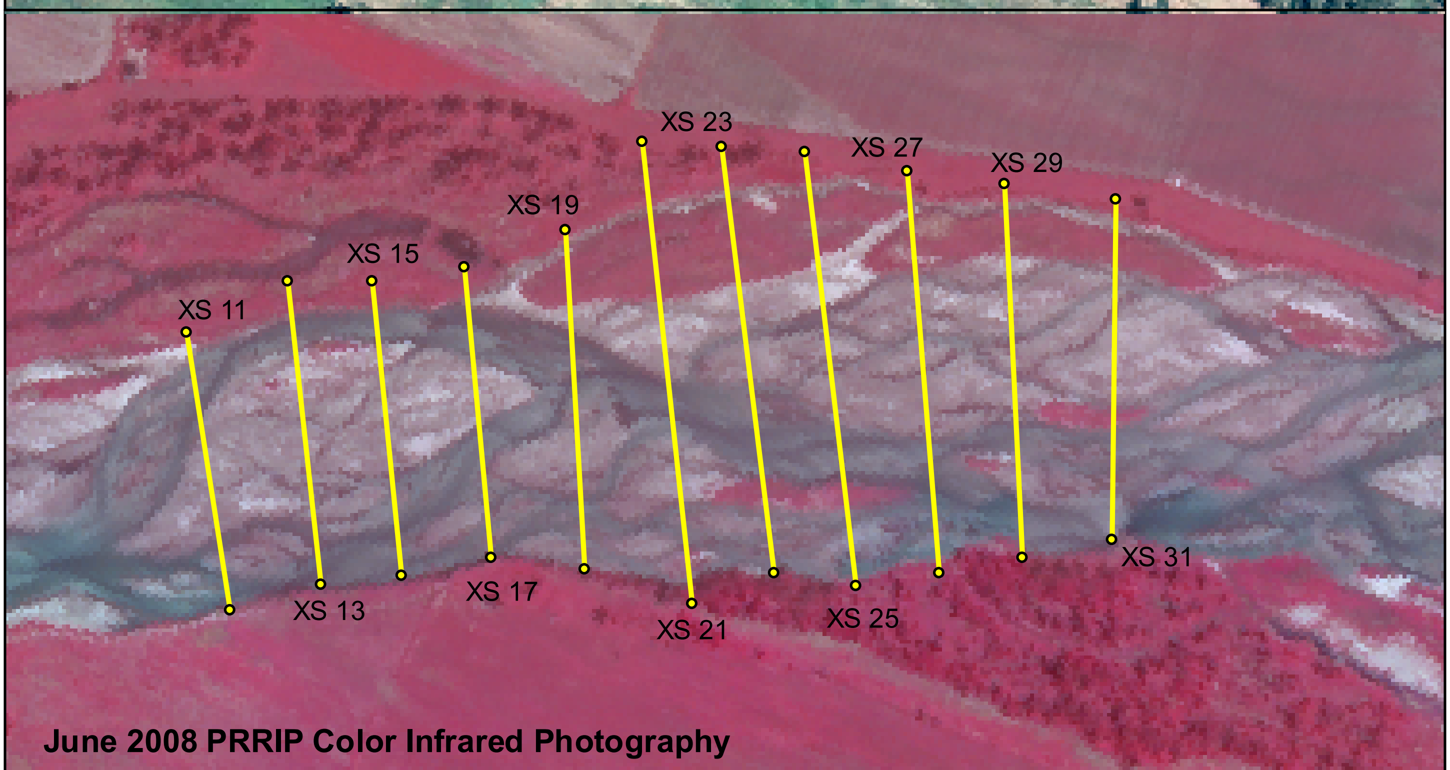
Meters
100

COTTONWOOD RANCH
OUTPUT REACH
TRANSECT LOCATIONS

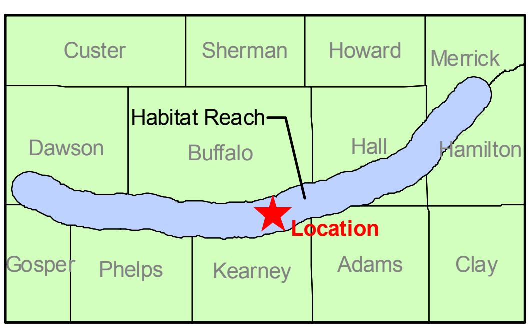
Date: 10/29/08
By: JMF

Figure C-3





PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



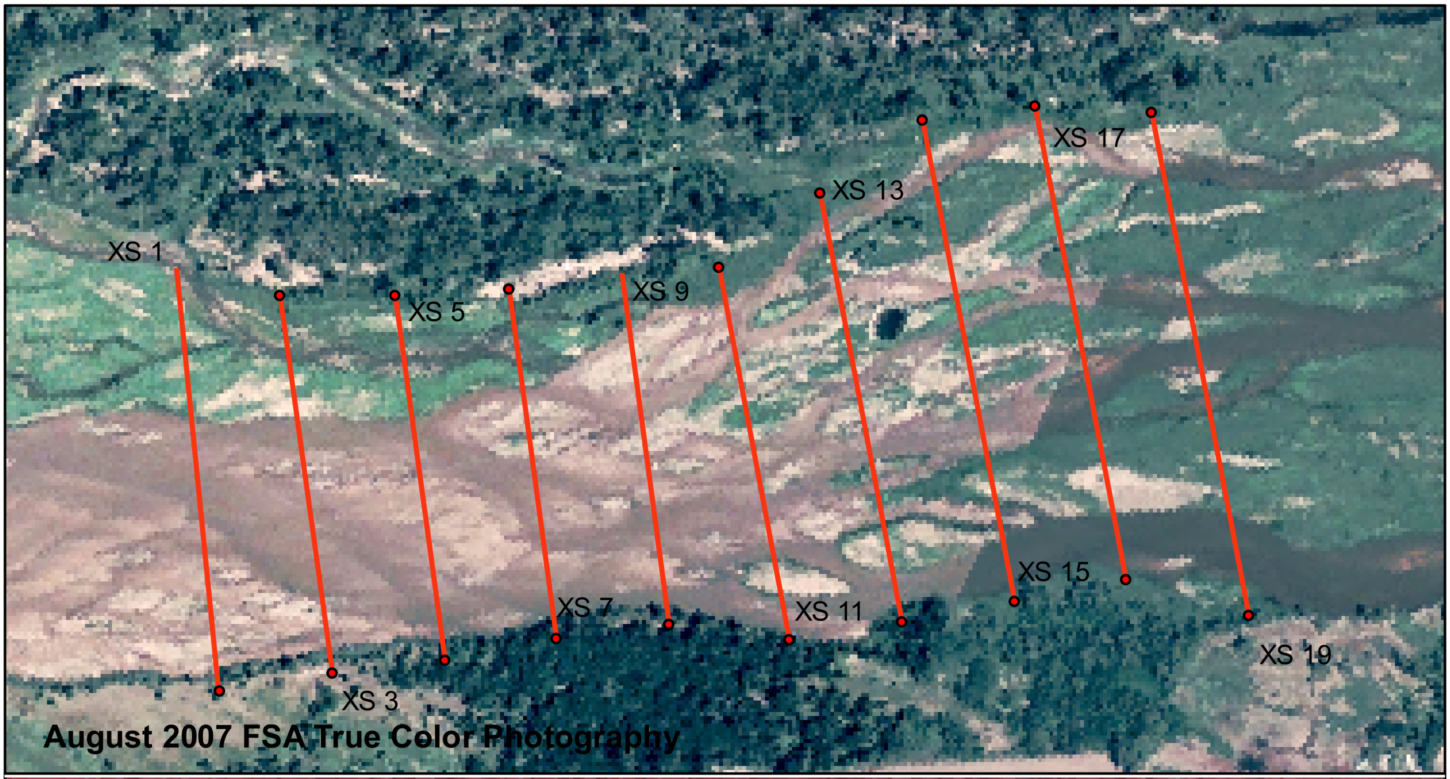
N

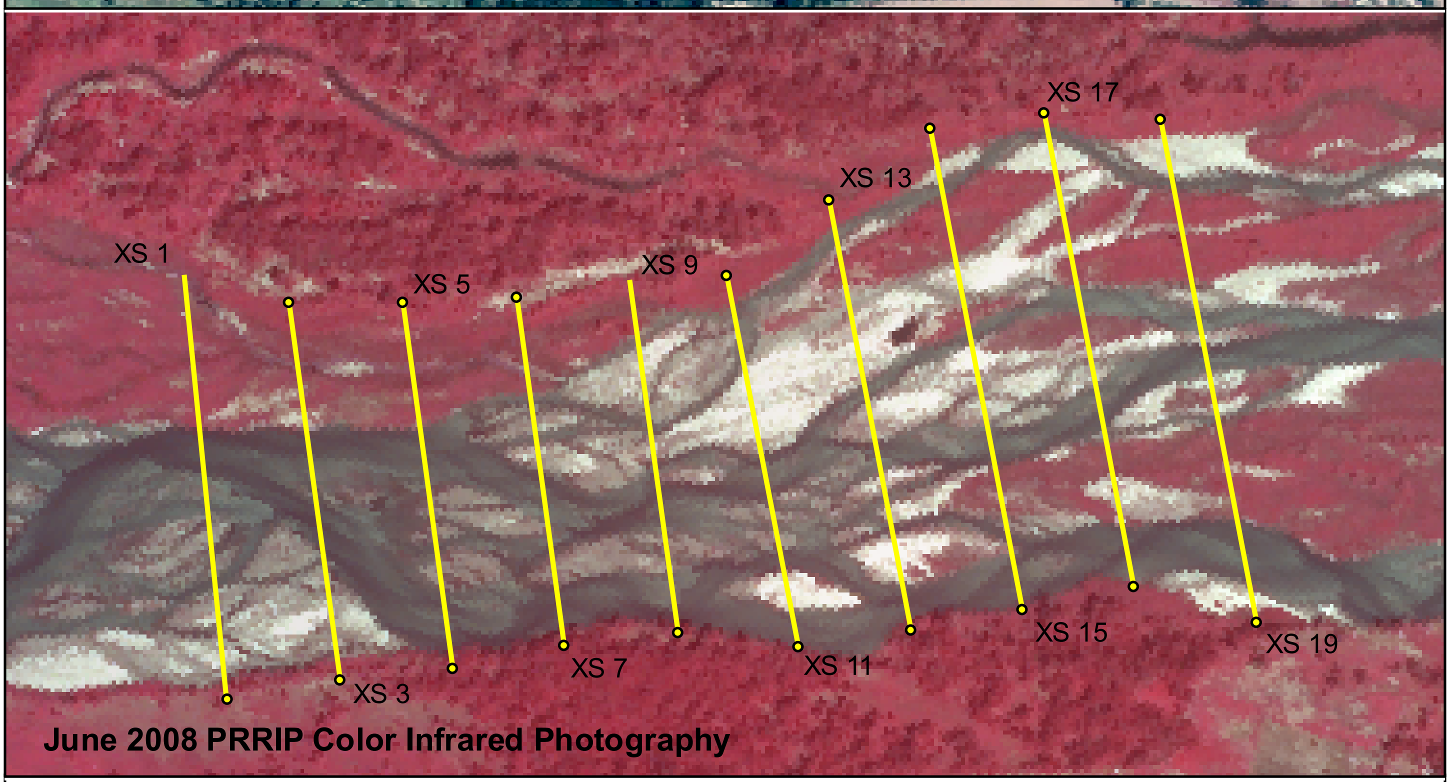
200 Meters

ROWE SANCTUARY
TRANSECT LOCATIONS

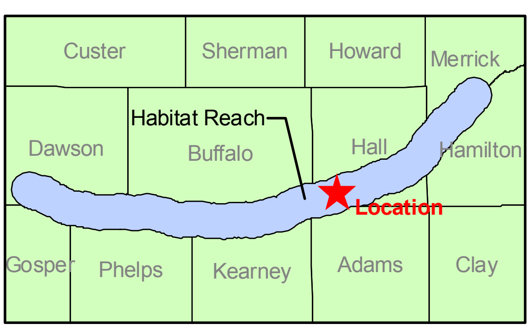
Date: 10/29/08
By: JMF

Figure C-4





PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



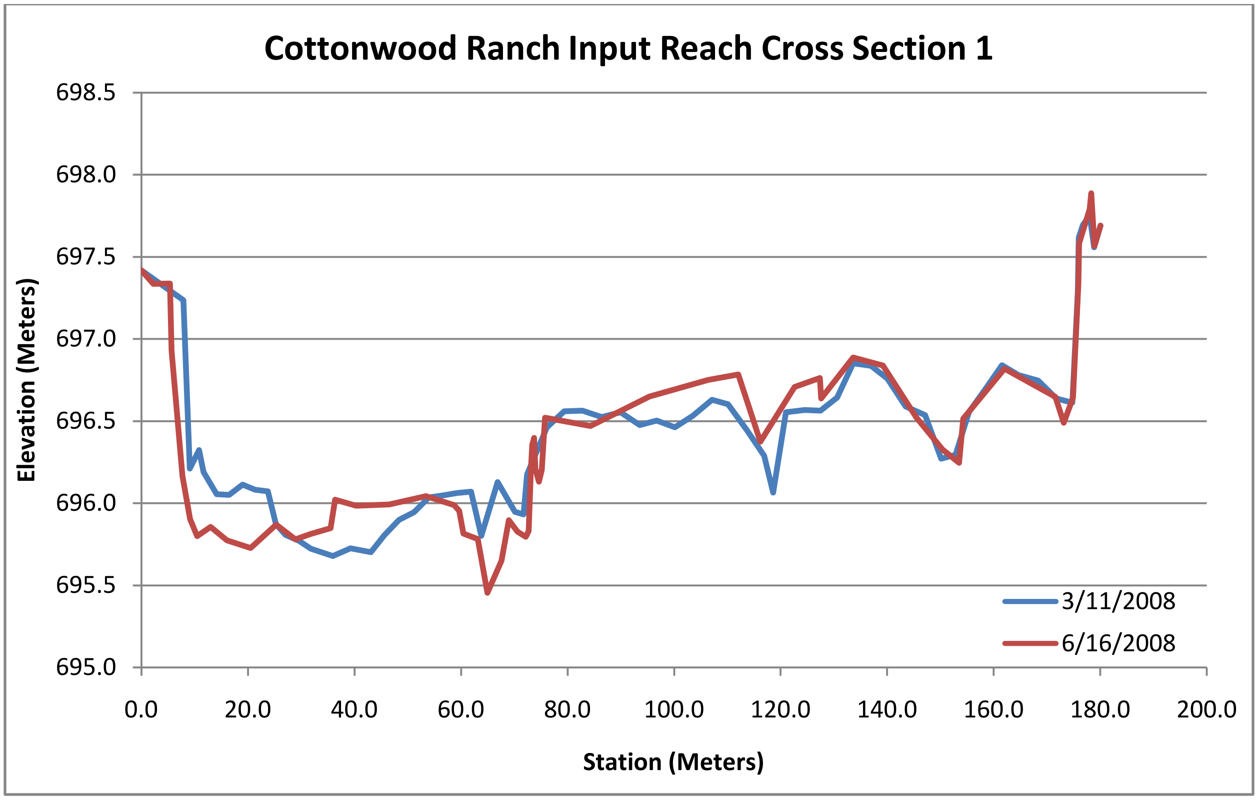
N

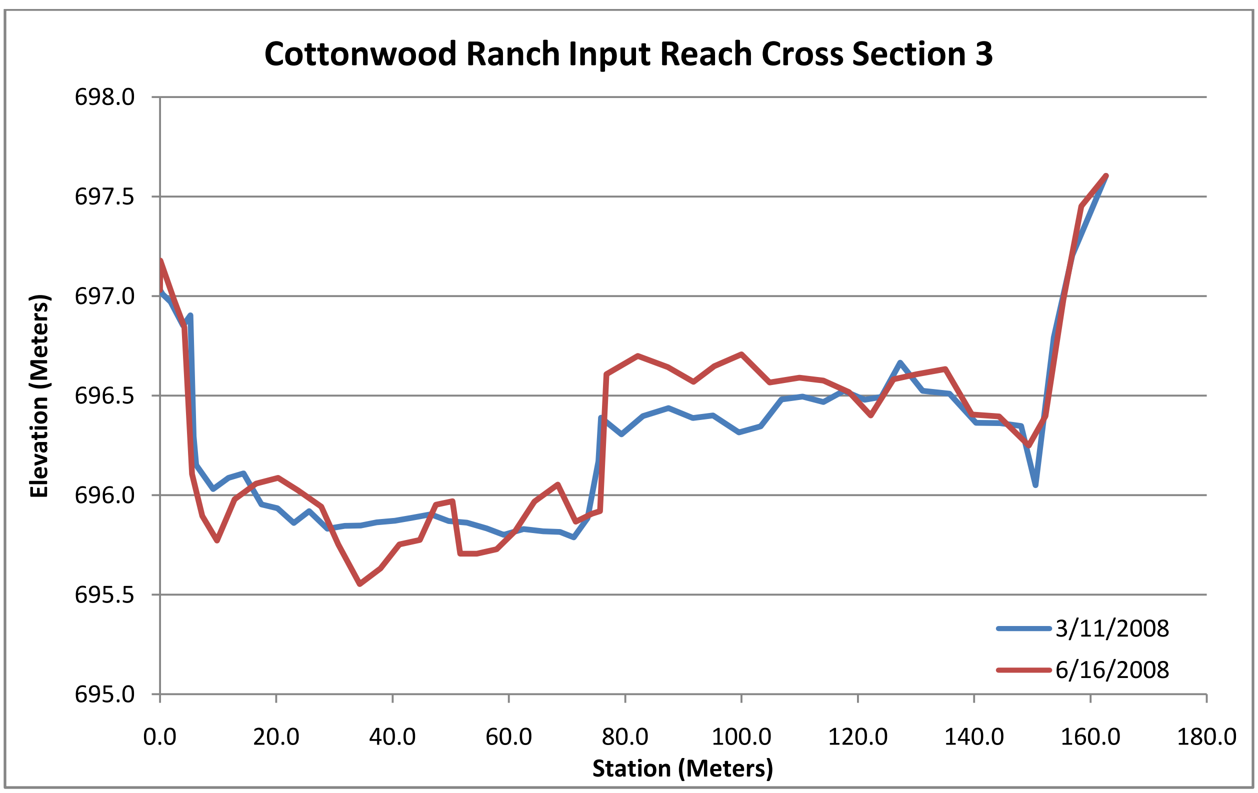
200 Meters

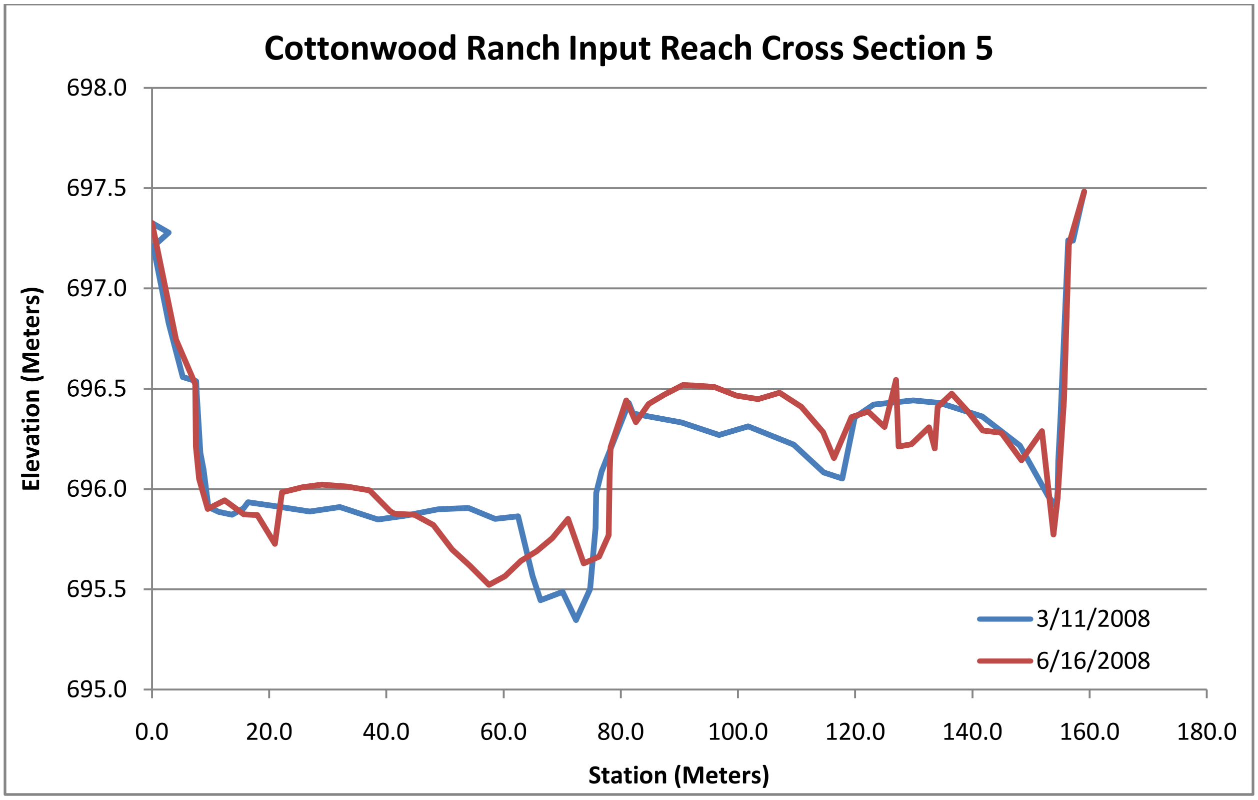
URIDIL PROPERTY
TRANSECT LOCATIONS

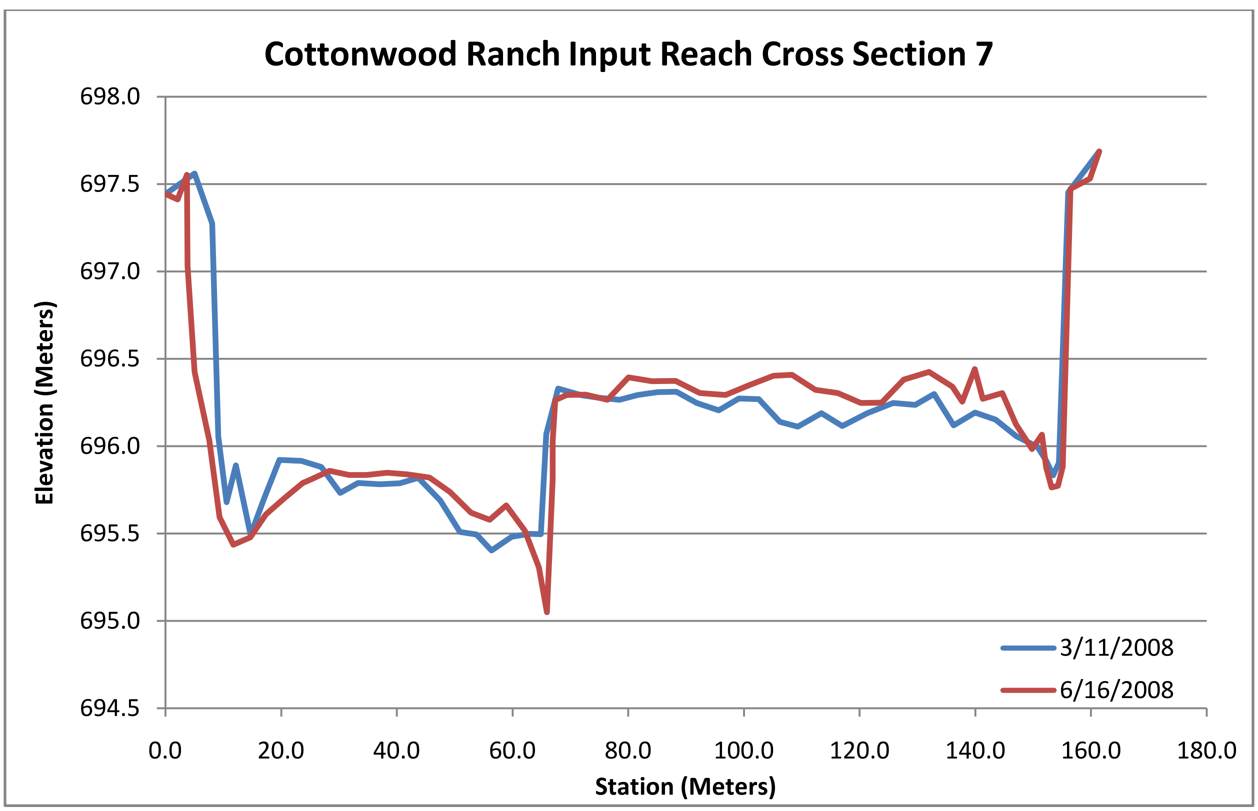
Date: 10/29/08
By: JMF

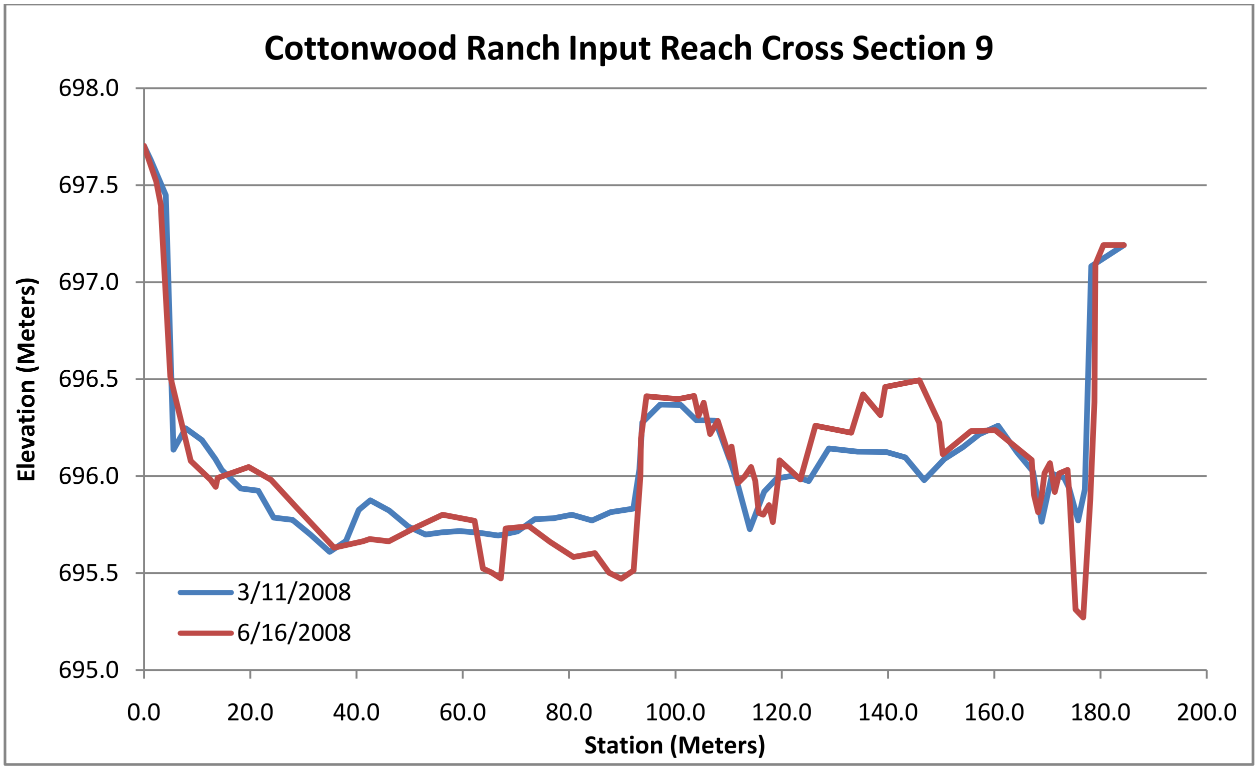
Figure C-5

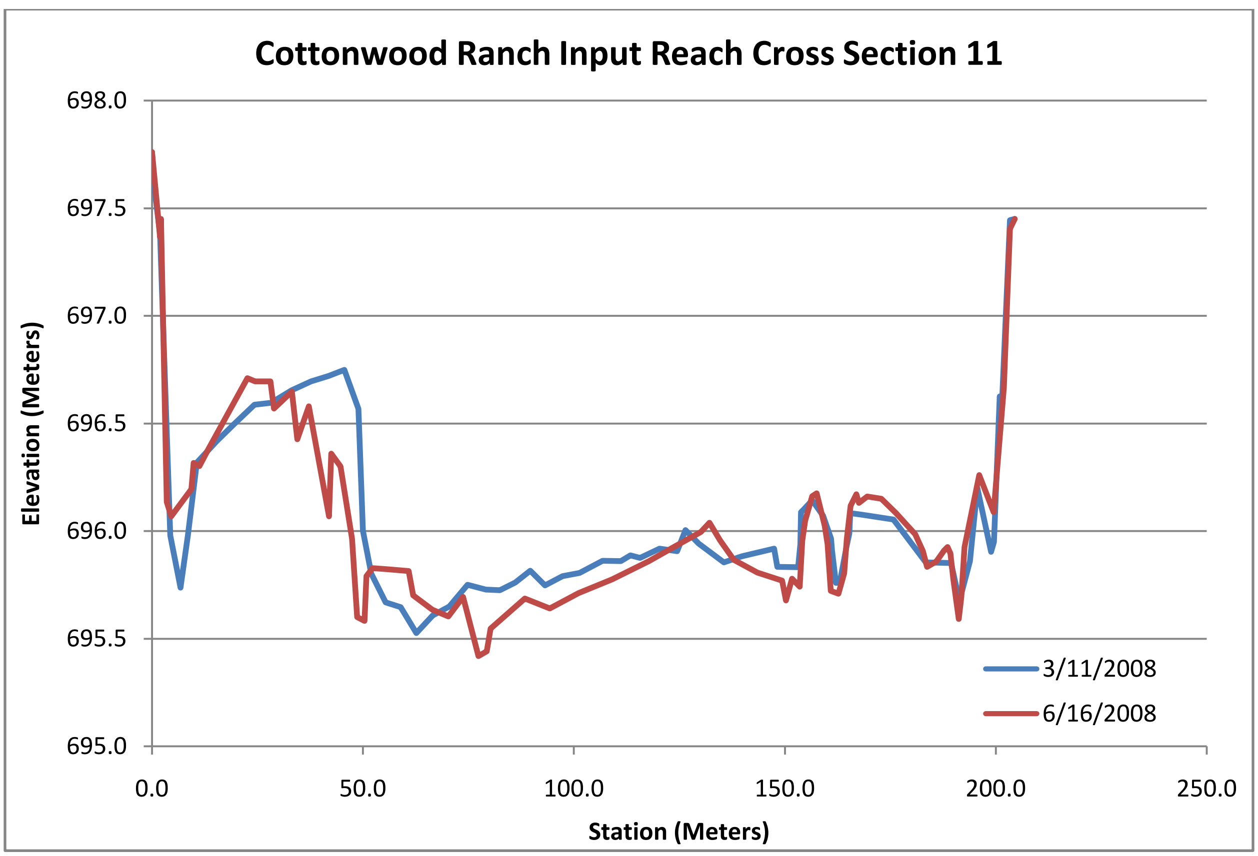

Cottonwood Ranch Input Reach Cross Section 1
698.5
698.0
697.5
697.0
696.5
696.0
695.5
695.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
Station (Meters)
3/11/2008
6/16/2008

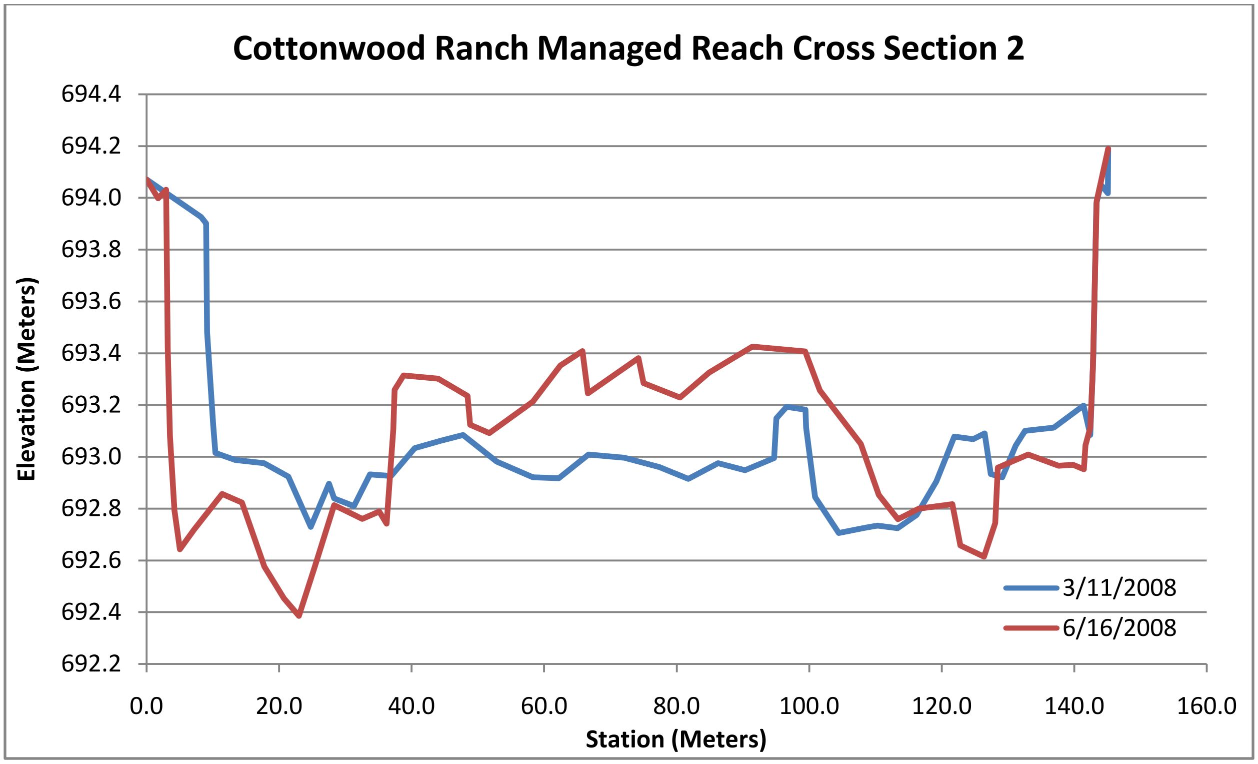

Cottonwood Ranch Input Reach Cross Section 3
698.0
697.5
697.0
696.5
696.0
695.5
695.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/11/2008
6/16/2008

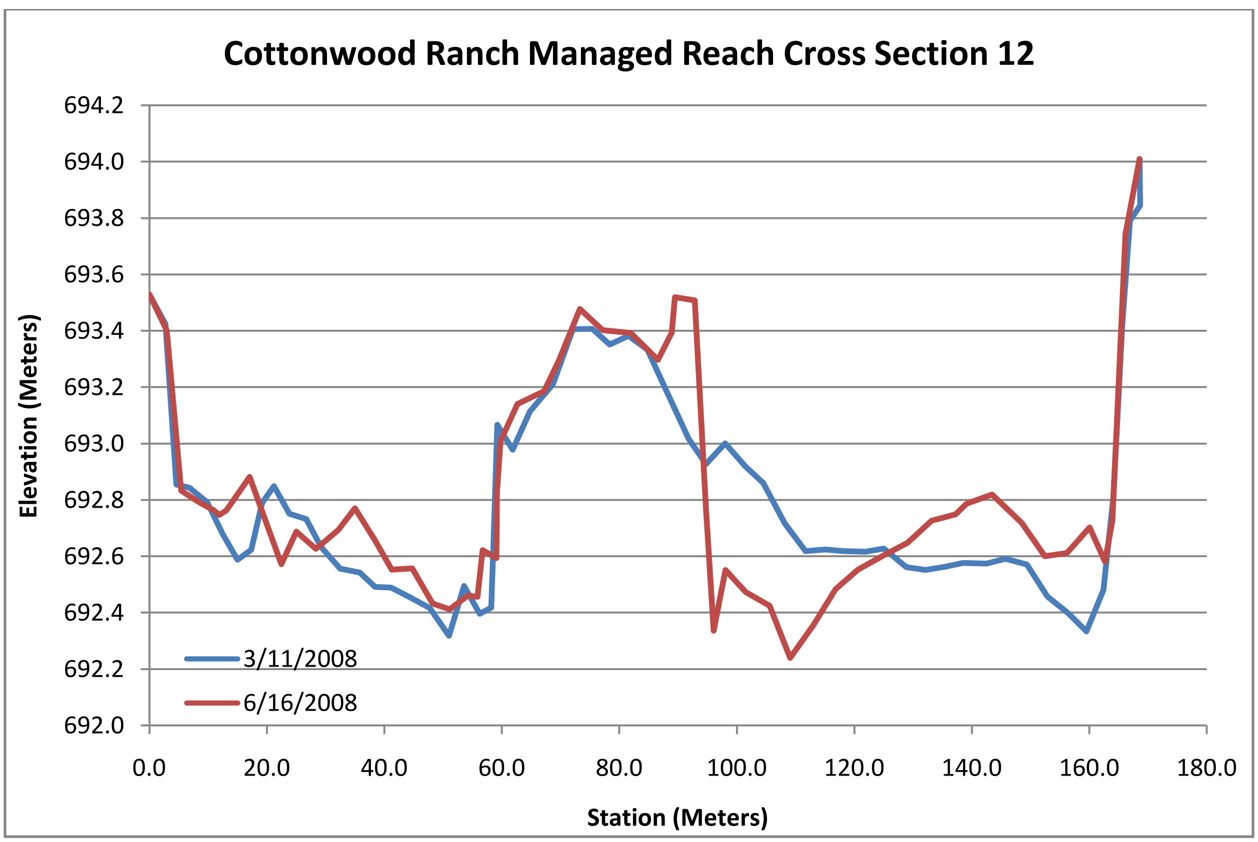

Cottonwood Ranch Input Reach Cross Section 5
698.0
697.5
697.0
696.5
696.0
695.5
695.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/11/2008
6/16/2008

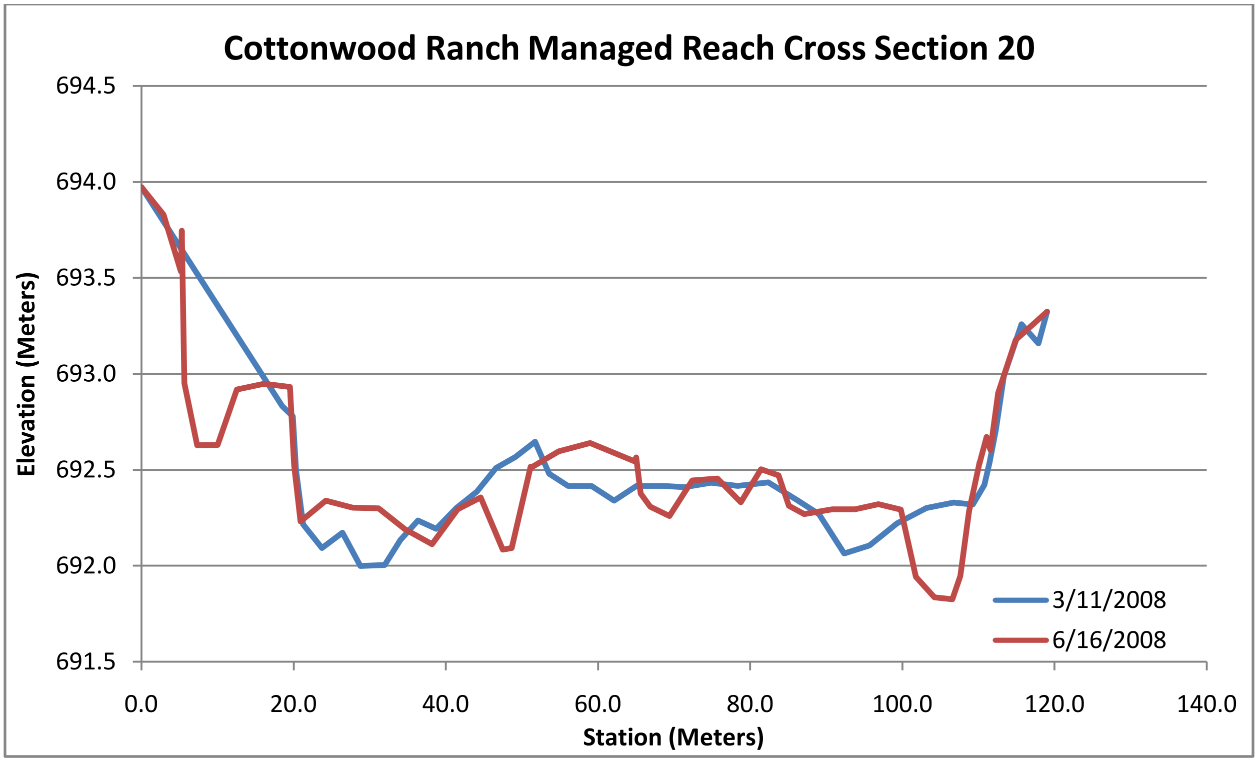

Cottonwood Ranch Input Reach Cross Section 7
698.0
697.5
697.0
696.5
696.0
695.5
695.0
694.5
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/11/2008
6/16/2008

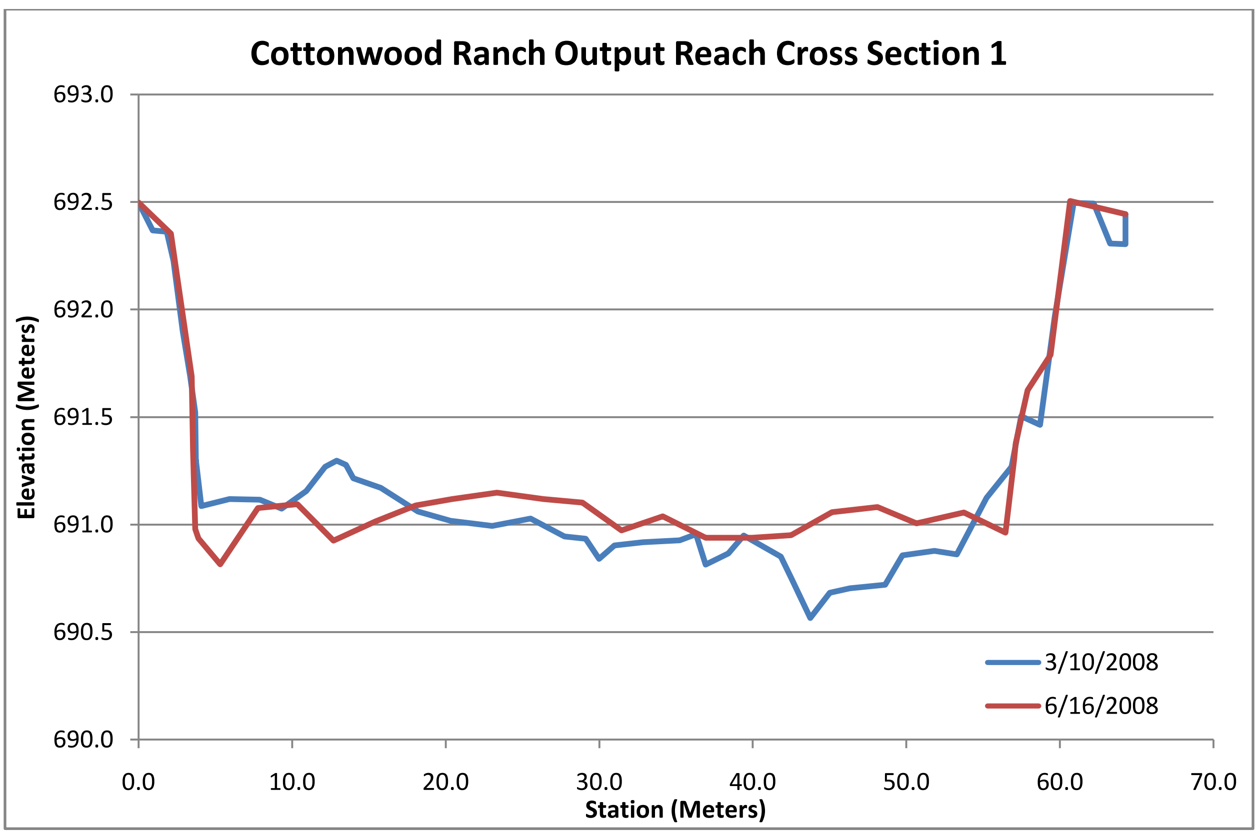

Cottonwood Ranch Input Reach Cross Section 9
Elevation (Meters)
698.0
697.5
697.0
696.5
696.0
695.5
695.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
Station (Meters)
3/11/2008
6/16/2008

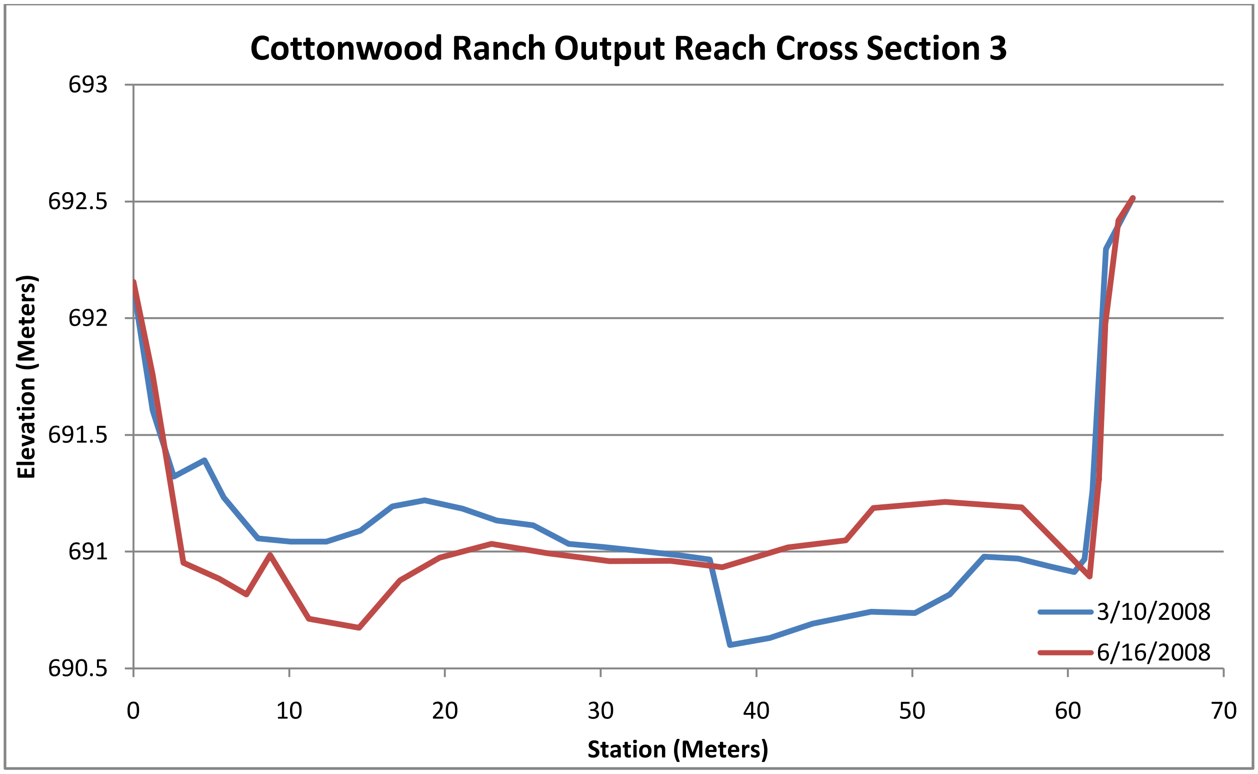

Cottonwood Ranch Input Reach Cross Section 11
Elevation (Meters)
698.0
697.5
697.0
696.5
696.0
695.5
695.0
0.0
50.0
100.0
150.0
200.0
250.0
Station (Meters)
3/11/2008
6/16/2008

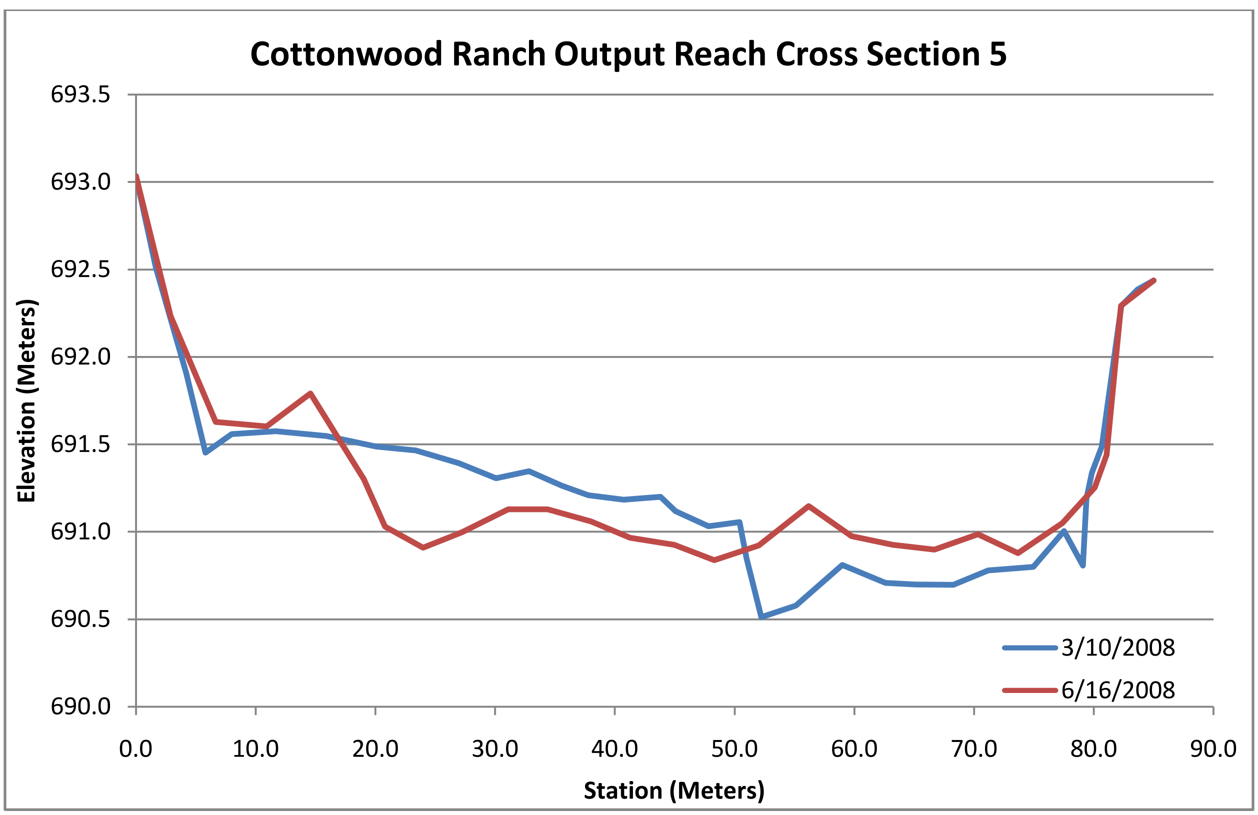

Cottonwood Ranch Managed Reach Cross Section 2
694.4
694.2
694.0
693.8
693.6
693.4
693.2
693.0
692.8
692.6
692.4
692.2
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
Station (Meters)
3/11/2008
6/16/2008

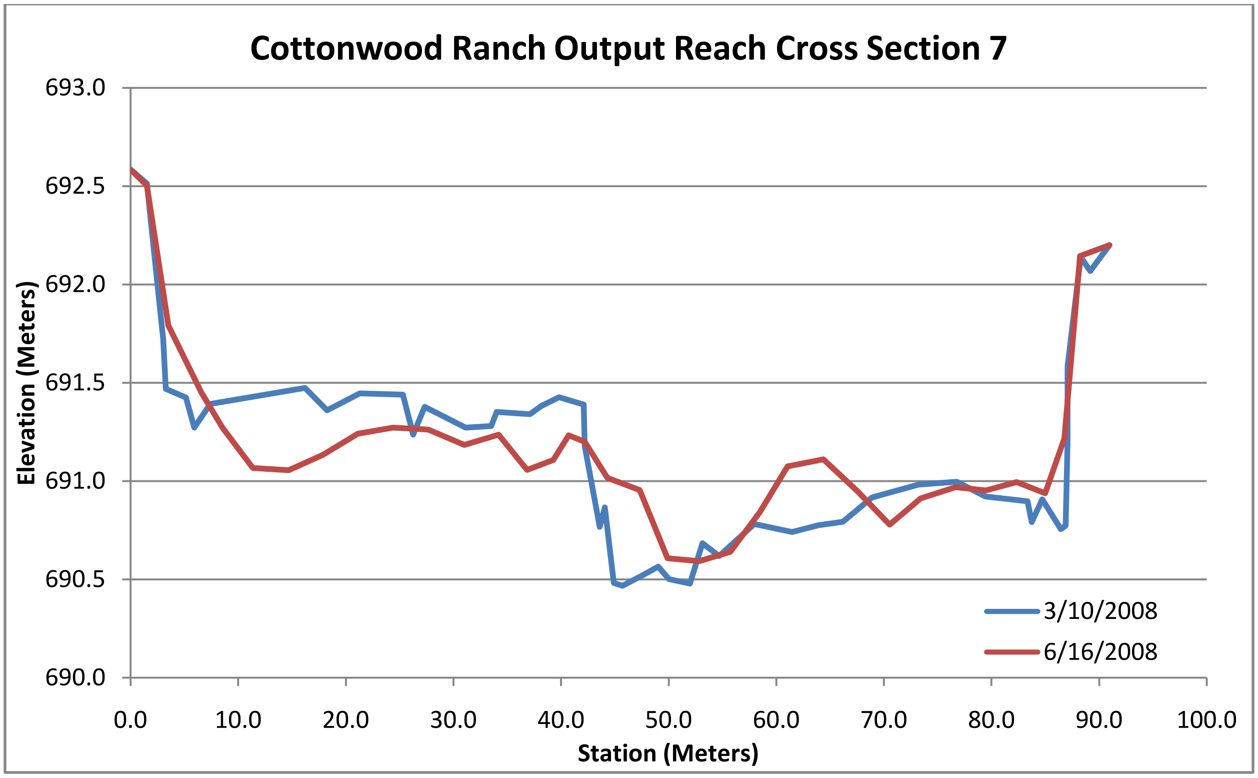

Cottonwood Ranch Managed Reach Cross Section 12
694.2
694.0
693.8
693.6
693.4
693.2
693.0
692.8
692.6
692.4
692.2
692.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/11/2008
6/16/2008

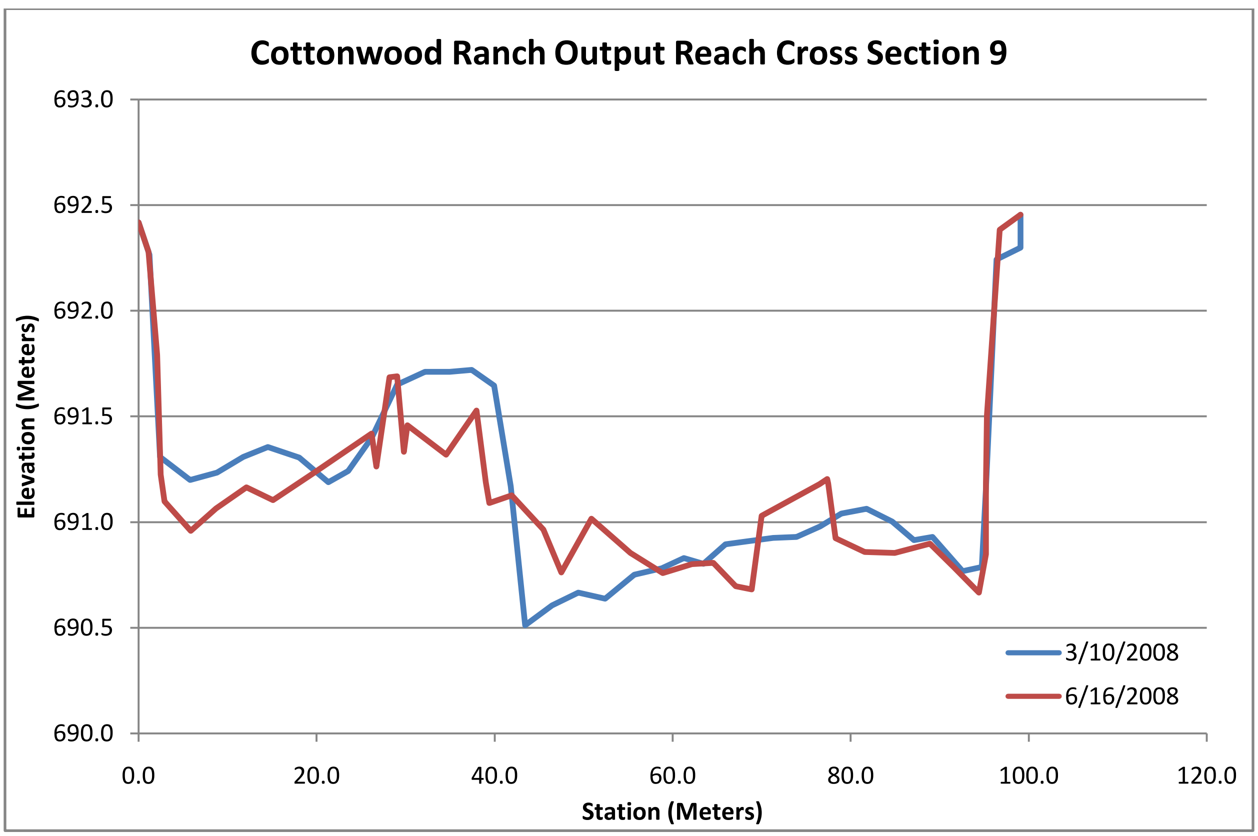

Cottonwood Ranch Managed Reach Cross Section 20
Elevation (Meters)
694.5
694.0
693.5
693.0
692.5
692.0
691.5
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
Station (Meters)
3/11/2008
6/16/2008

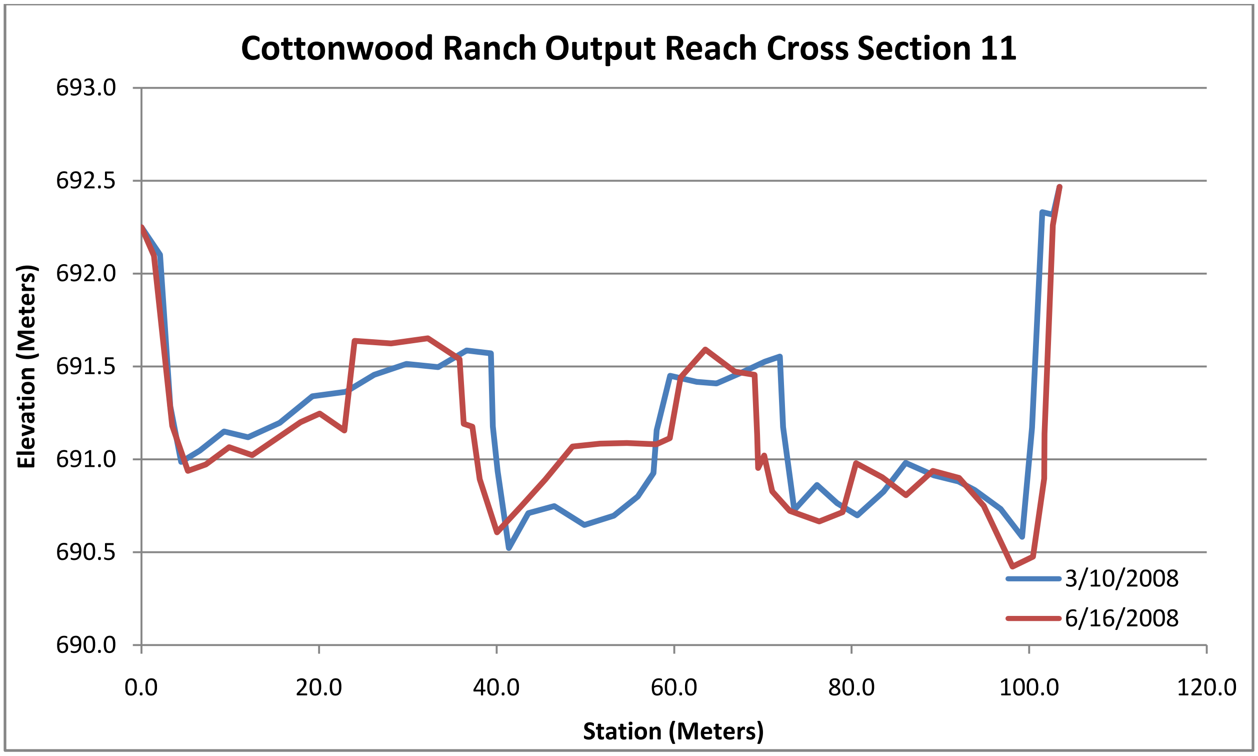

Cottonwood Ranch Output Reach Cross Section 1
Elevation (Meters)
693.0
692.5
692.0
691.5
691.0
690.5
690.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Station (Meters)
3/10/2008
6/16/2008

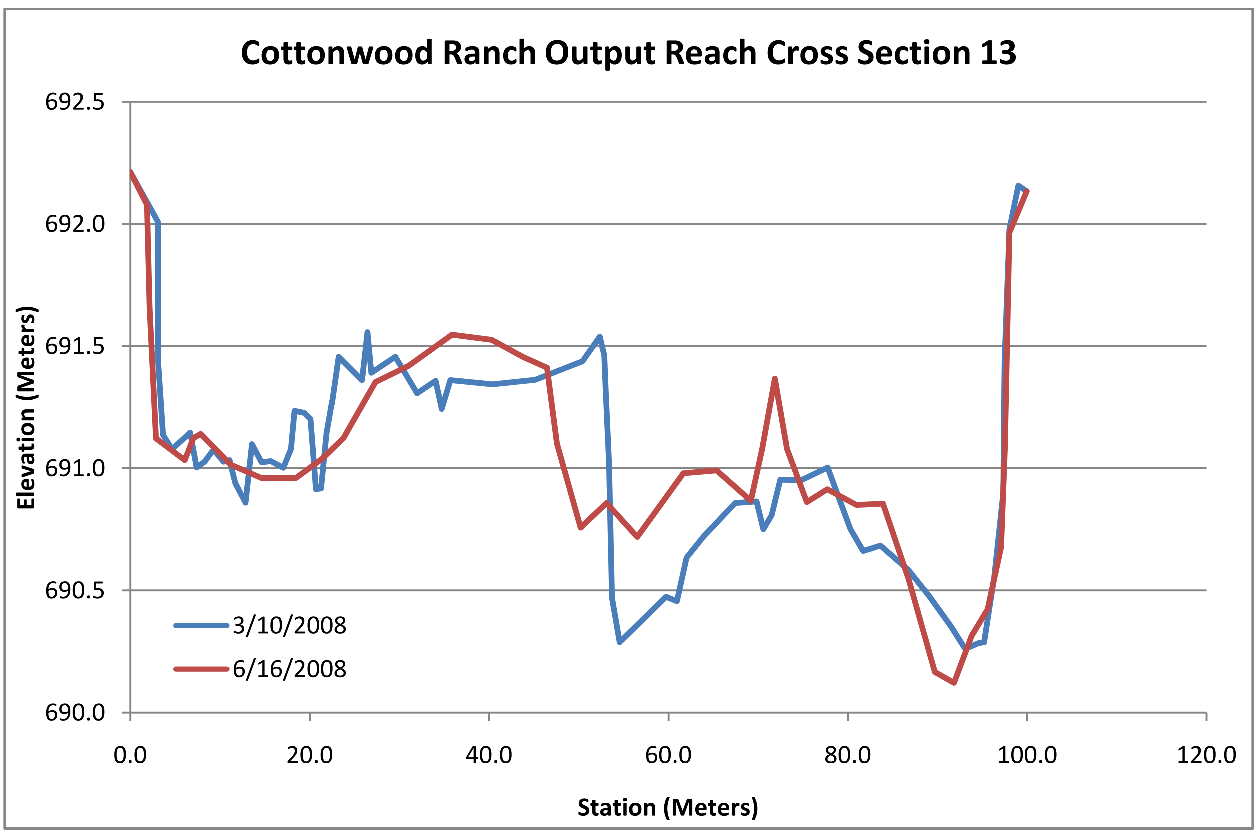

Cottonwood Ranch Output Reach Cross Section 3
693
692.5
692
691.5
691
690.5
0
10
20
30
40
50
60
70
Elevation (Meters)
Station (Meters)
3/10/2008
6/16/2008

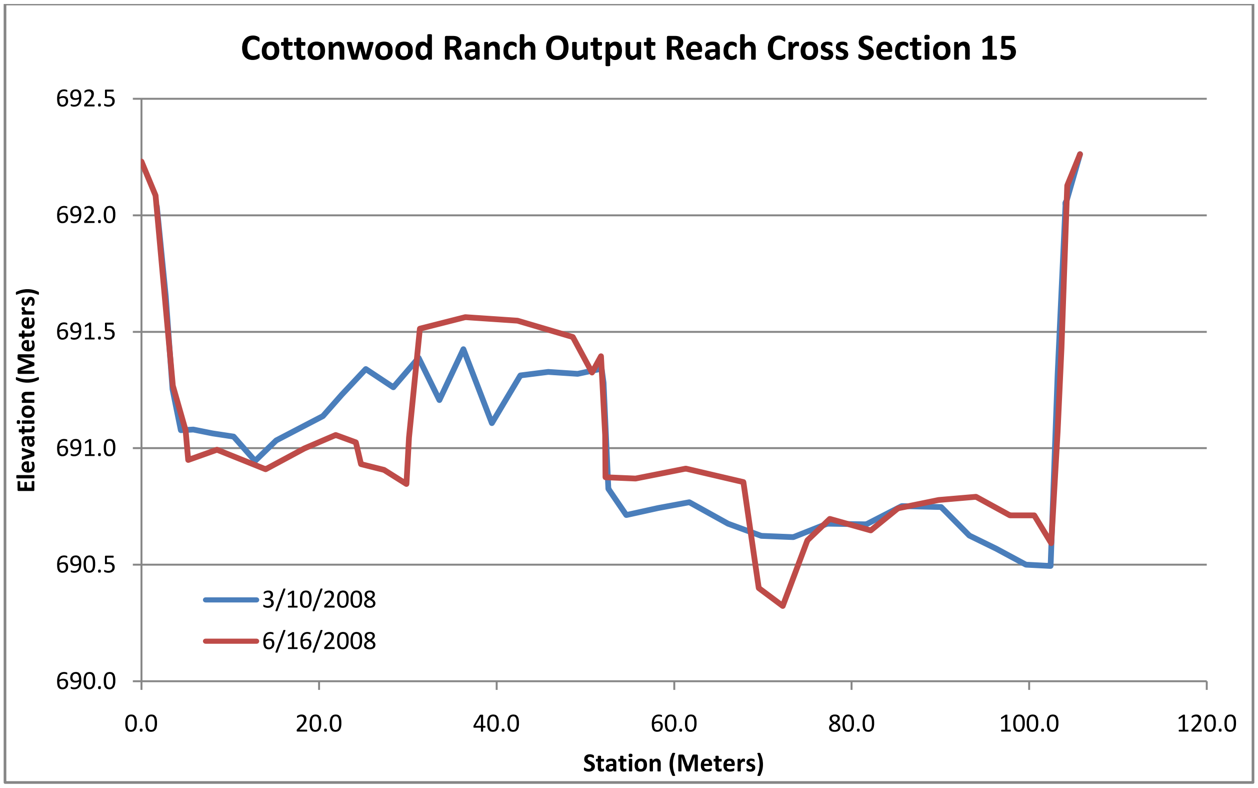

Cottonwood Ranch Output Reach Cross Section 5
693.5
693.0
692.5
692.0
691.5
691.0
690.5
690.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
Elevation (Meters)
Station (Meters)
3/10/2008
6/16/2008

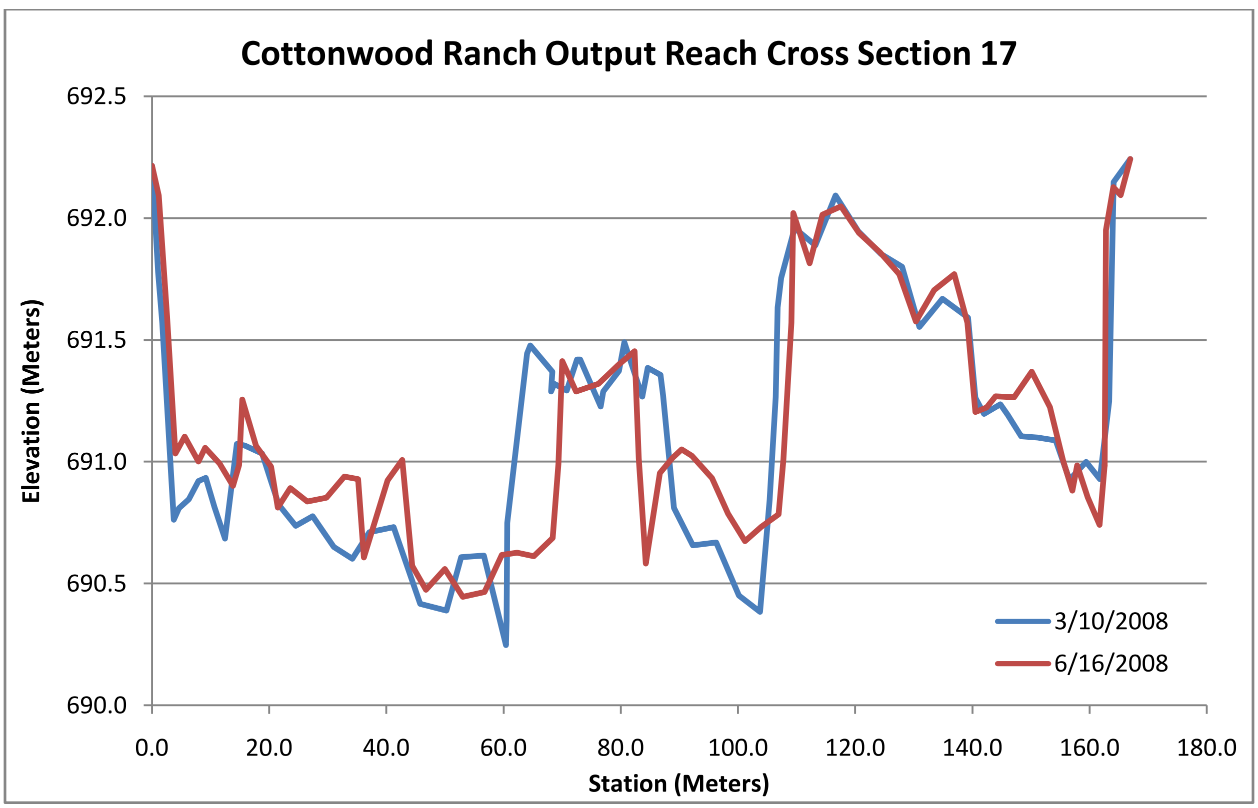

Cottonwood Ranch Output Reach Cross Section 7
693.0
692.5
692.0
691.5
691.0
690.5
690.0
Elevation (Meters)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Station (Meters)
3/10/2008
6/16/2008

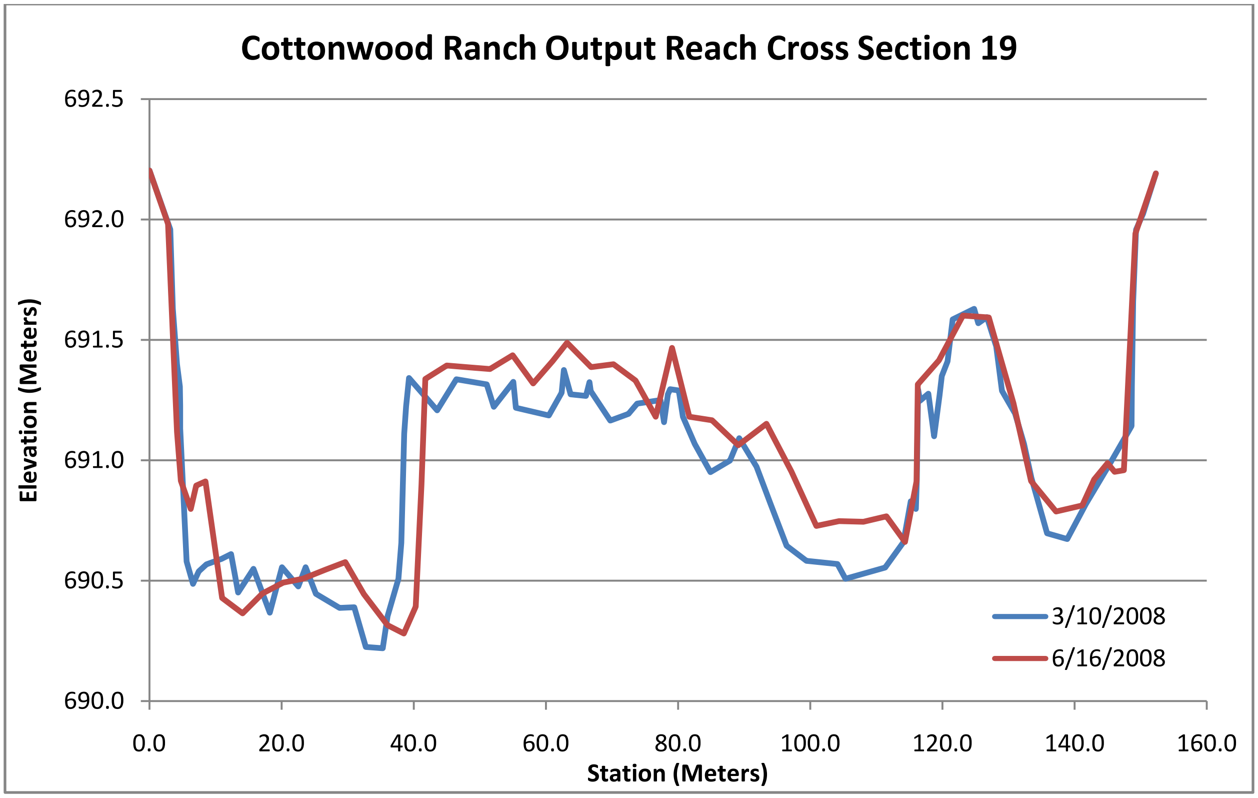

Cottonwood Ranch Output Reach Cross Section 9
693.0
692.5
692.0
691.5
691.0
690.5
690.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Station (Meters)
3/10/2008
6/16/2008


Cottonwood Ranch Output Reach Cross Section 11
693.0
692.5
692.0
691.5
691.0
690.5
690.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Station (Meters)
3/10/2008
6/16/2008

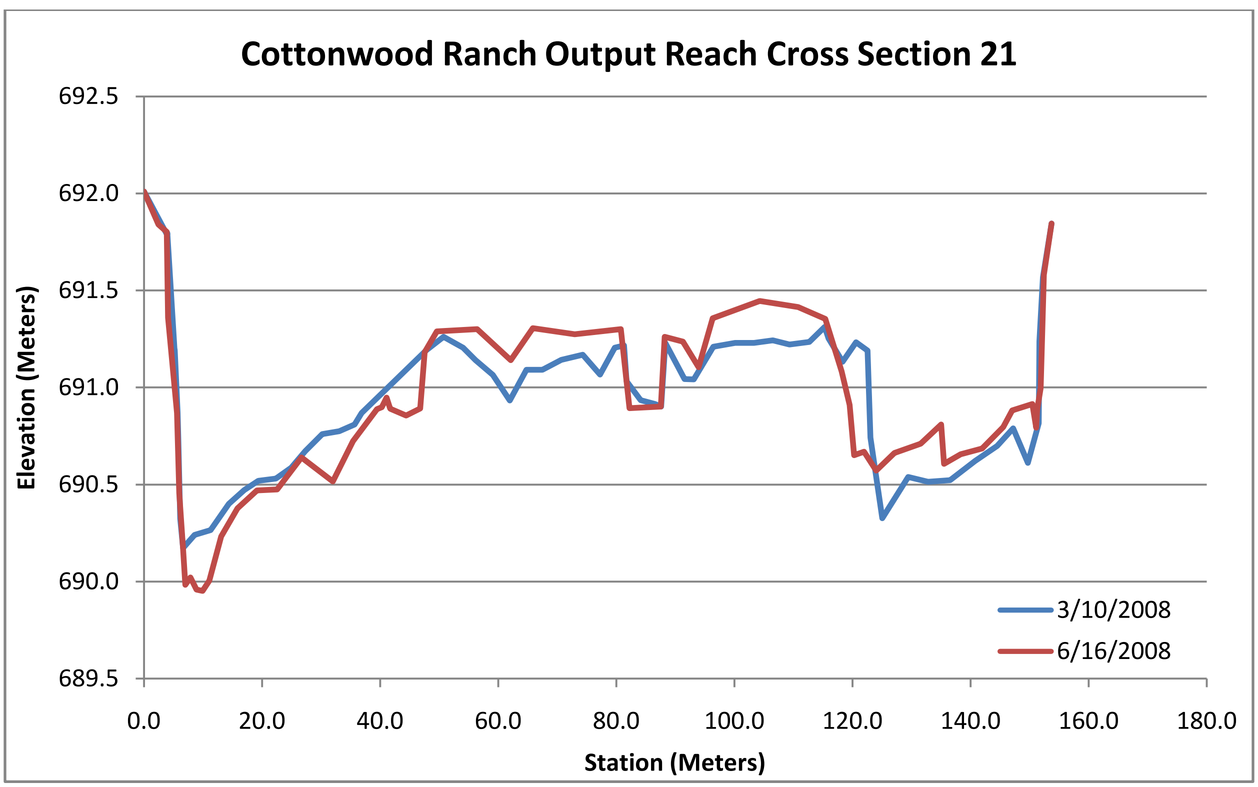

Cottonwood Ranch Output Reach Cross Section 13
692.5
692.0
691.5
691.0
690.5
690.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Station (Meters)
3/10/2008
6/16/2008


Cottonwood Ranch Output Reach Cross Section 15
692.5
692.0
691.5
691.0
690.5
690.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
Station (Meters)
3/10/2008
6/16/2008

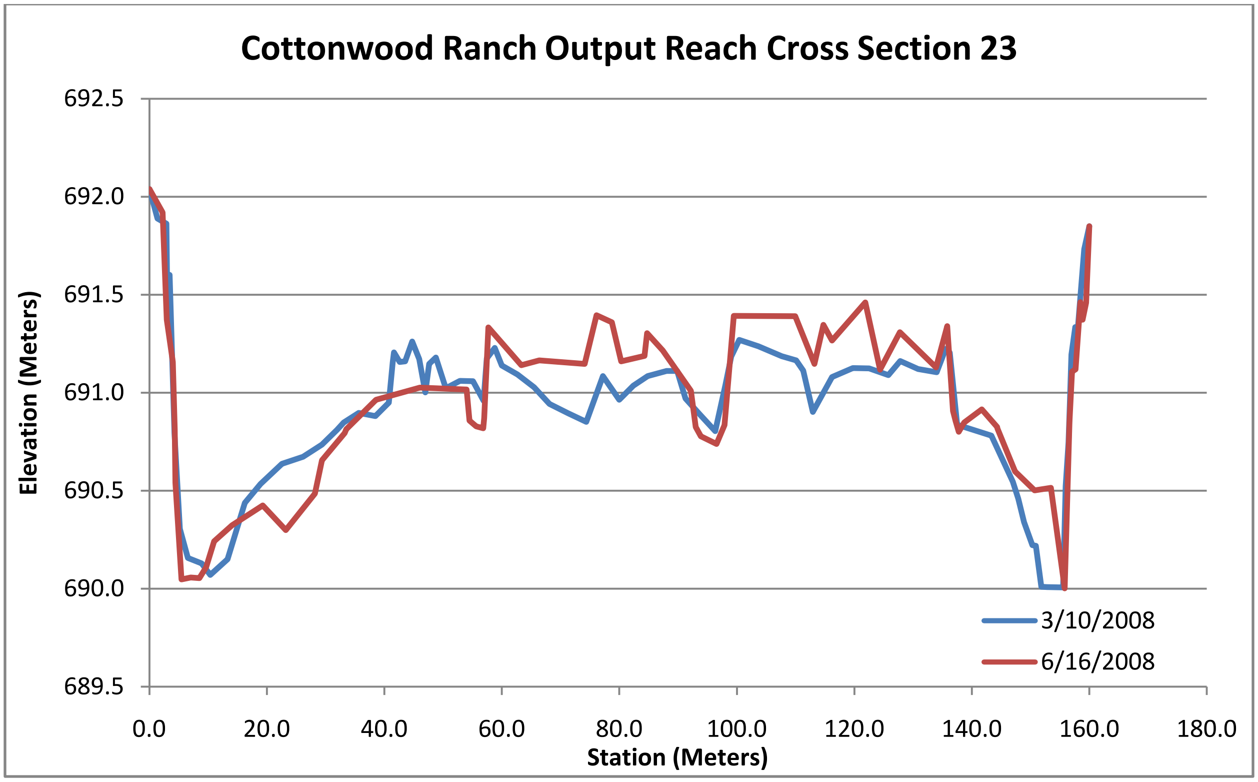

Cottonwood Ranch Output Reach Cross Section 17
692.5
692.0
691.5
691.0
690.5
690.0
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/10/2008
6/16/2008



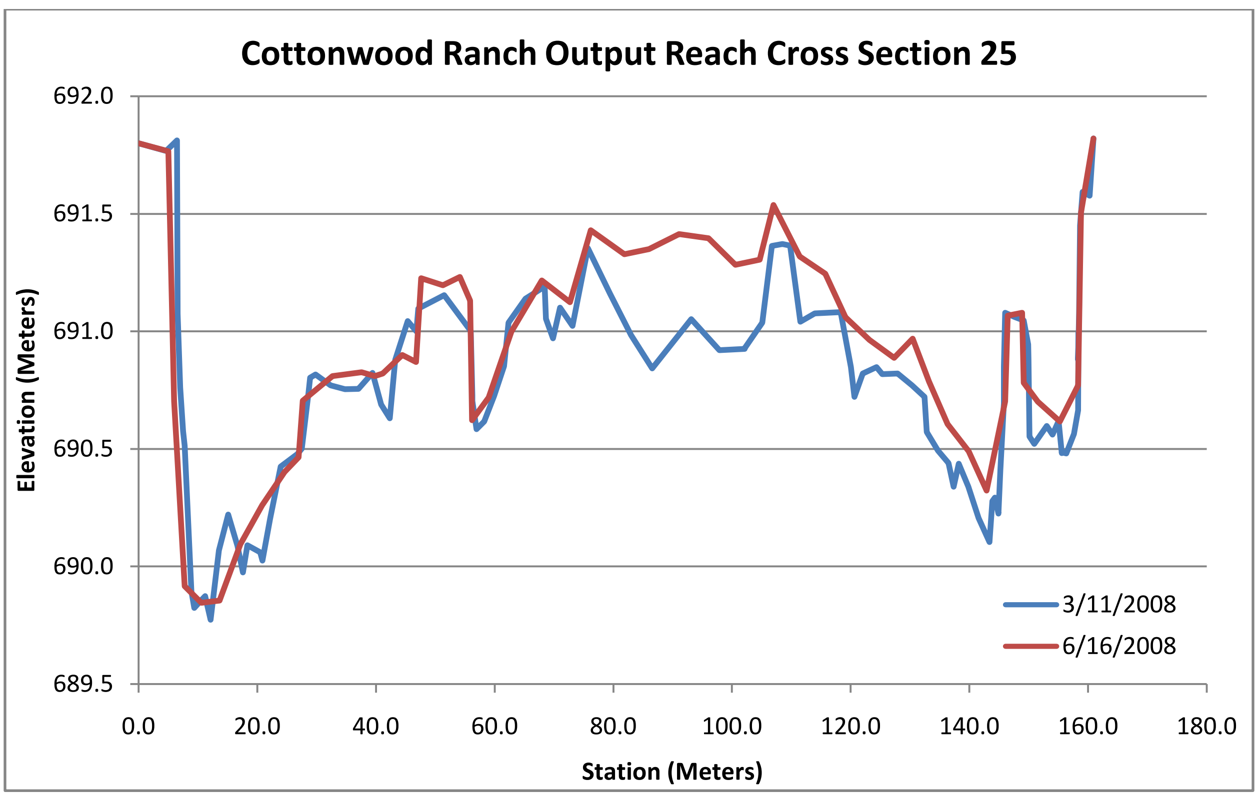
Cottonwood Ranch Output Reach Cross Section 19
Elevation (Meters)
692.5
692.0
691.5
691.0
690.5
690.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
Station (Meters)
3/10/2008
6/16/2008



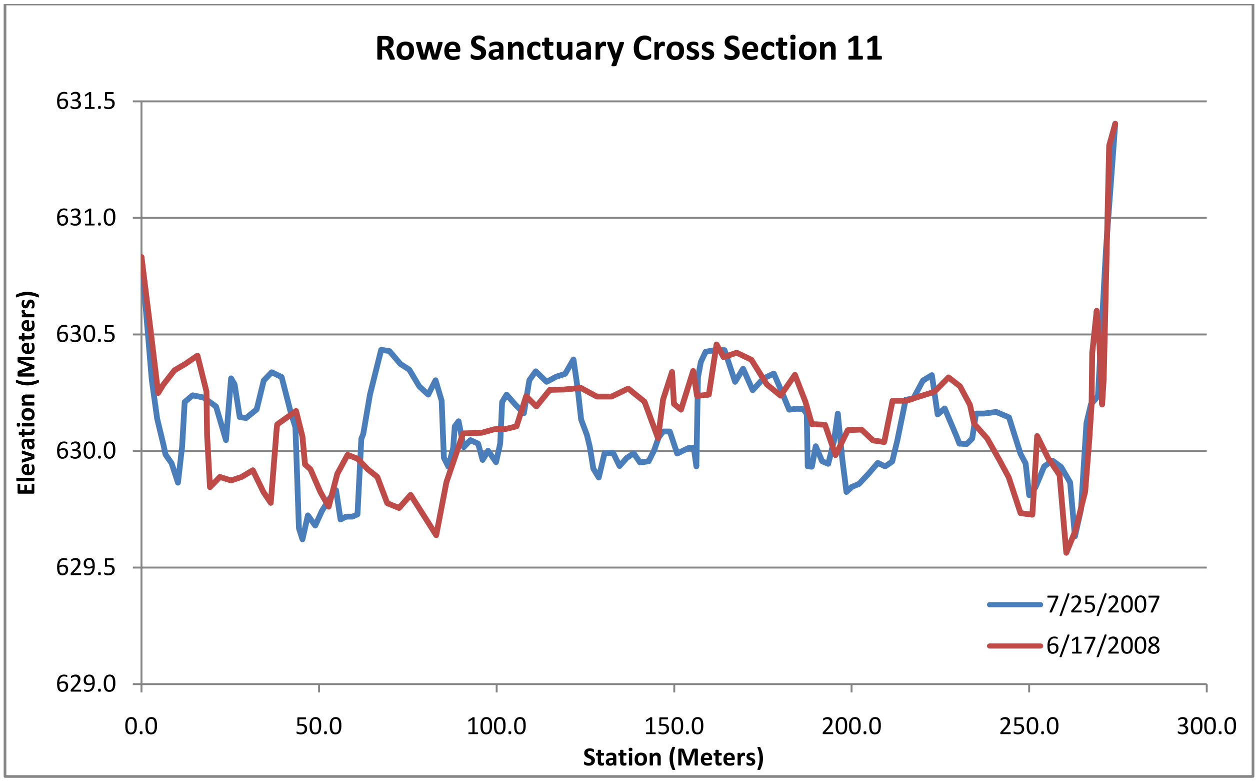
Cottonwood Ranch Output Reach Cross Section 21
Elevation (Meters)
692.5
692.0
691.5
691.0
690.5
690.0
689.5
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/10/2008
6/16/2008

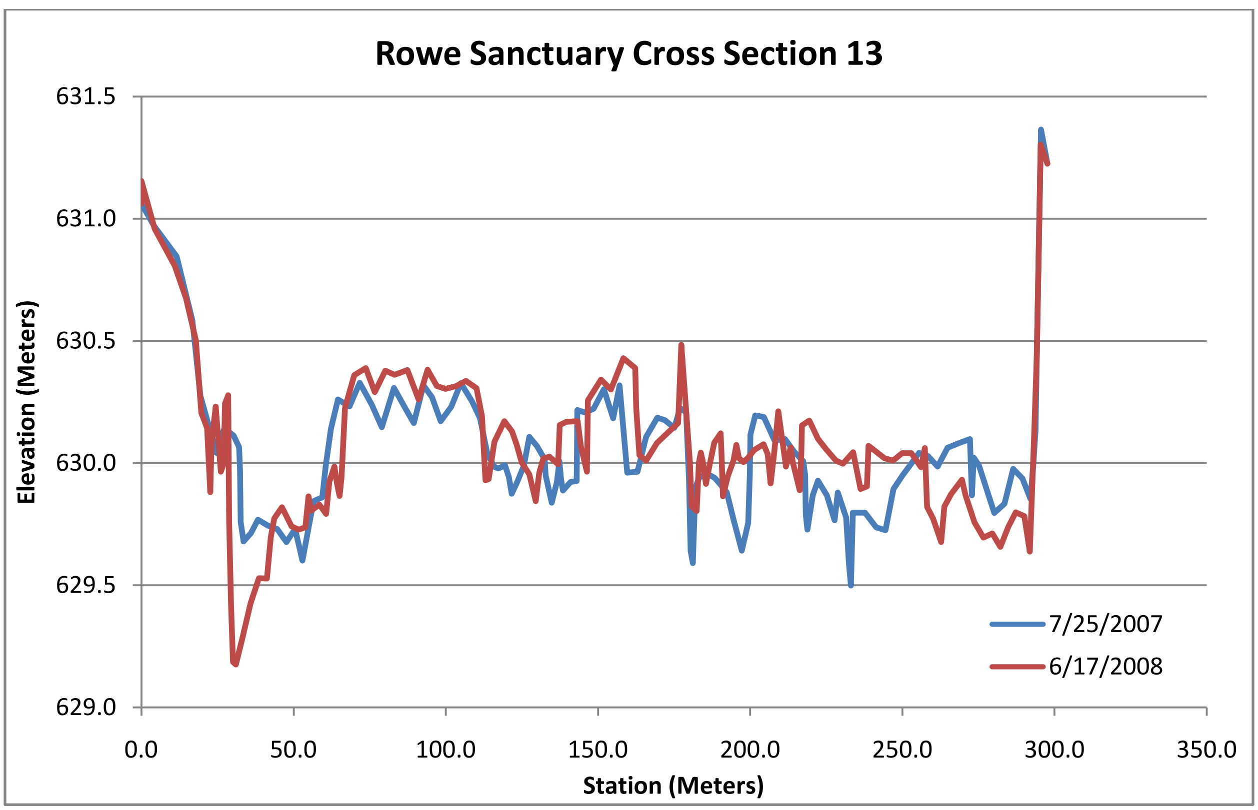


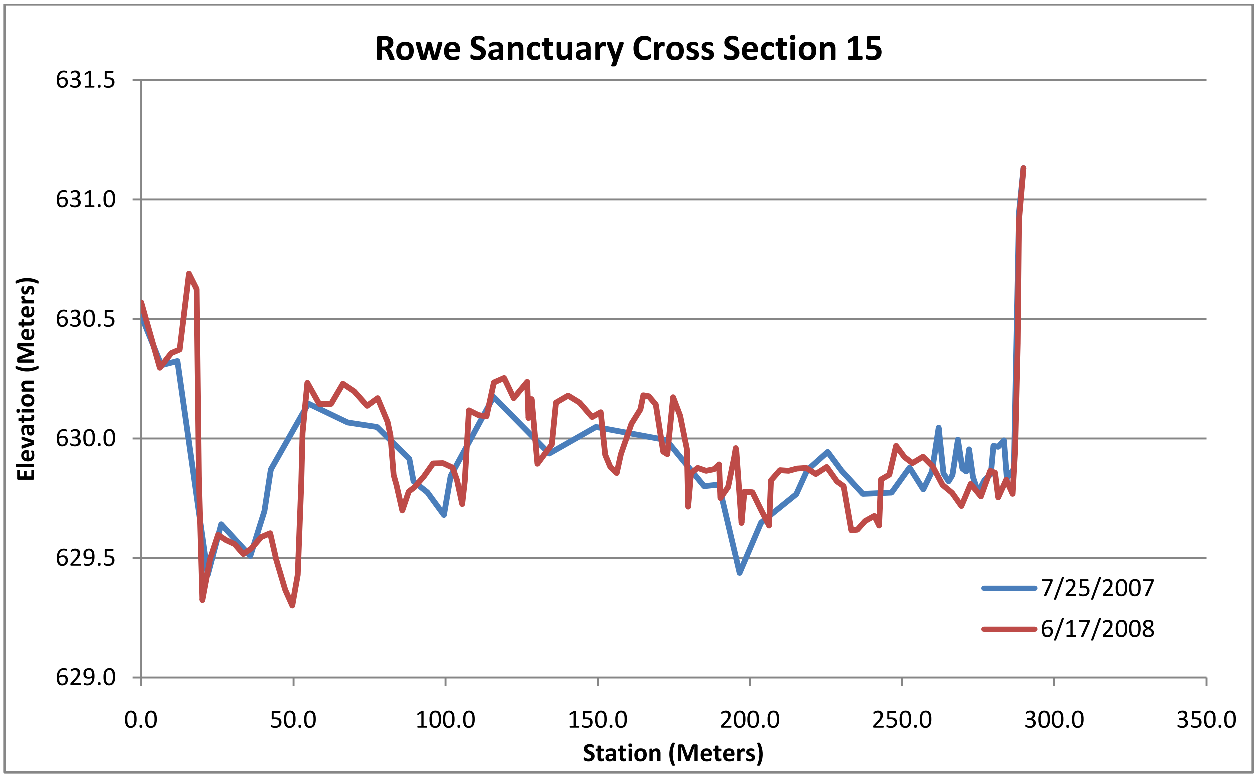
Cottonwood Ranch Output Reach Cross Section 23
692.5
692.0
691.5
691.0
690.5
690.0
689.5
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/10/2008
6/16/2008



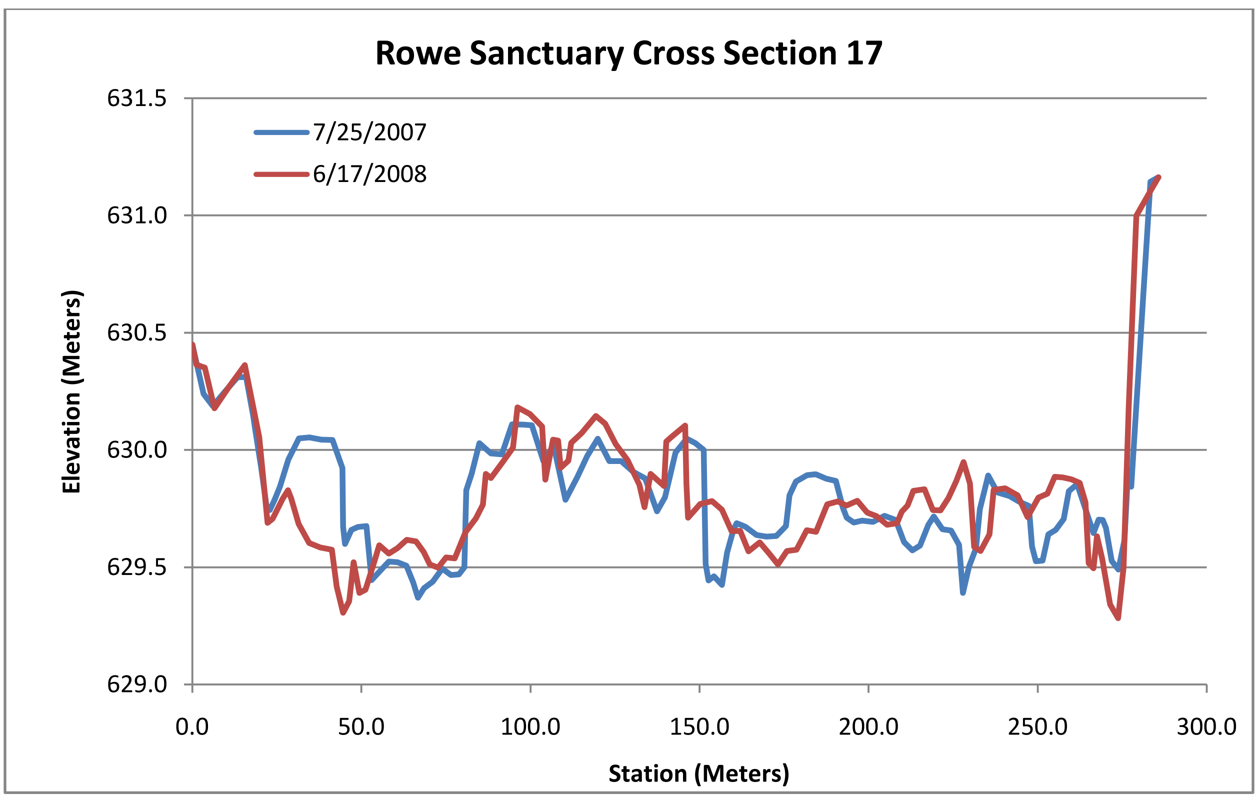
Cottonwood Ranch Output Reach Cross Section 25
692.0
691.5
691.0
690.5
690.0
689.5
Elevation (Meters)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
Station (Meters)
3/11/2008
6/16/2008


Rowe Sanctuary Cross Section 11
631.5
631.0
630.5
630.0
629.5
629.0
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Station (Meters)
7/25/2007
6/17/2008

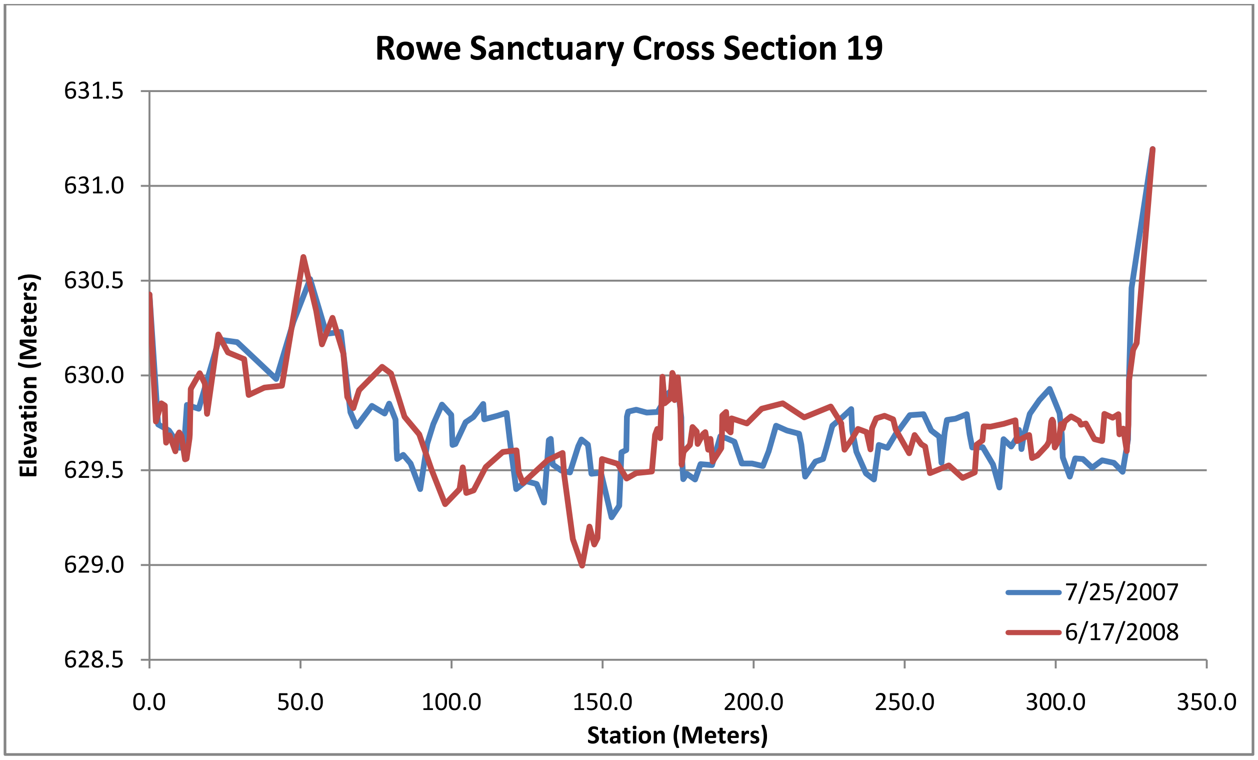

Rowe Sanctuary Cross Section 13
631.5
631.0
630.5
630.0
629.5
629.0
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Station (Meters)
7/25/2007
6/17/2008

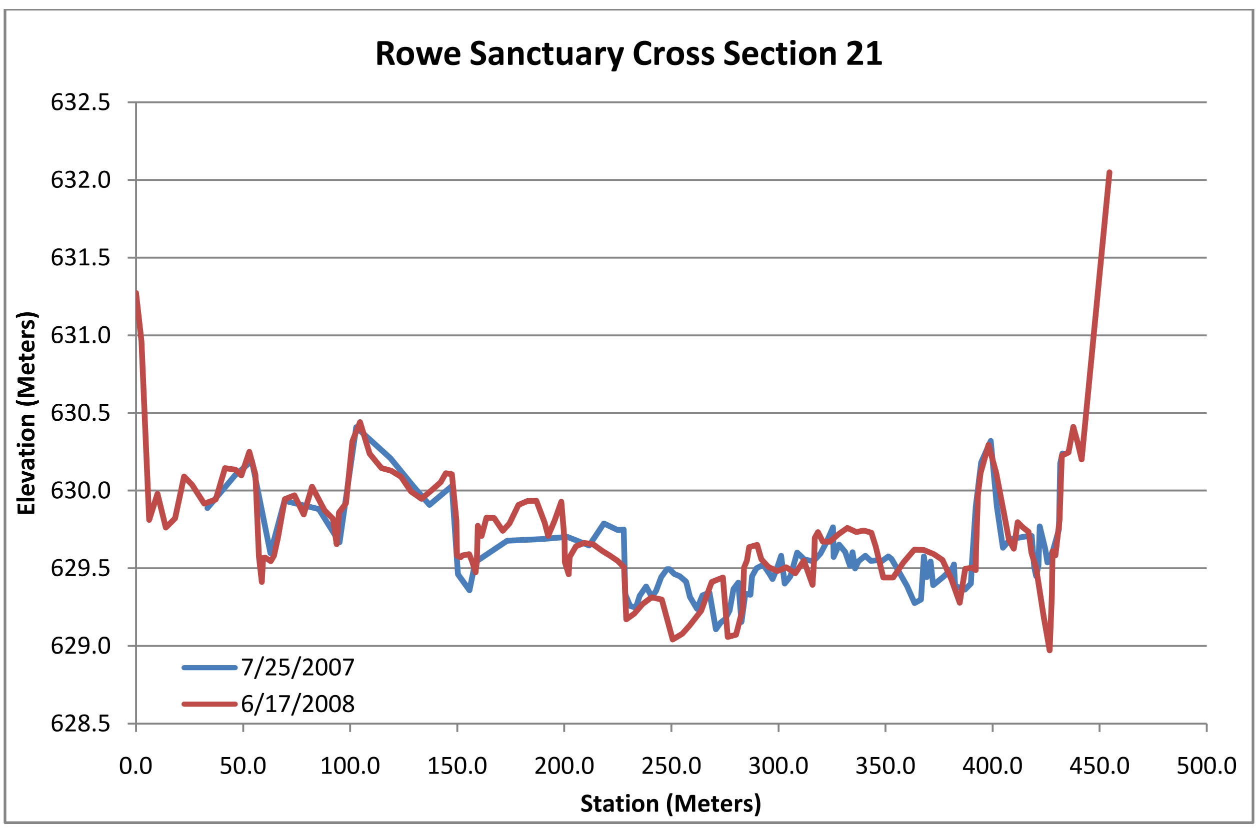


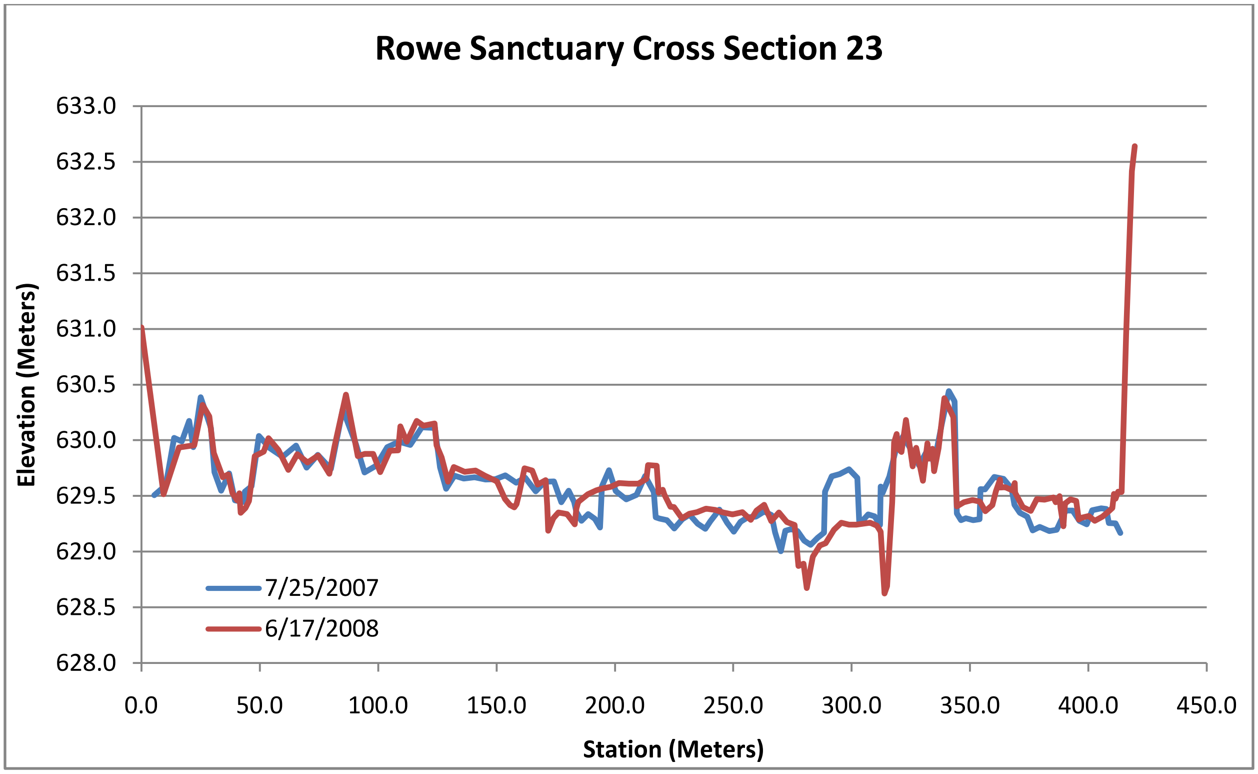
Rowe Sanctuary Cross Section 15
631.5
631.0
630.5
630.0
629.5
629.0
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Station (Meters)
7/25/2007
6/17/2008

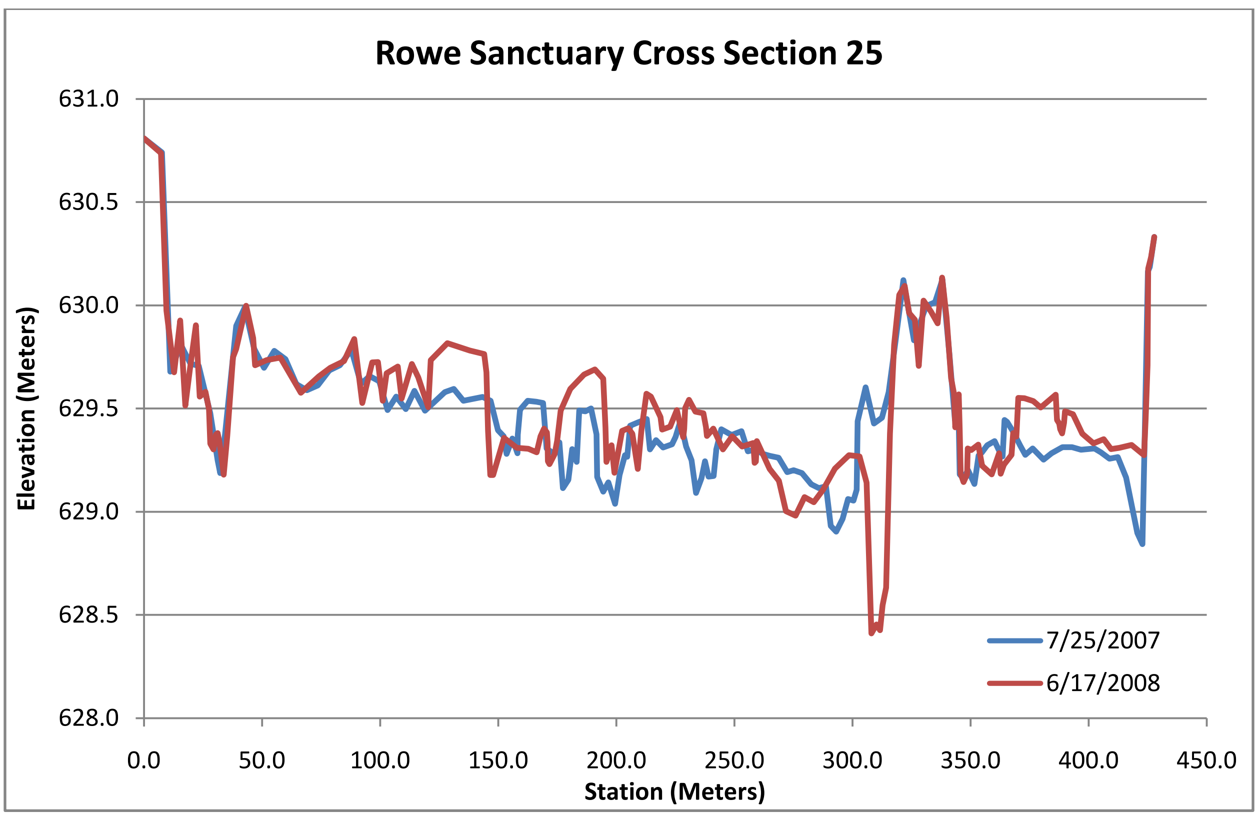


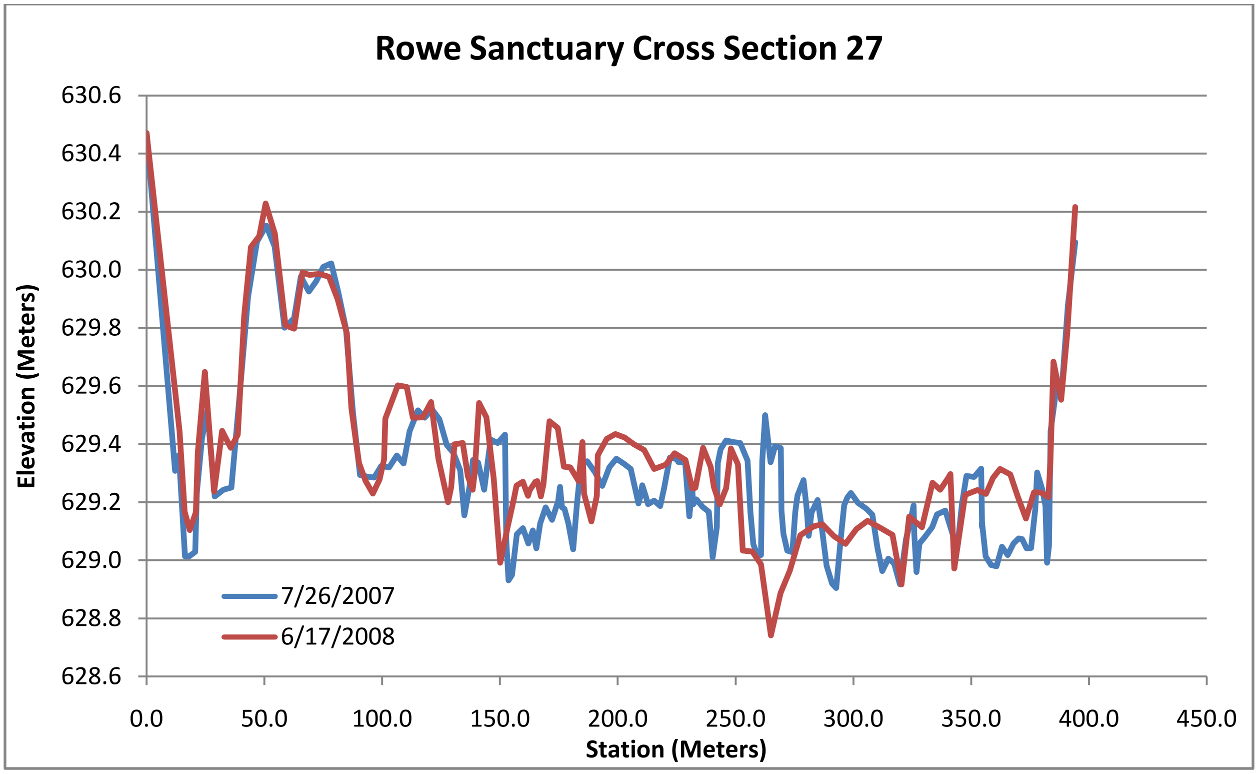
Rowe Sanctuary Cross Section 17
631.5
631.0
630.5
630.0
629.5
629.0
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Station (Meters)
7/25/2007
6/17/2008

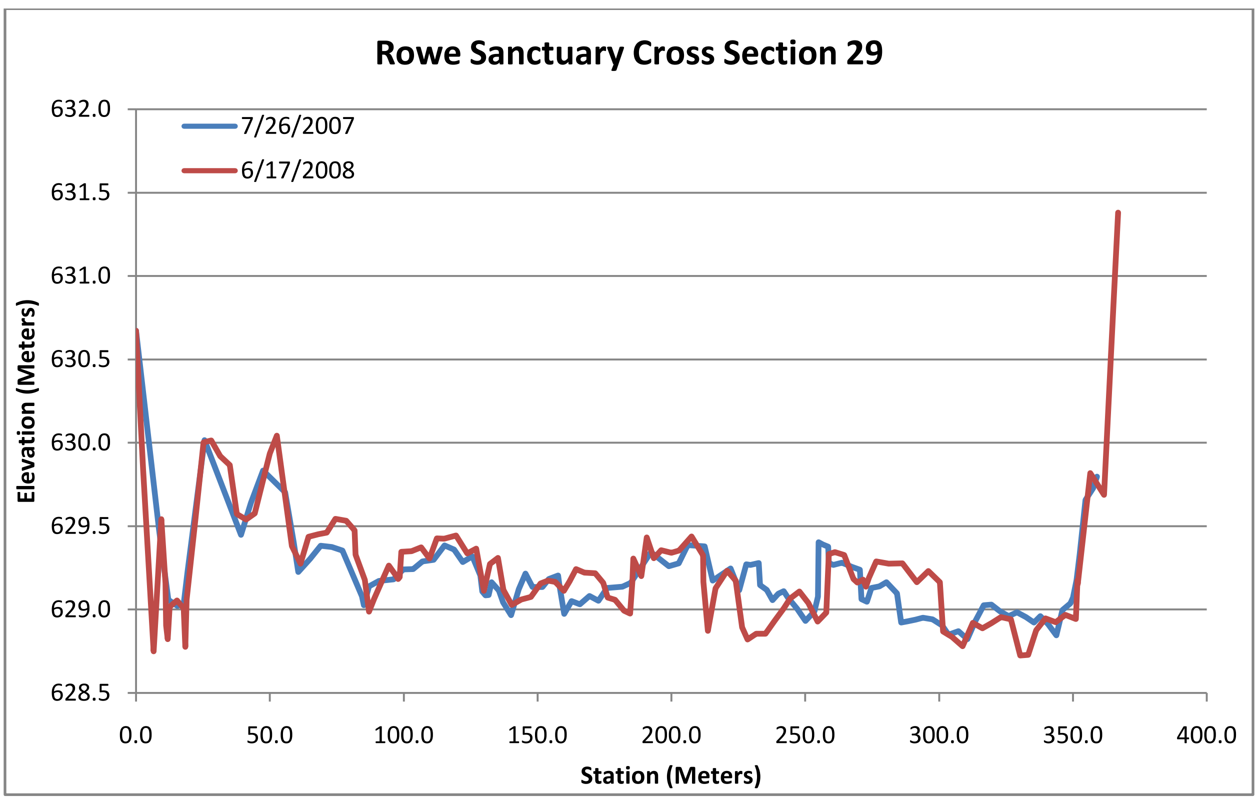

Rowe Sanctuary Cross Section 19
Elevation (Meters)
631.5
631.0
630.5
630.0
629.5
629.0
628.5
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Station (Meters)
7/25/2007
6/17/2008

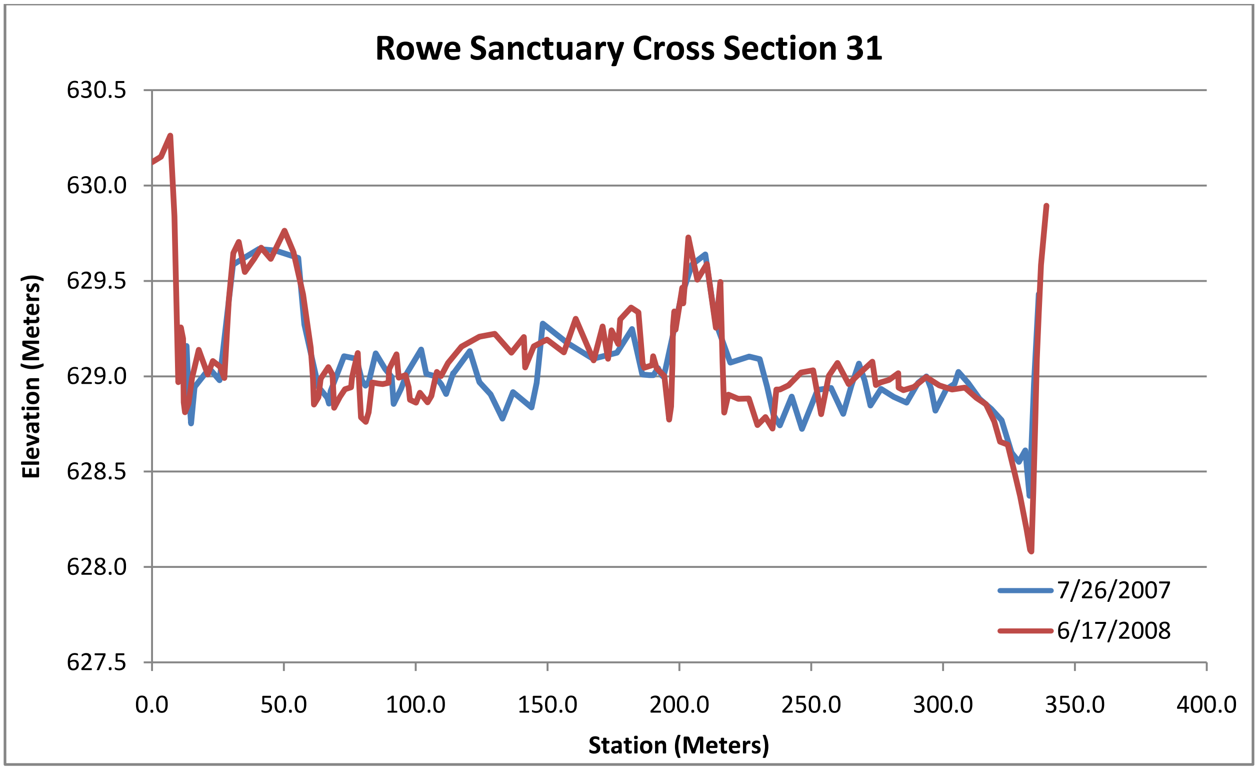

Rowe Sanctuary Cross Section 21
Elevation (Meters)
632.5
632.0
631.5
631.0
630.5
630.0
629.5
629.0
628.5
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
Station (Meters)
7/25/2007
6/17/2008

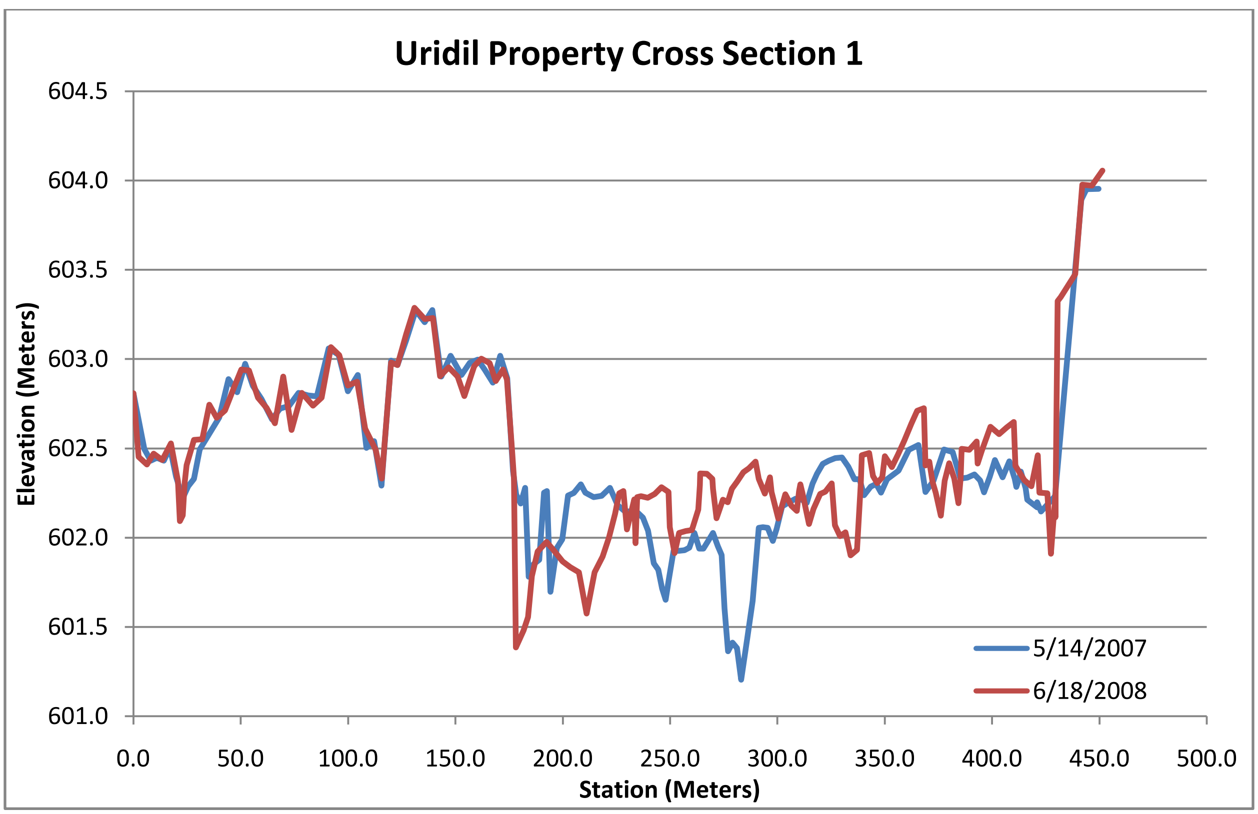

Rowe Sanctuary Cross Section 23
Elevation (Meters)
633.0
632.5
632.0
631.5
631.0
630.5
630.0
629.5
629.0
628.5
628.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Station (Meters)
7/25/2007
6/17/2008

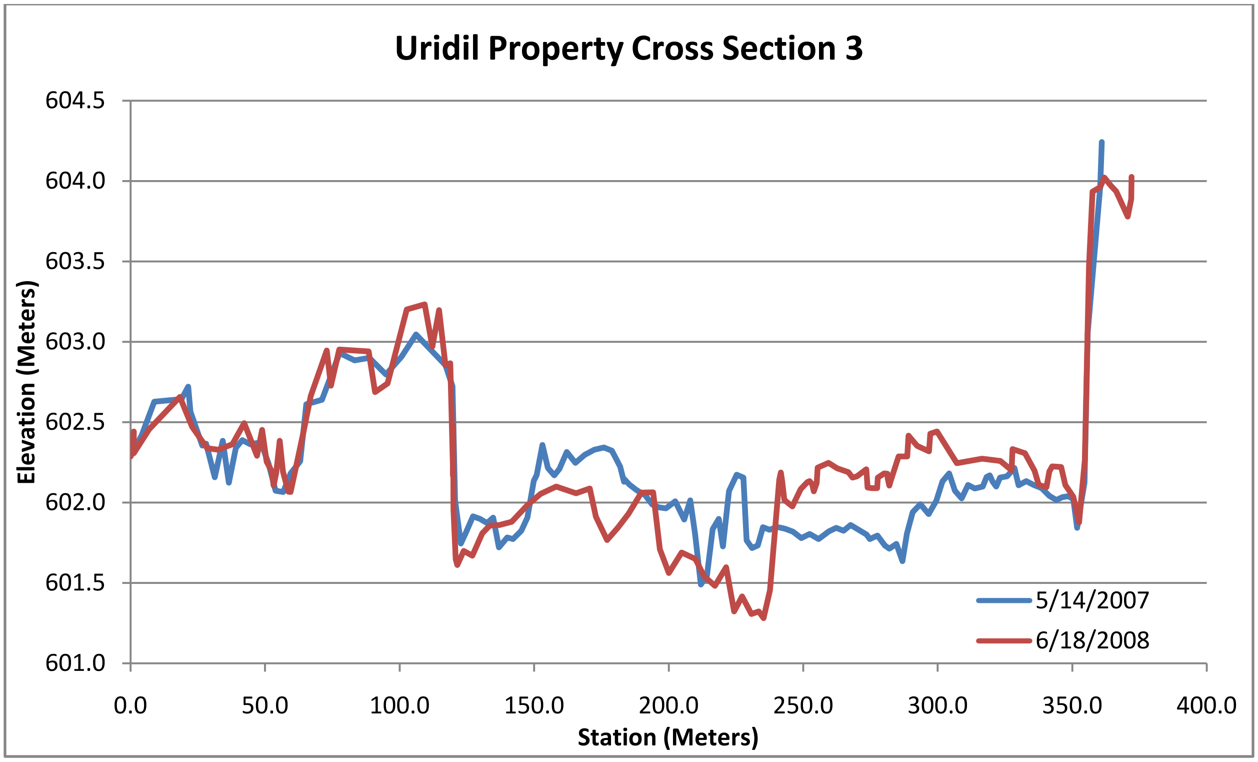

Rowe Sanctuary Cross Section 25
Elevation (Meters)
631.0
630.5
630.0
629.5
629.0
628.5
628.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Station (Meters)
7/25/2007
6/17/2008

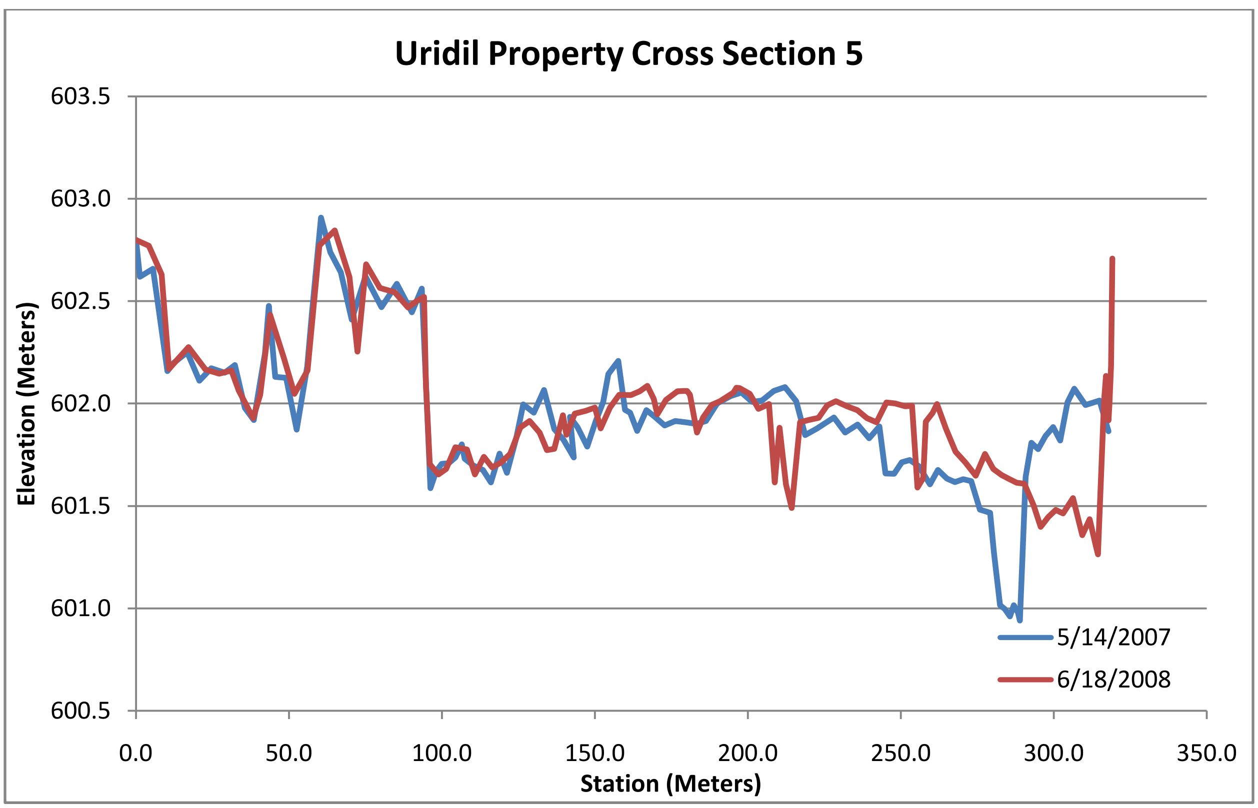

Rowe Sanctuary Cross Section 27
Elevation (Meters)
Station (Meters)
7/26/2007
6/17/2008
630.6
630.4
630.2
630.0
629.8
629.6
629.4
629.2
629.0
628.8
628.6
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0

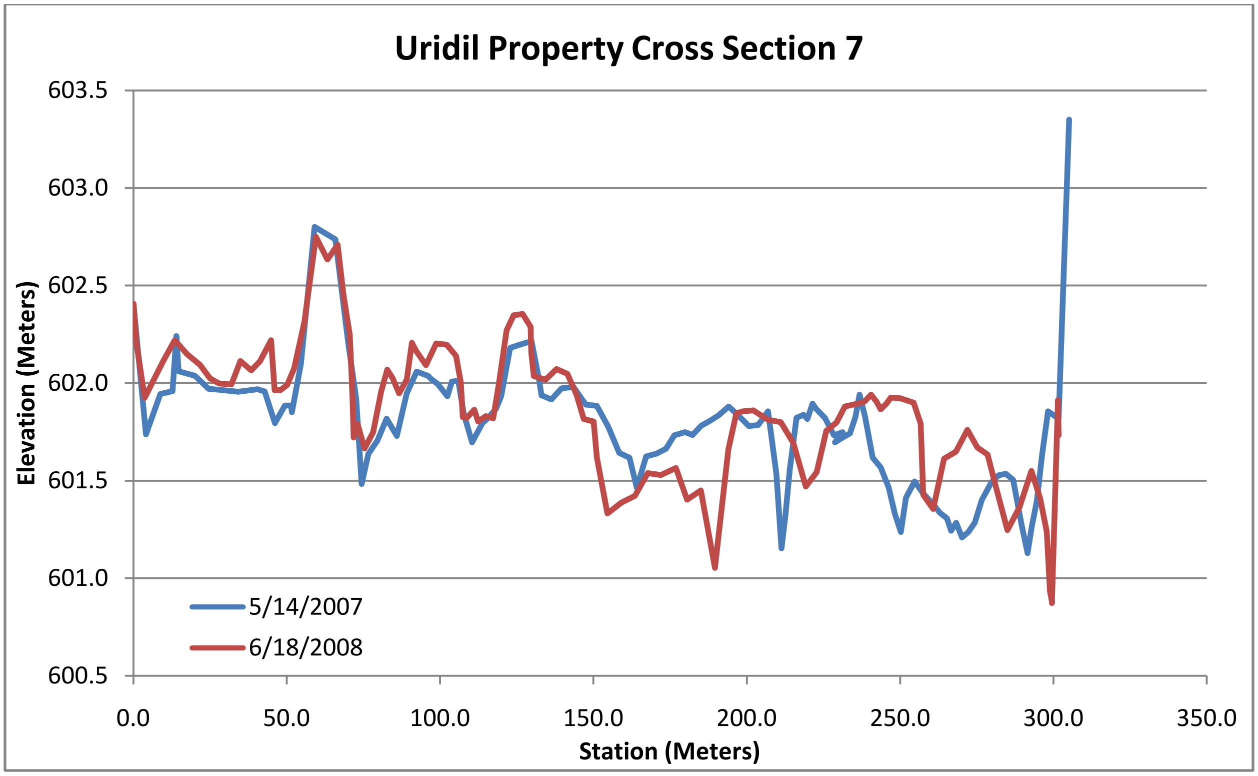

Rowe Sanctuary Cross Section 29
Elevation (Meters)
Station (Meters)
7/26/2007
6/17/2008
632.0
631.5
631.0
630.5
630.0
629.5
629.0
628.5
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0


Rowe Sanctuary Cross Section 31
Elevation (Meters)
630.5
630.0
629.5
629.0
628.5
628.0
627.5
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
Station (Meters)
7/26/2007
6/17/2008

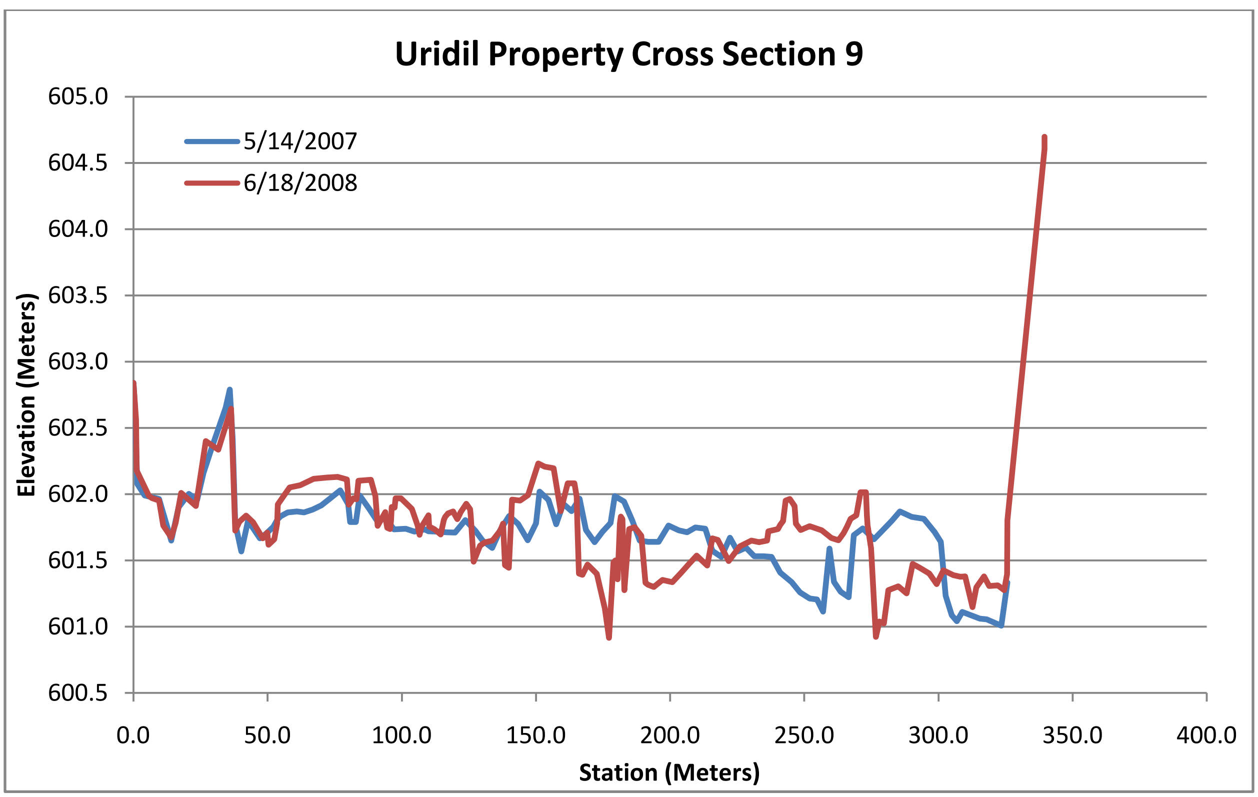

Uridil Property Cross Section 1
Elevation (Meters)
604.5
604.0
603.5
603.0
602.5
602.0
601.5
601.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
Station (Meters)
5/14/2007
6/18/2008


Uridil Property Cross Section 3
604.5
604.0
603.5
603.0
602.5
602.0
601.5
601.0
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
Station (Meters)
5/14/2007
6/18/2008

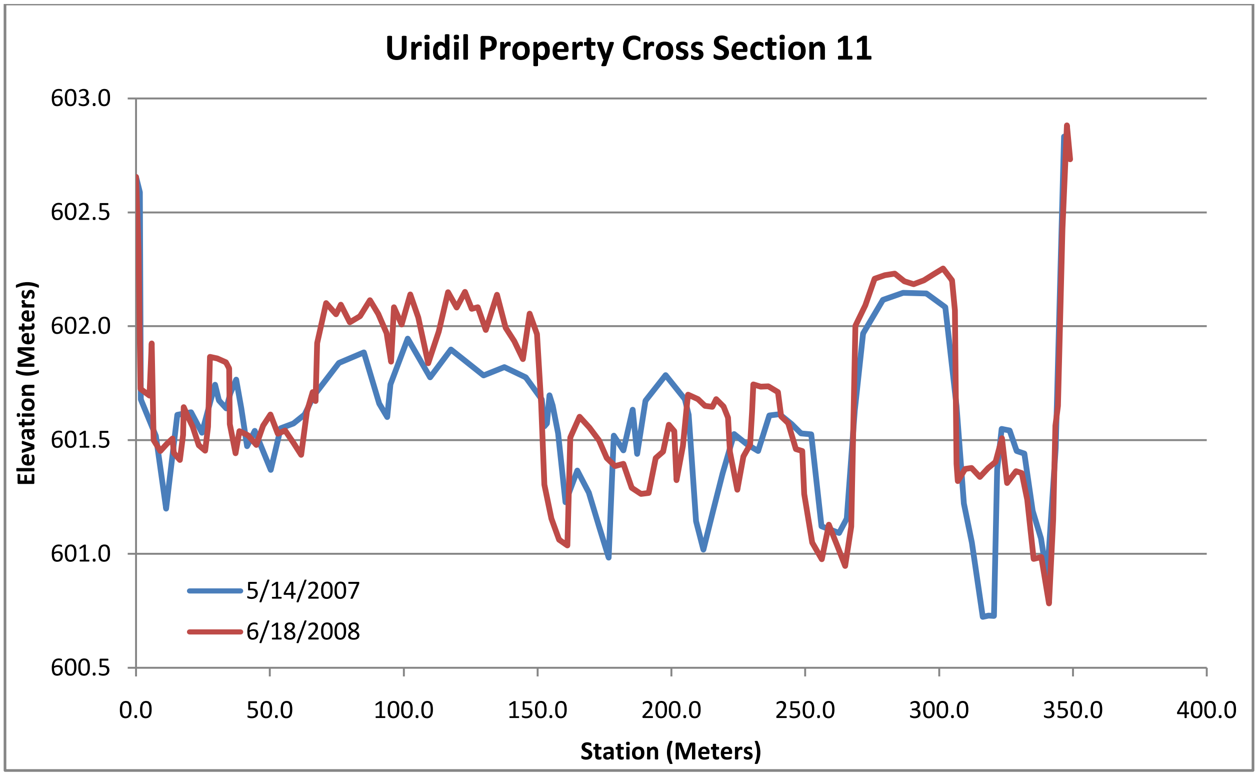

Uridil Property Cross Section 5
603.5
603.0
602.5
602.0
601.5
601.0
600.5
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Station (Meters)
5/14/2007
6/18/2008

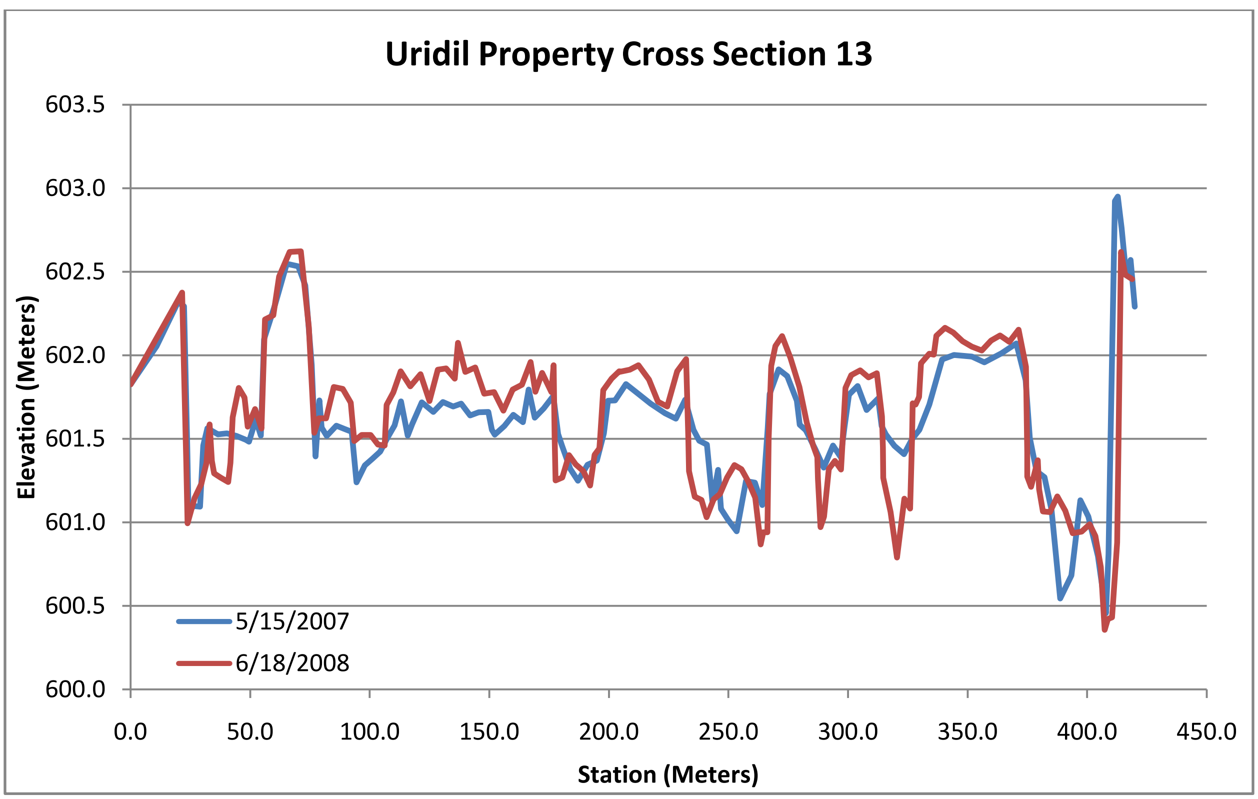


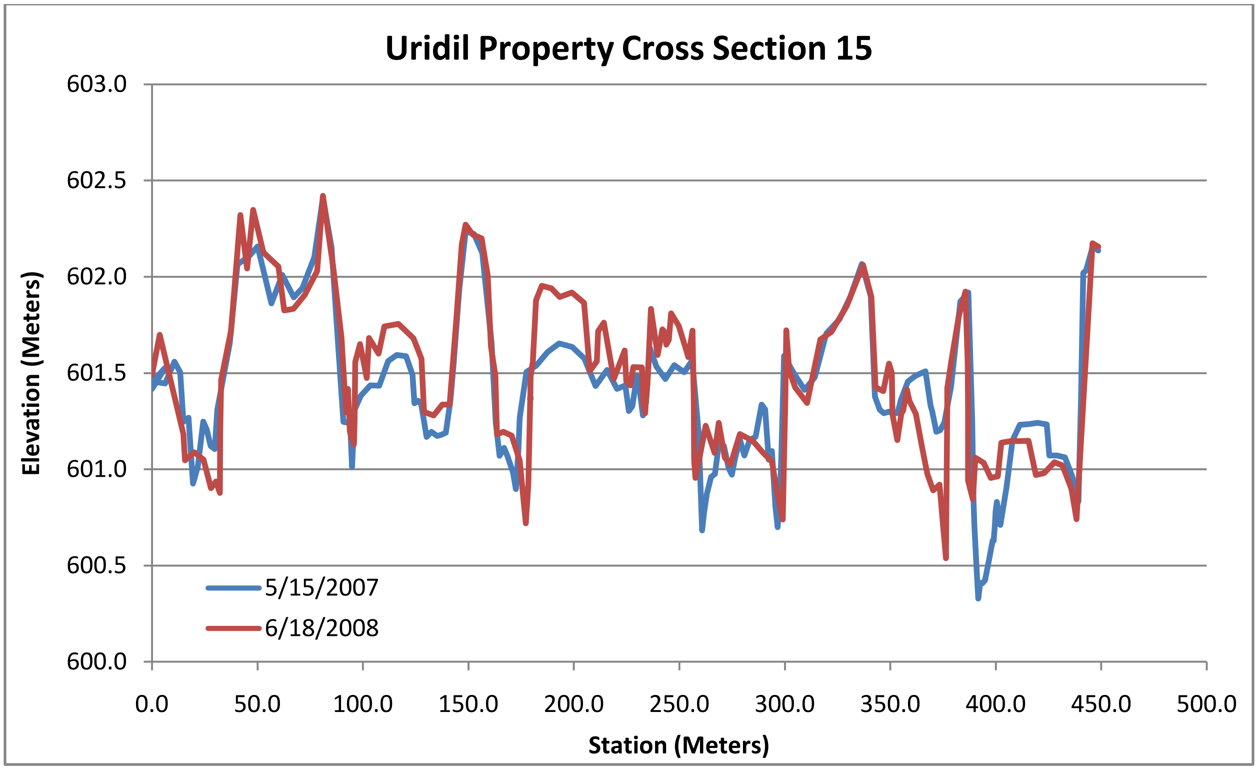
Uridil Property Cross Section 7
603.5
603.0
602.5
602.0
601.5
601.0
600.5
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Station (Meters)
5/14/2007
6/18/2008

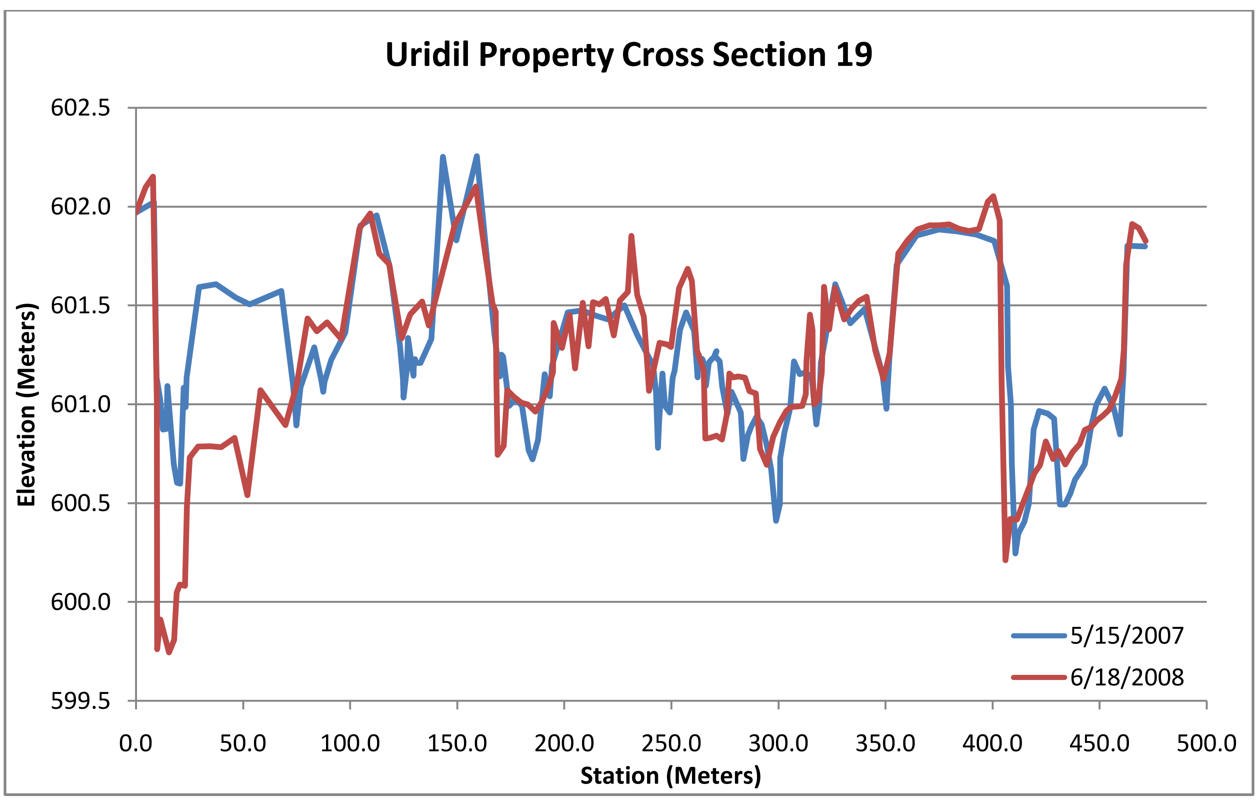


Uridil Property Cross Section 9
605.0
604.5
604.0
603.5
603.0
602.5
602.0
601.5
601.0
600.5
Elevation (Meters)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
Station (Meters)
5/14/2007
6/18/2008

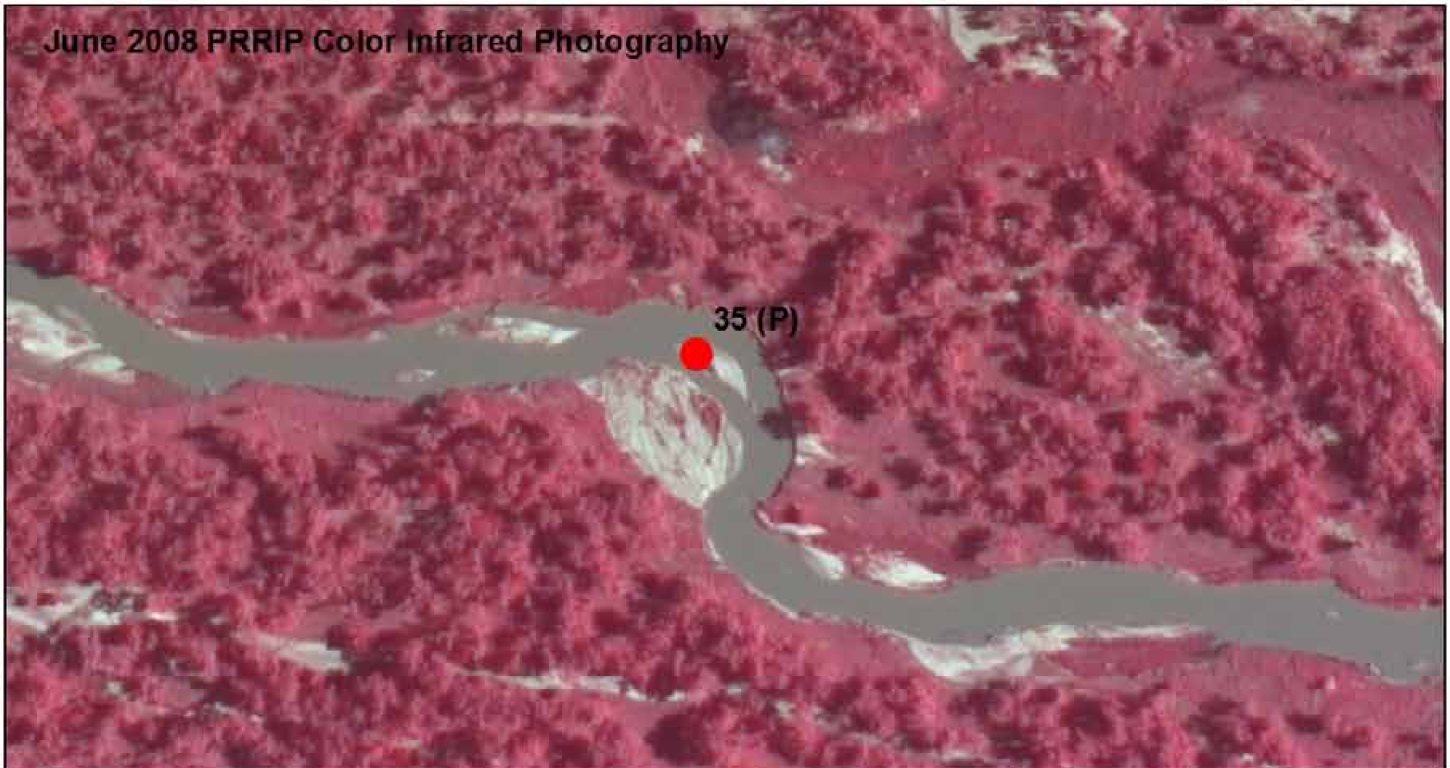

Uridil Property Cross Section 11
Elevation (Meters)
603.0
602.5
602.0
601.5
601.0
600.5
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
Station (Meters)
5/14/2007
6/18/2008


Uridil Property Cross Section 13
Elevation (Meters)
603.5
603.0
602.5
602.0
601.5
601.0
600.5
600.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
Station (Meters)
5/15/2007
6/18/2008


Uridil Property Cross Section 15
Elevation (Meters)
603.0
602.5
602.0
601.5
601.0
600.5
600.0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
Station (Meters)
5/15/2007
6/18/2008


Uridil Property Cross Section 19
Elevation (Meters)
602.5
602.0
601.5
601.0
600.5
600.0
599.5
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
Station (Meters)
5/15/2007
6/18/2008

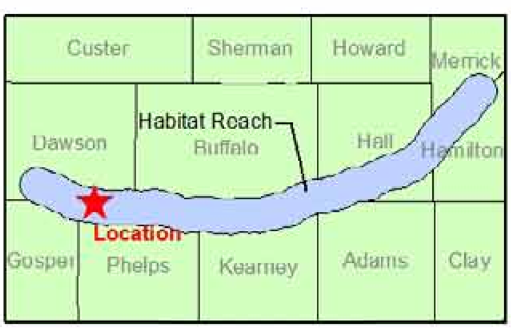
APPENDIX D – SAND BAR SURVEY SUMMARY SHEETS



Anchor Point Number:	35	Date:	6/25/2008	Flow:	600	cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	NO BARS W/ LESS THAN 25% VEG					All vegetated

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



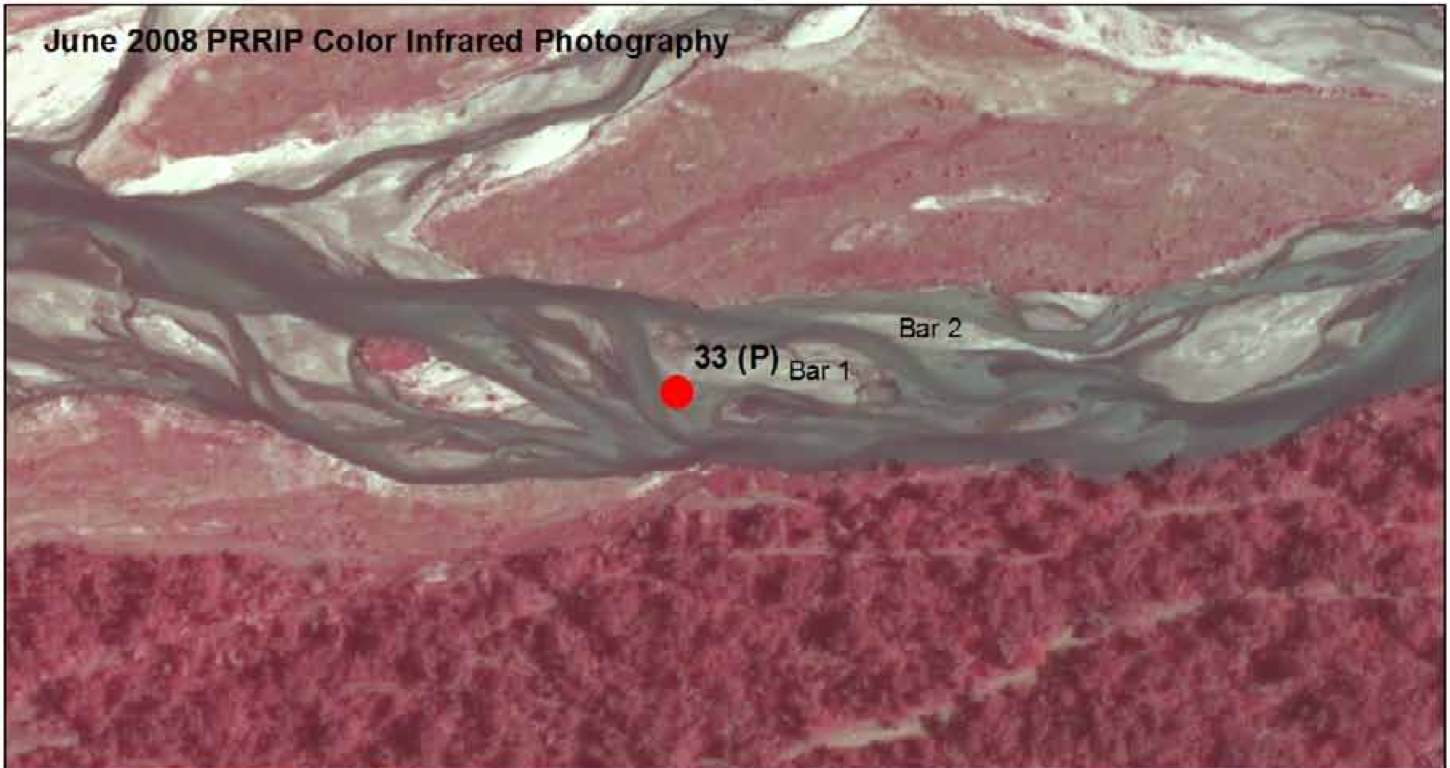
N

Meters
100

ANCHOR POINT 35
SAND BAR SURVEY

Date: 10/29/08
By: JMF

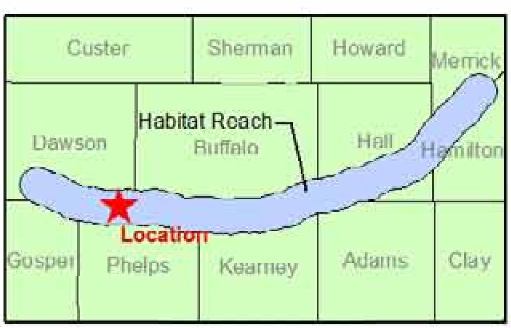
Figure D-1



Anchor Point Number:	33	Date:	6/25/2008	Flow:	600 cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	26	74	0.21	1.00	20%	
2	15	56	0.27	1.16	0%	

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



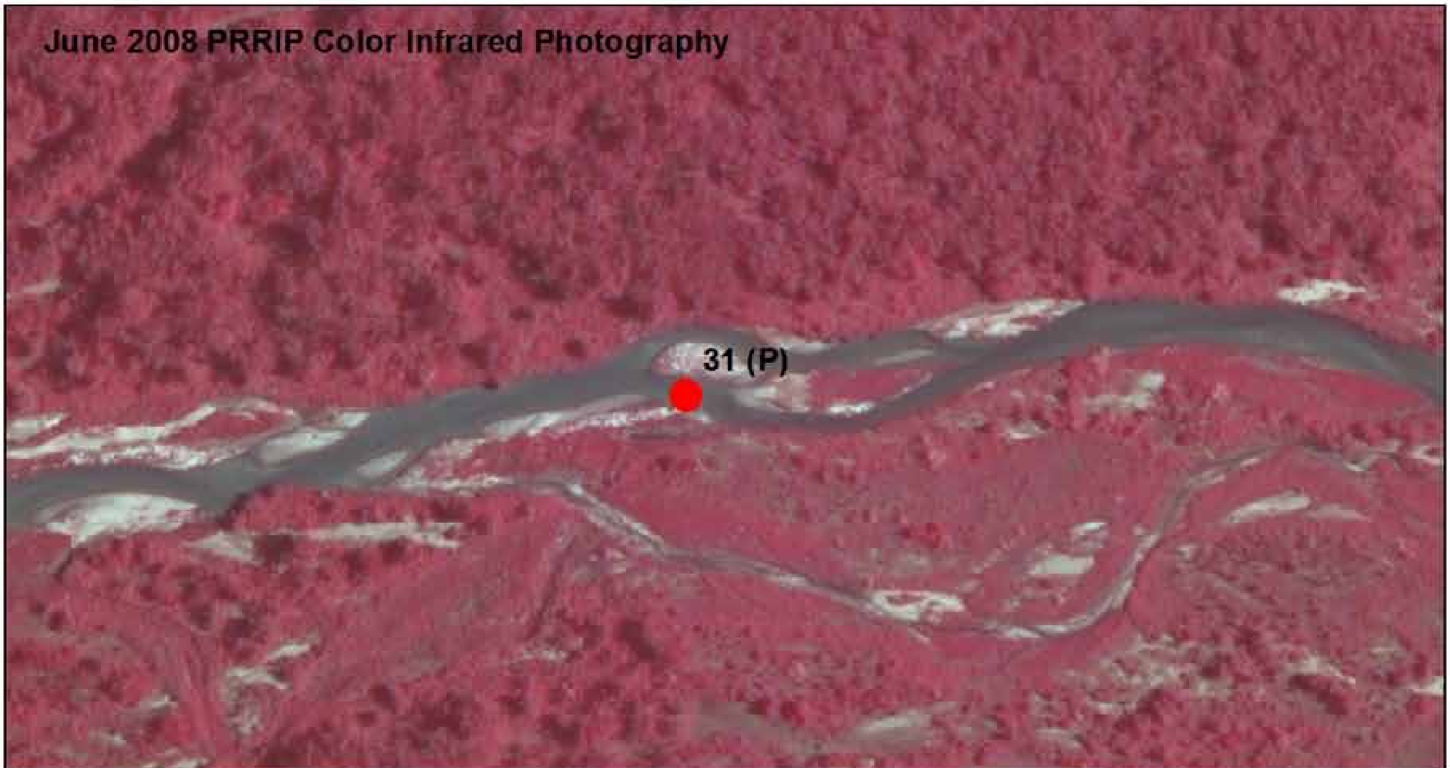
N

Meters
100

ANCHOR POINT 33
SAND BAR SURVEY

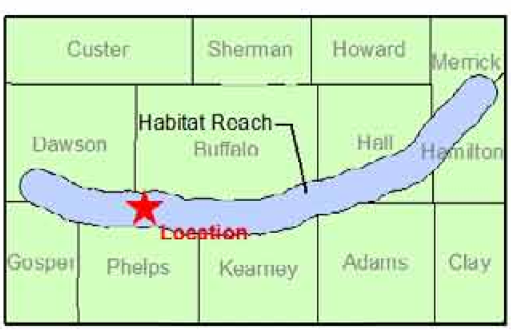
Date: 10/29/08
By: JMF

Figure D-2



Anchor Point Number:	31		Date:	6/25/2008	Flow:	600 cfs
Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	NO BARS					

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM



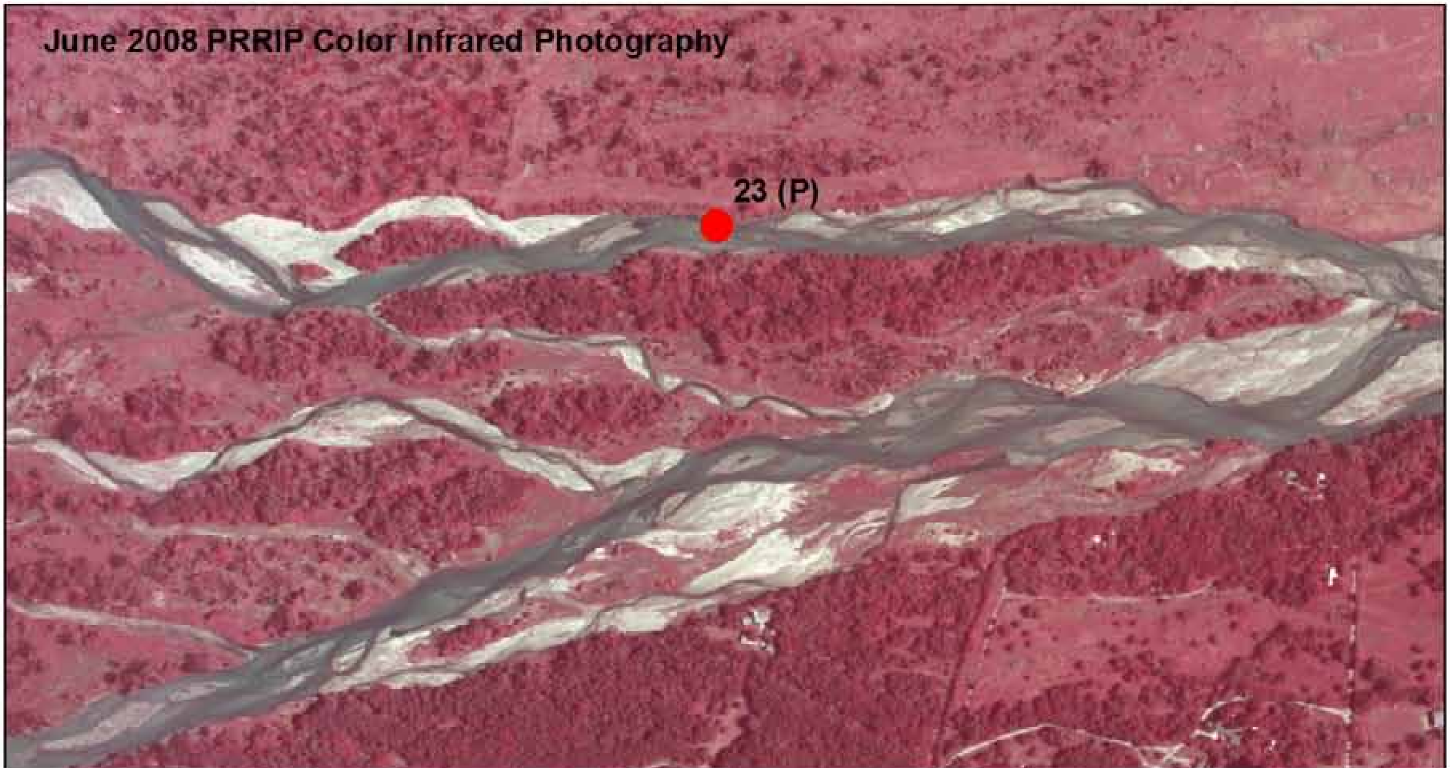
N

Meters
100

ANCHOR POINT 31
SAND BAR SURVEY

Date: 10/29/08
By: JMF

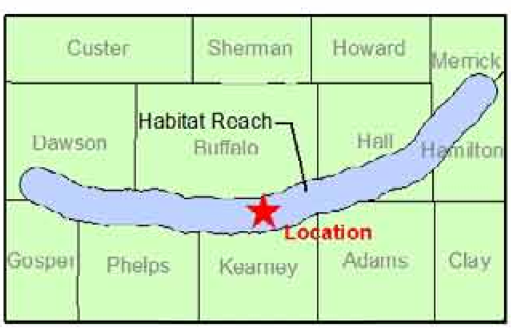
Figure D-3



Anchor Point Number:	23	Date:	6/24/2008	Flow:	700	cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	NO BARS					

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



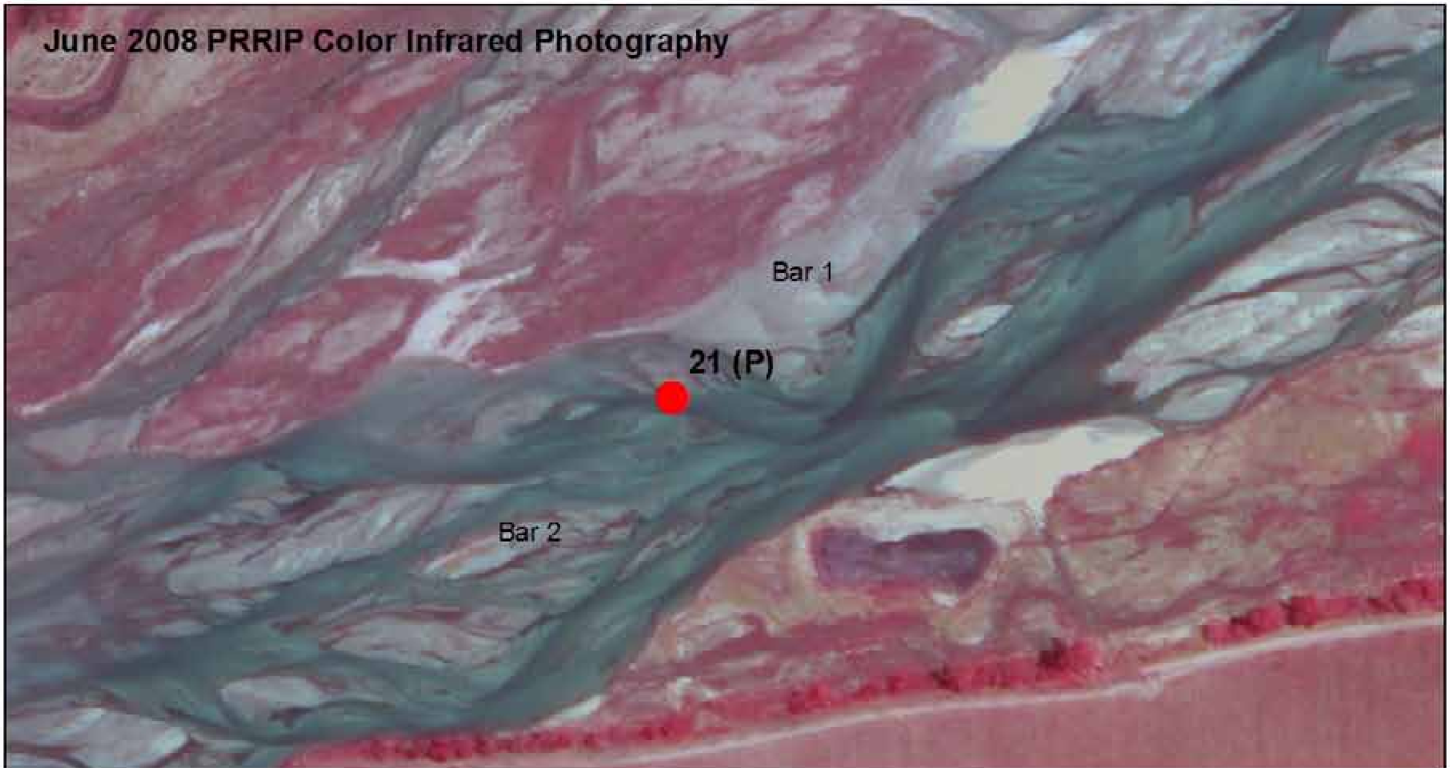
N

Meters
200

ANCHOR POINT 23
SAND BAR SURVEY

Date: 10/29/08
By: JMF

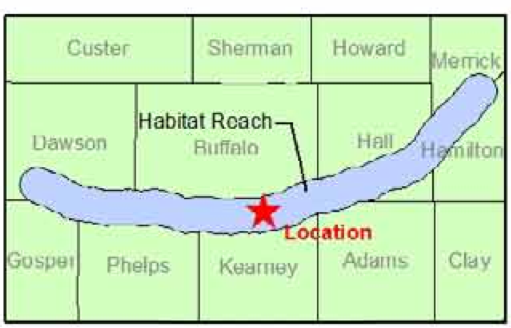
Figure D-4



Anchor Point Number: **21** Date: **6/24/2008** Flow: **700** cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	43	150	0.15	0.24	1%	Point Bar
2	35	54	0.09	0.51	0%	

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM



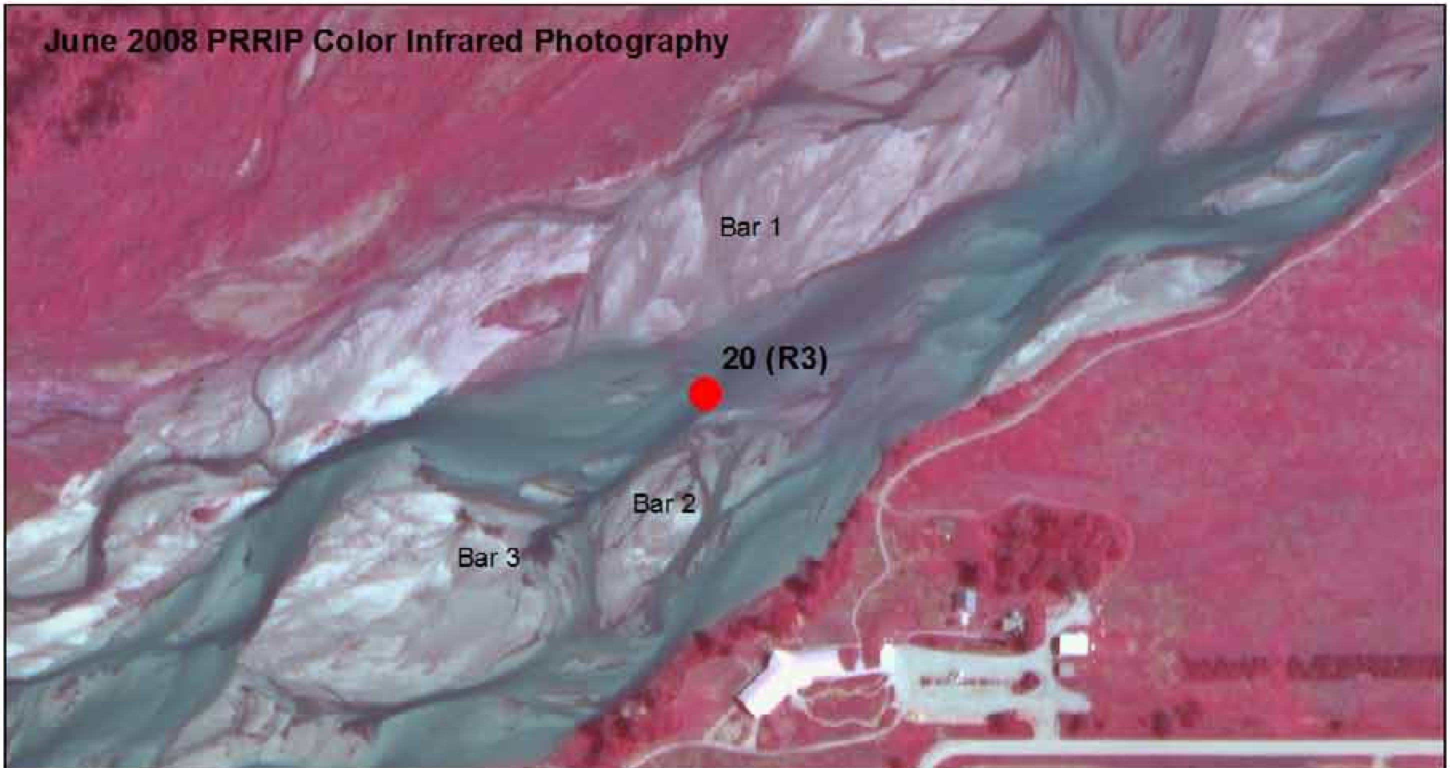
N

Meters
100

ANCHOR POINT 21
SAND BAR SURVEY

Date: 10/29/08
By: JMF

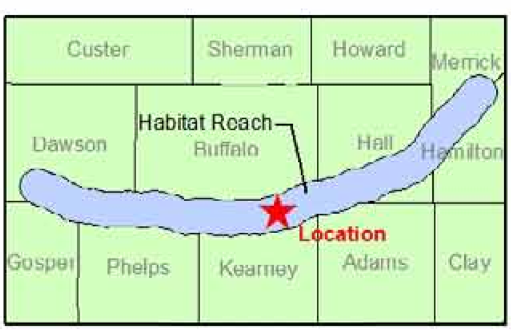
Figure D-5



Anchor Point Number: **20** Date: **6/24/2008** Flow: **700** cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	72	300	0.37	0.21	15%	
2	25	146	0.42	0.42	10%	
3	20	70	0.42	0.42	1%	partially in survey

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



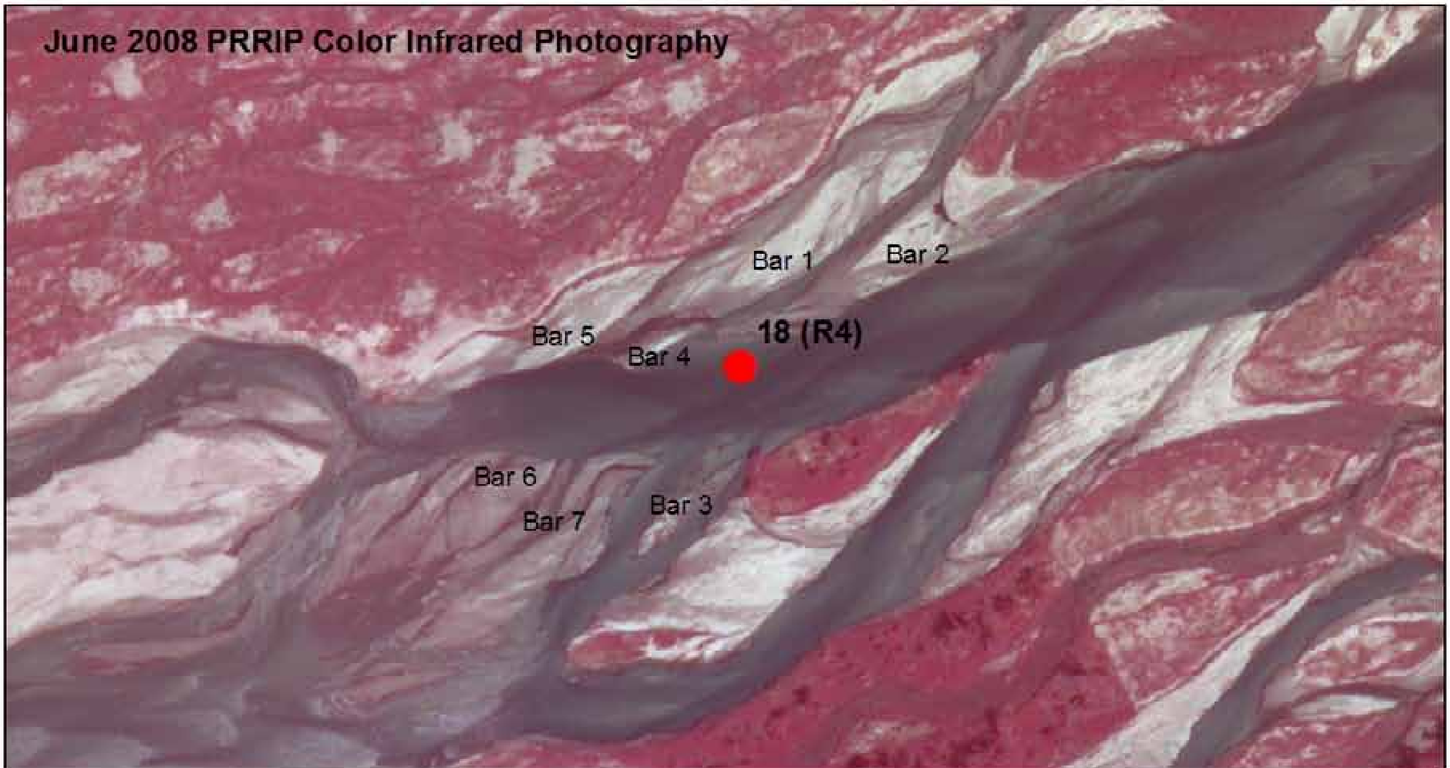
N

Meters
100

ANCHOR POINT 20
SAND BAR SURVEY

Date: 10/29/08
By: JMF

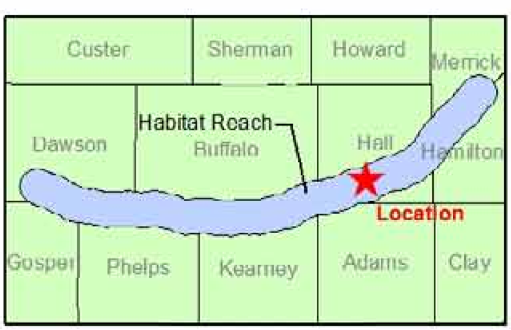
Figure D-6



Anchor Point Number:	18	Date:	6/24/2008	Flow:	700	cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	13	159	0.37	0.27	1%	
2	9	77	0.15	0.48	3%	
3	2	18	0.1	0.27	0%	
4	3	20	0.27	0.39	1%	
5	5	77	0.39	0.45	2%	Point Bar
6	10	25	0.06	0.55	0%	
7	18	25	0.15	0.55	2%	

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



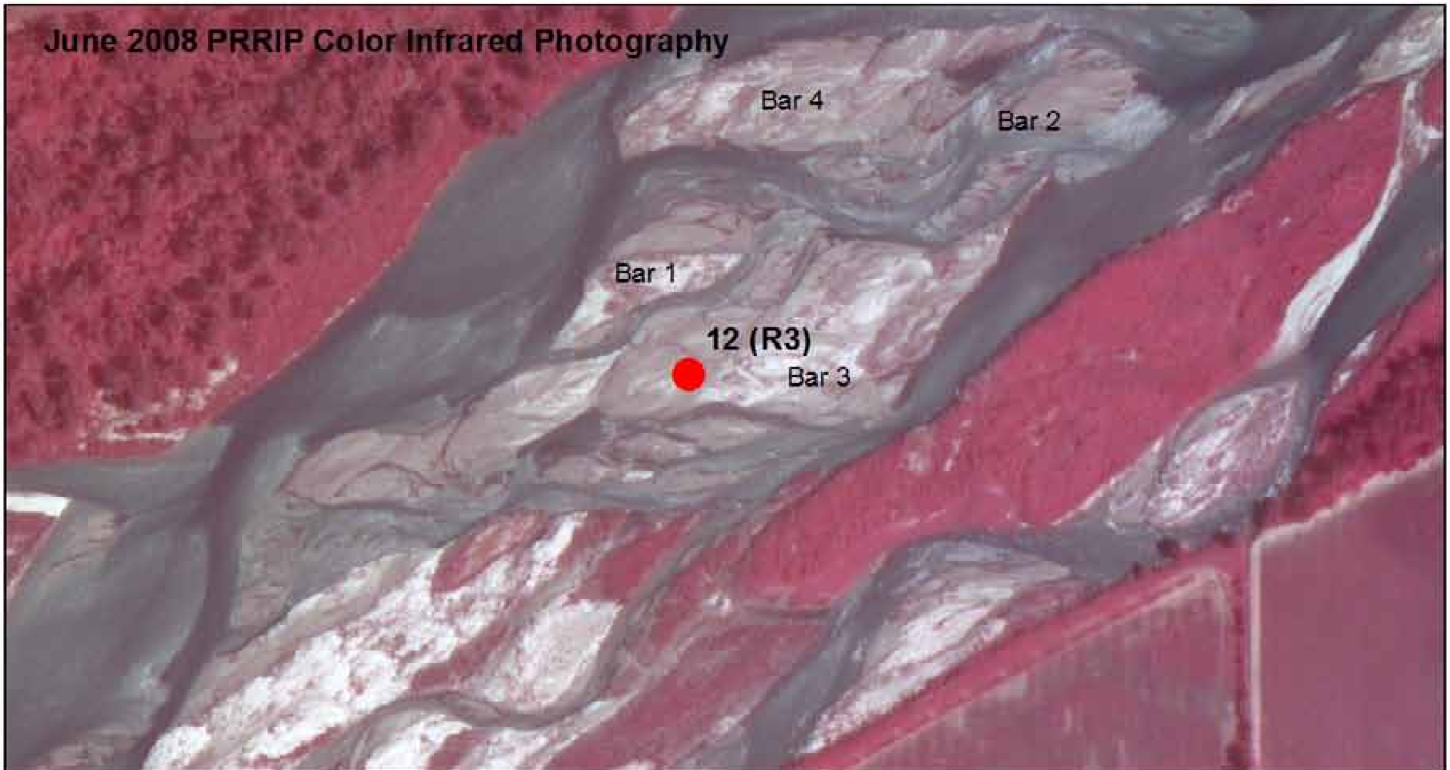
N

Meters
100

ANCHOR POINT 18
SAND BAR SURVEY

Date: 10/29/08
By: JMF

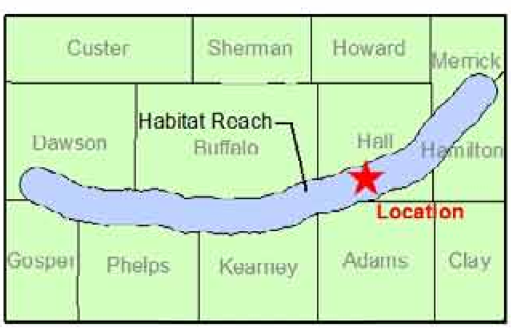
Figure D-7



Anchor Point Number:	12	Date:	6/26/2008	Flow:	3,000 cfs

Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	23	68	0.36	0.73	25%	
2	22	77	0.27	0.37	5%	
3	33	171	0.37	0.27	15%	
4	40	150	0.33	0.37	25%	

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



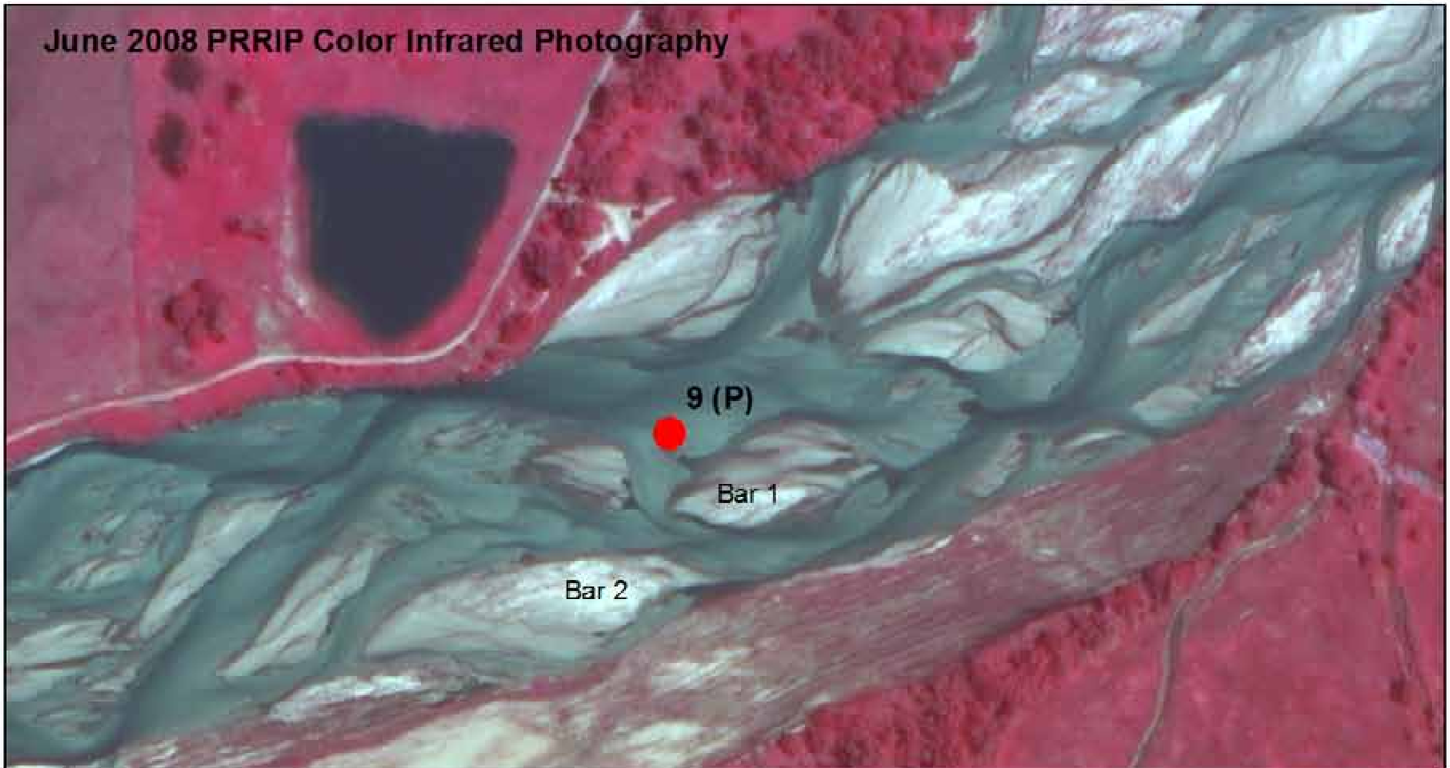
N

Meters
100

ANCHOR POINT 12
SAND BAR SURVEY

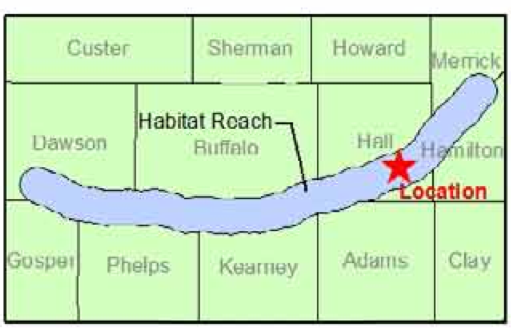
Date: 10/29/08
By: JMF

Figure D-8



Anchor Point Number:	9	Date:	6/26/2008	Flow:	3,000 cfs	
Bar Number	Max Width (m)	Max Length (m)	Max Elevation above Water (m)	Max Water Depth (m)	Vegetative Cover (%)	Comments
1	21	53	0.27	0.55	15%	
2	27	93	0.3	0.32	20%	

PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM



N

Meters
100

ANCHOR POINT 9
SAND BAR SURVEY

Date: 10/29/08
By: JMF

Figure D-9