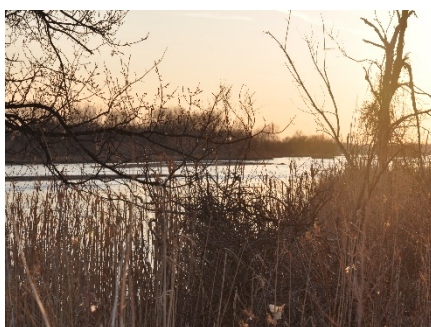




KEARNEY CANAL SEDIMENTATION ANALYSIS



06/02/2014

An analysis of sedimentation in the Kearney Canal during sediment augmentation activities of the Platte River Recovery Implementation Program
(Draft for Review by the Governance Committee)



PLATTE RIVER
RECOVERY IMPLEMENTATION PROGRAM

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Disclaimer:

The statements and conclusions contained in this draft of the Kearney Canal Sedimentation Analysis are the opinion of each author and do not represent Program-approved and agreed-to findings.

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Introduction

The Platte River Recovery Implementation Program (Program) began augmenting sediment in the Platte River in 2009 as a part of implementation of the Program's Adaptive Management Plan (Program, 2006). In 2009, augmentation of sediment occurred at the Cottonwood Ranch habitat complex as a part of channel widening activities. At that time, the Nebraska Public Power District (NPPD) expressed concern that these activities would result in increased sedimentation in the NPPD owned and operated Kearney Canal, which is located downstream of the Cottonwood Ranch complex (**Figure 1** – *inserted between pages 4 and 5*). To address these concerns, the Program's Governance Committee (GC) approved a three-year monitoring program that consisted of annual cross section and longitudinal surveys of the canal, as well as continuous and discrete water quality monitoring in the canal and the Platte River. The monitoring program concluded in the fall of 2013. This report presents the results of an analysis performed by the Program's Executive Director's Office (EDO) that was intended to: (1) identify aggradational and degradational trends in the Kearney Canal, and (2) evaluate the correlation between turbidity in the canal and Program sediment augmentation activities.

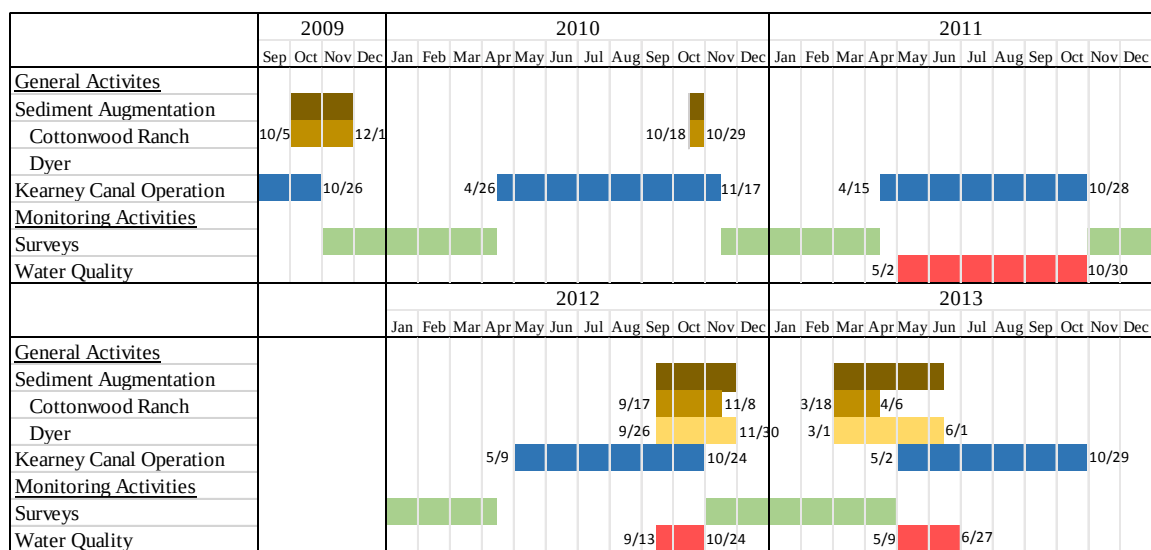
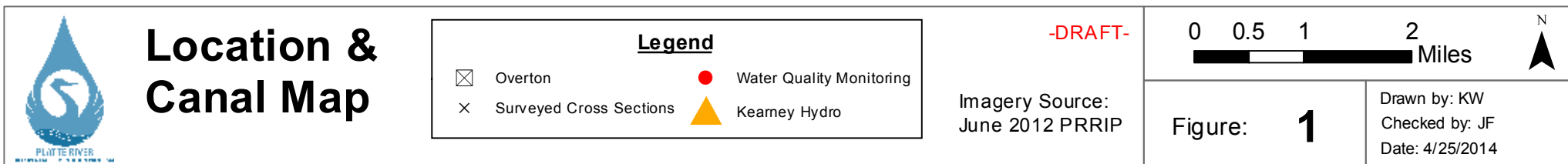
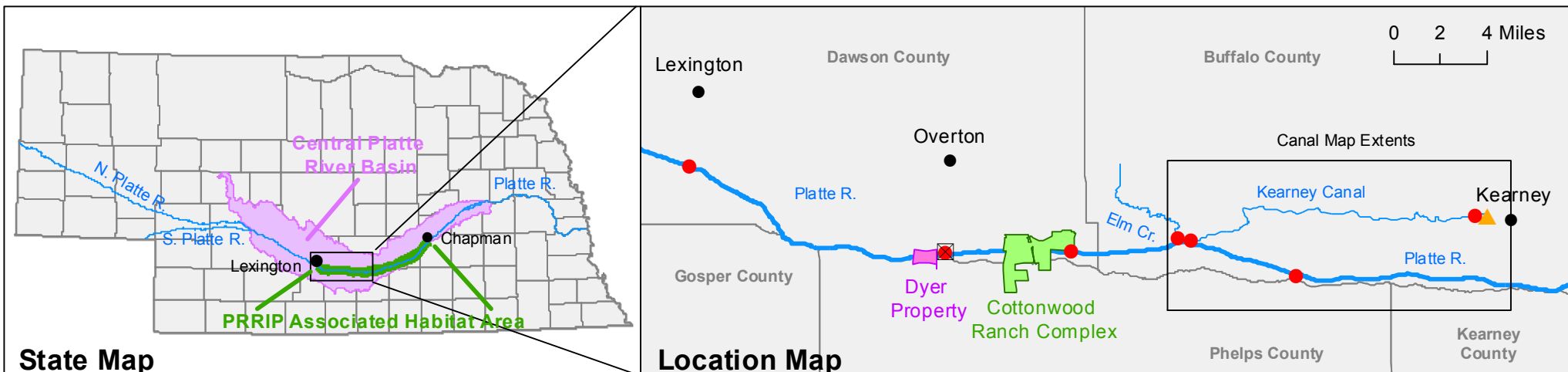


Figure 2: Timeline of relevant Program and NPPD activities (with begin and end dates).

Background

Relevant Activities

A timeline of relevant activities from 2009 to 2013 is shown in **Figure 2**. The Program augmented sediment in the Platte River in 2009, 2010, 2012 and 2013. Sediment augmentation did not take place in 2011. In 2009 and 2010, augmentation was performed in the fall at the Cottonwood Ranch complex as a part of channel widening activities. In 2012 and 2013, augmentation was performed in the fall and spring, respectively, at both the Cottonwood Ranch complex and Dyer property as part of a pilot-scale augmentation project (The Flat Water Group et al., 2013). In all years, NPPD operated the Kearney Canal during the irrigation season (mid-spring to mid-fall) and dewatered the canal during the non-irrigation season. NPPD surveyors performed the cross section and



longitudinal surveys of the canal during the non-irrigation season. Continuous and discrete water quality monitoring occurred in 2011 during canal operations and in 2012 and 2013 when sediment augmentation activities coincided with canal operations.

Platte River Conditions

A wide range of flows were observed in the Platte River near Overton from 2009 to 2013 during the months that NPPD operated the Kearney Canal (**Figure 3** and **Table 1**). Flows were highest in 2011 when the total discharge at Overton during the canal operating period was slightly greater than 1.92 million acre-feet (AF), while flows were lowest in 2012 at only 212,000 AF. The total discharges for the canal operating periods in 2009, 2010 and 2013 were 358,000 AF, 1.03 million AF and 401,000 AF, respectively.

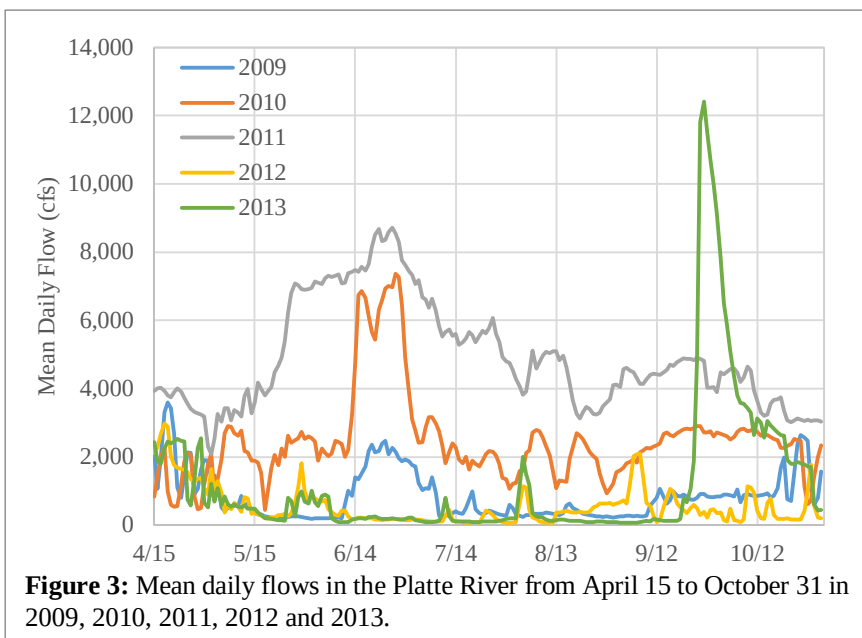


Figure 3: Mean daily flows in the Platte River from April 15 to October 31 in 2009, 2010, 2011, 2012 and 2013.

Total sediment transport loads during the canal operating periods from 2009 to 2013 were estimated using sediment transport equations calibrated against observations on the Platte River near Overton (**Table 1**) (Simons and Associates, 2000). Total sediment transport loads ranged from 73,000 tons in 2012 to 1.16 million tons in 2011, while total loads in 2009, 2010 and 2013 were 133,000 tons, 505,000 tons and 228,000 tons, respectively. For reference, the Program augmented approximately 50,000 tons of sediment in 2009 and 2010, while 100,000 tons and 82,000 tons of sediment were augmented in 2012 and 2013, respectively (The Flat Water Group et al., 2013).

Table 1: Total flows and sediment transport loads in the Platte River at Overton during the times that the NPPD was operating the Kearney Canal. In addition, total Program sediment augmentation loads and total diversions into the Kearney Canal (Diversions) are shown.

Irrigation Season	Platte River at Overton		Program	Diversions
	Total Flow	Total Sediment Load	Total Sediment Augmented	Total Flow
	(AF)	(tons)	(tons)	(AF)
2009	357,984	133,414	50,000	89,215
2010	1,028,169	505,046	50,000	110,247
2011	1,925,760	1,160,136	0	100,877
2012	212,772	73,213	100,000	56,922
2013	401,360	228,091	82,000	51,238

Kearney Canal Conditions

Total diversions into the Kearney Canal during each of the operating periods from 2009 to 2013 were estimated using average daily diversion data obtained from the Nebraska Department of Natural Resources¹ (**Table 1**). Total diversions into the Kearney Canal ranged from 51,000 AF in 2013 to 110,000 AF in 2010, while total diversions in 2009, 2011 and 2012 were 89,000 AF, 101,000 AF and 57,000 AF, respectively.

Data

Canal Surveys

The NPPD provided the EDO with data from post-irrigation season surveys from 2009, 2010, 2011 and 2012. The post-irrigation season survey of 2009 began in the late fall of 2009 and ended in the spring of 2010, with the same being true for the subsequent years' surveys in 2010, 2011 and 2012 (**Figure 2**). Cross sections were surveyed at the same 60 locations along the 16 miles of canal from the diversion on the Platte River to the hydropower plant (Kearney Hydro) in Kearney, Nebraska (**Figure 1**). The longitudinal profile of the canal was also surveyed every 25 feet along the same reach. These surveys were utilized by the EDO to identify aggradational and degradational trends in the canal.

Water Quality

The Program contracted EA Engineering, Science and Technology, Inc. (EA) from Lincoln, Nebraska to design and implement the water quality monitoring plan for the Kearney Canal (EA Engineering, Science, and Technology, Inc., 2011). In 2011, continuous monitoring of water temperature, turbidity, dissolved oxygen, pH and specific conductance took place at four (4) locations in the Platte River, two (2) locations in the Kearney Canal and one (1) location in Elm Creek from May to October (**Figure 1**). Discrete samples for suspended sediment were collected in the Kearney Canal, Elm Creek and the Platte River approximately every 7 days during the same period. In 2012 and 2013, largely the same monitoring design was implemented from September to October and May to June, respectively. EA provided the EDO with data and reports with findings from 2011, 2012 and 2013 (EA Engineering, Science, and Technology, 2012; 2013; 2014) including an analysis of correlation between turbidity levels in the canal and upstream sediment augmentation activities in the Platte River. A summary of EA's findings is provided in the Results section of this report, while copies of the reports provided by EA are attached as appendices.

Implications

The data collection efforts allowed for aggradational and degradational trends in the Kearney Canal to be evaluated for the 2010, 2011 and 2012 irrigation seasons (e.g., 2010 trends were identified by comparing the post-irrigation season surveys that started in 2009 and 2010), and allowed for the correlation between turbidity levels in the canal and sediment augmentation activities to be evaluated during the 2012 and 2013 irrigation seasons. Furthermore, general trends

¹ Kearney Canal diversion data from the 2008, 2009, 2010 and 2011 water years were obtained from each year's Hydrographic Report produced by the Nebraska Department of Natural Resources (NDNR, 2008; 2009; 2010; 2011), while data from 2012 and 2013 were obtained from daily emails sent by NDNR (NDNR, 2012 and 2013). All email data was provisional.

in river and canal turbidity were identified during the 2011 irrigation season when sediment augmentation activities were not implemented but water quality was monitored by EA.

Methods

Aggradational and Degradational Trends

The NPPD provided the EDO with canal longitudinal profile and cross section survey data that included the calculated difference in elevation between a particular year's and all the previous years' surveys. The calculated differences were provided at each measurement location. The canal profile was surveyed at locations that were determined by visually approximating the centerline of the canal at 25 foot increments along the canal profile from the diversion to Kearney Hydro. Visual approximation of the centerline likely resulted in lateral variability in measurement locations from year to year. As such, the profile surveys were only used to calculate canal slope. Cross sections were surveyed at the same 60 locations along the longitudinal profile of the canal each year. The survey points collected at each cross section varied from one year to the next, but a consistent coordinate system and centerline location were used to record the measurements. Consequently, determining the differences in bed and bank elevation at all the points along a cross section often required comparison of surveyed elevations to linearly-interpolated bed elevations between the previous year's survey points (discussed further in next paragraph). This introduced a small degree of uncertainty that is further discussed in the results section.

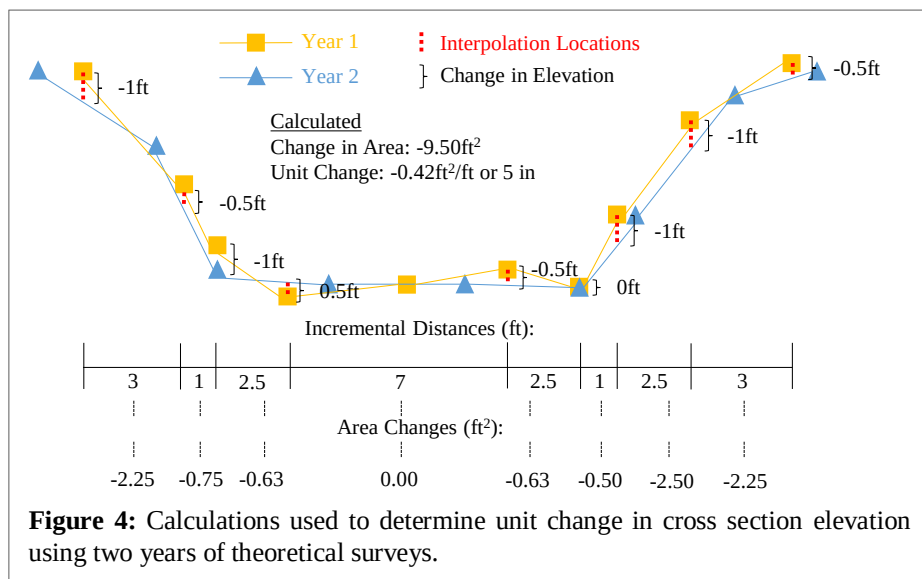


Figure 4: Calculations used to determine unit change in cross section elevation using two years of theoretical surveys.

Aggradational and degradational trends were identified by evaluating the change in cross sectional areas along the canal during four periods: (1) 2010 irrigation season, (2) 2011 irrigation season, (3) 2012 irrigation season, and (4) 2010 through 2012 irrigation seasons. An example of the calculation process is shown in **Figure 4** using two theoretical post-irrigation season surveys. First, the changes in elevation from Year 1 to Year 2 were calculated at the Year 1 survey point locations such that negative changes represented degrading conditions, while positive changes represented aggrading conditions. Linear interpolation was used to estimate the difference at locations where only Year 1 points were available. The change in area along the cross section was then calculated for each individual increment (defined as the linear distance between Year 1's survey points, as shown in **Figure 4**) by averaging the two change values associated with each increment and then

multiplying that value by the length of the increment. For example, for the left-most increment in **Figure 4**, the incremental change in area (-2.25 square feet) was determined by multiplying the two average changes in elevation (-1 foot and -0.5 foot) by the length of the increment (3 feet). All incremental changes were then summed to determine the total change in area (-9.5 square feet). This calculated change in area was then divided by the width of the cross section to obtain a unit change in elevation for the entire cross section (-0.42 square feet per foot or 5 inches) such that cross sections of varying widths could be directly compared. This process was repeated for each of the 60 cross sections during each of the 4 periods of change.

Results

Aggradational and Degradational Trends

The distributions of unit change in cross section elevation during each of the four periods were evaluated using box plots (**Figure 5**) and associated summary statistics (**Table 2**). In examining the distributions of unit change during each of the irrigation seasons, it appeared that the aggradational and degradational trends varied from season to season as the canal aggraded slightly in 2010 (0.17 inches, on average) and 2012 (0.65 inches, on average), but degraded slightly in 2011 (-0.42 inches, on average). The quartiles of the season to season changes ranged from 1.46 inches (2012) to -1.28

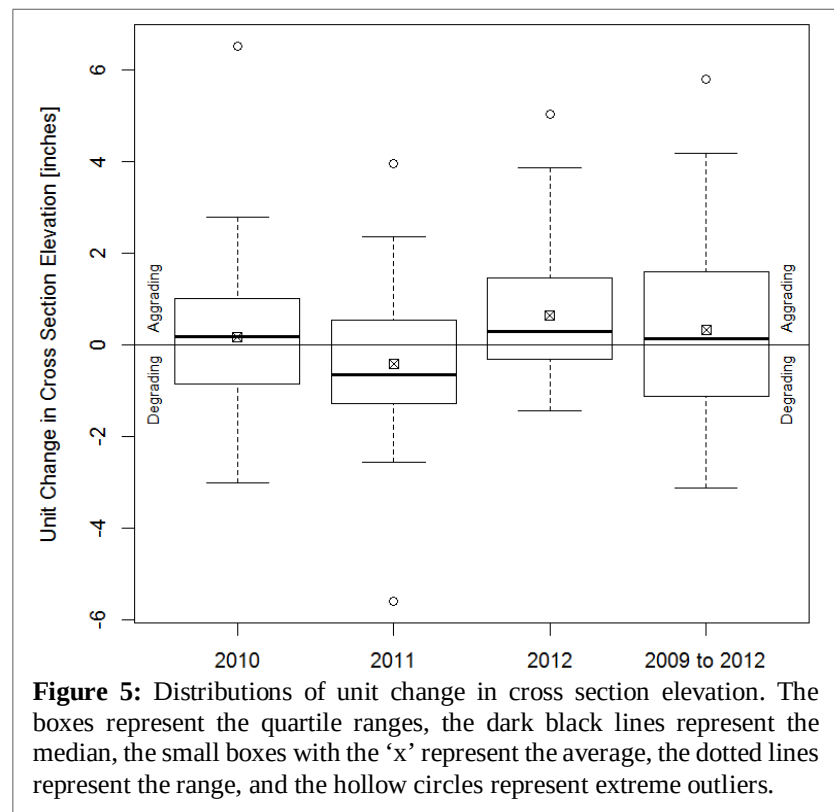


Figure 5: Distributions of unit change in cross section elevation. The boxes represent the quartile ranges, the dark black lines represent the median, the small boxes with the 'x' represent the average, the dotted lines represent the range, and the hollow circles represent extreme outliers.

inches (2011). In examining the distributions of total unit change during all three irrigation seasons (2010 to 2012), the canal appeared to be slightly aggradational (0.32 inches, on average). The upper and lower quartiles of the total change were 1.59 inches and -1.13 inches, respectively. To put the magnitude of total change during the 2010, 2011 and 2012 irrigation season into context, the 2010 and 2012 cross sections were plotted together and presented in **Appendix A**. Extreme outliers in all four of the distributions of unit change were generally large aggradational values of about 4 to 6.5 inches, with the exception of one large degradational value of -5.6 inches (2011). The influence of the outliers on all four of the unit change distributions was apparent as the averages of the distributions were generally slightly more positive than the medians.

The statistical significance of the average unit changes used to identify the aggradational and degradational trends were evaluated using an analysis of variance (ANOVA) procedure and a one-sample t-test performed in R (R Core Team, 2013). The average changes during each of the irrigation seasons and the average total change during all three irrigation seasons were analyzed separately to avoid comparing incremental changes to total changes. As such, the ANOVA procedure was used to evaluate the significance of the average changes during each of the irrigation seasons because the comparison involved three values (e.g., average unit change in 2010, 2011 and 2012), while the one-sample t-test was used to evaluate the significance of the average total change during all three irrigation seasons because the comparison only involved one value (e.g., average unit change from 2010 to 2012). Each of the statistical tests used a confidence level of 95% to evaluate significance.

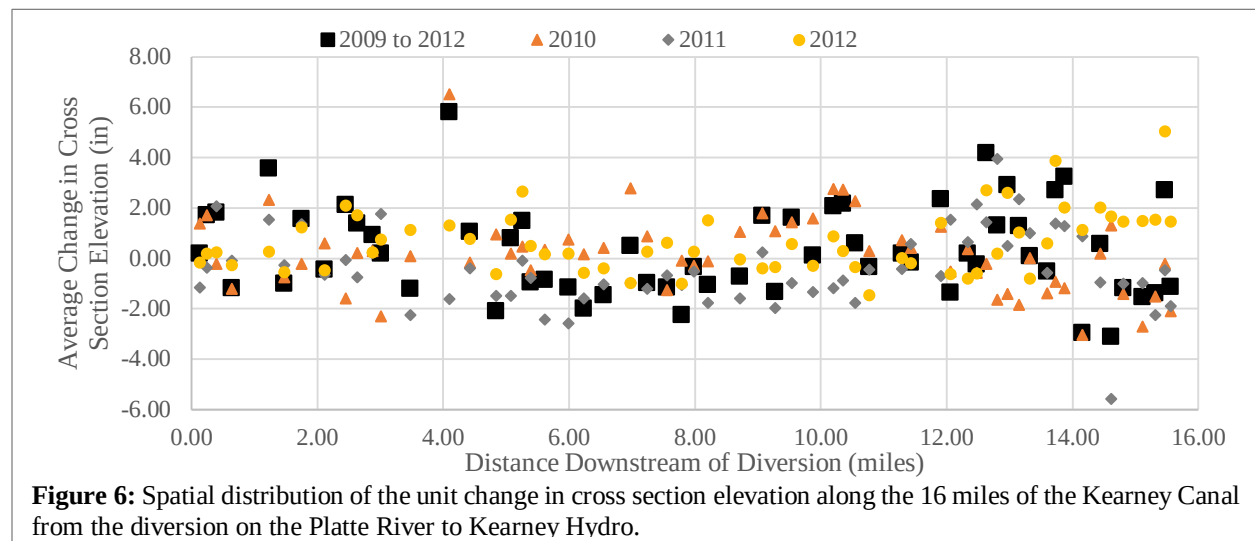
Irrigation Season (year)	Unit Change in Cross Section Elevation (inches)							Significant (Yes/No)
	Lower Outlier	Min	Lower Quartile	Median / (Average)	Upper Quartile	Max	Upper Outlier	
2010	NA	-3.02	-0.85	0.18 (0.17)	1.00	2.79	6.51	No
2011	-5.59	-2.57	-1.28	-0.66 (-0.42)	0.53	2.35	3.95	Yes
2012	NA	-1.45	-0.31	0.29 (0.65)	1.46	3.87	5.03	Yes
2010 - 2012	NA	-3.12	-1.13	0.15 (0.32)	1.59	4.18	5.80	No

Table 2: Sample statistics associated with the box plots of the distributions of unit change in cross section elevation during each of the four periods of interest.

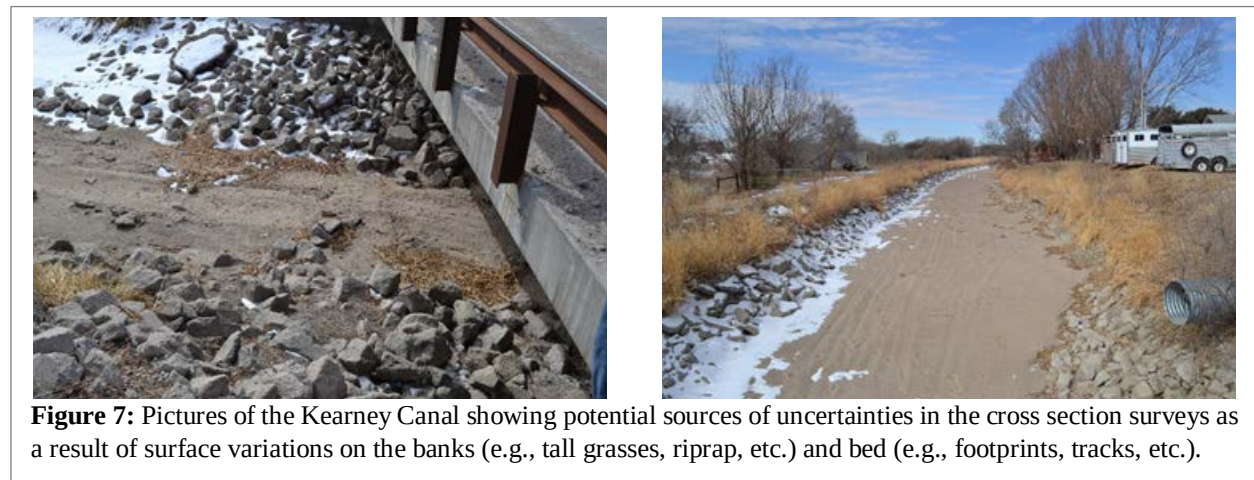
The results of the ANOVA analysis indicated that at least one of the average changes observed during each of the irrigation seasons was significantly different than zero (p-value equal to 0.001). Further analysis indicated that the average change during the 2011 irrigation season (-0.42 inches) was significantly degradational (p-value equal to 0.024) and the average change during the 2012 irrigation season (0.65 inches) was significantly aggradational (p-value equal to 0.001), while the average change during the 2010 irrigation season (0.17 inches) was determined to be statistically insignificant (p-value equal to 0.365). The results of the one-sample t-test indicated that the average total change during the 2010 to 2012 irrigation seasons was statistically insignificant (p-value 0.179) as well.

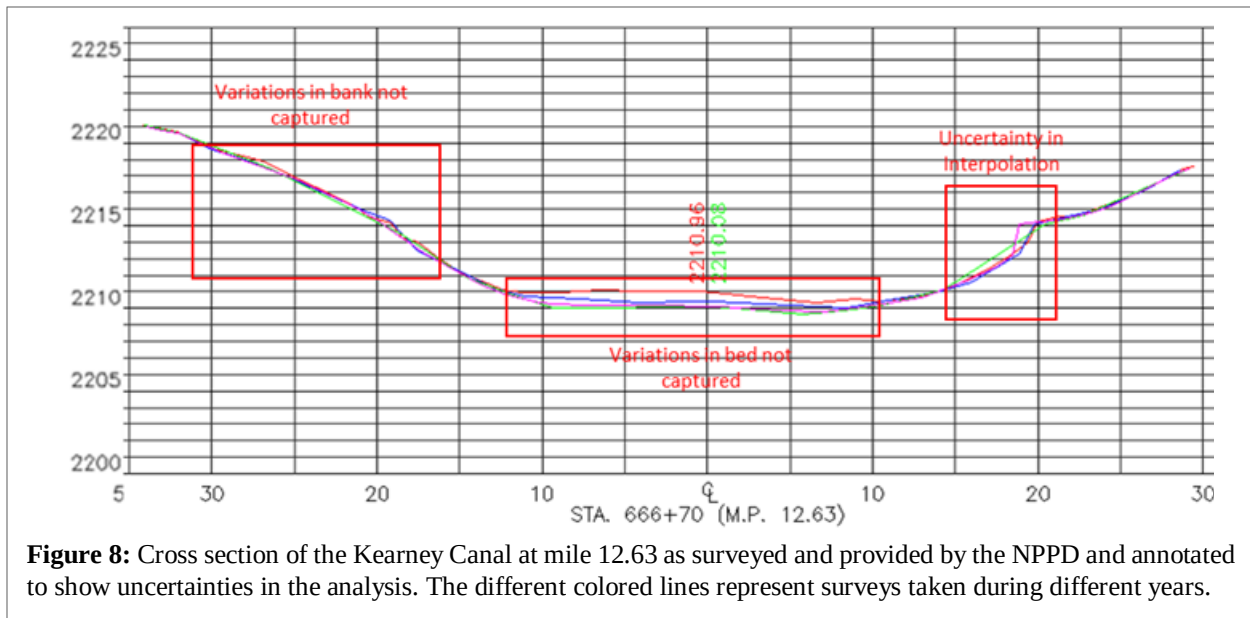
The ANOVA procedure used to compare the averages of the distributions of change assumed that the distributions were normally distributed with equal variances, and that each of the observations in the distributions were independent of one another. In reality, the distributions were likely not exactly normally distributed with equal variances (**Figure 5**) and the data was likely spatially and temporally correlated as typical areas of aggradation and degradation in the canal were identified when the unit changes were plotted spatially (**Figure 6**). For example, although the trends vary slightly from year to year, the canal seems to be slightly aggradational from the diversion to mile 3 and from mile 9 to mile 14, slightly degradational from mile 5 to mile 9 and beyond mile 14, and fairly neutral in other reaches. In response to recognizing that the distributions of change likely violated the assumptions inherent in the ANOVA procedure, the EDO sought guidance from Dr. Erin Blankenship, Professor in the Department of Statistics at the University of Nebraska-Lincoln. Dr. Blankenship analyzed the distributions of change using complex statistical techniques that allow for correlation and unequal variances in the distributions and arrived at the same results as presented above (the associated p-values did change slightly): the average change during the 2010

irrigation season was insignificant, but the changes during the 2011 and 2012 irrigation seasons were significant (Blankenship, 2014).



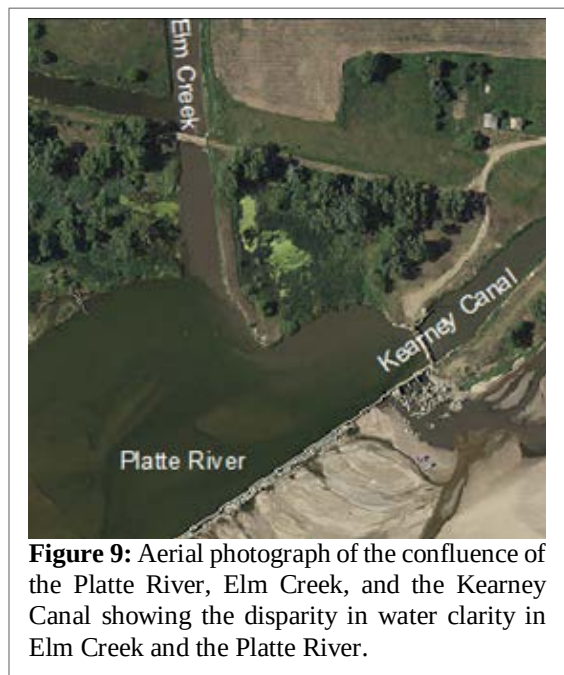
Given the small and partially insignificant changes in elevation observed in the canal, it is possible that the equipment and techniques used to perform the surveys had greater cumulative uncertainties than a majority of the observed changes. The surveying uncertainties were difficult to numerically quantify and included errors in the accuracy of the equipment (e.g., vertical and horizontal accuracies), which are typically on the order of $\frac{1}{2}$ inch to 1 inch, and uncertainties due to rod placement and linear interpolation between survey points. It was not feasible to survey all surface variations on the canal bed (e.g., footprints, ruts, and tracks) and bank (e.g., tall grasses and large riprap) (**Figure 7**) that were on the order of magnitude of change observed between surveys. As such, it is difficult to determine whether the elevation differences observed in the measured cross sections (**Figure 8**) were due to sedimentation or rod placement (**Figure 7** and **Figure 8** were in the same general location along the canal). For example, placement of the rod in reaches with riprapped banks (e.g., on a rock or beside it) likely changed the measured elevation by at least 1 or 2 inches, which would explain a majority, if not all, of the change when comparing two surveys.

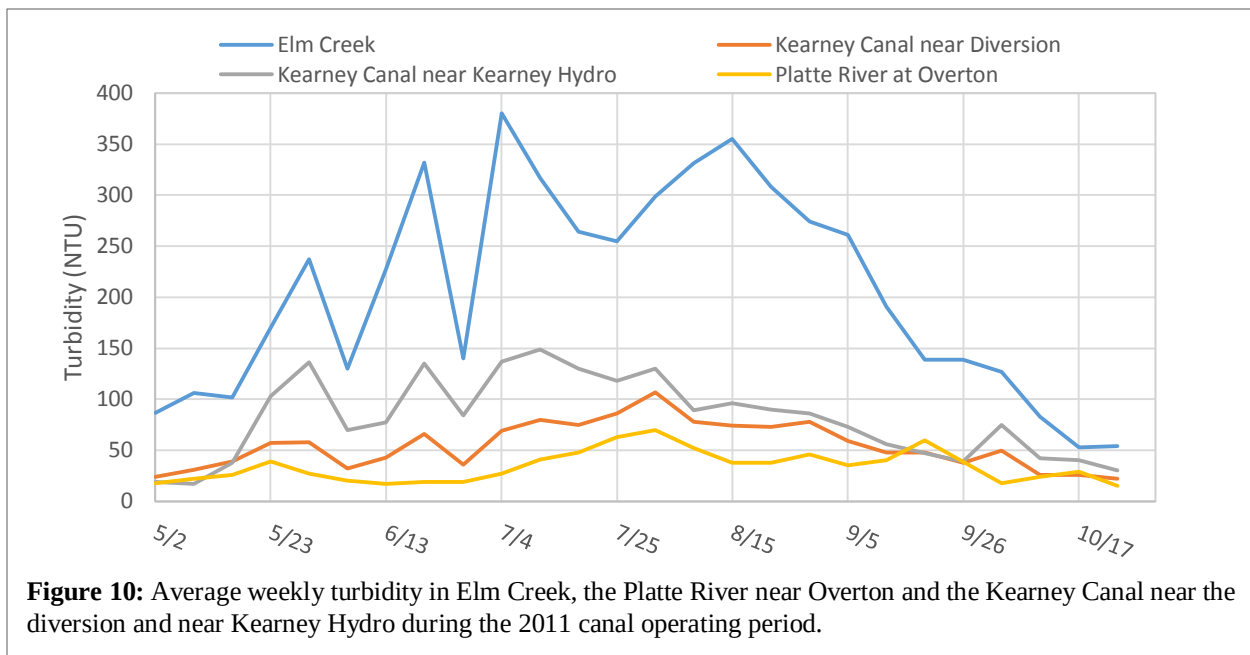




Changes in Canal Turbidity

In 2011, when sediment augmentation activities did not take place in the Platte River, the final water quality report provided by EA (**Appendix B**) contained findings regarding turbidity in Elm Creek and the Kearney Canal. Turbidity levels in Elm Creek were much higher than those in the Platte River and the Kearney Canal, which is apparent in the aerial photograph shown in **Figure 9**. Specifically, weekly average values of turbidity in Elm Creek were almost always much greater than 100 NTU, while average values of turbidity at most of the other monitoring locations were less than 100 NTU (with the exception of the Kearney Canal near Kearney Hydro) (**Figure 10**). Furthermore, peaks in weekly average turbidity in Elm Creek were in the range of 350 NTU, while peaks in turbidity at the other locations were in the range of 50 to 150 NTU or less. Turbidity in the Kearney Canal was determined to increase from upstream at the canal diversion to downstream near Kearney Hydro (**Figure 10**). The average turbidity near the diversion was 54 NTU and the average turbidity near Kearney Hydro was 86 NTU. Peaks in canal turbidity were determined to be in response to the occurrence of rainfall events. Lastly, it was determined that instantaneous values of canal turbidity and suspended sediment were not linearly correlated (R-squared values ranged from 0.06 to 0.15), indicating that one could not accurately be used as a predictor variable for the other.





In 2012 and 2013, when sediment augmentation did take place in the Platte River, the final water quality reports provided by EA (**Appendix C** and **Appendix D**, respectively) contained largely the same findings as the 2011 report, but also commented as to whether increases in canal turbidity were associated with dates of sediment augmentation. Increases in turbidity in the Kearney Canal from upstream to downstream were attributed to runoff from multiple agricultural drains discharging murky waters into the canal. Furthermore, regression models indicated with 95% confidence that in 2012 increases in canal turbidity were not correlated with dates of sediment augmentation. Instead, it was determined that increases in canal turbidity were positively correlated with increases in flows in the Platte River. The same regression models indicated that increases in canal turbidity were not correlated with dates of sediment augmentation in 2013 (dates of sediment augmentation actually had a negative correlation to canal turbidity). Additionally, a positive correlation between canal turbidity and Platte River flows was not evident in 2013. During both 2012 and 2013, peaks in canal turbidity occurred during times when sediment augmentation was not taking place, further proving that they are not in response to sediment augmentation activities. As such, EA concluded that sediment augmentation activities in 2012 and 2013 did not increase turbidity in the Kearney Canal.

Relationships between Augmentation and Canal Sedimentation

Suspended Material and Turbidity

The EA water quality monitoring analysis indicated that sediment augmentation activities in 2012 and 2013 did not increase turbidity levels in the Kearney Canal. Arriving at this conclusion was relatively straightforward using statistical techniques because turbidity is generally associated with fine sediments, which are quickly transported downstream as suspended material and/or wash load. It was estimated that fine sediments augmented at the Cottonwood Ranch and Dyer locations arrived at the canal diversion in less than a day because they were likely transported at velocities equal to that of the water in the river channel (2.2. feet per second at 1,200 cubic feet per second).

The short lag period between the time of augmentation and the time of potential response in the canal, along with the fact that turbidity in the canal was being continuously monitored, made the statistical analysis performed by EA evaluating the effects of sediment augmentation on canal turbidity relatively straightforward. However, evaluating the relationship between sediment augmentation activities and aggradational and degradational trends in the canal was less straightforward as discussed below.

Bed Material and Aggradation/Degradation

The results of the EDO analysis indicated that the only periods of statistically significant change at the 95% confidence level were those observed during the 2011 (degradational) and 2012 (aggradational) irrigation seasons. The slight aggradational change during the 2010 irrigation season and the slight aggradational total change during the three irrigation seasons from 2010 to 2012 were determined to be statistically insignificant. Furthermore, although difficult to numerically quantify, it is believed that many of the observed changes fall within the uncertainties associated with the collection of the survey data and the associated data analyses. However, despite these uncertainties, the relationship between sediment augmentation activities and the identified aggradational and degradational trends in the canal were evaluated to the extent possible.

It was assumed by the EDO that if sediment augmentation activities caused the Kearney Canal to aggrade significantly, it would have been due to the relatively coarse augmented material depositing in the canal. It is likely that most of the coarse material placed in the channel was transported downstream as bed load. Furthermore, the bed load migration rates, and associated travel times, are inherently greater than those associated with suspended material and/or wash load. A study by Crowley (1981) on the relationship between bed material transport and channel narrowing in the Platte River downstream of Grand Island presented general bed material transport velocities in the river. As part of that study it was estimated that during the highest flows (e.g., when completely submerged in at least 20 cm of water) large-scale bedforms (300 m wide by 2 m tall, on average) migrated downstream at a rate of 1.0 to 1.5 meters per hour (3.28 to 4.9 feet per hour), while typical migration rates were much slower (Crowley, 1981). It was assumed that the large-scale bed material transport velocities during high flows were representative of smaller-scale bed material transport velocities during normal flows. As such, these velocities were used by the EDO to relate sediment augmentation activities to sedimentation trends in the Kearney Canal.

Given the assumed transport velocities, it was estimated that the augmented sediment transported as bed load would not reach the canal diversion for at least 1 year after it had been placed in the river channel. For example, sediment augmented at the Cottonwood Ranch complex in the fall of 2009 likely started to arrive at the canal diversion in the fall of 2010 (end of the 2010 irrigation season), and continued thereafter. If a lag-time of one year is used to relate the effects of sediment augmentation on canal sedimentation, the results of the analysis suggest that the canal was relatively stable (no significant change in 2010) when affected by augmentation in 2009, degradational (in 2011) when affected by augmentation in 2010, and aggradational (in 2012) when augmentation did not take place in 2011. In reality, it is likely that the relationship between augmentation and sedimentation is not this direct and that sediment augmented in 2009, for example, could have affected canal operations in years after 2010. However, the variability of

aggradational and degradational trends in the canal after implementation of sediment augmentation (e.g., aggradational in 2010 and degradational in 2011), and the insignificant average total change during the 2010 to 2012 period, further indicated that sediment augmentation likely did not influence canal sedimentation during the study period.

The lack of a clear relationship between sediment augmentation activities and aggradational and degradational trends in the Kearney Canal is not surprising when the sediment augmentation loads are compared to the estimated natural sediment transport loads of the Platte River (**Table 1**). The total sediment loads augmented during most years were less than 35% of the total sediment loads naturally transported by the river during the canal operating periods. The exception was 2012 when more sediment was augmented than was naturally transported during the canal operating period. However, when the augmented loads were greater than the transport capacity of the river, the augmented sediment was not transported downstream immediately (The Flatware Group, 2013) and likely did not increase sediment loads.

Although there appears to be no clear relationship between sediment augmentation activities and aggradational and degradational trends in the Kearney Canal, there does appear to be a relationship between sedimentation trends in the canal and Platte River discharge. The irrigation season with the highest river discharge during the canal operating period was the only season that was significantly degradational (2011), while the irrigation season with the lowest river discharge was the only season that was significantly aggradational (2012). One potential reason for this relationship was the operational procedure of *sweeping the river* during low flow conditions in an attempt to maintain diversions. When the river was being *swept* at the canal diversion a large majority of the river's discharge (including its sediment loads) were diverted into the canal leaving very little flow and sediment in the channel to be transported downstream. This created favorable conditions for aggradation in the canal. However, during higher flows it was likely that only a fraction of the water in the river (including only a fraction of its sediment loads) were diverted into the canal, which likely created favorable conditions for degradation. Furthermore, sedimentation trends did not seem to be directly related to total canal diversions as the irrigation season with the highest total diversions (2010) was not significantly aggradational or degradational. As such, it is likely that Platte River flows and diversion operating procedures couple to create conditions such that the potential for degradation in the canal is highest when flows in the Platte River are highest, while potential for aggradation in the canal is highest when flows in the river are lowest.

Conclusions

Program sediment augmentation activities did not affect sedimentation in the Kearney Canal during the period of interest. The analysis of Kearney Canal turbidity monitoring data did not identify a relationship between sediment augmentation activities in 2012 and 2013 and turbidity levels in the Kearney Canal. Canal survey results suggested that the canal was not significantly aggradational or degradational during the 2010 irrigation season, while it was significantly degradational during the 2011 irrigation season and significantly aggradational during the 2012 irrigation season. Furthermore, the results suggested that the canal was not significantly aggradational or degradational over the three irrigation seasons from 2010 to 2012. It is possible that many of the observed changes in the canal were within the uncertainties associated with the

collection of the survey data and the associated data analysis. The sedimentation trends did not show a clear relationship with sediment augmentation activities but they did appear to correlate with flows in the Platte River in that the potential for aggradation increased with diminishing flows, while the potential for degradation increased with increasing flows.

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NDNR. 2008. Hydrographic Report – Discharge Records of Streams, Canals, Pumps and Storage in Reservoirs. Prepared under the direction of Brian P. Dunnigan, Director.

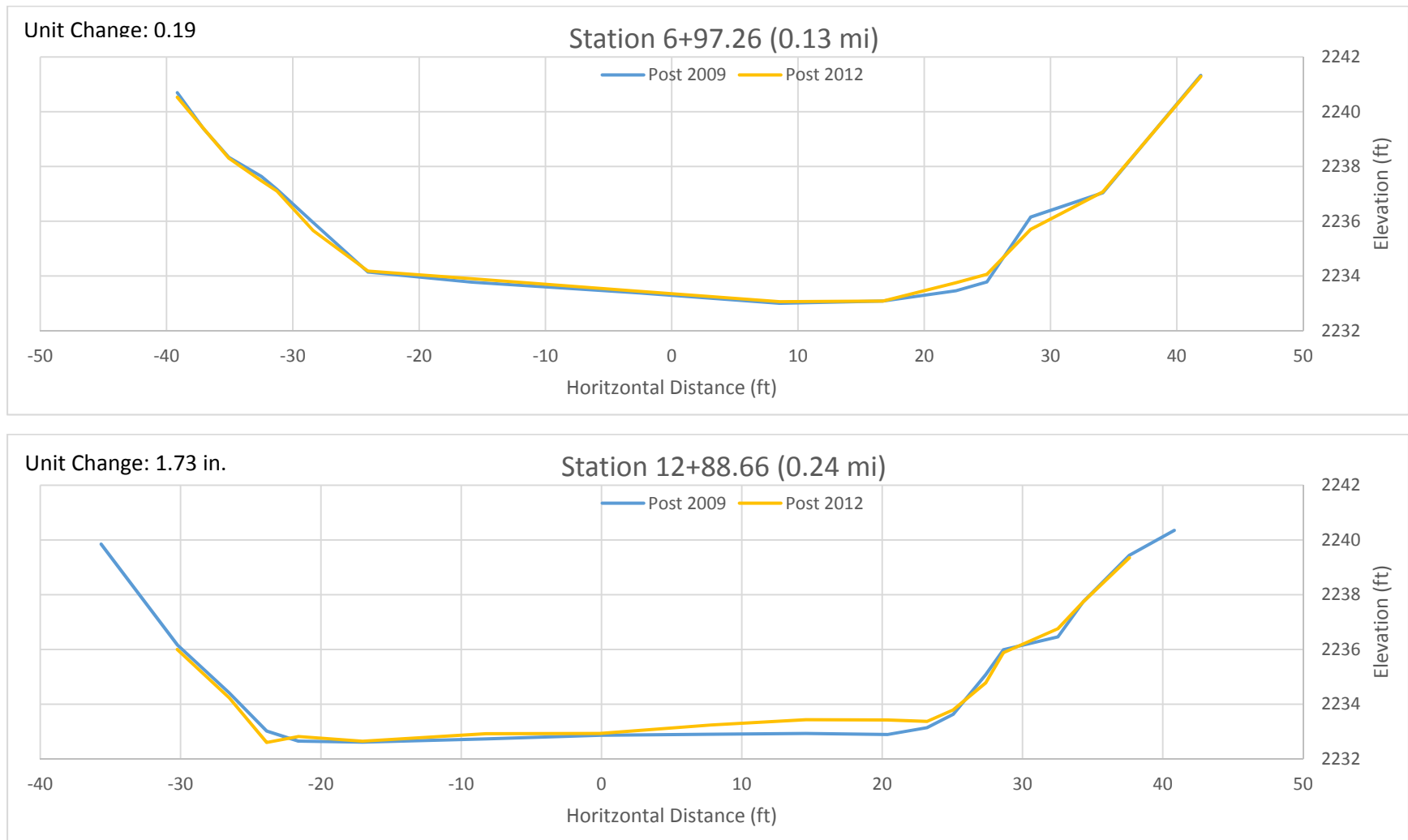
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Appendix A: Cross sections from post-irrigation seasons of 2009 and 2012

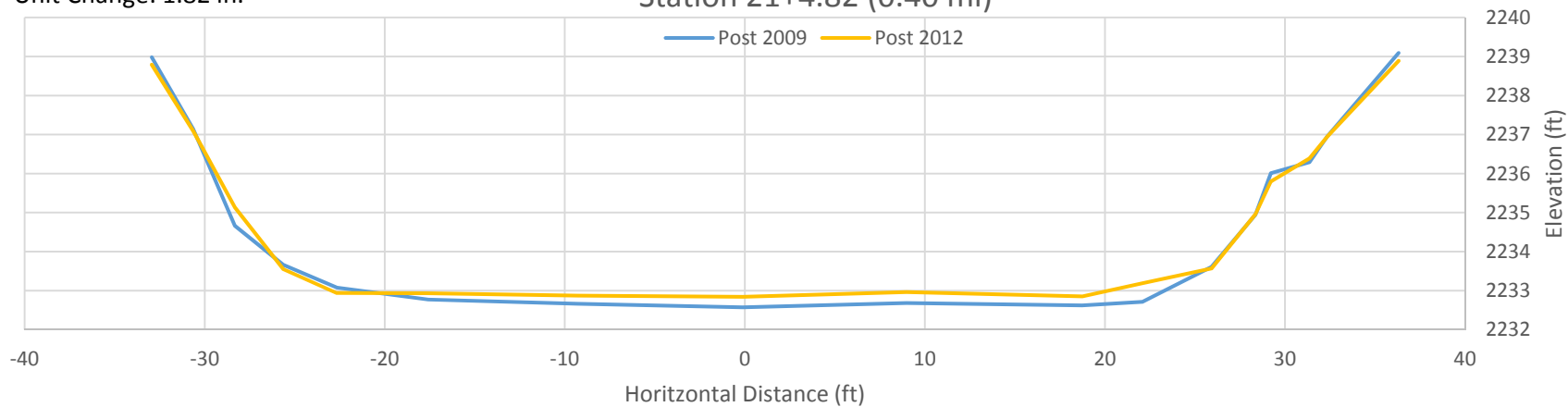
(Calculated using the raw 2009 elevation and the 2009 to 2012 changes)

Appendix A: Cross sections from the post irrigation seasons of 2009 and 2012 (calculated using the raw 2009 elevation and the 2009 to 2012 changes).



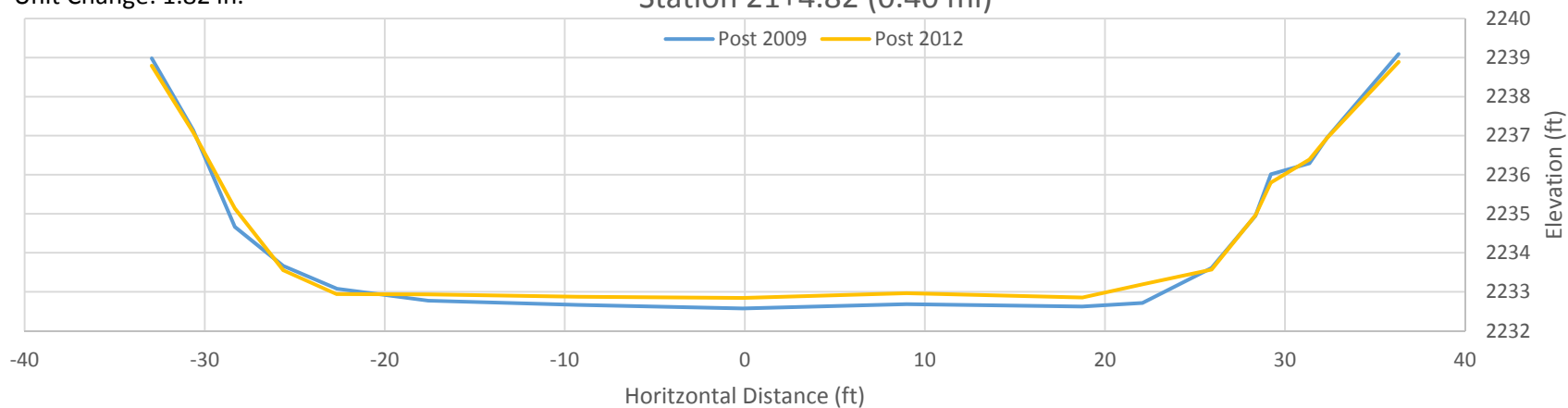
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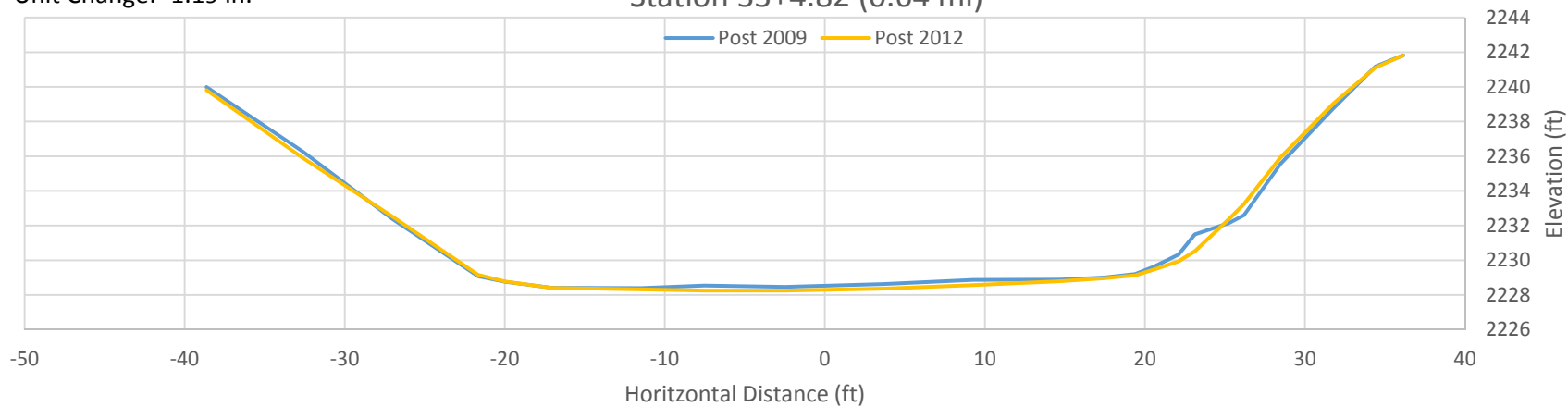
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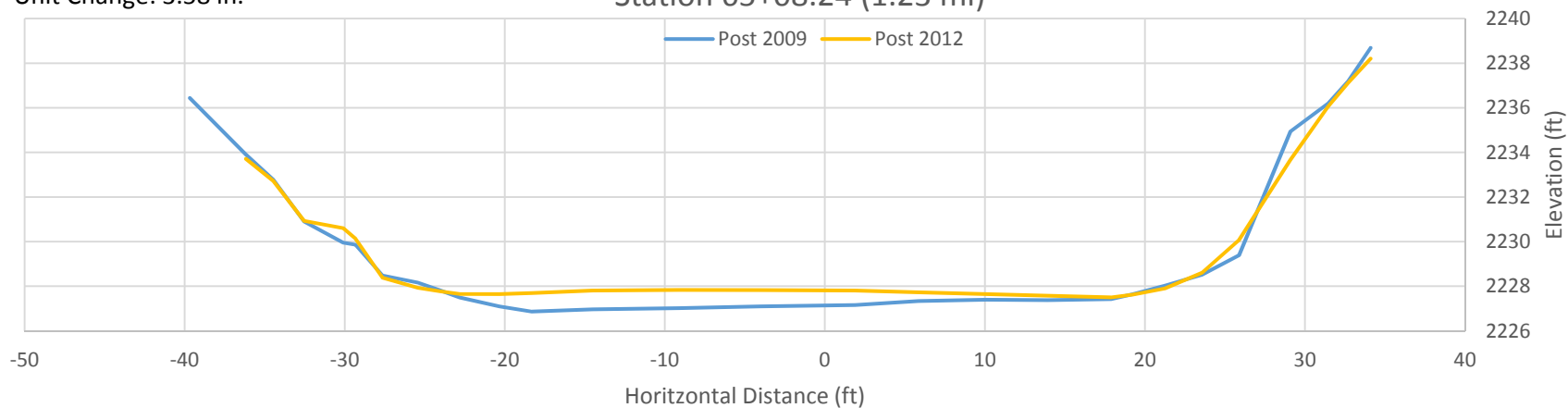
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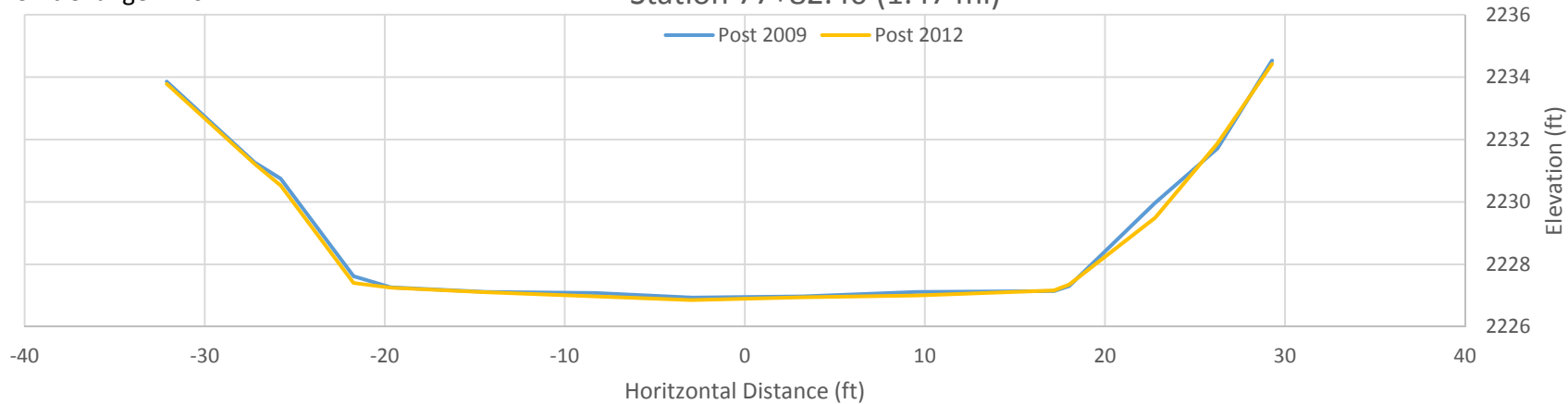
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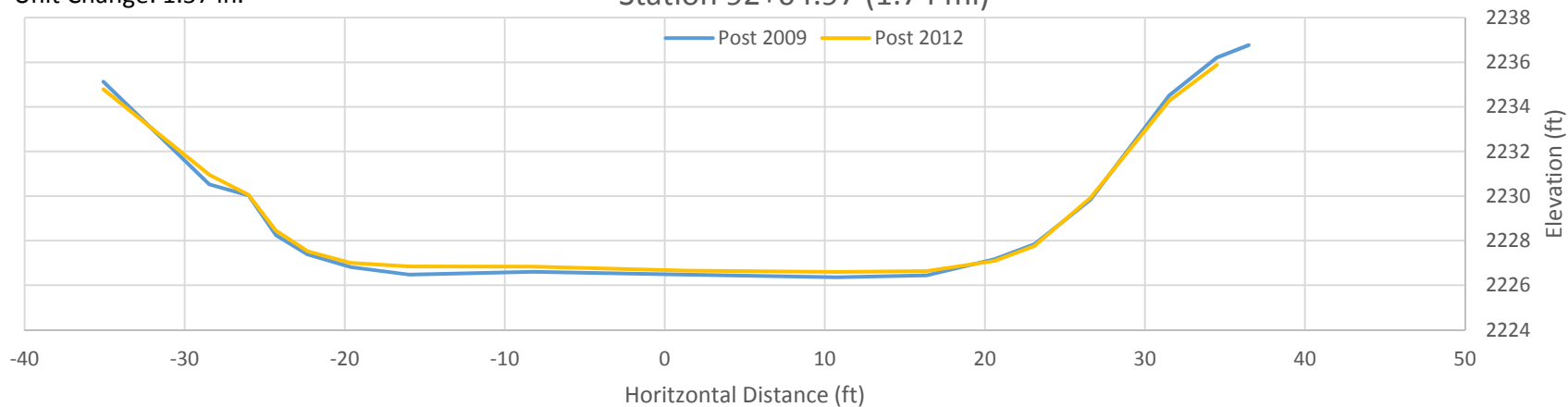
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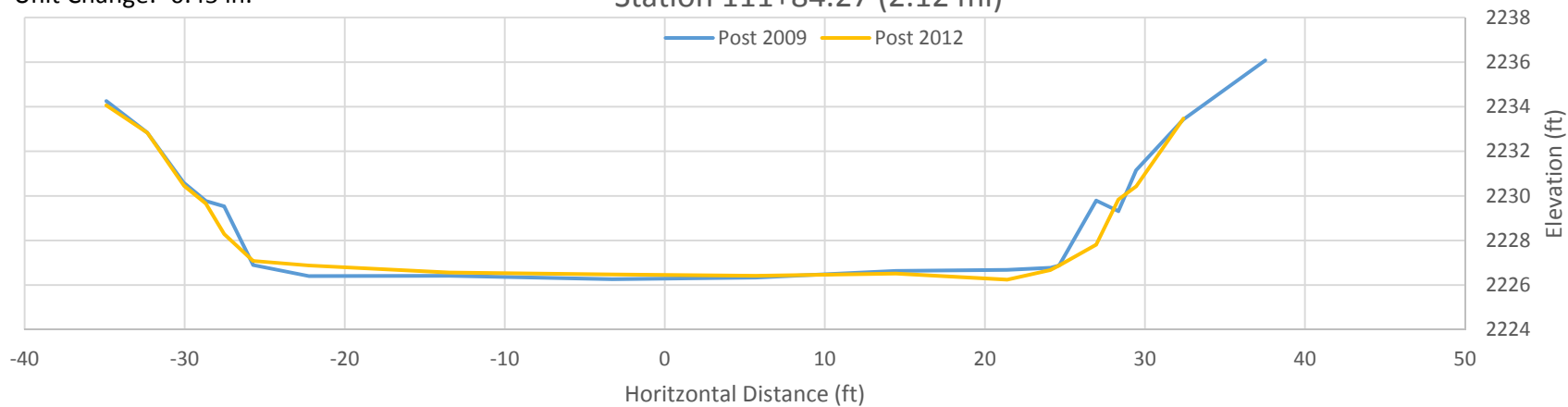
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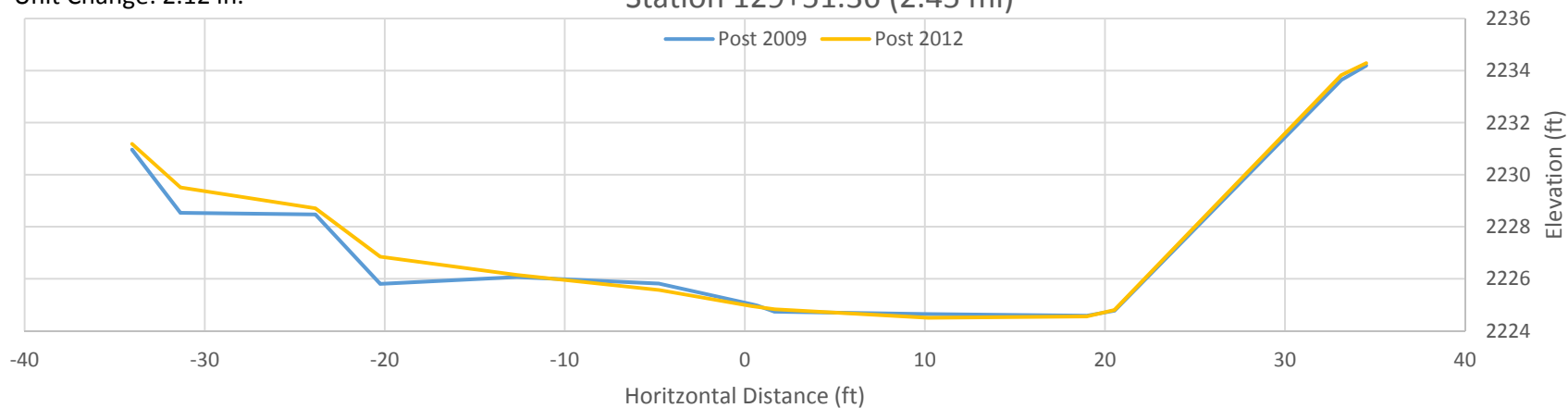
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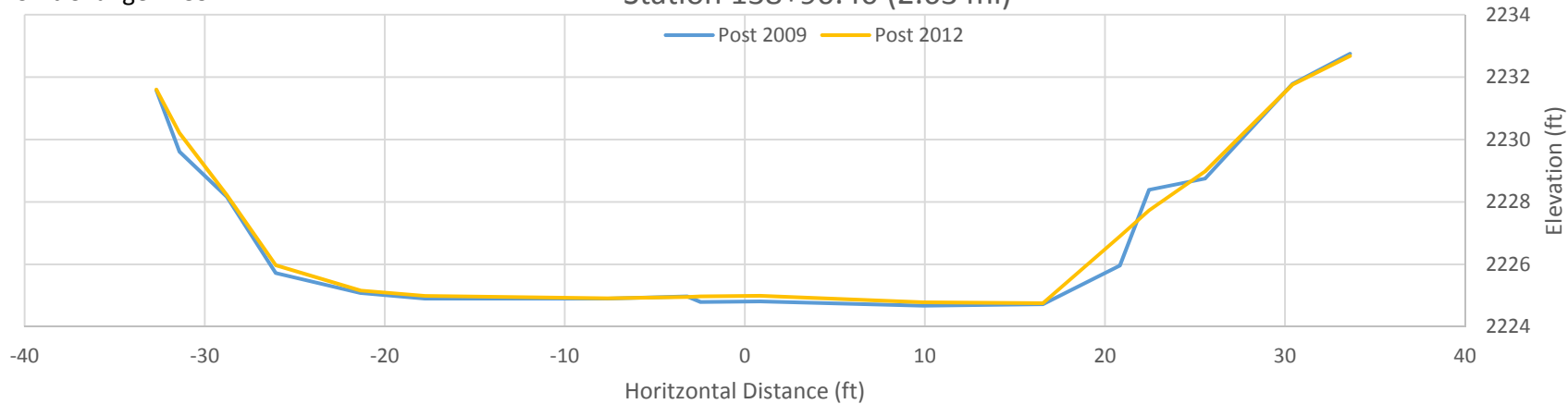
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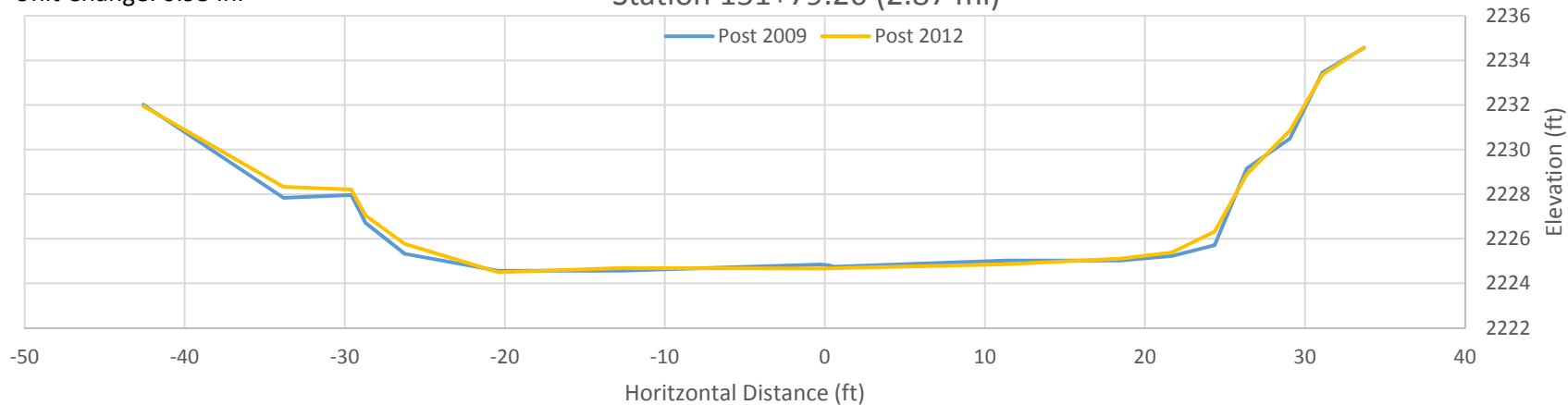
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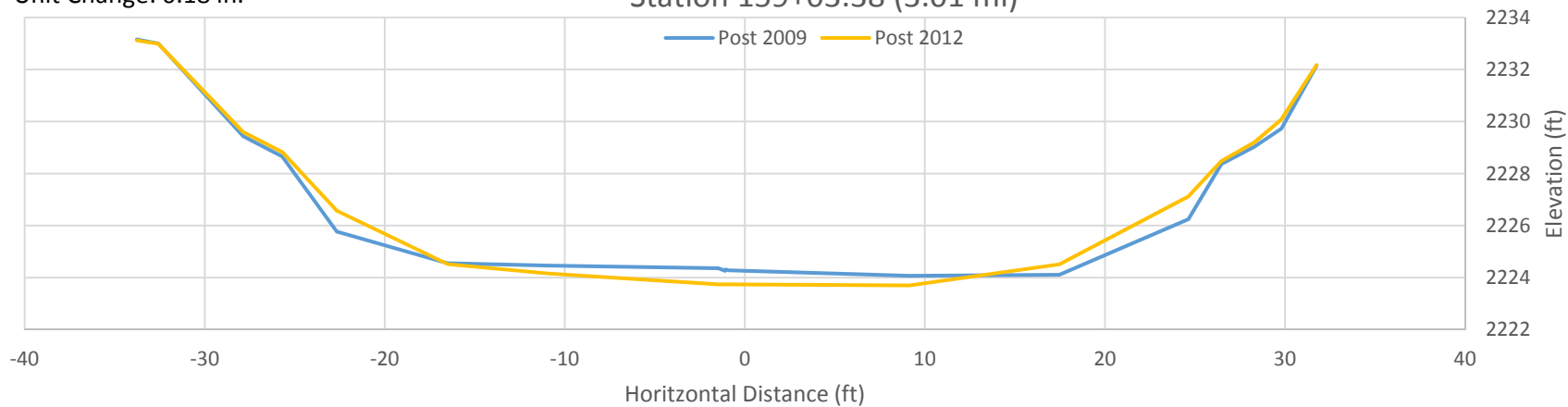
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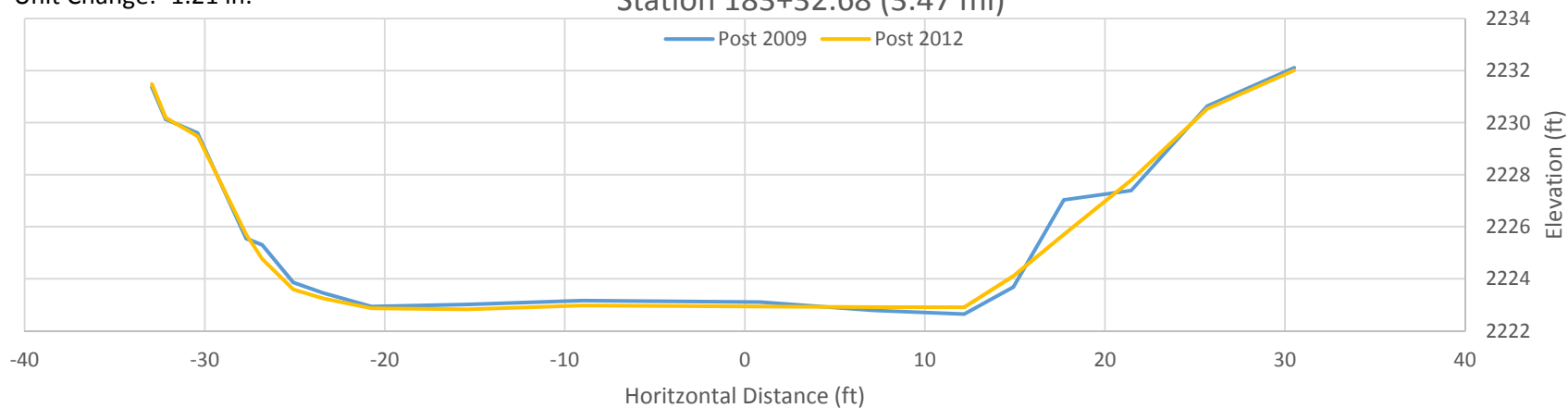
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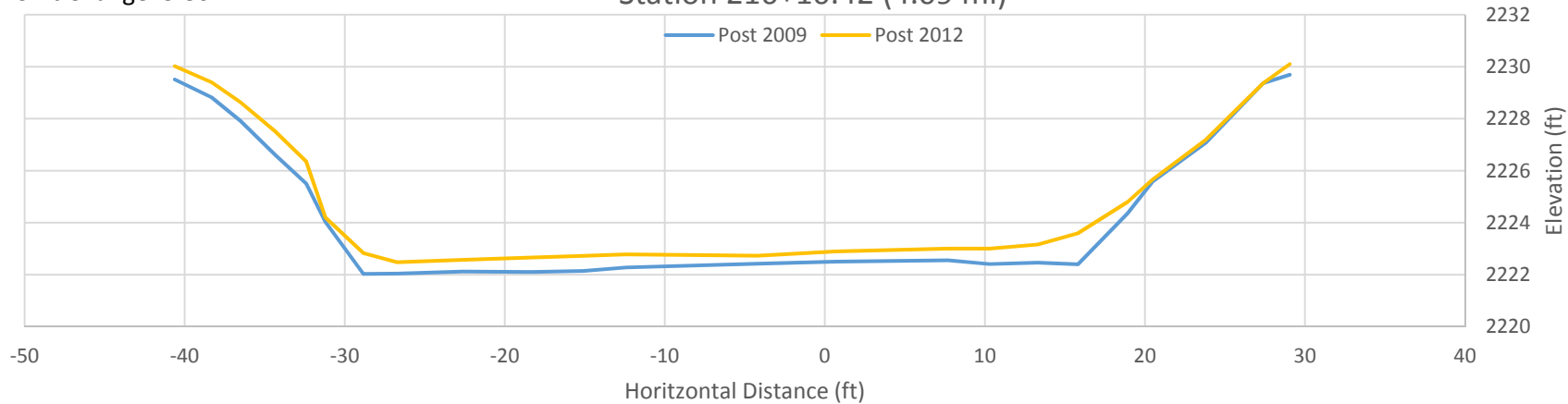
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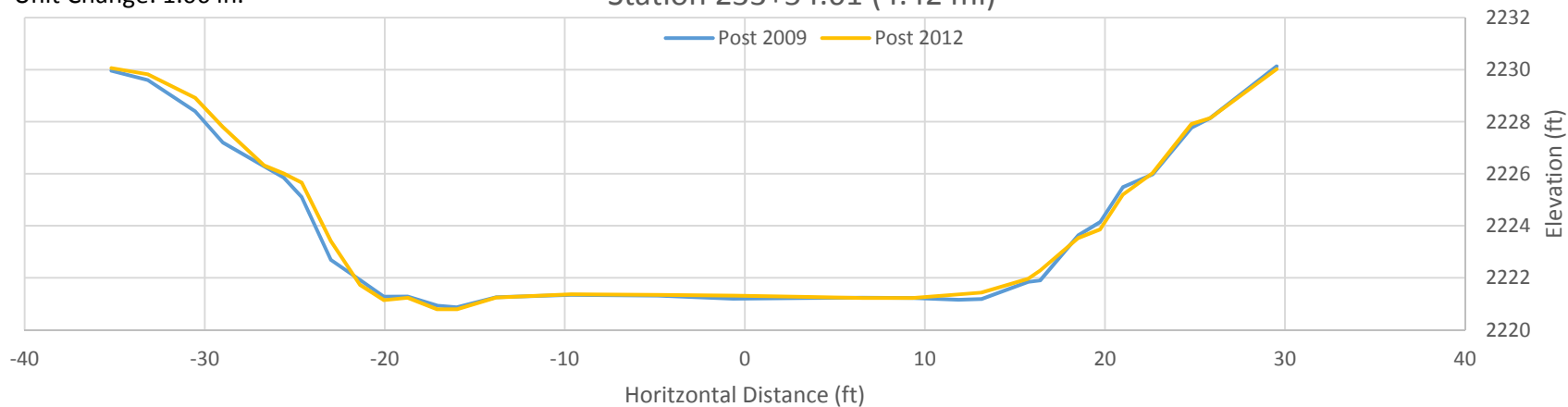
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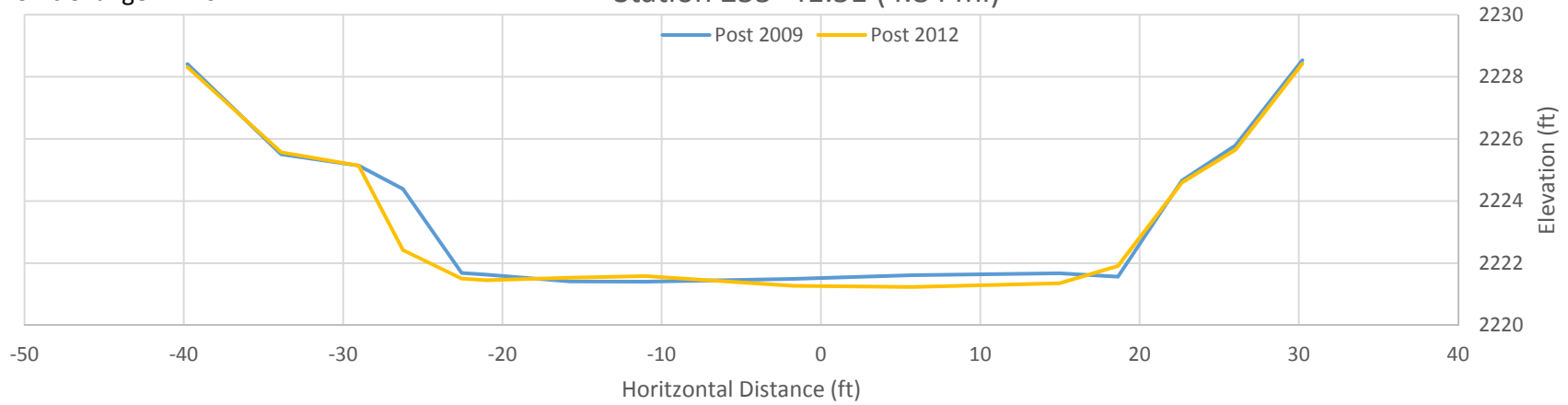
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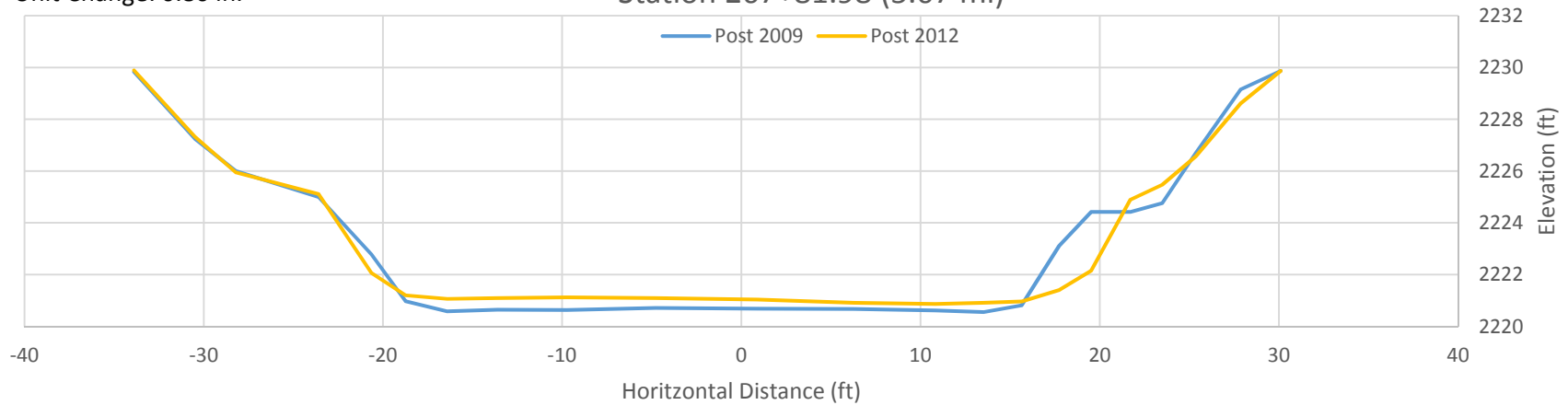
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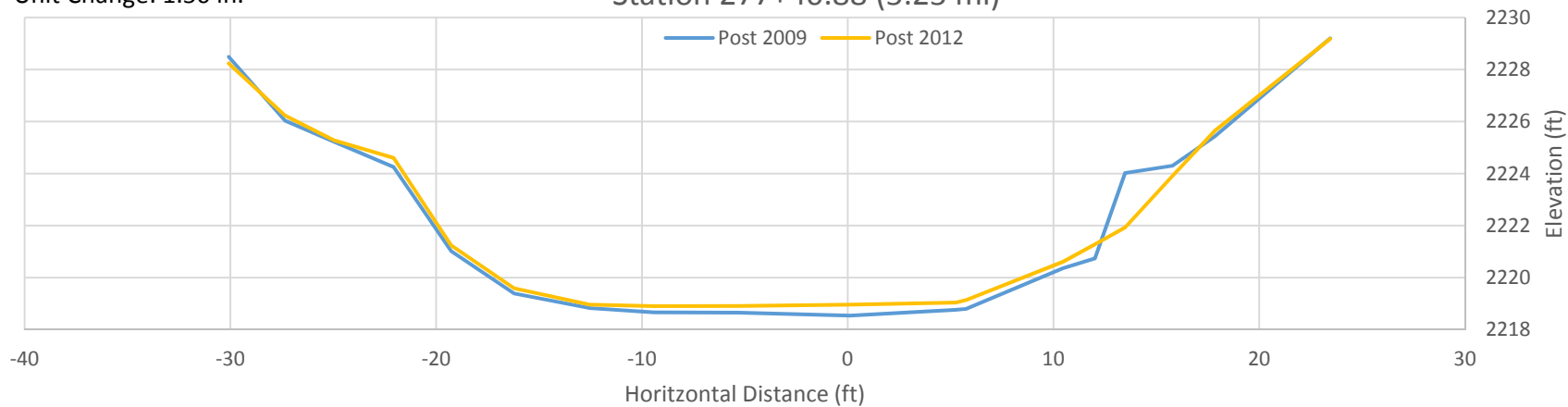
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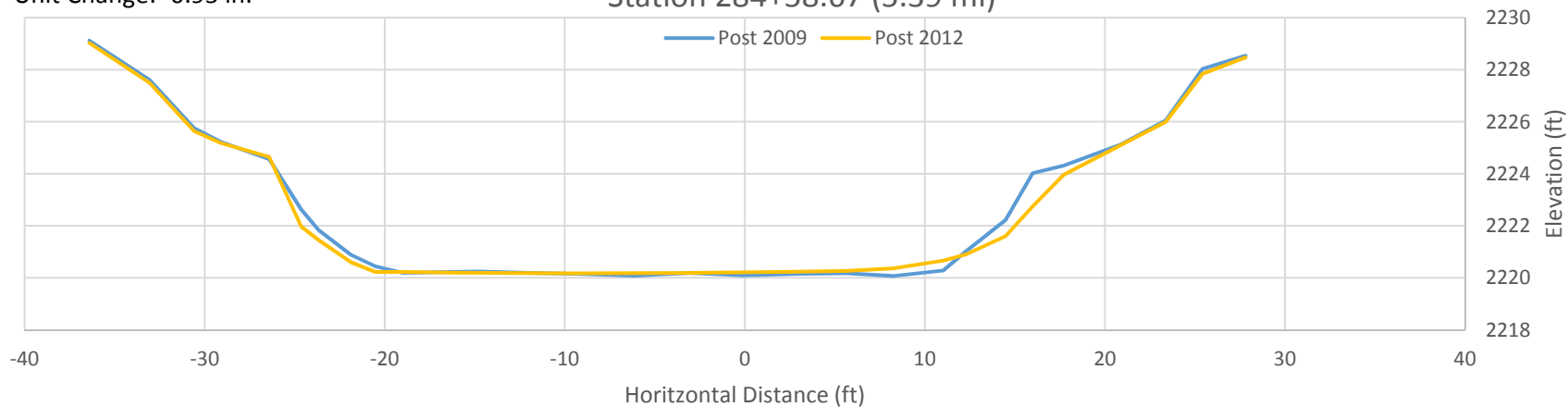
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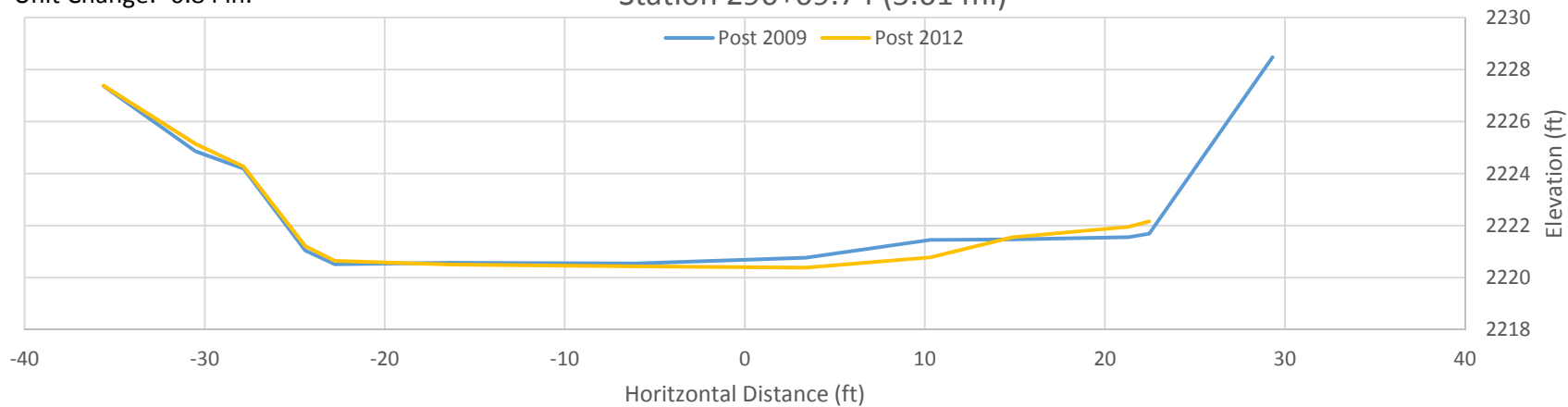
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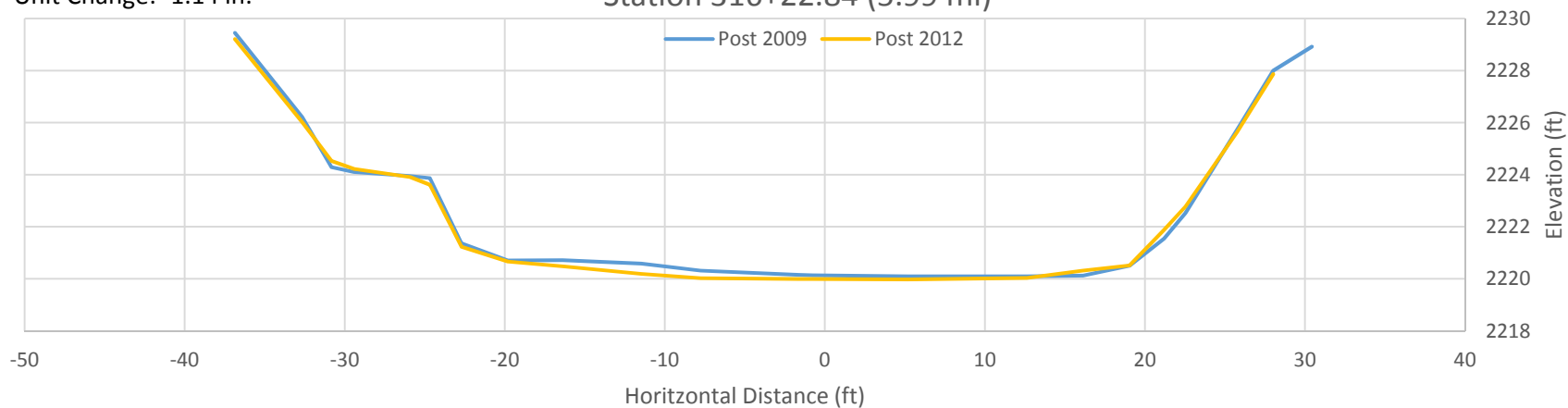
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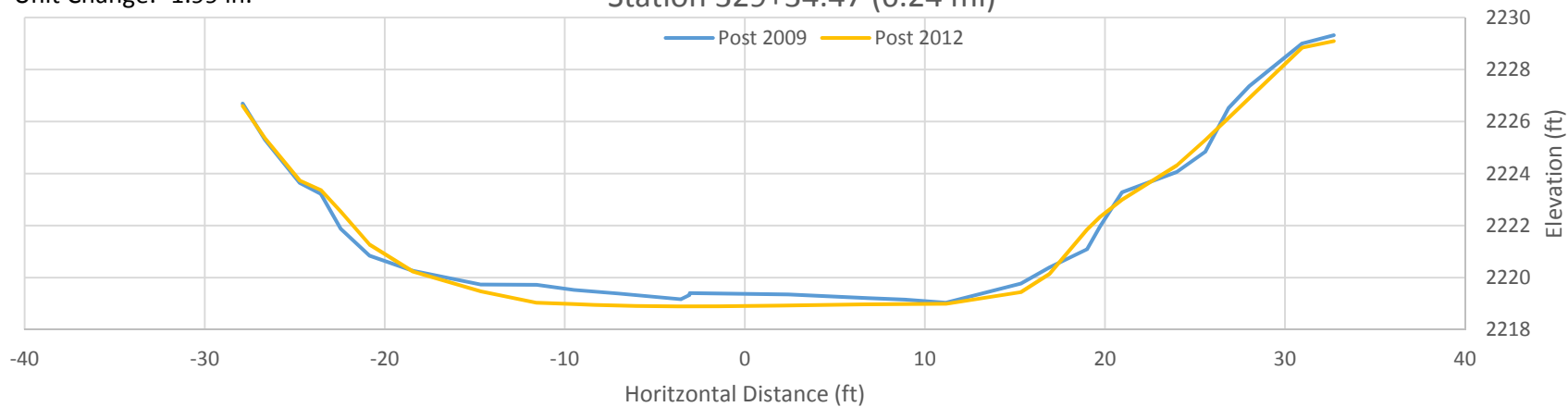
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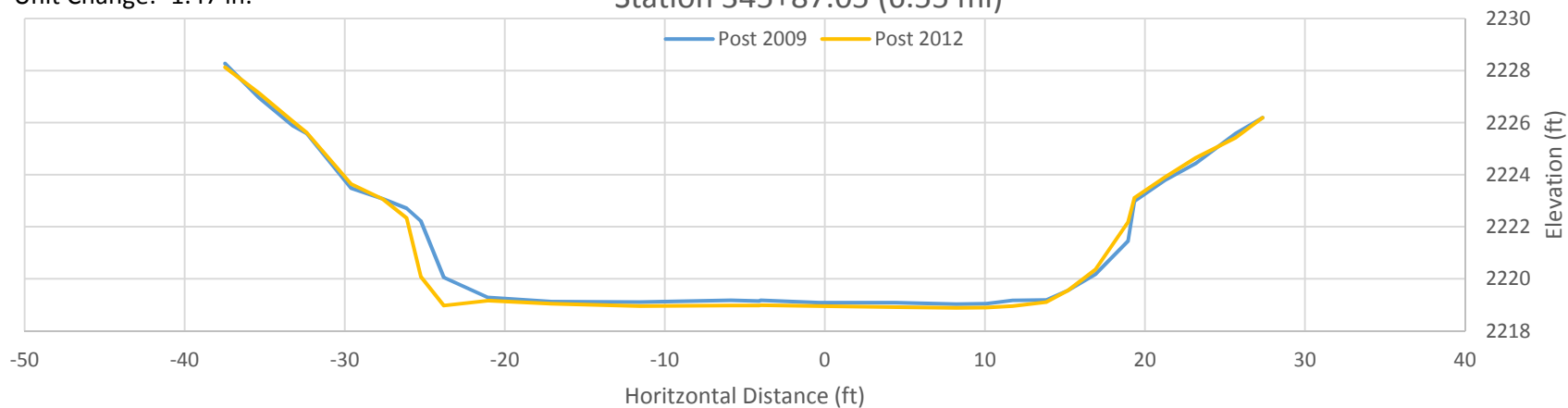
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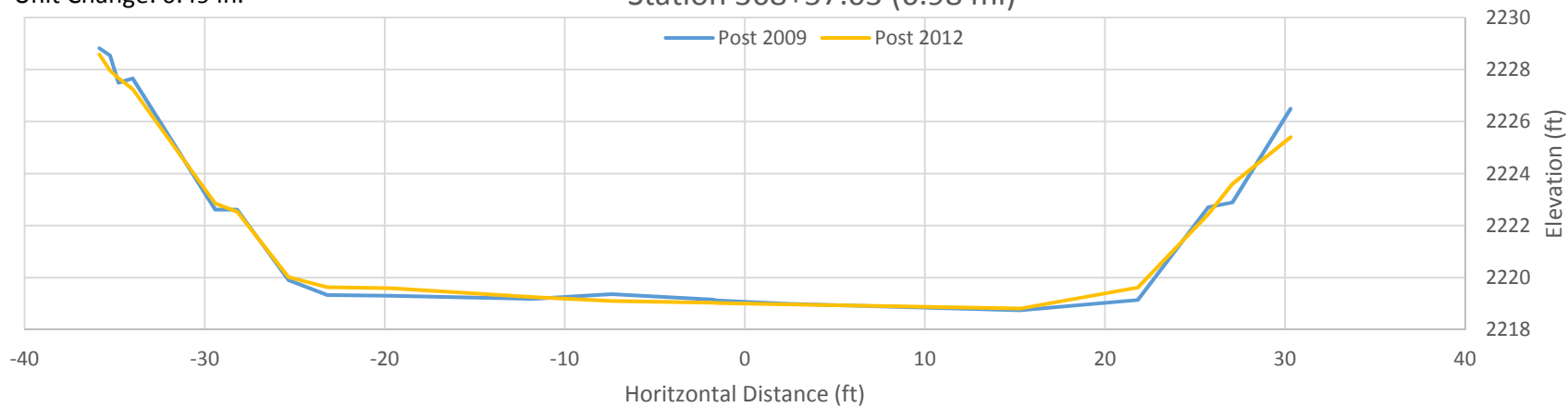
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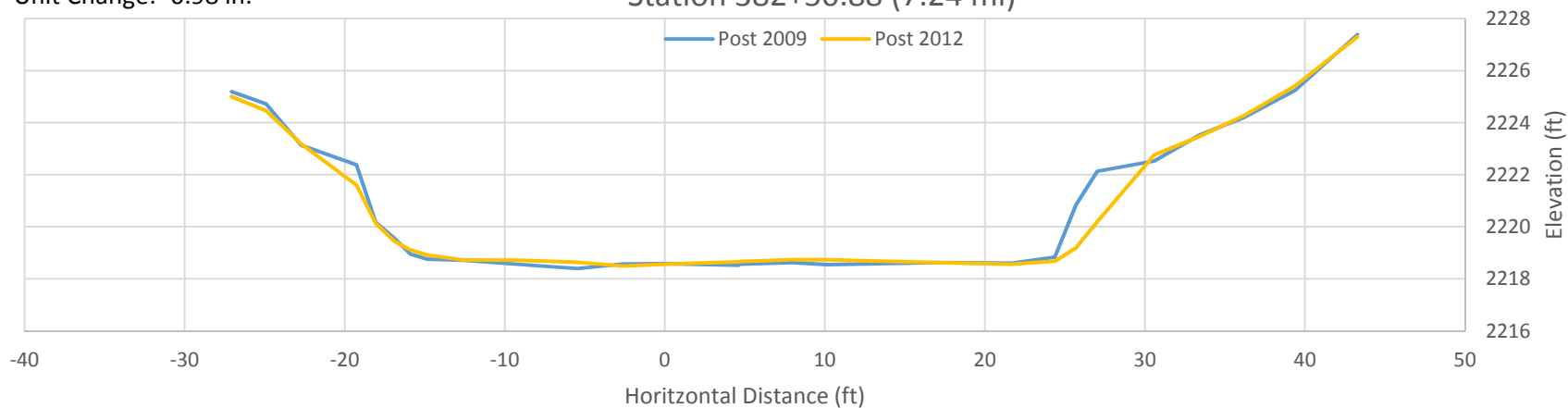
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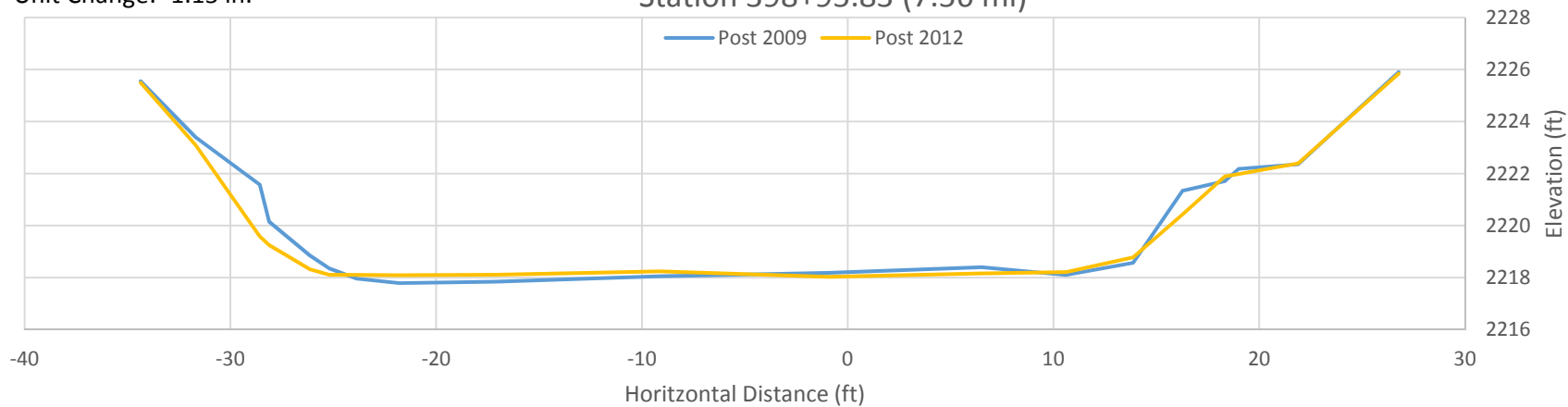
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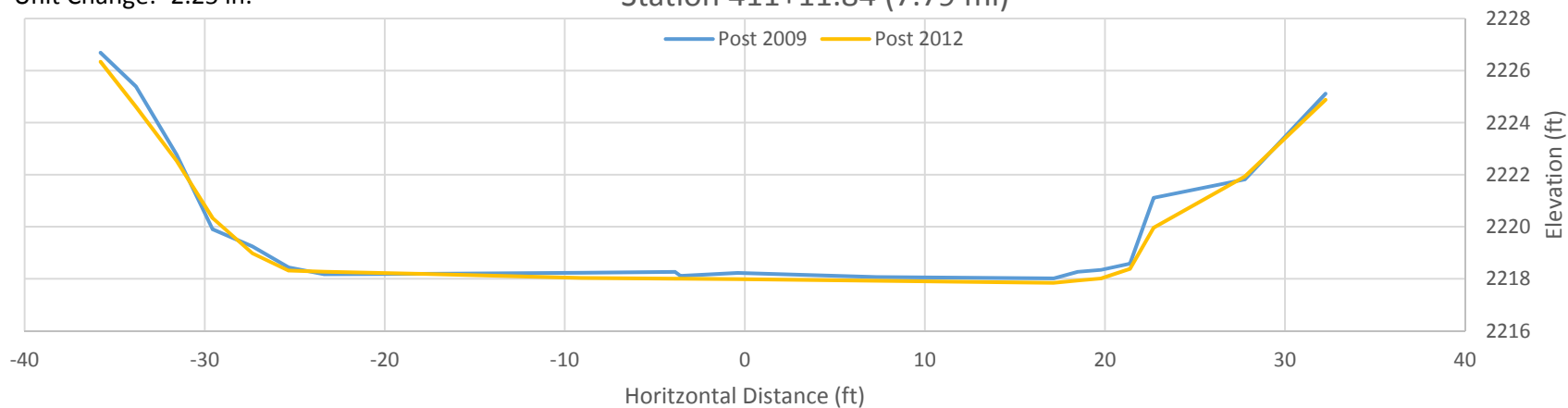
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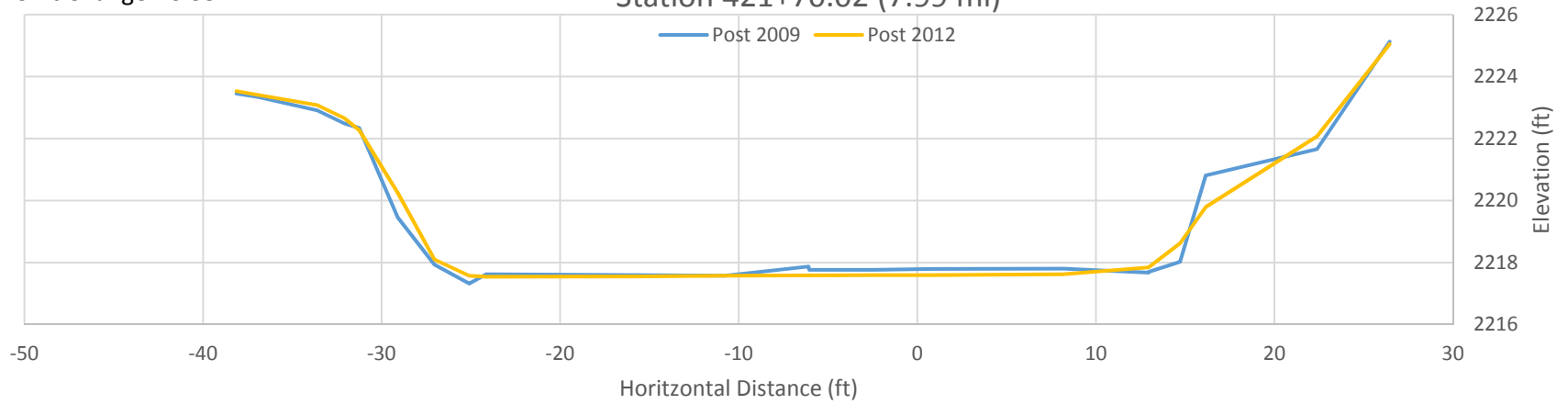
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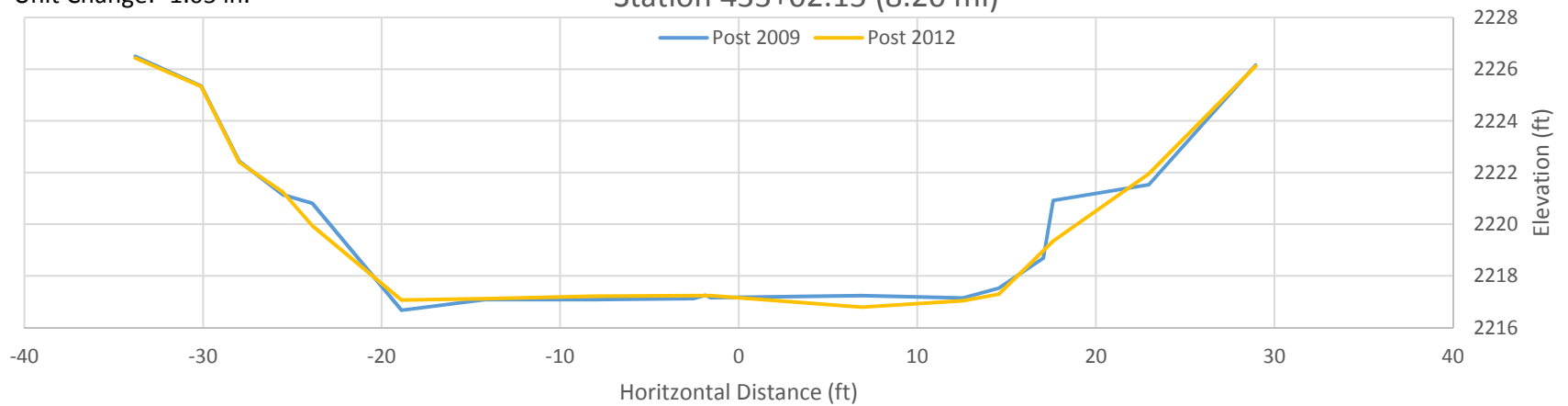
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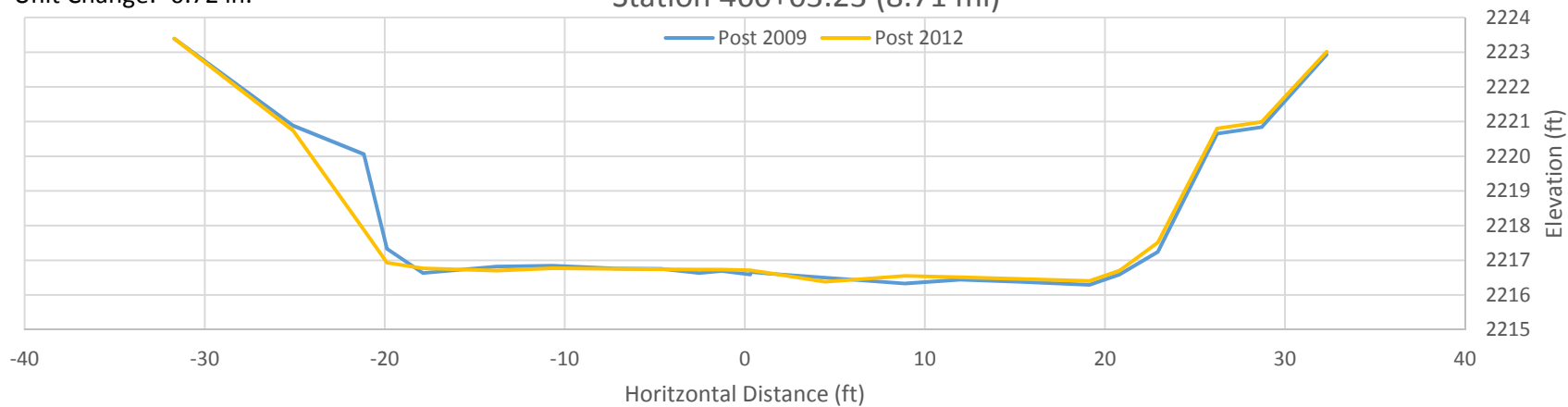
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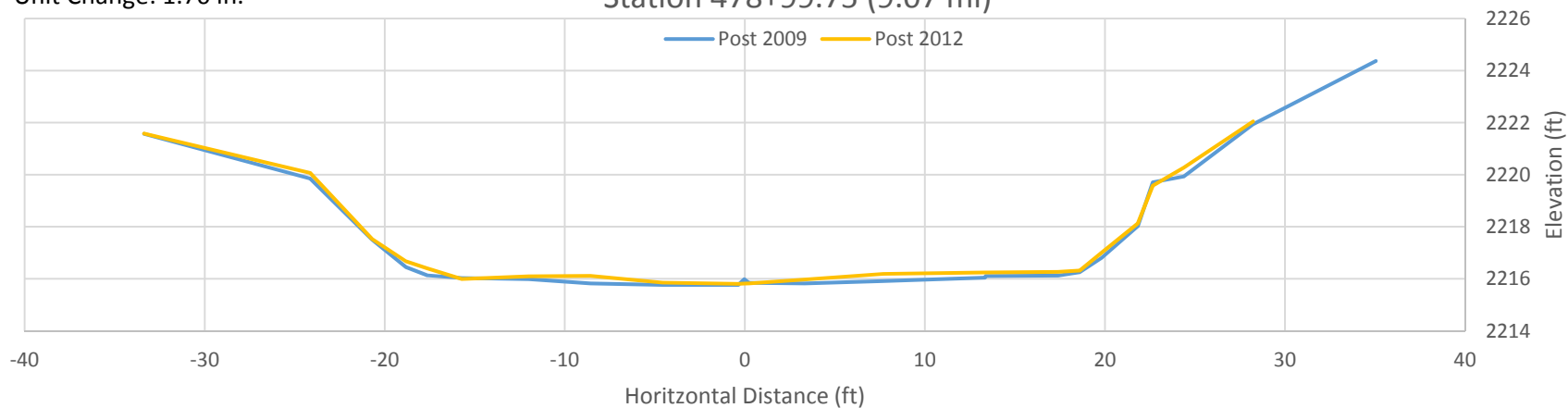
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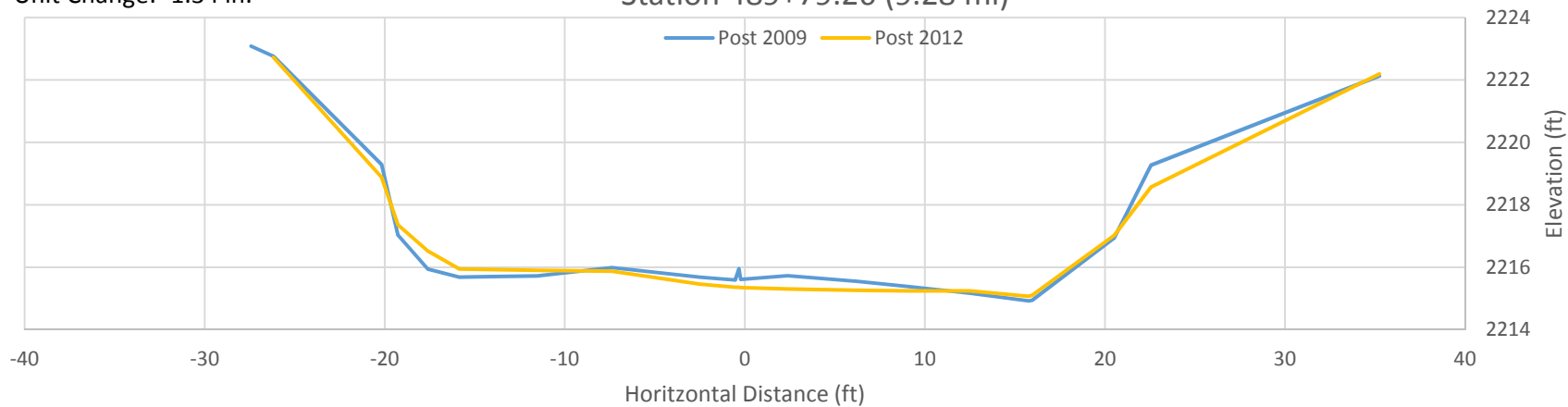
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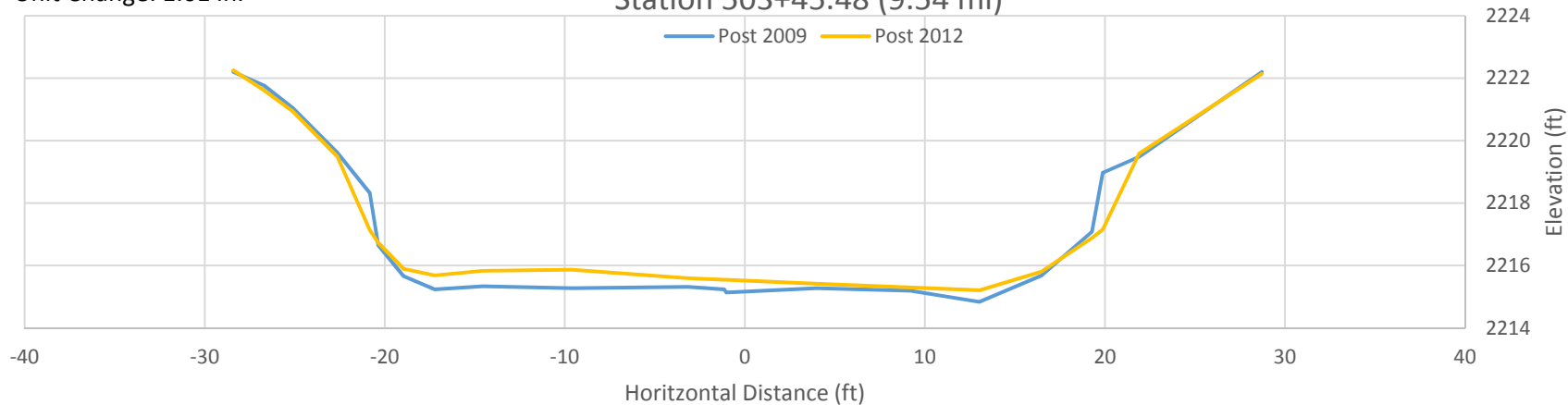
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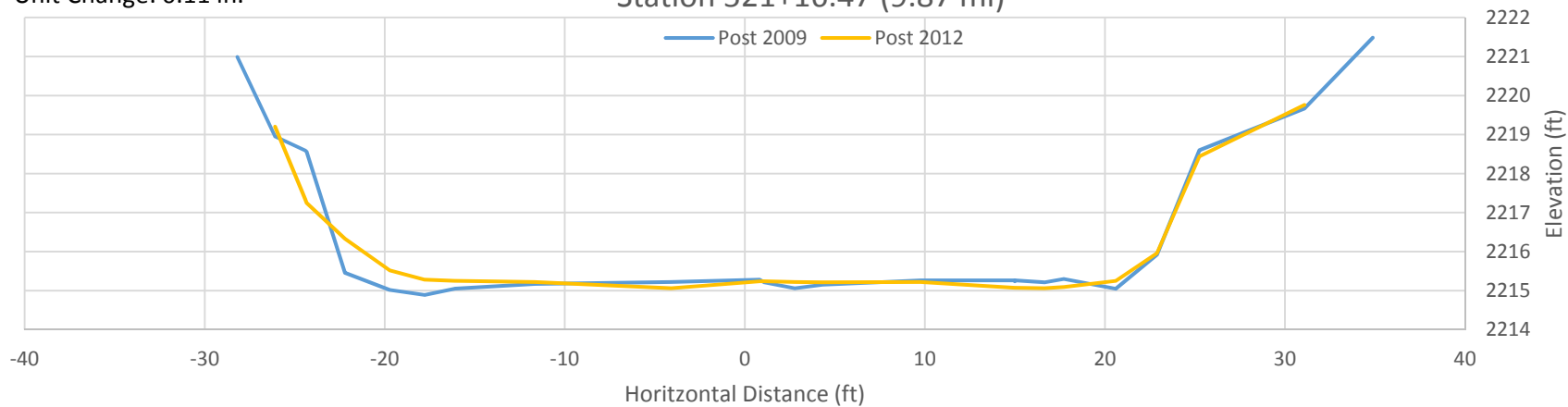
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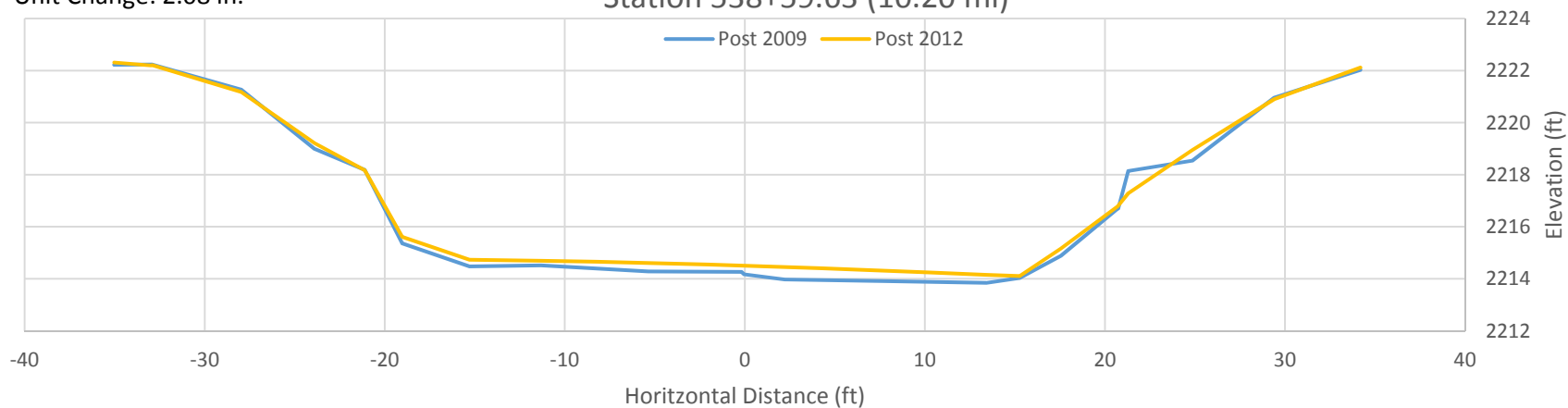
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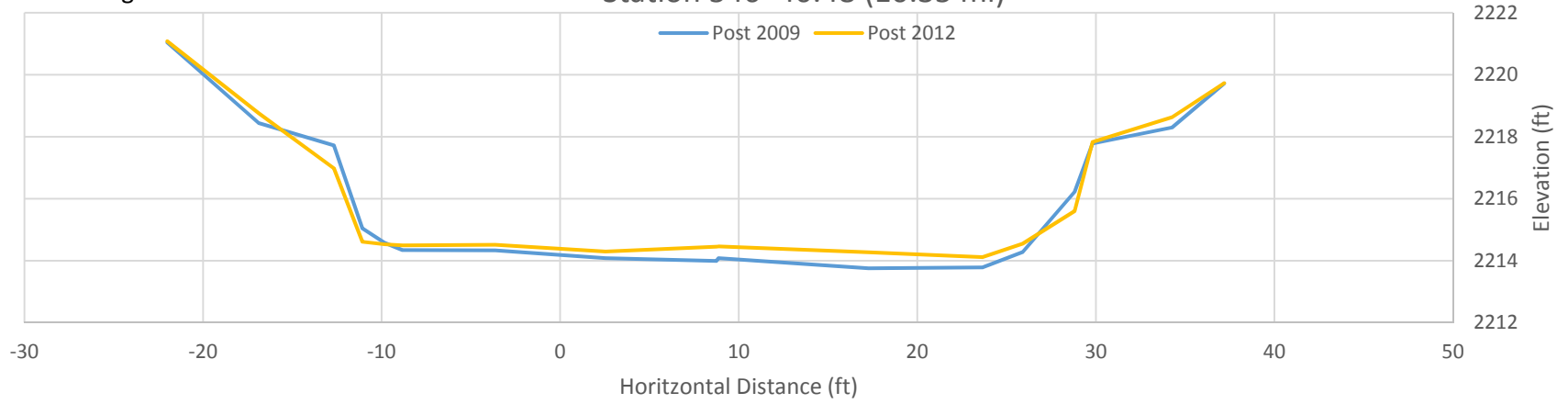
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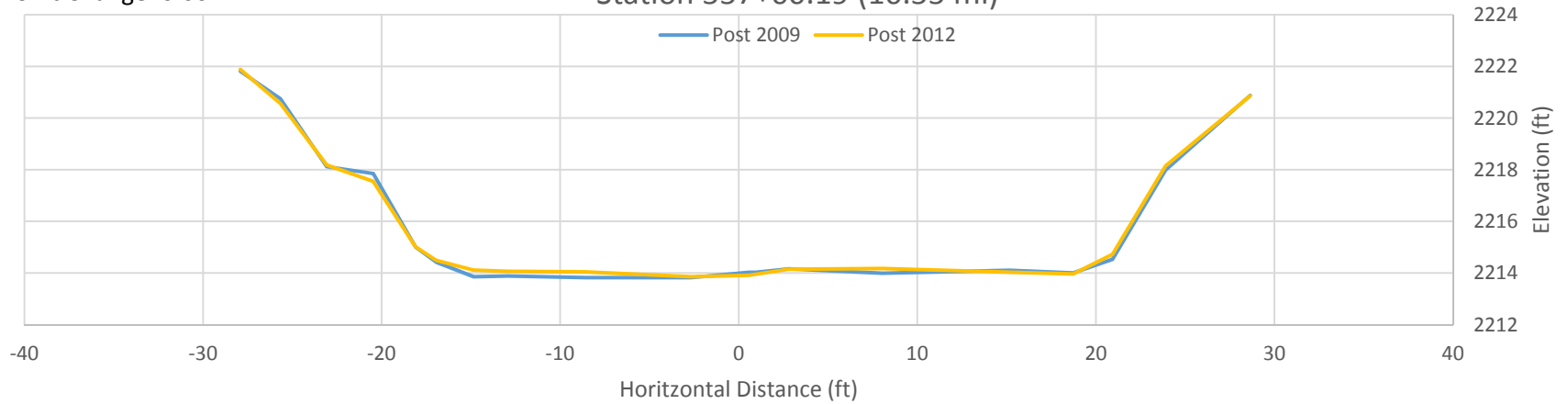
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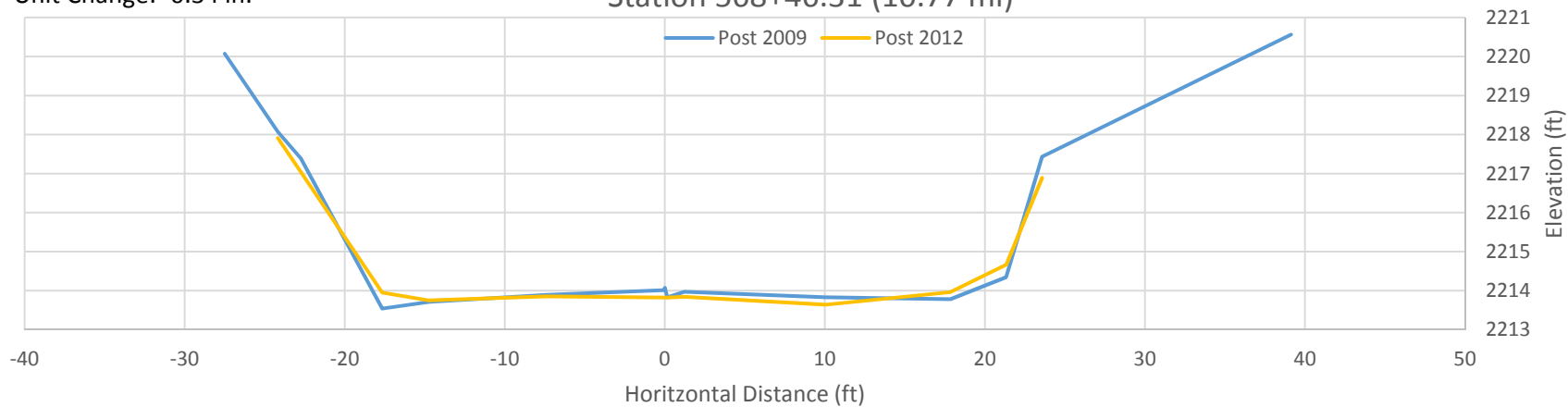
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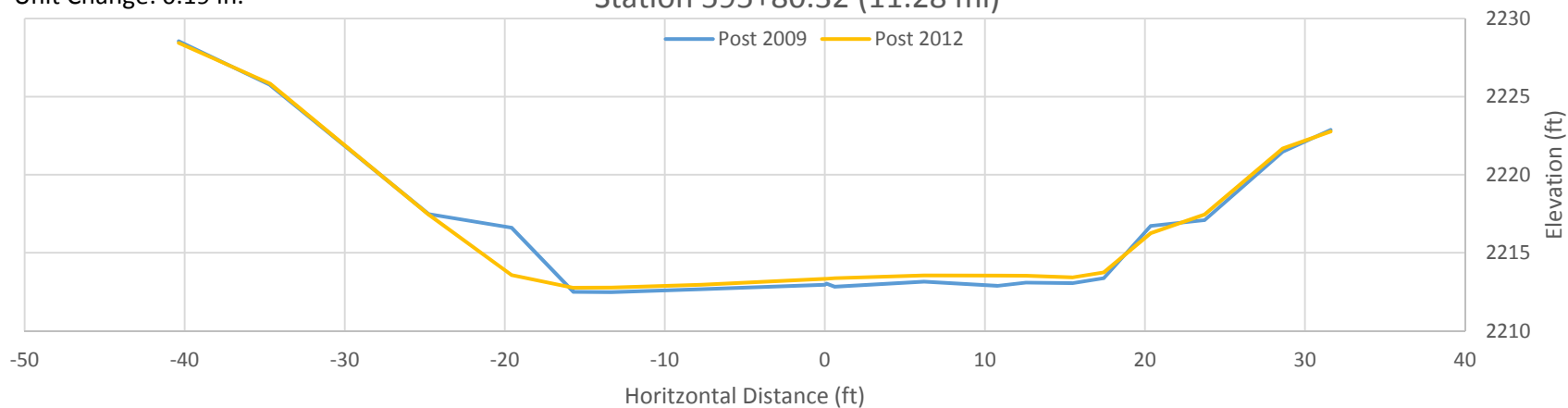
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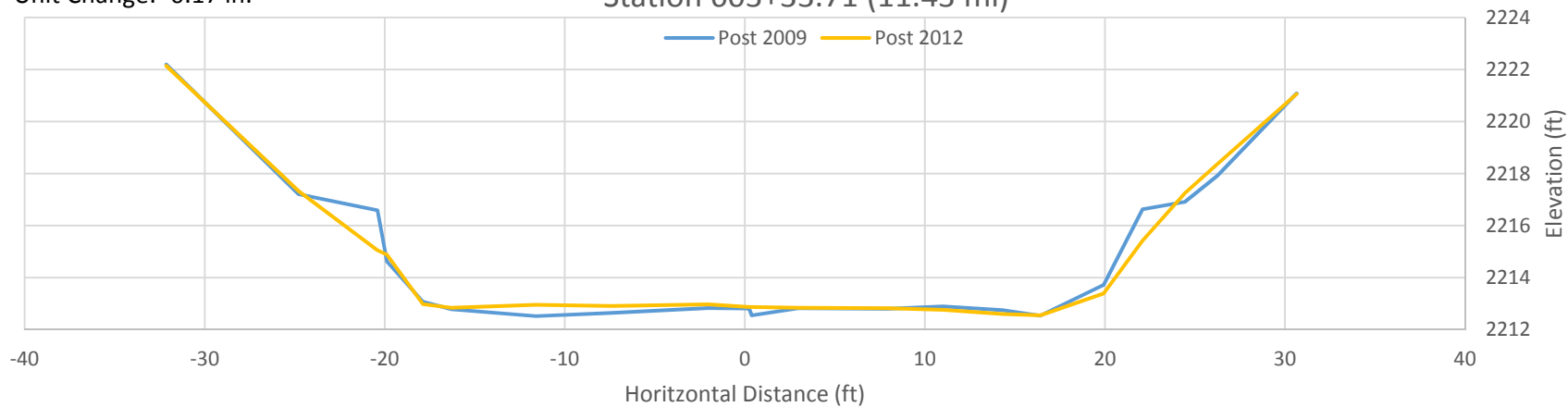
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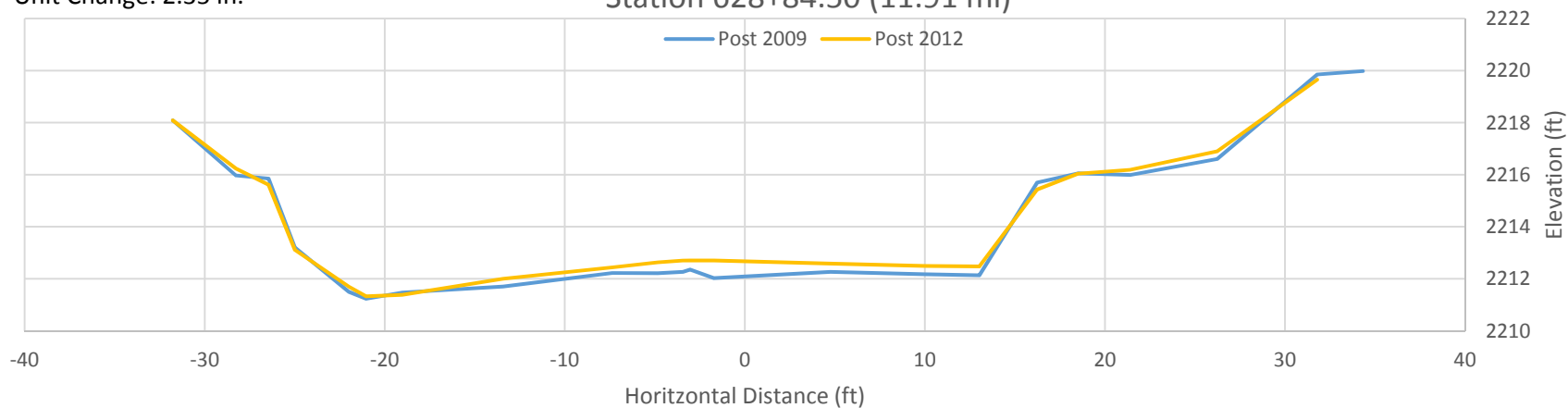
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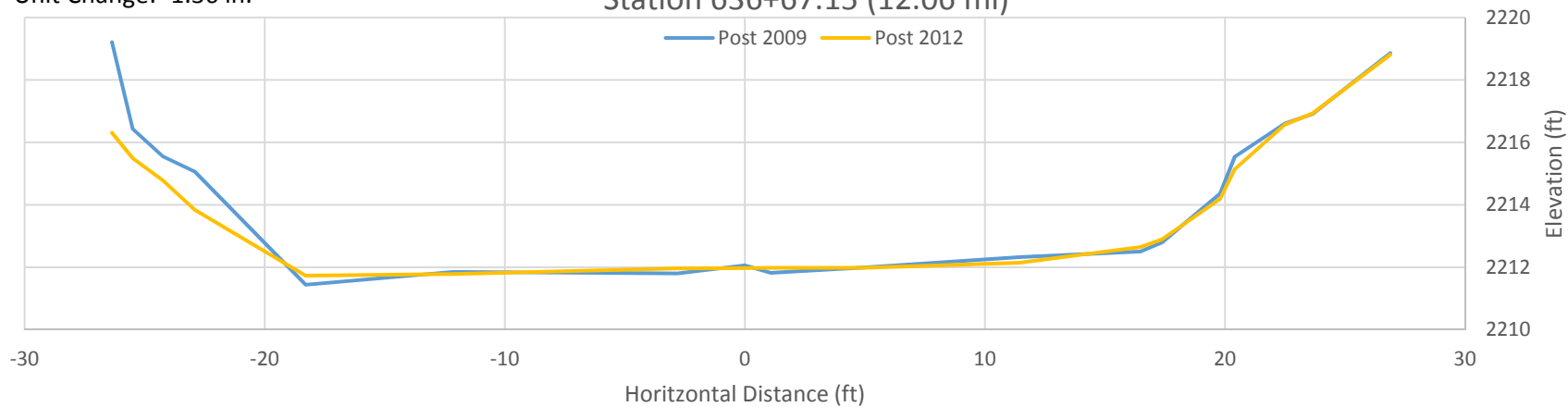
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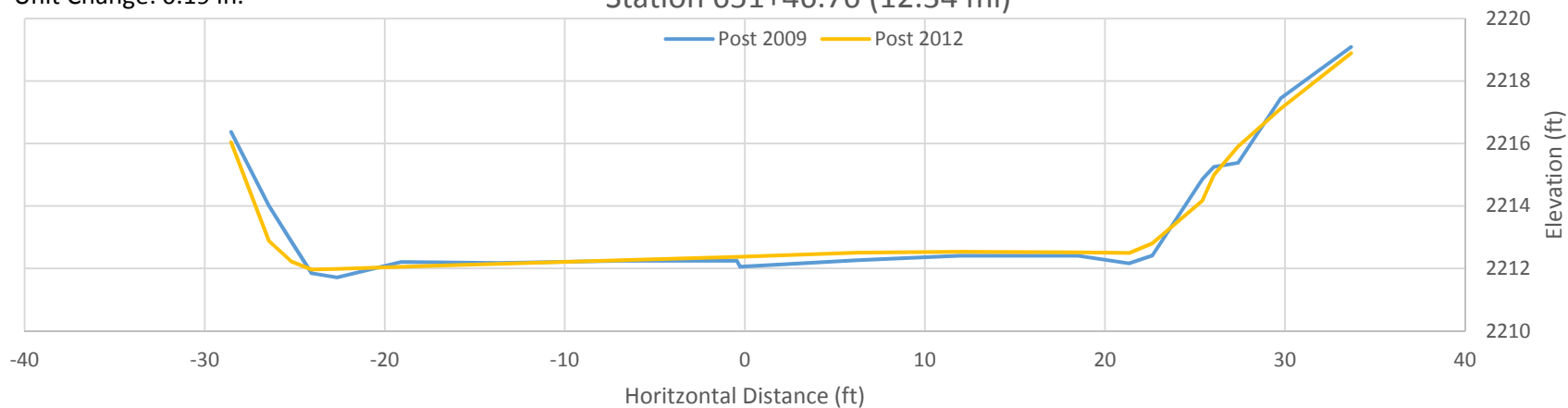
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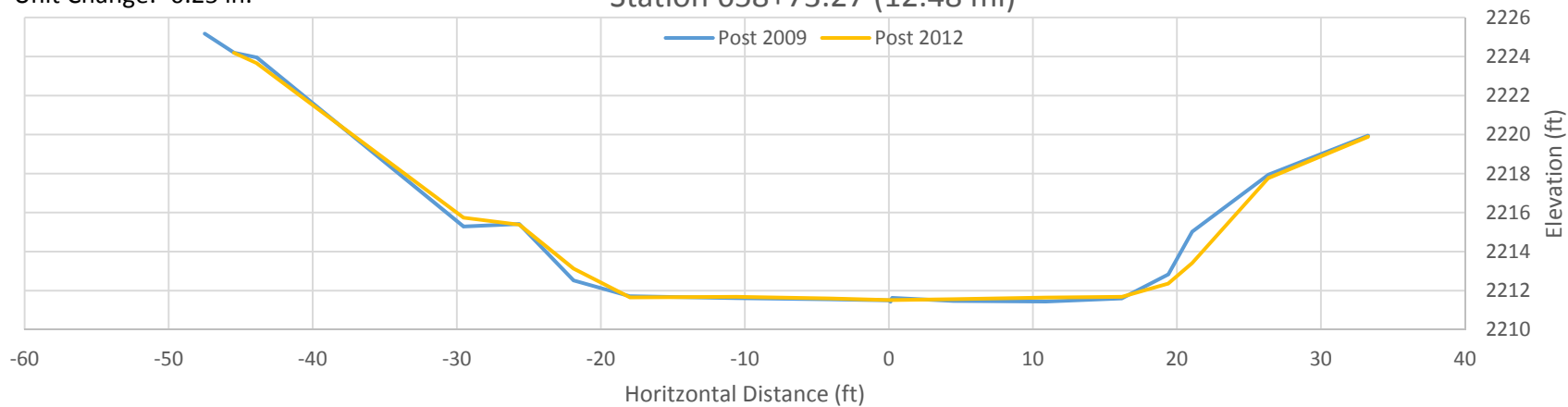
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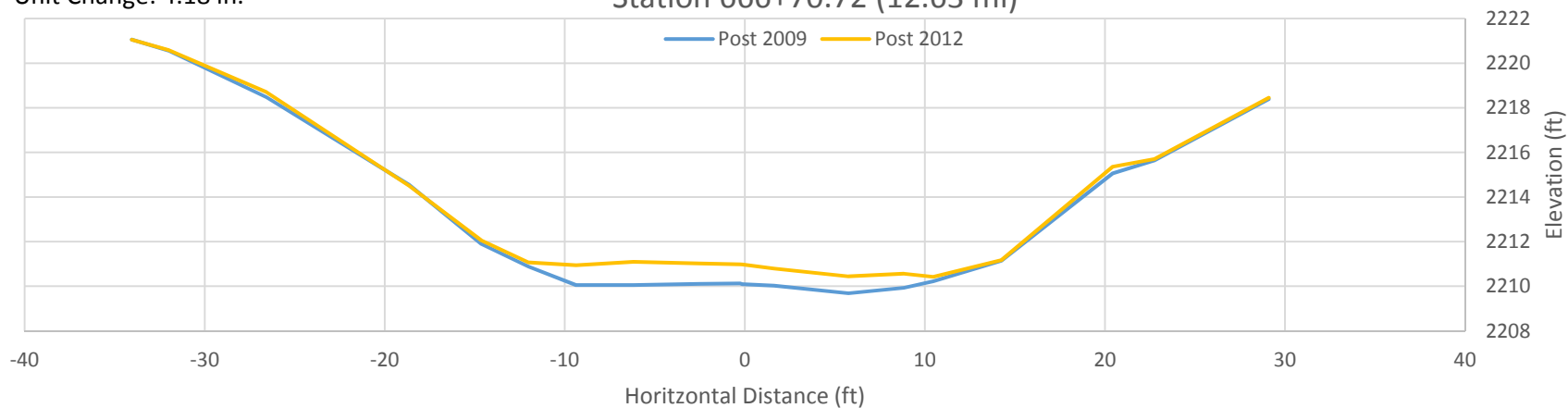
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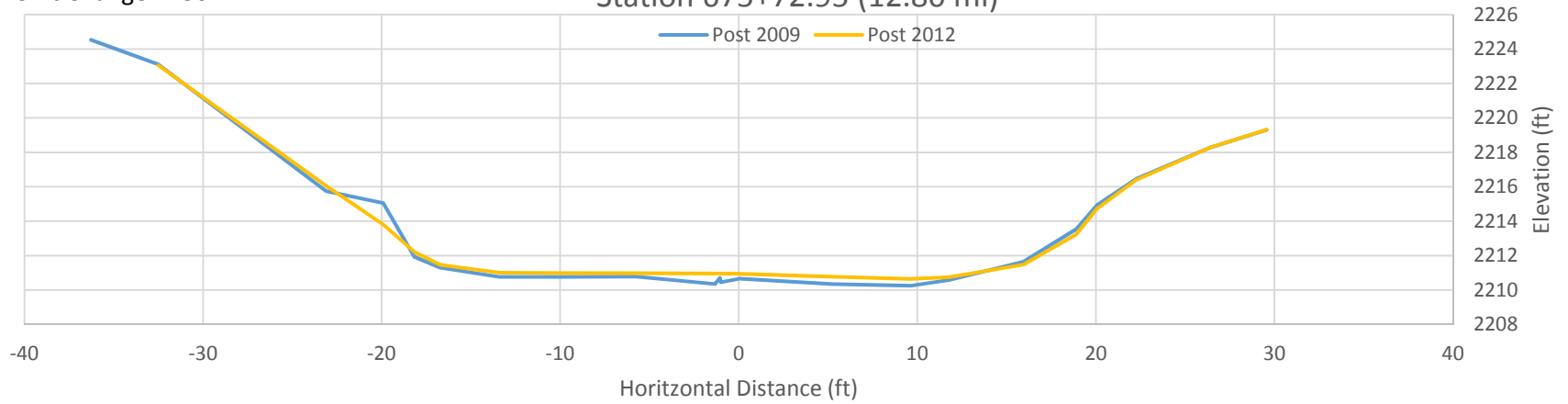
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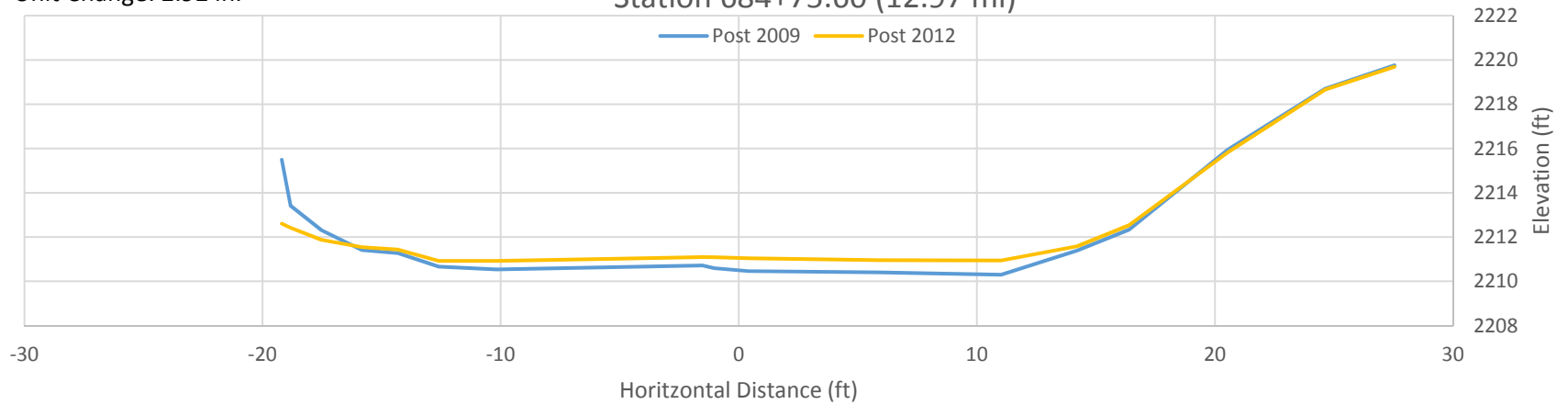
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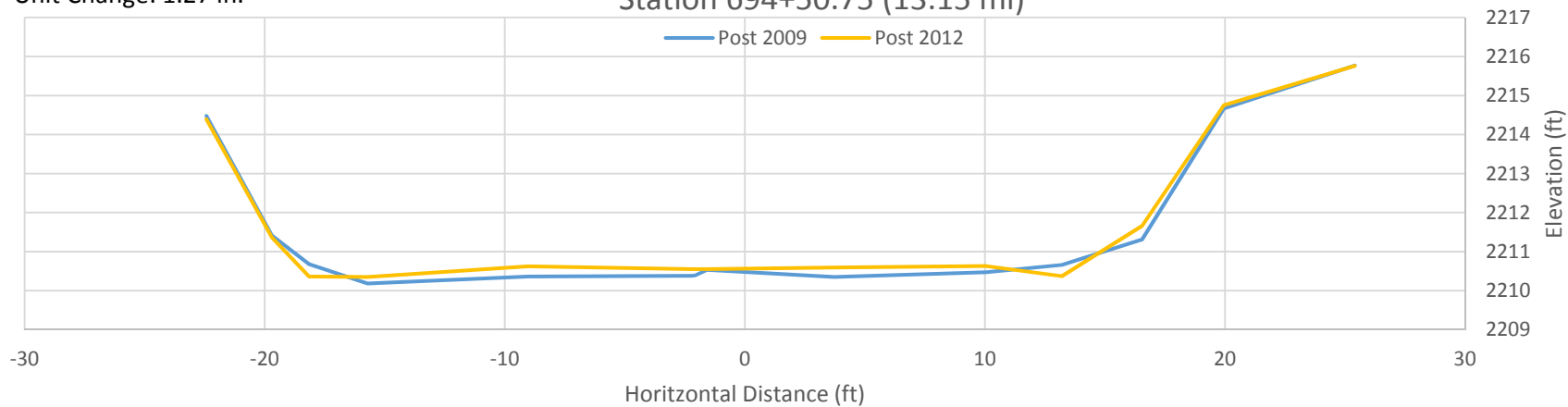
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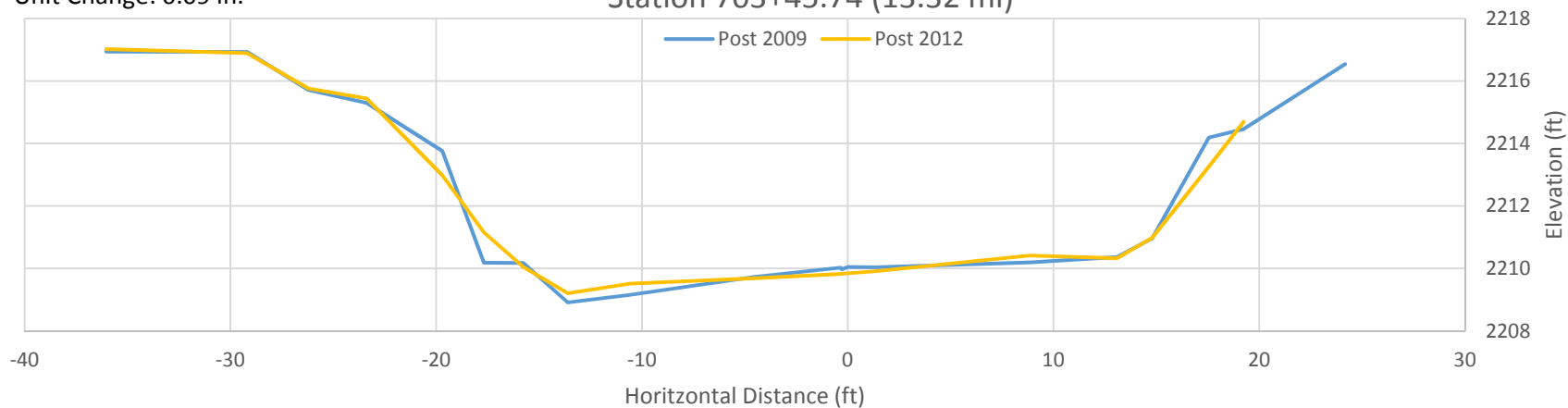
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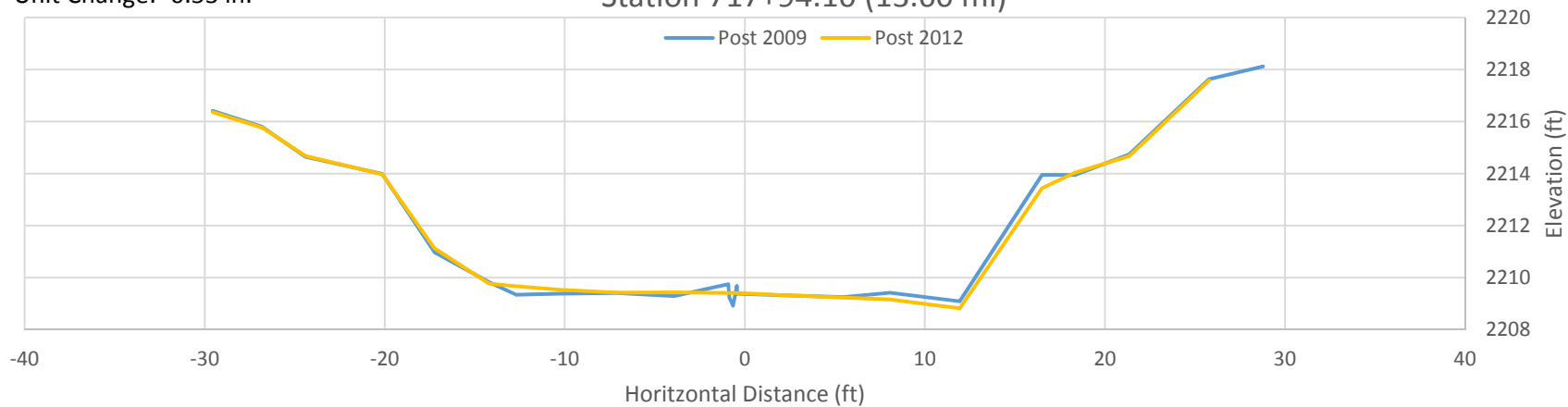
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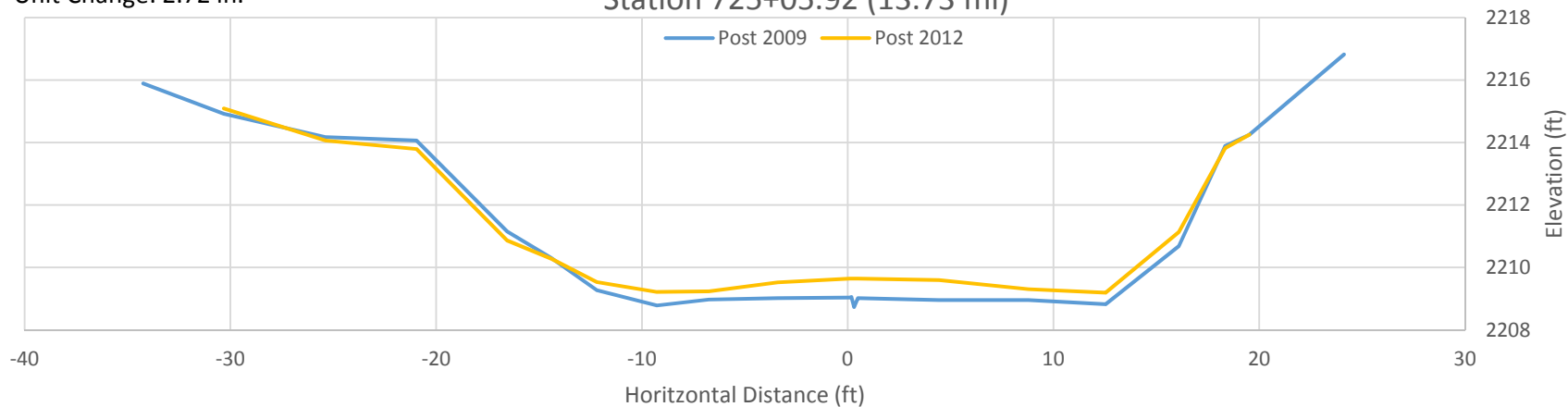
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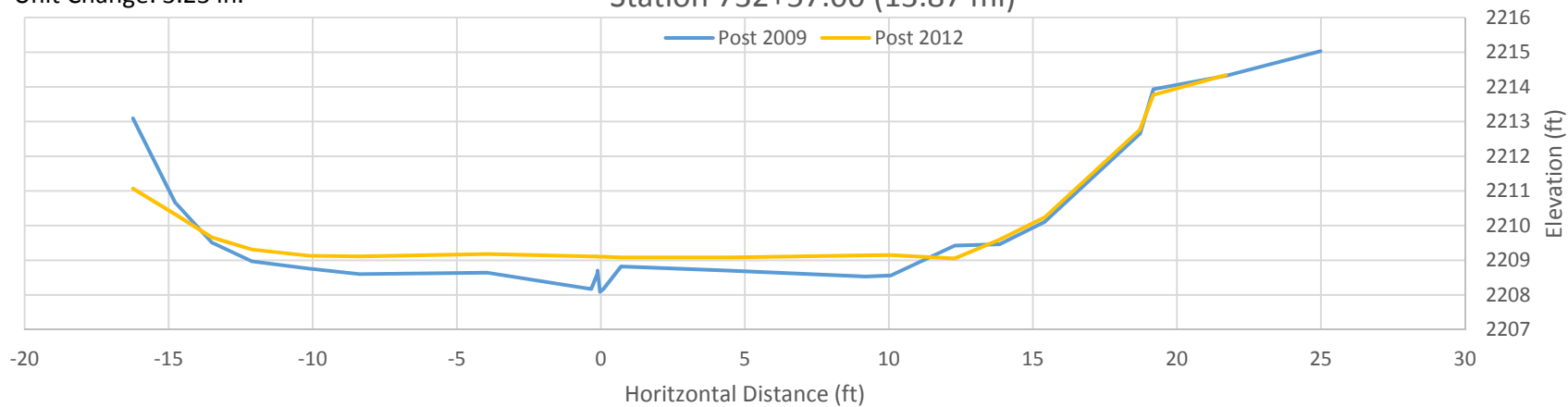
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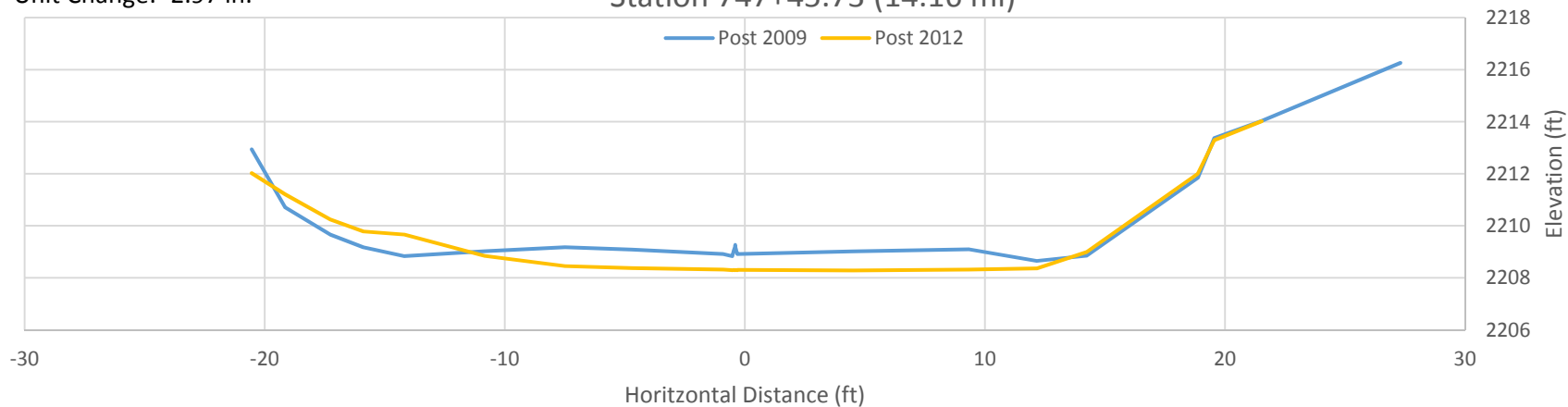
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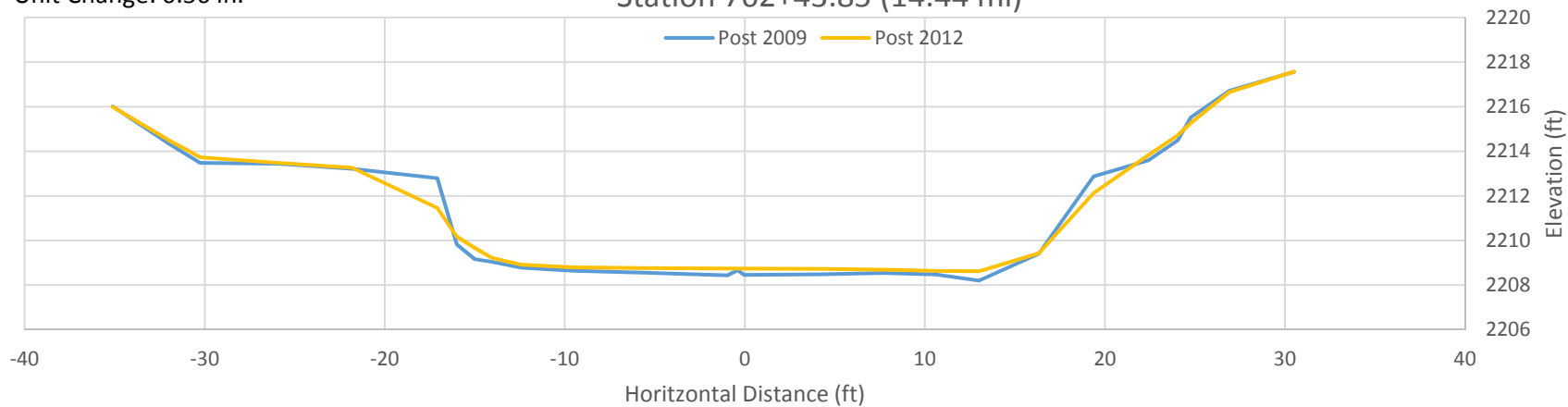
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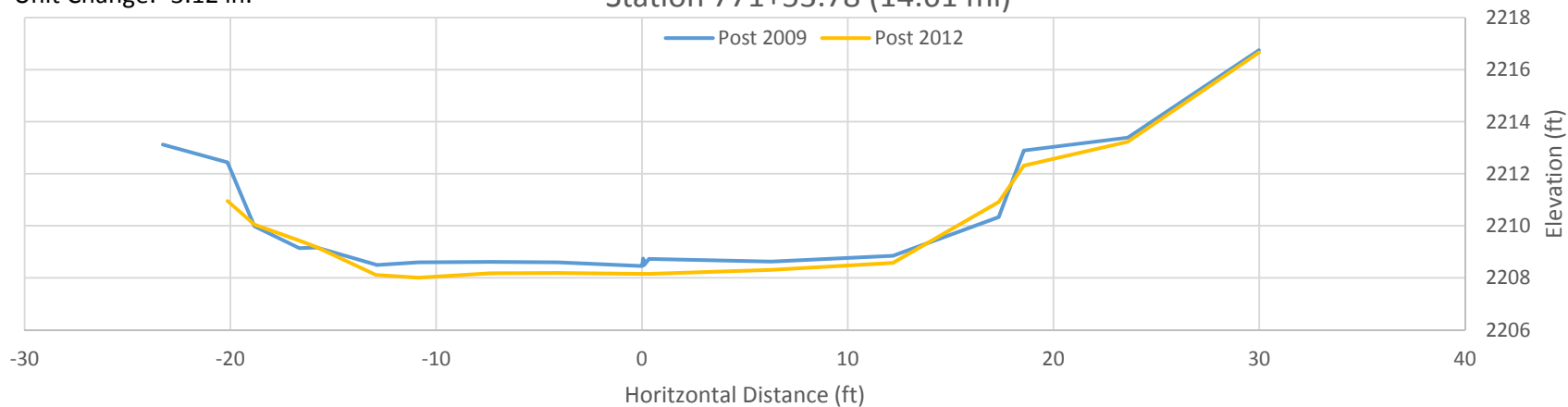
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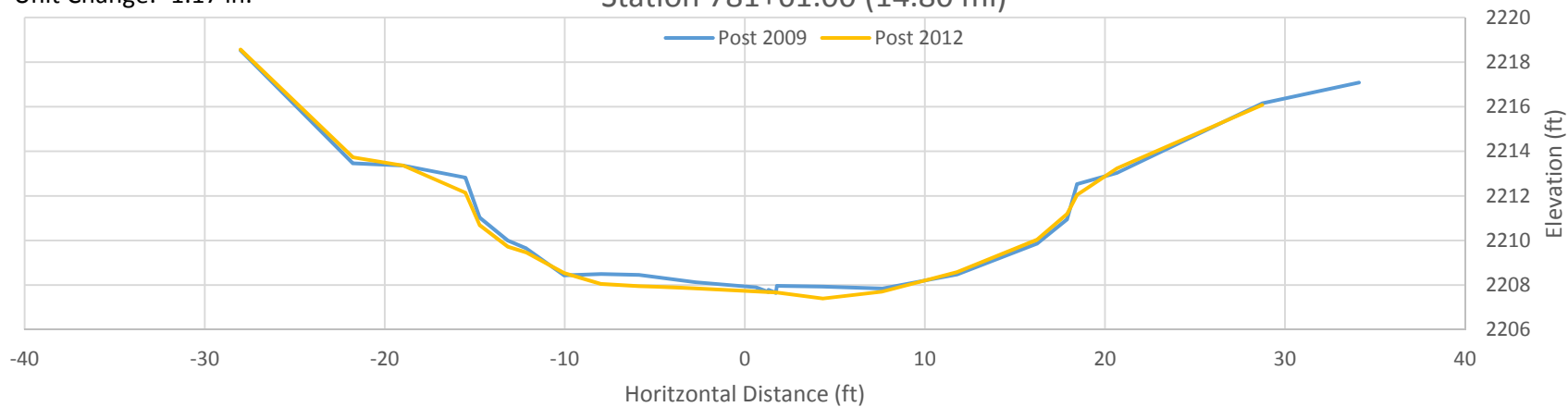
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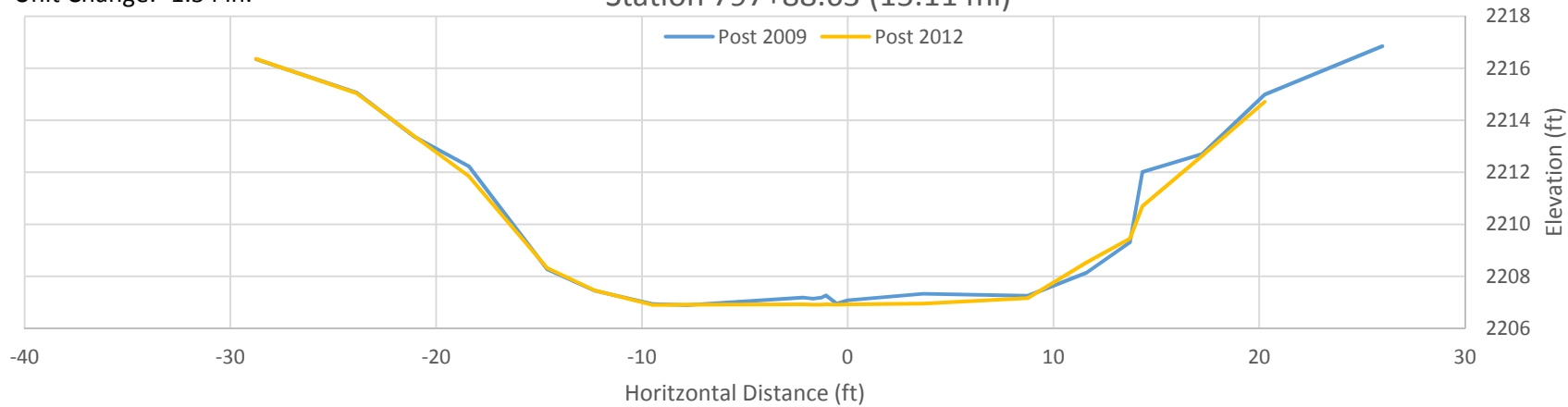
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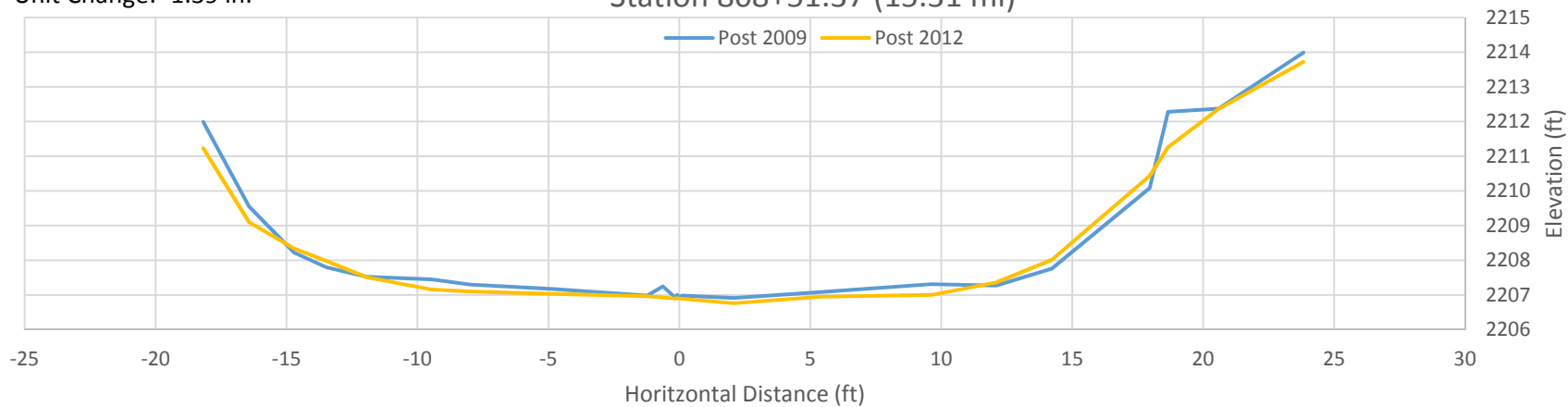
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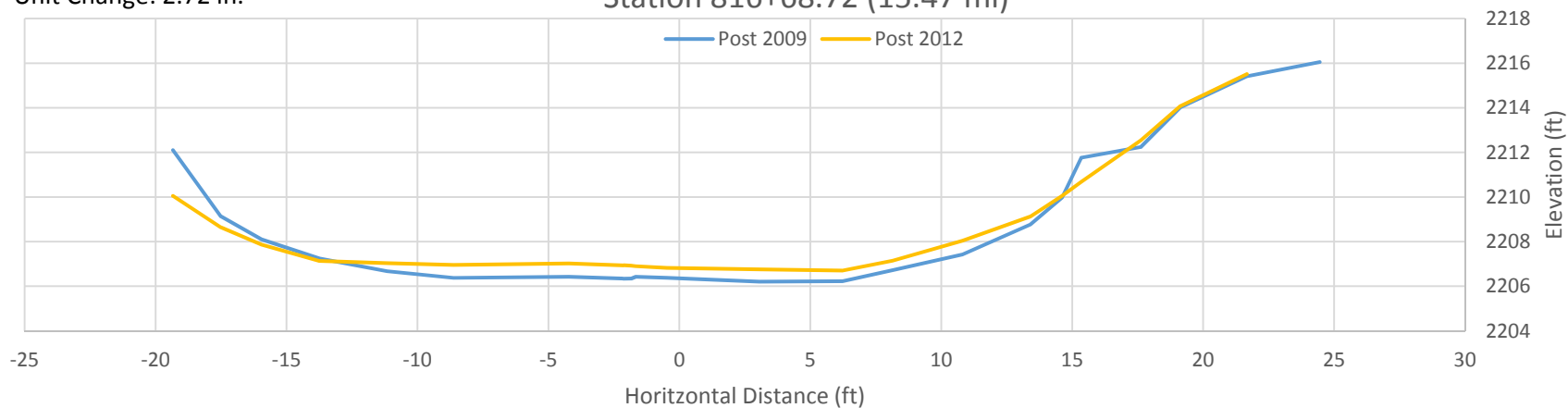
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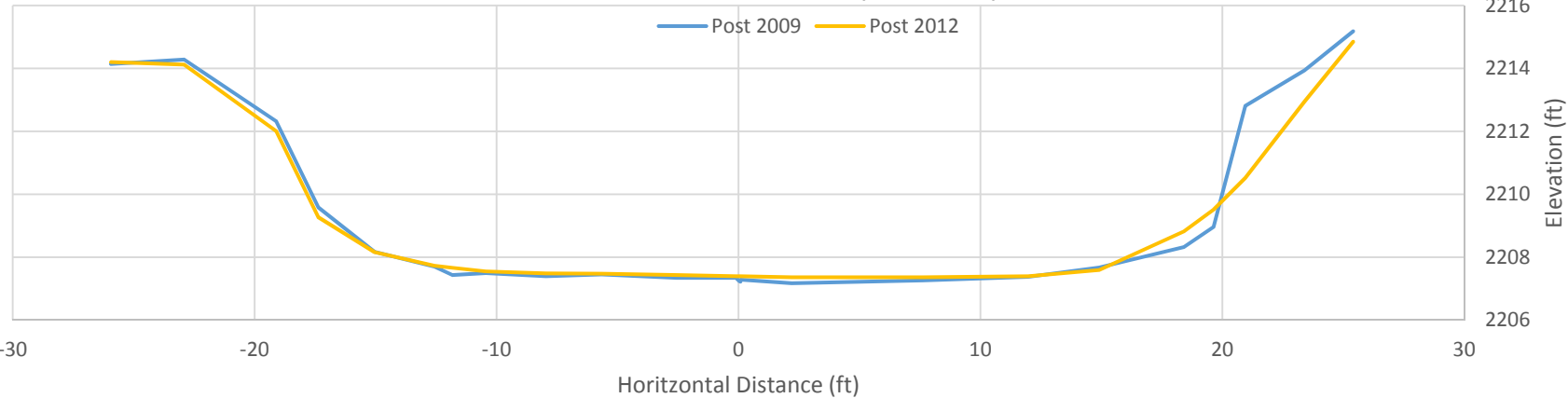
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Unit Change: -1.12 in.

Station 821+52.46 (15.56 mi)



Appendix B: 2011 EA Water Quality Report



PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Data Summary Report

**Kearney Canal Water Quality Monitoring
2011 Monitoring Season**

Draft

April 2012

Submitted to:

Platte River Recovery Implementation Program
4111 4th Avenue, Suite 6
Kearney, NE 68845

Submitted by:

EA Engineering, Science, and Technology, Inc.
221 Sun Valley Blvd, Suite D
Lincoln, NE 68521



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I. INTRODUCTION

The Platte River Recovery Implementation Program (Program) was initiated on January 1, 2007 between Nebraska, Wyoming, Colorado, and the Department of the Interior to address endangered species issues in the central and lower Platte River Basin. The species considered in the Program, referred to as “target species”, are the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), interior least tern (*Sterna antillarum*), and pallid sturgeon (*Scaphirhynchus albus*).

EA Engineering, Science, and Technology, Inc. (EA) was contracted by the Program to develop the Kearney Canal Water Quality Monitoring Protocol (Protocol) and implement the Protocol in 2011. This report presents the results of the water quality monitoring for the 2011 monitoring season (early May through late October). Data collected included stage/discharge, five water quality parameters (temperature, turbidity, dissolved oxygen, pH, and specific conductance), and representative water quality samples for suspended sediment concentration (SSC) analysis. The project team was comprised of the Program, EA, and the Nebraska Public Power District (NPPD).

I.A. Purpose

The purpose of the project is to monitor suspended sediments and water quality at locations on the Platte River, Elm Creek, and Kearney Canal to determine if Program activities alter suspended sediment concentrations in the Kearney Canal.

The Protocol defined the data collection procedures to obtain scientifically credible data in order to:

- Monitor the Platte River, Elm Creek, and Kearney Canal to obtain data on suspended sediment concentrations.
- Sample and analyze weekly grab samples for suspended sediment concentration.
- Determine spatial variations in water quality between the Platte River, Elm Creek, and Kearney Canal.

Implementation of the Protocol included:

- Collection and evaluation of data.
- Summarization of results.
- Evaluation of temporal and spatial variations in suspended sediments and water quality between the Platte River, Elm Creek, and Kearney Canal.
- Development of recommendations for subsequent water quality monitoring and/or research.

I.B. Program Activities

There were no Program activities conducted in 2011.



II. METHODS AND PROCEDURES

The Kearney Canal water quality monitoring program was designed to document water quality, detect water quality trends, and obtain representative samples for suspended sediment concentrations. The area of interest includes a reach of the Platte River from Lexington to Odessa, Elm Creek just to the west of the Kearney Canal Diversion, and the Kearney Canal from the diversion to the Kearney Hydro (Figure 1). Water quality was measured using *in-situ* continuous water quality sondes, depth integrated water samples collected for suspended sediment analyses, and discharge measurements obtained from established gaging stations. Photographs of the field work are included in Appendix D.

II.A. Monitoring Locations

Monitoring locations on the Platte River, Elm Creek, and Kearney Canal were selected to determine if Program activities are impacting suspended sediment concentrations at the NPPD Kearney Hydro. Monitoring locations on the Platte River included the existing Program Water Quality Monitoring Protocol sondes at Lexington, Overton, and Odessa. A Kearney Canal study sonde was deployed in the Platte River from the Highway 183 Bridge south of Elm Creek, Nebraska. The location on the Highway 183 Bridge does not have an existing stream gaging station. Sondes on the Kearney Canal were located based upon accessibility to bridges across the canal including one just upstream of the canal's Parshall flume, located downstream of the Platte River diversion, and one upstream above the Kearney Hydro. The sonde in Elm Creek was located upstream of its confluence with the Platte River and the Kearney Canal. The monitoring locations are listed in Table 1 and illustrated in Figure 1.

Table 1. Spatial Monitoring Matrix

Monitoring Location No.	Locations	Discharge	Water Quality	Analytical
1	Platte River near Lexington, NE	NDNR	EA	EA
2	Platte River near Overton, NE	USGS	EA	EA
2	Platte River near Elm Creek, NE	N/A	EA	EA
3	Elm Creek near confluence with the Platte River south of Elm Creek, NE	N/A	EA	EA
4	Kearney Canal downstream of the diversion south of Elm Creek, NE	NDNR	EA	EA
5	Platte River near Odessa, NE	NDNR	EA	EA
6	Kearney Canal near the Kearney Hydro in Kearney, NE	N/A	EA	EA

Notes:

NDNR – Nebraska Department of Natural Resources

USGS – United States Geological Survey

EA – EA Engineering, Science, and Technology, Inc.



Table 2. Monitoring Location Identification

Monitoring Location No.	Locations	Identification
1	Platte River near Lexington, NE	LEXP
2	Platte River near Overton, NE	OVPR
3	Platte River near Elm Creek, NE	ELMP
4	Elm Creek near confluence with the Platte River south of Elm Creek, NE	ELMC
5	Kearney Canal downstream of the diversion south of Elm Creek, NE	KCDIV
6	Platte River near Odessa, NE	ODSP
7	Kearney Canal near the Kearney Hydro in Kearney, NE	KCPH

II.B. Parameters of Interest

Water quality data was categorized into three groups:

- **Discharge** – Discharge and river stage or gage height were collected. Existing gaging stations maintained by the United States Geological Survey (USGS) and Nebraska Department of Natural Resources (NDNR) were used where possible. Gaging stations were not installed or maintained under the Program.
- **Continuous Water Quality Monitoring** – Continuous water quality data were collected for water temperature, turbidity (optical sensor), dissolved oxygen by optical or Luminescent Dissolved Oxygen (LDO) technology, pH, and specific conductance. Data were logged at set intervals and downloaded at regular intervals.
- **Discrete Water Quality Monitoring** – Representative and discrete water samples were collected by EA and analyzed by Ward Laboratories, Inc. Samples were analyzed for suspended sediment concentration.

II.B.1. Frequency and Duration

The index period for the collection of continuous water quality monitoring data was from May 2, 2011 through October 30, 2011. The frequency and duration of data collection was based upon the 2011 operation schedule of the Kearney Canal as listed below:

- **Discharge**
 - Existing gaging stations on the Platte River are operated continuously by the USGS and NDNR. Discharge on the Kearney Canal was obtained from an existing NPPD gaging station maintained by the NDNR. Discharge was estimated by the agencies using rating curves at these stations. A data point was collected every 15 minutes at the USGS gaging station located at Overton and every 30 minutes at the NDNR gaging stations at Lexington, Odessa, and the Kearney Canal.



• **Continuous Water Quality Monitoring**

- o EA installed sondes at two locations on the Kearney Canal, one on the Platte River at Highway 183 south of Elm Creek, Nebraska, and one on Elm Creek near the confluence with the Platte River. EA also provided operation and maintenance from the week beginning May 2, 2011 through the week ending October 30, 2011. Sondes previously installed on the Platte River at Lexington, Overton, and Odessa provided data for the same time period. A data point was collected every 30 minutes.
- o Operation and maintenance of the sondes (including downloading of data) was conducted weekly from May through September and bi-weekly during October as seen in Table 3.

Table 3. Date and Location of Operation and Maintenance Events (2011)

Date	Sites	Date	Sites
April 20	LEXPR, OVRPR, ODSR	August 4	LEXPR, OVRPR, ELMR, ELMCR, KCDIV, ODSR, KCPH
May 5	LEXPR, OVRPR, ELMR, KCDIV, ODSR, KCPH	August 8	OVRPR, ODSR
May 6	ELMCR	August 9	LEXPR, ELMR, ELMCR, KCDIV, KCPH
May 17	LEXPR, OVRPR, ELMR, KCDIV, ODSR, KCPH	August 16	LEXPR, OVRPR, ODSR
May 18	ELMCR	August 17	ELMR, ELMCR, KCDIV, KCPH
May 24	LEXPR, OVRPR, ELMR, ELMCR, KCDIV, ODSR, KCPH	August 21	LEXPR, OVRPR, ODSR
May 31	LEXPR, OVRPR, ELMR	August 22	ELMR, ELMCR, KCDIV, KCPH
June 1	ELMCR, KCDIV, ODSR, KCPH	August 31	ODSR
June 7	LEXPR, OVRPR, ELMR, ELMCR, KCDIV, ODSR, KCPH	September 1	LEXPR, OVRPR, ELMR, ELMCR, KCDIV, KCPH
June 8	LEXPR	September 6	OVRPR, ODSR
June 14	OVRPR, ODSR	September 7	LEXPR, ELMR, ELMCR, KCDIV, KCPH
June 15	LEXPR, ELMR, ELMCR, KCDIV, KCPH	September 14	LEXPR, ELMR, ELMCR, KCDIV, ODSR, KCPH
June 22	LEXPR, OVRPR, ELMR, ELMCR, KCDIV, ODSR, KCPH	September 20	ODSR
June 29	LEXPR, ELMR, ELMCR, KCDIV, KCPH	September 21	LEXPR, ELMR, ELMCR, KCDIV, KCPH
June 30	OVRPR, ODSR	September 27	LEXPR, ELMR, ODSR
July 5	LEXPR, OVRPR, ODSR	September 28	ELMCR, KCDIV, KCPH
July 6	ELMR, ELMCR, KCDIV, KCPH	October 4	OVRPR



Date	Sites	Date	Sites
July 14	LEXPR, OVRPR, ELMPR, ELMCR, KCDIV, ODSPR, KCPH	October 11	LEXPR, OVRPR, ELMPR, ELMCR, KCDIV, ODSPR, KCPH
July 20	ODSPR	October 25	LEXPR, OVRPR, ELMPR, ELMCR, KCDIV, ODSPR
July 21	LEXPR, OVRPR, ELMPR, ELMCR, KCDIV, ODSPR, KCPH	October 26	KCPH
July 28	OVPR, ODSPR	November 9	ODSPR
July 29	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	November 10	LEXPR, OVRPR, ELMPR, ELMCR, KCDIV, KCPH

- **Discrete Water Quality Monitoring**

- The index period for the collection of discrete water quality data was determined by the operation of NPPD's Kearney Canal; which occurred from May 2, 2011 to October 28, 2011.
- Representative water samples for analytical analysis of SSC were collected at five monitoring locations listed in Table 4 during maintenance activities of the sondes. Samples were not collected at Lexington on May 6 and May 18.



Table 4. Date and Location of Discrete Water Quality Sampling Events (2011)

Date	Sites	Date	Sites
May 6	ELMPR, ELMCR, KCDIV, KCPH	August 4	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
May 18	ELMPR, ELMCR, KCDIV, KCPH	August 9	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
May 25	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	August 17	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
May 31	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	August 22	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
June 8	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	September 1	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
June 15	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	September 7	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
June 23	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	September 15	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
June 29	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	September 21	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
July 6	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	September 28	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
July 14	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	October 11	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
July 21	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	October 25	LEXPR, ELMPR, ELMCR, KCDIV, KCPH
July 29	LEXPR, ELMPR, ELMCR, KCDIV, KCPH	--	--

II.C. Discharge and River Stage

Platte River discharge measurements were obtained from existing gaging stations maintained by the USGS and NDNR (Table 1). Discharge was estimated using rating curves maintained by the owning agencies. Periodic measurements of the depth and flow rate by the respective agencies are used to adjust the rating curves as needed.

II.D. Continuous Water Quality Monitoring

Existing sondes at Lexington, Overton and Odessa, installed as part of the central and lower Platte River baseline monitoring program, were used for the Kearney Canal water quality monitoring. Sondes for the Kearney Canal water quality monitoring were deployed at four locations including the Highway 183 Bridge south of Elm Creek, Kearney Canal immediately upstream of the canal's Parshall flume, upstream of the Kearney Hydro in Kearney at the Kearney Country Club, and Elm Creek near its confluence with the Platte River. The data and units of measure collected are listed in Table 5.



Table 5. Continuous Water Quality Parameters

Water Quality Parameter	Unit	Range	Accuracy	Resolution
Hydrolab MS-5				
Temperature	Degrees Celsius	-5 to +50°C	± 0.10 °C	0.01 °C
Turbidity	Nephelometric Turbidity Units	0 to 3,000 NTU	± 1% up to 100 NTU ± 3% up to 100–400 NTU ± 5% from 400–3,000 NTU	0.1 NTU from 0-400 NTU 1 NTU for >400-3,000 NTU
Luminescent Dissolved Oxygen	mg/L	0 to 30 mg/L	± 0.01 mg/L @ ≤ 8 mg/L ± 0.02 mg/L @ > 8 mg/L	0.01 or 0.1 mg/L
pH	Standard Units	0 to 14 units	± 0.2 units	0.01 units
Specific Conductance	mS/cm	0 to 100 mS/cm	± 1% of reading; + 0.001 mS/cm	0.0001 mS/cm
Eureka Manta 2				
Temperature	Degrees Celsius	-5 to +50°C	± 0.10 °C	0.01 °C
Turbidity	Nephelometric Turbidity Units	0 to 3,000 NTU	0-100 < 1% of reading 100-400 < 3% of reading over 400 < 5% of reading	0.1 NTU
Dissolved Oxygen	mg/L	0 to 25 mg/L	1% of reading or 0.02 mg/L, whichever is greater	± 0.01 mg/L
pH	Standard Units	0 to 14 units	± 0.2 units	0.01 units
Specific Conductance	mS/cm	0 to 100 mS/cm	1% of reading ± 1 count	0.1 mS/cm

II.D.1. Continuous Water Quality Sonde Installation

Prior to installation, each sonde was calibrated following the manufacturer's specification using calibration standards, and documented on the field data sheets (Appendix E). The sondes on the Platte River were suspended on the downstream side of bridges at selected monitoring locations. The sondes on the Kearney Canal were suspended on the downstream side of bridges; one off the 19th Street Bridge in Kearney at the entrance to the Kearney Country Club and the second off of an aluminum foot bridge used by NPPD staff upstream of the Parshall flume. An alternative method was used to deploy a sonde on Elm Creek due to the unavailability of a bridge for use in the target location. Access was granted by private landowners to construct a cable system across the creek just south of Interstate 80. Field staff used earth anchors, ¼-inch cable, and T-posts to hang the sonde in the center of the creek; which had the capability to pull the cable through the eyelets of each earth anchor in order to retrieve the sonde.

The sondes, which include the data logger and battery source, were housed in a section of PVC pipe (casing) for protection from floating debris and tethered to bridge railings or cable using



heavy duty chain. The sonde was locked to the end of the chain and inserted into the casing. The cap for the casing had an opening large enough for the chain to pass through. The casing was attached to the chain by drilling a hole near the top of the casing and inserting a bolt through the casing, passing through the chain; eliminating pressure on the sonde created by flowing water. The submerged section of the casing containing the sonde was slotted and/or perforated with circular holes, and the bottom was open to prevent sediment accumulation. A second bolt was placed at the bottom of the casing to prevent the sonde from falling through the casing. A football-sized float was attached to the bottom of the casing to keep the sonde suspended just below the water surface (approximately 6 inches) and minimize sedimentation of the sonde during decreasing flows and channel meandering. Sondes were retrievable for maintenance and data transfer by pulling up the chain to the bridge deck. Flagging tape was placed every 5 feet on the chains that were deployed from Platte River bridges to enhance visibility. The heavy duty chain was attached to the bridge by wrapping the chain around the railing and locking the chain to itself at four of the Platte River monitoring locations (Lexington, Overton, Elm Creek at Highway 183 bridge, and Odessa) and on the Kearney Canal off the 19th Street Bridge. At the Kearney Canal, downstream of the diversion, the sonde was attached by a cable that ran through a support brace on the aluminum bridge to an earth anchor in the bank. The Elm Creek sonde was retrieved through a cable system that allowed field staff to pull the sonde to the stream bank.

Flows on the Platte River, Elm Creek, and Kearney Canal were sustained at levels throughout the season so that relocation of the sondes was not necessary. Sand bar development was minimal all year on the Platte River due to high flows. The Elm Creek sonde was redeployed to the deepest part of the stream throughout the year. Sedimentation was occurring along each bank but was not a problem until the Kearney Canal was shut down for the year, at which time the Elm Creek sonde was removed.

The sonde at Overton was vandalized after the September 6, 2011 operation and maintenance event. The chain that suspended the sonde from the bridge railing was cut and the sonde was released into the Platte River. EA field staff reported the sonde missing during the September 14, 2011 operation and maintenance event. A secondary deployment location on private property was selected that was approximately 275 feet downstream from the original deployment location on the north bank. Field staff located and retrieved the missing sonde from its casing during deployment of the back-up sonde. The missing sonde was located near the north bank approximately 225 feet downstream from the bridge lodged in a tree pile. It was recovered on October 4, 2011.

II.D.2. Continuous Water Quality Sonde Operation and Maintenance

Operation and maintenance was performed on each sonde, including data transfer and calibration, approximately every 1 to 2 weeks depending on environmental conditions (see Table 2). During these visits, hand-held water quality meter measurements, sonde calibration records, and data transfer notes were recorded on the field data sheets.

Calibration, maintenance, and data transfer was completed based upon manufacturer's directions. Data was downloaded from the sonde to a field laptop onsite before the recorded data exceeded



the memory capacity or battery life of the sonde. Files were named by location as listed in Table 2, followed by numerical year, month, and day of data transfer (e.g., KCPH25MAY). To ensure file integrity and provide backup, all files were saved to the laptop hard drive and a portable USB jump drive while in the field. Following the transfer process, files were opened and reviewed to ensure successful transfer of all data before creating a new log file in the sonde. The downloaded data were reviewed in the field for missing data, outlier data, and logging errors so corrections could be made immediately, if needed. A field data sheet was filled out for each monitoring location visit to document activities related to sonde maintenance, calibration, setup, and data transfer.

The processes for maintenance, data transfer, and calibration of the sondes are listed below:

- **Measurement Using Hand-Held Meter** – Prior to retrieval of data from the sondes, the field crew collected and recorded duplicate water quality parameters using hand-held water quality meters (YSI-85 and YSI-556). A meter was used to collect and record the barometric pressure for calibration purposes.
- **Continuous Water Quality Sonde QA/QC** – Duplicate and known (spiked) parameter readings were taken for QC purposes. Duplicate water quality readings were collected by submerging hand-held meter probes in a 5-gallon bucket next to the sonde probes that were set to display real time readings; these values were recorded. Measurements of known (spiked) calibration standards were taken with the sonde during each maintenance visit to assess drift and/or accuracy of the sonde during the monitoring season. These QC measurements were recorded on the field data sheets.
- **Download Data From Continuous Sonde** – The field crew downloaded the data from the sonde to a laptop computer and a portable USB jump drive.
- **Review Continuous Water Quality Data** – After data transfer, data files were opened and reviewed for general data quality (i.e., proper logging interval, abnormal or missing data, data outliers, and missing parameters). If data recording issues were present, the deficiency was documented, the sonde adjusted/repared, and the corrective action documented.
- **Re-deploy the Sonde** – As a final step, the field crew cleaned and calibrated the sonde following the manufacturer’s specification using calibration standards, and the calibration documented. The documentation included the drift of actual reading from the calibrated reading. Once calibrated, the datalogger was turned on and the sonde was re-deployed.

II.D.3. Hand-Held Water Quality Instrument Operation

As part of Quality Assurance (QA) and Quality Control (QC), a second set of hand-held water quality instruments (capable of reading temperature, dissolved oxygen, pH, specific conductance, and turbidity) were calibrated and maintained to enable the collection of duplicate water quality



parameters during each site visit. Manufacturer directions for operation, calibration, and maintenance were followed and documented on the field data sheets. These instruments were calibrated at the beginning of each field day prior to monitoring.

The hand-held meter that was used for calibrating specific conductance was designated for checking the accuracy of the water temperature probe. The hand-held meter was checked for accuracy to a mercury-in-glass calibration thermometer that is traceable to the National Institute of Standards and Technology (NIST) certification of its accuracy (Service ID Number 31010C; NIST 1988). A hand-held meter was also used to collect barometric pressure.

II.E. Discrete Water Quality Monitoring

II.E.1. Discrete Water Sample Collection

Representative water samples were collected for analytical analysis of SSC. One depth integrated sample was collected at two locations on the Platte River (Lexington and Highway 183 Bridge at Elm Creek) and at each location on Elm Creek and Kearney Canal in which sondes were deployed. Collection of the water sample occurred during maintenance of each sonde. The following procedures were used to collect representative samples during the discrete sampling events:

- Before a sample was collected at each site, the composite container (1-pint glass milk bottle) was rinsed with site water at least three times.
- One depth integrated sample was collected adjacent to the water quality sonde. The depth integrated sampler was lowered from the water surface to the streambed at a constant rate of travel to continuously extract a sample from the water source.
- Once the composite container was filled it was removed from the depth integrated sampler and emptied into one sample container. One sample container was required for each sample.
- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory.

II.E.2. Analytical Method

The analytical method, required containers, volume, preservative, and holding times for the SSC samples are listed in Table 6.



Table 6. Discrete Sampling Handling and Analytical Methods

Analyte	Method	Sample Container	Reporting Limit	Preservation
Suspended Sediment Concentration	ASTM D3977-97	250 mL Plastic	1 mg/L	Cool, 4°C

II.E.3. Sample Labels

Every sample collected and submitted for analysis had a sample label uniquely identifying the sample and listing the parameters to be analyzed. Each label included the following information:

- Submitted by – EA Engineering
- Sample identification code – e.g., KCPH25MAY
 - Samples from the monitoring locations were identified as follows:

Table 7. Discrete Sampling Locations and Identification

Water body	Sonde Location	Location Identification
Platte River	Lexington	LEXPR
Platte River	Highway 183 bridge south of Elm Creek	ELMPR
Elm Creek	Near confluence with Platte River south of I-80	ELMCR
Kearney Canal	Downstream of the diversion	KCDIV
Kearney Canal	Upstream of the Kearney Hydro	KCPH

- Sample date for all samples (military format)
- Sample times for all samples (military format)
- Sample type (e.g. water)
- Samplers' initials

II.E.4. QC Sample Collection and Documentation

A duplicate water sample was collected at one randomly selected site during each discrete water quality sampling event. Duplicate samples were labeled as “DUP” followed by day and month sampled (e.g., DUP25MAY). An arbitrary sample time was placed on the container label and chain-of-custody form delivered to the laboratory so that it did not indicate which location the duplicate was taken. The actual location and sample time were recorded on the chain-of-custody copy received by EA staff after the samples were delivered to the laboratory.

- Before a sample was collected at each site, site water was used to rinse both composite containers (1-pint glass milk bottle and 2-gallon milk jug) at least three times.
- Two depth integrated samples were collected adjacent to the water quality sonde. The depth integrated sampler was lowered from the water surface to the streambed at a constant rate of travel to continuously extract a sample from the water source.



- Once the 1-pint composite container was filled it was removed from the depth integrated sampler and emptied into a 2-gallon jug that was shaken/swirled to mix the composited sample. Two sample containers were filled; parent sample and a duplicate.
- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory. Duplicate samples were processed in the same manner as the environmental samples.

II.E.5. Chain-of-Custody

Every suite of samples collected was tracked and documented through a chain-of-custody record supplied by Ward Laboratories, Inc. A chain-of-custody was completed as samples were collected and was submitted with the samples. Each chain-of-custody record included the following:

- Submitted by – EA Engineering
- Sample identification code – e.g., ELMCR25MAY
- Sample date for all samples (military format)
- Sample times for all samples (military format)
- Sample type (e.g. water)
- Required analysis for containers
- Sampler signature for sample collection
- Signature, date, and time relinquished

II.E.6. Field Book

The following information was documented in the field book or on the field data sheets:

- Date of sampling
- Field crew member names
- Location and sampling beginning and ending time
- Samples collected/work performed in field
- The rationale for choosing each composite location during discrete water sampling
- Duplicates or blanks collected with the location and sampling time
- Weather and site conditions
- Any irregularities encountered and lessons learned during the field effort

II.E.7. Sample Control and Handling

Sample control and custody are critical to maintaining sample integrity for analysis and to tracking samples from time of collection to time of analysis. The following procedures were followed to maintain sample integrity:



- The sample containers were appropriately labeled and filled with a representative composite or grab water samples.
- The containers were placed in a zip-seal bag in an upright position in a cooler containing ice. The field crew kept the cooler out of direct sunlight and secured in the vehicle to prevent loss of samples/cooler.
- After all samples were collected, the sample containers were cross-checked with the chain-of-custody to ensure required sample information matches.
- Samples were delivered directly to the laboratory

III. DATA SUMMARY

The monitoring season for the 2011 Kearney Canal water quality monitoring program was initiated the week of May 2, 2011 and completed the week ending October 30, 2011. Water quality was monitored at seven locations, including the existing Platte River baseline water quality sondes at Lexington, Overton, and Odessa (Figure 1).

III.A. Data Obtained from USGS

The USGS maintains the National Water Information System (NWIS) website that provides access to water data for locations throughout the United States. EA accessed the USGS website on a monthly basis from May through October to download stage/discharge data from a gaging station located on the Platte River for Overton (06768000). Data that was obtained from USGS is considered provisional data and is subject to revision.

III.B. Data Obtained from NDNR

NDNR collects and reports flow data for streams, canal and pump diversions, and storage in reservoirs at locations throughout Nebraska. The data is gathered through Field Offices and the program is coordinated through NDNR's Planning and Assistance Division. EA utilized information from two gaging stations located on the Platte River near Lexington (228400) and Odessa (6770000) and from one gaging station located on the Kearney Canal downstream of the diversion (73000). Data was collected in 30 minute increments and was provided to EA as a daily mean for discharge. Data was not collected at Lexington from August 8, 2011 at 0030 hours through September 8, 2011 at 1030 hours due to malfunctioning equipment. Data that was obtained from NDNR is considered provisional data and is subject to revision.

III.C. Data Collected by EA

EA continued to maintain previously installed Hydrolab MS5s and installed Eureka Manta 2 sondes, initiating data collection May 5 to 6, 2011. Temperature, pH, dissolved oxygen, specific conductance, and turbidity data were collected at 30-minute intervals.



Composite water samples were collected at five monitoring locations 23 times during the monitoring season for suspended sediment analyses.

As part of the data summarization process it was necessary to determine if water quality data collected was representative of river conditions. The field data sheets were reviewed to identify variables which may have affected data quality. Several conditions were recorded that may have affected the sondes ability to collect representative water quality data. Issues which affected water quality data and were evident in the water quality values logged include:

- The measurement cell on the specific conductance probes was filling with sediments at the electrodes, even in high velocity areas of the river; decreasing the functionality of the probe resulting in depressed specific conductance readings.
- The Hydrolab sondes experienced sporadic decreases in specific conductance readings after operation and maintenance, usually coinciding with higher discharge events. The manufacturer was contacted on multiple occasions to try and determine the cause of the malfunction. A Hach Hydromet representative attended an operation and maintenance event on June 21, 2011 in an effort to determine the cause of the depressed specific conductance readings. It was determined that a combination of factors may result in lowered specific conductance, including probes in close proximity to other probes, increased biotic activity on the probes, and the design of the specific conductance probe allowing air bubbles to accumulate inside the probe interfering with the reading of the probe. Modifications were made to the PVC protective cover in an effort to slow the flow of water over the probes. Adjustments led to an increase in biofouling and were therefore removed.
- Algal growth occluded the optical lenses on the turbidity and dissolved oxygen probes, resulting in elevated turbidity and erratic dissolved oxygen readings.
- Aquatic insects of the Order Trichoptera colonized the probes affecting pH, specific conductance, dissolved oxygen, and turbidity.
- Parameter specific probes on the sondes would malfunction or fail resulting in missing data.
- Data collected at Overton contained inaccurate readings for specific conductance, turbidity, and dissolved oxygen from September 19, 2011 to October 04, 2011 due to vandalism which temporarily resulted in a lost sonde.

IV. SUMMARY STATISTICS

Summary statistics were completed following data review to ensure that summarized were representative of water quality in the central Platte River and the Kearney Canal. Summary statistics were calculated using standard function formulas found in Microsoft® Excel spread sheets. Summarization included tabular presentation of weekly and monthly observations (number (N), mean, maximum, minimum, and standard deviation) for each parameter. Data was graphed to present observed temporal and spatial variations. Flow data was not available for the Platte River at Elm Creek, Elm Creek, and the Kearney Canal at the Hydro. Flow data are not graphed or discussed in this section, however summary flow data, when available, is presented in



Appendix A. Raw data from the sonde and flow data (where collected) are presented on a CD referenced in Appendix F and G, respectively.

V. VARIATIONS

Variations in the water quality data (weekly means) were evaluated after raw data had been reviewed to ensure that the data was representative of water quality in the central Platte River, Elm Creek, and Kearney Canal. Data was assessed for temporal and spatial variations.

V.A. Temporal Variation

Temporal variation of water quality parameters were assessed using line graphs showing all monitoring locations (i.e., X-axis presents time, Y-axis presents parameter value) and are presented in Appendix B, Figures B-1 through B-6.

- Temperature** – Water temperature during the monitoring season exhibited the same seasonal temporal trend at the seven monitoring locations. Water temperatures trended upward when the monitoring program was initiated, peaked during the later summer months, and trended downward with the onset of fall and cooler air temperatures to minimum observed temperatures. Elm Creek tracked the seasonal trend exhibited at the seven monitoring locations but with a weekly mean temperature 2 to 3°C less than the other six monitoring locations. The lower mean temperature in Elm Creek is the result of the significantly smaller surface area and canopy coverage reducing direct sunlight warming of the water that occurs at the more open monitoring locations.
- Specific Conductance** – Specific conductance exhibited no temporal trend at the seven monitoring locations during the monitoring season. The weekly mean of specific conductance remained stable with the exception of the Elm Creek which exhibited specific conductance peaks during increased flow events (April to August). During the October monitoring period, water flow in Elm Creek was diminished so that the sonde was in a stagnant pool. The degraded water quality in the pool increased specific conductance in Elm Creek from 0.774 mS/cm on October 3 to 1.251 mS/cm on October 24 (delta=0.477).
- pH** – pH at the seven monitoring locations consistently ranged between 7.8 and 8.7 from April to late September. Effects of the stagnant pool resulting from no flows in Elm Creek were evident in the pH data. Weekly mean pH on September 12 was 7.7 within the pH range observed during the monitoring period. The pH of the stagnant pool in Elm Creek decreased to a low weekly mean of 6.9 on 17 October.
- Turbidity** – Turbidity exhibited the same temporal trend at five of the seven monitoring locations during the monitoring season. Turbidity at Elm Creek was significantly higher than the six other monitoring locations and exhibited turbidity peaks in response to rainfall events. Turbidity at the Kearney Hydro was higher than the remaining five monitoring locations (Lexington, Overton, Elm Creek Platte River, Kearney Canal



Diversion, and Odessa) and exhibited turbidity peaks in response to rainfall events. The Kearney Canal gained turbidity downstream of the Kearney Canal Diversion.

- **Dissolved Oxygen** – The same temporal trend for Dissolved Oxygen was exhibited at the seven monitoring locations during the monitoring season. Weekly mean concentrations of dissolved oxygen were the highest during the cold water periods, and lowest during the summer months when water temperatures were higher. That trend follows the inverse relationship between temperature and the solubility of gas in water. Weekly mean dissolved oxygen at the Elm Creek monitoring location was lower than the other six monitoring locations from 23 May to 22 August.

V.B. Spatial Variation

Spatial variation was assessed using box plots of the water quality parameter values for all monitoring locations (i.e., X-axis presents monitoring location, Y-axis presents parameter value). Box plots present minimum, 25th percentile, median, 75th percentile, and maximum values of the parameter. Box plots for each water quality parameter monitored are presented in Appendix B, Figures B-7 through B-12.

- **Temperature** – No spatial variation was evident in the box plots by monitoring location presenting water temperature at the seven monitoring locations. Temperature ranges (25th and 75th percentile) observed at the Elm Creek monitoring location were lower than what was observed at the other six locations for the monitoring season.
- **Specific Conductance** – Spatial variation was not evident in the specific conductance box plots except that the specific conductance range at the Elm Creek monitoring location was significantly wider than at the other six monitoring locations. The wider range at Elm Creek is a product of the degraded water quality observed in October and rainfall events in the watershed.
- **pH** – Spatial variation was not evident in the pH box plots by monitoring location. The minimum pH was observed in Elm Creek during October, when degraded water quality occurred in Elm Creek due to low inflows.
- **Turbidity** – Spatial variation was evident in the turbidity box plots. Turbidity at the Elm Creek monitoring location was significantly higher than the other six monitoring locations. Turbidity at Lexington, Overton, Elm Creek Platte River, Odessa, Kearney Canal Diversion and Hydro was similar. The turbidity box plots show that the Kearney Canal gains turbidity downstream of the Kearney Canal Diversion.
- **Dissolved Oxygen** – Spatial variation was evident in the dissolved oxygen box plots. Dissolved oxygen values at the 25th to 75th percentile range were similar. Maximum dissolved oxygen was observed at the Elm Creek monitoring location.



V.C. Suspended Sediments and Turbidity Correlation

Suspended sediment concentrations determined by laboratory analyses of water samples collected adjacent to the sondes and turbidity as measured by the sonde were paired to determine if the two parameters were correlated. Turbidity recorded when the water samples were collected near the sondes was used for the paired readings. Pearson's r was used to measure the linear correlation between the two parameters (i.e., suspended sediments and turbidity). Correlation is dimensionless and scaled to lie in the range of $-1 \leq r \leq 1$. When $r = 0$ there is no correlation and when the increase or decrease in the variables is synchronous r is positive. If the variables vary in opposite directions r is negative. A summary of paired statistics (count, minimum, maximum, average, Pearson's r , and R^2) for suspended sediment concentrations and turbidity is presented in Table 8.

Table 8. Summary Statistics Suspended Sediments and Turbidity

	Count	Minimum	Maximum	Average	Pearson's r	R ²
Platte River near Lexington, NE						
Turbidity, NTU	21	11.20	75.20	35.95	0.3594	0.1292
Suspended Sediment, ppm	21	9.48	381.86	79.81		
Platte River near Elm Creek, NE						
Turbidity, NTU	23	16.20	76.20	35.77	0.3935	0.1548
Suspended Sediment, ppm	23	0.00	360.63	60.86		
Elm Creek						
Turbidity, NTU	23	78.70	398.40	209.27	0.2384	0.0568
Suspended Sediment, ppm	23	12.86	674.42	146.73		
Kearney Canal Diversion						
Turbidity, NTU	23	19.10	97.40	54.06	0.2045	0.0418
Suspended Sediment, ppm	23	0.00	532.23	68.68		
Kearney Canal Hydro						
Turbidity, NTU	23	16.90	231.50	86.23	0.3292	0.1083
Suspended Sediment, ppm	21	1.52	464.15	86.63		

Pearson's r for paired suspended sediment and turbidity concentrations ranged from 0.2045 to 0.3935 at the five locations. The low correlation coefficients for this data set indicate that there is not a linear association between suspended sediment concentration and turbidity (Appendix B, Figures B-13 through B-17).

V.D. Water Quality During Program Activities

There were no Program activities conducted in 2011.

VI. QUALITY CONTROL SUMMARY

The Quality Control Summary describes the results of the data quality evaluation performed on the water quality parameters collected during the 2011 monitoring season. Water temperature, specific conductance, pH, turbidity, dissolved oxygen, and discharge data were collected in 2011. Analytical data included suspended sediment. The quality of the data collected and



analyzed was assessed using the elements of precision, accuracy, representativeness, completeness, and comparability.

VI.A. Precision

Measurement of precision was accomplished by collecting duplicate water quality readings and duplicate samples. The premise being that two samples collected simultaneously from the same location should yield similar results. The variation between duplicate samples that is accepted is a function of the monitoring objectives and the inherent variation around each parameter. Precision was measured during the Protocol in terms of Relative Percent Difference (RPD) which is calculated using the following formula:

$$RPD = (X_1 - X_2) / [(X_1 + X_2) / 2]$$

X_1 and X_2 = reported concentrations for each duplicate sample.

Data were considered acceptable if the RPD was less than or equal to 50% for each parameter.

VI.A.1. Continuous Water Quality Data

Duplicate water quality readings were collected for continuous water quality data using hand-held meters for temperature, specific conductance, pH, turbidity, and dissolved oxygen at each location during each sonde maintenance event. A summary of duplicate readings that exceeded the 50% RPD threshold is presented in Table 9; all duplicate sample collection results are presented in Appendix C.

Table 9. Relative Percent Difference (RPD) Exceedances for Duplicate Samples

Parameter	Location	Date	Hand Held	Sonde	RPD
Turbidity	ELMCR	May 18, 2011	19.9	40.10	67.33%
Turbidity	ELMCR	May 24, 2011	43.8	104.50	81.86%
Turbidity	ELMCR	June 1, 2011	45	21.20	71.90%
Turbidity	ELMCR	June 7, 2011	26.5	72.20	92.60%
Turbidity	ELMCR	June 15, 2011	40	101.90	87.24%
Turbidity	ELMCR	June 22, 2011	64.8	180.10	94.16%
Turbidity	ELMCR	June 29, 2011	41.40	92.50	76.33%
Turbidity	ELMCR	July 6, 2011	62.20	135.80	74.34%
Turbidity	ELMCR	July 14, 2011	66.10	134.30	68.06%
Turbidity	ELMCR	July 21, 2011	63.10	127.10	67.30%
Turbidity	ELMCR	July 29, 2011	67.30	173.10	88.02%
Turbidity	ELMCR	August 4, 2011	68.30	164.50	82.65%
Turbidity	ELMCR	August 9, 2011	65.70	194.80	99.12%
Turbidity	ELMCR	August 17, 2011	102.40	200.00	64.55%
Turbidity	ELMCR	August 22, 2011	201.00	558.00	94.07%
Turbidity	ELMCR	September 1, 2011	68.30	115.20	51.12%
Turbidity	ELMCR	September 7, 2011	40.60	100.50	84.90%
Turbidity	ELMCR	September 14, 2011	29.10	71.10	83.83%



Parameter	Location	Date	Hand Held	Sonde	RPD
Turbidity	ELMCR	September 21, 2011	65.20	135.20	69.86%
Turbidity	ELMCR	September 28, 2011	30.00	75.40	86.15%
Turbidity	ELMCR	October 11, 2011	64.90	123.30	62.06%
Turbidity	ELMPR	June 7, 2011	4.36	9.50	74.17%
Turbidity	ELMPR	June 15, 2011	5.79	13.60	80.56%
Turbidity	ELMPR	June 22, 2011	11.40	22.10	63.88%
Turbidity	ELMPR	June 29, 2011	6.78	17.70	89.22%
Turbidity	ELMPR	July 6, 2011	11.60	26.50	78.22%
Turbidity	ELMPR	August 4, 2011	20.70	36.00	53.97%
Turbidity	ELMPR	August 9, 2011	17.30	30.80	56.13%
Turbidity	ELMPR	August 17, 2011	13.50	29.20	73.54%
Turbidity	ELMPR	August 22, 2011	16.300	34.90	72.66%
Turbidity	ELMPR	September 7, 2011	10.34	24.20	80.25%
Turbidity	ELMPR	September 21, 2011	10.970	20.40	60.12%
Turbidity	ELMPR	September 27, 2011	9.87	19.30	64.66%
Turbidity	ELMPR	November 10, 2011	8.29	13.90	50.56%
Turbidity	KCDIV	May 24, 2011	12.60	21.70	53.06%
Turbidity	KCDIV	June 7, 2011	10.34	22.90	75.57%
Turbidity	KCDIV	June 15, 2011	10.53	24.70	80.44%
Turbidity	KCDIV	June 22, 2011	16.90	32.30	62.60%
Turbidity	KCDIV	June 29, 2011	9.81	16.80	52.54%
Turbidity	KCDIV	July 6, 2011	20.50	170.50	157.07%
Turbidity	KCDIV	July 14, 2011	24.20	40.90	51.31%
Turbidity	KCDIV	August 4, 2011	33.00	58.00	54.95%
Turbidity	KCDIV	August 22, 2011	25.10	47.60	61.90%
Turbidity	KCDIV	September 1, 2011	20.00	0.60	188.35%
Turbidity	KCDIV	September 14, 2011	18.30	31.40	52.72%
Turbidity	KCDIV	September 28, 2011	18.10	31.80	54.91%
Turbidity	KCDIV	November 10, 2011	6.97	11.90	52.25%
Turbidity	KCPH	June 7, 2011	14.500	28.60	65.43%
Turbidity	KCPH	June 22, 2011	22.800	41.20	57.50%
Turbidity	KCPH	July 21, 2011	35.500	69.50	64.76%
Turbidity	KCPH	July 29, 2011	40.200	88.40	74.96%
Turbidity	KCPH	August 22, 2011	29.500	60.60	69.03%
Turbidity	KCPH	September 28, 2011	8.040	14.30	56.04%
Turbidity	KCPH	November 10, 2011	14.200	25.10	55.47%
Turbidity	LEXPR	May 17, 2011	9.30	4.80	63.83%
Turbidity	LEXPR	June 7, 2011	5.74	11.30	65.26%
Turbidity	LEXPR	June 29, 2011	9.55	17.60	59.30%
Turbidity	LEXPR	July 5, 2011	8.95	17.40	64.14%
Turbidity	LEXPR	August 9, 2011	16.100	29.00	57.21%
Turbidity	LEXPR	August 16, 2011	10.81	26.30	83.48%
Turbidity	LEXPR	August 21, 2011	10.44	18.30	54.70%
Turbidity	LEXPR	September 1, 2011	10.19	35.00	109.80%



Parameter	Location	Date	Hand Held	Sonde	RPD
Turbidity	ODSPR	June 7, 2011	9.03	20.00	75.58%
Turbidity	ODSPR	June 22, 2011	11.20	28.20	86.29%
Turbidity	ODSPR	June 30, 2011	9.53	19.19	67.27%
Turbidity	ODSPR	July 14, 2011	20.00	41.00	68.85%
Turbidity	ODSPR	July 28, 2011	27.50	56.70	69.36%
Turbidity	ODSPR	August 16, 2011	16.60	38.00	78.39%
Turbidity	ODSPR	September 14, 2011	14.30	30.40	72.04%
Turbidity	OVRPR	June 14, 2011	9.61	18.40	62.76%
Turbidity	OVRPR	June 30, 2011	5.42	9.40	53.71%
Turbidity	OVRPR	July 5, 2011	9.33	17.90	62.95%
Turbidity	OVRPR	July 29, 2011	24.10	43.80	58.03%
Turbidity	OVRPR	November 10, 2011	5.55	0.00	200.00%

The procedure for collecting duplicate water samples was to retrieve the sonde from the water and immediately place it in a five gallon bucket of source water in the shade. The handheld instruments used for the paired readings were then immersed in the same bucket with the sonde and permitted to equilibrate. During the equilibration period, the sonde was connected to the laptop and set to display live readings of the water quality parameters being measured. Once parameters were stabilized, readings were recorded on the field data sheets.

- **Temperature** – All of the possible 160 duplicate readings were taken for temperature during the 2011 monitoring season. None of the paired readings exceeded the 50% RPD for duplicate temperature readings. The minimum RPD was 0.00%, and the maximum RPD was 5.77%.
- **Specific Conductance** – All of the possible 160 duplicate specific conductance readings were taken during the 2011 monitoring season. None of the paired readings exceeded the 50% RPD with a minimum RPD of 0.00% and maximum RPD of 6.04%.
- **pH** – All of the possible 160 duplicate pH readings were taken during the 2011 monitoring season. None of the paired readings exceeded the 50% RPD with a minimum RPD of 0.00% and maximum RPD of 12.46%.
- **Turbidity** – All of the possible 160 duplicate turbidity readings were taken during the 2011 monitoring season. Of the paired RPD readings, 74 (46%) exceeded the 50% RPD for duplicate turbidity readings ranging from 50.56% to 200.00%. The minimum RPD for turbidity was 0.00%.
- **Dissolved Oxygen** – All of the possible 160 duplicate dissolved oxygen readings were taken during the 2011 monitoring season. None of the paired readings exceeded the 50% RPD, with a minimum RPD of 0.00% and maximum RPD of 17.70%.



VI.A.2. Discrete Water Quality Data

One duplicate water sample was collected for each discrete water sampling event. A summary of suspended sediment concentrations is presented below, and all duplicate sample collection results are presented in Appendix C. A summary of duplicate readings that exceeded the 50% RPD threshold is presented in Table 10.

Table 10. Relative Percent Difference (RPD) Exceedances for Duplicate Samples

Date	Location	Concentration, ppm	RPD
05/06/11	DUP	1.56	60.09%
	KCDIV	2.90	
05/18/11	DUP	6.66	147.52%
	KCPH	44.10	
05/25/11	DUP	114.48	150.15%
	LEXPR	16.30	
05/31/11	DUP	29.52	60.66%
	KCDIV	15.78	
07/21/11	DUP	16.01	170.75%
	ELMCR	202.94	
08/04/11	DUP	306.73	145.47%
	KCDIV	48.42	
08/09/11	DUP	115.84	62.89%
	KCPH	222.10	
08/17/11	DUP	0.00	200.00%
	ELMPR	17.75	
08/22/11	DUP	0.00	200.00%
	KCDIV	18.07	
09/01/11	DUP	23.84	77.48%
	KCDIV	53.99	
09/07/11	DUP	1.91	200.00%
	KCDIV	0.00	
09/15/11	DUP	14.77	55.97%
	LEXPR	26.25	
10/11/11	DUP	21.84	58.31%
	KCDIV	11.98	

- Suspended Sediment Concentration** – Twenty-three water sampling events were performed during the 2011 monitoring season for the collection and analysis of suspended sediment. A duplicate water sample was collected during each sampling event for precision analysis. RPD exceeded 50% in 13 of the 23 (57%) duplicate analyses performed, ranging from 55.97% to 200.00%.

VI.B. Accuracy

Measurement of accuracy was accomplished with sonde calibration standards and was quantified as the percent recovery from analysis of a known concentration. The data quality objective for accuracy for all measurements in the Protocol is:



%Recovery = 85% to 115%

Other checks for accuracy were accomplished through close adherence to instrument calibration procedures. A summary of duplicate readings that were outside the recovery range are presented in Table 11 and all duplicate sample collection results are presented in Appendix C.

Table 11. Percent Recovery Exceedances for Spiked Sample Recoveries

Parameter	Location	Date	Spike	Sonde	% Recovery
Turbidity	ELMCR	May 6, 2011	100	118.50	118.50%
Turbidity	ELMCR	October 11, 2011	100	123.40	123.40%
Turbidity	ELMPR	May 5, 2011	100	115.40	115.40%
Turbidity	ELMPR	May 17, 2011	100	82.80	82.80%
Turbidity	ELMPR	October 11, 2011	100	120.00	120.00%
Turbidity	KCDIV	October 11, 2011	100	122.09	122.09%
Turbidity	KCPH	May 5, 2011	100	117.19	117.19%
Turbidity	KCPH	May 17, 2011	100	83.09	83.09%
Turbidity	KCPH	October 11, 2011	100	120.00	120.00%
Turbidity	LEXPR	May 5, 2011	100	117.90	117.90%
Turbidity	LEXPR	May 17, 2011	100	82.70	82.70%
Turbidity	LEXPR	June 8, 2011	100	74.20	74.20%
Turbidity	LEXPR	September 1, 2011	100	76.90	76.90%
Turbidity	ODSPR	May 5, 2011	100	121.40	121.40%
Turbidity	ODSPR	May 17, 2011	100	82.50	82.50%
Turbidity	ODSPR	October 11, 2011	100	122.30	122.30%
Turbidity	OVRPR	May 5, 2011	100	116.00	116.00%
Turbidity	OVRPR	October 25, 2011	100	141.20	141.20%

Accuracy readings were collected after duplicate readings had been taken and the sonde and probes were cleaned. The sonde was placed in known (spiked) standards and the sonde parameter reading in the standard (spike) was recorded on the field data sheets to measure accuracy.

- **Specific Conductance** – All of the possible 163 accuracy readings were taken for specific conductance during the 2011 monitoring season. All of the spiked specific conductance readings for accuracy were within the 85 to 115% recovery range.
- **pH** – All of the possible 163 accuracy readings were taken for pH during the 2011 monitoring season. All of the spiked pH readings for accuracy were within the 85 to 115% recovery range.



- **Turbidity** – All of the possible 163 accuracy readings were taken for turbidity during the 2011 monitoring season. Eighteen of the spiked turbidity readings for accuracy fell outside the accuracy range of 85 to 115%.
- **Dissolved Oxygen** – All of the possible 163 accuracy readings were taken for dissolved oxygen during the 2011 monitoring season. All of the spiked dissolved oxygen readings for accuracy were within the 85 to 115% recovery range.

VI.C. Representativeness

- **Continuous Water Quality Data**

Representativeness was addressed by adhering to the Protocol procedures, manufacturer calibration procedures, and a sampling plan that describes appropriate location, time, and conditions for data collection. Conditions that may result in a “non-representative sample” were noted on the field data sheet and were evaluated during the data review process. A review of the field data sheets (Appendix E) revealed several “conditions” which resulted in “non-representative” data points being collected.

Temperature and pH were found to be consistent and stable during the monitoring program and minimally affected by monitored environmental conditions. Environmental conditions resulting in non-representative data being collected, including: burial of the sonde in sediment, sediment accumulation in the specific conductance measurement cell, algal growth on the optical aperture of the dissolved oxygen and turbidity probes, and insect colonization on all the probes – particularly the dissolved oxygen and turbidity probes. The raw data in combination with the field data sheets was reviewed to determine “non-representative” data. Non-representative data were excluded from the summary data.

VI.D. Comparability

Comparability of data can be affected by several factors including changes in sample location, parameters, collection, or analytical techniques, etc. Quality assurance procedures were incorporated throughout the Protocol to help assure that comparable data was obtained. These quality assurance procedures included written descriptions of all sample locations; assignment of sampling responsibilities to the same personnel or the appropriate training for new personnel; establishment of a set parameter list; and description of data collection, analysis, and assessment procedures. Adherence to these procedures was closely evaluated during the data quality review process.

VI.E. Completeness

Completeness refers to the amount of data necessary to meet the monitoring objectives. To help ensure that all of the designed monitoring data and water samples were collected, a sampling schedule was prepared and distributed. An inventory and review process was implemented to maintain data collected, and routinely checked for potential errors, missing data, and missing



645 information on field data sheets. It was the responsibility of the sample collector to make sure
646 field data sheets were completely and accurately filled out, and to report missing data from the
647 sondes.

648 **VI.F. Deviations from Methods and Procedures**

649 No deviations were identified from the methods and procedures listed in the Water Quality
650 Monitoring Protocol.

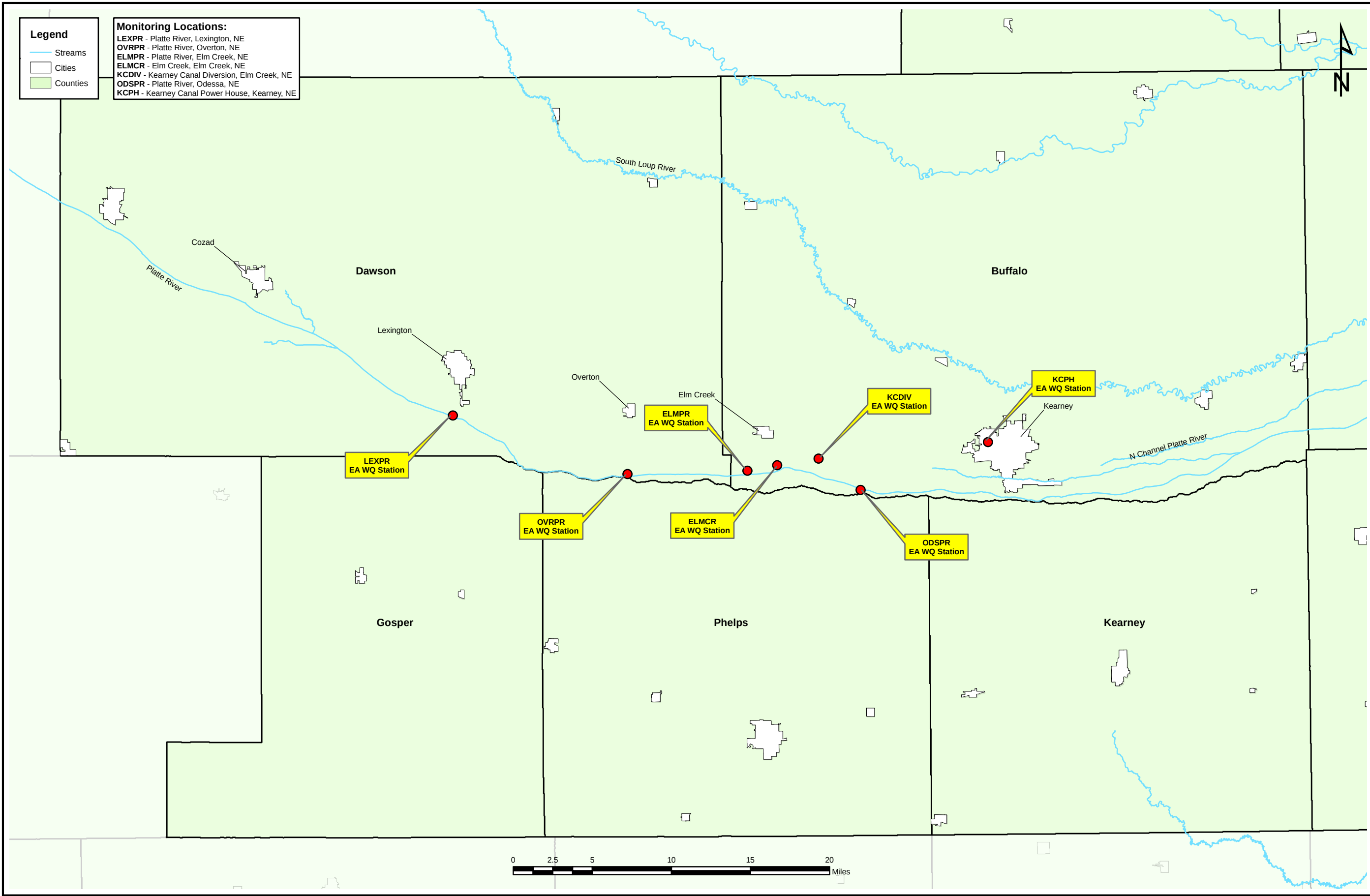


FIGURE 1
KEARNEY CANAL WATER QUALITY MONITORING LOCATIONS



APPENDIX A

Summary Statistics



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Discrete Water Quality Data

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Acronym List	
°C = degrees Celsius	mS/cm = milliSiemens per centimeter
cfs = cubic feet per second	NA = Not Applicable
ELMCR = Elm Creek, Elm Creek, NE	NTU = Nephelometric Turbidity Units
ELMPR = Platte River, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCDIV = Kearney Canal Diversion, Elm Creek, NE	OVRPR = Platte River, Overton, NE
KCPH = Kearney Canal Power House, Kearney, NE	ppm = parts per million
LEXPR = Platte River, Lexington, NE	SSC = Suspended Sediment Concentration
mg/L = milligrams per liter	-- = No data Available



Continuous Water Quality Data Weekly Average



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Table A-1. Temperature, Weekly Average, Platte River, Lexington, NE

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	15.5	10.7	22.7	15.4	334	2.8
5/9/2011	16.7	11.0	23.8	17.3	336	4.0
5/16/2011	14.4	10.3	19.1	14.0	334	2.2
5/23/2011	17.9	14.8	21.3	17.8	334	1.5
5/30/2011	20.8	16.3	24.3	21.0	333	1.8
6/6/2011	21.5	17.1	25.2	21.7	331	2.2
6/13/2011	22.4	19.8	24.8	22.4	334	1.2
6/20/2011	21.6	17.7	25.9	21.4	335	2.1
6/27/2011	24.6	21.6	28.1	24.5	333	1.7
7/4/2011	26.3	24.1	29.8	26.2	334	1.3
7/11/2011	26.1	21.7	30.4	26.5	314	2.5
7/18/2011	28.5	26.6	30.6	28.4	334	1.0
7/25/2011	27.7	25.9	30.3	27.7	334	1.2
8/1/2011	27.3	24.6	30.2	27.3	334	1.4
8/8/2011	24.3	21.5	28.1	24.3	334	1.6
8/15/2011	25.3	23.1	28.5	25.2	332	1.4
8/22/2011	25.7	22.7	29.5	25.5	336	1.6
8/29/2011	23.6	18.4	28.0	23.8	335	2.1
9/5/2011	20.3	17.6	23.8	20.3	331	1.4
9/12/2011	14.3	11.6	18.9	13.6	219	2.4
9/19/2011	17.5	15.1	19.8	17.7	333	1.2
9/26/2011	17.5	14.6	20.8	17.5	334	1.5
10/3/2011	17.2	14.8	19.9	17.2	336	1.2
10/10/2011	14.4	12.2	16.7	14.5	334	1.0
10/17/2011	11.7	8.3	15.4	11.8	336	1.6
10/24/2011	10.4	6.9	15.0	10.4	332	2.0



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Table A-2. Specific Conductance, Weekly Average, Platte River, Lexington, NE

Date	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.748	0.701	0.762	0.755	28	0.016
5/9/2011	0.761	0.718	0.783	0.771	165	0.019
5/16/2011	0.754	0.726	0.769	0.755	159	0.009
5/23/2011	0.801	0.709	0.862	0.805	264	0.037
5/30/2011	0.877	0.849	0.894	0.876	330	0.009
6/6/2011	0.804	0.774	0.866	0.787	312	0.032
6/13/2011	0.796	0.762	0.828	0.796	334	0.017
6/20/2011	0.820	0.765	0.852	0.820	335	0.020
6/27/2011	0.833	0.811	0.844	0.834	290	0.009
7/4/2011	0.789	0.763	0.823	0.784	325	0.018
7/11/2011	0.778	0.718	0.809	0.776	267	0.012
7/18/2011	0.915	0.758	1.016	0.928	277	0.058
7/25/2011	0.935	0.851	1.020	0.928	302	0.056
8/1/2011	0.814	0.767	0.852	0.819	177	0.023
8/8/2011	0.763	0.751	0.773	0.765	79	0.007
8/15/2011	0.769	0.753	0.776	0.771	310	0.004
8/22/2011	0.752	0.722	0.758	0.753	318	0.003
8/29/2011	0.747	0.725	0.755	0.748	335	0.005
9/5/2011	0.748	0.725	0.756	0.749	320	0.006
9/12/2011	0.725	0.708	0.741	0.725	219	0.009
9/19/2011	0.744	0.737	0.749	0.744	333	0.003
9/26/2011	0.724	0.704	0.745	0.724	316	0.013
10/3/2011	0.707	0.692	0.726	0.706	247	0.007
10/10/2011	0.758	0.720	0.776	0.763	269	0.013
10/17/2011	0.733	0.710	0.755	0.733	151	0.010
10/24/2011	0.731	0.721	0.758	0.728	283	0.007



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Table A-3. pH, Weekly Average, Platte River, Lexington, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.1	7.8	8.3	8.1	334	0.1
5/9/2011	7.5	7.0	8.0	7.4	336	0.3
5/16/2011	7.6	7.0	8.0	7.7	334	0.3
5/23/2011	7.8	7.6	8.0	7.8	334	0.1
5/30/2011	7.6	7.5	7.8	7.6	333	0.1
6/6/2011	8.0	7.5	8.4	8.2	331	0.3
6/13/2011	8.1	7.9	8.3	8.1	334	0.1
6/20/2011	8.2	7.9	8.4	8.2	335	0.2
6/27/2011	8.3	8.1	8.5	8.3	333	0.1
7/4/2011	8.2	8.1	8.6	8.2	334	0.1
7/11/2011	8.3	8.1	8.6	8.3	314	0.2
7/18/2011	8.3	8.2	8.5	8.3	334	0.1
7/25/2011	8.4	8.2	8.8	8.4	334	0.2
8/1/2011	8.5	8.4	8.8	8.5	334	0.1
8/8/2011	8.3	8.2	8.6	8.3	334	0.1
8/15/2011	8.5	8.2	8.7	8.6	332	0.1
8/22/2011	8.6	8.6	8.7	8.6	336	0.0
8/29/2011	8.4	8.2	8.7	8.3	335	0.2
9/5/2011	8.3	8.2	8.3	8.3	331	0.0
9/12/2011	8.5	8.4	8.6	8.5	219	0.1
9/19/2011	8.2	8.0	8.4	8.1	333	0.1
9/26/2011	8.2	7.8	8.4	8.3	334	0.2
10/3/2011	8.3	8.2	8.4	8.3	336	0.1
10/10/2011	8.3	8.1	8.4	8.3	334	0.1
10/17/2011	8.3	8.1	8.4	8.3	336	0.1
10/24/2011	8.2	7.7	8.4	8.3	332	0.2



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Table A-4. Turbidity, Weekly Average, Platte River, Lexington, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	18	9	27	18	192	3
5/9/2011	--	--	--	--	--	--
5/16/2011	28	18	56	24	251	9
5/23/2011	44	29	81	42	311	10
5/30/2011	34	23	57	33	312	6
6/6/2011	27	20	37	27	302	3
6/13/2011	27	19	39	26	317	4
6/20/2011	28	20	42	28	316	4
6/27/2011	26	19	37	26	317	3
7/4/2011	30	22	41	30	309	3
7/11/2011	41	30	61	39	273	6
7/18/2011	62	48	78	62	327	5
7/25/2011	74	52	93	76	329	9
8/1/2011	63	52	81	63	332	7
8/8/2011	50	32	72	52	230	9
8/15/2011	35	26	51	35	277	3
8/22/2011	31	25	40	30	324	2
8/29/2011	37	30	53	36	276	5
9/5/2011	29	21	44	28	318	4
9/12/2011	30	21	42	30	201	3
9/19/2011	30	23	40	30	314	3
9/26/2011	24	15	51	25	258	5
10/3/2011	25	10	68	20	269	11
10/10/2011	27	13	68	22	312	13
10/17/2011	27	16	56	23	246	10
10/24/2011	15	5	58	10	318	11



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Table A-5. Dissolved Oxygen, Weekly Average, Platte River, Lexington, NE

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	9.5	6.7	10.8	9.6	334	0.8
5/9/2011	8.3	5.7	9.9	8.4	336	0.8
5/16/2011	9.0	7.2	9.8	9.1	334	0.6
5/23/2011	7.7	5.8	10.0	7.7	333	0.4
5/30/2011	7.6	6.6	8.6	7.6	333	0.5
6/6/2011	7.2	6.1	8.4	7.2	330	0.6
6/13/2011	7.0	5.9	8.8	6.9	334	0.6
6/20/2011	7.0	5.3	8.6	6.8	335	0.7
6/27/2011	7.3	6.0	9.1	7.1	333	0.9
7/4/2011	7.4	6.3	9.8	7.2	334	0.9
7/11/2011	7.3	6.0	8.9	7.3	314	0.7
7/18/2011	6.6	5.8	8.1	6.5	334	0.6
7/25/2011	7.2	6.1	10.6	6.9	334	1.1
8/1/2011	7.2	6.2	10.3	7.0	333	0.8
8/8/2011	7.4	6.5	8.2	7.4	334	0.4
8/15/2011	7.4	6.7	10.2	7.3	332	0.5
8/22/2011	7.4	5.3	8.2	7.4	331	0.4
8/29/2011	7.6	6.8	8.6	7.6	334	0.4
9/5/2011	8.2	7.7	8.6	8.2	331	0.3
9/12/2011	9.5	8.5	10.2	9.7	215	0.4
9/19/2011	9.0	8.3	10.1	8.9	328	0.4
9/26/2011	9.0	8.1	9.8	9.0	334	0.4
10/3/2011	8.8	8.1	9.5	8.8	336	0.3
10/10/2011	9.4	8.0	12.5	9.4	328	0.3
10/17/2011	10.2	9.3	11.2	10.2	336	0.4
10/24/2011	10.4	9.5	11.2	10.5	332	0.5



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Table A-6. Discharge, Weekly Average, Platte River, Lexington, NE

Date	Discharge, cfs					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	1,521	1,439	1,584	1,527	336	29
5/9/2011	1,976	1,402	2,640	1,840	336	421
5/16/2011	2,594	2,192	3,486	2,522	336	335
5/23/2011	6,348	3,468	8,626	6,281	336	1,224
5/30/2011	5,778	5,441	6,253	5,763	336	157
6/6/2011	5,602	5,338	5,979	5,585	336	149
6/13/2011	5,477	4,917	6,243	5,396	336	342
6/20/2011	6,504	5,905	7,320	6,395	336	362
6/27/2011	5,568	4,928	6,318	5,636	336	437
7/4/2011	4,361	3,590	5,037	4,451	336	389
7/11/2011	3,944	3,572	4,527	3,876	336	248
7/18/2011	5,426	4,506	6,630	5,328	336	498
7/25/2011	4,714	3,646	6,692	4,434	336	799
8/1/2011	3,319	2,875	3,738	3,330	336	238
8/8/2011	3,270	3,270	3,270	3,270	1	NA
8/15/2011	--	--	--	--	--	--
8/22/2011	--	--	--	--	--	--
8/29/2011	--	--	--	--	--	--
9/5/2011	2,340	2,021	2,479	2,348	170	75
9/12/2011	2,598	2,206	3,062	2,496	336	283
9/19/2011	2,822	2,553	2,951	2,830	336	69
9/26/2011	2,705	2,354	2,929	2,770	336	161
10/3/2011	2,224	1,681	2,656	2,326	336	266
10/10/2011	1,632	1,439	2,455	1,568	336	218
10/17/2011	1,318	1,203	1,439	1,317	336	68
10/24/2011	1,095	993	1,202	1,094	336	61



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Table A-7. Temperature, Weekly Average, Platte River, Overton, NE

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	15.7	10.4	23.8	15.6	333	3.1
5/9/2011	16.9	10.8	24.6	17.7	336	4.0
5/16/2011	14.6	10.2	20.2	14.0	335	2.4
5/23/2011	18.1	14.5	22.0	17.9	335	1.7
5/30/2011	21.0	16.7	25.2	21.1	335	1.9
6/6/2011	21.6	17.2	25.8	21.8	334	2.2
6/13/2011	22.7	19.8	25.5	22.5	334	1.5
6/20/2011	21.9	17.7	26.7	21.8	334	2.2
6/27/2011	24.7	21.6	28.8	24.7	334	1.8
7/4/2011	26.5	24.1	30.7	26.2	334	1.6
7/11/2011	26.3	21.9	31.3	26.6	334	2.6
7/18/2011	28.7	26.4	31.5	28.5	334	1.3
7/25/2011	28.0	25.8	31.2	27.7	334	1.4
8/1/2011	27.6	24.7	31.2	27.5	334	1.5
8/8/2011	24.6	21.6	29.0	24.6	335	1.7
8/15/2011	25.6	23.0	29.6	25.5	332	1.6
8/22/2011	26.0	22.5	30.6	25.6	336	1.9
8/29/2011	23.9	18.1	29.3	24.0	335	2.3
9/5/2011	20.6	17.4	24.7	20.5	333	1.7
9/12/2011	16.8	11.7	24.9	16.8	336	3.9
9/19/2011	17.7	15.1	20.4	17.6	336	1.4
9/26/2011	17.7	14.5	21.6	17.7	336	1.7
10/3/2011	17.3	14.9	20.6	17.2	336	1.4
10/10/2011	14.5	11.9	17.3	14.6	334	1.3
10/17/2011	11.7	8.0	15.7	11.8	336	1.8
10/24/2011	10.4	6.7	15.4	10.3	333	2.2



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Table A-8. Specific Conductance, Weekly Average, Platte River, Overton, NE

Specific Conductance, mS/cm						
Date	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.760	0.737	0.772	0.759	273	0.006
5/9/2011	0.756	0.713	0.786	0.765	322	0.024
5/16/2011	0.753	0.734	0.767	0.755	330	0.008
5/23/2011	0.785	0.732	0.845	0.780	334	0.032
5/30/2011	0.866	0.845	0.882	0.866	335	0.009
6/6/2011	0.819	0.797	0.860	0.811	334	0.019
6/13/2011	0.801	0.782	0.822	0.799	334	0.010
6/20/2011	0.803	0.758	0.840	0.805	316	0.017
6/27/2011	0.832	0.746	0.852	0.843	212	0.025
7/4/2011	0.794	0.755	0.834	0.785	334	0.022
7/11/2011	0.784	0.756	0.816	0.782	334	0.012
7/18/2011	0.908	0.802	0.989	0.917	324	0.046
7/25/2011	0.934	0.844	1.015	0.930	332	0.053
8/1/2011	0.793	0.734	0.851	0.790	330	0.031
8/8/2011	0.745	0.724	0.775	0.743	281	0.014
8/15/2011	0.771	0.741	0.780	0.773	254	0.006
8/22/2011	0.758	0.747	0.772	0.758	295	0.004
8/29/2011	0.748	0.726	0.759	0.750	151	0.008
9/5/2011	0.750	0.728	0.761	0.751	286	0.007
9/12/2011	0.726	0.698	0.748	0.729	328	0.014
9/19/2011	0.721	0.710	0.731	0.721	45	0.005
9/26/2011	0.715	0.712	0.716	0.715	4	0.002
10/3/2011	0.722	0.716	0.735	0.720	118	0.005
10/10/2011	0.756	0.732	0.768	0.761	25	0.012
10/17/2011	--	--	--	--	--	--
10/24/2011	0.724	0.716	0.739	0.722	264	0.006



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Table A-9. pH, Weekly Average, Platte River, Overton, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.2	7.4	8.6	8.4	333	0.3
5/9/2011	8.3	8.1	8.6	8.3	336	0.1
5/16/2011	8.3	8.1	8.4	8.3	335	0.1
5/23/2011	8.0	7.7	8.1	8.0	335	0.1
5/30/2011	7.9	7.6	8.1	7.9	335	0.1
6/6/2011	8.1	7.8	8.3	8.1	334	0.1
6/13/2011	8.1	7.9	8.3	8.1	334	0.1
6/20/2011	8.0	7.7	8.2	8.0	334	0.1
6/27/2011	8.1	7.9	8.4	8.1	334	0.1
7/4/2011	8.2	8.0	8.5	8.2	334	0.1
7/11/2011	8.2	7.8	8.4	8.1	334	0.1
7/18/2011	8.1	7.9	8.3	8.1	334	0.1
7/25/2011	8.2	7.9	8.5	8.1	334	0.1
8/1/2011	8.2	8.0	8.5	8.2	334	0.1
8/8/2011	8.2	8.1	8.3	8.2	335	0.1
8/15/2011	8.2	8.0	8.4	8.2	332	0.1
8/22/2011	8.3	8.2	8.4	8.3	336	0.1
8/29/2011	8.3	8.1	8.4	8.3	335	0.1
9/5/2011	8.2	7.9	8.3	8.2	333	0.1
9/12/2011	8.0	7.7	8.3	8.0	336	0.1
9/19/2011	7.6	7.3	7.9	7.6	336	0.1
9/26/2011	7.8	7.2	8.2	7.7	336	0.3
10/3/2011	8.4	7.6	8.8	8.5	336	0.3
10/10/2011	8.4	8.2	8.5	8.4	334	0.1
10/17/2011	8.1	7.4	8.5	8.1	336	0.4
10/24/2011	8.4	7.5	8.8	8.6	333	0.4



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Table A-10. Turbidity, Weekly Average, Platte River, Overton, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	18	13	33	18	306	3
5/9/2011	22	11	40	19	333	6
5/16/2011	26	17	52	24	330	7
5/23/2011	39	22	70	38	326	9
5/30/2011	27	21	39	26	327	3
6/6/2011	20	16	38	20	334	2
6/13/2011	17	14	30	17	331	2
6/20/2011	19	13	28	19	327	2
6/27/2011	19	15	26	18	332	2
7/4/2011	27	19	42	27	308	4
7/11/2011	41	33	59	40	138	5
7/18/2011	48	40	60	48	237	4
7/25/2011	63	37	88	67	273	13
8/1/2011	70	55	94	70	327	6
8/8/2011	52	37	77	52	313	7
8/15/2011	38	31	55	37	320	4
8/22/2011	38	31	54	36	245	5
8/29/2011	46	33	66	45	129	7
9/5/2011	35	25	50	34	261	5
9/12/2011	40	27	66	38	252	8
9/19/2011	60	45	78	60	78	7
9/26/2011	--	--	--	--	--	--
10/3/2011	18	10	33	17	257	4
10/10/2011	24	11	58	23	303	8
10/17/2011	29	16	67	29	258	6
10/24/2011	15	10	37	14	291	4



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Table A-11. Dissolved Oxygen, Weekly Average, Platte River, Overton, NE

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	9.8	7.5	11.7	9.7	333	1.2
5/9/2011	9.1	6.8	11.5	9.2	336	1.3
5/16/2011	9.2	7.6	11.2	9.1	335	0.7
5/23/2011	7.6	6.8	8.8	7.6	335	0.4
5/30/2011	7.5	6.4	8.7	7.5	335	0.7
6/6/2011	7.4	6.0	9.3	7.3	333	0.9
6/13/2011	7.2	5.7	9.4	7.0	333	1.0
6/20/2011	7.0	5.5	9.5	6.8	334	1.0
6/27/2011	7.4	5.6	10.0	7.1	334	1.3
7/4/2011	7.5	5.9	10.5	7.1	334	1.3
7/11/2011	7.3	5.7	9.7	7.1	334	1.0
7/18/2011	6.5	5.4	8.7	6.2	334	0.9
7/25/2011	7.1	5.6	10.5	6.7	334	1.2
8/1/2011	7.2	6.0	9.8	6.8	334	1.0
8/8/2011	7.4	6.4	8.5	7.3	335	0.5
8/15/2011	7.4	6.5	8.6	7.1	332	0.6
8/22/2011	7.4	6.4	8.5	7.2	336	0.6
8/29/2011	7.6	6.6	9.0	7.5	335	0.6
9/5/2011	8.3	7.5	9.1	8.2	333	0.5
9/12/2011	8.0	5.2	9.9	8.1	327	1.1
9/19/2011	7.7	4.8	9.9	8.3	129	1.5
9/26/2011	8.8	8.0	9.9	8.4	54	0.6
10/3/2011	8.7	8.0	9.6	8.6	261	0.4
10/10/2011	9.4	8.6	10.3	9.4	334	0.4
10/17/2011	10.1	8.5	11.3	10.2	336	0.6
10/24/2011	10.7	6.9	12.6	10.8	333	1.1



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Table A-12. Discharge, Platte River, Weekly Average, Overton, NE

Date	Discharge, cfs					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	3,127	1,770	3,550	3,390	336	556
5/9/2011	3,510	1,960	4,350	3,515	336	506
5/16/2011	4,146	2,550	4,780	4,200	336	445
5/23/2011	6,107	4,710	7,060	6,360	292	833
5/30/2011	6,944	6,590	7,230	6,910	336	166
6/6/2011	7,117	5,590	7,420	7,230	336	372
6/13/2011	7,353	5,890	8,410	7,310	336	449
6/20/2011	8,448	6,770	8,850	8,590	336	408
6/27/2011	7,318	6,230	8,300	7,240	336	519
7/4/2011	6,207	4,550	7,020	6,360	336	531
7/11/2011	5,543	4,250	5,990	5,610	336	372
7/18/2011	5,723	4,720	6,340	5,770	336	314
7/25/2011	5,253	4,380	6,520	4,880	336	638
8/1/2011	4,352	3,670	5,350	4,250	336	469
8/8/2011	5,051	4,430	5,280	5,110	336	169
8/15/2011	3,873	3,030	5,240	3,500	336	692
8/22/2011	3,394	3,170	3,660	3,400	336	124
8/29/2011	4,239	3,640	4,670	4,180	336	327
9/5/2011	4,335	4,040	4,520	4,330	336	129
9/12/2011	4,584	4,370	4,900	4,550	330	144
9/19/2011	4,873	4,740	4,950	4,880	336	41
9/26/2011	4,248	3,030	4,950	4,450	336	578
10/3/2011	4,468	4,020	4,920	4,480	336	181
10/10/2011	3,772	3,390	4,830	3,660	336	365
10/17/2011	3,553	3,150	3,960	3,510	336	289
10/24/2011	3,215	3,050	3,390	3,205	336	58

**Table A-13. Temperature, Weekly Average, Platte River, Elm Creek, NE**

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	16.1	11.4	22.0	15.8	158	2.7
5/9/2011	15.9	10.9	22.4	16.1	336	3.0
5/16/2011	14.4	10.9	19.6	13.8	333	2.2
5/23/2011	17.4	13.3	21.7	17.1	334	1.9
5/30/2011	20.7	16.8	25.5	20.7	333	2.1
6/6/2011	21.4	17.1	25.9	21.5	334	2.3
6/13/2011	22.6	19.6	26.0	22.2	333	1.8
6/20/2011	22.0	17.8	26.7	22.0	333	2.1
6/27/2011	24.5	20.7	28.9	24.2	333	2.1
7/4/2011	26.4	23.6	31.0	26.0	332	1.9
7/11/2011	26.5	22.1	31.8	26.4	333	2.6
7/18/2011	28.7	25.8	32.0	28.4	334	1.7
7/25/2011	28.2	25.2	31.9	28.0	334	1.8
8/1/2011	27.8	24.7	32.0	27.7	333	1.8
8/8/2011	25.3	22.2	29.8	25.2	333	1.8
8/15/2011	25.7	22.6	30.0	25.5	333	1.7
8/22/2011	26.0	22.8	30.6	25.6	333	1.8
8/29/2011	24.4	19.5	29.3	24.0	334	2.1
9/5/2011	21.4	18.8	24.8	21.2	333	1.6
9/12/2011	17.9	14.3	25.0	17.5	333	2.9
9/19/2011	17.4	14.6	20.7	17.4	333	1.5
9/26/2011	17.4	14.6	21.2	17.4	334	1.6
10/3/2011	17.1	14.8	20.4	16.9	336	1.3
10/10/2011	15.1	12.7	18.2	15.0	333	1.2
10/17/2011	12.3	9.5	14.5	12.4	336	1.3
10/24/2011	10.9	8.3	14.4	11.0	334	1.5



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Table A-14. Specific Conductance, Weekly Average, Platte River, Elm Creek, NE

Date	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.816	0.802	0.834	0.816	154	0.004
5/9/2011	0.814	0.790	0.835	0.818	263	0.009
5/16/2011	0.813	0.788	0.832	0.815	296	0.008
5/23/2011	0.811	0.767	0.842	0.818	334	0.020
5/30/2011	0.866	0.840	0.889	0.866	323	0.014
6/6/2011	0.872	0.830	0.901	0.871	334	0.015
6/13/2011	0.880	0.820	0.925	0.875	309	0.023
6/20/2011	0.879	0.815	0.911	0.883	230	0.024
6/27/2011	0.886	0.836	0.909	0.889	328	0.015
7/4/2011	0.856	0.812	0.894	0.857	230	0.020
7/11/2011	0.863	0.836	0.881	0.865	108	0.010
7/18/2011	0.922	0.834	0.978	0.930	300	0.032
7/25/2011	0.951	0.892	1.006	0.946	332	0.031
8/1/2011	0.862	0.803	0.908	0.865	280	0.029
8/8/2011	0.882	0.825	0.900	0.889	294	0.017
8/15/2011	0.857	0.830	0.889	0.858	139	0.013
8/22/2011	0.840	0.823	0.849	0.843	67	0.006
8/29/2011	0.828	0.804	0.842	0.832	47	0.012
9/5/2011	0.838	0.812	0.857	0.842	80	0.014
9/12/2011	0.836	0.812	0.849	0.836	113	0.010
9/19/2011	0.833	0.806	0.848	0.832	210	0.010
9/26/2011	0.828	0.812	0.841	0.830	50	0.007
10/3/2011	0.833	0.801	0.854	0.837	171	0.014
10/10/2011	0.847	0.800	0.875	0.843	171	0.022
10/17/2011	--	--	--	--	--	--
10/24/2011	0.849	0.845	0.854	0.848	261	0.003



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Table A-15. pH, Weekly Average, Platte River, Elm Creek, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.7	8.4	8.8	8.7	158	0.1
5/9/2011	8.4	8.1	8.6	8.4	336	0.1
5/16/2011	8.2	8.0	8.5	8.3	333	0.1
5/23/2011	8.1	7.9	8.4	8.1	334	0.1
5/30/2011	8.1	7.7	8.4	8.1	333	0.2
6/6/2011	8.1	7.7	8.5	8.1	334	0.2
6/13/2011	8.0	7.7	8.4	8.0	333	0.2
6/20/2011	8.0	7.7	8.3	7.9	333	0.2
6/27/2011	8.1	7.9	8.4	8.1	333	0.2
7/4/2011	8.0	7.7	8.4	8.0	332	0.2
7/11/2011	8.0	7.7	8.4	8.0	333	0.2
7/18/2011	8.0	7.8	8.3	8.0	334	0.1
7/25/2011	8.0	7.8	8.4	8.0	334	0.1
8/1/2011	8.1	7.9	8.4	8.1	333	0.1
8/8/2011	8.0	7.8	8.2	8.0	333	0.1
8/15/2011	8.0	7.8	8.3	8.0	333	0.1
8/22/2011	8.1	8.0	8.3	8.1	333	0.1
8/29/2011	8.1	7.8	8.3	8.1	334	0.1
9/5/2011	8.1	7.9	8.4	8.1	333	0.1
9/12/2011	8.0	7.8	8.2	8.0	333	0.1
9/19/2011	8.0	7.9	8.4	8.0	333	0.1
9/26/2011	8.3	7.9	8.5	8.4	334	0.2
10/3/2011	8.3	8.2	8.5	8.3	336	0.1
10/10/2011	8.1	7.9	8.3	8.1	333	0.1
10/17/2011	8.1	8.0	8.3	8.2	336	0.1
10/24/2011	8.1	8.0	8.7	8.1	334	0.1



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Table A-16. Turbidity, Weekly Average, Platte River, Elm Creek, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	17	10	22	17	158	2
5/9/2011	19	12	32	18	333	4
5/16/2011	25	15	37	25	323	4
5/23/2011	34	17	78	31	317	12
5/30/2011	22	17	34	22	322	3
6/6/2011	17	12	24	17	327	2
6/13/2011	17	12	37	16	281	4
6/20/2011	24	19	35	23	234	3
6/27/2011	25	20	34	25	323	2
7/4/2011	38	23	60	37	251	7
7/11/2011	48	34	69	48	230	7
7/18/2011	54	42	68	53	231	5
7/25/2011	69	48	86	70	326	9
8/1/2011	75	54	97	74	301	8
8/8/2011	53	38	72	53	306	7
8/15/2011	50	36	75	48	206	7
8/22/2011	40	28	58	40	269	6
8/29/2011	46	31	66	46	298	8
9/5/2011	44	30	65	44	181	9
9/12/2011	37	28	56	37	192	5
9/19/2011	40	27	70	39	294	8
9/26/2011	40	24	66	41	240	7
10/3/2011	--	--	--	--	--	--
10/10/2011	23	18	36	23	257	3
10/17/2011	31	24	57	30	321	6
10/24/2011	24	19	34	23	334	3



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Table A-17. Dissolved Oxygen, Weekly Average, Platte River, Elm Creek, NE

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	9.6	7.9	10.9	9.5	158	0.8
5/9/2011	9.3	7.4	11.4	9.2	336	1.1
5/16/2011	9.3	7.5	11.2	9.2	332	0.9
5/23/2011	7.9	6.5	10.7	7.6	334	1.1
5/30/2011	7.9	5.6	11.4	7.4	333	1.7
6/6/2011	7.2	4.9	10.4	6.9	334	1.6
6/13/2011	6.8	5.1	9.5	6.4	332	1.4
6/20/2011	6.7	5.0	9.4	6.4	333	1.2
6/27/2011	7.3	5.2	10.6	6.9	332	1.7
7/4/2011	7.1	5.4	10.3	6.8	332	1.5
7/11/2011	6.7	3.3	9.2	6.7	333	1.2
7/18/2011	6.4	5.1	8.8	6.1	333	1.1
7/25/2011	7.0	5.4	10.1	6.5	334	1.2
8/1/2011	7.2	6.0	10.1	6.8	332	1.1
8/8/2011	7.5	6.1	9.4	7.2	330	0.9
8/15/2011	7.6	6.6	9.1	7.3	333	0.8
8/22/2011	7.7	6.6	9.7	7.4	333	0.8
8/29/2011	7.1	5.7	9.0	7.1	334	0.8
9/5/2011	8.2	6.7	9.8	7.9	331	0.8
9/12/2011	8.3	6.6	9.5	8.6	331	0.8
9/19/2011	8.9	7.9	10.3	8.6	332	0.7
9/26/2011	8.9	8.1	10.2	8.7	333	0.6
10/3/2011	8.6	7.7	10.0	8.5	335	0.6
10/10/2011	9.1	7.9	10.5	9.1	332	0.6
10/17/2011	10.2	9.2	11.5	10.0	335	0.6
10/24/2011	10.6	9.5	11.9	10.4	332	0.7



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Table A-18. Temperature, Weekly Average, Elm Creek, Elm Creek, NE

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	17.6	14.1	22.6	16.9	120	2.4
5/9/2011	16.7	10.1	23.2	17.8	336	4.2
5/16/2011	13.6	9.7	18.1	13.0	334	2.0
5/23/2011	17.0	13.8	21.3	16.7	334	1.6
5/30/2011	20.4	16.7	24.2	20.5	333	1.4
6/6/2011	20.4	16.0	24.6	20.6	334	2.3
6/13/2011	20.9	13.5	23.5	21.2	333	1.8
6/20/2011	20.5	17.9	24.1	20.2	334	1.5
6/27/2011	23.3	20.6	25.8	23.3	334	1.3
7/4/2011	24.6	21.5	27.5	24.7	334	1.3
7/11/2011	25.2	22.9	28.7	25.1	334	1.5
7/18/2011	27.8	26.2	29.3	27.8	178	0.8
7/25/2011	26.7	24.9	28.6	26.8	118	1.0
8/1/2011	26.5	24.7	28.9	26.5	333	1.0
8/8/2011	23.5	21.8	26.3	23.4	333	1.1
8/15/2011	24.1	22.2	26.4	24.0	333	0.9
8/22/2011	24.1	21.7	26.5	24.0	333	1.2
8/29/2011	22.9	19.6	25.8	22.9	333	1.4
9/5/2011	18.6	17.3	20.0	18.6	334	0.6
9/12/2011	15.7	12.4	20.4	15.0	333	2.8
9/19/2011	14.5	12.8	16.1	14.5	333	0.7
9/26/2011	14.4	12.8	16.3	14.5	333	0.8
10/3/2011	16.0	13.5	19.1	16.2	336	1.2
10/10/2011	13.4	11.1	16.2	13.3	331	1.1
10/17/2011	9.8	7.4	12.0	9.8	336	1.3
10/24/2011	10.4	7.5	13.0	10.5	165	1.2



Table A-19. Specific Conductance, Weekly Average, Elm Creek, Elm Creek, NE

Date	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.911	0.888	0.926	0.913	120	0.010
5/9/2011	0.860	0.809	0.966	0.860	315	0.021
5/16/2011	0.779	0.734	0.819	0.781	331	0.023
5/23/2011	0.783	0.642	0.932	0.803	334	0.068
5/30/2011	0.867	0.641	1.008	0.855	333	0.106
6/6/2011	1.031	0.856	1.103	1.037	331	0.053
6/13/2011	0.923	0.431	1.032	0.985	332	0.164
6/20/2011	0.764	0.473	0.957	0.761	334	0.121
6/27/2011	1.016	0.852	1.102	1.032	334	0.057
7/4/2011	0.801	0.613	0.946	0.774	333	0.109
7/11/2011	0.924	0.824	0.969	0.928	334	0.027
7/18/2011	0.899	0.864	0.978	0.891	178	0.023
7/25/2011	0.987	0.973	1.030	0.983	118	0.013
8/1/2011	0.883	0.789	0.972	0.891	333	0.060
8/8/2011	0.793	0.713	0.821	0.795	333	0.022
8/15/2011	0.811	0.745	0.848	0.824	306	0.027
8/22/2011	0.817	0.798	0.838	0.816	315	0.008
8/29/2011	0.791	0.767	0.811	0.791	333	0.010
9/5/2011	0.770	0.755	0.809	0.766	334	0.011
9/12/2011	0.769	0.750	0.789	0.768	333	0.010
9/19/2011	0.755	0.740	0.772	0.754	333	0.008
9/26/2011	0.774	0.756	0.799	0.774	333	0.010
10/3/2011	0.774	0.558	0.849	0.804	321	0.066
10/10/2011	0.820	0.717	0.909	0.841	331	0.058
10/17/2011	0.985	0.840	1.175	0.988	335	0.102
10/24/2011	1.251	1.162	1.324	1.255	165	0.039



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Table A-20. pH, Weekly Average, Elm Creek, Elm Creek, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.6	8.4	8.8	8.5	120	0.1
5/9/2011	8.1	7.9	8.5	8.1	336	0.1
5/16/2011	8.0	7.9	8.2	8.0	334	0.1
5/23/2011	7.8	7.6	8.1	7.8	334	0.1
5/30/2011	7.9	7.7	8.1	8.0	333	0.1
6/6/2011	8.1	7.8	8.2	8.1	334	0.1
6/13/2011	8.0	7.3	8.1	8.0	333	0.2
6/20/2011	7.7	7.3	8.0	7.7	334	0.2
6/27/2011	7.9	7.7	8.0	7.9	334	0.1
7/4/2011	7.8	7.6	8.0	7.8	334	0.1
7/11/2011	8.0	7.8	8.1	8.0	334	0.1
7/18/2011	8.1	8.0	8.1	8.1	178	0.0
7/25/2011	8.1	8.1	8.1	8.1	118	0.0
8/1/2011	8.1	8.1	8.2	8.1	333	0.0
8/8/2011	8.1	8.0	8.1	8.1	333	0.0
8/15/2011	8.1	8.0	8.2	8.1	333	0.1
8/22/2011	8.1	8.1	8.2	8.1	333	0.0
8/29/2011	8.2	8.1	8.3	8.2	333	0.1
9/5/2011	8.0	7.9	8.2	8.0	334	0.1
9/12/2011	7.7	7.6	7.9	7.7	333	0.1
9/19/2011	7.7	7.6	8.1	7.7	333	0.1
9/26/2011	7.8	7.7	8.2	7.8	333	0.1
10/3/2011	7.5	7.0	7.9	7.7	336	0.3
10/10/2011	7.2	7.0	7.6	7.2	331	0.1
10/17/2011	6.9	6.5	7.4	6.9	336	0.2
10/24/2011	7.0	6.6	8.4	6.9	165	0.2



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Table A-21. Turbidity, Weekly Average, Elm Creek, Elm Creek, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	87	64	125	84	118	14
5/9/2011	106	61	168	106	333	20
5/16/2011	102	69	149	100	326	15
5/23/2011	170	59	418	167	317	84
5/30/2011	237	60	716	203	323	158
6/6/2011	130	85	294	127	321	28
6/13/2011	227	89	1,341	132	298	254
6/20/2011	332	98	1,013	298	315	178
6/27/2011	140	96	219	134	305	24
7/4/2011	380	127	1,196	390	328	207
7/11/2011	317	189	470	313	333	56
7/18/2011	264	142	388	268	178	47
7/25/2011	255	166	350	254	118	41
8/1/2011	299	207	426	294	331	41
8/8/2011	331	266	402	331	327	27
8/15/2011	355	296	445	351	329	28
8/22/2011	308	246	392	307	330	27
8/29/2011	274	221	352	272	328	24
9/5/2011	261	190	320	264	334	27
9/12/2011	191	130	328	177	324	41
9/19/2011	139	108	248	135	306	21
9/26/2011	139	86	269	137	286	27
10/3/2011	127	57	383	113	305	55
10/10/2011	83	52	367	74	320	37
10/17/2011	53	35	79	54	321	9
10/24/2011	54	31	96	52	149	15



Table A-22. Dissolved Oxygen, Weekly Average, Elm Creek, Elm Creek, NE

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	10.9	6.8	16.7	10.8	120	2.7
5/9/2011	8.4	5.5	13.8	8.3	335	1.8
5/16/2011	8.8	7.3	10.6	8.9	334	0.7
5/23/2011	7.0	5.5	9.1	6.8	333	0.7
5/30/2011	6.2	5.3	7.4	6.1	333	0.5
6/6/2011	6.4	5.3	8.0	6.6	333	0.7
6/13/2011	6.1	3.6	7.1	6.2	333	0.6
6/20/2011	5.7	4.2	7.1	5.9	333	0.8
6/27/2011	5.9	4.6	6.9	5.9	333	0.6
7/4/2011	5.9	4.9	6.8	5.8	333	0.4
7/11/2011	5.9	5.4	6.7	5.9	334	0.3
7/18/2011	5.7	5.1	6.2	5.7	178	0.3
7/25/2011	6.6	6.0	7.3	6.5	118	0.4
8/1/2011	6.4	5.8	7.5	6.4	332	0.4
8/8/2011	7.1	6.3	7.8	7.2	333	0.4
8/15/2011	7.1	6.5	7.9	7.0	333	0.3
8/22/2011	7.2	6.7	8.4	7.1	332	0.3
8/29/2011	7.2	6.6	8.2	7.2	331	0.4
9/5/2011	8.3	7.7	8.8	8.3	333	0.2
9/12/2011	9.0	7.9	10.1	9.3	333	0.7
9/19/2011	9.5	8.8	10.8	9.4	331	0.4
9/26/2011	9.5	8.6	11.1	9.4	332	0.7
10/3/2011	7.8	4.2	11.4	7.9	335	1.8
10/10/2011	8.4	4.7	10.8	8.5	330	1.2
10/17/2011	9.9	7.7	12.3	9.9	335	1.0
10/24/2011	9.6	6.6	12.7	9.9	165	1.3



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Table A-23. Temperature, Weekly Average, Kearney Canal Diversion, Elm Creek, NE

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	17.1	12.3	23.1	16.7	156	2.8
5/9/2011	16.5	10.7	23.4	17.2	336	3.6
5/16/2011	14.4	10.5	19.6	13.9	334	2.2
5/23/2011	17.9	14.4	21.7	17.7	334	1.6
5/30/2011	21.1	17.0	25.2	21.1	333	1.8
6/6/2011	21.6	17.4	25.9	21.9	334	2.2
6/13/2011	22.6	20.0	25.4	22.5	333	1.5
6/20/2011	21.9	17.8	26.2	21.8	334	2.0
6/27/2011	24.8	21.6	28.8	24.7	333	1.8
7/4/2011	26.5	23.9	30.7	26.3	333	1.6
7/11/2011	26.5	22.2	31.5	26.6	334	2.6
7/18/2011	28.8	26.4	31.7	28.6	333	1.4
7/25/2011	28.1	25.7	31.3	28.0	334	1.4
8/1/2011	27.7	24.9	31.3	27.6	333	1.5
8/8/2011	24.9	22.1	29.1	24.8	333	1.6
8/15/2011	25.6	22.8	29.5	25.5	334	1.6
8/22/2011	26.0	22.4	30.5	25.6	333	1.9
8/29/2011	24.1	18.9	29.1	24.0	334	2.2
9/5/2011	20.7	17.9	24.3	20.7	333	1.5
9/12/2011	17.1	12.6	24.4	16.7	333	3.6
9/19/2011	17.4	14.8	20.1	17.5	333	1.4
9/26/2011	17.5	14.2	21.4	17.5	333	1.7
10/3/2011	17.3	14.6	20.4	17.2	336	1.3
10/10/2011	14.8	12.4	17.2	14.8	333	1.2
10/17/2011	11.9	8.6	14.8	12.0	336	1.4
10/24/2011	11.7	8.0	14.6	11.8	165	1.7



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Table A-24. Specific Conductance, Weekly Average, Kearney Canal Diversion, Elm Creek, NE

Date	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.821	0.808	0.842	0.821	156	0.006
5/9/2011	0.815	0.763	0.849	0.823	336	0.019
5/16/2011	0.792	0.769	0.801	0.794	334	0.006
5/23/2011	0.800	0.741	0.869	0.798	334	0.033
5/30/2011	0.871	0.848	0.892	0.872	332	0.010
6/6/2011	0.855	0.823	0.890	0.854	334	0.016
6/13/2011	0.838	0.772	0.875	0.838	333	0.024
6/20/2011	0.826	0.768	0.868	0.833	327	0.025
6/27/2011	0.871	0.849	0.888	0.872	321	0.008
7/4/2011	0.829	0.788	0.864	0.829	262	0.021
7/11/2011	0.852	0.827	0.868	0.853	270	0.009
7/18/2011	0.936	0.837	0.994	0.940	282	0.035
7/25/2011	0.959	0.904	1.020	0.956	309	0.037
8/1/2011	0.842	0.783	0.906	0.836	331	0.038
8/8/2011	0.809	0.738	0.826	0.813	282	0.013
8/15/2011	0.820	0.775	0.833	0.823	238	0.010
8/22/2011	0.805	0.792	0.818	0.805	243	0.004
8/29/2011	0.793	0.762	0.803	0.795	309	0.008
9/5/2011	0.791	0.730	0.807	0.794	323	0.014
9/12/2011	0.781	0.767	0.798	0.779	333	0.008
9/19/2011	0.781	0.768	0.791	0.781	333	0.005
9/26/2011	0.772	0.725	0.800	0.774	332	0.010
10/3/2011	0.762	0.719	0.779	0.767	272	0.013
10/10/2011	0.847	0.825	0.860	0.851	254	0.010
10/17/2011	0.832	0.813	0.852	0.829	336	0.012
10/24/2011	0.843	0.837	0.848	0.844	165	0.002



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Table A-25. pH, Weekly Average, Kearney Canal Diversion, Elm Creek, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.6	8.3	8.8	8.5	156	0.1
5/9/2011	8.3	8.0	8.6	8.3	336	0.1
5/16/2011	8.2	8.0	8.4	8.2	334	0.1
5/23/2011	8.0	7.9	8.2	8.0	334	0.1
5/30/2011	8.0	8.0	8.2	8.0	333	0.0
6/6/2011	7.5	7.2	8.1	7.4	334	0.3
6/13/2011	7.6	7.4	7.8	7.6	333	0.1
6/20/2011	7.5	7.1	8.0	7.3	334	0.3
6/27/2011	7.6	7.2	7.9	7.7	333	0.2
7/4/2011	7.6	7.4	7.9	7.6	333	0.1
7/11/2011	7.7	7.5	8.0	7.7	334	0.1
7/18/2011	8.0	7.7	8.2	7.9	333	0.2
7/25/2011	8.2	8.1	8.5	8.2	334	0.1
8/1/2011	8.2	8.0	8.5	8.2	333	0.1
8/8/2011	8.1	8.0	8.3	8.1	333	0.1
8/15/2011	8.1	8.0	8.3	8.2	334	0.1
8/22/2011	8.3	8.1	8.4	8.3	333	0.1
8/29/2011	8.2	8.1	8.3	8.2	334	0.1
9/5/2011	8.4	8.3	8.4	8.4	332	0.0
9/12/2011	8.4	8.2	8.5	8.4	333	0.1
9/19/2011	8.5	8.3	8.6	8.5	333	0.1
9/26/2011	8.4	8.3	8.6	8.5	333	0.1
10/3/2011	8.1	7.7	8.4	8.1	336	0.2
10/10/2011	8.0	7.8	8.2	8.1	333	0.1
10/17/2011	8.1	8.0	8.2	8.1	336	0.0
10/24/2011	8.1	8.0	8.3	8.1	165	0.1



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Table A-26. Turbidity, Weekly Average, Kearney Canal Diversion, Elm Creek, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	24	18	35	23	156	3
5/9/2011	31	21	40	31	311	4
5/16/2011	39	23	55	38	321	5
5/23/2011	57	36	83	54	298	11
5/30/2011	58	34	158	48	315	26
6/6/2011	32	27	40	32	323	3
6/13/2011	43	27	187	32	328	32
6/20/2011	66	28	175	57	313	31
6/27/2011	36	28	52	35	314	5
7/4/2011	69	38	190	68	282	23
7/11/2011	80	58	137	75	302	15
7/18/2011	75	63	95	75	313	5
7/25/2011	86	58	124	89	313	16
8/1/2011	107	85	140	106	308	10
8/8/2011	78	60	122	76	308	11
8/15/2011	74	59	94	73	309	7
8/22/2011	73	67	84	73	19	4
8/29/2011	78	57	95	80	158	9
9/5/2011	59	45	93	57	272	9
9/12/2011	48	38	68	47	302	6
9/19/2011	48	36	127	45	303	13
9/26/2011	38	23	62	39	310	8
10/3/2011	50	22	94	46	216	16
10/10/2011	26	20	38	26	226	3
10/17/2011	26	22	38	26	305	3
10/24/2011	22	17	27	22	164	2

**Table A-27. Dissolved Oxygen, Weekly Average, Kearney Canal Diversion, Elm Creek, NE**

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	9.7	7.7	11.6	9.5	156	1.2
5/9/2011	9.0	7.0	10.9	9.2	336	1.1
5/16/2011	9.3	8.0	10.9	9.2	333	0.6
5/23/2011	7.7	6.9	9.1	7.6	334	0.5
5/30/2011	7.4	6.4	8.6	7.3	333	0.5
6/6/2011	7.2	6.0	8.3	7.1	334	0.6
6/13/2011	6.9	5.9	8.1	6.8	333	0.6
6/20/2011	6.6	5.5	8.1	6.6	334	0.6
6/27/2011	7.2	5.9	8.7	7.1	333	0.7
7/4/2011	7.3	6.4	9.2	7.1	333	0.7
7/11/2011	7.1	6.3	9.3	7.1	333	0.6
7/18/2011	6.7	5.8	8.8	6.5	333	0.7
7/25/2011	7.2	5.9	10.1	6.9	333	1.1
8/1/2011	7.3	6.0	9.8	7.1	333	1.0
8/8/2011	7.5	6.6	8.5	7.4	333	0.5
8/15/2011	7.5	6.7	8.5	7.4	334	0.5
8/22/2011	7.5	6.6	8.7	7.4	333	0.6
8/29/2011	7.4	6.2	8.7	7.3	334	0.6
9/5/2011	8.3	7.7	8.9	8.2	333	0.4
9/12/2011	8.8	7.5	9.8	9.0	332	0.7
9/19/2011	8.9	8.3	9.8	8.8	333	0.4
9/26/2011	9.0	7.8	11.1	8.6	331	0.8
10/3/2011	7.8	5.7	11.4	7.6	336	1.1
10/10/2011	9.0	7.2	10.2	9.1	333	0.7
10/17/2011	10.1	9.2	11.0	10.1	333	0.5
10/24/2011	10.1	9.2	11.5	10.2	165	0.6

**Table A-28. Discharge, Weekly Average, Kearney Canal Diversion, Elm Creek, NE**

Date	Discharge, cfs					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	41	34	49	41	336	3
5/9/2011	40	31	48	41	336	5
5/16/2011	225	36	294	237	336	48
5/23/2011	281	189	329	284	336	31
5/30/2011	303	256	372	306	336	19
6/6/2011	317	310	323	318	336	3
6/13/2011	322	283	345	326	336	16
6/20/2011	332	296	361	331	336	15
6/27/2011	335	332	337	335	336	1
7/4/2011	332	329	334	333	336	2
7/11/2011	333	323	362	330	336	8
7/18/2011	344	298	365	344	336	10
7/25/2011	328	263	348	343	336	26
8/1/2011	336	304	367	342	336	18
8/8/2011	281	247	318	280	336	19
8/15/2011	320	282	349	319	336	17
8/22/2011	333	314	343	333	336	7
8/29/2011	329	315	350	325	336	14
9/5/2011	314	308	317	315	336	3
9/12/2011	315	310	322	315	336	3
9/19/2011	309	296	322	308	336	6
9/26/2011	149	44	320	110	336	99
10/3/2011	116	89	187	122	336	22
10/10/2011	295	183	310	301	336	26
10/17/2011	296	285	308	294	336	9
10/24/2011	176	25	292	179	212	68



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Table A-29. Temperature, Weekly Average, Platte River, Odessa, NE

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	15.1	9.9	23.3	14.8	334	3.0
5/9/2011	16.5	10.8	23.5	17.1	336	3.6
5/16/2011	14.5	10.5	19.9	14.2	334	2.3
5/23/2011	18.0	14.0	22.1	17.8	335	1.8
5/30/2011	21.3	17.1	25.9	21.3	334	2.0
6/6/2011	21.7	17.1	26.1	21.9	335	2.4
6/13/2011	22.8	19.8	26.0	22.6	333	1.7
6/20/2011	22.2	17.6	26.8	22.3	335	2.2
6/27/2011	24.9	21.3	29.2	24.7	334	2.0
7/4/2011	26.6	24.0	31.2	26.3	334	1.8
7/11/2011	26.6	22.0	32.0	26.7	334	2.7
7/18/2011	28.9	26.0	32.2	28.7	334	1.6
7/25/2011	28.3	25.4	31.8	28.2	335	1.7
8/1/2011	28.0	24.9	31.9	27.8	334	1.7
8/8/2011	25.0	22.0	29.9	25.0	334	1.8
8/15/2011	25.7	22.4	30.0	25.5	332	1.8
8/22/2011	26.1	22.4	31.1	25.7	336	2.1
8/29/2011	24.3	18.6	29.7	24.0	334	2.3
9/5/2011	21.0	17.7	24.9	20.8	334	1.7
9/12/2011	17.2	12.5	24.9	17.0	335	3.6
9/19/2011	17.6	14.6	20.6	17.6	335	1.5
9/26/2011	17.6	14.3	21.8	17.6	335	1.8
10/3/2011	17.3	14.6	20.7	17.2	336	1.3
10/10/2011	14.9	12.0	17.7	14.9	335	1.3
10/17/2011	12.0	8.4	15.2	12.1	336	1.5
10/24/2011	10.7	7.5	14.8	10.6	334	1.8



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Table A-30. Specific Conductance, Weekly Average, Platte River, Odessa, NE

Date	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.807	0.790	0.833	0.806	300	0.006
5/9/2011	0.808	0.790	0.816	0.810	212	0.006
5/16/2011	0.785	0.762	0.796	0.787	260	0.009
5/23/2011	0.795	0.710	0.852	0.794	322	0.033
5/30/2011	0.863	0.801	0.882	0.867	327	0.012
6/6/2011	0.831	0.761	0.872	0.839	334	0.031
6/13/2011	0.837	0.790	0.863	0.838	329	0.017
6/20/2011	0.819	0.768	0.864	0.821	328	0.022
6/27/2011	0.858	0.820	0.875	0.860	330	0.009
7/4/2011	0.829	0.789	0.862	0.833	328	0.016
7/11/2011	0.842	0.801	0.856	0.843	198	0.010
7/18/2011	0.924	0.814	0.959	0.928	217	0.031
7/25/2011	0.929	0.860	0.996	0.924	233	0.032
8/1/2011	0.840	0.784	0.892	0.834	242	0.031
8/8/2011	0.805	0.782	0.818	0.805	298	0.008
8/15/2011	0.816	0.780	0.830	0.821	210	0.010
8/22/2011	0.803	0.768	0.821	0.805	116	0.007
8/29/2011	0.791	0.781	0.799	0.791	60	0.005
9/5/2011	0.800	0.781	0.808	0.803	114	0.006
9/12/2011	0.792	0.770	0.800	0.793	112	0.006
9/19/2011	0.770	0.750	0.792	0.769	128	0.011
9/26/2011	0.756	0.749	0.772	0.754	33	0.006
10/3/2011	--	--	--	--	--	--
10/10/2011	0.826	0.803	0.838	0.827	250	0.008
10/17/2011	0.813	0.797	0.824	0.816	34	0.008
10/24/2011	0.813	0.763	0.822	0.815	277	0.009



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Table A-31. pH, Weekly Average, Platte River, Odessa, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.4	8.3	8.6	8.4	334	0.1
5/9/2011	8.4	8.3	8.5	8.4	336	0.1
5/16/2011	8.4	8.3	8.6	8.4	334	0.1
5/23/2011	8.1	7.9	8.4	8.1	335	0.1
5/30/2011	8.1	7.9	8.3	8.0	334	0.1
6/6/2011	8.1	7.9	8.3	8.1	335	0.1
6/13/2011	8.1	7.8	8.3	8.1	333	0.1
6/20/2011	7.9	7.6	8.2	7.9	335	0.1
6/27/2011	8.0	7.7	8.2	8.0	334	0.1
7/4/2011	8.1	7.9	8.4	8.1	334	0.1
7/11/2011	8.2	7.9	8.5	8.2	334	0.1
7/18/2011	8.2	8.1	8.5	8.2	334	0.1
7/25/2011	8.3	8.1	8.6	8.3	335	0.1
8/1/2011	8.3	8.2	8.6	8.3	334	0.1
8/8/2011	8.3	8.2	8.4	8.3	334	0.1
8/15/2011	8.3	8.0	8.4	8.3	332	0.1
8/22/2011	8.3	8.1	8.5	8.3	336	0.1
8/29/2011	8.2	7.9	8.5	8.3	334	0.1
9/5/2011	8.3	8.2	8.4	8.3	334	0.1
9/12/2011	8.2	8.0	8.4	8.3	335	0.1
9/19/2011	8.4	8.1	8.6	8.5	335	0.1
9/26/2011	8.5	8.3	8.6	8.5	335	0.0
10/3/2011	8.2	7.6	8.5	8.3	336	0.2
10/10/2011	7.8	7.5	8.1	7.8	335	0.1
10/17/2011	7.9	7.6	8.1	7.9	336	0.1
10/24/2011	8.1	7.8	8.5	8.1	334	0.1



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Table A-32. Turbidity, Weekly Average, Platte River, Odessa, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	26	19	42	25	331	4
5/9/2011	26	20	41	24	332	4
5/16/2011	29	22	49	28	313	5
5/23/2011	59	37	99	60	298	14
5/30/2011	42	27	62	42	309	7
6/6/2011	29	24	46	29	335	2
6/13/2011	28	21	66	26	326	8
6/20/2011	35	22	62	34	320	7
6/27/2011	31	23	48	30	324	4
7/4/2011	59	32	88	66	314	16
7/11/2011	74	59	110	73	293	9
7/18/2011	82	71	143	81	311	7
7/25/2011	88	66	110	89	303	9
8/1/2011	98	82	127	96	320	9
8/8/2011	72	62	128	70	294	8
8/15/2011	65	58	90	65	244	4
8/22/2011	61	48	79	61	314	5
8/29/2011	72	54	103	71	271	9
9/5/2011	52	35	87	50	276	9
9/12/2011	46	31	87	45	283	8
9/19/2011	50	37	71	50	280	6
9/26/2011	42	27	81	42	325	9
10/3/2011	35	27	63	34	319	6
10/10/2011	27	18	52	23	333	9
10/17/2011	26	22	36	25	335	2
10/24/2011	21	16	30	21	332	3



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Table A-33. Dissolved Oxygen, Weekly Average, Platte River, Odessa, NE

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	9.8	7.7	15.0	9.7	334	0.9
5/9/2011	9.2	7.2	11.0	9.3	336	1.1
5/16/2011	9.6	7.9	11.4	9.5	334	0.8
5/23/2011	7.8	6.6	10.8	7.8	335	0.8
5/30/2011	7.5	5.6	10.1	7.2	334	1.1
6/6/2011	7.4	5.5	9.3	7.3	335	1.1
6/13/2011	7.1	5.4	9.5	6.8	333	1.1
6/20/2011	6.5	4.8	9.0	6.4	335	1.0
6/27/2011	7.1	5.2	9.7	6.8	334	1.2
7/4/2011	7.3	6.1	9.9	7.0	334	1.0
7/11/2011	7.3	6.1	9.7	7.2	334	0.8
7/18/2011	7.0	6.0	9.3	6.7	334	0.9
7/25/2011	7.6	5.9	11.2	7.1	335	1.4
8/1/2011	7.7	6.3	10.7	7.3	334	1.2
8/8/2011	7.6	6.6	9.1	7.3	334	0.7
8/15/2011	7.7	6.7	9.2	7.4	253	0.7
8/22/2011	7.8	6.6	9.3	7.6	336	0.8
8/29/2011	7.8	6.7	9.3	7.8	334	0.7
9/5/2011	8.5	7.5	9.9	8.2	334	0.7
9/12/2011	8.9	7.3	10.1	9.2	335	0.8
9/19/2011	9.0	8.2	10.2	8.8	335	0.6
9/26/2011	9.0	8.0	10.3	8.8	335	0.6
10/3/2011	8.7	7.5	9.9	8.5	336	0.6
10/10/2011	9.3	8.5	10.8	9.2	335	0.5
10/17/2011	10.3	9.2	11.7	10.1	336	0.7
10/24/2011	10.5	9.3	12.6	10.1	334	1.0



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Table A-34. Discharge, Weekly Average, Platte River, Odessa, NE

Date	Discharge, cfs					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	2,852	1,319	3,403	3,170	336	613
5/9/2011	3,378	2,020	4,097	3,427	336	511
5/16/2011	3,830	2,494	4,580	3,962	336	384
5/23/2011	6,184	4,097	7,444	6,885	336	1,223
5/30/2011	7,971	6,928	9,550	7,967	336	580
6/6/2011	7,448	5,637	9,376	7,334	336	847
6/13/2011	6,998	5,621	8,243	7,042	336	500
6/20/2011	8,933	7,391	10,713	8,763	336	784
6/27/2011	7,574	6,547	9,293	7,427	336	736
7/4/2011	5,698	3,887	6,910	5,774	336	677
7/11/2011	4,869	3,975	6,036	4,937	336	299
7/18/2011	5,623	4,271	7,338	5,641	336	645
7/25/2011	5,607	4,310	8,266	5,269	336	1,165
8/1/2011	4,061	2,985	5,384	4,121	336	725
8/8/2011	4,525	4,038	4,923	4,554	336	172
8/15/2011	3,300	2,056	5,423	3,043	336	1,028
8/22/2011	2,253	1,941	2,731	2,209	336	178
8/29/2011	3,658	2,613	4,599	3,774	336	544
9/5/2011	3,933	3,525	4,275	3,952	336	202
9/12/2011	4,414	4,029	5,076	4,317	336	270
9/19/2011	5,071	4,921	5,261	5,066	336	64
9/26/2011	4,150	2,201	5,182	4,533	336	864
10/3/2011	4,839	3,980	6,429	4,582	336	592
10/10/2011	3,461	2,465	6,431	2,817	336	1,172
10/17/2011	2,905	2,670	3,221	2,835	336	159
10/24/2011	2,991	2,657	3,222	3,002	336	148



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Table A-35. Temperature, Weekly Average, Kearney Canal Power House, Kearney, NE

Date	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	18.5	13.3	25.5	18.4	161	3.0
5/9/2011	17.4	9.8	25.5	18.3	336	4.9
5/16/2011	14.3	9.9	18.7	14.1	333	2.1
5/23/2011	18.0	14.7	20.6	18.0	334	1.5
5/30/2011	21.3	17.4	24.3	21.4	333	1.5
6/6/2011	21.8	17.5	25.5	22.0	334	2.2
6/13/2011	23.0	20.4	24.7	23.1	334	1.2
6/20/2011	22.2	18.2	25.3	22.4	333	1.9
6/27/2011	25.0	22.3	27.8	25.0	333	1.5
7/4/2011	26.8	24.5	29.7	26.7	333	1.2
7/11/2011	26.7	22.5	30.4	27.2	334	2.3
7/18/2011	29.2	27.4	30.6	29.3	334	0.8
7/25/2011	28.4	26.8	30.1	28.6	334	0.8
8/1/2011	28.1	26.3	30.2	27.7	274	1.1
8/8/2011	24.7	23.0	26.2	24.6	259	0.8
8/15/2011	25.8	23.7	27.7	25.6	334	1.0
8/22/2011	26.1	22.0	28.8	26.1	333	1.5
8/29/2011	24.3	20.0	27.5	24.3	333	1.9
9/5/2011	20.7	19.4	22.4	20.7	334	0.7
9/12/2011	17.1	12.5	22.8	16.7	333	3.7
9/19/2011	17.3	15.9	18.6	17.3	334	0.6
9/26/2011	18.3	16.8	20.5	18.0	169	1.1
10/3/2011	17.4	15.1	20.2	17.3	175	1.2
10/10/2011	14.7	13.4	16.2	14.5	334	0.6
10/17/2011	11.6	9.7	14.0	11.5	336	1.1
10/24/2011	11.8	8.1	13.2	12.8	165	1.5



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Table A-36. Specific Conductance, Weekly Average, Kearney Canal Power House, Kearney, NE

Date	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	0.795	0.760	0.813	0.795	160	0.009
5/9/2011	0.814	0.784	0.831	0.814	336	0.009
5/16/2011	0.789	0.757	0.829	0.788	314	0.010
5/23/2011	0.791	0.621	0.853	0.799	307	0.042
5/30/2011	0.848	0.652	0.899	0.860	333	0.048
6/6/2011	0.857	0.839	0.878	0.860	333	0.010
6/13/2011	0.837	0.667	0.877	0.841	332	0.031
6/20/2011	0.808	0.602	0.865	0.842	240	0.056
6/27/2011	0.874	0.781	0.896	0.874	330	0.014
7/4/2011	0.819	0.751	0.867	0.813	322	0.030
7/11/2011	0.818	0.693	0.860	0.837	299	0.040
7/18/2011	0.915	0.842	0.967	0.933	181	0.044
7/25/2011	0.963	0.847	1.011	0.967	278	0.036
8/1/2011	0.855	0.787	0.911	0.864	251	0.040
8/8/2011	0.811	0.802	0.822	0.813	174	0.004
8/15/2011	0.817	0.793	0.829	0.819	268	0.008
8/22/2011	0.804	0.790	0.811	0.804	323	0.003
8/29/2011	0.791	0.757	0.800	0.794	292	0.008
9/5/2011	0.795	0.775	0.806	0.800	261	0.009
9/12/2011	0.781	0.762	0.801	0.778	288	0.012
9/19/2011	0.781	0.775	0.791	0.782	330	0.002
9/26/2011	0.781	0.766	0.795	0.781	146	0.003
10/3/2011	0.702	0.495	0.826	0.743	175	0.110
10/10/2011	0.822	0.687	0.857	0.845	334	0.044
10/17/2011	0.828	0.812	0.849	0.825	336	0.012
10/24/2011	0.845	0.841	0.851	0.845	165	0.002



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Table A-37. pH, Weekly Average, Kearney Canal Power House, Kearney, NE

Date	pH					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	8.7	8.4	9.1	8.7	161	0.2
5/9/2011	8.4	8.2	8.7	8.4	336	0.1
5/16/2011	8.2	7.7	8.4	8.2	333	0.1
5/23/2011	8.0	7.9	8.2	8.0	334	0.1
5/30/2011	8.0	7.8	8.1	8.0	333	0.1
6/6/2011	8.1	8.1	8.2	8.1	334	0.0
6/13/2011	8.1	7.8	8.2	8.1	334	0.1
6/20/2011	7.9	7.7	8.1	8.0	333	0.1
6/27/2011	8.0	7.9	8.2	8.1	333	0.1
7/4/2011	8.0	7.9	8.3	8.0	333	0.1
7/11/2011	8.1	7.9	8.3	8.0	334	0.1
7/18/2011	8.1	8.0	8.3	8.1	334	0.1
7/25/2011	8.1	8.0	8.3	8.1	334	0.1
8/1/2011	8.2	8.1	8.3	8.3	274	0.1
8/8/2011	8.1	8.1	8.1	8.1	259	0.0
8/15/2011	8.1	8.0	8.2	8.1	334	0.1
8/22/2011	8.1	7.7	8.4	8.2	333	0.1
8/29/2011	8.1	8.0	8.2	8.1	333	0.1
9/5/2011	8.2	8.1	8.2	8.2	334	0.0
9/12/2011	8.1	8.0	8.4	8.2	333	0.1
9/19/2011	8.1	8.0	8.2	8.1	334	0.0
9/26/2011	8.2	8.0	8.5	8.1	169	0.2
10/3/2011	8.1	7.5	8.6	8.1	175	0.4
10/10/2011	7.8	7.7	7.9	7.8	334	0.1
10/17/2011	7.8	7.7	7.9	7.8	336	0.0
10/24/2011	7.8	7.7	7.9	7.8	165	0.1



Table A-38. Turbidity, Weekly Average, Kearney Canal Power House, Kearney, NE

Date	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	19	11	31	19	147	4
5/9/2011	17	7	38	16	326	5
5/16/2011	38	8	63	41	301	14
5/23/2011	103	55	309	88	306	47
5/30/2011	136	57	864	100	296	136
6/6/2011	70	48	90	70	221	7
6/13/2011	77	51	193	73	301	21
6/20/2011	135	56	529	103	299	87
6/27/2011	84	62	116	82	318	10
7/4/2011	137	88	223	140	329	25
7/11/2011	149	106	252	147	238	20
7/18/2011	130	89	169	131	328	16
7/25/2011	118	86	150	117	325	16
8/1/2011	130	101	163	131	268	13
8/8/2011	89	58	117	88	250	11
8/15/2011	96	63	205	94	327	19
8/22/2011	90	71	110	91	327	7
8/29/2011	86	63	112	87	332	8
9/5/2011	73	53	96	73	333	10
9/12/2011	56	40	86	52	333	11
9/19/2011	47	38	62	47	334	5
9/26/2011	39	15	54	43	165	10
10/3/2011	75	16	259	54	174	65
10/10/2011	42	32	80	38	332	9
10/17/2011	40	26	58	39	334	7
10/24/2011	30	13	44	33	163	8



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Table A-39. Dissolved Oxygen, Weekly Average, Kearney Canal Power House, Kearney, NE

Date	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/2/2011	11.4	10.2	12.8	11.4	219	0.7
5/9/2011	11.4	8.7	13.1	11.9	336	1.2
5/16/2011	10.4	8.4	12.7	10.0	334	1.2
5/23/2011	10.4	8.8	12.2	10.3	336	1.0
5/30/2011	10.5	9.3	11.9	10.3	334	0.7
6/6/2011	10.2	8.5	11.8	10.0	336	0.9
6/13/2011	9.8	7.5	11.7	9.7	333	1.2
6/20/2011	9.1	6.8	11.5	9.2	336	1.3
6/27/2011	9.2	7.6	11.2	9.1	335	0.7
7/4/2011	7.6	6.8	8.8	7.6	335	0.4
7/11/2011	7.5	6.4	8.7	7.5	335	0.7
7/18/2011	7.4	6.0	9.3	7.3	333	0.9
7/25/2011	7.2	5.7	9.4	7.0	333	1.0
8/1/2011	7.0	5.5	9.5	6.8	334	1.0
8/8/2011	7.4	5.6	10.0	7.1	334	1.3
8/15/2011	7.5	5.9	10.5	7.1	334	1.3
8/22/2011	7.3	5.7	9.7	7.1	334	1.0
8/29/2011	6.5	5.4	8.7	6.2	334	0.9
9/5/2011	7.1	5.6	10.5	6.7	334	1.2
9/12/2011	7.2	6.0	9.8	6.8	334	1.0
9/19/2011	7.4	6.4	8.5	7.3	335	0.5
9/26/2011	7.4	6.5	8.6	7.1	332	0.6
10/3/2011	7.4	6.4	8.5	7.2	336	0.6
10/10/2011	7.6	6.6	9.0	7.5	335	0.6
10/17/2011	8.3	7.5	9.1	8.2	333	0.5
10/24/2011	8.0	5.2	9.9	8.1	327	1.1



Continuous Water Quality Data Monthly Average



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Table A-40. Temperature, Monthly Average, Platte River, Lexington, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	16.2	10.3	23.8	16.5	1,479	3.1
June 2011	22.0	17.1	27.4	22.2	1,429	2.0
July 2011	27.0	21.7	30.6	27.2	1,460	2.0
August 2011	25.5	21.5	30.2	25.4	1,480	1.8
September 2011	18.6	11.6	28.0	18.5	1,312	3.2
October 2011	13.5	6.9	19.9	13.7	1,482	3.1

Table A-41. Specific Conductance, Monthly Average, Platte River, Lexington, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.787	0.700	0.890	0.767	749	0.046
June 2011	0.822	0.762	0.894	0.818	1,364	0.035
July 2011	0.852	0.718	1.020	0.825	1,315	0.078
August 2011	0.768	0.722	0.852	0.761	1,028	0.025
September 2011	0.740	0.705	0.756	0.744	1,283	0.012
October 2011	0.731	0.692	0.776	0.728	1,094	0.021

Table A-42. pH, Monthly Average, Platte River, Lexington, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	7.7	7.0	8.3	7.8	1,479	0.3
June 2011	8.1	7.5	8.4	8.2	1,429	0.3
July 2011	8.3	8.1	8.8	8.3	1,460	0.1
August 2011	8.5	8.2	8.8	8.6	1,480	0.1
September 2011	8.3	7.8	8.6	8.3	1,312	0.2
October 2011	8.3	7.7	8.4	8.3	1,482	0.1



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Table A-43. Turbidity, Monthly Average, Platte River, Lexington, NE

Date	Turbidity, NTU					
	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	32	9	81	31	883	13
June 2011	28	19	57	27	1,342	5
July 2011	50	20	93	48	1,375	19
August 2011	44	25	81	37	1,278	14
September 2011	31	18	53	30	1,174	5
October 2011	22	5	68	19	1,268	12

Table A-44. Dissolved Oxygen, Monthly Average, Platte River, Lexington, NE

Date	Dissolved Oxygen, mg/L					
	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.6	5.7	10.8	8.6	1,478	1.0
June 2011	7.1	5.3	8.8	7.1	1,428	0.7
July 2011	7.1	5.8	10.6	7.0	1,460	0.9
August 2011	7.4	5.3	10.3	7.4	1,473	0.6
September 2011	8.7	6.8	10.2	8.6	1,303	0.7
October 2011	9.7	8.0	12.5	9.6	1,476	0.8

Table A-45. Discharge, Monthly Average, Platte River, Lexington, NE

Date	Discharge, cfs					
	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	3,234	1,402	8,626	2,425	1,488	2,058
June 2011	5,851	4,917	7,320	5,754	1,440	470
July 2011	4,659	3,572	6,692	4,580	1,488	733
August 2011	3,319	2,875	3,738	3,329	337	238
September 2011	2,671	2,021	3,062	2,776	1,082	240
October 2011	1,607	965	2,656	1,457	1,488	504



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Table A-46. Temperature, Monthly Average, Platte River, Overton, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	16.4	10.2	24.6	16.7	1,482	3.3
June 2011	22.3	17.2	28.2	22.2	1,432	2.1
July 2011	27.2	21.9	31.5	27.3	1,480	2.1
August 2011	25.8	21.6	31.2	25.7	1,481	2.0
September 2011	19.0	11.7	29.3	18.9	1,436	3.3
October 2011	13.6	6.7	20.6	13.7	1,483	3.2

Table A-47. Specific Conductance, Monthly Average, Platte River, Overton, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.771	0.713	0.877	0.762	1,402	0.034
June 2011	0.819	0.746	0.882	0.809	1,292	0.029
July 2011	0.853	0.755	1.015	0.833	1,468	0.073
August 2011	0.768	0.724	0.851	0.763	1,160	0.026
September 2011	0.739	0.698	0.761	0.744	814	0.016
October 2011	0.725	0.716	0.768	0.722	455	0.010

Table A-48. pH, Monthly Average, Platte River, Overton, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.2	7.4	8.6	8.2	1,482	0.2
June 2011	8.0	7.7	8.3	8.0	1,432	0.1
July 2011	8.1	7.8	8.5	8.1	1,480	0.1
August 2011	8.2	8.0	8.5	8.2	1,481	0.1
September 2011	7.9	7.2	8.4	8.0	1,436	0.3
October 2011	8.3	7.4	8.8	8.4	1,483	0.4



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Table A-49. Turbidity, Monthly Average, Platte River, Overton, NE

Turbidity, NTU						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	26	11	70	24	1,406	10
June 2011	20	13	39	19	1,415	4
July 2011	42	17	88	42	1,100	17
August 2011	50	31	94	46	1,205	14
September 2011	41	25	78	39	720	10
October 2011	22	10	67	19	1,155	8

Table A-50. Dissolved Oxygen, Monthly Average, Platte River, Overton, NE

Dissolved Oxygen, mg/L						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.9	6.8	11.7	8.9	1,482	1.3
June 2011	7.3	5.5	9.7	7.1	1,430	1.0
July 2011	7.1	5.4	10.5	6.9	1,480	1.2
August 2011	7.4	6.0	9.8	7.2	1,481	0.7
September 2011	8.1	4.8	9.9	8.1	1,034	0.9
October 2011	9.8	6.9	12.6	9.7	1,312	1.0

Table A-51. Discharge, Monthly Average, Platte River, Overton, NE

Discharge, cfs						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	4,284	1,770	7,060	3,990	1,444	1,397
June 2011	7,528	5,590	8,850	7,290	1,440	670
July 2011	5,806	4,250	7,350	5,760	1,488	681
August 2011	4,148	3,030	5,350	4,090	1,488	717
September 2011	4,505	3,030	4,950	4,530	1,434	387
October 2011	3,777	2,980	4,920	3,670	1,488	540



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Table A-52. Temperature, Monthly Average, Platte River, Elm Creek, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	16.2	10.9	23.4	16.3	1254	2.8
June 2011	22.1	17.1	28.2	21.9	1,429	2.2
July 2011	27.2	22.1	32.0	27.2	1,477	2.4
August 2011	26.1	22.2	32.0	25.9	1,476	2.0
September 2011	19.4	14.3	29.3	19.3	1,427	3.1
October 2011	13.9	8.3	20.4	13.9	1,483	2.8

Table A-53. Specific Conductance, Monthly Average, Platte River, Elm Creek, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.816	0.767	0.862	0.817	1140	0.016
June 2011	0.878	0.815	0.925	0.876	1,291	0.019
July 2011	0.906	0.812	1.006	0.900	1,110	0.046
August 2011	0.867	0.803	0.908	0.872	780	0.025
September 2011	0.834	0.804	0.857	0.833	500	0.011
October 2011	0.844	0.800	0.875	0.847	651	0.015

Table A-54. pH, Monthly Average, Platte River, Elm Creek, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.3	7.9	8.8	8.3	1254	0.2
June 2011	8.0	7.7	8.5	8.0	1,429	0.2
July 2011	8.0	7.7	8.4	8.0	1,477	0.2
August 2011	8.0	7.8	8.4	8.1	1,476	0.1
September 2011	8.1	7.8	8.5	8.1	1,427	0.2
October 2011	8.2	7.9	8.7	8.2	1,483	0.1



Table A-55. Turbidity, Monthly Average, Platte River, Elm Creek, NE

Turbidity, NTU						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	24	10	78	23	1219	9
June 2011	20	12	37	20	1,264	4
July 2011	51	22	86	51	1,173	16
August 2011	54	28	97	50	1,208	15
September 2011	41	24	70	40	1,056	8
October 2011	26	18	57	25	980	6

Table A-56. Dissolved Oxygen, Monthly Average, Platte River, Elm Creek, NE

Dissolved Oxygen, mg/L						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.9	5.9	11.4	8.9	1253	1.2
June 2011	7.1	4.9	10.8	6.7	1,428	1.6
July 2011	6.8	3.3	10.6	6.6	1,475	1.3
August 2011	7.4	5.7	10.1	7.2	1,472	0.9
September 2011	8.4	5.8	10.3	8.4	1,422	0.9
October 2011	9.7	7.7	11.9	9.7	1,477	1.0



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Table A-57. Temperature, Monthly Average, Elm Creek, Elm Creek, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	16.2	9.7	23.2	16.4	1220	3.3
June 2011	20.9	13.5	25.3	21.0	1,428	1.8
July 2011	25.5	21.5	29.3	25.3	1,108	1.7
August 2011	24.4	21.7	28.9	24.1	1,476	1.6
September 2011	16.9	12.4	25.8	15.7	1,426	3.2
October 2011	12.8	7.4	19.1	12.9	1,264	2.7

Table A-58. Specific Conductance, Monthly Average, Elm Creek, Elm Creek, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.829	0.642	0.998	0.827	1196	0.073
June 2011	0.910	0.431	1.103	0.972	1,424	0.155
July 2011	0.898	0.613	1.037	0.922	1,107	0.096
August 2011	0.823	0.713	0.972	0.813	1,431	0.048
September 2011	0.769	0.740	0.811	0.767	1,426	0.015
October 2011	0.906	0.558	1.324	0.847	1,248	0.173

Table A-59. pH, Monthly Average, Elm Creek, Elm Creek, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.0	7.6	8.8	8.0	1220	0.2
June 2011	7.9	7.3	8.2	8.0	1,428	0.2
July 2011	7.9	7.6	8.1	8.0	1,108	0.1
August 2011	8.1	8.0	8.2	8.1	1,476	0.0
September 2011	7.9	7.6	8.3	7.9	1,426	0.2
October 2011	7.2	6.5	8.4	7.2	1,264	0.4



Table A-60. Turbidity, Monthly Average, Elm Creek, Elm Creek, NE

Turbidity, NTU						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	120	59	418	104	1189	55
June 2011	227	70	1341	144	1,338	181
July 2011	301	105	1196	279	1,086	139
August 2011	320	207	445	321	1,459	38
September 2011	199	97	328	184	1,353	60
October 2011	86	31	383	71	1,178	48

Table A-61. Dissolved Oxygen, Monthly Average, Elm Creek, Elm Creek, NE

Dissolved Oxygen, mg/L						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.2	5.3	16.7	8.0	1218	1.8
June 2011	6.0	3.6	8.0	6.1	1,426	0.7
July 2011	6.0	4.9	7.3	5.9	1,106	0.4
August 2011	7.0	5.8	8.4	7.0	1,474	0.5
September 2011	8.8	6.6	11.0	8.8	1,420	0.9
October 2011	8.9	4.2	12.7	9.0	1,261	1.6



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Table A-62. Temperature, Monthly Average, Kearney Canal Diversion, Kearney, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	16.7	10.5	23.4	17.0	1256	3.0
June 2011	22.3	17.4	27.9	22.2	1427	2.0
July 2011	27.3	22.2	31.7	27.4	1478	2.1
August 2011	25.9	22.1	31.3	25.7	1477	2.0
September 2011	19.1	12.6	29.1	19.0	1426	3.3
October 2011	14.4	8.0	20.4	14.5	1266	2.7

Table A-63. Specific Conductance, Monthly Average, Kearney Canal Diversion, Kearney, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.810	0.741	0.883	0.805	1256	0.029
June 2011	0.849	0.768	0.892	0.853	1419	0.026
July 2011	0.894	0.788	1.020	0.873	1255	0.059
August 2011	0.818	0.738	0.906	0.811	1213	0.027
September 2011	0.783	0.725	0.807	0.782	1415	0.012
October 2011	0.815	0.719	0.860	0.830	1123	0.037

Table A-64. pH, Monthly Average, Kearney Canal Diversion, Kearney, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.2	7.9	8.8	8.2	1256	0.2
June 2011	7.6	7.1	8.1	7.6	1427	0.3
July 2011	7.9	7.4	8.5	7.8	1478	0.3
August 2011	8.2	8.0	8.5	8.2	1477	0.1
September 2011	8.4	8.1	8.6	8.4	1425	0.1
October 2011	8.1	7.7	8.5	8.1	1266	0.1



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Table A-65. Turbidity, Monthly Average, Kearney Canal Diversion, Kearney, NE

Turbidity, NTU						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	39	18	83	37	1176	13
June 2011	48	27	187	35	1364	29
July 2011	74	30	190	73	1349	20
August 2011	86	59	140	80	944	17
September 2011	53	29	127	49	1250	14
October 2011	31	17	94	26	1006	13

Table A-66. Dissolved Oxygen, Monthly Average, Kearney Canal Diversion, Kearney, NE

Dissolved Oxygen, mg/L						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.7	6.9	11.6	8.7	1255	1.1
June 2011	7.0	5.5	8.5	7.0	1427	0.6
July 2011	7.1	5.8	10.1	7.0	1476	0.8
August 2011	7.5	6.0	9.8	7.3	1477	0.6
September 2011	8.5	6.2	10.4	8.6	1424	0.8
October 2011	9.1	5.7	11.5	9.3	1262	1.2

Table A-67. Discharge, Monthly Average, Kearney Canal Diversion, Kearney, NE

Discharge, cfs						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	152	31	329	189	1,488	113
June 2011	323	283	372	321	1,440	15
July 2011	335	263	365	337	1,488	15
August 2011	320	247	367	328	1,489	27
September 2011	289	51	325	313	1,439	71
October 2011	216	25	310	285	1,316	90



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Table A-68. Temperature, Monthly Average, Platte River, Odessa, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	16.2	9.9	23.6	16.4	1,483	3.2
June 2011	22.4	17.1	28.4	22.3	1,431	2.2
July 2011	27.4	22.0	32.2	27.5	1,481	2.3
August 2011	26.0	21.9	31.9	25.9	1,478	2.1
September 2011	19.2	12.5	29.7	19.1	1,435	3.4
October 2011	13.8	7.5	20.7	13.9	1,485	3.0

Table A-69. Specific Conductance, Monthly Average, Platte River, Odessa, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.803	0.710	0.877	0.804	1,225	0.026
June 2011	0.840	0.761	0.882	0.842	1,413	0.027
July 2011	0.874	0.789	0.996	0.853	1,117	0.050
August 2011	0.817	0.768	0.892	0.809	873	0.023
September 2011	0.785	0.749	0.808	0.790	440	0.016
October 2011	0.819	0.763	0.838	0.818	609	0.010

Table A-70. pH, Monthly Average, Platte River, Odessa, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.3	7.9	8.6	8.4	1,483	0.2
June 2011	8.0	7.6	8.3	8.0	1,431	0.1
July 2011	8.2	7.8	8.6	8.2	1,481	0.1
August 2011	8.3	7.9	8.6	8.3	1,478	0.1
September 2011	8.3	8.0	8.6	8.3	1,435	0.1
October 2011	8.0	7.5	8.5	8.0	1,485	0.3



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Table A-71. Turbidity, Monthly Average, Platte River, Odessa, NE

Turbidity, NTU						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	35	19	99	28	1,400	16
June 2011	32	21	66	29	1,392	8
July 2011	71	28	143	77	1,364	20
August 2011	75	48	128	68	1,271	16
September 2011	52	30	103	49	1,244	12
October 2011	28	16	63	25	1,459	8

Table A-72. Dissolved Oxygen, Monthly Average, Platte River, Odessa, NE

Dissolved Oxygen, mg/L						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	9.0	6.4	15.0	9.1	1,483	1.2
June 2011	7.1	4.8	9.8	6.9	1,431	1.1
July 2011	7.3	5.8	11.2	7.1	1,481	1.1
August 2011	7.7	6.3	10.7	7.4	1,399	0.9
September 2011	8.7	6.7	10.3	8.7	1,435	0.8
October 2011	9.7	7.5	12.9	9.6	1,485	1.0

Table A-73. Discharge, Monthly Average, Platte River, Odessa, NE

Discharge, cfs						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	4,216	1,319	7,908	3,752	1,488	1,660
June 2011	7,889	5,621	10,713	7,884	1,440	989
July 2011	5,605	3,887	8,266	5,442	1,488	928
August 2011	3,505	1,941	5,423	3,531	1,488	1,035
September 2011	4,324	2,201	5,261	4,275	1,440	632
October 2011	3,599	2,465	6,431	3,091	1,488	1,007



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Table A-74. Temperature, Monthly Average, Kearney Canal Power House, Kearney, NE

Temperature, °C						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	17.1	9.8	25.5	17.5	1260	3.6
June 2011	22.5	17.5	27.3	22.7	1427	1.9
July 2011	27.6	22.5	30.6	28.0	1479	1.8
August 2011	26.0	22.0	30.2	25.8	1344	1.7
September 2011	19.2	12.5	27.5	19.3	1359	3.3
October 2011	13.6	8.1	20.2	13.8	1010	2.4

Table A-75. Specific Conductance, Monthly Average, Kearney Canal Power House, Kearney, NE

Specific Conductance, mS/cm						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	0.803	0.621	0.886	0.801	1213	0.032
June 2011	0.843	0.602	0.899	0.850	1331	0.043
July 2011	0.871	0.693	1.011	0.857	1221	0.069
August 2011	0.817	0.757	0.911	0.809	1160	0.029
September 2011	0.786	0.762	0.806	0.783	1173	0.010
October 2011	0.807	0.495	0.857	0.833	1010	0.072

Table A-76. pH, Monthly Average, Kearney Canal Power House, Kearney, NE

pH						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.3	7.7	9.1	8.2	1260	0.2
June 2011	8.0	7.7	8.2	8.1	1427	0.1
July 2011	8.1	7.9	8.3	8.1	1479	0.1
August 2011	8.1	7.7	8.4	8.1	1344	0.1
September 2011	8.1	8.0	8.5	8.2	1359	0.1
October 2011	7.9	7.5	8.6	7.8	1010	0.2



Table A-77. Turbidity, Monthly Average, Kearney Canal Power House, Kearney, NE

Turbidity, NTU						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	49	7	309	36	1174	43
June 2011	106	48	864	79	1200	86
July 2011	128	62	252	129	1361	25
August 2011	99	58	205	93	1316	20
September 2011	60	15	111	56	1353	17
October 2011	45	13	259	38	1003	31

Table A-78. Dissolved Oxygen, Monthly Average, Kearney Canal Power House, Kearney, NE

Dissolved Oxygen, mg/L						
Date	Monthly					
	Mean	Min	Max	Median	N	STD
May 2011	8.9	5.8	13.2	8.6	1086	1.4
June 2011	7.1	5.7	8.2	7.2	1425	0.5
July 2011	7.1	5.8	10.3	7.0	1475	0.8
August 2011	7.6	5.5	10.3	7.5	1342	0.8
September 2011	8.6	6.2	13.1	8.6	1357	1.0
October 2011	9.4	3.9	11.7	9.7	1007	1.4



Discrete Water Quality Data



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Table A-79. Discrete Water Quality Data, Suspended Sediment Concentration, (Platte River, Elm Creek, Kearney Canal), NE

Date	LEXPR	ELMPR	ELMCR	KCDIV	KCPH
	SSC, ppm	SSC, ppm	SSC, ppm	SSC, ppm	SSC, ppm
May 6, 2011	--	2	13	3	2
May 18, 2011	--	7	66	31	44
May 25, 2011	16	34	133	36	48
May 31, 2011	28	20	42	16	68
June 8, 2011	24	27	106	22	48
June 15, 2011	111	78	225	110	170
June 23, 2011	64	13	124	37	63
June 29, 2011	37	84	156	69	133
July 6, 2011	142	65	272	125	189
July 14, 2011	368	361	674	532	464
July 21, 2011	85	40	203	20	48
July 29, 2011	153	87	269	41	98
August 4, 2011	61	79	36	48	9
August 9, 2011	382	293	362	242	222
August 17, 2011	17	18	98	0	--
August 22, 2011	34	78	58	18	16
September 1, 2011	16	8	68	54	24
September 7, 2011	9	2	77	0	8
September 15, 2011	26	17	82	47	63
September 21, 2011	32	44	35	64	42
September 28, 2011	26	0	33	2	--
October 11, 2011	27	18	105	12	21
October 25, 2011	17	27	139	52	41



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PRRIP – DRAFT

Acronym List	
°C = degrees Celsius	LEXPR = Platte River, Lexington, NE
cfs = cubic feet per second	mg/L = milligrams per liter
ELMCR = Elm Creek, Elm Creek, NE	mS/cm = milliSiemens per centimeter
ELMPR = Platte River, Elm Creek, NE	NTU = Nephelometric Turbidity Units
KCDIV = Kearney Canal Diversion, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCPH = Kearney Canal Power House, Kearney, NE	OVRPR = Platte River, Overton, NE



Temporal Variations



Figure B-1. Temporal Variation, Temperature, Weekly Mean, (Platte River, Elm Creek, Kearney Canal), NE

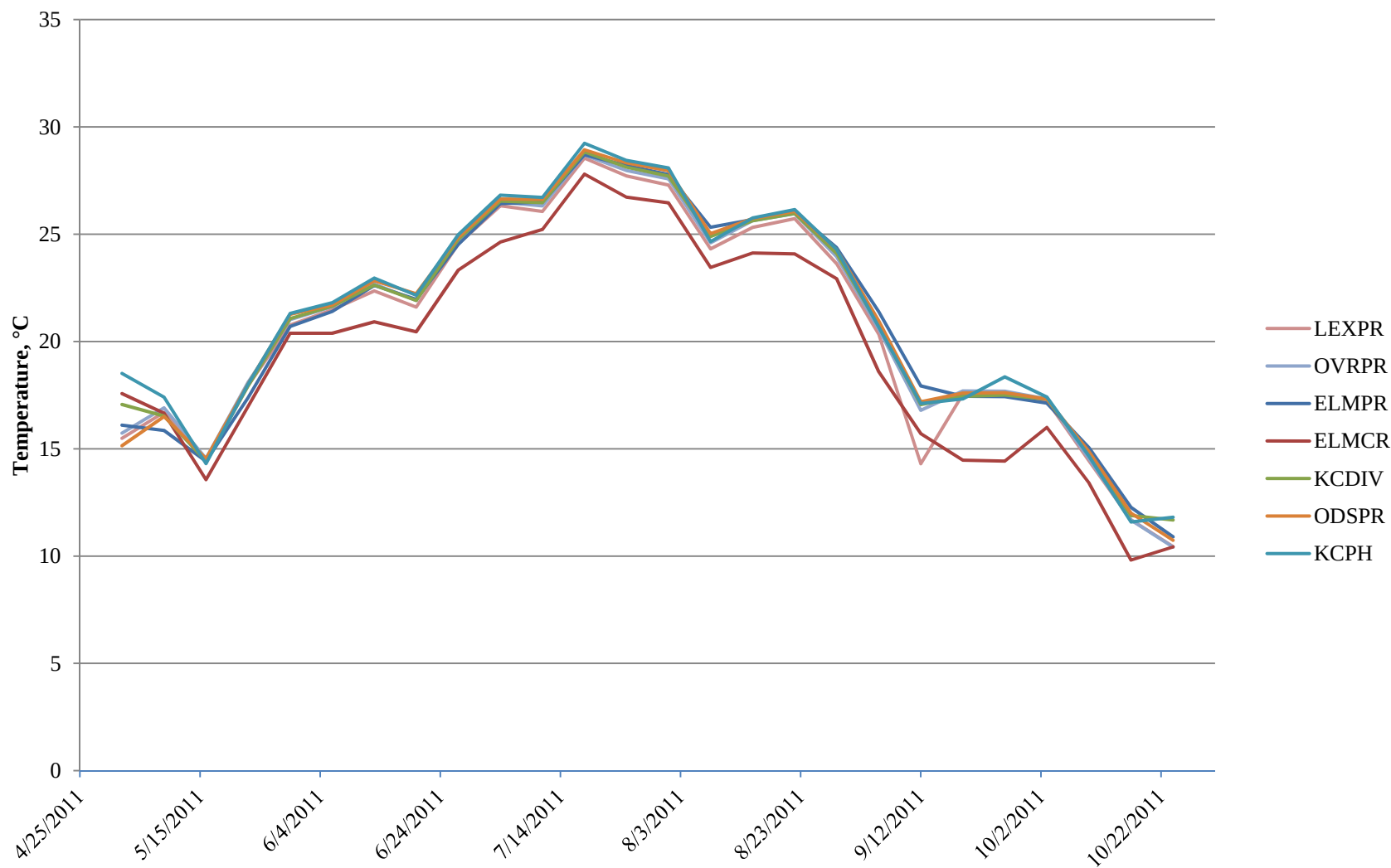




Figure B-2. Temporal Variation, Specific Conductance, Weekly Mean, (Platte River, Elm Creek, Kearney Canal), NE

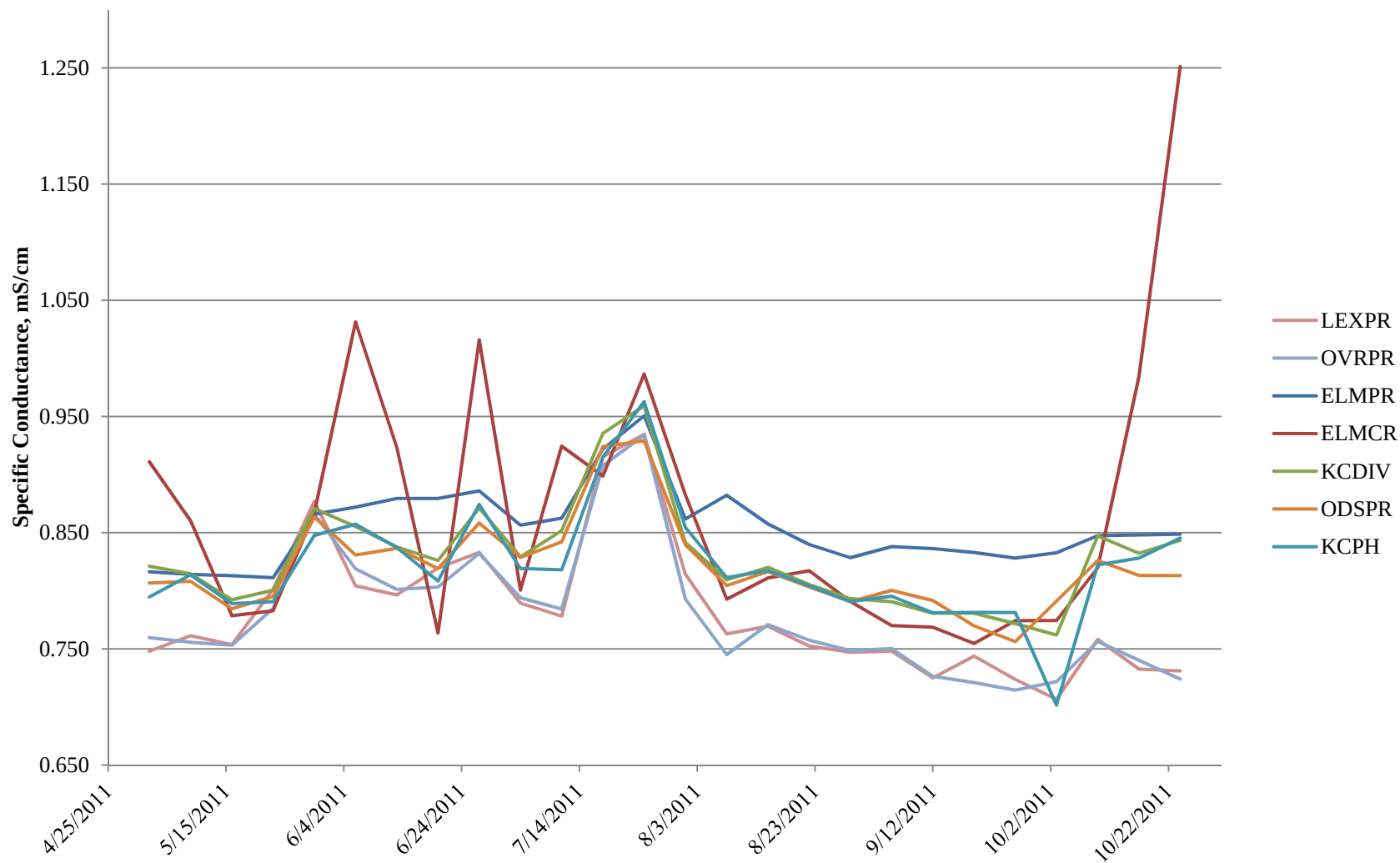




Figure B-3. Temporal Variation, pH, Weekly Mean, (Platte River, Elm Creek, Kearney Canal), NE

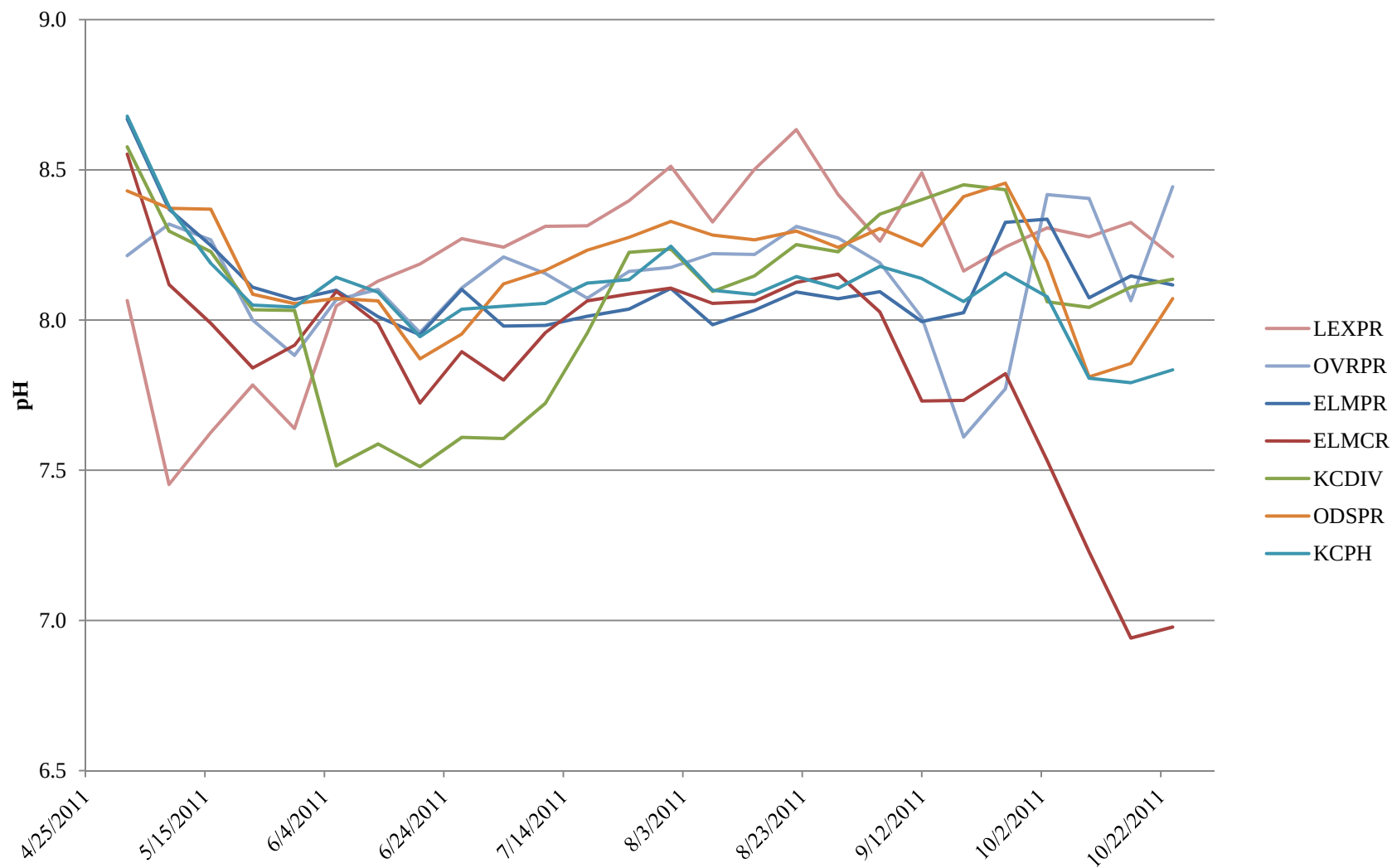




Figure B-4. Temporal Variation, Turbidity, Weekly Mean, (Platte River, Elm Creek, Kearney Canal), NE

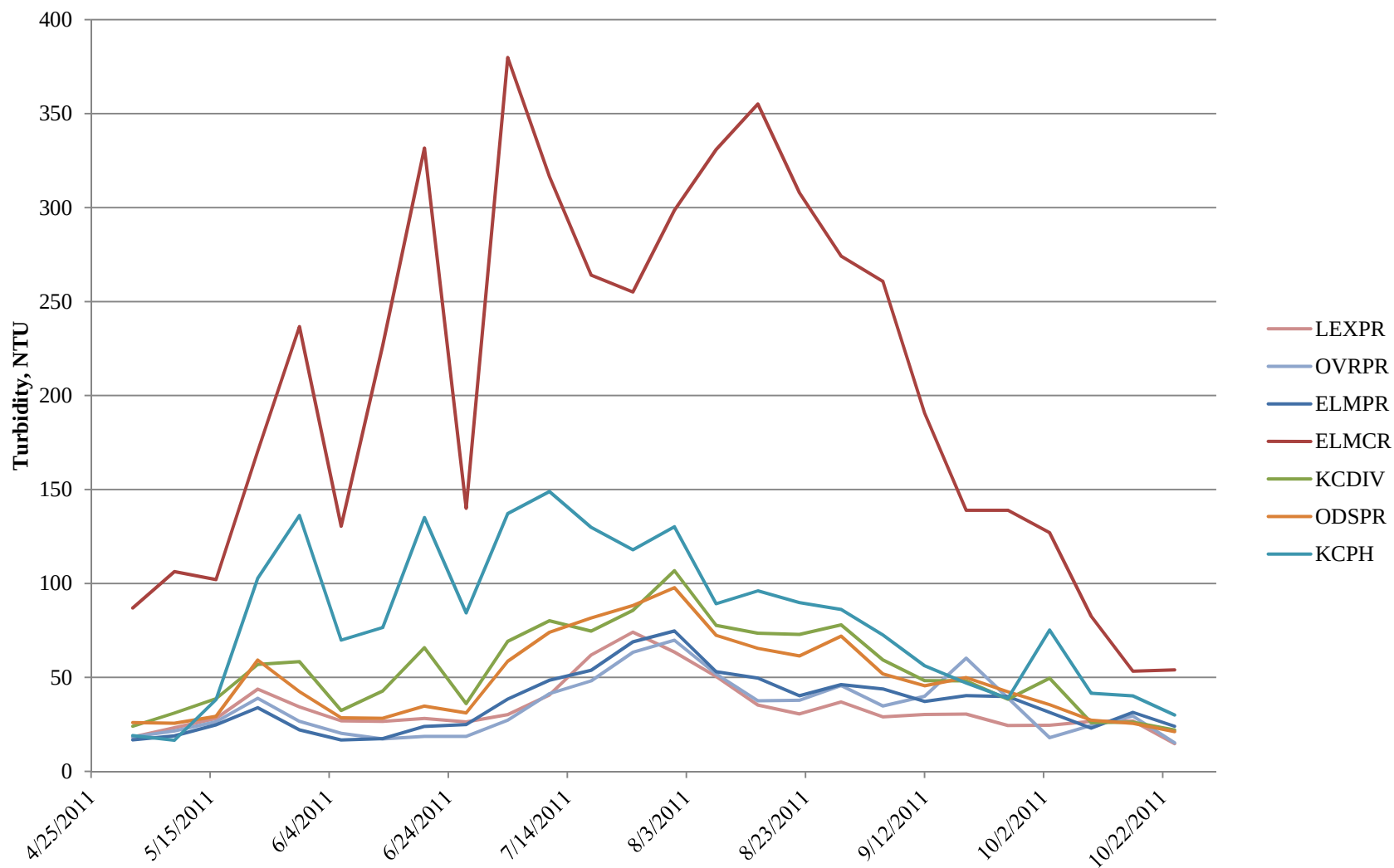




Figure B-5. Temporal Variation, Dissolved Oxygen, Weekly Mean, (Platte River, Elm Creek, Kearney Canal), NE

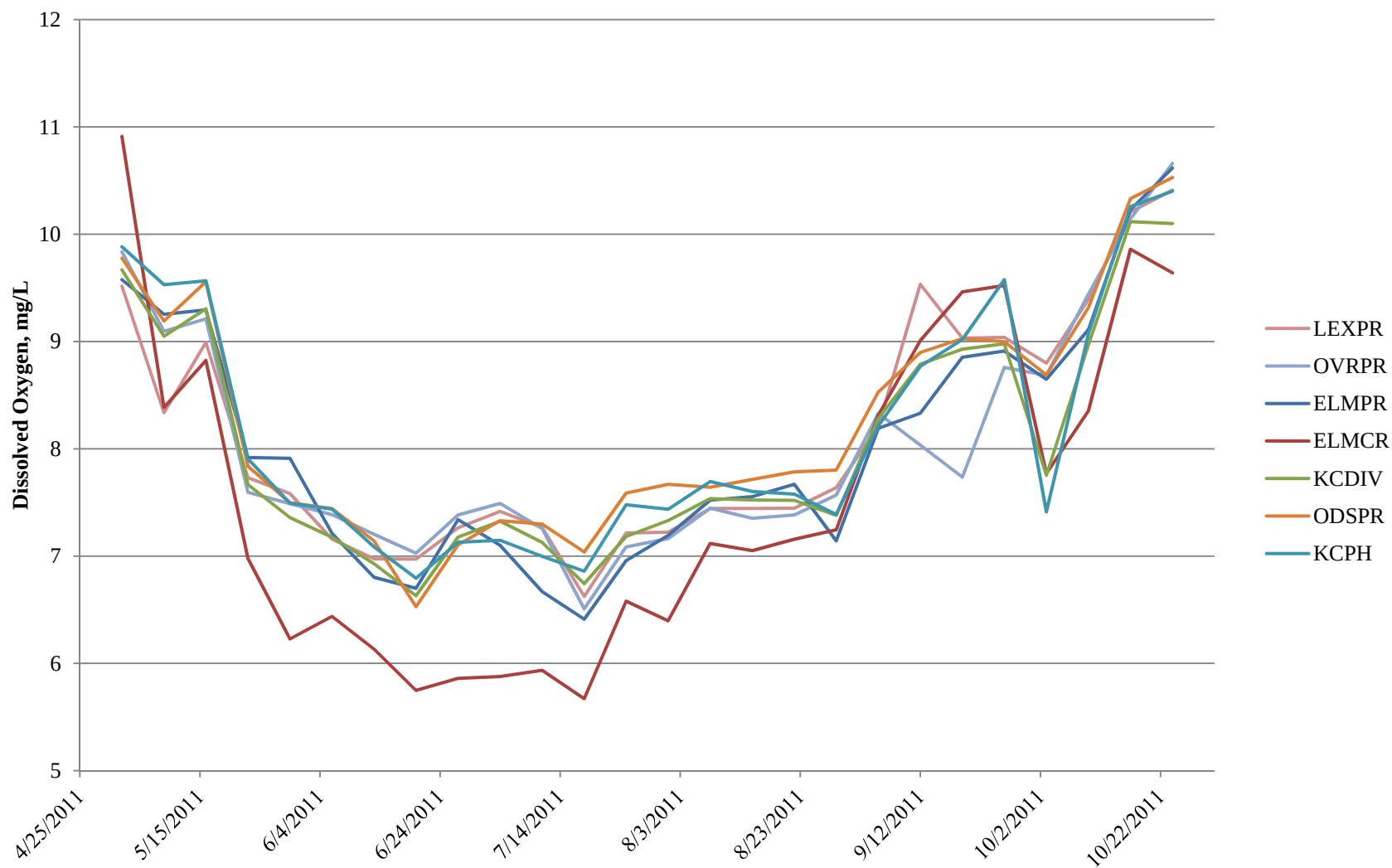
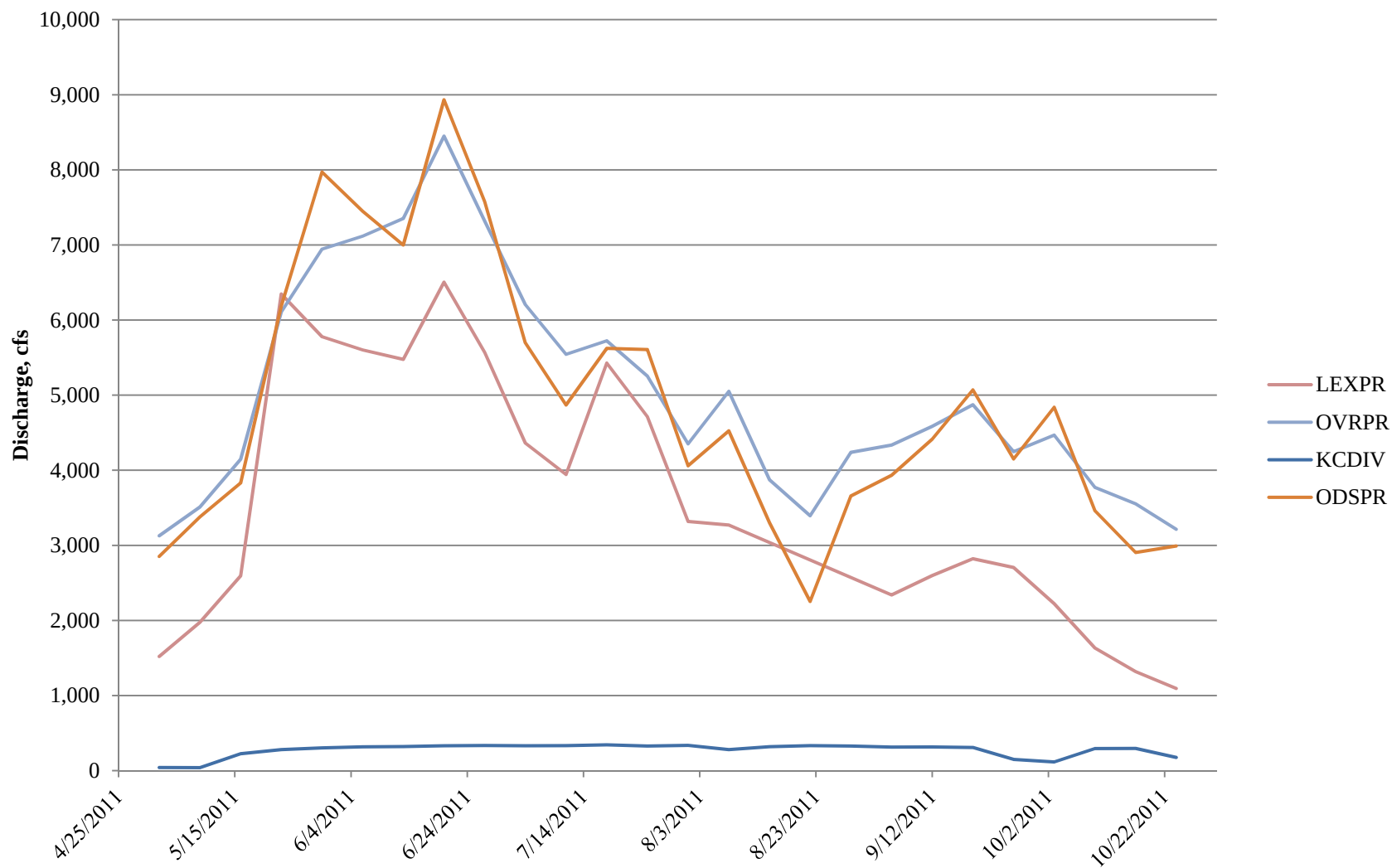




Figure B-6. Temporal Variation, Discharge, Weekly Mean, (Platte River, Elm Creek, Kearney Canal), NE





Spatial Variation



Figure B-7. Spatial Variation, Temperature, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal), NE

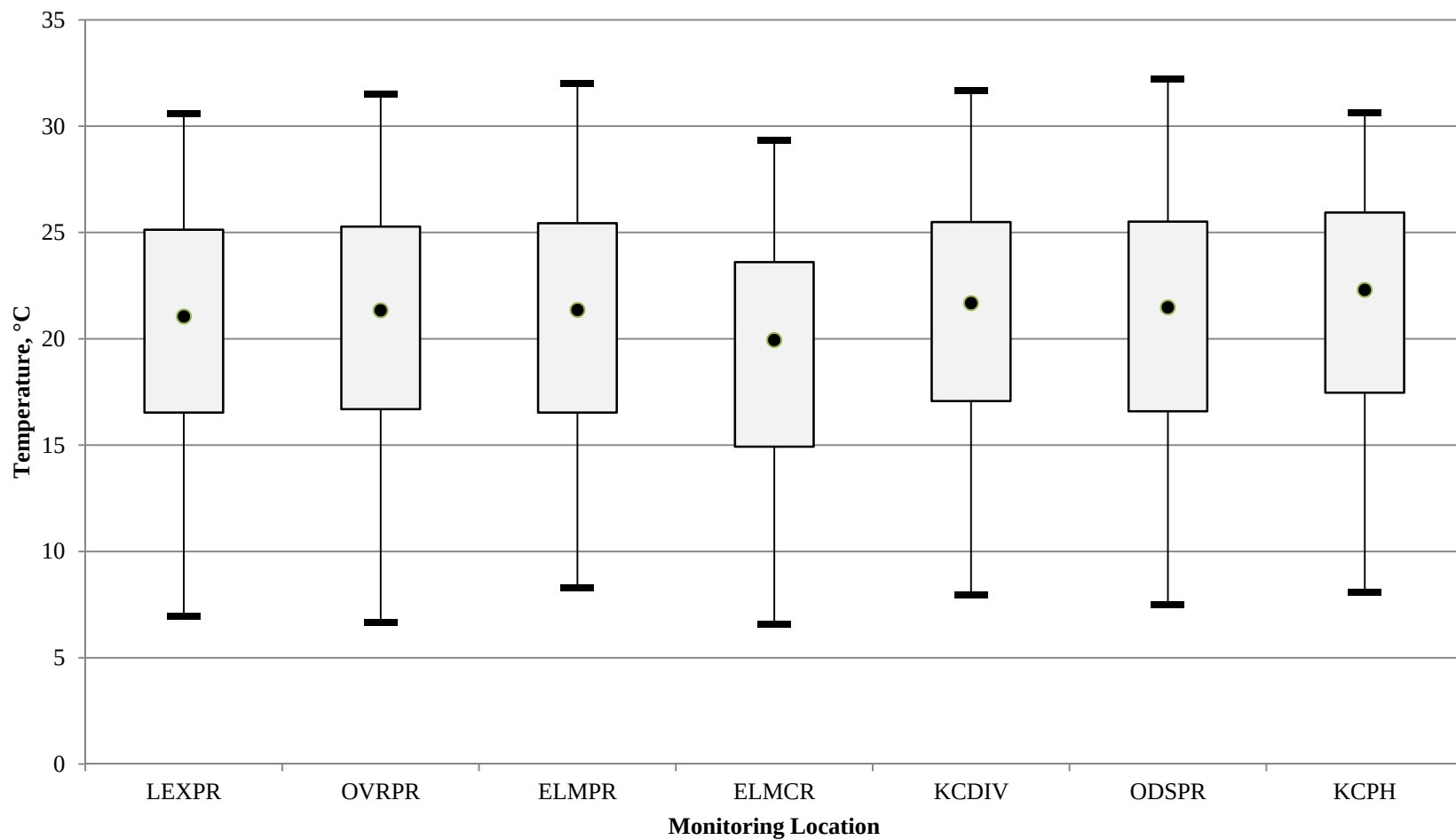




Figure B-8. Spatial Variation, Specific Conductance, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal), NE

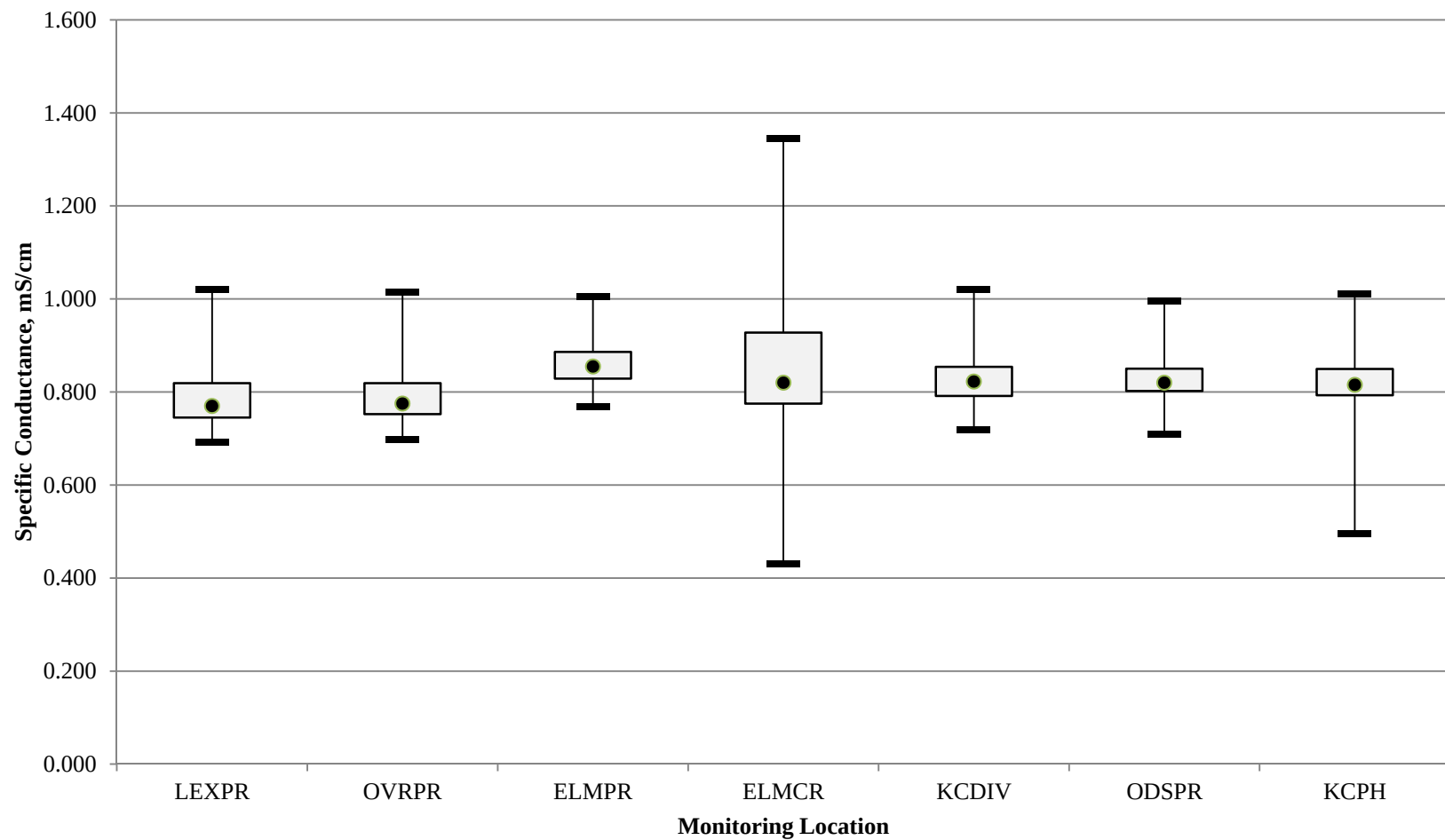




Figure B-9. Spatial Variation, pH, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal), NE

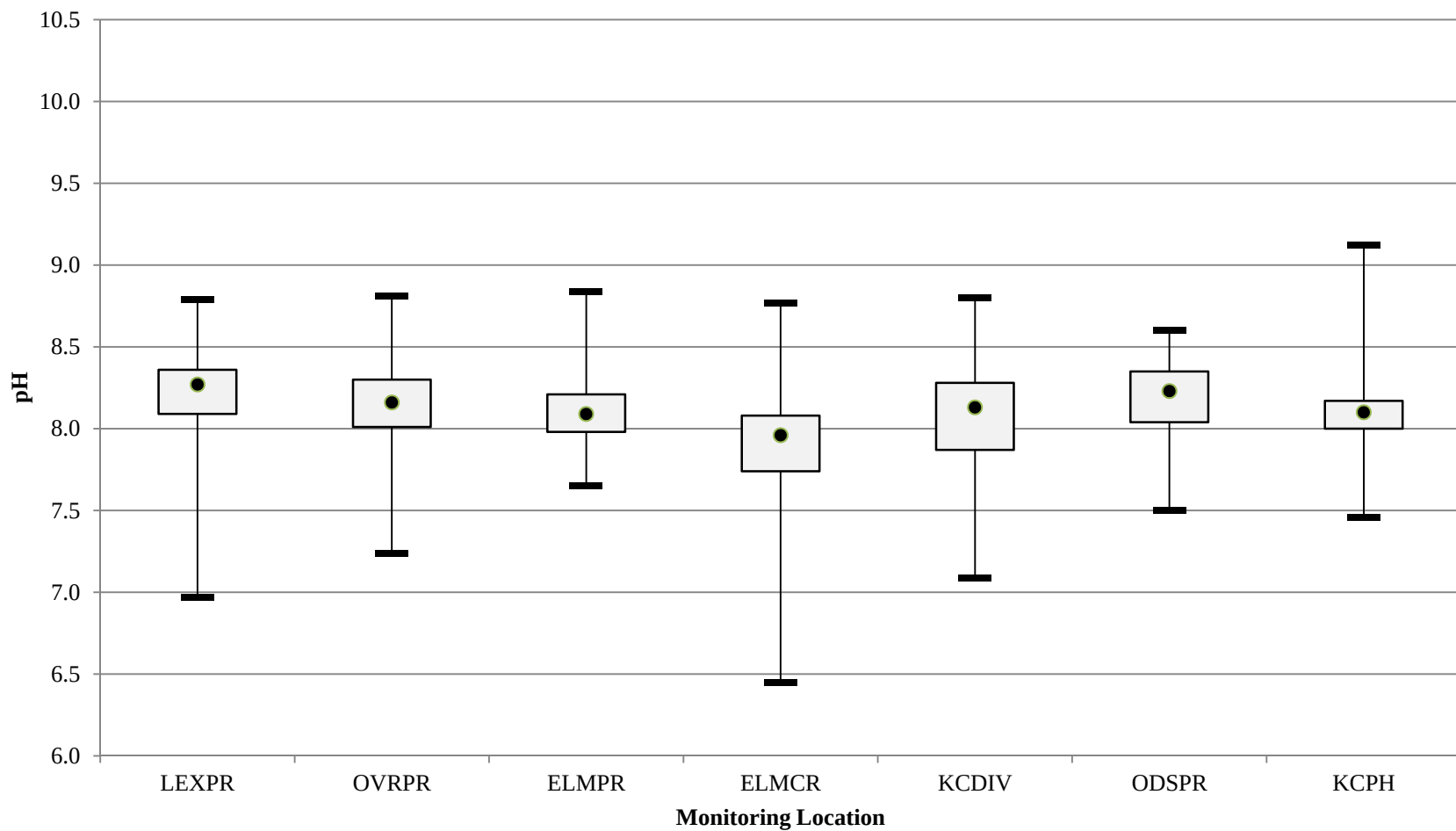




Figure B-10. Spatial Variation, Turbidity, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal), NE

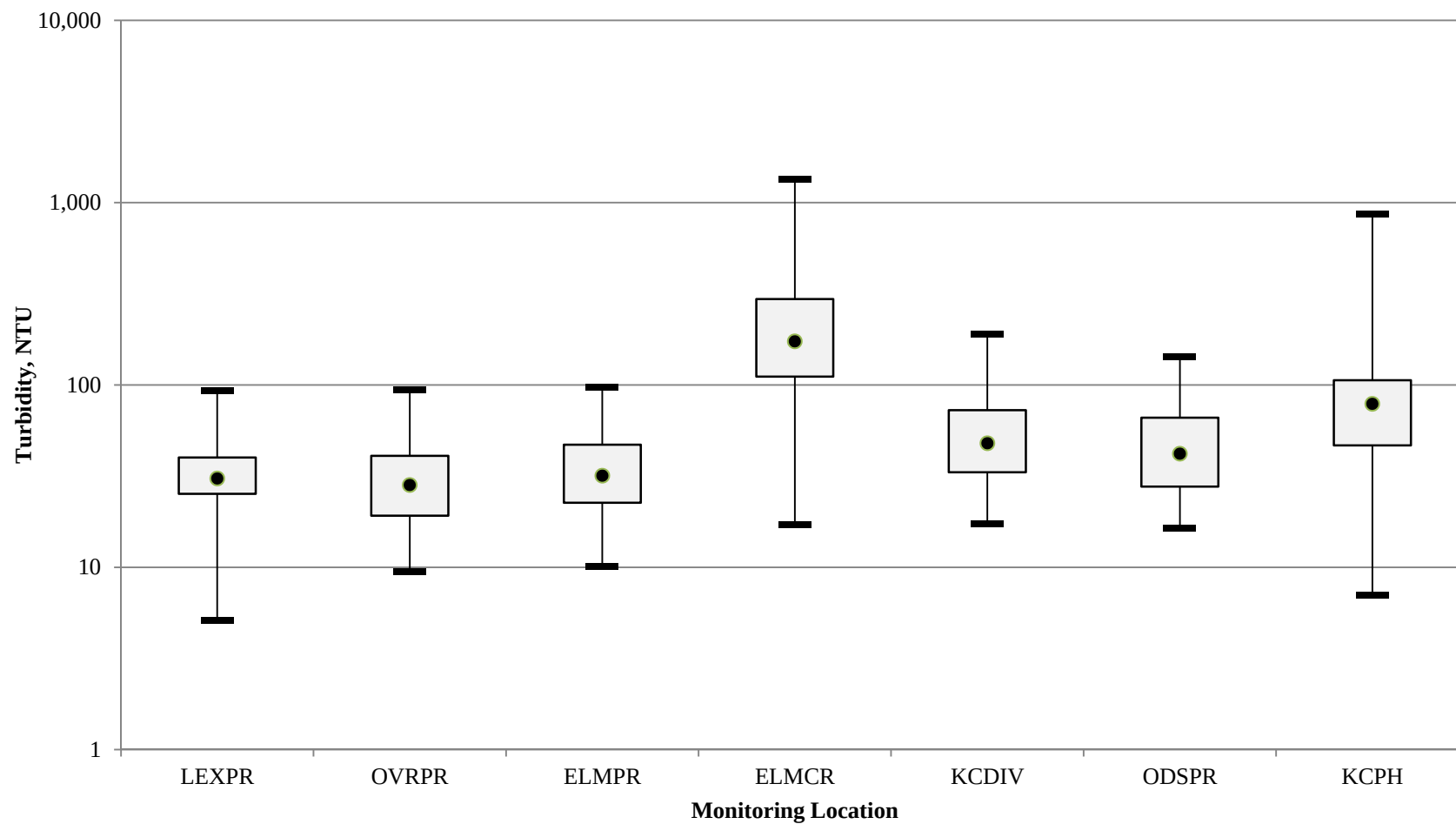




Figure B-11. Spatial Variation, Dissolved Oxygen, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal), NE

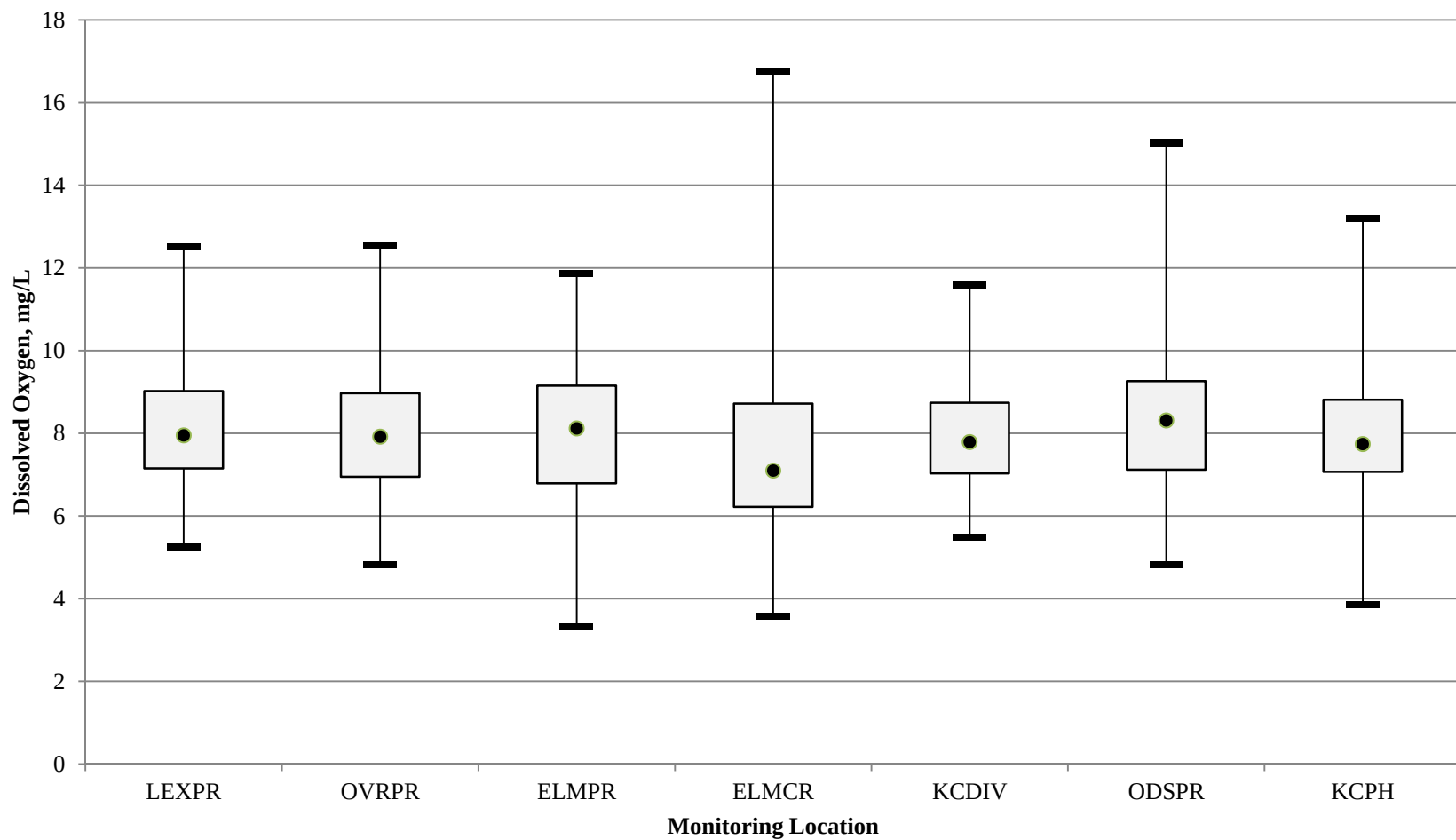
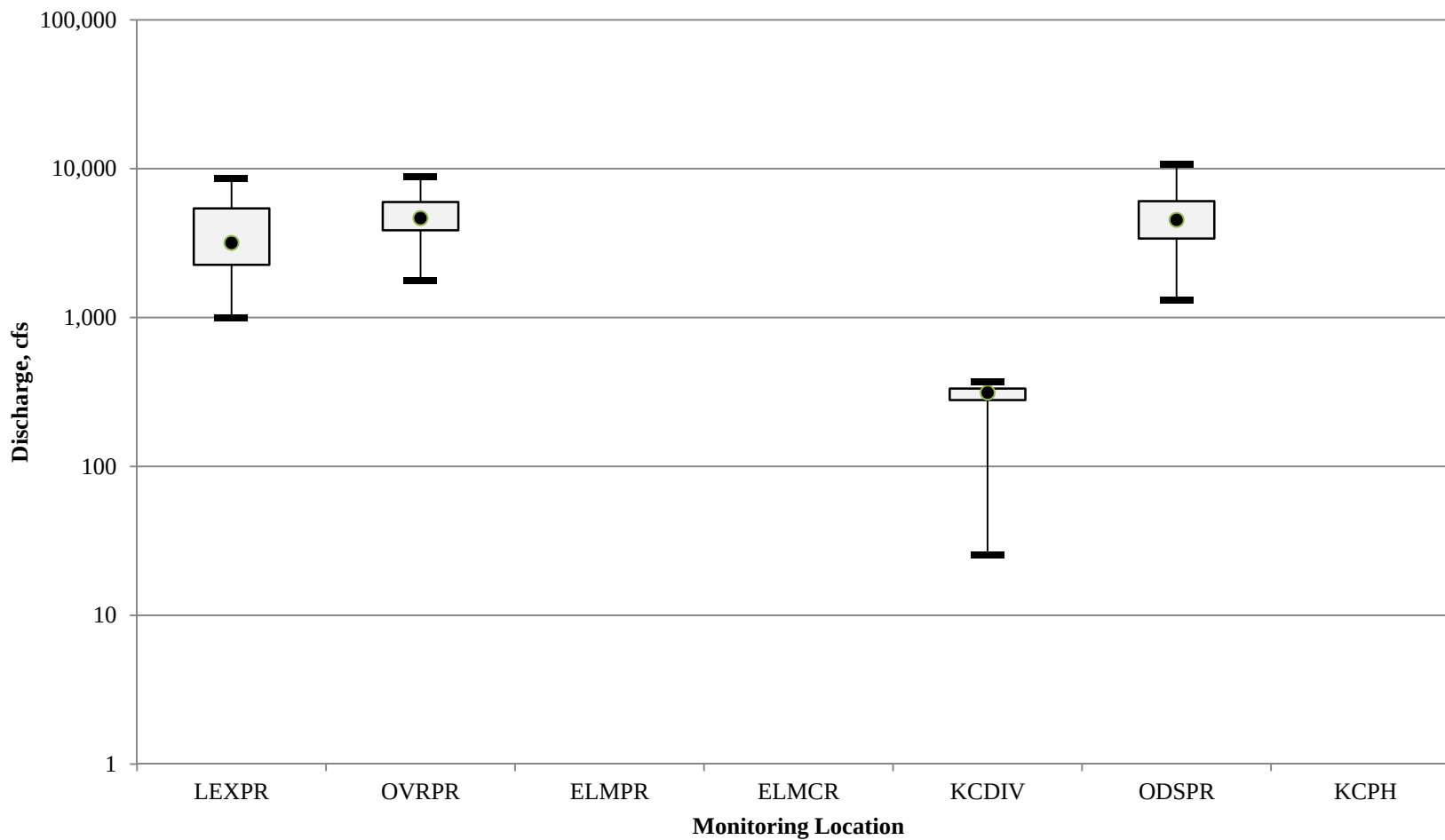




Figure B-12. Spatial Variation, Discharge, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal), NE





Linear Correlation



Figure B-13. Linear Correlation, Suspended Sediment Concentration, Platte River, Lexington, NE

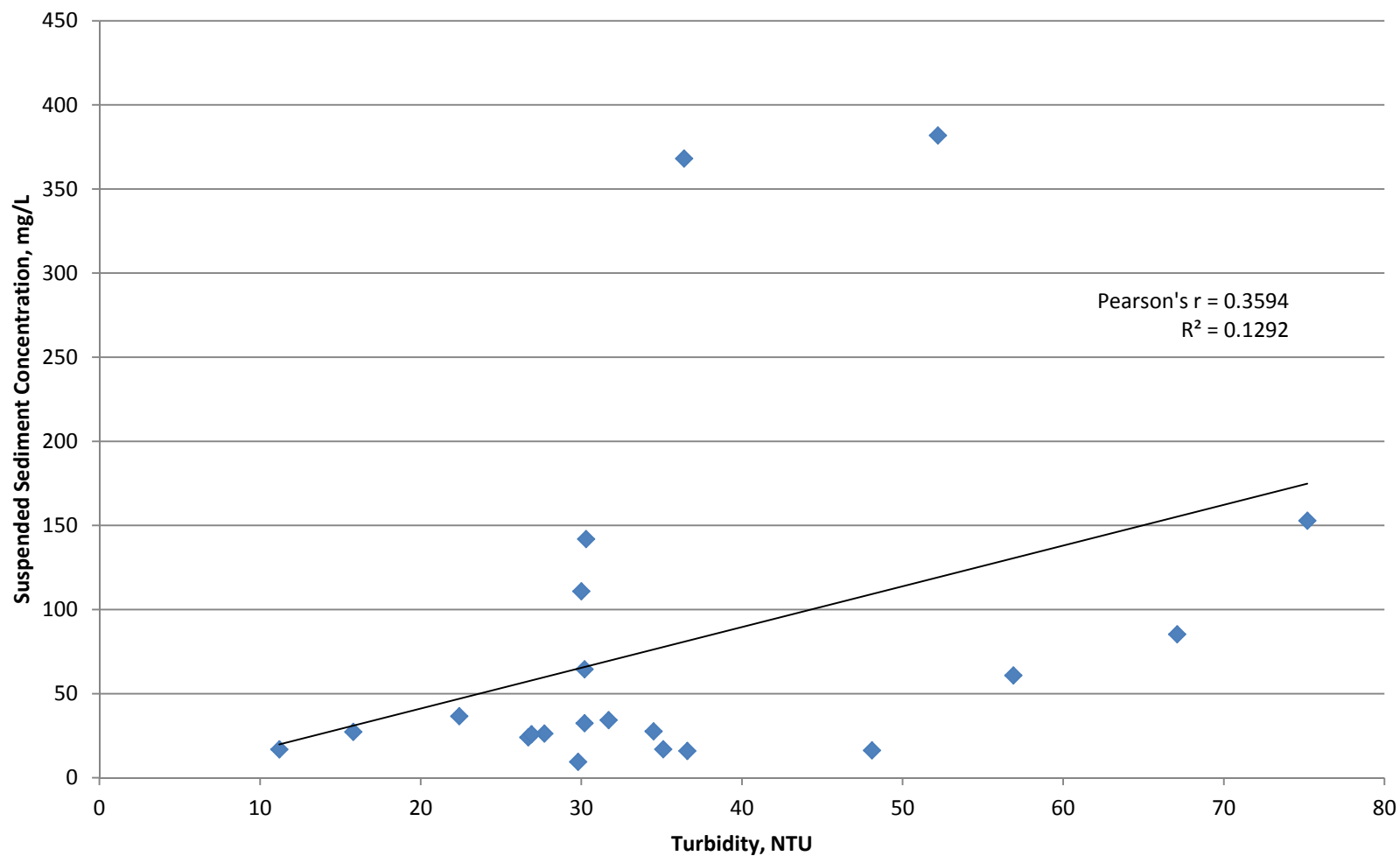




Figure B-14. Linear Correlation, Suspended Sediment Concentration, Platte River, Elm Creek, NE

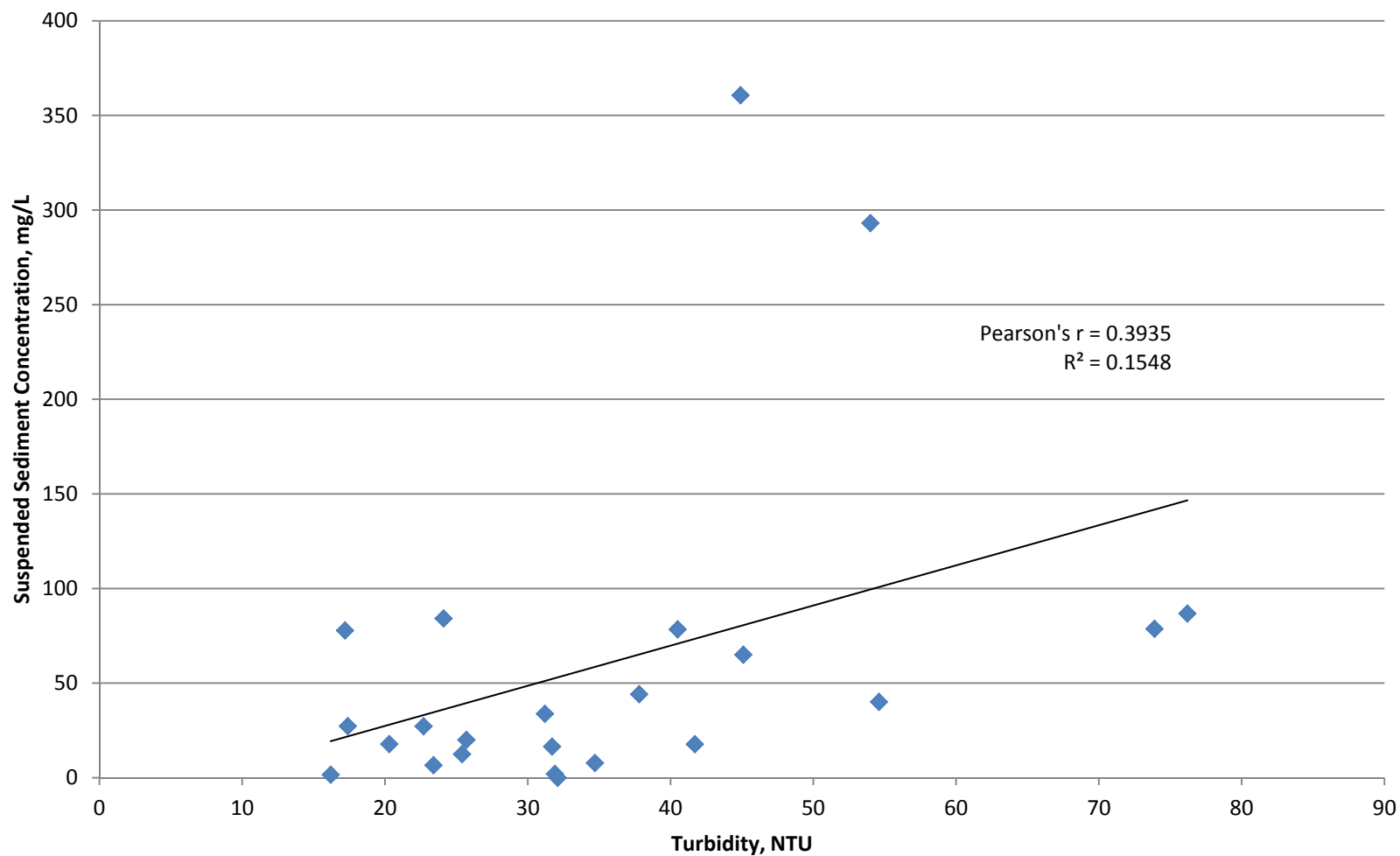




Figure B-15. Linear Correlation, Suspended Sediment Concentration, Elm Creek, Elm Creek, NE

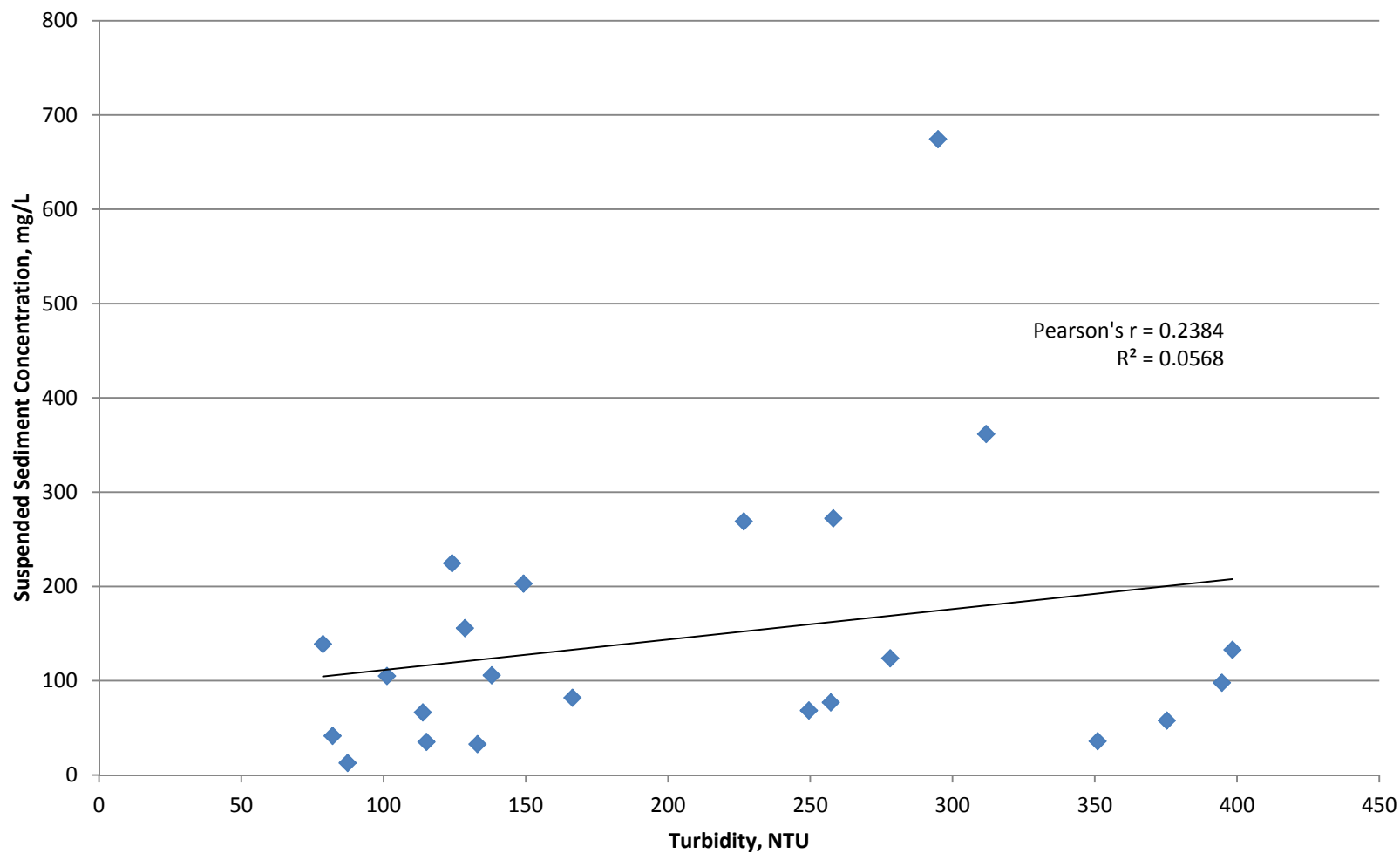




Figure B-16. Linear Correlation, Suspended Sediment Concentration, Kearney Canal Diversion, Elm Creek, NE

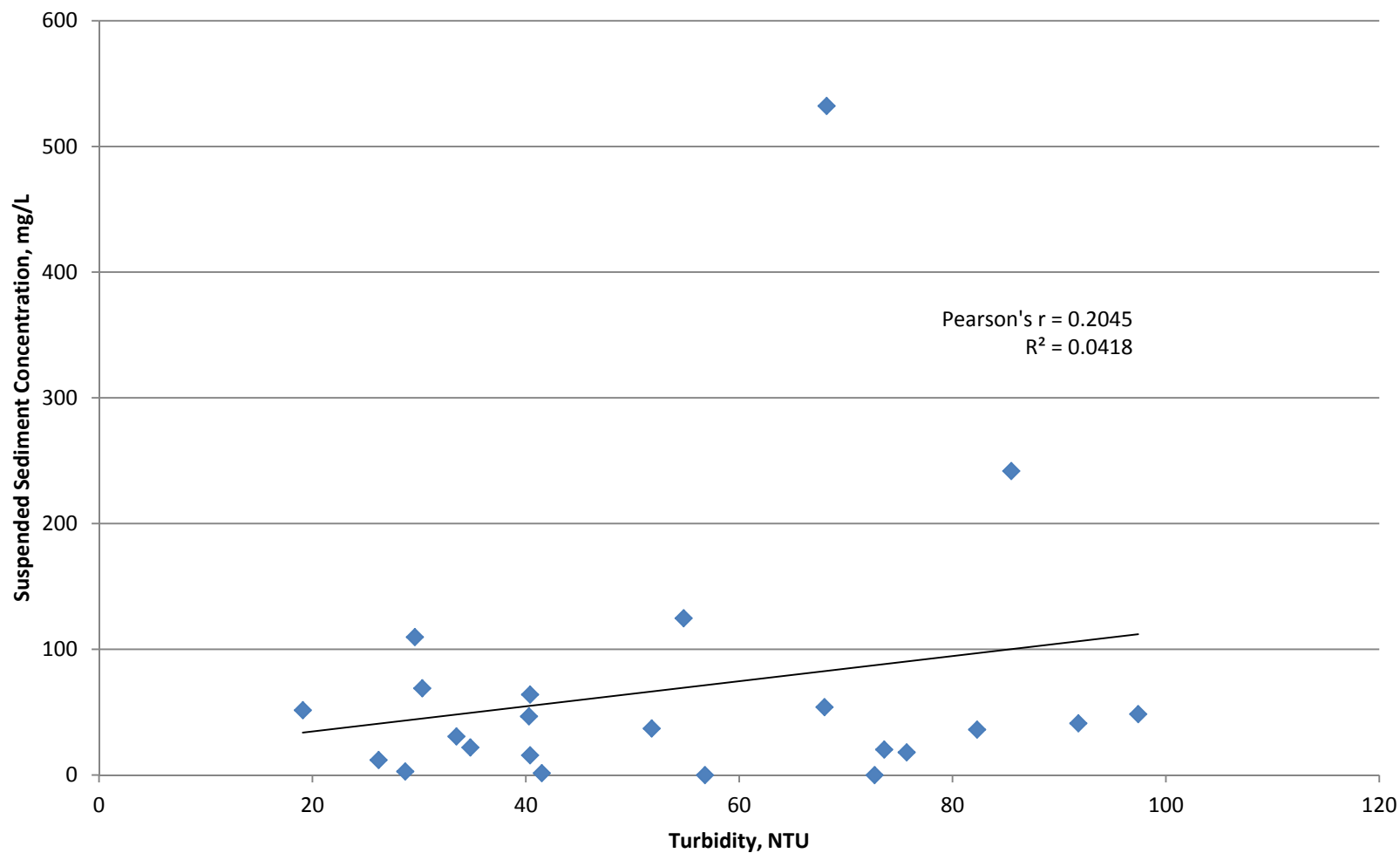
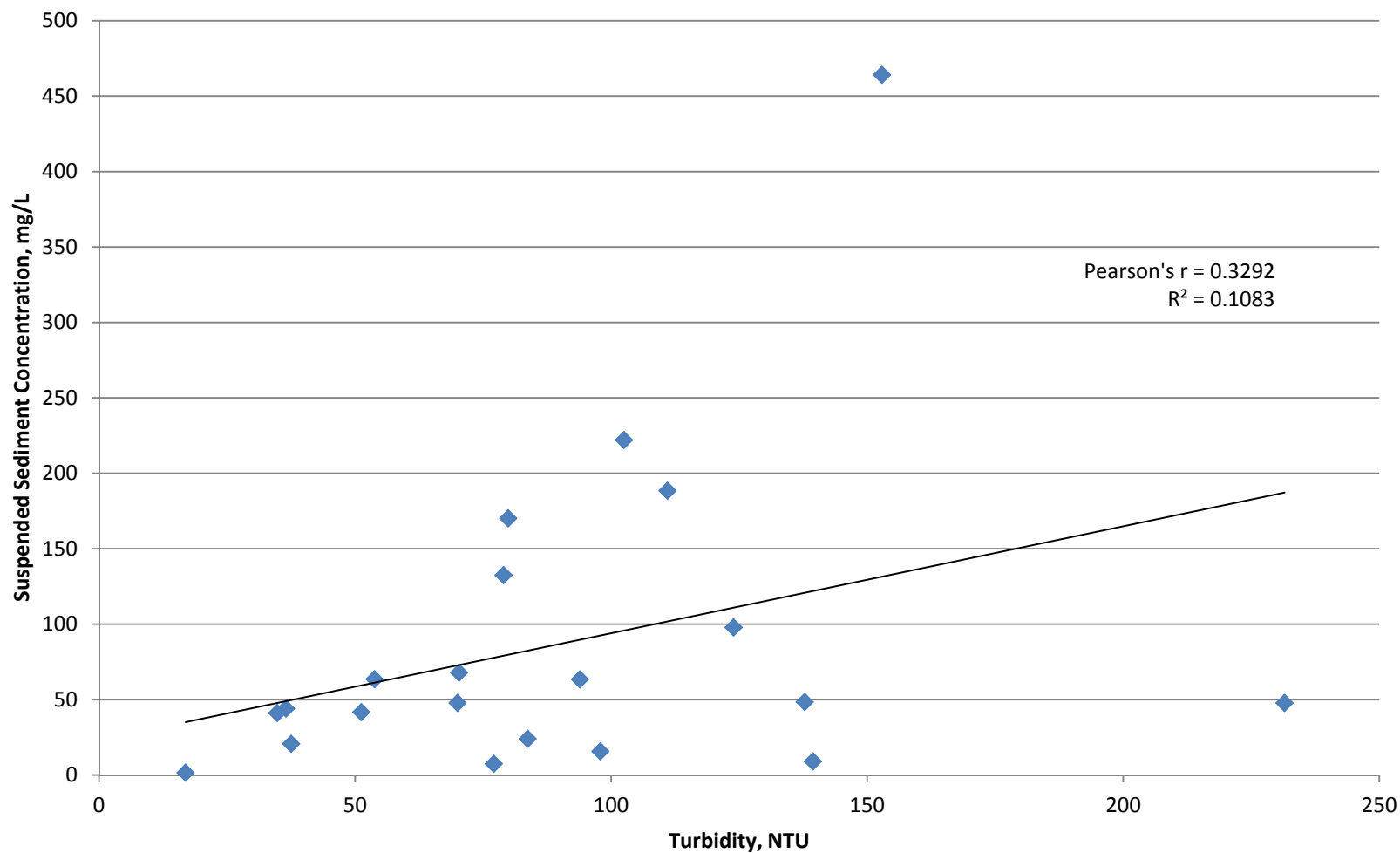




Figure B-17. Linear Correlation, Suspended Sediment Concentration, Kearney Canal Power House, Kearney, NE





APPENDIX C

QA/QC Data



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Acronym List	
%R = Percent Recovery	LEXPR = Platte River, Lexington, NE
°C = degrees Celsius	mg/L = Milligrams per liter
DUP = Duplicate	mS/cm = milliSiemens per centimeter
ELMCR = Elm Creek, Elm Creek, NE	NTU = Nephelometric Turbidity Units
ELMPR = Platte River, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCDIV = Kearney Canal Diversion, Elm Creek, NE	OVRPR = Platte River, Overton, NE
KCPH = Kearney Canal Power House, Kearney, NE	RPD = Relative Percent Difference



Precision, Duplicate Continuous Water Quality Data, Relative Percent Difference



Table C-1. Duplicate Water Quality RPDs, Continuous Data, Platte River, Lexington, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/05/11	12.36	12.37	0.08%	8.08	8.38	3.65%	8.72	9.82	11.87%	0.757	0.746	1.46%	7.46	7.40	0.81%
05/17/11	12.80	12.63	1.34%	8.12	7.98	1.74%	9.10	9.16	0.66%	0.776	0.767	1.17%	9.30	4.80	63.83%
05/24/11	18.30	18.44	0.76%	8.00	7.90	1.26%	7.37	7.51	1.88%	0.764	0.763	0.13%	10.26	12.50	19.68%
05/31/11	17.21	17.43	1.27%	8.04	7.95	1.13%	7.10	7.24	1.95%	0.880	0.876	0.46%	13.80	8.44	48.20%
06/07/11	21.77	21.86	0.41%	7.99	7.44	7.13%	6.45	6.26	2.99%	0.832	0.853	2.49%	5.74	11.30	65.26%
06/15/11	20.13	20.26	0.64%	7.97	8.21	2.97%	6.28	6.44	2.52%	0.819	0.771	6.04%	6.23	9.30	39.54%
06/22/11	17.97	18.20	1.27%	7.98	7.95	0.38%	7.38	7.00	5.29%	0.815	0.807	0.99%	6.47	7.90	19.90%
06/29/11	21.96	22.03	0.32%	7.82	8.21	4.87%	6.19	6.19	0.00%	0.836	0.830	0.72%	9.55	17.60	59.30%
07/05/11	28.33	28.41	0.28%	8.34	8.57	2.72%	8.48	8.55	0.82%	0.821	0.814	0.86%	8.95	17.40	64.14%
07/14/11	22.02	22.15	0.59%	8.04	8.04	0.00%	7.16	7.48	4.37%	0.781	0.771	1.29%	11.50	11.30	1.75%
07/21/11	26.47	26.67	0.75%	7.86	8.24	4.72%	6.22	5.79	7.16%	0.927	0.918	0.98%	17.70	21.10	17.53%
07/29/11	25.75	25.83	0.31%	8.06	8.20	1.72%	6.44	5.70	12.19%	0.906	0.916	1.10%	20.50	24.80	18.98%
08/04/11	24.47	24.55	0.33%	8.13	8.30	2.07%	7.09	7.08	0.14%	0.793	0.793	0.00%	17.80	22.10	21.55%
08/09/11	23.65	23.80	0.63%	8.08	8.51	5.18%	7.00	6.89	1.58%	0.767	0.764	0.39%	16.10	29.00	57.21%
08/16/11	26.90	26.97	0.26%	8.13	8.38	3.03%	7.96	7.69	3.45%	0.778	0.778	0.00%	10.81	26.30	83.48%
08/21/11	26.40	26.47	0.26%	8.33	8.47	1.67%	7.63	7.74	1.43%	0.769	0.765	0.52%	10.44	18.30	54.70%
09/01/11	23.51	23.59	0.34%	8.14	8.37	2.79%	7.17	7.25	1.11%	0.757	0.744	1.73%	10.19	35.00	109.80%
09/07/11	18.14	18.27	0.71%	8.21	8.30	1.09%	8.38	8.17	2.54%	0.759	0.750	1.19%	13.30	14.40	7.94%
09/14/11	17.31	17.33	0.12%	8.36	8.26	1.20%	8.10	8.22	1.47%	0.735	0.734	0.14%	9.68	8.10	17.77%
09/21/11	15.87	15.92	0.31%	8.28	8.46	2.15%	8.83	9.03	2.24%	0.746	0.740	0.81%	11.90	9.00	27.75%
09/27/11	19.96	20.06	0.50%	8.48	8.20	3.36%	10.16	9.56	6.09%	0.750	0.753	0.40%	9.18	13.60	38.81%
10/11/11	14.18	14.29	0.77%	8.05	8.21	1.97%	10.16	8.91	13.11%	0.753	0.743	1.34%	6.88	9.80	35.01%
10/25/11	11.46	11.58	1.04%	8.16	8.19	0.37%	10.64	9.68	9.45%	0.738	0.743	0.68%	14.40	12.40	14.93%
11/10/11	3.31	3.40	2.68%	8.38	7.58	10.03%	11.86	12.20	2.83%	0.769	0.748	2.77%	5.94	7.50	23.21%



Table C-2. Duplicate Water Quality RPDs, Continuous Data, Platte River, Overton, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/05/11	12.97	13.07	0.77%	8.26	8.34	0.96%	9.71	10.21	5.02%	0.764	0.756	1.05%	4.30	5.55	25.38%
05/17/11	13.30	13.91	4.48%	8.13	8.41	3.39%	9.82	10.27	4.48%	0.783	0.757	3.38%	5.78	5.50	4.96%
05/24/11	18.52	18.34	0.98%	8.05	8.03	0.25%	7.51	7.64	1.72%	0.769	0.765	0.52%	10.78	7.40	37.18%
05/31/11	17.98	18.07	0.50%	8.09	8.10	0.12%	7.47	7.61	1.86%	0.873	0.860	1.50%	8.99	10.90	19.21%
06/07/11	22.66	22.81	0.66%	8.09	7.98	1.37%	7.33	7.18	2.07%	0.839	0.850	1.30%	5.38	4.00	29.42%
06/14/11	23.72	23.81	0.38%	8.26	8.26	0.00%	7.86	8.36	6.17%	0.837	0.800	4.52%	9.61	18.40	62.76%
06/22/11	18.54	18.58	0.22%	8.13	8.06	0.86%	8.28	7.67	7.65%	0.825	0.810	1.83%	6.03	8.20	30.50%
06/30/11	24.04	24.15	0.46%	7.93	8.01	1.00%	7.33	6.19	16.86%	0.849	0.839	1.18%	5.42	9.40	53.71%
07/05/11	29.09	29.17	0.27%	8.45	8.45	0.00%	9.10	9.47	3.98%	0.824	0.820	0.49%	9.33	17.90	62.95%
07/14/11	23.57	23.62	0.21%	8.21	8.15	0.73%	7.93	7.94	0.13%	0.788	0.781	0.89%	11.20	17.20	42.25%
07/21/11	26.78	26.81	0.11%	7.97	8.05	1.00%	6.70	6.22	7.43%	0.922	0.909	1.42%	14.00	18.00	25.00%
07/29/11	29.03	28.92	0.38%	8.36	8.29	0.84%	9.02	8.67	3.96%	0.909	0.918	0.99%	24.10	43.80	58.03%
08/04/11	25.46	25.54	0.31%	8.20	8.09	1.35%	7.44	6.67	10.91%	0.791	0.783	1.02%	19.10	21.10	9.95%
08/08/11	28.62	28.69	0.24%	8.36	8.23	1.57%	7.61	7.50	1.46%	0.772	0.768	0.52%	20.50	33.60	48.43%
08/16/11	27.57	27.68	0.40%	8.21	8.36	1.81%	8.49	8.12	4.46%	0.783	0.775	1.03%	12.10	18.30	40.79%
08/21/11	27.95	27.61	1.22%	8.47	8.32	1.79%	7.90	7.96	0.76%	0.774	0.767	0.91%	13.10	17.60	29.32%
09/01/11	24.49	24.63	0.57%	8.28	8.25	0.36%	7.62	7.56	0.79%	0.763	0.748	1.99%	10.02	16.30	47.72%
09/06/11	20.85	20.97	0.57%	8.31	8.33	0.24%	9.05	8.53	5.92%	0.764	0.758	0.79%	9.78	14.40	38.21%
10/11/11	14.16	14.22	0.42%	8.23	8.57	4.05%	8.98	8.97	0.11%	0.751	0.736	2.02%	7.20	4.80	40.00%
10/25/11	11.30	11.36	0.53%	8.30	8.19	1.33%	11.19	10.28	8.48%	0.748	0.754	0.80%	7.67	10.20	28.32%
11/10/11	4.14	4.14	0.00%	8.44	7.89	6.74%	12.47	12.79	2.53%	0.780	0.741	5.13%	5.55	0.00	200.00%



Table C-3. Duplicate Water Quality RPDs, Continuous Data, Platte River, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/17/11	16.00	16.04	0.25%	8.40	8.70	3.51%	11.10	11.30	1.79%	0.830	0.818	1.41%	6.84	4.7	37.09%
05/24/11	20.27	20.44	0.84%	8.40	8.47	0.83%	10.45	10.39	0.58%	0.814	0.811	0.41%	6.5	10.8	50.00%
05/31/11	18.04	18.21	0.94%	8.26	8.31	0.60%	9.07	9.27	2.18%	0.865	0.854	1.27%	6.8	10.3	40.79%
06/07/11	25.27	25.48	0.83%	8.54	8.31	2.73%	10.70	10.49	1.98%	0.886	0.900	1.52%	4.4	9.5	74.17%
06/15/11	19.52	19.72	1.02%	8.02	8.19	2.10%	6.72	6.87	2.21%	0.911	0.874	4.06%	5.8	13.6	80.56%
06/22/11	21.82	22.01	0.87%	8.34	8.13	2.55%	9.53	9.05	5.17%	0.901	0.898	0.30%	11.4	22.1	63.88%
06/29/11	21.62	21.82	0.92%	7.98	8.03	0.62%	7.22	7.15	0.97%	0.899	0.887	1.31%	6.8	17.7	89.22%
07/06/11	22.94	23.14	0.87%	7.96	7.91	0.63%	5.81	5.75	1.04%	0.841	0.839	0.21%	11.6	26.5	78.22%
07/14/11	28.50	28.71	0.73%	8.36	8.09	3.28%	8.48	8.57	1.06%	0.887	0.893	0.63%	16.0	17.1	6.65%
07/21/11	28.49	28.73	0.84%	8.19	8.18	0.12%	8.32	7.52	10.10%	0.936	0.927	0.97%	16.3	25.8	45.13%
07/29/11	25.92	26.14	0.85%	8.17	8.00	2.10%	7.34	6.96	5.31%	0.928	0.938	1.04%	20.2	29.0	35.77%
08/04/11	26.09	26.31	0.84%	8.29	8.12	2.07%	7.67	7.56	1.44%	0.860	0.858	0.20%	20.7	36.0	53.97%
08/09/11	23.83	24.07	1.00%	8.25	8.06	2.33%	7.20	7.02	2.53%	0.888	0.888	0.00%	17.3	30.8	56.13%
08/17/11	23.49	23.70	0.89%	8.18	7.93	3.10%	7.50	7.74	3.15%	0.881	0.882	0.16%	13.5	29.2	73.54%
08/22/11	23.99	24.21	0.91%	8.04	8.06	0.25%	7.45	7.38	0.94%	0.838	0.853	1.77%	16.3	34.9	72.66%
09/01/11	25.10	25.37	1.07%	8.33	8.10	2.80%	8.08	8.07	0.12%	0.847	0.839	0.96%	10.4	8.4	21.47%
09/07/11	19.60	19.78	0.91%	8.30	8.22	0.97%	8.24	8.12	1.47%	0.854	0.844	1.15%	10.3	24.2	80.25%
09/14/11	17.83	17.93	0.56%	8.70	8.09	7.27%	8.80	8.49	3.59%	0.846	0.850	0.48%	10.5	15.0	35.20%
09/21/11	16.40	16.56	0.97%	8.39	8.15	2.90%	9.55	9.54	0.10%	0.850	0.852	0.25%	11.0	20.4	60.12%
09/27/11	20.29	20.53	1.18%	8.44	8.02	5.10%	10.23	9.38	8.67%	0.793	0.801	0.94%	9.9	19.3	64.66%
10/11/11	15.03	15.18	0.99%	8.24	8.38	1.68%	8.62	8.70	0.92%	0.861	0.860	0.17%	11.9	15.7	27.54%
10/25/11	11.80	11.93	1.10%	8.41	8.51	1.18%	12.22	10.88	11.60%	0.843	0.854	1.32%	14.4	19.9	32.07%
11/10/11	6.41	6.53	1.85%	8.79	8.68	1.26%	12.81	12.87	0.47%	0.873	0.866	0.83%	8.3	13.9	50.56%



PRRIP – FINAL

Table C-4. Duplicate Water Quality RPDs, Continuous Data, Elm Creek, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/18/11	10.70	10.78	0.74%	7.82	7.86	0.51%	7.65	7.30	4.68%	0.747	0.735	1.67%	19.9	40.1	67.33%
05/24/11	21.80	22.00	0.91%	7.96	7.92	0.50%	5.65	5.78	2.27%	0.831	0.828	0.42%	43.8	104.5	81.86%
06/01/11	21.28	21.50	1.03%	8.00	8.01	0.12%	5.98	5.85	2.20%	1.002	1.014	1.19%	45.0	21.2	71.90%
06/07/11	24.63	24.76	0.53%	8.04	8.03	0.12%	6.15	5.78	6.20%	1.097	1.099	0.18%	26.5	72.2	92.60%
06/15/11	20.98	21.14	0.76%	8.14	8.17	0.37%	8.14	8.17	0.37%	1.027	0.985	4.16%	40.0	101.9	87.24%
06/22/11	20.68	20.88	0.96%	7.95	7.87	1.01%	7.11	6.60	7.44%	0.816	0.816	0.02%	64.8	180.1	94.16%
06/29/11	23.89	24.07	0.75%	7.81	7.91	1.27%	5.67	5.64	0.53%	1.100	1.085	1.37%	41.4	92.5	76.33%
07/06/11	23.63	23.89	1.09%	7.67	7.79	1.55%	4.07	4.66	13.52%	0.900	0.897	0.39%	62.2	135.8	74.34%
07/14/11	26.47	26.68	0.79%	8.03	7.97	0.75%	6.32	6.18	2.24%	0.928	0.934	0.61%	66.1	134.3	68.06%
07/21/11	28.40	28.65	0.88%	7.99	8.11	1.49%	6.17	5.91	4.30%	0.996	0.996	0.01%	63.1	127.1	67.30%
07/29/11	25.92	26.16	0.92%	8.02	8.02	0.00%	5.32	5.31	0.19%	1.034	1.039	0.48%	67.3	173.1	88.02%
08/04/11	28.43	28.65	0.77%	8.27	8.25	0.24%	7.92	7.87	0.63%	0.898	0.898	0.06%	68.3	164.5	82.65%
08/09/11	23.19	23.89	2.97%	8.20	8.15	0.61%	6.81	6.73	1.18%	0.805	0.796	1.15%	65.7	194.8	99.12%
08/17/11	23.73	23.96	0.96%	8.14	8.06	0.99%	7.07	6.97	1.42%	0.792	0.796	0.53%	102.4	200.0	64.55%
08/22/11	23.86	24.05	0.79%	8.14	8.14	0.00%	6.66	6.57	1.36%	0.816	0.831	1.82%	201.0	558.0	94.07%
09/01/11	25.58	25.64	0.23%	8.41	8.16	3.02%	7.60	7.41	2.53%	0.808	0.797	1.42%	68.3	115.2	51.12%
09/07/11	18.38	18.54	0.87%	8.40	8.48	0.95%	10.50	10.00	4.88%	0.767	0.754	1.71%	40.6	100.5	84.90%
09/14/11	18.08	18.34	1.43%	8.84	8.51	3.80%	14.86	13.81	7.32%	0.772	0.773	0.13%	29.1	71.1	83.83%
09/21/11	16.99	17.11	0.70%	8.42	8.26	1.92%	11.13	11.00	1.17%	0.756	0.760	0.51%	65.2	135.2	69.86%
09/28/11	16.18	16.40	1.35%	8.29	8.02	3.31%	9.85	9.41	4.57%	0.772	0.773	0.06%	30.0	75.4	86.15%
10/11/11	15.28	15.45	1.11%	8.00	7.60	5.13%	8.31	8.47	1.91%	0.739	0.742	0.45%	64.9	123.3	62.06%
10/25/11	13.18	13.27	0.68%	8.09	7.86	2.88%	11.26	9.97	12.15%	1.240	1.252	0.96%	78.1	97.2	21.79%
11/10/11	6.27	6.12	2.42%	8.61	8.62	0.12%	13.67	13.02	4.87%	1.365	1.335	2.22%	8.9	14.2	45.67%



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Table C-5. Duplicate Water Quality RPDs, Continuous Data, Kearney Canal Diversion, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/17/11	15.60	15.62	0.13%	8.24	8.52	3.34%	9.98	10.71	7.06%	0.806	0.803	0.32%	9.07	10.50	14.61%
05/24/11	21.20	21.39	0.89%	8.23	8.26	0.36%	8.72	8.51	2.44%	0.806	0.802	0.52%	12.60	21.70	53.06%
06/01/11	21.07	21.28	0.99%	8.14	8.13	0.12%	8.55	8.51	0.47%	0.884	0.893	0.99%	14.90	21.30	35.36%
06/07/11	25.45	25.65	0.78%	8.23	8.16	0.85%	8.10	7.97	1.62%	0.883	0.888	0.56%	10.34	22.90	75.57%
06/15/11	22.03	22.22	0.86%	8.14	7.42	9.25%	7.62	7.74	1.56%	0.867	0.832	4.12%	10.53	24.70	80.44%
06/22/11	21.75	21.94	0.87%	8.14	7.88	3.25%	8.20	7.81	4.87%	0.853	0.851	0.21%	16.90	32.30	62.60%
06/29/11	24.94	25.14	0.80%	8.04	7.27	10.06%	7.93	7.69	3.07%	0.884	0.869	1.70%	9.81	16.80	52.54%
07/06/11	24.55	24.77	0.89%	8.09	7.54	7.04%	7.15	7.21	0.84%	0.819	0.811	0.93%	20.50	170.50	157.07%
07/14/11	27.89	27.93	0.14%	8.20	7.66	6.81%	7.65	7.53	1.58%	0.866	0.867	0.08%	24.20	40.90	51.31%
07/21/11	29.21	29.46	0.85%	8.13	7.80	4.14%	7.81	7.29	6.89%	0.949	0.949	0.05%	27.10	35.50	26.84%
07/29/11	27.00	27.21	0.77%	8.22	8.30	0.97%	7.96	7.67	3.71%	0.948	0.955	0.74%	30.10	44.30	38.17%
08/04/11	28.73	28.99	0.90%	8.38	8.31	0.84%	8.45	8.42	0.36%	0.841	0.840	0.11%	33.00	58.00	54.95%
08/09/11	24.93	25.15	0.88%	8.29	8.22	0.85%	7.70	7.55	1.97%	0.821	0.805	1.96%	28.80	37.00	24.92%
08/17/11	25.38	25.61	0.90%	8.24	8.10	1.71%	8.09	7.77	4.04%	0.822	0.823	0.13%	24.10	34.00	34.08%
08/22/11	25.59	25.81	0.86%	8.25	8.16	1.10%	7.89	7.68	2.70%	0.801	0.818	2.08%	25.10	47.60	61.90%
09/01/11	26.43	26.66	0.87%	8.34	8.19	1.81%	7.94	7.90	0.51%	0.812	0.802	1.19%	20.00	0.60	188.35%
09/07/11	19.76	19.96	1.01%	8.40	8.26	1.68%	8.91	8.53	4.36%	0.806	0.801	0.57%	19.30	17.00	12.67%
09/14/11	17.73	17.83	0.56%	8.50	8.22	3.35%	8.78	8.70	0.92%	0.795	0.793	0.28%	18.30	31.40	52.72%
09/21/11	17.26	17.41	0.87%	8.41	8.17	2.90%	9.47	9.41	0.64%	0.790	0.793	0.39%	15.10	20.50	30.34%
09/28/11	16.50	16.66	0.97%	8.31	8.19	1.45%	9.15	8.81	3.79%	0.787	0.785	0.24%	18.10	31.80	54.91%
10/11/11	15.33	15.47	0.91%	7.85	8.07	2.76%	8.85	9.03	2.01%	0.818	0.822	0.43%	19.30	15.80	19.94%
10/25/11	13.26	13.42	1.20%	7.97	8.28	3.82%	12.13	10.35	15.84%	0.834	0.846	1.44%	13.60	16.90	21.64%
11/10/11	8.28	8.16	1.46%	8.80	8.34	5.37%	17.59	14.73	17.70%	0.851	0.839	1.47%	6.97	11.90	52.25%



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Table C-6. Duplicate Water Quality RPDs, Continuous Data, Platte River, Odessa, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/05/11	14.03	14.28	1.77%	8.40	8.56	1.89%	10.04	11.24	11.28%	0.820	0.822	0.24%	6.67	10.90	48.15%
05/17/11	15.10	14.95	1.00%	8.33	8.52	2.26%	11.18	11.04	1.26%	0.809	0.798	1.37%	7.66	10.10	27.48%
05/24/11	18.94	19.16	1.15%	8.24	8.28	0.48%	8.99	9.22	2.53%	0.796	0.787	1.14%	11.40	15.40	29.85%
06/01/11	21.97	22.13	0.73%	8.22	8.15	0.86%	9.01	8.63	4.31%	0.878	0.883	0.57%	11.70	15.50	27.94%
06/07/11	23.51	23.70	0.80%	8.23	8.26	0.36%	8.70	8.43	3.15%	0.869	0.870	0.12%	9.03	20.00	75.58%
06/14/11	24.33	24.50	0.70%	8.28	8.23	0.61%	7.88	8.38	6.15%	0.876	0.839	4.31%	10.94	13.50	20.95%
06/22/11	19.88	20.07	0.95%	8.14	8.08	0.74%	8.40	7.89	6.26%	0.858	0.842	1.88%	11.20	28.20	86.29%
06/30/11	24.39	24.55	0.65%	8.11	8.07	0.49%	8.27	7.12	14.94%	0.879	0.861	2.07%	9.53	19.19	67.27%
07/05/11	29.81	29.98	0.57%	8.41	8.34	0.84%	9.11	9.57	4.93%	0.869	0.842	3.16%	12.70	17.10	29.53%
07/14/11	26.09	26.27	0.69%	8.23	8.25	0.24%	8.38	8.46	0.95%	0.854	0.854	0.00%	20.00	41.00	68.85%
07/20/11	31.22	31.29	0.22%	8.37	8.33	0.48%	8.03	7.50	6.83%	0.916	0.910	0.66%	23.90	38.10	45.81%
07/28/11	29.62	29.70	0.27%	8.48	8.44	0.47%	8.80	8.48	3.70%	0.932	0.933	0.11%	27.50	56.70	69.36%
08/04/11	27.23	27.39	0.59%	8.41	8.41	0.00%	9.04	9.08	0.44%	0.838	0.834	0.48%	29.10	36.80	23.37%
08/08/11	29.44	29.61	0.58%	8.47	8.39	0.95%	8.69	8.52	1.98%	0.810	0.802	0.99%	28.60	33.90	16.96%
08/16/11	27.26	27.41	0.55%	8.31	8.36	0.60%	9.02	8.77	2.81%	0.830	0.820	1.21%	16.60	38.00	78.39%
08/21/11	28.04	28.18	0.50%	8.64	8.39	2.94%	8.75	8.59	1.85%	0.824	0.819	0.61%	20.30	29.90	38.25%
09/06/11	21.58	21.74	0.74%	8.34	8.52	2.14%	9.53	8.98	5.94%	0.807	0.784	2.89%	19.70	24.00	19.68%
09/14/11	18.91	19.14	1.21%	8.61	8.38	2.71%	9.72	9.72	0.00%	0.795	0.792	0.38%	14.30	30.40	72.04%
09/20/11	19.67	19.77	0.51%	8.43	8.32	1.31%	9.49	9.17	3.43%	0.793	0.791	0.25%	16.40	13.90	16.50%
09/27/11	20.92	21.07	0.71%	8.48	8.49	0.12%	10.33	9.68	6.50%	0.778	0.779	0.13%	12.20	14.40	16.54%
10/11/11	15.86	16.02	1.00%	7.98	8.68	8.40%	9.22	9.32	1.08%	0.819	0.816	0.37%	15.50	15.50	0.00%
10/25/11	13.45	13.64	1.40%	8.27	8.13	1.71%	12.18	10.96	10.54%	0.824	0.830	0.73%	13.40	13.80	2.94%
11/09/11	7.01	7.11	1.42%	8.61	7.60	12.46%	12.88	11.62	10.29%	0.861	0.832	3.43%	8.23	9.60	15.37%



Table C-7. Duplicate Water Quality RPDs, Continuous Data, Kearney Canal Powerhouse, Kearney, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/17/11	15.30	15.26	0.26%	8.27	8.43	1.92%	10.45	10.11	3.31%	0.814	0.797	2.12%	9.51	12.70	28.73%
05/24/11	20.38	20.50	0.59%	8.19	8.19	0.00%	8.02	8.21	2.34%	0.801	0.800	0.12%	16.90	19.30	13.26%
06/01/11	21.78	21.89	0.50%	8.15	8.15	0.00%	8.31	8.15	1.94%	0.886	0.899	1.40%	15.90	20.70	26.23%
06/07/11	24.61	24.76	0.61%	8.18	8.13	0.61%	7.73	7.55	2.36%	0.878	0.870	0.88%	14.50	28.60	65.43%
06/15/11	22.92	23.01	0.39%	8.16	8.23	0.85%	7.27	7.43	2.18%	0.869	0.836	3.85%	17.50	26.30	40.18%
06/22/11	19.99	20.10	0.55%	8.11	8.03	0.99%	7.94	7.49	5.83%	0.846	0.839	0.84%	22.80	41.20	57.50%
06/29/11	24.97	25.08	0.44%	8.02	8.02	0.00%	7.43	7.27	2.18%	0.885	0.881	0.46%	19.80	28.20	35.00%
07/06/11	25.70	25.85	0.58%	8.15	8.15	0.00%	6.46	6.93	7.02%	0.839	0.832	0.85%	29.90	44.00	38.16%
07/14/11	25.40	25.54	0.55%	8.12	7.95	2.12%	7.45	7.35	1.35%	0.864	0.868	0.46%	35.90	59.20	49.00%
07/21/11	27.61	27.77	0.58%	8.17	8.19	0.24%	7.28	6.64	9.20%	0.936	0.920	1.69%	35.50	69.50	64.76%
07/29/11	27.53	27.69	0.58%	8.28	8.15	1.58%	8.08	7.73	4.43%	0.950	0.952	0.18%	40.20	88.40	74.96%
08/04/11	27.00	27.18	0.66%	8.33	8.16	2.06%	8.02	7.98	0.50%	0.853	0.849	0.42%	40.50	47.10	15.07%
08/09/11	25.84	26.01	0.66%	8.37	8.21	1.93%	7.79	7.51	3.66%	0.811	0.804	0.90%	35.00	45.80	26.73%
08/17/11	25.78	25.94	0.62%	8.26	8.10	1.96%	8.22	7.98	2.96%	0.823	0.822	0.12%	27.50	36.70	28.66%
08/22/11	26.46	26.60	0.53%	8.34	8.07	3.29%	7.95	7.65	3.85%	0.806	0.813	0.82%	29.50	60.60	69.03%
09/01/11	26.93	27.12	0.70%	8.35	8.10	3.04%	7.93	7.89	0.51%	0.812	0.801	1.31%	20.70	22.00	6.09%
09/07/11	20.04	20.15	0.55%	8.38	8.23	1.81%	8.68	8.34	4.00%	0.806	0.791	1.93%	26.20	29.90	13.19%
09/14/11	17.47	17.48	0.06%	8.54	8.21	3.94%	8.86	8.81	0.57%	0.794	0.793	0.15%	24.40	30.30	21.57%
09/21/11	17.41	17.50	0.52%	8.37	8.13	2.91%	9.56	9.63	0.73%	0.787	0.788	0.06%	21.40	30.00	33.46%
09/28/11	18.60	18.83	1.23%	8.45	8.06	4.72%	10.13	9.63	5.06%	0.782	0.783	0.09%	8.04	14.30	56.04%
10/11/11	15.32	15.37	0.33%	8.13	8.09	0.49%	8.81	8.87	0.68%	0.804	0.807	0.34%	26.30	22.30	16.46%
10/26/11	10.26	10.87	5.77%	8.65	8.15	5.95%	9.86	9.69	1.74%	0.838	0.844	0.65%	10.32	16.80	47.79%
11/10/11	5.55	5.55	0.00%	8.83	8.65	2.06%	17.15	15.84	7.94%	0.568	0.553	2.64%	14.20	25.10	55.47%



**Accuracy, Continuous Water Quality Data,
Percent Recovery**



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Table C-8. Percent Recovery, Continuous Data, Platte River, Lexington, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
04/20/11	6.80	97.14%	10.03	100.30%	12.07	12.08	99.92%	1.418	100.35%	102.20	102.20%
05/05/11	7.13	101.86%	9.95	99.50%	9.60	9.65	99.48%	1.399	99.01%	117.90	117.90%
05/17/11	7.01	100.14%	9.97	99.70%	10.13	10.17	99.61%	1.414	100.07%	82.70	82.70%
05/24/11	6.94	99.14%	10.02	100.20%	8.98	8.91	100.79%	1.419	100.42%	99.60	99.60%
05/31/11	7.02	100.29%	9.99	99.90%	9.45	9.44	100.11%	1.407	99.58%	98.70	98.70%
06/07/11	6.87	98.14%	9.95	99.50%	7.91	7.98	99.12%	1.472	104.18%	97.60	97.60%
06/08/11	7.28	104.00%	9.91	99.10%	7.42	7.64	97.12%	1.426	100.92%	74.20	74.20%
06/15/11	7.09	101.29%	10.10	101.00%	8.47	8.33	101.68%	1.319	93.35%	108.90	108.90%
06/22/11	6.77	96.71%	9.83	98.30%	8.30	8.76	94.75%	1.416	100.21%	107.10	107.10%
06/29/11	7.06	100.86%	10.06	100.60%	8.09	8.31	97.35%	1.417	100.28%	96.60	96.60%
07/05/11	7.10	101.43%	10.02	100.20%	7.40	7.57	97.75%	1.432	101.34%	100.20	100.20%
07/14/11	6.85	97.86%	9.95	99.50%	8.41	8.05	104.47%	1.400	99.08%	114.60	114.60%
07/21/11	7.10	101.43%	9.95	99.50%	7.59	7.81	97.18%	1.410	99.79%	99.60	99.60%
07/29/11	6.94	99.14%	10.07	100.70%	8.08	7.91	102.15%	1.430	101.20%	97.50	97.50%
08/04/11	6.95	99.29%	10.03	100.30%	8.08	8.11	99.63%	1.417	100.28%	102.10	102.10%
08/09/11	7.16	102.29%	10.03	100.30%	8.58	8.57	100.12%	1.413	100.00%	98.10	98.10%
08/16/11	6.85	97.86%	9.87	98.70%	7.58	7.74	97.93%	1.423	100.71%	99.50	99.50%
08/21/11	6.87	98.14%	10.10	101.00%	7.55	7.54	100.13%	1.433	101.42%	105.90	105.90%
09/01/11	7.18	102.57%	10.00	100.00%	8.11	7.81	103.84%	1.428	101.06%	76.90	76.90%
09/07/11	7.03	100.43%	10.06	100.60%	9.07	9.08	99.89%	1.407	99.58%	100.30	100.30%
09/14/11	7.16	102.29%	10.02	100.20%	9.49	9.56	99.27%	1.376	97.38%	103.70	103.70%
09/21/11	7.12	101.71%	10.31	103.10%	9.60	9.81	97.86%	1.382	97.81%	102.10	102.10%
09/27/11	6.81	97.29%	10.02	100.20%	8.17	8.19	99.76%	1.435	101.56%	95.00	95.00%
10/11/11	6.93	99.00%	10.10	101.00%	9.80	9.88	99.19%	1.390	98.37%	99.60	99.60%
10/25/11	7.15	102.14%	10.02	100.20%	10.19	10.47	97.33%	1.390	98.37%	107.40	107.40%



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Table C-9. Percent Recovery, Continuous Data, Platte River, Overton, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
04/20/11	6.94	99.14%	10.05	100.50%	11.88	11.97	99.25%	1.410	99.79%	103.70	103.70%
05/05/11	6.99	99.86%	9.82	98.20%	9.57	9.55	100.21%	1.415	100.14%	116.00	116.00%
05/17/11	6.93	99.00%	10.25	102.50%	9.81	9.76	100.51%	1.417	100.28%	87.80	87.80%
05/24/11	7.00	100.00%	9.94	99.40%	8.87	8.94	99.22%	1.417	100.28%	94.30	94.30%
05/31/11	7.08	101.14%	9.93	99.30%	9.29	9.26	100.32%	1.412	99.93%	99.50	99.50%
06/07/11	6.92	98.86%	10.00	100.00%	7.65	7.71	99.22%	1.441	101.98%	100.50	100.50%
06/14/11	7.02	100.29%	10.00	100.00%	7.90	7.50	105.33%	1.373	97.17%	96.30	96.30%
06/22/11	7.00	100.00%	10.03	100.30%	8.30	8.69	95.51%	1.404	99.36%	105.70	105.70%
06/30/11	7.01	100.14%	9.93	99.30%	7.58	7.71	98.31%	1.403	99.29%	99.30	99.30%
07/05/11	6.93	99.00%	10.02	100.20%	7.54	7.51	100.40%	1.429	101.13%	97.70	97.70%
07/14/11	7.03	100.43%	10.00	100.00%	8.05	7.81	103.07%	1.417	100.28%	105.10	105.10%
07/21/11	7.04	100.57%	10.00	100.00%	7.77	7.80	99.62%	1.402	99.22%	101.50	101.50%
07/28/11	6.99	99.86%	9.96	99.60%	7.42	7.50	98.93%	1.438	101.77%	97.60	97.60%
08/04/11	7.06	100.86%	10.01	100.10%	7.91	7.90	100.13%	1.408	99.65%	99.90	99.90%
08/08/11	6.90	98.57%	10.00	100.00%	7.33	7.48	97.99%	1.418	100.35%	102.50	102.50%
08/16/11	7.00	100.00%	10.01	100.10%	7.70	7.64	100.79%	1.414	100.07%	100.70	100.70%
08/21/11	7.00	100.00%	10.00	100.00%	7.56	7.55	100.13%	1.428	101.06%	101.30	101.30%
09/01/11	6.99	99.86%	10.09	100.90%	7.69	7.67	100.26%	1.400	99.08%	102.50	102.50%
09/06/11	7.06	100.86%	9.99	99.90%	8.24	8.29	99.40%	1.404	99.36%	102.60	102.60%
10/04/11	6.96	99.43%	9.92	99.20%	7.63	7.95	95.97%	1.373	97.17%	99.70	99.70%
10/11/11	7.20	102.86%	10.08	100.80%	9.58	9.87	97.06%	1.394	98.66%	88.40	88.40%
10/25/11	6.90	98.57%	10.03	100.30%	10.43	10.66	97.84%	1.449	102.55%	141.20	141.20%



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Table C-10. Percent Recovery, Continuous Data, Platte River, Elm Creek, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/05/11	7.13	101.86%	10.22	102.20%	8.05	8.36	96.29%	1.383	97.88%	115.40	115.40%
05/17/11	7.05	100.71%	10.10	101.00%	8.81	8.69	101.38%	1.410	99.79%	82.80	82.80%
05/24/11	6.98	99.71%	9.90	99.00%	7.95	7.92	100.38%	1.425	100.85%	99.60	99.60%
05/31/11	7.07	101.00%	10.14	101.40%	8.78	8.92	98.43%	1.412	99.93%	100.40	100.40%
06/07/11	6.84	97.71%	9.68	96.80%	7.05	6.71	105.07%	1.453	102.83%	99.09	99.09%
06/15/11	7.23	103.29%	10.23	102.30%	8.42	8.10	103.95%	1.347	95.33%	100.69	100.69%
06/22/11	6.78	96.86%	9.81	98.10%	7.69	7.89	97.47%	1.430	101.20%	100.80	100.80%
06/29/11	6.98	99.71%	10.02	100.20%	7.88	8.20	96.10%	1.403	99.29%	101.90	101.90%
07/06/11	7.15	102.14%	10.11	101.10%	8.41	8.43	99.76%	1.411	99.86%	104.00	104.00%
07/14/11	6.84	97.71%	9.81	98.10%	7.66	7.25	105.66%	1.436	101.63%	95.80	95.80%
07/21/11	7.11	101.57%	10.10	101.00%	7.62	7.59	100.40%	1.403	99.29%	102.50	102.50%
07/29/11	7.01	100.14%	10.02	100.20%	7.87	7.93	99.24%	1.425	100.85%	103.50	103.50%
08/04/11	7.01	100.14%	10.02	100.20%	7.79	7.86	99.11%	1.413	100.00%	100.19	100.19%
08/09/11	7.13	101.86%	10.09	100.90%	8.46	8.84	95.70%	1.408	99.65%	101.59	101.59%
08/17/11	6.90	98.57%	9.92	99.20%	8.42	8.10	103.95%	1.422	100.64%	101.59	101.59%
08/22/11	7.03	100.43%	10.01	100.10%	8.07	8.04	100.37%	1.426	100.92%	99.40	99.40%
09/01/11	6.92	98.86%	9.98	99.80%	7.66	7.55	101.46%	1.409	99.72%	100.50	100.50%
09/07/11	7.15	102.14%	10.18	101.80%	8.92	8.94	99.78%	1.396	98.80%	103.59	103.59%
09/14/11	7.05	100.71%	10.01	100.10%	9.51	9.55	99.58%	1.415	100.14%	98.50	98.50%
09/21/11	7.05	100.71%	10.02	100.20%	9.39	9.26	101.40%	1.409	99.72%	104.50	104.50%
09/27/11	6.46	92.29%	9.48	94.80%	8.00	7.92	101.01%	1.424	100.78%	96.00	96.00%
10/11/11	7.4	105.71%	10.35	103.50%	9.48	9.75	97.23%	1.395	98.73%	120.00	120.00%
10/25/11	7.28	104.00%	10.18	101.80%	10.35	10.23	101.17%	1.421	100.57%	109.90	109.90%



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Table C-11. Percent Recovery, Continuous Data, Elm Creek, Elm Creek, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/06/11	7.32	104.57%	10.46	104.60%	8.59	9.23	93.07%	1.381	97.74%	118.50	118.50%
05/18/11	6.96	99.43%	9.98	99.80%	10.07	9.99	100.80%	1.407	99.58%	85.30	85.30%
05/24/11	6.94	99.14%	9.86	98.60%	8.18	8.00	102.25%	1.430	101.20%	96.40	96.40%
06/01/11	6.98	99.71%	9.97	99.70%	7.75	7.81	99.23%	1.426	100.92%	97.80	97.80%
06/07/11	7.01	100.14%	9.96	99.60%	7.41	7.09	104.51%	1.440	101.91%	101.30	101.30%
06/15/11	7.07	101.00%	10.14	101.40%	8.33	8.04	103.61%	1.342	94.98%	100.40	100.40%
06/22/11	6.94	99.14%	9.90	99.00%	7.76	7.83	99.11%	1.431	101.27%	100.40	100.40%
06/29/11	7.01	100.14%	10.01	100.10%	7.53	7.92	95.08%	1.408	99.65%	97.90	97.90%
07/06/11	7.05	100.71%	10.06	100.60%	8.57	8.44	101.54%	1.407	99.58%	102.50	102.50%
07/14/11	6.94	99.14%	9.86	98.60%	7.70	7.22	106.65%	1.415	100.14%	103.50	103.50%
07/21/11	7.03	100.43%	10.03	100.30%	7.58	7.21	105.13%	1.428	101.06%	100.40	100.40%
07/29/11	7.03	100.43%	10.05	100.50%	7.65	7.73	98.97%	1.426	100.92%	99.59	99.59%
08/04/11	6.96	99.43%	9.96	99.60%	7.29	7.24	100.69%	1.427	100.99%	102.50	102.50%
08/09/11	7.11	101.57%	10.10	101.00%	8.37	8.45	99.05%	1.391	98.44%	105.30	105.30%
08/17/11	6.92	98.86%	9.93	99.30%	8.23	8.15	100.98%	1.428	101.06%	103.90	103.90%
08/22/11	7.00	100.00%	10.00	100.00%	7.98	7.97	100.13%	1.426	100.92%	105.69	105.69%
09/01/11	6.94	99.14%	9.97	99.70%	7.34	7.23	101.52%	1.417	100.28%	90.80	90.80%
09/07/11	7.23	103.29%	10.27	102.70%	8.82	8.78	100.46%	1.390	98.37%	100.30	100.30%
09/14/11	7.30	104.29%	10.18	101.80%	9.43	9.22	102.28%	1.409	99.72%	107.10	107.10%
09/21/11	6.98	99.71%	10.06	100.60%	9.16	8.92	102.69%	1.413	100.00%	99.30	99.30%
09/28/11	6.67	95.29%	9.82	98.20%	8.88	8.93	99.44%	1.410	99.79%	110.30	110.30%
10/11/11	7.17	102.43%	10.14	101.40%	9.62	9.58	100.42%	1.406	99.50%	123.40	123.40%
10/25/11	7.56	108.00%	10.52	105.20%	9.84	9.72	101.23%	1.409	99.72%	110.09	110.09%



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Table C-12. Percent Recovery, Continuous Data, Kearney Canal Diversion, Elm Creek, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/05/11	7.13	101.86%	10.19	101.90%	8.17	8.44	96.80%	1.379	97.59%	114.90	114.90%
05/17/11	7.01	100.14%	10.02	100.20%	8.80	8.65	101.73%	1.415	100.14%	85.09	85.09%
05/24/11	6.98	99.71%	9.97	99.70%	7.97	7.87	101.27%	1.425	100.85%	98.09	98.09%
06/01/11	7.01	100.14%	9.97	99.70%	7.73	7.72	100.13%	1.421	100.57%	98.50	98.50%
06/07/11	7.01	100.14%	9.96	99.60%	7.03	6.87	102.33%	1.442	102.05%	104.50	104.50%
06/15/11	6.65	95.00%	9.64	96.40%	8.14	7.89	103.17%	1.347	95.33%	101.40	101.40%
06/22/11	7.23	103.29%	10.17	101.70%	7.64	7.78	98.20%	1.431	101.27%	100.30	100.30%
06/29/11	6.61	94.43%	9.64	96.40%	7.47	7.59	98.42%	1.412	99.93%	99.40	99.40%
07/06/11	7.13	101.86%	9.94	99.40%	8.28	8.33	99.40%	1.401	99.15%	102.90	102.90%
07/14/11	6.98	99.71%	10.05	100.50%	7.54	7.21	104.58%	1.414	100.07%	102.00	102.00%
07/21/11	6.94	99.14%	10.01	100.10%	7.36	7.18	102.51%	1.423	100.71%	98.80	98.80%
07/29/11	7.09	101.29%	10.06	100.60%	7.55	7.57	99.74%	1.431	101.27%	104.90	104.90%
08/04/11	7.00	100.00%	9.97	99.70%	7.25	7.26	99.86%	1.428	101.06%	103.50	103.50%
08/09/11	7.15	102.14%	10.14	101.40%	8.24	8.14	101.23%	1.395	98.73%	102.50	102.50%
08/17/11	6.92	98.86%	9.93	99.30%	8.10	8.04	100.75%	1.423	100.71%	100.30	100.30%
08/22/11	6.96	99.43%	9.97	99.70%	7.72	7.73	99.87%	1.431	101.27%	98.90	98.90%
09/01/11	6.98	99.71%	10.05	100.50%	7.53	7.39	101.89%	1.407	99.58%	100.00	100.00%
09/07/11	7.09	101.29%	10.06	100.60%	8.46	8.46	100.00%	1.399	99.01%	100.69	100.69%
09/14/11	7.03	100.43%	10.21	102.10%	9.56	9.49	100.74%	1.403	99.29%	102.69	102.69%
09/21/11	6.94	99.14%	9.93	99.30%	9.22	9.11	101.21%	1.431	101.27%	106.50	106.50%
09/28/11	7.03	100.43%	10.02	100.20%	9.14	9.22	99.13%	1.403	99.29%	95.90	95.90%
10/11/11	7.05	100.71%	10.02	100.20%	9.39	9.42	99.68%	1.405	99.43%	122.09	122.09%
10/25/11	7.05	100.71%	9.98	99.80%	9.68	9.47	102.22%	1.424	100.78%	109.80	109.80%



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Table C-13. Percent Recovery, Continuous Data, Platte River, Odessa, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
04/20/11	7.10	101.43%	9.82	98.20%	10.40	11.05	94.12%	1.395	98.73%	103.50	103.50%
05/05/11	7.01	100.14%	10.23	102.30%	9.20	9.28	99.14%	1.426	100.92%	121.40	121.40%
05/17/11	6.91	98.71%	10.04	100.40%	9.09	9.22	98.59%	1.412	99.93%	82.50	82.50%
05/24/11	7.05	100.71%	9.95	99.50%	8.65	8.47	102.13%	1.423	100.71%	93.80	93.80%
06/01/11	7.01	100.14%	9.93	99.30%	7.89	7.86	100.38%	1.422	100.64%	107.60	107.60%
06/07/11	6.97	99.57%	9.99	99.90%	7.25	7.37	98.37%	1.432	101.34%	93.20	93.20%
06/14/11	6.98	99.71%	10.01	100.10%	7.69	7.42	103.64%	1.371	97.03%	98.50	98.50%
06/22/11	6.95	99.29%	10.04	100.40%	7.93	8.17	97.06%	1.418	100.35%	103.70	103.70%
06/30/11	7.03	100.43%	9.94	99.40%	7.34	7.67	95.70%	1.424	100.78%	102.00	102.00%
07/05/11	6.95	99.29%	10.00	100.00%	7.50	7.47	100.40%	1.384	97.95%	96.40	96.40%
07/14/11	6.99	99.86%	10.01	100.10%	7.66	7.44	102.96%	1.435	101.56%	103.00	103.00%
07/20/11	7.08	101.14%	9.94	99.40%	6.96	7.01	99.29%	1.398	98.94%	103.20	103.20%
07/28/11	7.07	101.00%	9.99	99.90%	7.32	7.45	98.26%	1.427	100.99%	106.20	106.20%
08/04/11	6.97	99.57%	10.06	100.60%	7.50	7.54	99.47%	1.422	100.64%	101.60	101.60%
08/08/11	6.96	99.43%	9.99	99.90%	7.31	7.37	99.19%	1.417	100.28%	100.20	100.20%
08/16/11	6.99	99.86%	10.00	100.00%	7.58	7.62	99.48%	1.408	99.65%	98.30	98.30%
08/21/11	7.02	100.29%	9.98	99.80%	7.70	7.69	100.13%	1.425	100.85%	99.70	99.70%
08/31/11	6.93	99.00%	10.02	100.20%	7.26	7.23	100.41%	1.409	99.72%	110.70	110.70%
09/06/11	7.08	101.14%	10.07	100.70%	8.30	8.31	99.88%	1.404	99.36%	101.50	101.50%
09/14/11	7.01	100.14%	10.02	100.20%	8.90	8.95	99.44%	1.412	99.93%	104.20	104.20%
09/20/11	6.89	98.43%	10.01	100.10%	8.50	8.57	99.18%	1.418	100.35%	92.80	92.80%
09/27/11	7.03	100.43%	9.97	99.70%	8.09	8.08	100.12%	1.417	100.28%	109.90	109.90%
10/11/11	7.02	100.29%	10.04	100.40%	9.21	9.32	98.82%	1.398	98.94%	122.30	122.30%
10/25/11	6.98	99.71%	10.03	100.30%	10.74	10.28	104.47%	1.422	100.64%	109.10	109.10%



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Table C-14. Percent Recovery, Continuous Data, Kearney Canal Powerhouse, Kearney, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/05/11	7.19	102.71%	10.27	102.70%	8.16	8.57	95.22%	1.412	99.93%	117.19	117.19%
05/17/11	6.98	99.71%	10.06	100.60%	8.86	8.82	100.45%	1.405	99.43%	83.09	83.09%
05/24/11	6.96	99.43%	9.93	99.30%	8.08	8.01	100.87%	1.428	101.06%	98.19	98.19%
06/01/11	7.01	100.14%	9.97	99.70%	7.70	7.79	98.84%	1.441	101.98%	102.80	102.80%
06/07/11	7.00	100.00%	9.94	99.40%	6.95	6.73	103.27%	1.421	100.57%	102.09	102.09%
06/15/11	7.09	101.29%	10.15	101.50%	7.98	7.69	103.77%	1.356	95.97%	97.19	97.19%
06/22/11	7.00	100.00%	9.97	99.70%	7.80	8.00	97.50%	1.412	99.93%	101.59	101.59%
06/29/11	6.96	99.43%	9.93	99.30%	7.31	7.44	98.25%	1.427	100.99%	102.90	102.90%
07/06/11	7.11	101.57%	10.14	101.40%	8.26	8.26	100.00%	1.401	99.15%	97.80	97.80%
07/14/11	6.90	98.57%	9.88	98.80%	7.63	7.31	104.38%	1.437	101.70%	99.59	99.59%
07/21/11	7.09	101.29%	10.10	101.00%	7.87	7.69	102.34%	1.405	99.43%	107.40	107.40%
07/29/11	7.01	100.14%	10.00	100.00%	7.58	7.44	101.88%	1.421	100.57%	106.90	106.90%
08/04/11	6.98	99.71%	9.96	99.60%	7.40	7.40	100.00%	1.422	100.64%	96.90	96.90%
08/09/11	7.11	101.57%	10.13	101.30%	7.94	7.94	100.00%	1.404	99.36%	106.30	106.30%
08/17/11	6.92	98.86%	9.96	99.60%	7.96	7.95	100.13%	1.421	100.57%	94.00	94.00%
08/22/11	6.96	99.43%	9.93	99.30%	7.65	7.59	100.79%	1.428	101.06%	101.50	101.50%
09/01/11	6.90	98.57%	9.93	99.30%	7.27	7.12	102.11%	1.417	100.28%	104.30	104.30%
09/07/11	7.09	101.29%	10.09	100.90%	8.25	8.33	99.04%	1.389	98.30%	99.59	99.59%
09/14/11	7.09	101.29%	10.22	102.20%	9.92	10.00	99.20%	1.411	99.86%	105.00	105.00%
09/21/11	7.11	101.57%	9.89	98.90%	9.18	8.97	102.34%	1.412	99.93%	96.30	96.30%
09/28/11	6.44	92.00%	9.53	95.30%	8.75	8.61	101.63%	1.412	99.93%	97.69	97.69%
10/11/11	7.23	103.29%	10.19	101.90%	9.19	9.25	99.35%	1.405	99.43%	120.00	120.00%
10/26/11	7.05	100.71%	10.07	100.70%	11.15	11.12	100.27%	1.413	100.00%	112.00	112.00%



Precision, Duplicate Discrete Water Quality Data, Relative Percent Differences



PRRIP – FINAL

Table C-15. Duplicate Water Quality RPDs, Discrete Data, Suspended Sediment Concentration, (Platte River, Elm Creek, Kearney Canal), NE

Date	Location	Concentration, ppm	RPD
05/06/11	DUP	1.56	60.09%
	KCDIV	2.90	
05/18/11	DUP	6.66	147.52%
	KCPH	44.10	
05/25/11	DUP	114.48	150.15%
	LEXPR	16.30	
05/31/11	DUP	29.52	60.66%
	KCDIV	15.78	
06/08/11	DUP	75.63	45.15%
	KCPH	47.77	
06/15/11	DUP	165.01	3.06%
	KCPH	170.13	
06/23/11	DUP	63.18	2.02%
	LEXPR	64.47	
06/29/11	DUP	162.67	4.28%
	ELMCR	155.86	
07/06/11	DUP	172.21	9.04%
	KCPH	188.51	
07/14/11	DUP	681.54	24.60%
	KCDIV	532.23	
07/21/11	DUP	16.01	170.75%
	ELMCR	202.94	
07/29/11	DUP	55.54	29.84%
	KCDIV	41.12	
08/04/11	DUP	306.73	145.47%
	KCDIV	48.42	
08/09/11	DUP	115.84	62.89%
	KCPH	222.10	
08/17/11	DUP	0.00	200.00%
	ELMPR	17.75	
08/22/11	DUP	0.00	200.00%
	KCDIV	18.07	
09/01/11	DUP	23.84	77.48%
	KCDIV	53.99	
09/07/11	DUP	1.91	200.00%
	KCDIV	0.00	
09/15/11	DUP	14.77	55.97%
	LEXPR	26.25	
09/21/11	DUP	61.00	4.83%
	KCDIV	64.02	
09/28/11	DUP	3.33	--
	KCPH	NS	
10/11/11	DUP	21.84	58.31%
	KCDIV	11.98	
10/25/11	DUP	34.70	16.91%
	KCPH	41.11	

*NS – No Sample



APPENDIX D

Photo Log



1. Manta 2 deployment into the Kearney Canal downstream of the diversion.



2. Manta 2 sampling location in the Kearney Canal downstream of the diversion near Elm Creek, NE.



3. Manta 2 deployment into Elm Creek near the confluence with the Platte River.



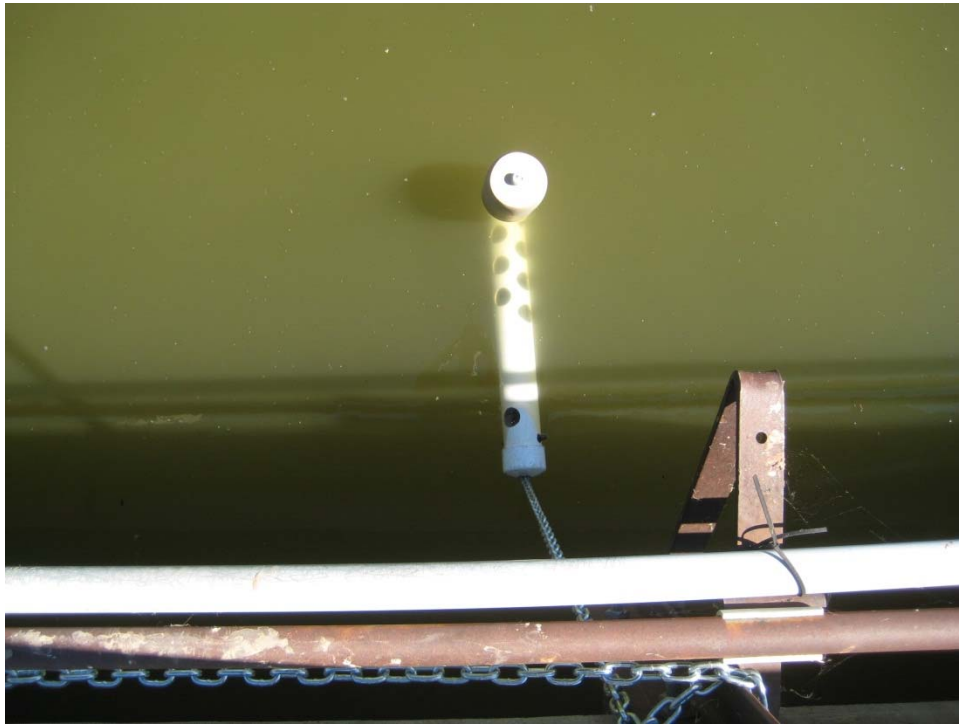
4. Manta 2 sampling location in Elm Creek near the confluence with the Platte River near Elm Creek, NE.



5. View of the confluence with the Platte River looking north upstream of Elm Creek at the Manta 2 sampling location.



6. Manta 2 sampling location in the Kearney Canal upstream of the Kearney Hydro in Kearney, NE.



7. Log chain attachment to the 19th Street bridge at the entrance of the Kearney Country Club upstream of the Kearney Hydro in Kearney, NE.



8. Detritus/trash accumulation on the Manta 2 deployed in the Kearney Canal upstream of the Kearney Hydro in Kearney, NE.



9. Biofouling of the Manta 2 deployed in the Kearney Canal downstream of the diversion near Elm Creek, NE.



10. Suspended Sediment sampling in the Kearney Canal downstream of the diversion near Elm Creek, NE.



APPENDIX E

Field Data Sheets (CD only)

APPENDIX F

Raw Water Quality Data (CD only)

APPENDIX G

Flow Data (CD only)

Appendix C: 2012 Water Quality Report



PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Annual Data Summary Report

**Kearney Canal Water Quality
2012 Monitoring Season**

Final

September 2013

Submitted to:

Platte River Recovery Implementation Program
4111 4th Avenue, Suite 6
Kearney, NE 68845

Submitted by:

EA Engineering, Science, and Technology, Inc.
221 Sun Valley Blvd, Suite D
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Appendices

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Appendix F – Raw Water Quality Parameter Data (CD only)
Appendix G – Flow Data (CD only)



I. INTRODUCTION

The Platte River Recovery Implementation Program (Program) was initiated on January 1, 2007 between Nebraska, Wyoming, Colorado, and the Department of the Interior to address endangered species issues in the central and lower Platte River Basin. The species considered in the Program, referred to as “target species”, are the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), interior least tern (*Sterna antillarum*), and pallid sturgeon (*Scaphirhynchus albus*).

EA Engineering, Science, and Technology, Inc. (EA) was contracted by the Program to develop the Kearney Canal Water Quality Monitoring Protocol [(Protocol) PRRIP 2010] that provided the guidance for water quality monitoring for the Kearney Canal. The Protocol was implemented in 2011. In 2012, EA developed a Protocol Addendum (PRRIP 1012a) and an Annual Water Quality Monitoring Plan (PRRIP 2012b) and conducted water quality monitoring in 2012. This report presents the results of the water quality monitoring for the 2012 monitoring season (September 13 through October 24). Data collected included stage/discharge, five water quality parameters (temperature, turbidity, dissolved oxygen, pH, and specific conductance), and representative water quality samples for suspended sediment concentration (SSC) analysis. The project team was comprised of the Program, EA, and the Nebraska Public Power District (NPPD).

I.A. Purpose

The purpose of the project is to monitor suspended sediments and water quality at locations on the Platte River, Elm Creek, and Kearney Canal to determine if Program activities alter suspended sediment concentrations in the Kearney Canal.

The Protocol defined the data collection procedures to obtain scientifically credible data in order to:

- Monitor the Platte River, Elm Creek, and Kearney Canal to obtain data on suspended sediment concentrations.
- Sample and analyze weekly grab samples for suspended sediment concentration.
- Determine spatial variations in water quality between the Platte River, Elm Creek, and Kearney Canal.

Implementation of the Protocol included:

- Collection and evaluation of data.
- Summarization of results.
- Statistical analysis of possible variation of water quality by Program actions.
- Development of recommendations for subsequent water quality monitoring and/or research.



I.B. Program Activities

The Program completed two major events in the Central Platte River that required monitoring of the Kearney Canal in 2012 (Figure 1).

- Sediment Augmentation – Dyer Property. Action performed from September 26 through November 30, 2012 upstream of the Overton monitoring location. Augmentation material was produced by establishing a sand pumping operation at an existing sand pit on the Dyer property. The sand pumping operation produced augmentation material that was pumped to an active river channel for disbursement.
- Sediment Augmentation – Cottonwood Ranch. Action performed from September 17 through November 8, 2012 upstream of the Odessa monitoring location. Augmentation material was produced by mechanical placement of existing material located on high sand bar areas within the river channel into active flowing areas within the Platte River channel.

II. METHODS AND PROCEDURES

The Kearney Canal water quality monitoring program was designed to document water quality, detect water quality trends, and obtain representative samples for suspended sediment concentrations. The area of interest includes a reach of the Platte River from Lexington to Odessa, Elm Creek just to the west of the Kearney Canal Diversion, and the Kearney Canal from the diversion to the Kearney Hydro (Figure 1). Water quality was measured using *in-situ* continuous water quality sondes, water samples collected for suspended sediment analyses, and discharge measurements obtained from established gaging stations. Photographs of the field work are included in Appendix D.

II.A. Monitoring Locations

Monitoring locations on the Platte River, Elm Creek, and Kearney Canal were selected to determine if Program activities are impacting suspended sediment concentrations at the NPPD Kearney Hydro. Monitoring locations on the Platte River included the existing Program Water Quality Monitoring Protocol sondes at Lexington, Overton, and Odessa. An additional Kearney Canal study sonde was deployed in the Platte River from the Highway 183 Bridge south of Elm Creek, Nebraska. No existing stream gaging station exists at this location.

A sonde was deployed in Elm Creek upstream of its confluence with the Platte River and the Kearney Canal. Sondes on the Kearney Canal were located based upon accessibility to bridges across the canal including one just upstream of the Canal Parshall flume, located downstream of the Platte River diversion, and one upstream above the Kearney Hydro. The monitoring locations are listed in Table 1 and illustrated in Figure 1.


Table 1. Spatial Monitoring Matrix

Monitoring Location No.	Locations	Discharge	Water Quality	Analytical
1	Platte River near Lexington, NE	NDNR	EA	EA
2	Platte River near Overton, NE	USGS	EA	EA
2	Platte River near Elm Creek, NE	N/A	EA	EA
3	Elm Creek near confluence with the Platte River south of Elm Creek, NE	N/A	EA	EA
4	Kearney Canal downstream of the diversion south of Elm Creek, NE	NDNR	EA	EA
5	Platte River near Odessa, NE	NDNR	EA	EA
6	Kearney Canal near the Kearney Hydro in Kearney, NE	N/A	EA	EA

Notes:

NDNR – Nebraska Department of Natural Resources

USGS – United States Geological Survey

EA – EA Engineering, Science, and Technology, Inc.

Table 2. Monitoring Location Identification

Monitoring Location No.	Locations	Identification
1	Platte River near Lexington, NE	LEXPR
2	Platte River near Overton, NE	OVRPR
3	Platte River near Elm Creek, NE	ELMPR
4	Elm Creek near confluence with the Platte River south of Elm Creek, NE	ELMCR
5	Kearney Canal downstream of the diversion south of Elm Creek, NE	KCDIV
6	Platte River near Odessa, NE	ODSPR
7	Kearney Canal near the Kearney Hydro in Kearney, NE	KCPH

II.B. Parameters of Interest

Water quality data was categorized into three groups:

- **Discharge** – Discharge and river stage or gage height were collected. Existing gaging stations maintained by the United States Geological Survey (USGS) and Nebraska Department of Natural Resources (NDNR) were used where possible. Gaging stations were not installed or maintained under the Program.
- **Continuous Water Quality Monitoring** – Continuous water quality data were collected for water temperature, turbidity (optical sensor), dissolved oxygen by optical and



Luminescent Dissolved Oxygen (LDO)) technology, pH, and specific conductance. Data were logged at set intervals and downloaded at regular intervals.

- **Discrete Water Quality Monitoring** – Representative and discrete water samples were collected by EA and analyzed by Ward Laboratories, Inc. Samples were analyzed for suspended sediment concentration.

II.B.1. Frequency and Duration

The frequency and duration of data collection for summarization and evaluation was based upon the time period for completion of Program actions in 2012. The water quality monitoring index period for one-week pre- and post- Program activities in 2012 was September 10 through December 6, 2012. Water quality monitoring data sondes were deployed on September 13 and maintained until the Kearney Canal flows stopped on October 24, 2012.

- **Discharge**
 - Existing gaging stations on the Platte River are operated continuously by the USGS and NDNR. Discharge on the Kearney Canal was obtained from an existing NPPD gaging station maintained by the NDNR. Discharge was estimated by the agencies using rating curves at these stations. A data point was collected every 15 minutes at the USGS gaging station located at Overton and every 30 minutes at the NDNR gaging stations at Lexington, Odessa, and the Kearney Canal.
- **Continuous Water Quality Monitoring**
 - EA installed sondes for the Kearney Canal water quality monitoring at four locations including the Highway 183 Bridge south of Elm Creek, Kearney Canal immediately upstream of the canal's Parshall flume, upstream of the Kearney Hydro in Kearney at the Kearney Country Club, and Elm Creek near its confluence with the Platte River. EA also provided operation and maintenance from September 13 through October 24, 2012. Sondes previously installed on the Platte River at Lexington, Overton, and Odessa provided data for the same time period. A data point was collected every 30 minutes.
 - Operation and maintenance of the sondes (including downloading of data) was conducted weekly from September through October as seen in Table 3.



Table 3. Dates of Major Events; Dates and Location of Operation and Maintenance Events (2012)

Date	Sites
September 13	Odessa, Overton, Platte River at Elm Creek, Kearney Canal at Power House
September 14	Kearney Canal Diversion, Elm Creek
September 17	Cottonwood Ranch Sediment Augmentation Initiated
September 19	Odessa, Overton
September 20	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Power House
September 26	Dyer Property Sediment Augmentation Initiated
September 26	Odessa, Overton
September 27	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Power House
October 2	Odessa, Overton
October 4	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Power House
October 11	Odessa, Overton
October 12	Kearney Canal Diversion, Platte River at Elm Creek, Kearney Canal at Power House
October 17	Odessa, Overton, Kearney Canal at Power House
October 24	Overton
October 24	Kearney Canal De-Watered, sondes removed
November 8	Cottonwood Ranch Sediment Augmentation End
November 30	Dyer Property Sediment Augmentation End

- **Discrete Water Quality Monitoring**

- The index period for the collection of discrete water quality data was determined by the Program actions initiated the week of September 17 and NPPD's Kearney Canal cessation of operations; which occurred October 24, 2011.
- Representative water samples for analytical analysis of SSC were collected weekly at five monitoring locations listed in Table 4 during maintenance activities of the sondes.



Table 4. Date and Location of Discrete Water Quality Sampling Events (2012)

Date	Sample Locations and Sonde Activity
September 13	Sondes deployed in Kearney Canal
September 20	Sample - LEXPR, ELMPR, ELMCR, KCDIV, KCPH
September 27	Sample - LEXPR, ELMPR, ELMCR, KCDIV, KCPH
October 4	Sample - LEXPR, ELMPR, ELMCR, KCDIV, KCPH
October 12	Sample - LEXPR, ELMPR, ELMCR, KCDIV, KCPH
October 18	No samples collected
October 24	Sondes Removed from Kearney Canal

II.C. Discharge and River Stage

Platte River discharge measurements were obtained from existing gaging stations maintained by the USGS and NDNR (Table 1). Discharge was estimated using rating curves maintained by the owning agencies. Periodic measurements of the depth and flow rate by the respective agencies are used to adjust the rating curves as needed.

II.D. Continuous Water Quality Monitoring

Two different manufactures of sondes were used to collect water quality data. The sondes collect the same data but were purchased at different times. The Hydrolab MS-5 data sondes were purchased utilizing a grant from the Nebraska Department of Environmental Quality (NDEQ). The Eureka Manta 2 Sondes are owned by the Program and were purchased for the Kearney Canal water quality monitoring. The existing Hydrolab sondes at Overton and Odessa, installed as part of the Platte River monitoring program, were used for the Kearney Canal water quality monitoring. The Eureka Manta 2 sondes were deployed at four locations including the Platte River Highway 183 Bridge south of Elm Creek, Kearney Canal immediately upstream of the canal's Parshall flume, upstream of the Kearney Hydro in Kearney at the Kearney Country Club, and Elm Creek near its confluence with the Platte River. The data and units of measure collected are listed in Table 5.

**Table 5. Continuous Water Quality Parameters**

Water Quality Parameter	Unit	Range	Accuracy	Resolution
Hydrolab MS-5				
Temperature	Degrees Celsius	-5 to +50°C	± 0.10 °C	0.01 °C
Turbidity	Nephelometric Turbidity Units	0 to 3,000 NTU	± 1% up to 100 NTU ± 3% up to 100–400 NTU ± 5% from 400–3,000 NTU	0.1 NTU from 0-400 NTU 1 NTU for >400-3,000 NTU
Luminescent Dissolved Oxygen	mg/L	0 to 30 mg/L	± 0.01 mg/L @ ≤ 8 mg/L ± 0.02 mg/L @ > 8 mg/L	0.01 or 0.1 mg/L
pH	Standard Units	0 to 14 units	± 0.2 units	0.01 units
Specific Conductance	mS/cm	0 to 100 mS/cm	± 1% of reading; + 0.001 mS/cm	0.0001 mS/cm
Eureka Manta 2				
Temperature	Degrees Celsius	-5 to +50°C	± 0.10 °C	0.01 °C
Turbidity	Nephelometric Turbidity Units	0 to 3,000 NTU	0-100 < 1% of reading 100-400 < 3% of reading over 400 < 5% of reading	0.1 NTU
Dissolved Oxygen	mg/L	0 to 25 mg/L	1% of reading or 0.02 mg/L, whichever is greater	± 0.01 mg/L
pH	Standard Units	0 to 14 units	± 0.2 units	0.01 units
Specific Conductance	mS/cm	0 to 100 mS/cm	1% of reading ± 1 count	0.1 mS/cm

II.D.1. Continuous Water Quality Sonde Installation

Prior to installation, each sonde was calibrated following the manufacturer's specification using calibration standards, as documented on the field data sheets (Appendix E). The sondes on the Platte River were suspended on the downstream side of bridges at selected monitoring locations. The sondes on the Kearney Canal were suspended on the downstream side of bridges; one off the 19th Street Bridge in Kearney at the entrance to the Kearney Country Club and the second off of an aluminum foot bridge used by NPPD staff upstream of the Parshall flume. An alternative method was used to deploy a sonde on Elm Creek due to the unavailability of a bridge for use in the target location. Access was granted by private landowners to construct a cable system across the creek just south of Interstate 80. Field staff used anchored wood fence post, ¼-inch cable, adjustable turn buckles and pulleys to hang the sonde in the center of the creek; allowing for the capability to pull the cable through the pulleys in order to retrieve the sonde for downloading and maintenance.



The sondes, which include the data logger and battery source, were housed in a section of PVC pipe (casing) for protection from floating debris and tethered to bridge railings or cable using heavy duty chain. The sonde was locked to the end of the chain and inserted into the casing. The cap for the casing had an opening large enough for the chain to pass through. The casing was attached to the chain by drilling a hole near the top of the casing and inserting a bolt through the casing, passing through the chain; eliminating stress to the sonde anchor point created by flowing water. The submerged section of the casing containing the sonde was slotted and/or perforated with circular holes, and the bottom was open to prevent sediment accumulation. A second bolt was placed at the bottom of the casing to prevent the sonde from falling through the casing. A football-sized float was attached to the bottom of the casing to keep the sonde suspended just below the water surface (approximately 6 inches) and minimize sedimentation of the sonde during decreasing flows and channel meandering. Sondes were retrievable for maintenance and data transfer by pulling up the chain to the bridge deck. Flagging tape was placed every 5 feet on the chains that were deployed from Platte River bridges to enhance visibility. The heavy duty chain was attached to the bridge by wrapping the chain around the railing and locking the chain to itself at four of the Platte River monitoring locations (Lexington, Overton, Elm Creek at Highway 183 bridge, and Odessa) and on the Kearney Canal off the 19th Street Bridge. At the Kearney Canal, downstream of the diversion, the sonde was attached by a cable that ran through a support brace on the aluminum bridge to an earth anchor in the bank. The Elm Creek sonde was retrieved through a cable system that allowed field staff to pull the sonde to the stream bank.

Flows on the Platte River ranged from low to none (dry) during the monitoring period. No flow or flow too low for water quality monitoring was present at the Lexington location during the monitoring period and a sonde was not deployed at this location. Very low flow resulted in the temporary removal of the sonde from the Platte River at Odessa from October 2 to October 11. Malfunctioning data sondes resulted in the temporary removal of sondes at the Kearney Canal diversion from October 4 to 12 and Elm Creek at Elm Creek from October 12 and not reinstalled because of no water in Elm Creek. Sondes were deployed continuously for the monitoring period at Overton, Platte River at Elm Creek, and Kearney Canal Hydro.

II.D.2. Continuous Water Quality Sonde Operation and Maintenance

Operation and maintenance was performed weekly which included data transfer and calibration of the sondes. During these visits, hand-held water quality meter measurements, sonde calibration records, and data transfer notes were recorded on the field data sheets.

Calibration, maintenance, and data transfer was completed based upon manufacturer's directions. Data was downloaded from the sonde to a field laptop onsite before the recorded data exceeded the memory capacity or battery life of the sonde. Files were named by location as listed in Table 2, followed by numerical year, month, and day of data transfer (e.g., KCPH25MAY). To ensure file integrity and provide backup, all files were saved to the laptop hard drive and a portable USB jump drive while in the field. Following the transfer process, files were opened and reviewed to ensure successful transfer of all data before creating a new log file in the sonde. The downloaded data were reviewed in the field for missing data, outlier data, and logging errors so



corrections could be made immediately, if needed. A field data sheet was filled out for each monitoring location visit to document activities related to sonde maintenance, calibration, setup, and data transfer.

The processes for maintenance, data transfer, and calibration of the sondes are listed below:

- **Measurement Using Hand-Held Meter** – Prior to retrieval of data from the sondes, the field crew collected and recorded duplicate water quality parameters using hand-held water quality meters (YSI-556). A handheld barometric meter was used to collect site and time specific barometric pressure for calibration purposes.
- **Continuous Water Quality Sonde QA/QC** – Duplicate and known (spiked) parameter readings were taken for QC purposes. Duplicate water quality readings were collected by submerging hand-held meter probes in a 5-gallon bucket next to the sonde probes that were set to display real time readings; these values were recorded. Measurements of known (spiked) calibration standards were taken with the sonde during each maintenance visit to assess drift and/or accuracy of the sonde during the monitoring season. These QC measurements were recorded on the field data sheets.
- **Download Data From Continuous Sonde** – The field crew downloaded the data from the sonde to a laptop computer and a portable USB jump drive.
- **Review Continuous Water Quality Data** – After data transfer, data files were opened and reviewed for general data quality (i.e., proper logging interval, abnormal or missing data, data outliers, and missing parameters). If data recording issues were present, the deficiency was documented, the sonde adjusted/repared, and the corrective action documented.
- **Re-deploy the Sonde** – As a final step, the field crew cleaned and calibrated the sonde following the manufacturer's specification using calibration standards, and the calibration documented. The documentation included the drift of actual reading from the calibrated reading. Once calibrated, the datalogger was turned on and the sonde was re-deployed.

II.D.3. Hand-Held Water Quality Instrument Operation

As part of Quality Assurance (QA) and Quality Control (QC), a second set of hand-held water quality instruments (capable of reading temperature, dissolved oxygen, pH, specific conductance, and turbidity) were calibrated and maintained to enable the collection of duplicate water quality parameters during each site visit. Manufacturer directions for operation, calibration, and maintenance were followed and documented on the field data sheets. These instruments were calibrated at the beginning of each field day prior to monitoring.

The hand-held meter that was used for calibrating specific conductance was designated for checking the accuracy of the water temperature probe. The hand-held meter was checked for



accuracy to a mercury-in-glass calibration thermometer that is traceable to the National Institute of Standards and Technology (NIST) certification of its accuracy (Service ID Number 31010C; NIST 1988). A hand-held barometer was also used to collect barometric pressure.

II.E. Discrete Water Quality Monitoring

II.E.1. Discrete Water Sample Collection

Representative water samples were collected for analytical analysis of SSC. One grab sample was collected at two locations on the Platte River (Lexington and Highway 183 Bridge at Elm Creek) and at each location on Elm Creek and Kearney Canal in which sondes were deployed. Collection of the water sample occurred during maintenance of each sonde. The following procedures were used to collect representative samples using one of two methods during the discrete sampling events.

If water depth was shallow enough to wade:

- Sampler entered the water and stood downstream and within arm's reach of the data sonde.
- After all disturbed sediments were washed away from the sonde, the sample container was submerged to the depth of the sonde probes, permitted to fill, removed and capped.
- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory.

If water depth was too deep to safely wade:

- A Van Dorn water bottle was lowered into the river/canal from the bridge and permitted to float downstream and adjacent to the sonde for sample collection.
- The water bottle was tripped via a messenger and the sampler retrieved to the bridge deck.
- The water was swirled in the water bottle and then discharged into a sample container.
- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory.

II.E.2. Analytical Method

The analytical method, required containers, volume, preservative, and holding times for the SSC samples are listed in Table 6.



Table 6. Discrete Sampling Handling and Analytical Methods

Analyte	Method	Sample Container	Reporting Limit	Preservation
Suspended Sediment Concentration	ASTM D3977-97	250 mL Plastic	1 mg/L	Cool, 4°C

II.E.3. Sample Labels

Every sample collected and submitted for analysis had a sample label uniquely identifying the sample and listing the parameters to be analyzed. Each label included the following information:

- Submitted by – EA Engineering
- Sample identification code – e.g., KCPH25MAY
 - Samples from the monitoring locations were identified as follows:

Table 7. Discrete Sampling Locations and Identification

Water body	Sonde Location	Location Identification
Platte River	Lexington	LEXPR
Platte River	Highway 183 bridge south of Elm Creek	ELMPR
Elm Creek	Near confluence with Platte River south of I-80	ELMCR
Kearney Canal	Downstream of the diversion	KCDIV
Kearney Canal	Upstream of the Kearney Hydro	KCPH

- Sample date for all samples (military format)
- Sample times for all samples (military format)
- Sample type (e.g. water)
- Samplers' initials

II.E.4. QC Sample Collection and Documentation

A duplicate water sample was collected at one randomly selected site during each discrete water quality sampling event. Duplicate samples were labeled as “DUP” followed by day and month sampled (e.g., DUP25MAY). An arbitrary sample time was placed on the container label and chain-of-custody form delivered to the laboratory so that it did not indicate which location the duplicate was taken. The actual location and sample time were recorded on the chain-of-custody copy received by EA staff after the samples were delivered to the laboratory.

- For wadeable duplicate collections, paired sample bottles were submerged to fill two sample containers simultaneously. For the collections from deep water, the Van Dorn water bottles contained adequate water to fill two sample containers – parent sample and a duplicate.



- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory. Duplicate samples were processed in the same manner as the environmental samples.

II.E.5. Chain-of-Custody

Every suite of samples collected was tracked and documented through a chain-of-custody record supplied by Ward Laboratories, Inc. A chain-of-custody was completed as samples were collected and was submitted with the samples. Each chain-of-custody record included the following:

- Submitted by – EA Engineering
- Sample identification code – e.g., ELMCR25MAY
- Sample date for all samples (military format)
- Sample times for all samples (military format)
- Sample type (e.g. water)
- Required analysis for containers
- Sampler signature for sample collection
- Signature, date, and time relinquished

II.E.6. Field Book

The following information was documented in the field book or on the field data sheets:

- Date of sampling
- Field crew member names
- Location and sampling beginning and ending time
- Samples collected/work performed in field
- The rationale for choosing each composite location during discrete water sampling
- Duplicates or blanks collected with the location and sampling time
- Weather and site conditions
- Any irregularities encountered and lessons learned during the field effort

II.E.7. Sample Control and Handling

Sample control and custody are critical to maintaining sample integrity for analysis and was achieved by tracking samples from time of collection to time of analysis. The following procedures were followed to maintain sample integrity:

- The sample containers were appropriately labeled and filled with a representative composite or grab water samples.
- The containers were placed in a zip-seal bag in an upright position in a cooler containing ice. The field crew kept the cooler out of direct sunlight and secured in the vehicle to



prevent loss of samples/cooler.

- After all samples were collected, the sample containers were cross-checked with the chain-of-custody to ensure required sample information matches.
- Samples were delivered directly to the laboratory

III. DATA SOURCE SUMMARY

The monitoring season for the 2012 Kearney Canal water quality monitoring program was initiated the week of September 13, 2012 and completed the week ending October 26, 2012. Water quality was monitored at six locations, including the existing Platte River baseline water quality sondes at Overton, and Odessa (Figure 1). A water quality sonde was scheduled for deployment at Lexington for the Platte River water quality monitoring, however very low flows prevented the deployment of a sonde at this location in 2012.

III.A. Data Obtained from USGS

The USGS maintains the National Water Information System (NWIS) website that provides access to water data for locations throughout the United States. EA accessed the USGS website on a monthly basis from September through October to download stage/discharge data from a gaging station located on the Platte River for Overton (06768000). Data that was obtained from USGS is considered provisional data and is subject to revision.

III.B. Data Obtained from NDNR

NDNR collects and reports flow data for streams, canal and pump diversions, and storage in reservoirs at locations throughout Nebraska. The data is gathered through Field Offices and the program is coordinated through NDNR's Planning and Assistance Division. EA utilized information from two gaging stations located on the Platte River near Lexington (228400) and Odessa (6770000) and from two gaging stations located on the Kearney Canal one downstream of the diversion (73000) and one downstream of the hydro (75000). Data was collected and provided to EA in 30 minute increments. Data that was obtained from NDNR is considered provisional data and is subject to revision.

III.C. Data Collected by EA

EA continued to maintain previously installed Hydrolab MS5s and installed Eureka Manta 2 sondes, initiating data collection September 13 and 14, 2012. Temperature, pH, dissolved oxygen, specific conductance, and turbidity data were collected at 30-minute intervals. Grab water samples were collected at five monitoring locations 4 times during the monitoring season for suspended sediment analyses.

As part of the data summarization process it was necessary to determine if water quality data collected was representative of river conditions. The field data sheets were reviewed to identify



variables which may have affected data quality. Several conditions were recorded that may have affected the sondes ability to collect representative water quality data. Issues which affected water quality data and were evident in the water quality values logged include:

- The measurement cell on the specific conductance probes was filling with sediments and/or air bubble(s) at the electrodes; decreasing the functionality of the probe resulting in depressed specific conductance readings.
- Aquatic insects of the Order Trichoptera colonized the probes affecting pH, specific conductance, dissolved oxygen, and turbidity.
- Parameter-specific probes on the sondes would malfunction or fail resulting in missing data.
- On two occasions a data sonde experienced intermittent loss of power resulting in periods of no water quality data recorded.

Further discussions on the variables affecting water quality data are presented in Appendix C.

III.D. Data Quality Control Summary

The Quality Control Summary describes the results of the data quality evaluation performed on the water quality parameters collected during the 2012 monitoring season. Data quality for the 2011 water quality monitoring year was evaluated in its respective “Annual Data Summary Report” (PRRIP 2012). Data collected in 2012 included: temperature, specific conductance, pH, turbidity, dissolved oxygen, discharge, and total suspended solids. Overall the quality of the Kearney Canal water quality data collected was found to be of sufficient quality to characterize the water quality during the monitoring period. The quality of the data collected and analyzed was assessed using the elements of precision, accuracy, representativeness, completeness, and comparability. Results of the Data Quality Control Summary are presented in Appendix C.

IV. DATA SUMMARY

Summary statistics were completed following data review to ensure that summarized data was representative of water quality in the central Platte River and the Kearney Canal. The 2012 action-based water quality summary statistics were calculated for the index period of September 13 to October 24. This period is inclusive of the implementation of Platte River Program actions on September 17 and extends until diversions to the Kearney Canal stopped on October 24. Kearney Canal water quality data collected in 2011 was indexed from September 13 through October 24, 2011 for inter-year comparisons. All data were loaded into a Microsoft® Access 2010 database to generate summaries and queries for further analysis. Additional summaries, graphics, and statistical analyses were performed using R statistical software (<http://www.r-project.org/>) or Microsoft® Excel 2010. Summarization included tabular presentation of weekly and monthly observations (number (N), mean, maximum, minimum, and standard deviation) for each parameter. Graphs were generated to present observed temporal and spatial variations. Index period summary statistics for 2011 and 2012 are presented in Appendix A. Raw water quality and flow data from the 2012 monitoring year are presented on a CD referenced in



Appendix F and G. Raw water quality and flow data for the 2011 monitoring year are presented in “Annual Data Summary Report – Kearney Water Quality Monitoring” (PRRIP 2012).

IV.A. 2012 Variations (intra-year)

Variations in the 2012 water quality data (daily means) were evaluated after raw data had been reviewed to ensure that the data was representative of water quality in the central Platte River, Elm Creek, and Kearney Canal. Data was assessed for temporal and spatial variations in context to Platte River Program actions.

IV.A.1. Temporal Variation

Temporal variation of water quality parameters were assessed using line graphs showing all monitoring locations (i.e., X-axis presents time, Y-axis presents parameter value) and are presented in Appendix B, Figures B-1 through B-6. The very low to no flow at Lexington precluded the deployment of the water quality data sondes and no water quality data were collected at that location in 2012.

- **Temperature** – Water temperature during the monitoring season exhibited the same seasonal temporal trend at the six monitoring locations. Water temperatures trended downward from when the monitoring program was initiated (mid-September) with the onset of fall and cooler air temperatures. Kearney Canal and Platte River water temperature displayed no evidence of temporal variation as a result of Program-actions.
- **Specific Conductance** – Specific conductance exhibited no temporal trend at the six monitoring locations during the monitoring season. The daily mean of specific conductance were similar at all locations with the exception of Elm Creek. Specific conductance daily mean at Elm Creek were consistently ~100 mS/cm higher than the other monitoring locations. The higher specific conductance at Elm Creek is a product of the water source and is not the result of Program-actions.
- **pH** – pH at the seven monitoring locations consistently ranged between 7.8 and 9.0 during the index period. Elm Creek pH on average was the lowest and the Kearney Canal Hydro had the highest pH during the index period. Kearney Canal and Platte River water pH displayed no evidence of temporal variation as a result of Program-actions.
- **Turbidity** – Turbidity exhibited no temporal trends at the six monitoring locations; however, daily mean turbidity concentrations varied between the monitoring locations. Turbidity at Elm Creek was consistently higher than the five other monitoring locations. The observed turbidity extremes observed in Elm Creek are a result of Platte River discharge fluctuations (Figure B-6) produced by power generation at Central Nebraska Public Power and Irrigation District (CNPPID) J-2 hydro. During peak power production the resulting high discharges in the Platte River travel upstream into Elm Creek, creating periods of low turbidity in Elm Creek. Likewise, when power production drops, water flows out of Elm Creek into the Platte River, which draws turbid water downstream



creating periods of high turbidity in the creek that are more representative of overall Elm Creek water quality. The operation of the J-2 hydro is discussed in more detail in Section V.B. These events were noted on several occasions by the field crew.

Turbidity at the Kearney Canal hydro was, on average, higher than what was observed at Overton, Platte River at Elm Creek, Kearney Canal Diversion, and Odessa monitoring locations. The Kearney Canal increased in turbidity downstream of the Kearney Canal Diversion, possibly due to several small drains originating from farmed land which drain into the Kearney Canal.

- **Dissolved Oxygen** – The same temporal trend for dissolved oxygen was exhibited at the six monitoring locations during the monitoring season. Daily mean concentrations of dissolved oxygen increased during the index period as water temperatures decreased. That trend follows the inverse relationship between temperature and the solubility of gas in water. Daily mean dissolved oxygen at the Elm Creek monitoring location was more erratic than the other five monitoring locations, which is likely a product of Platte River discharge fluctuations created by J-2 hydro power generation.
- **Discharge** – The Lexington monitoring location exhibited a temporal trend for discharge that was not influenced by J-2 hydro discharge, was not influenced by a precipitation event, and is representative of Platte River discharge. The Overton and Odessa monitoring location discharge exhibit wide fluctuations as a result of J-2 hydro operations. The Kearney Canal diversion and hydro locations exhibit more stable discharges that are controlled by the Platter River diversion structure and the Parshall flume. Kearney Canal and Platte River discharge displayed no evidence of temporal variation as a result of Program-actions.

IV.A.2. Spatial Variation

Spatial variation was assessed using box plots of the water quality parameter values for all monitoring locations (i.e., X-axis presents monitoring location, Y-axis presents parameter value). Box plots present minimum, 25th percentile, median, 75th percentile, and maximum values of the parameter. Box plots for each water quality parameter monitored are presented in Appendix B, Figures B-7 through B-13.

- **Temperature** – No spatial variation was evident in the box plots presenting water temperature at the six monitoring locations. Temperature range (maximum to minimum) observed at the Kearney Canal hydro monitoring location was less than what was observed at the other five locations for the monitoring season.
- **Specific Conductance** – Spatial variation was evident in the specific conductance box plots with the 75th to 25th percentile range and median at Elm Creek higher than that observed at the other five monitoring locations. Specific conductance at Overton, Platte River at Elm Creek, Kearney Canal Diversion and Hydro, and Odessa were similar for



the index period. Kearney Canal and Platte River specific conductance displayed no evidence of spatial variation as a result of Program-actions.

- **pH** – Spatial variation was evident in the pH box plots by monitoring location. The 25th to 75th percentile pH range exhibited at Elm Creek was different and lower than the range observed at the other monitoring locations. The Kearney Canal Hydro had a different and higher 25th to 75th percentile range than the other monitoring locations. The pH ranges observed at Overton, Platte River at Elm Creek, Kearney Canal Diversion and Odessa monitoring locations were similar. Kearney Canal and Platte River pH displayed no evidence of spatial variation as a result of Program-actions.
- **Turbidity** – Spatial variation was evident in the log turbidity box plots (Appendix B, Figure B-11). Turbidity at the Elm Creek monitoring location was higher than the other five monitoring locations. Turbidity at Lexington, Overton, Elm Creek Platte River, Odessa, Kearney Canal Diversion and Hydro was similar. Kearney Canal and Platte River turbidity displayed no evidence of spatial variation as a result of Program-actions.
- **Dissolved Oxygen** – Spatial variation was not evident in the dissolved oxygen box plots. The minimum/maximum dissolved oxygen range at Elm Creek was significantly larger than the ranges at the other monitoring locations, although the 25th to 75th percentile ranges were similar among all six monitoring locations. This high dissolved oxygen range at Elm Creek is a product of J-2 hydro discharge's impact on the creek. Maximum dissolved oxygen was observed at the Elm Creek monitoring location. Kearney Canal and Platte River dissolved oxygen displayed no evidence of spatial variation as a result of Program-actions.
- **Discharge** – Discharge was monitored by NDNR or the USGS at Lexington, Overton, Kearney Canal Diversion, and Odessa monitoring locations during the index period. Discharge was not monitored at Platte River at Elm Creek, Elm Creek, and the Kearney Canal Hydro. Spatial variation is evident in the limited discharge data. The observed range of discharge at the Lexington monitoring location is narrow and indicates that discharge was stable during the monitoring period. The range of discharges at Overton and Odessa are a product of the J-2 hydro power production releases. The Kearney Canal discharge recorded at the flume is narrow as would be accepted for a closed system canal discharge. Kearney Canal and Platte River discharge displayed no evidence of spatial variation as a result of Program-actions.

IV.B. 2011 and 2012 Variations (inter-year)

The 2012 water quality data (daily means) collected during Program-actions on the central Platte River and Kearney Canal were compared to water quality data collected in 2011 (inter-year). Inter-year variations were assessed for temporal and spatial variations due to Program-actions during the index period of September 13 to October 24, 2011 and 2012.



IV.B.1. Inter-year Temporal Variation

Inter-year temporal variation of water quality parameters were assessed using line graphs showing the 2011 data and the Program-action year (2012) data by monitoring locations (i.e., X-axis presents time, Y-axis presents parameter value) and are presented in Appendix B, Figures B-14 through B-19. Deployment of the data sonde at Lexington was not completed in 2012 due to very low to no discharge and no water quality data was collected at this monitoring location.

- **Temperature** – Inter-year water temperature exhibited the same trends at all the monitoring locations. Water temperature decreased from late summer to late fall, as expected. Of note in this series of graphs is the increased range of daily mean water temperature fluctuations evident in 2012 from October 5 to the termination of data collection. This trend is evident at all of the monitoring locations and is not reflective of Program-actions. This fluctuation is more of a product of the very low flows in the Platte River in 2012 (Figure B-19) which represents a smaller volume of water in the river that is more susceptible to daily water temperature extremes.
- **Specific Conductance** – Inter-year specific conductance exhibited similar trends and similar data ranges during the two years at the six monitoring locations. The 2012 specific conductance at Elm Creek was higher than the specific conductance observed in 2011. The 2012 specific conductance variation at the Elm Creek is a product of the drought condition low flows in Elm Creek during the 2012 monitoring period (Photos 7 and 8; Appendix D).
- **pH** – Inter-year pH values exhibited similar trends and similar ranges for the two observation years at the six monitoring locations.
- **Turbidity** – Inter-year 2012 daily mean turbidity concentrations were lower at Overton, Platte River at Elm Creek, Elm Creek, Kearney Canal Diversion, and Odessa monitoring locations than turbidity observed in 2011. Daily mean 2012 turbidity concentration at the Kearney Canal Hydro was similar to turbidity concentrations observed in 2011. The low turbidity concentrations observed in 2012 are a product of very low river flow -- a result of no precipitation events in the Platte River basin due to the drought conditions in 2012.
- **Dissolved Oxygen** – Inter-year dissolved oxygen concentrations exhibited similar ranges for the two observation years at the six monitoring locations. The 2012 dissolved oxygen at Elm Creek displayed concentration fluctuations that were not present in 2011. The fluctuations in the dissolved oxygen at Elm Creek in 2012 are a product of Platte River flows resulting from J-2 hydro production (Figure B-6).
- **Discharge** – Inter-year discharge was not similar for the two observation years at Lexington, Overton and Odessa where the 2012 discharge was less than the 2011 discharge. Discharge at the Kearney Canal diversion was higher in 2011 than what was observed in 2011.



IV.B.2. Inter-year Spatial Variation

Inter-year spatial variation was assessed using boxplots of the water quality parameters' values for all monitoring locations (i.e., X-axis presents monitoring location, Y-axis presents parameter value). Box plots present Platte River, Elm Creek and Kearney Canal water quality data collected in 2011 and 2012 for the 2012 monitoring period of September 13 to October 24. Box plots present weekly minimum, 25th percentile, median, 75th percentile, and maximum values of the parameter. Boxplot figures for each water quality parameter monitored are presented in Appendix B, Figures B-20 through B-25.

- **Temperature** – No spatial variation in water temperature was evident in the boxplots presenting weekly summaries by location at the seven monitoring locations. Temperature ranges (minimum and maximum) observed at the seven locations were essentially the same for 2011 and 2012. Temperature displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **Specific Conductance** – Spatial variation was evident in the boxplots presenting weekly data by location at the seven monitoring locations. The 2012 specific conductance displayed a wider range of data (minimum to maximum) at all of the monitoring locations compared to what was seen in 2011. The increased weekly specific conductance range observed at the monitoring locations is the result of the very low flows in the Platte River and subsequent influence of the J-2 hydro releases. Specific conductance displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **pH** – No spatial variation in pH was evident in the boxplots presenting weekly data by location at the seven monitoring locations. pH ranges (minimum and maximum) observed at the six locations were essentially the same for 2011 and the 2012 Program-action monitoring period. pH displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **Turbidity** – Turbidity variation was evident in the boxplots presenting weekly data by location at the seven monitoring locations. The 2012 weekly turbidity ranges at all of the monitoring locations (minimum to maximum as well as 25th to 75th percentiles) were much wider than those observed in 2011. The larger weekly turbidity ranges observed at the monitoring locations are the result of the very low flows in the Platte River as influenced by J-2 hydro releases. To determine if the observed increase in turbidity ranges observed in 2012 compared to 2011 are a result of Program-actions the data is discussed further and statistically evaluated Section V.
- **Dissolved Oxygen** – No spatial variation was evident in the boxplots presenting weekly data by location at the seven monitoring locations. Dissolved oxygen ranges (minimum to maximum) observed at the six locations were essentially the same. Dissolved oxygen



displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.

- **Discharge** – Discharge variation was evident in the boxplots presenting weekly data by monitoring location at the five monitoring locations where discharge was monitored. The J-2 hydropower cycling by Central Nebraska Public Power and Irrigation district return is discharged to the Platte River upstream of the Overton monitoring location and its effects are evident at Overton and Odessa. The increased boxplot ranges at Overton and Odessa in 2012 are a reflective the J-2 hydro releases and the low baseflow in the Platte River observed in 2012. Discharge at the Lexington monitoring location (upstream of the J-2 hydro) was demonstrably lower in 2012 than 2011. Discharge at the Kearney Canal diversion and hydro were similar to discharge ranges observed in 2011.

IV.C. Suspended Sediments and Turbidity Correlation

Suspended sediment concentrations determined by laboratory analyses of water samples (grabs) collected adjacent to the sondes and turbidity as measured by the sonde and hand-held meter were paired to determine if the two parameters were correlated. Turbidity recorded by the sonde when the water samples were collected and turbidity as measured by hand-held meter from a portion of the sample aliquot used for laboratory analysis were used for the paired readings. Pearson's r was used to measure the linear correlation between the two parameters (i.e., suspended sediments and turbidity). Correlation is dimensionless and scaled to lie in the range of $-1 \leq r \leq 1$. When $r = 0$ there is no correlation and when the increase or decrease in the variables is synchronous r is positive. If the variables vary in opposite directions, r is negative. A summary of paired statistics (count, minimum, maximum, average, Pearson's r , and R^2) for 2012 index period suspended sediment concentrations and turbidity at Lexington, Platte River at Elm Creek, Elm Creek, Kearney Canal Diversion and Hydro is presented in Table 8.

Table 8. Summary Statistics Suspended Sediments and Turbidity

	Count	Minimum	Maximum	Average	Pearson's r	R ²
Turbidity - LaMotte 2020 Turbidity Meter						
Turbidity, NTU	22	2.45	39.0	10.36	-0.0266	0.0007
Suspended Sediment, ppm	24	7.92	446.92	120.03		
Turbidity – Hydrolab MS5 or Eureka Manta 2						
Turbidity, NTU	18	5.50	148.00	30.24	-0.1052	0.0111
Suspended Sediment, ppm	24	7.92	446.92	120.03		

Suspended sediment and turbidity data were pooled for calculation of Pearson's r because of the small data sets (4 per location) at each monitoring location. Pearson's r for suspended sediment paired with turbidity determined with a LaMotte2020 Meter was -0.0266 and paired with the data sondes was -0.1051. The correlation coefficients for the 2012 data set are less than what was calculated by location in 2011 – Pearson's r ranged from a low of 0.2045 to 0.3935 (Appendix A, Table A-37). This analysis of the 2012 suspended sediment and turbidity data supports the findings obtained in 2011 –that there is no linear association between suspended sediment concentrations and turbidity (Appendix B, Figures B-26 through B-28).



V. STATISTICAL ANALYSIS OF TURBIDITY DATA

Turbidity is quite variable in the Kearney Canal during the period of canal operation in 2012 (Figure B-4). The approach in this statistical portion of the study was to determine how likely it is that Program actions caused some of the higher turbidity observations by: (1) comparing turbidity between the two stations within the Kearney Canal (diversion v hydro), (2) comparing turbidity to discharge, and (3) comparing the turbidity time series to the dates of Program actions.

- A Wilcoxon Sign Rank Test can be used to determine if the mean of a sample set is significantly different from another. This test was used to evaluate if the mean turbidity observed at the Kearney Canal Diversion is significantly different or similar to the mean turbidity observed at the Kearney Canal Hydro.
- A series of linear regression models were fit to the Platte River discharge, turbidity and Program action dates data to evaluate if changes in discharge and/or program actions caused increased turbidity.

V.A. Wilcoxon Sign Rank Test

One overall pattern observed in both 2011 and 2012 is that turbidity appears to be higher at the Kearney Canal Hydro location than the Diversion location (Figure 1, Figure B-4 and B-23). This graphical observation was tested using the Wilcoxon Sign Rank test which is a non-parametric test to compare whether the mean of one sample set is significantly different from another. Test results showed that in both 2011 and 2012, at the 95% confidence level ($p < 0.05$), the turbidity at the Hydro station is on average higher than at the Diversion (Table 9). The statistically significant turbidity increase in the Kearney Canal downstream of the Kearney Canal Diversion is likely due to several small drains originating from irrigated farmland that drain into the Kearney Canal. This turbidity increase cannot be due to Program actions, but instead appears to be a common feature in the canal.

Table 9. One-sided Wilcoxon Sign Rank Test Comparison of Kearney Canal Diversion and Kearney Canal Hydro Daily Turbidity

Year	Estimated Median Turbidity Difference (Hydro - Diversion)	p-value
2011	6.5 NTU	0.019
2012	8.4 NTU	<0.001

V.B. Linear Regression Models

Turbidity is closely related to river discharge, and the river discharge in 2012 along this reach of the Platte River was dominated by a low base flow (due to drought) and periodic discharges from CNPPID J-2 Hydro. Figure B-29 presents the 2012 J-2 discharge returned to the Platte River and Platte River discharge at Overton, NE from September 13 to October 24, 2012. Platte River discharge at Overton in 2012 is a product of the J-2 discharge to the river and the J-2 return is located upstream of the Program-actions completed in 2012 (Figure 1). A series of plots was



developed to examine the relationship between discharge and turbidity in the Kearney Canal and nearby locations. It is clear that the variability in the Overton discharge is dominated by the J-2 Return. The Overton discharge was then compared to the turbidity observed along the Platte River at Elm Creek, the Kearney Canal Diversion, and the Kearney Canal Hydro (Figure B-30 through B-32). The discharge at the diversion in the canal is also shown and is muted, and slightly shifted, version of the Overton discharge. Examination of these figures suggests that the high variability in discharge observed in the river is correlated with the observed turbidity, with a possible lag at the Kearney Canal Hydro station because of the distance traveled.

To statistically evaluate these relationships between turbidity and discharge, regression models were fit to daily turbidity averages from September 13 to October 24 in both 2011 and 2012. Because this is a time series analysis with potential autocorrelation, a generalized least squares regression approach was used that accounted for autocorrelation, and “date” was included as a variable to identify any long-term temporal trends in the observations. Both turbidity and discharge were log scaled. Regression results are presented in Table 10.

Table 10. Regression model fit for daily average turbidity from September 13 to October 24 using the generalized least squares model: $\log(\text{Turbidity}) = \beta_0 + \beta_1 \text{ date} + \beta_2(\log(\text{discharge})) + \varepsilon$ (where errors are autocorrelated with lag of 1)

Location	Years	Date		log(flow)	
		Coefficient (β_1)	Significant Relationship? ^a	Coefficient (β_2)	Significant Relationship? ^a
Lexington	2011	0.011	no	1.1	yes, positive
	2012	--	--	--	--
Overton	2011	-0.034	yes, negative	1.2	no
	2012	0.003	no	0.44	yes, positive
Platte River at Elm Creek ^b	2011	-0.022	yes, negative	0.37	No
	2012	0.003	no	0.49	yes, positive
Kearney Canal Diversion	2011	-0.010	yes, negative	-0.33	yes, negative
	2012	-0.002	no	1.3	yes, positive
Kearney Canal Hydro ^c	2011	-0.004	no	0.03	no
	2012	-0.003	no	1.1	yes, positive
Odessa	2011	-0.005	yes, negative	0.60	yes, positive
	2012	0.004	no	1.8	yes, positive

^aVariable is indicated as significant if generalized least squares fit indicates that the coefficient is different from zero based on the 95% confidence interval.

^bDischarge used for comparison at this location was measured at Overton.

^cDischarge used for comparison at this location was measured at the Kearney Canal Diversion.

The “coefficient” columns report the fitted model parameters, and the columns labeled “significant relationship?” indicates whether the fitted coefficient is significantly different from zero. The results show that during this time period in 2011, turbidity was on average decreasing, but was not in 2012. In addition, in 2012 there is a significant positive relationship between discharge and turbidity at every station. These results support the graphical findings from Figures B-23, B-30, B-31, and B-32 and confirm the strong relationship between discharge and turbidity in the 2012 dataset. The decrease in turbidity observed in 2011 that is not apparent in 2012 could



be due to the lack of natural rain-driven discharge in the Platte River in 2012. It also could be attributed to Program actions, so further analysis was performed using the specific dates of the Program actions.

Figure B-33 and B-34 show the dates that two types of Program actions occurred upstream of the Kearney Canal along with the turbidity at the Kearney Canal Hydro station. A visual inspection of the plots is inconclusive because some turbidity peaks occurred during Program actions, but some did not. For further examination, additional turbidity regression models were fit using both discharge and Program action dates as explanatory variables and is presented in Table 11.

Table 11. Regression model fit for daily average turbidity from September 13 to October 24 using the generalized least squares model: $\log(\text{Turbidity}) = \beta_0 + \beta_1(\log(\text{discharge})) + \beta_2(\text{Dyer Property activity yes/no}) + \beta_3(\text{Cottonwood Property activity yes/no}) + \varepsilon$ (where errors are autocorrelated with lag of 1)

Location	Year	log(flow)		Dyer Property Activity		Cottonwood Property Activity	
		Coefficient (β_1)	Significant Relationship? ^a	Coefficient (β_2)	Significant Relationship? ^a	Coefficient (β_3)	Significant Relationship? ^a
Overton	2012	0.45	yes, positive	-0.03	no	-0.02	no
Platte River at Elm Creek ^b	2012	0.37	yes, positive	0.21	yes, positive	0.00	no
Kearney Canal Diversion	2012	1.4	yes, positive	0.11	no	-0.10	no
Kearney Canal Hydro ^c	2012	1.1	yes, positive	0.03	no	-0.06	no
Odessa	2012	1.5	yes, positive	-0.36	no	-0.33	no

^aVariable is indicated as significant if generalized least squares fit indicates that the coefficient is different from zero based on the 95% confidence interval.

^bDischarge used for comparison at this location was measured at Overton.

^cDischarge used for comparison at this location was measured at the Kearney Canal Diversion.

The models presented in Table 11 confirm the significant, positive relationship between discharge and turbidity during this time period at each of the locations considered. In most cases, there was no significant relationship between the dates of Program action dates and turbidity. At one location, Platte River at Elm Creek, the dates of sediment augmentation at the Dyer Property are significantly, positively correlated with observed turbidity. This effect does not appear to extend into the Kearney Canal.

VI. SUMMARY

The Kearney Canal water quality monitoring was performed to monitor the water quality of the Kearney Canal during two major (sediment augmentation at the Dyer property and Cottonwood Ranch) Program actions in 2012. The inclusive water quality monitoring period was from September 13 to October 24, 2012, at the end of which the Kearney Canal was de-watered. Water quality data was collected at Overton, Platte River at Elm Creek, Elm Creek, Kearney



Canal Diversion and Hydro, and Odessa monitoring locations. Because of very low flow conditions at Lexington, no water quality data was collected. Kearney Canal water quality data was summarized and studied to determine if Program-actions altered intra-year water quality (upstream v. downstream) and inter-year water quality (2011 vs. 2012).

The Program completed two major sediment augmentation events upstream of the Kearney Canal diversion in 2012 (Table A-38 and A-39).

- Sediment Augmentation – Dyer Property. Action performed from September 26 through November 30, 2012 upstream of the Overton monitoring location. Augmentation material was produced by establishing a sand pumping operation at an existing sand pit at the Dyer property. The sand pumping operation produced augmentation material that was pumped to an active river channel for disbursement.
- Sediment Augmentation – Cottonwood Ranch. Action performed from September 17 through November 8, 2012 upstream of the Odessa monitoring location. Augmentation material was produced by mechanical placement of existing material located in high sand bar areas within the river channel into active flowing areas within the Platte River channel.

The graphical and statistical evaluation of the Kearney Canal data suggests that the peaks in turbidity in the canal can be attributed to peaks in river discharge (driven by the J-2 Return discharge). The fact that Program Actions and peak river discharge frequently coincided make it difficult to completely distinguish between these forces that could influence turbidity, particularly near the end of the time series (see Figure B-33 and B-34). However, because (1) elevated turbidity occurred even when there were no Program Actions, and (2) turbidity significantly increases downstream of the Kearney Canal diversion (Table 11), it does not appear likely that the Program actions are significantly increasing turbidity in the Kearney Canal.

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APPENDIX A

Summary Statistics



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Acronym List	
°C = degrees Celsius	mS/cm = milliSiemens per centimeter
cfs = cubic feet per second	NA = Not Applicable
ELMCR = Elm Creek, Elm Creek, NE	NTU = Nephelometric Turbidity Units
ELMPR = Platte River, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCDIV = Kearney Canal Diversion, Elm Creek, NE	OVRPR = Platte River, Overton, NE
KCPH = Kearney Canal Power House, Kearney, NE	ppm = parts per million
LEXPR = Platte River, Lexington, NE	SSC = Suspended Sediment Concentration
mg/L = milligrams per liter	-- = No data Available



Continuous Water Quality Data Weekly Average

**Table A-1. Temperature, Weekly Average, Platte River, Overton, NE**

Middle Day of Week	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	17.5	13.4	22.4	17.7	190	2.3
9/20/2012	16.9	12.8	21.8	16.9	334	2.1
9/27/2012	17.2	12.8	24.7	16.7	335	2.8
10/4/2012	12.4	3.3	22.2	11.9	334	4.5
10/11/2012	11.6	5.8	19.5	11.2	334	3.2
10/18/2012	11.4	3.9	19.2	11.8	335	3.7
10/25/2012	12.3	9.2	16.1	12.0	143	1.4

Table A-2. Temperature, Weekly Average, Platte River, Elm Creek, NE

Middle Day of Week	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	19.0	15.5	23.7	18.7	157	2.0
9/20/2012	17.4	13.7	22.1	17.2	333	1.8
9/27/2012	17.7	13.5	23.4	17.0	333	2.8
10/4/2012	13.1	4.8	22.5	12.6	333	4.2
10/11/2012	12.0	6.3	19.5	11.2	333	2.9
10/18/2012	11.6	4.2	18.8	11.8	336	3.7
10/25/2012	12.2	9.5	15.8	11.9	144	1.3



Table A-3. Temperature, Weekly Average, Elm Creek at Elm Creek, NE

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	20.3	17.3	23.6	20.3	122	1.3
9/20/2012	17.4	14.4	20.9	17.4	329	1.5
9/27/2012	17.2	13.5	22.5	16.7	327	2.1
10/4/2012	13.7	5.8	19.2	13.8	324	3.5
10/11/2012	12.3	9.8	16.1	12.4	113	1.7
10/18/2012	--	--	--	--	--	--
10/25/2012	--	--	--	--	--	--

Table A-4. Temperature, Weekly Average, Kearney Canal Diversion, NE

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	19.4	14.5	24.1	19.3	125	2.7
9/20/2012	17.4	13.2	22.3	17.1	334	2.4
9/27/2012	17.0	13.4	23.5	16.3	196	2.7
10/4/2012	11.6	11.0	13.0	11.2	8	0.7
10/11/2012	13.0	8.4	19.1	12.3	119	3.3
10/18/2012	11.8	4.3	18.5	12.1	336	3.7
10/25/2012	12.2	10.8	13.8	12.1	77	0.8

**Table A-5. Temperature, Weekly Average, Kearney Canal Hydro, NE**

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	18.6	15.9	20.6	18.8	161	1.3
9/20/2012	17.3	15.2	19.3	17.3	334	1.0
9/27/2012	17.5	15.1	19.3	17.7	333	1.0
10/4/2012	13.2	6.8	19.5	14.1	333	3.7
10/11/2012	11.0	6.8	15.5	10.9	333	1.9
10/18/2012	11.5	6.5	15.9	12.6	334	2.9
10/25/2012	12.4	11.4	13.6	12.4	129	0.6

Table A-6. Temperature, Weekly Average, Platte River Odessa, NE

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	19.4	14.5	24.1	19.3	125	2.7
9/20/2012	17.4	13.2	22.3	17.1	334	2.4
9/27/2012	17.0	13.4	23.5	16.3	196	2.7
10/4/2012	11.6	11.0	13.0	11.2	8	0.7
10/11/2012	13.0	8.4	19.1	12.3	119	3.3
10/18/2012	11.8	4.3	18.5	12.1	336	3.7
10/25/2012	12.2	10.8	13.8	12.1	77	0.8



Table A-7. Specific Conductance, Weekly Average, Platte River Overton, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	0.82	0.74	1.20	0.83	190	0.07
9/20/2012	0.81	0.71	0.93	0.82	265	0.05
9/27/2012	0.80	0.72	1.06	0.81	205	0.04
10/4/2012	0.82	0.74	1.09	0.82	167	0.04
10/11/2012	0.78	0.73	0.82	0.78	35	0.03
10/18/2012	0.83	0.77	1.27	0.82	208	0.04
10/25/2012	0.79	0.70	0.87	0.85	143	0.07

Table A-8. Specific Conductance, Weekly Average, Platte River at Elm Creek, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	0.84	0.76	1.02	0.83	157	0.05
9/20/2012	0.81	0.75	0.94	0.81	333	0.03
9/27/2012	0.82	0.75	0.96	0.83	333	0.03
10/4/2012	0.85	0.76	1.04	0.86	333	0.03
10/11/2012	0.83	0.74	1.12	0.84	333	0.05
10/18/2012	0.87	0.75	1.12	0.88	336	0.05
10/25/2012	0.89	0.89	0.91	0.89	144	0.01

**Table A-9. Specific Conductance, Weekly Average, Elm Creek at Elm Creek, NE**

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	0.91	0.82	1.02	0.90	121	0.05
9/20/2012	0.87	0.80	0.99	0.87	328	0.04
9/27/2012	0.88	0.80	0.97	0.87	327	0.04
10/4/2012	0.94	0.85	1.01	0.95	324	0.04
10/11/2012	0.92	0.81	1.03	0.92	113	0.07
10/18/2012	--	--	--	--	--	--
10/25/2012	--	--	--	--	--	--

Table A-10. Specific Conductance, Weekly Average, Kearney Canal Diversion, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	0.84	0.77	0.94	0.83	125	0.05
9/20/2012	0.81	0.74	0.89	0.80	313	0.04
9/27/2012	0.83	0.75	0.87	0.85	196	0.04
10/4/2012	0.85	0.85	0.85	0.85	8	0.00
10/11/2012	0.84	0.77	0.87	0.84	113	0.03
10/18/2012	0.87	0.76	1.07	0.87	336	0.04
10/25/2012	0.87	0.87	0.90	0.87	77	0.01

**Table A-11. Specific Conductance, Weekly Average, Kearney Canal Hydro, NE**

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	0.85	0.76	0.92	0.85	151	0.04
9/20/2012	0.81	0.75	0.89	0.81	333	0.03
9/27/2012	0.82	0.76	0.87	0.82	333	0.03
10/4/2012	0.85	0.78	0.96	0.85	333	0.03
10/11/2012	0.82	0.75	0.89	0.83	327	0.05
10/18/2012	0.88	0.77	0.94	0.88	328	0.04
10/25/2012	0.90	0.90	0.91	0.90	129	0.00

Table A-12. Specific Conductance, Weekly Average, Platte River Odessa, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	0.83	0.76	0.93	0.84	146	0.04
9/20/2012	0.79	0.76	0.86	0.79	159	0.03
9/27/2012	0.82	0.73	0.87	0.83	92	0.04
10/4/2012	--	--	--	--	--	--
10/11/2012	--	--	--	--	--	--
10/18/2012	0.88	0.80	0.90	0.88	206	0.01
10/25/2012	0.89	0.88	0.91	0.88	144	0.01



Table A-13. pH, Weekly Average, Platte River Overton, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.3	8.0	8.6	8.2	190	0.2
9/20/2012	8.3	8.0	8.8	8.2	334	0.2
9/27/2012	8.2	7.8	8.6	8.3	335	0.2
10/4/2012	8.3	8.2	8.6	8.3	334	0.1
10/11/2012	8.4	8.1	8.6	8.4	334	0.1
10/18/2012	8.4	8.2	8.6	8.4	335	0.1
10/25/2012	8.3	8.2	8.4	8.3	143	0.0

Table A-14. pH, Weekly Average, Platte River at Elm Creek, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.4	8.2	8.5	8.4	157	0.1
9/20/2012	8.3	8.1	8.5	8.3	333	0.1
9/27/2012	8.3	8.1	8.5	8.3	333	0.1
10/4/2012	8.2	8.1	8.5	8.2	333	0.1
10/11/2012	8.2	7.9	8.9	8.1	333	0.1
10/18/2012	8.1	7.9	8.3	8.1	336	0.1
10/25/2012	8.0	7.9	8.1	8.0	144	0.1



Table A-15. pH, Weekly Average, Elm Creek at Elm Creek, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.0	7.7	8.3	8.0	122	0.1
9/20/2012	8.0	7.7	8.3	8.0	328	0.1
9/27/2012	8.1	7.8	8.6	8.0	327	0.2
10/4/2012	8.0	7.7	8.5	8.0	324	0.2
10/11/2012	8.0	7.9	8.3	8.0	113	0.1
10/18/2012	--	--	--	--	--	--
10/25/2012	--	--	--	--	--	--

Table A-16. pH, Weekly Average, Kearney Canal Diversion, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.2	8.1	8.3	8.2	125	0.0
9/20/2012	8.2	8.0	8.4	8.2	334	0.1
9/27/2012	8.2	8.0	8.3	8.2	196	0.1
10/4/2012	8.1	8.0	8.1	8.1	8	0.0
10/11/2012	8.3	8.3	8.4	8.3	119	0.0
10/18/2012	8.3	8.2	8.4	8.3	336	0.0
10/25/2012	8.3	8.2	8.4	8.3	77	0.0



Table A-17. pH, Weekly Average, Kearney Canal Hydro, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.7	8.5	8.8	8.7	161	0.1
9/20/2012	8.6	8.4	8.7	8.6	334	0.1
9/27/2012	8.4	8.2	8.6	8.4	333	0.1
10/4/2012	8.5	8.3	8.9	8.4	333	0.2
10/11/2012	8.5	8.4	9.2	8.5	333	0.2
10/18/2012	8.7	8.5	9.2	8.6	334	0.2
10/25/2012	8.5	8.4	8.6	8.6	129	0.1

Table A-18. pH, Weekly Average, Platte River Odessa, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.4	8.2	8.6	8.4	191	0.1
9/20/2012	8.4	8.2	8.7	8.4	334	0.1
9/27/2012	8.3	8.1	8.7	8.3	335	0.1
10/4/2012	8.3	8.1	8.5	8.3	79	0.1
10/11/2012	8.4	8.2	8.6	8.4	160	0.1
10/18/2012	8.3	7.9	8.6	8.4	334	0.1
10/25/2012	8.3	7.6	8.4	8.3	144	0.2



Table A-19. Turbidity, Weekly Average, Platte River Overton, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	12.7	0.3	60.3	3.4	190	13.9
9/20/2012	12.1	0.3	52.9	4.4	333	12.9
9/27/2012	9.5	1.8	53.2	3.9	334	10.6
10/4/2012	8.3	2.2	64.9	6.2	331	6.4
10/11/2012	18.9	6.1	52.1	17.8	331	8.2
10/18/2012	13.7	4.7	56.8	11.7	334	7.4
10/25/2012	6.0	1.7	15.2	6.0	143	1.7

Table A-20. Turbidity, Weekly Average, Platte River at Elm Creek, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	21.2	5.7	72.5	16.7	157	13.5
9/20/2012	18.3	3.7	67.3	13.8	330	11.1
9/27/2012	10.2	2.5	54.8	5.9	332	9.3
10/4/2012	7.5	2.0	82.8	4.4	332	9.5
10/11/2012	17.4	2.6	84.9	11.1	331	14.2
10/18/2012	28.5	3.7	196.5	17.2	332	35.0
10/25/2012	7.0	4.3	11.2	6.8	144	1.4



Table A-21. Turbidity, Weekly Average, Elm Creek at Elm Creek, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	37.9	6.6	83.5	28.4	121	21.9
9/20/2012	74.5	14.3	222.8	62.5	326	43.5
9/27/2012	63.2	9.7	180.4	51.5	318	41.1
10/4/2012	61.1	7.1	155.8	55.3	314	29.0
10/11/2012	51.9	1.3	164.3	44.9	111	35.6
10/18/2012	--	--	--	--	--	--
10/25/2012	--	--	--	--	--	--

Table A-22. Turbidity, Weekly Average, Kearney Canal Diversion, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	23.7	9.9	41.5	20.9	125	9.8
9/20/2012	25.7	5.8	85.8	21.5	325	13.6
9/27/2012	18.9	6.2	48.4	14.7	195	11.5
10/4/2012	8.4	6.0	12.3	7.9	6	2.1
10/11/2012	8.3	4.2	28.6	7.2	115	4.5
10/18/2012	29.1	2.1	190.9	17.8	336	33.2
10/25/2012	6.9	4.8	9.9	6.7	77	1.4

**Table A-23. Turbidity, Weekly Average, Kearney Canal Hydro, NE**

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	26.4	10.3	54.1	25.1	161	10.3
9/20/2012	45.2	14.7	157.6	40.3	329	19.8
9/27/2012	27.2	8.9	57.4	26.1	332	11.9
10/4/2012	17.8	7.9	50.8	14.6	332	8.8
10/11/2012	33.1	6.6	154.0	22.9	325	28.1
10/18/2012	28.3	6.3	165.5	19.7	326	26.7
10/25/2012	9.5	4.4	20.4	9.1	129	3.4

Table A-24. Turbidity, Weekly Average, Platte River Odessa, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	18.7	0.3	103.1	8.0	191	21.6
9/20/2012	22.2	0.3	100.5	12.0	333	22.9
9/27/2012	11.3	0.3	114.7	1.7	335	19.1
10/4/2012	9.6	0.3	58.1	0.3	79	16.4
10/11/2012	10.0	0.3	64.2	3.0	158	15.9
10/18/2012	9.5	0.3	87.4	1.5	221	16.6
10/25/2012	68.8	1.8	334.6	42.7	67	64.7

**Table A-25. Dissolved Oxygen, Weekly Average, Platte River Overton, NE**

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.8	7.8	10.3	8.6	190	0.6
9/20/2012	8.6	7.3	10.0	8.5	334	0.6
9/27/2012	8.8	8.0	10.2	8.8	335	0.5
10/4/2012	10.1	8.3	12.5	10.1	334	1.0
10/11/2012	10.4	8.7	11.6	10.4	334	0.6
10/18/2012	10.1	8.6	11.8	10.0	335	0.7
10/25/2012	9.8	9.2	10.6	9.7	143	0.4

Table A-26. Dissolved Oxygen, Weekly Average, Platte River at Elm Creek, NE

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	9.0	7.9	10.6	8.9	157	0.5
9/20/2012	9.0	7.8	10.5	8.9	332	0.5
9/27/2012	9.4	8.1	12.0	9.2	333	0.8
10/4/2012	9.9	8.1	11.8	10.0	332	0.8
10/11/2012	10.1	8.5	11.3	10.1	332	0.6
10/18/2012	10.0	8.7	11.8	9.9	336	0.8
10/25/2012	9.8	9.2	10.4	9.7	144	0.3



Table A-27. Dissolved Oxygen, Weekly Average, Elm Creek at Elm Creek, NE

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	7.0	5.2	8.9	7.1	121	0.8
9/20/2012	7.9	4.8	11.9	8.0	328	1.2
9/27/2012	9.1	5.5	16.6	8.6	327	2.2
10/4/2012	9.7	6.6	15.2	9.4	322	1.9
10/11/2012	10.9	8.6	15.6	9.9	111	2.2
10/18/2012	--	--	--	--	--	--
10/25/2012	--	--	--	--	--	--

Table A-28. Dissolved Oxygen, Weekly Average, Kearney Canal Diversion, NE

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.7	7.7	10.0	8.5	125	0.6
9/20/2012	8.7	7.7	10.1	8.6	333	0.5
9/27/2012	8.8	7.7	10.0	8.7	195	0.6
10/4/2012	9.8	9.4	10.2	9.9	8	0.4
10/11/2012	10.0	8.6	11.2	10.2	119	0.7
10/18/2012	10.2	8.8	12.5	10.2	336	0.9
10/25/2012	9.9	9.0	11.9	9.6	77	0.7



Table A-29. Dissolved Oxygen, Weekly Average, Kearney Canal Hydro, NE

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	9.2	7.6	11.0	9.2	161	0.9
9/20/2012	9.0	7.5	10.3	9.1	332	0.8
9/27/2012	9.2	7.8	10.6	9.2	332	0.8
10/4/2012	10.1	7.7	12.0	10.1	332	1.0
10/11/2012	10.5	8.4	11.8	10.6	331	0.7
10/18/2012	10.3	8.2	11.9	10.4	332	0.9
10/25/2012	9.6	8.6	10.4	9.7	129	0.5

Table A-30. Dissolved Oxygen, Weekly Average, Platte River Odessa, NE

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	8.3	7.2	9.7	8.4	191	0.6
9/20/2012	8.6	7.3	10.1	8.6	334	0.6
9/27/2012	8.5	7.2	10.1	8.5	335	0.7
10/4/2012	8.8	7.8	9.7	8.8	79	0.4
10/11/2012	9.7	7.9	11.3	9.8	160	0.9
10/18/2012	9.6	7.9	11.6	9.5	334	0.9
10/25/2012	9.7	8.9	10.4	9.7	144	0.4

**Table A-31. Discharge, Weekly Average, Platte River Lexington, NE**

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	51	46	57	51	192	4
9/20/2012	63	56	70	63	336	4
9/27/2012	78	70	82	79	336	3
10/4/2012	90	83	99	89	336	4
10/11/2012	111	97	134	106	336	10
10/18/2012	113	107	119	114	336	3
10/25/2012	114	110	120	114	144	2

Table A-32. Discharge, Weekly Average, Platte River Overton, NE

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	645	75	1810	163	192	700
9/20/2012	568	108	1830	172	336	617
9/27/2012	387	126	1620	172	336	457
10/4/2012	245	119	1640	142	251	318
10/11/2012	685	122	1780	269	264	634
10/18/2012	343	134	1720	167	245	425
10/25/2012	159	150	167	159	126	4

**Table A-33. Discharge, Weekly Average, Kearney Canal Diversion, NE**

Middle Day of Week	Discharge, cfs					
	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	153	115	217	147	192	34
9/20/2012	247	142	289	257	336	37
9/27/2012	209	137	282	211	336	42
10/4/2012	166	120	232	155	336	35
10/11/2012	205	128	238	215	336	34
10/18/2012	194	162	243	189	336	22
10/25/2012	78	0	162	71	144	79

Table A-34. Discharge, Weekly Average, Kearney Hydro, NE

Middle Day of Week	Discharge, cfs					
	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	130	108	174	124	192	21
9/20/2012	207	130	390	211	336	39
9/27/2012	190	129	381	184	336	41
10/4/2012	142	106	184	141	336	25
10/11/2012	160	106	191	172	336	27
10/18/2012	153	131	184	150	336	14
10/25/2012	88	1	143	127	144	52

**Table A-35. Discharge, Weekly Average, Platte River Odessa, NE**

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
9/13/2012	279	95	1123	117	192	283
9/20/2012	381	83	1248	243	336	312
9/27/2012	223	94	634	184	336	130
10/4/2012	255	134	871	220	336	143
10/11/2012	495	195	1400	342	336	357
10/18/2012	232	115	623	180	336	122
10/25/2012	99	93	114	97	144	5



Discrete Water Quality Data



Table A-36. Discrete Water Quality Data, Suspended Sediment Concentration, (Platte River, Elm Creek, Kearney Canal), NE

Date	LEXPR SSC, ppm	ELMPR SSC, ppm	ELMCR SSC, ppm	KCDIV SSC, ppm	KCPH SSC, ppm
September 20, 2012	49.11	46.09	71.06	76.56	76.41
September 27, 2012	7.94	83.12	38.77	54.59	20.98
October 4, 2012	7.92	15.90	42.78	100.66	99.50
October 12, 2012	446.92	198.39	220.28	231.34	395.08

Table A-37. 2011 Summary Statistics Suspended Sediments and Turbidity

	Count	Minimum	Maximum	Average	Pearson's r	R ²
Platte River near Lexington, NE						
Turbidity, NTU	21	11.20	75.20	35.95	0.3594	0.1292
Suspended Sediment, ppm	21	9.48	381.86	79.81		
Platte River near Elm Creek, NE						
Turbidity, NTU	23	16.20	76.20	35.77	0.3935	0.1548
Suspended Sediment, ppm	23	0.00	360.63	60.86		
Elm Creek						
Turbidity, NTU	23	78.70	398.40	209.27	0.2384	0.0568
Suspended Sediment, ppm	23	12.86	674.42	146.73		
Kearney Canal Diversion						
Turbidity, NTU	23	19.10	97.40	54.06	0.2045	0.0418
Suspended Sediment, ppm	23	0.00	532.23	68.68		
Kearney Canal Hydro						
Turbidity, NTU	23	16.90	231.50	86.23	0.3292	0.1083
Suspended Sediment, ppm	21	1.52	464.15	86.63		



Table A-38. Pilot Scale Sediment Augmentation Management Action, Augmentation Days, Dyer Property

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
September																										X	X	X			
October	X	X	X	X					X	X	X				X	X	X	X	X						X	X					
November					X	X	X							X	X	X		X	X	X						X	X	X	X	X	

Table A-39. Pilot Scale Sediment Augmentation Management Action, Augmentation Days, Cottonwood Ranch

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
September																	X	X	X	X	X	X		X	X	X	X	X	X		
October		X	X	X	X	X		X	X			X	X		X	X	X	X	X							X	X				
November					X	X	X	X																							



APPENDIX B

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Acronym List	
°C = degrees Celsius	LEXPR = Platte River, Lexington, NE
cfs = cubic feet per second	mg/L = milligrams per liter
ELMCR = Elm Creek, Elm Creek, NE	mS/cm = milliSiemens per centimeter
ELMPR = Platte River, Elm Creek, NE	NTU = Nephelometric Turbidity Units
KCDIV = Kearney Canal Diversion, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCPH = Kearney Canal Power House, Kearney, NE	OVRPR = Platte River, Overton, NE



Intra- Year Temporal Variations



Figure B-1. Temporal Variation, Temperature, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

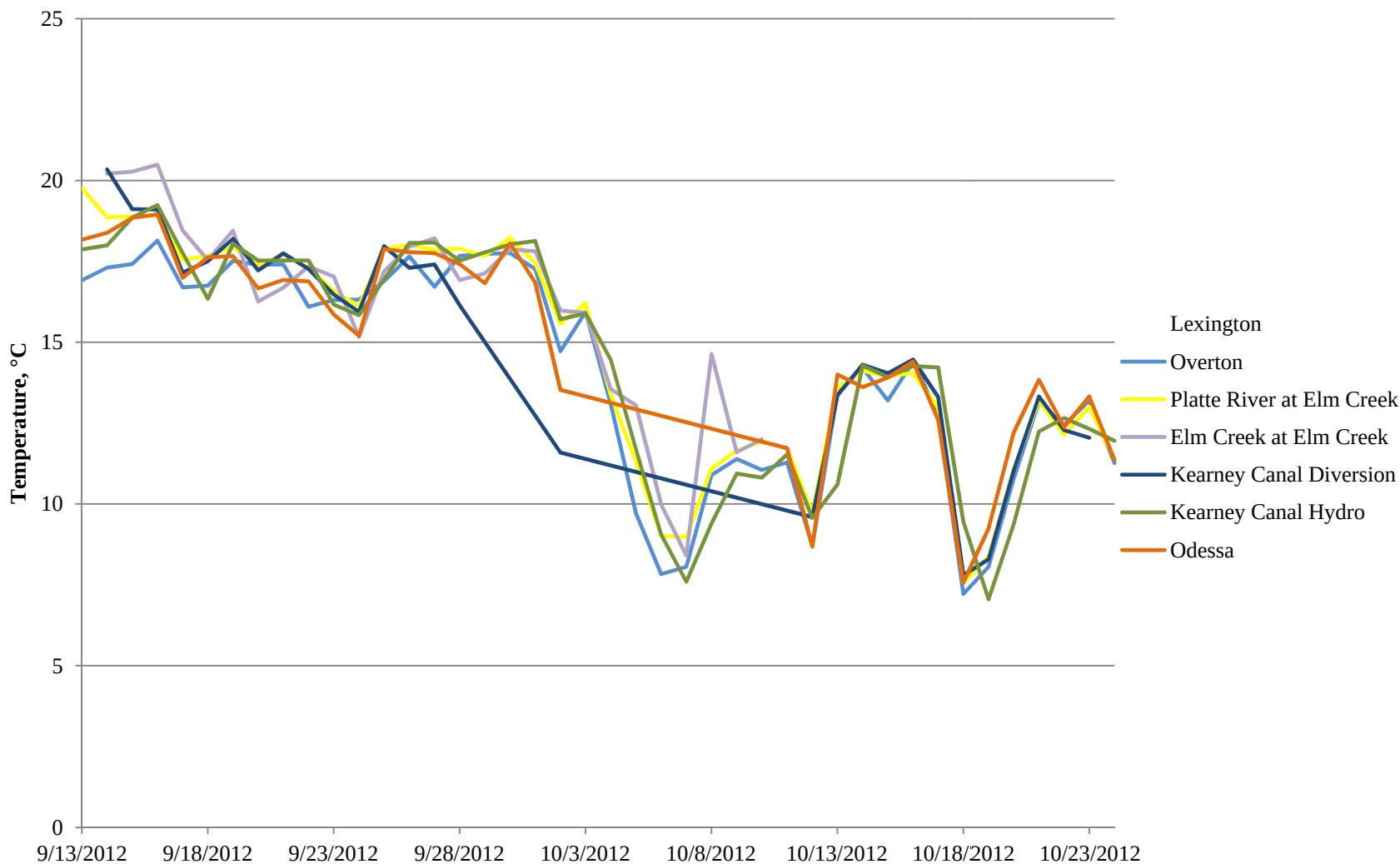




Figure B-2. Temporal Variation, Specific Conductance, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

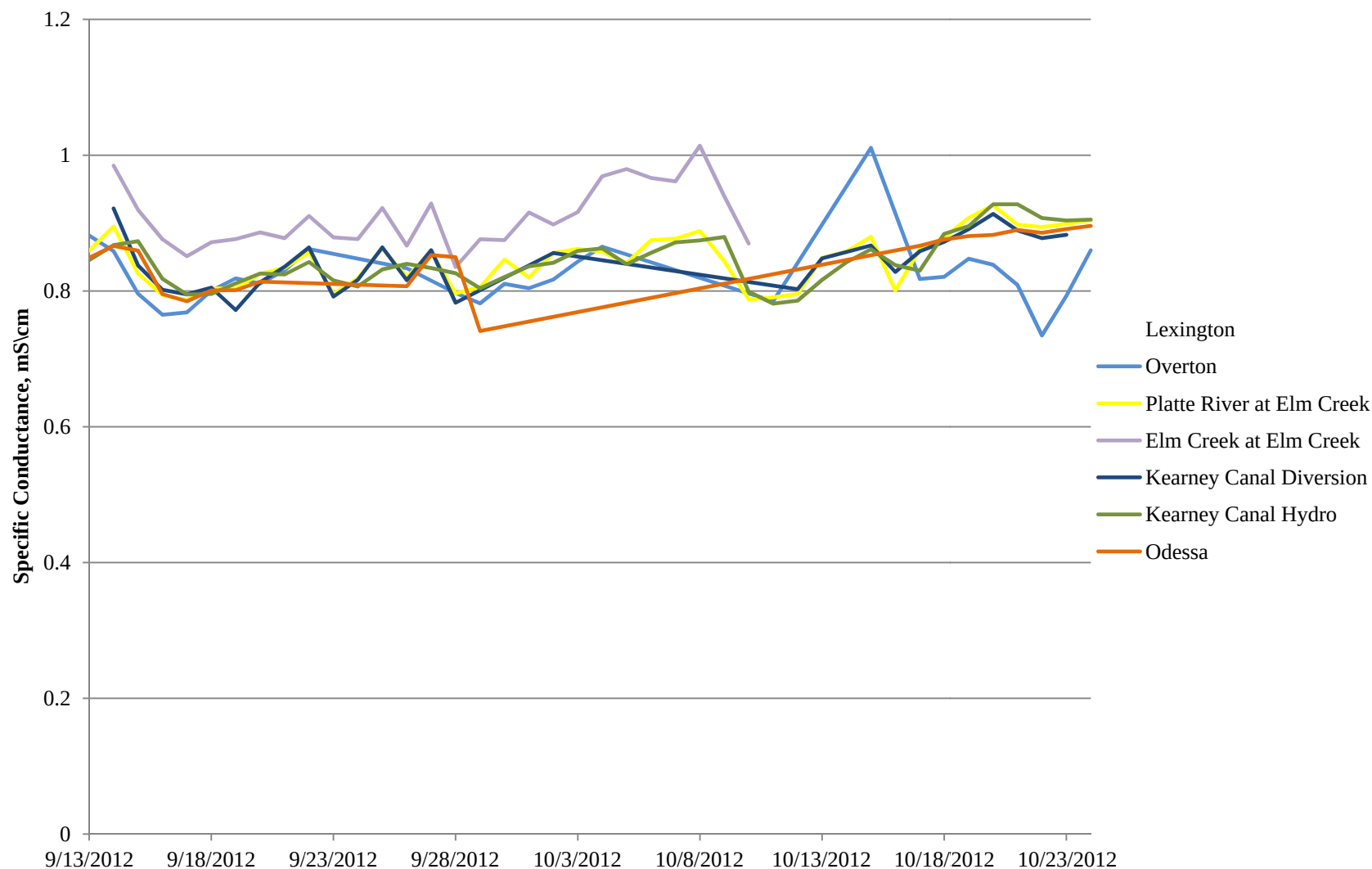




Figure B-3. Temporal Variation, pH, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

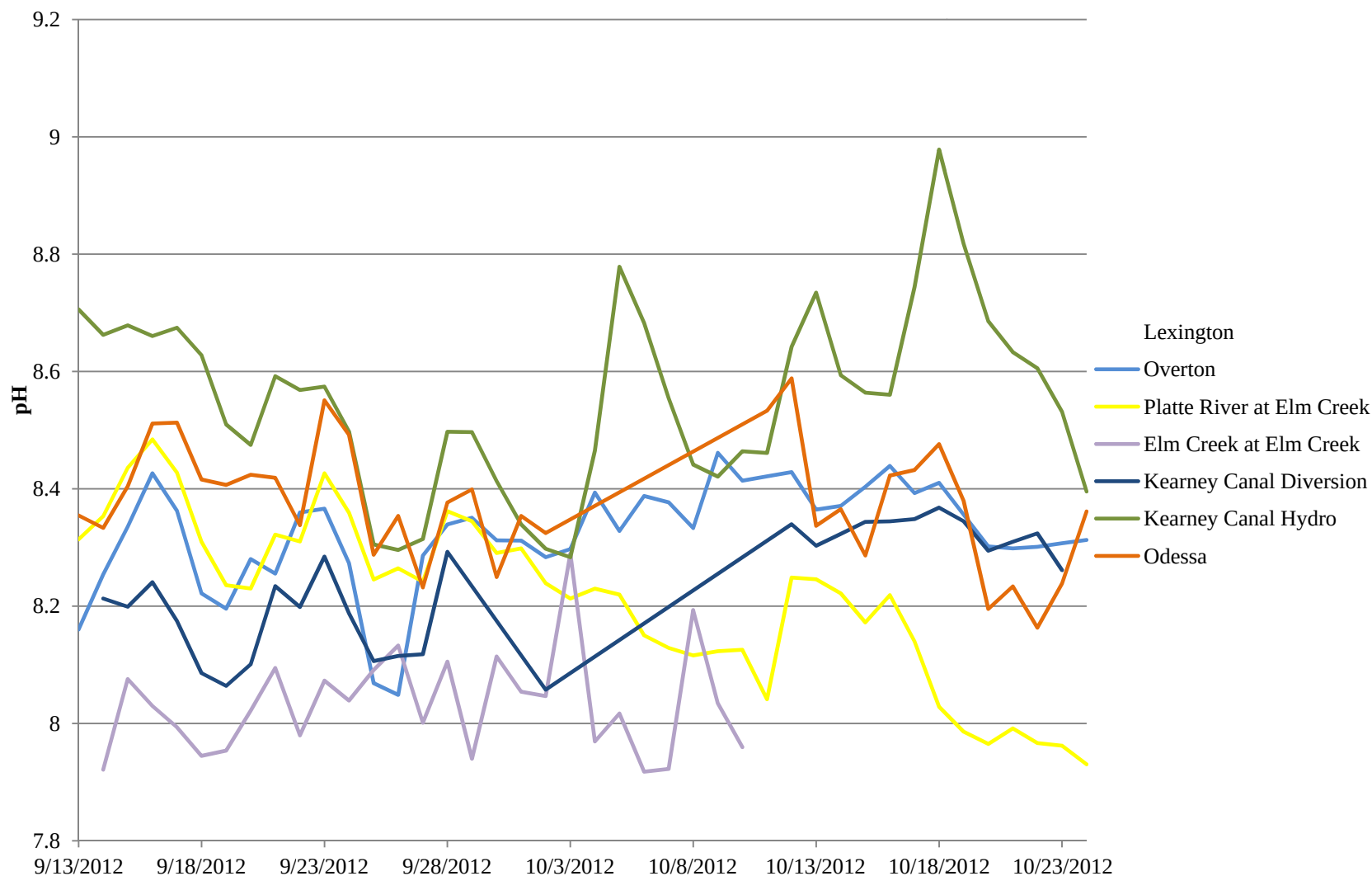




Figure B-4. Temporal Variation, Turbidity, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

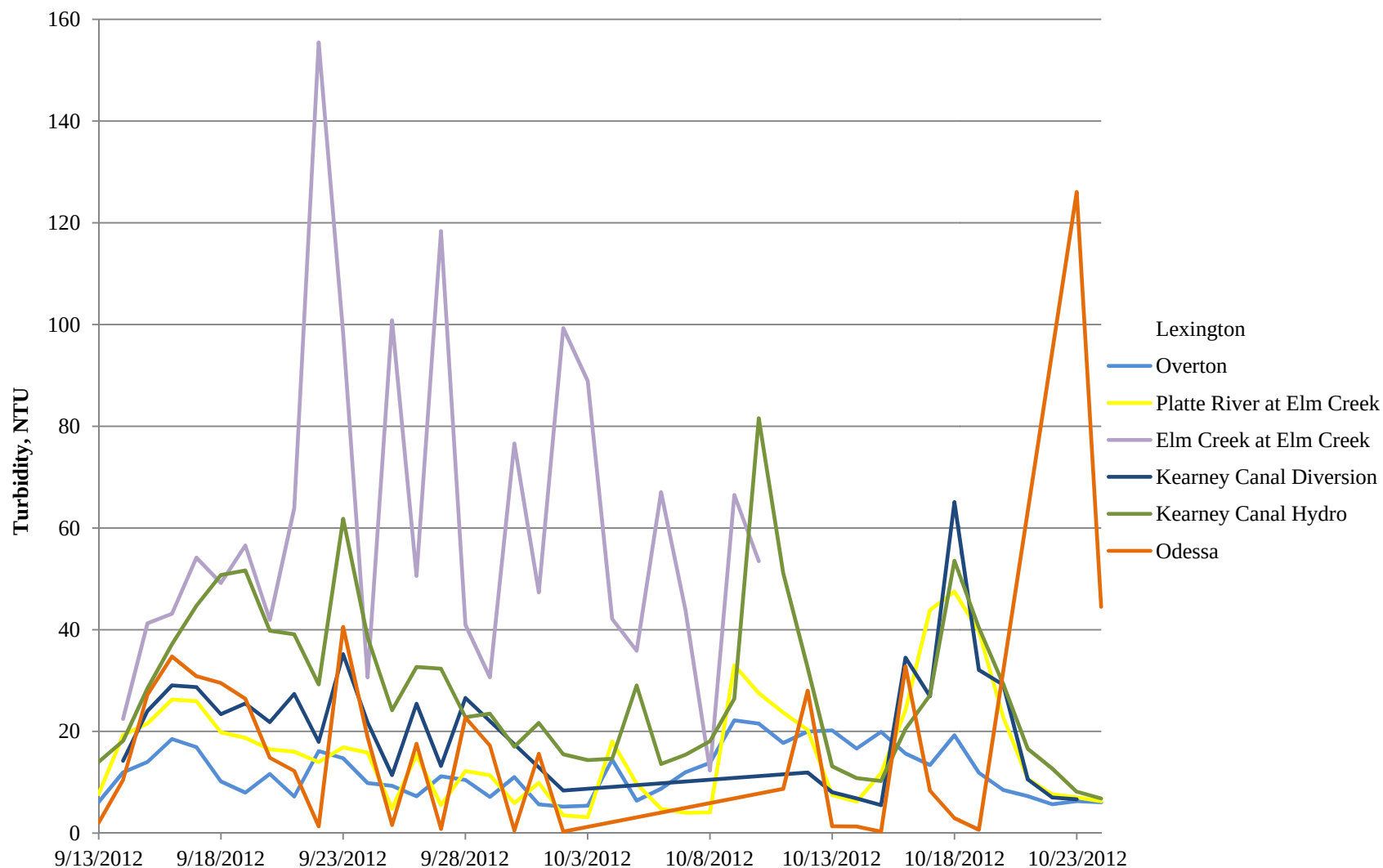




Figure B-5. Temporal Variation, Dissolved Oxygen, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

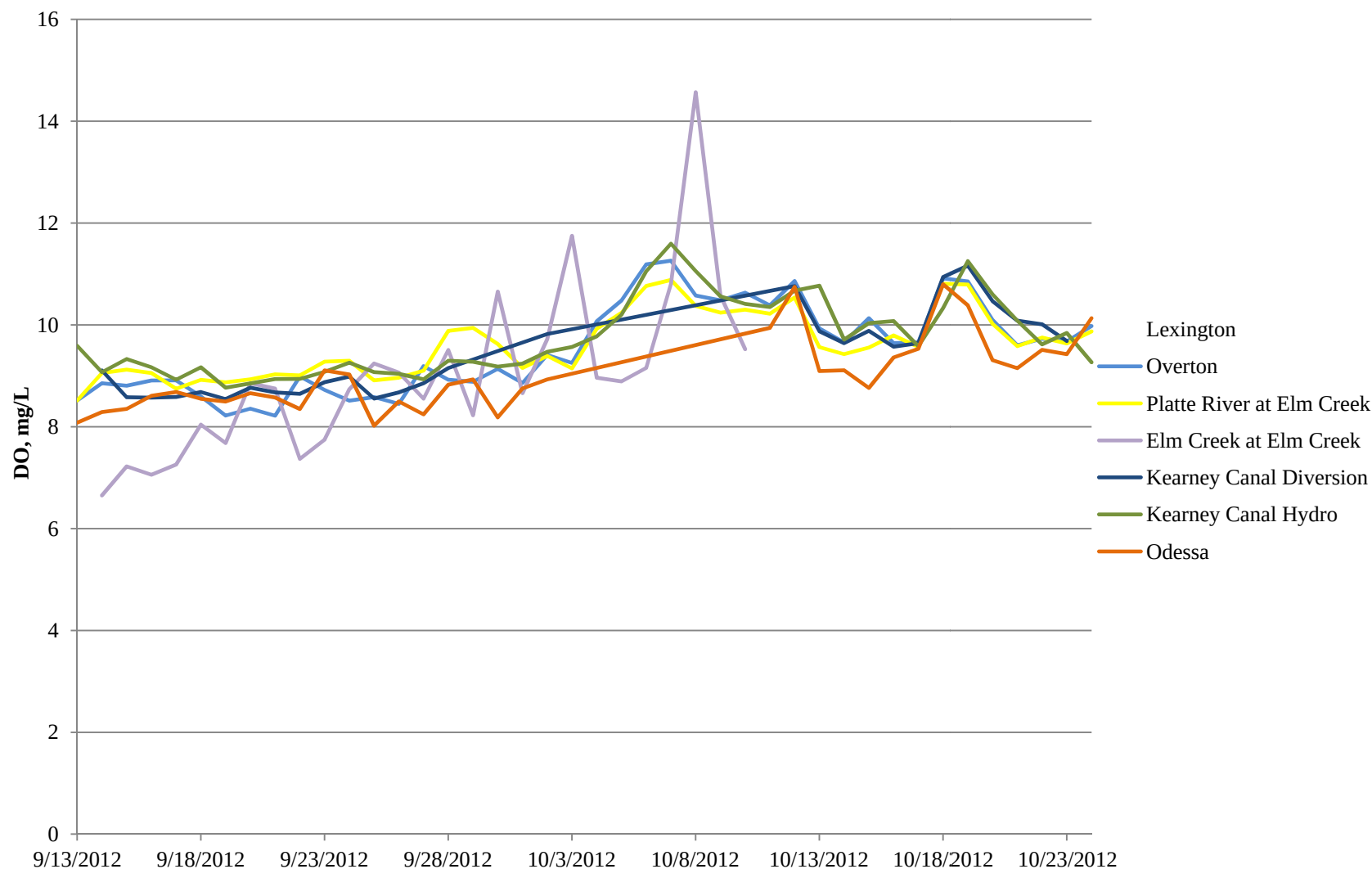
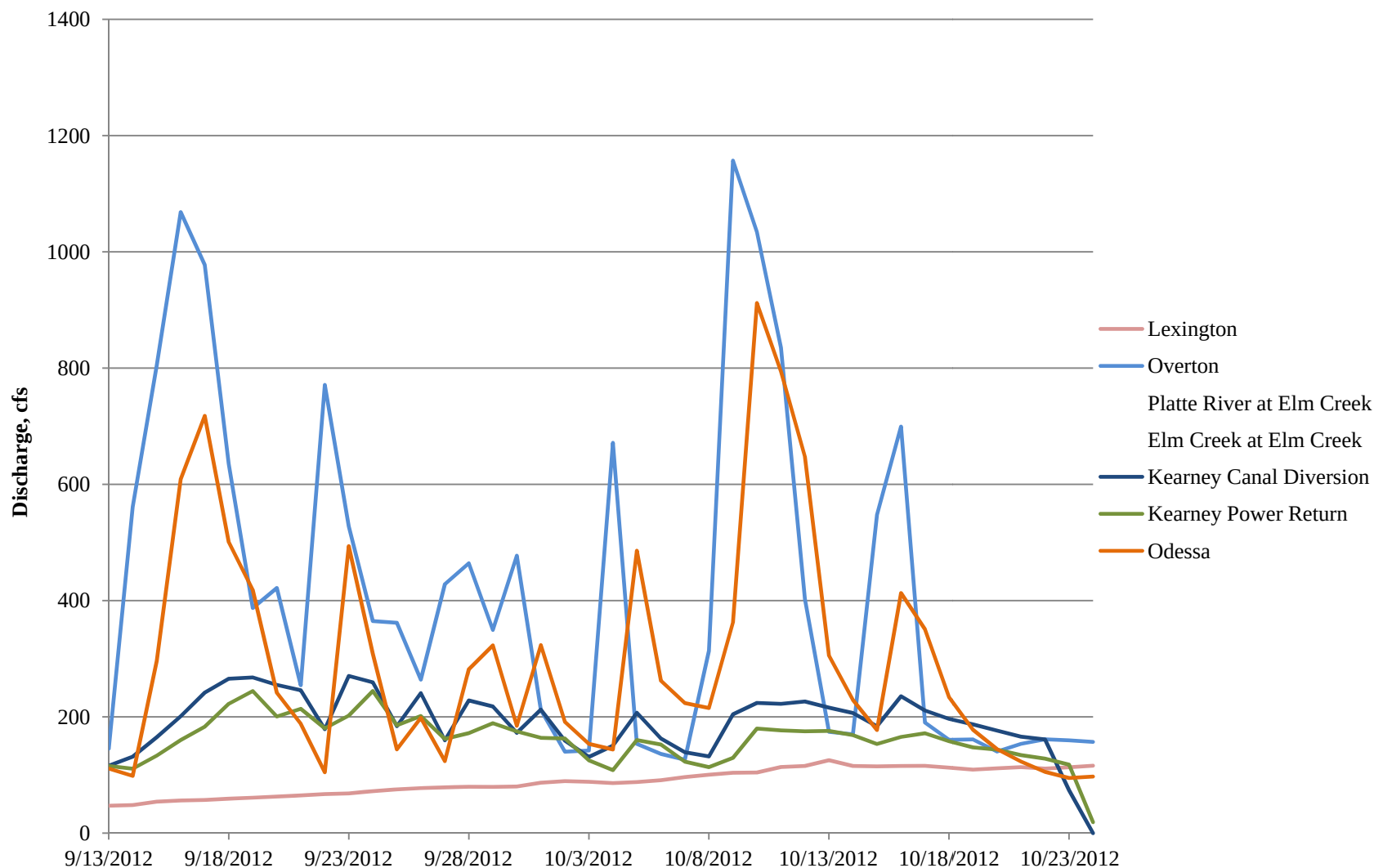




Figure B-6. Temporal Variation, Discharge, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)





Intra-Year Spatial Variation



Figure B-7. Spatial Variation, Temperature, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

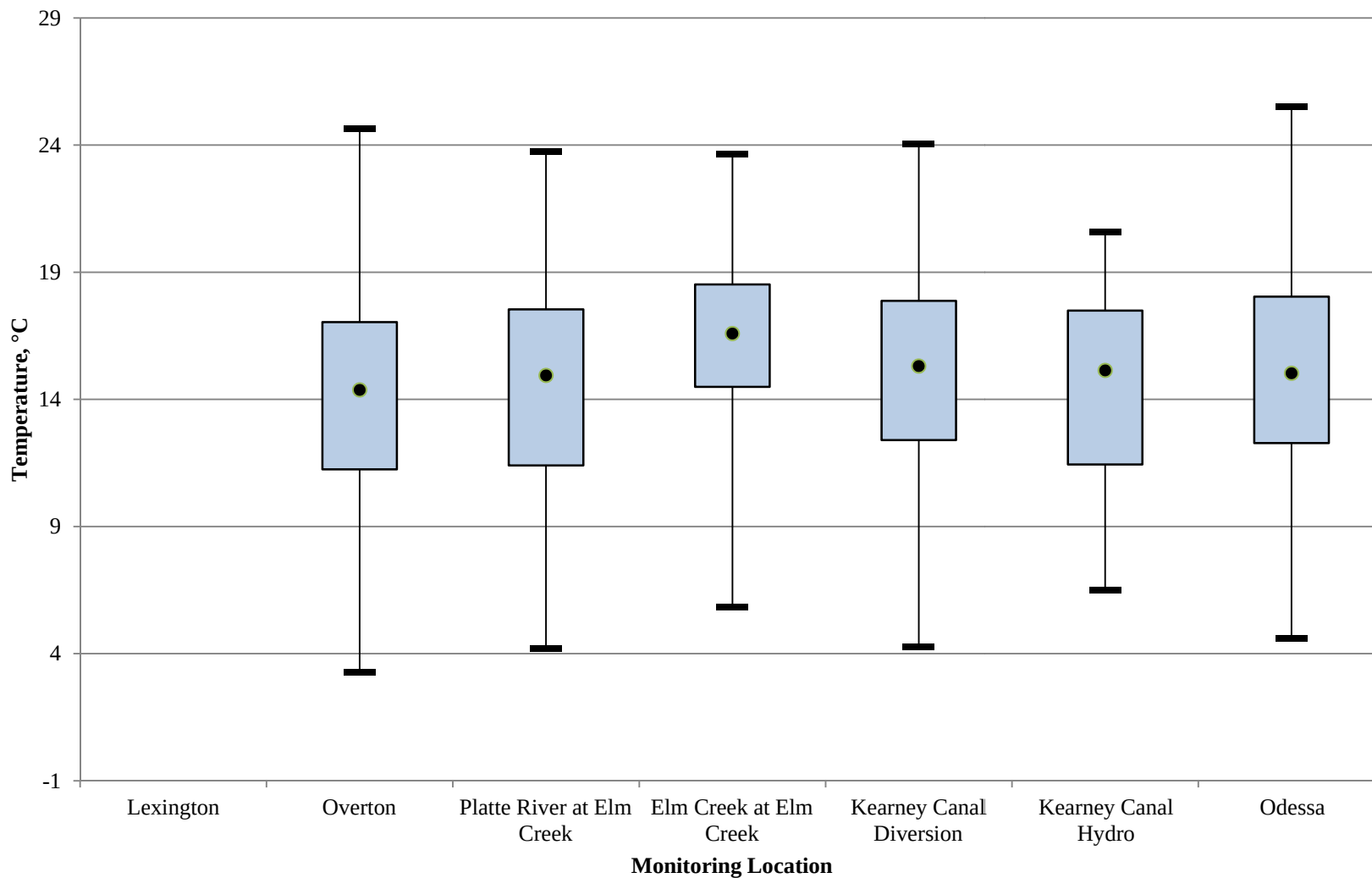




Figure B-8. Spatial Variation, Specific Conductance, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

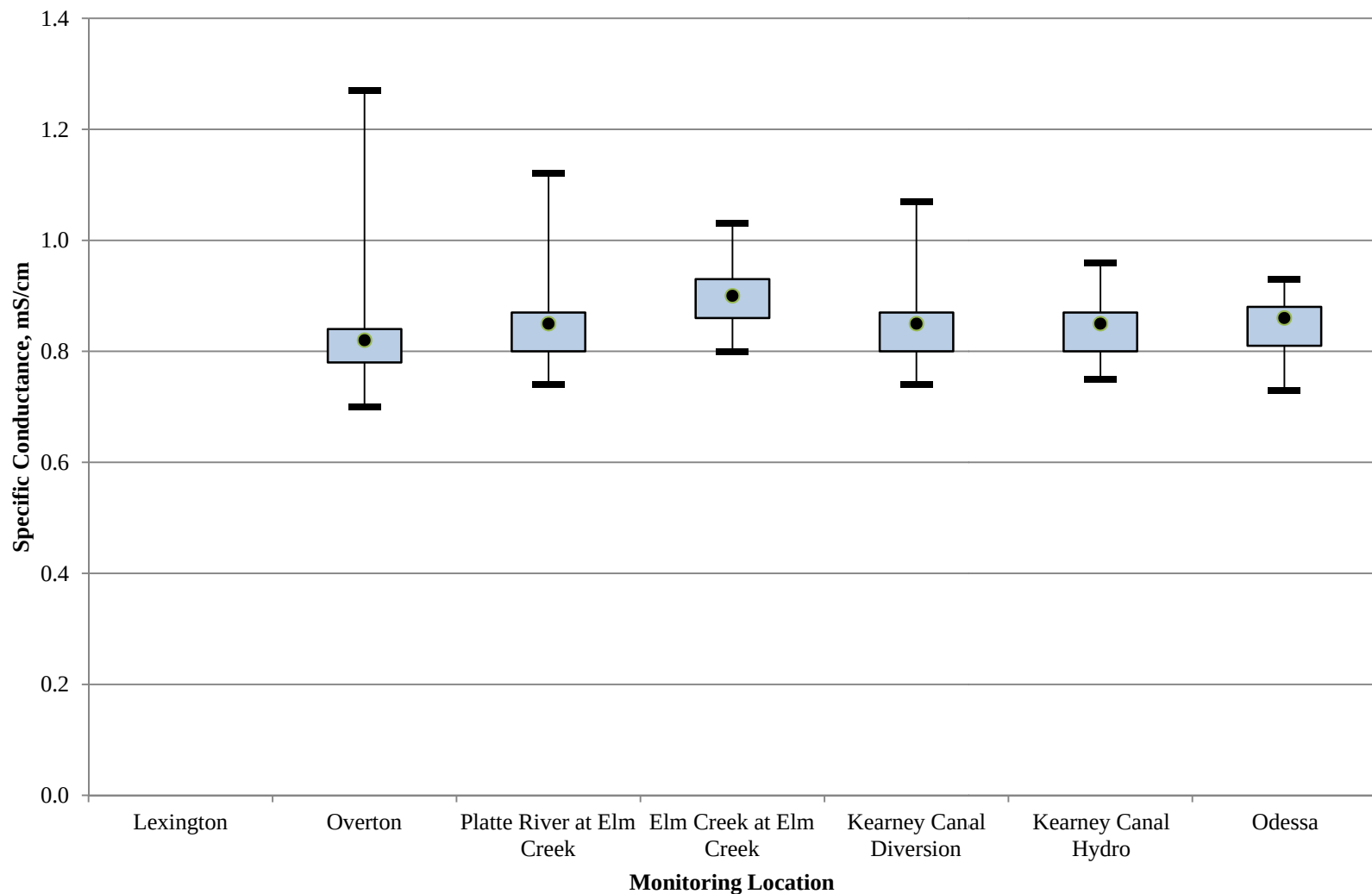




Figure B-9. Spatial Variation, pH, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

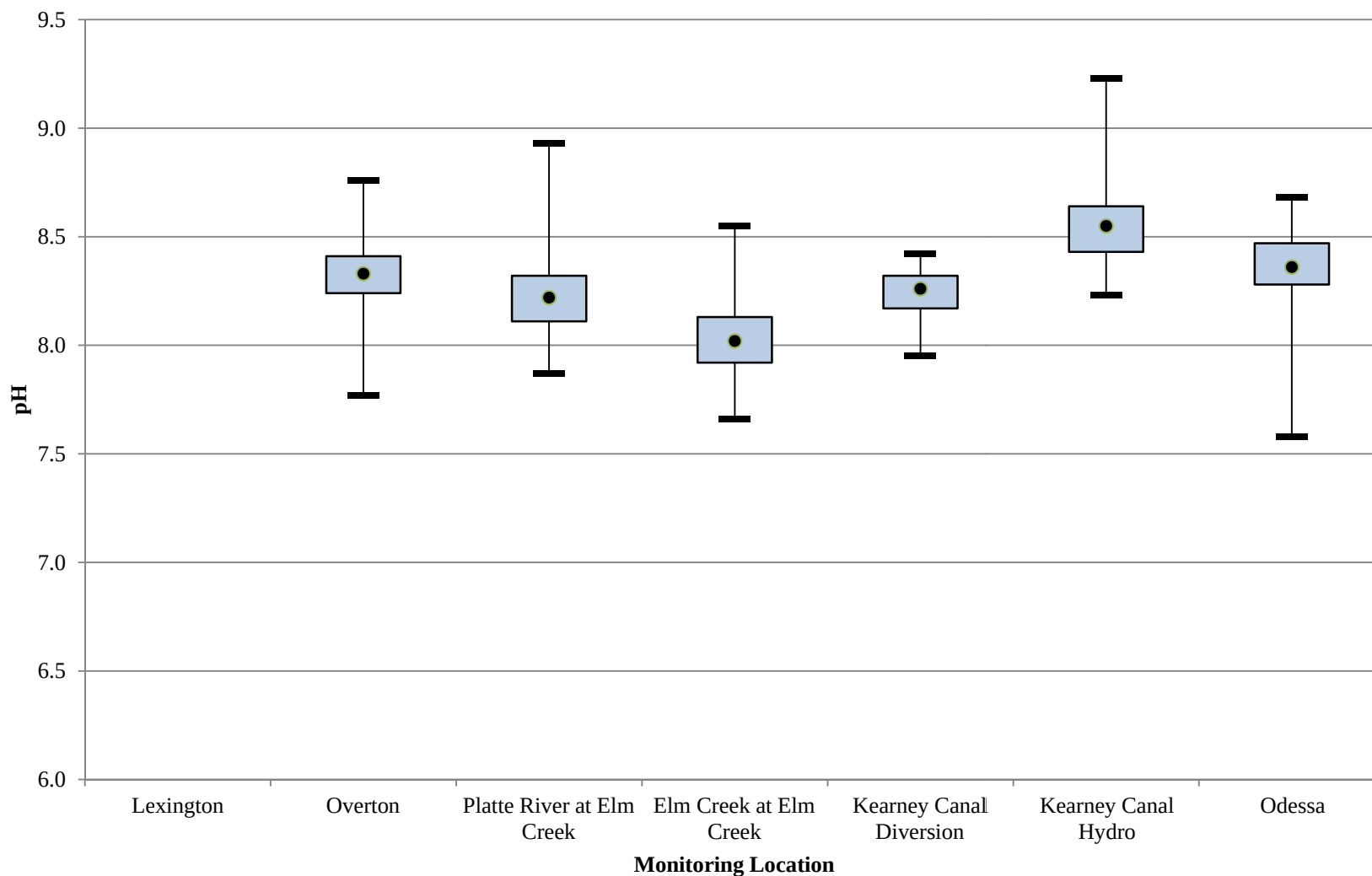




Figure B-10. Spatial Variation, Turbidity, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

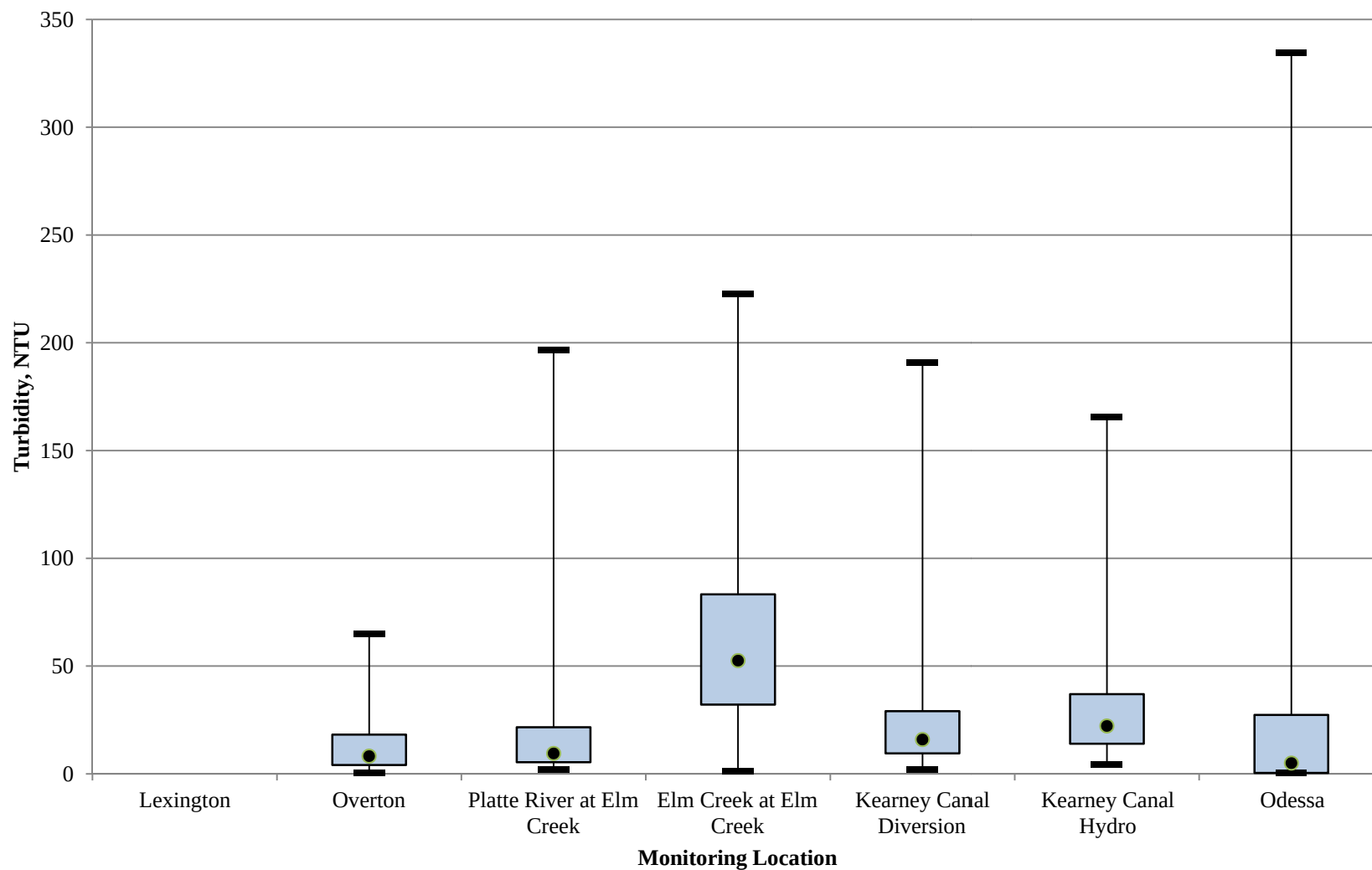




Figure B-11. Spatial Variation, Log Turbidity, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

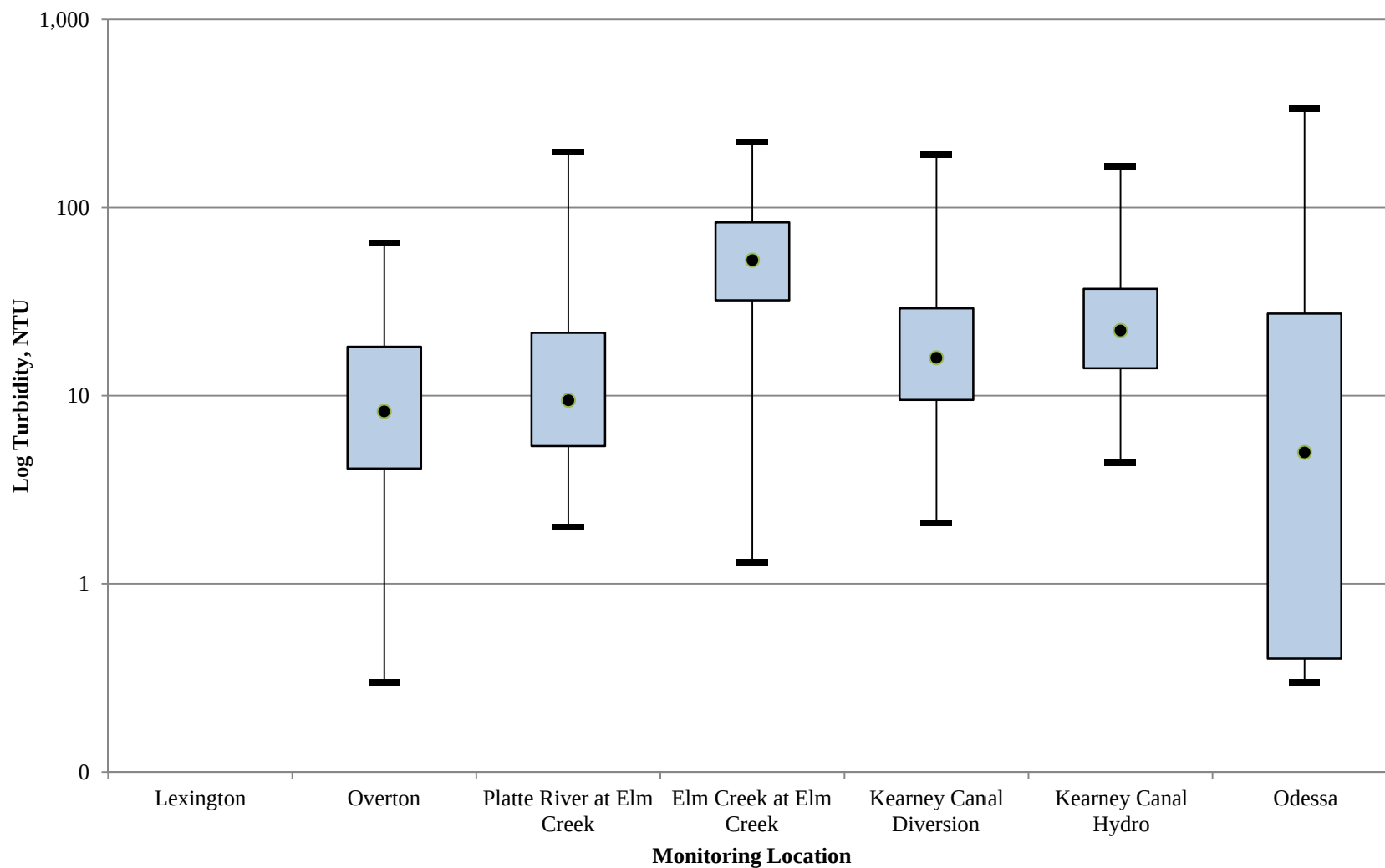




Figure B-12. Spatial Variation, Dissolved Oxygen, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

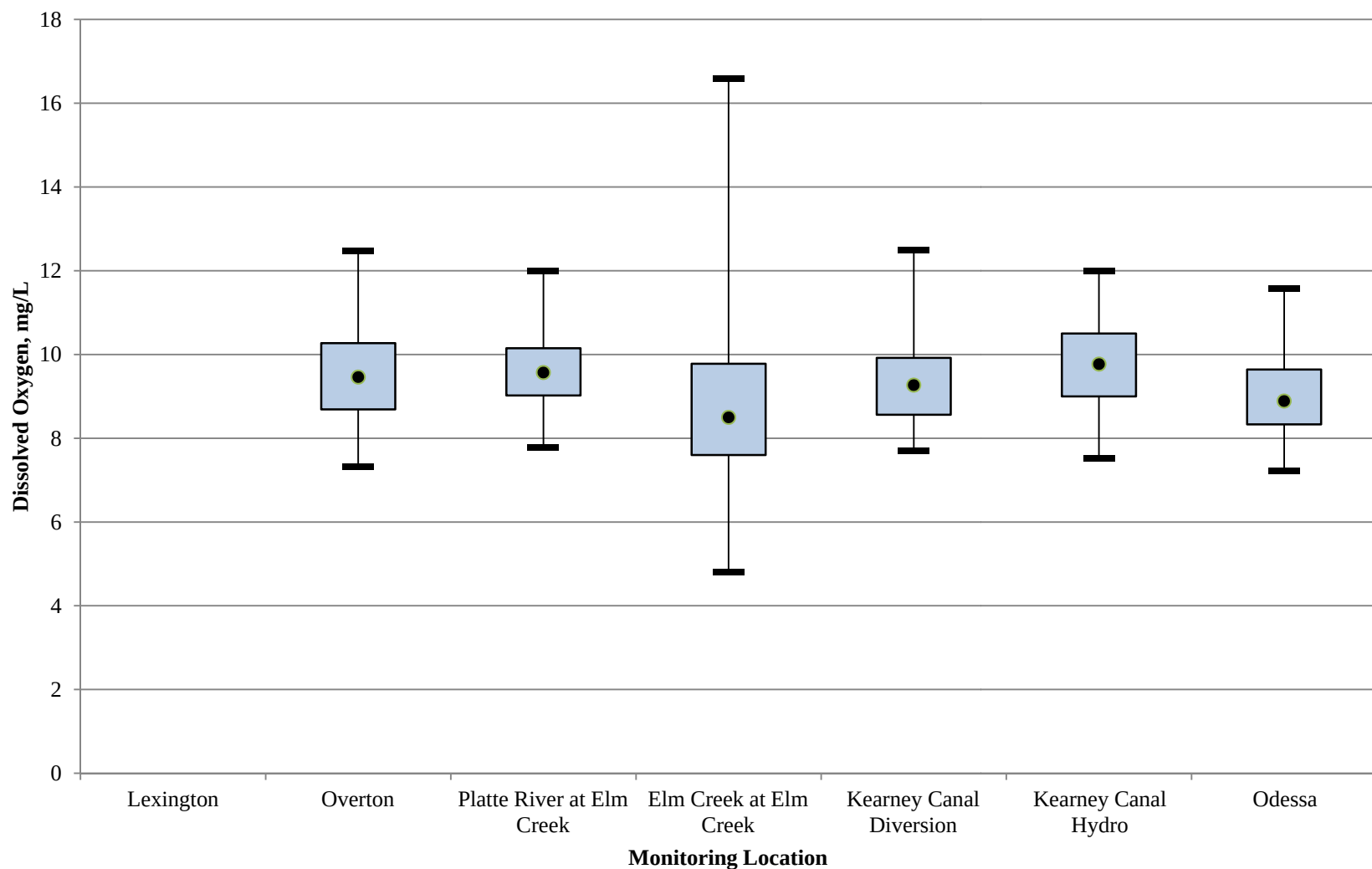
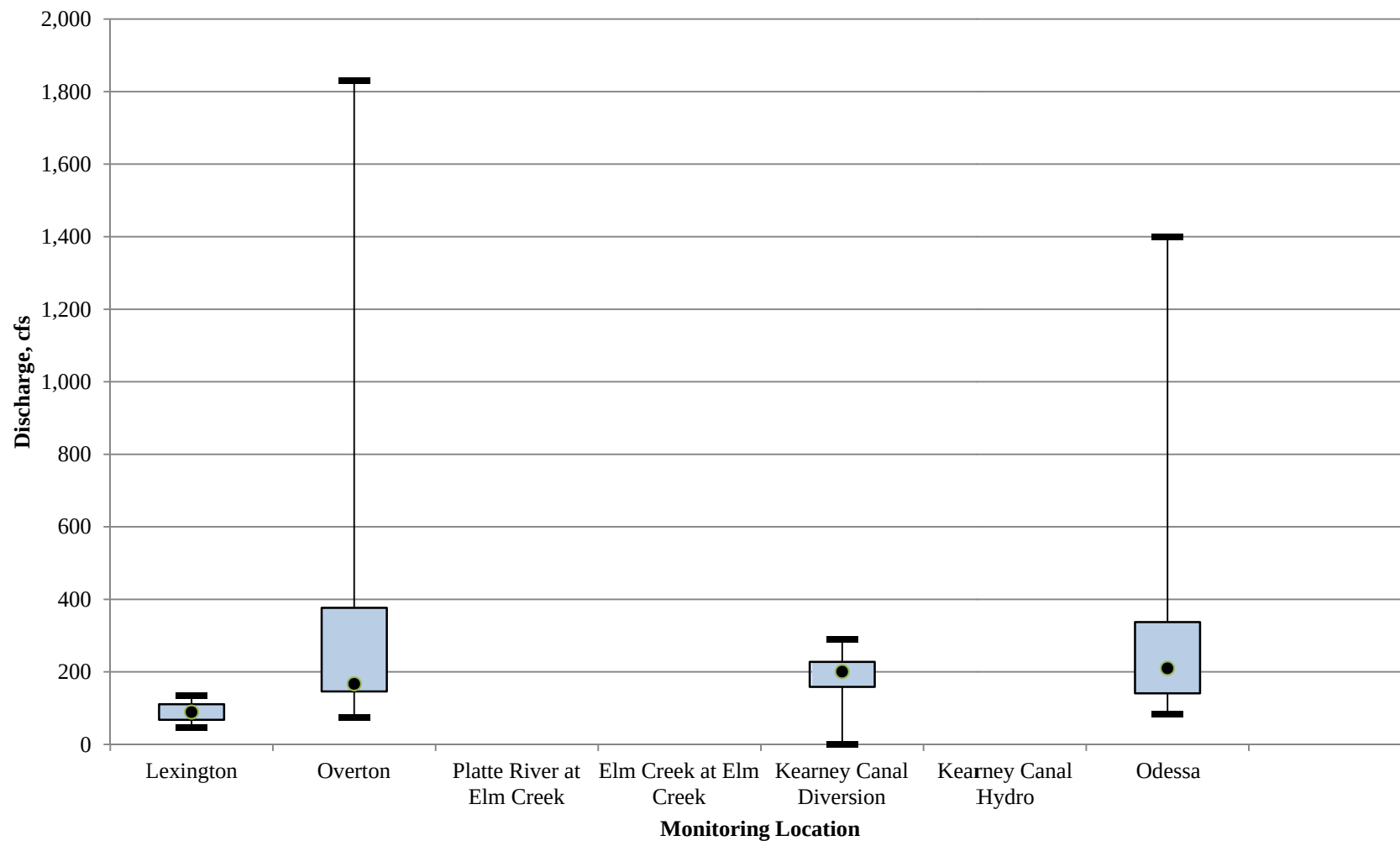




Figure B-13. Spatial Variation, Discharge, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)





Inter-Year Temporal Variation



Figure B-14. Temporal Variation, Temperature, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

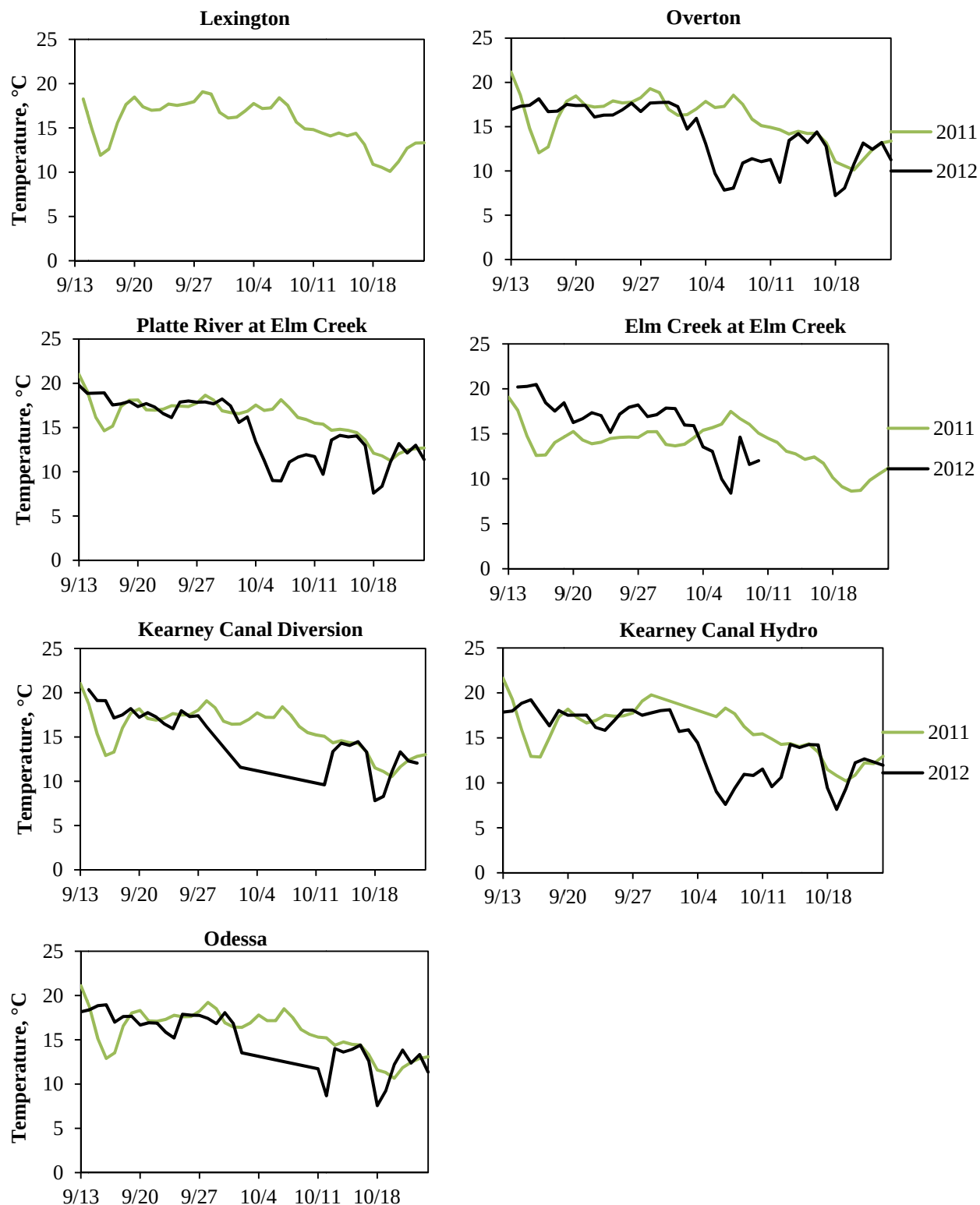




Figure B-15. Temporal Variation, Specific Conductance, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

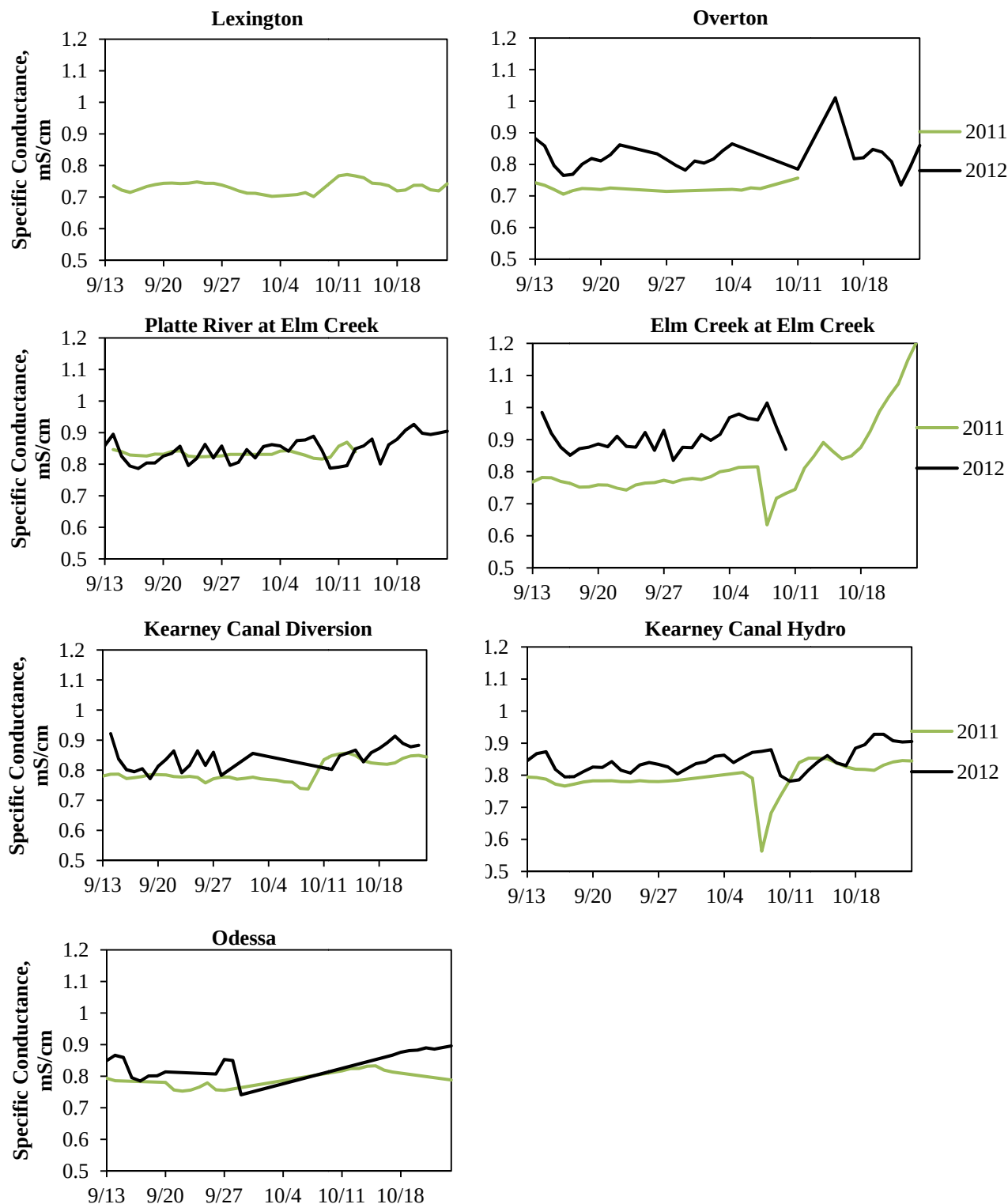




Figure B-16. Temporal Variation, pH, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

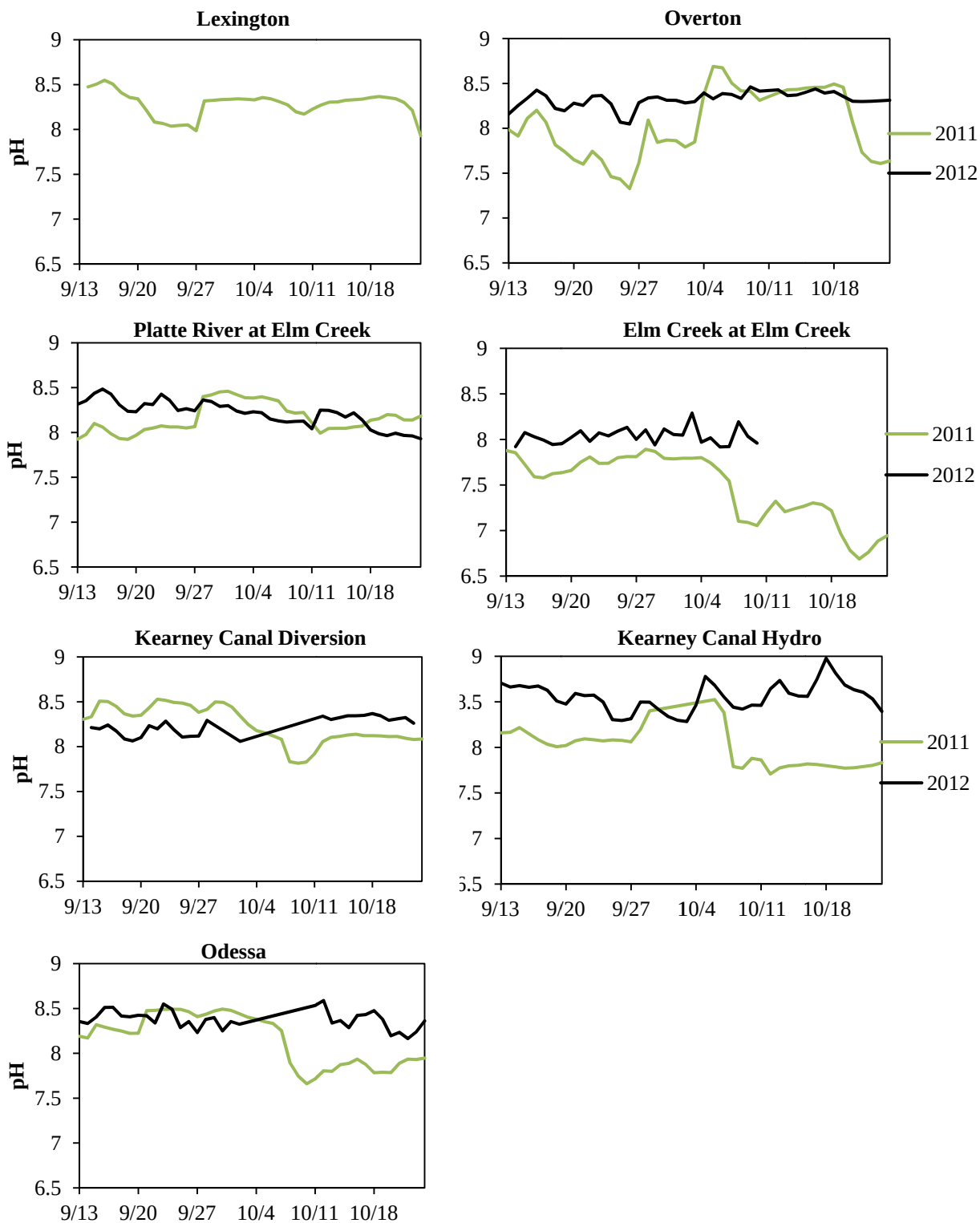




Figure B-17. Temporal Variation, Turbidity, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

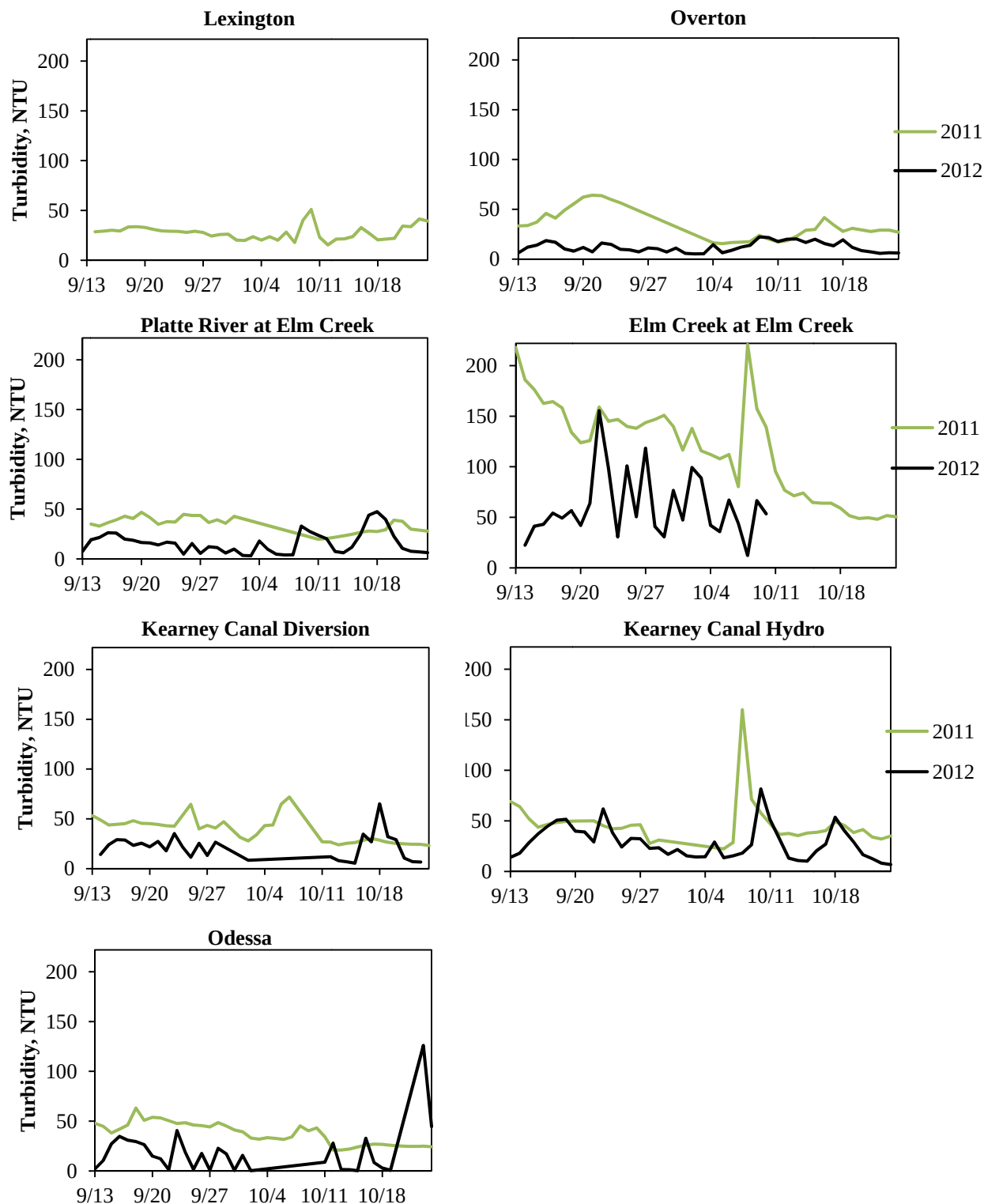




Figure B-18. Temporal Variation, Dissolved Oxygen, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

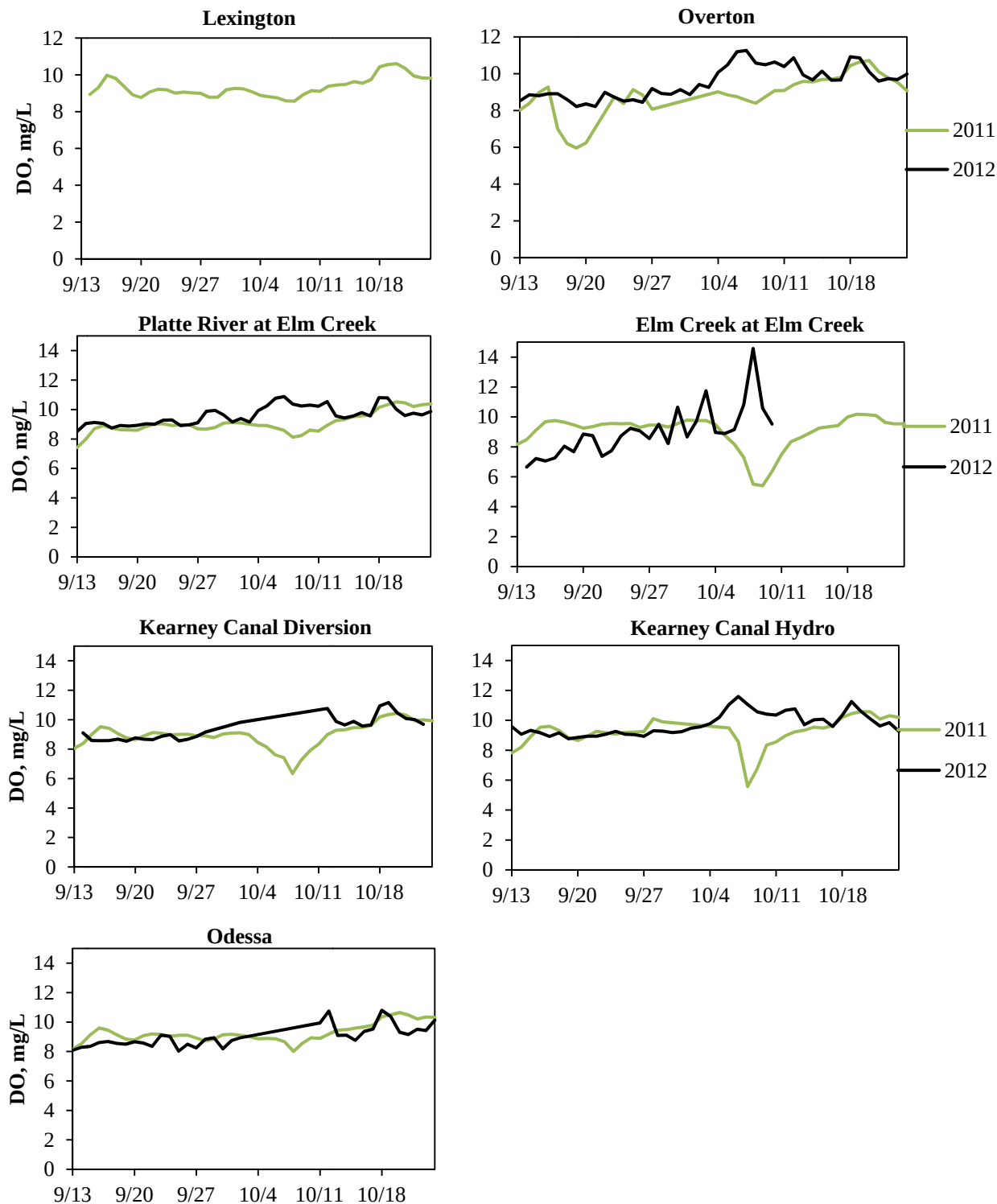
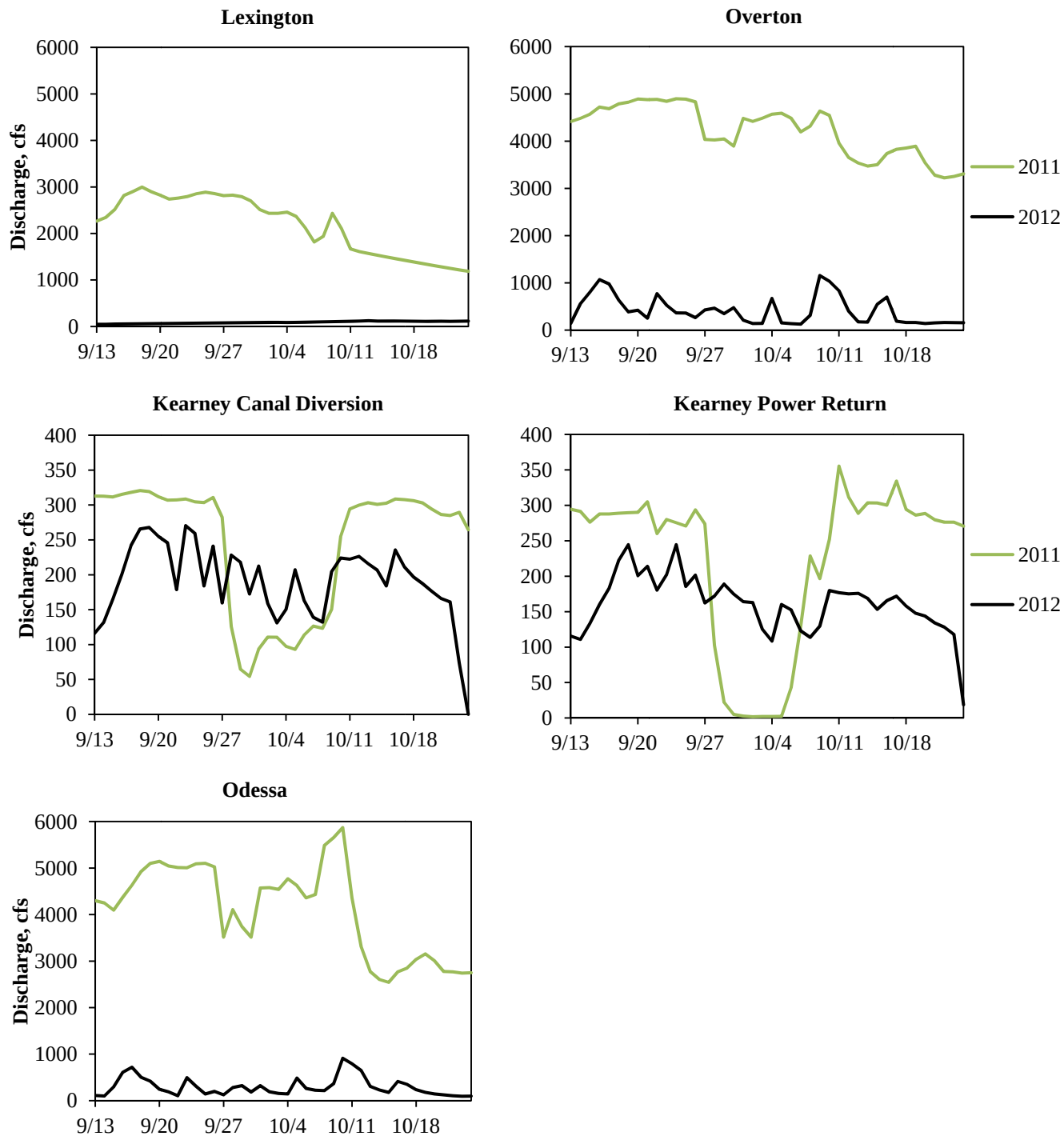




Figure B-19. Temporal Variation, Discharge, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)





Inter-Year Spatial Variation



Figure B-20. Spatial Variation, Temperature, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

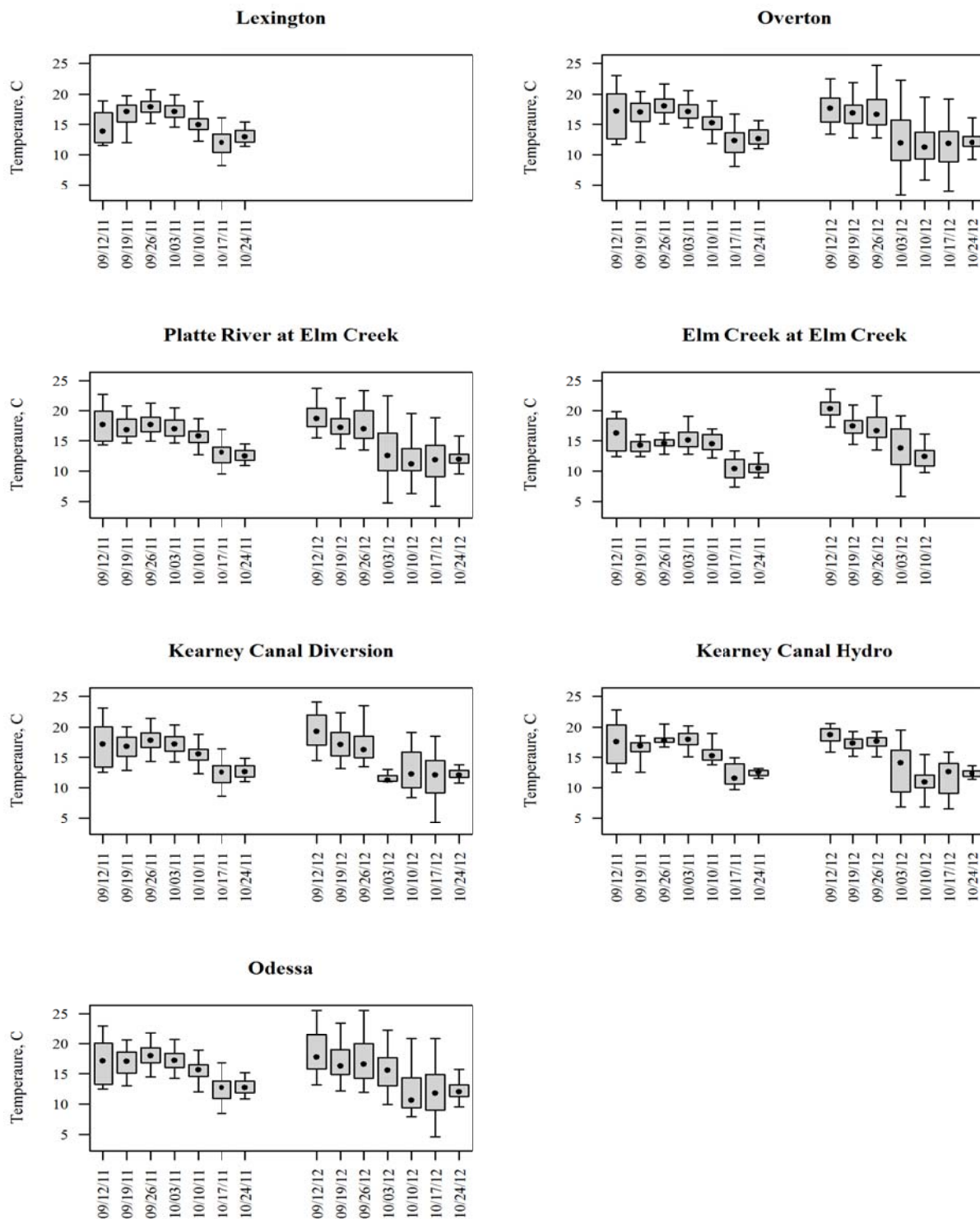




Figure B-21. Spatial Variation, Specific Conductance, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

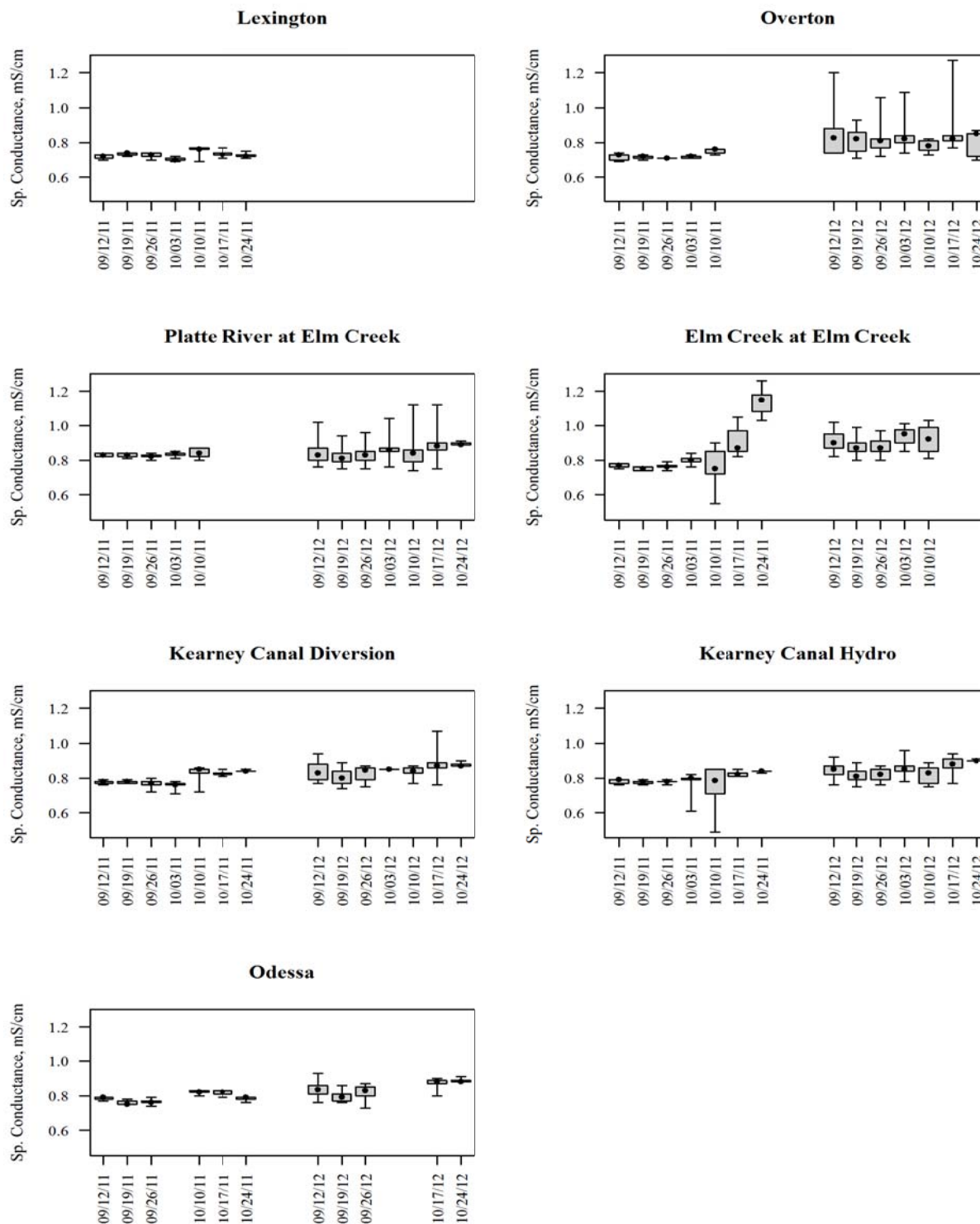




Figure B-22. Spatial Variation, pH, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

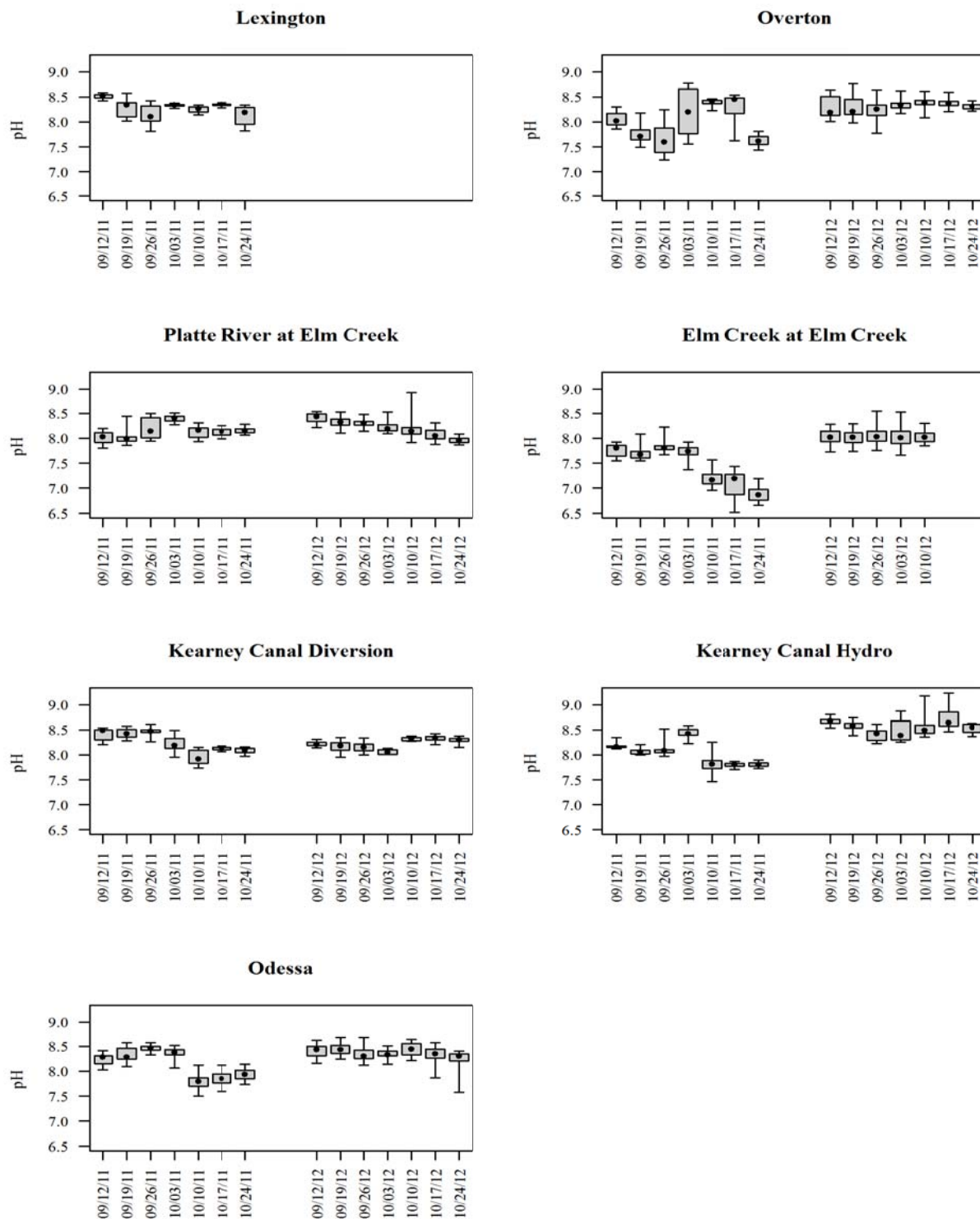




Figure B-23. Spatial Variation, Log Turbidity, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

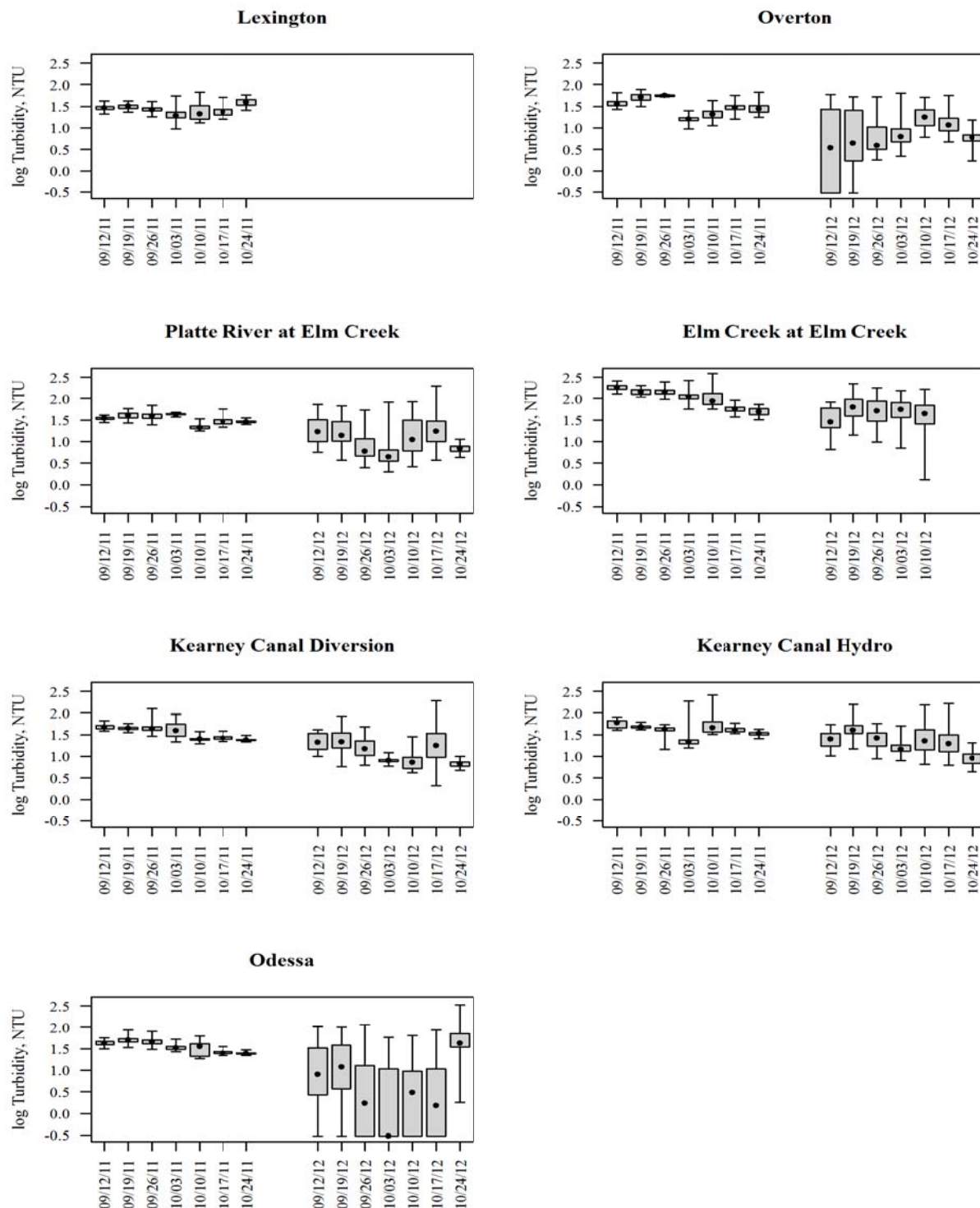




Figure B-24. Spatial Variation, Dissolved Oxygen, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

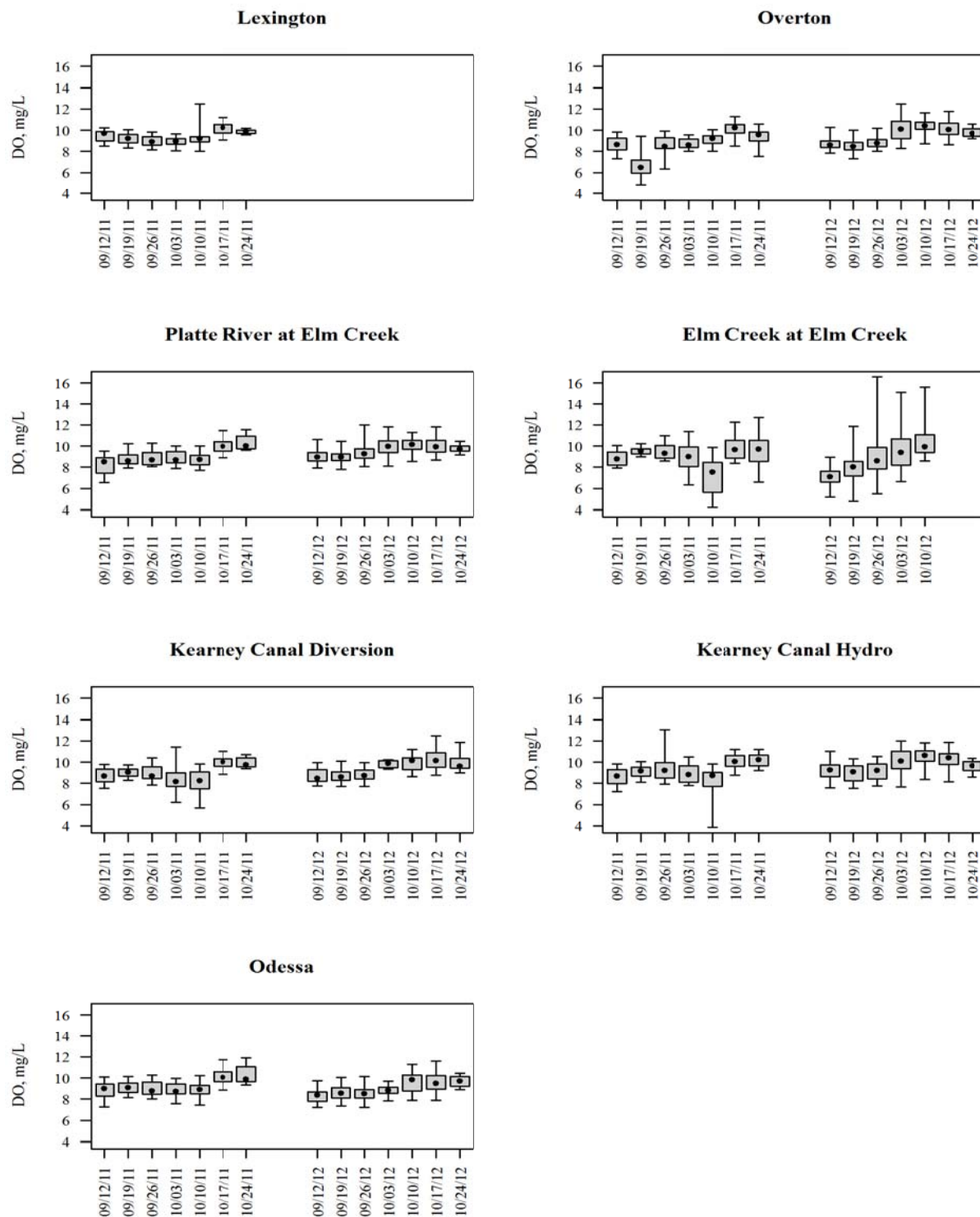
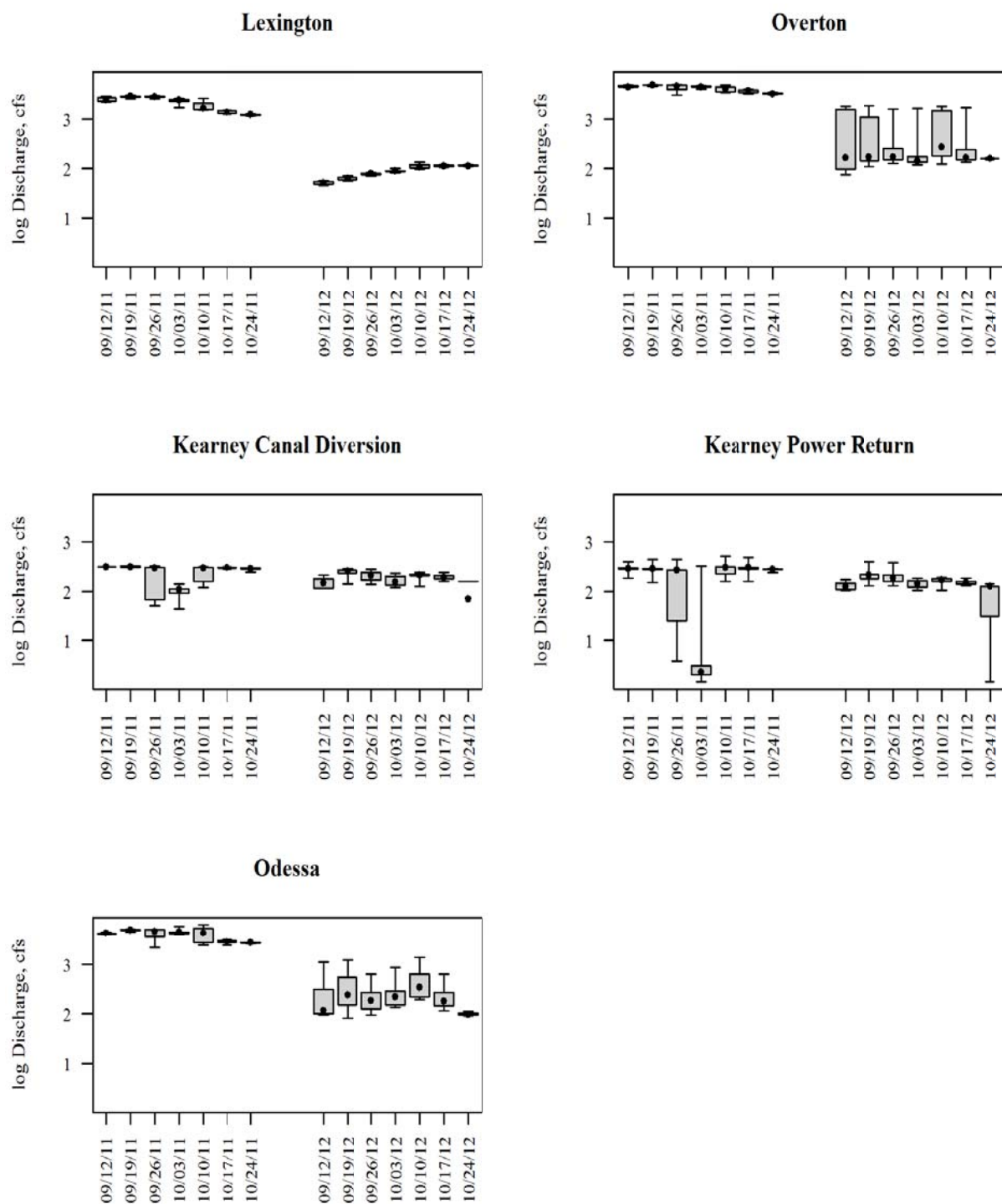




Figure B-25. Spatial Variation, Log Discharge, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)





Correlation of Total Suspended Sediments and Turbidity



Figure B-26. 2012 Linear Correlation, Suspended Sediments and Sonde Determined Turbidity

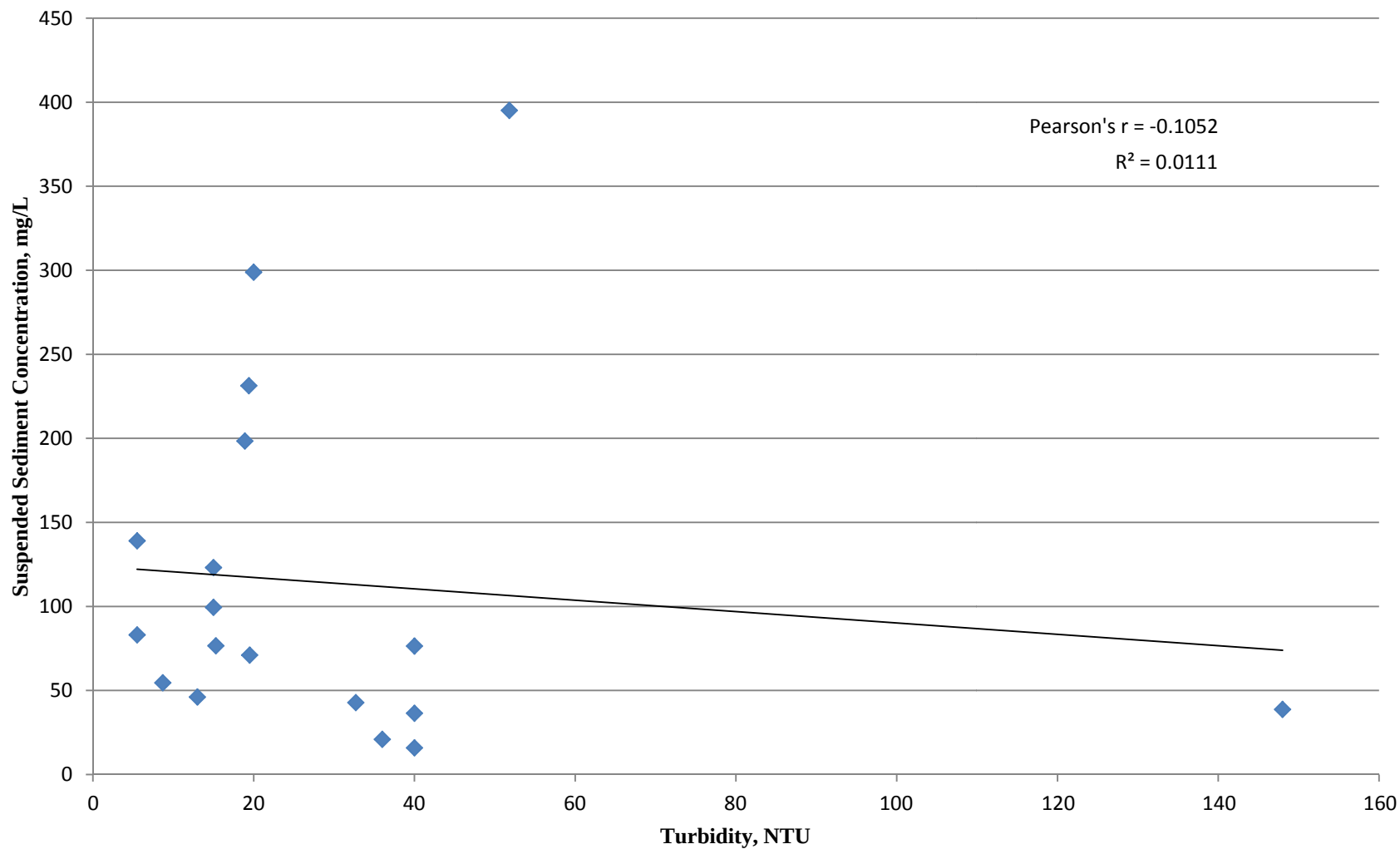




Figure B-27. 2012 Linear Correlation, Suspended Sediments and LaMotte Determined Turbidity

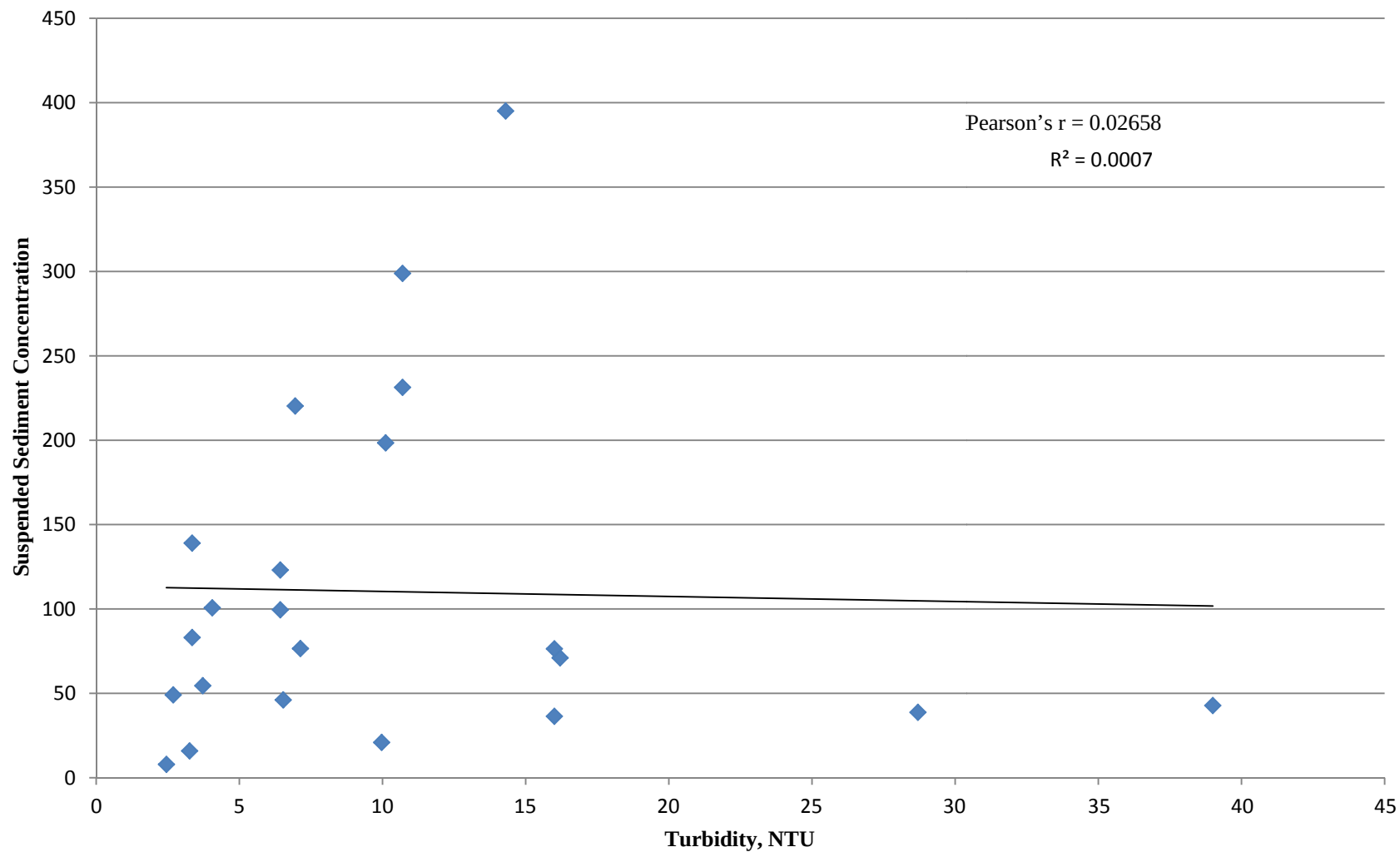
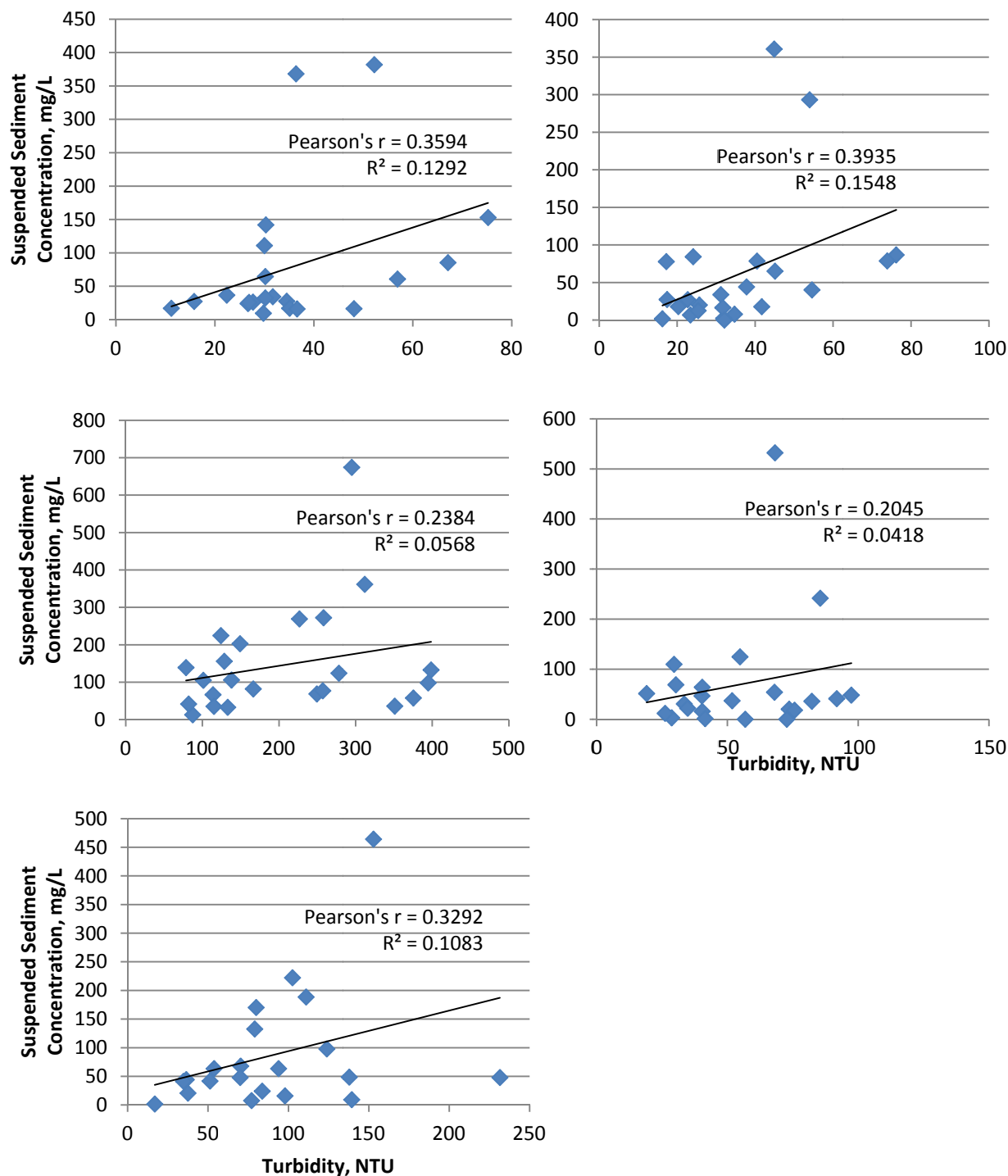




Figure B-28. 2011 Linear Correlation, Suspended Sediments and Turbidity





Statistical Analysis of Turbidity



Figure B-29. Discharge at J-2 Return and at Overton, 2012

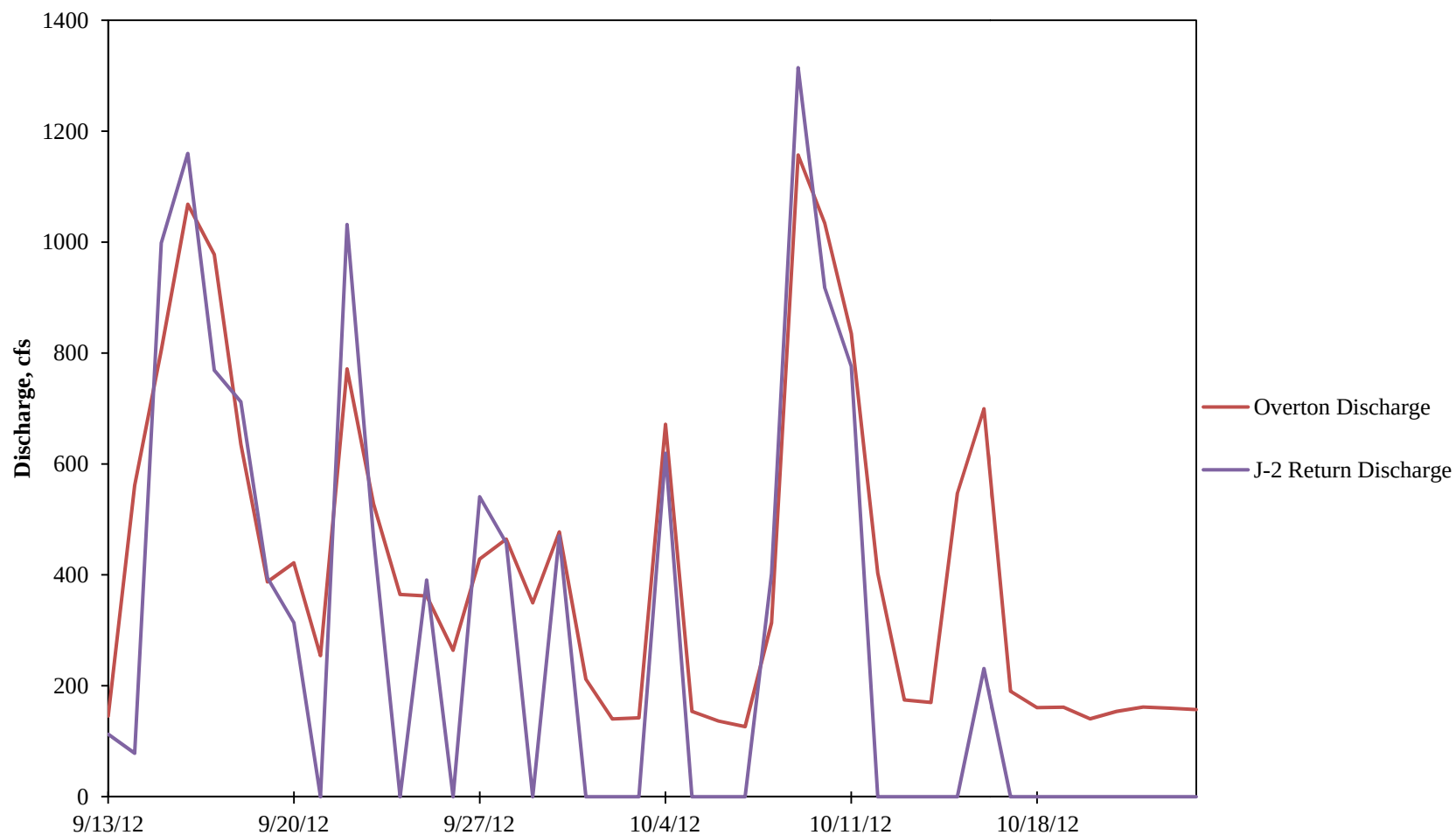




Figure B-30. Discharge at Overton and Platte River at Elm Creek, Turbidity, 2012

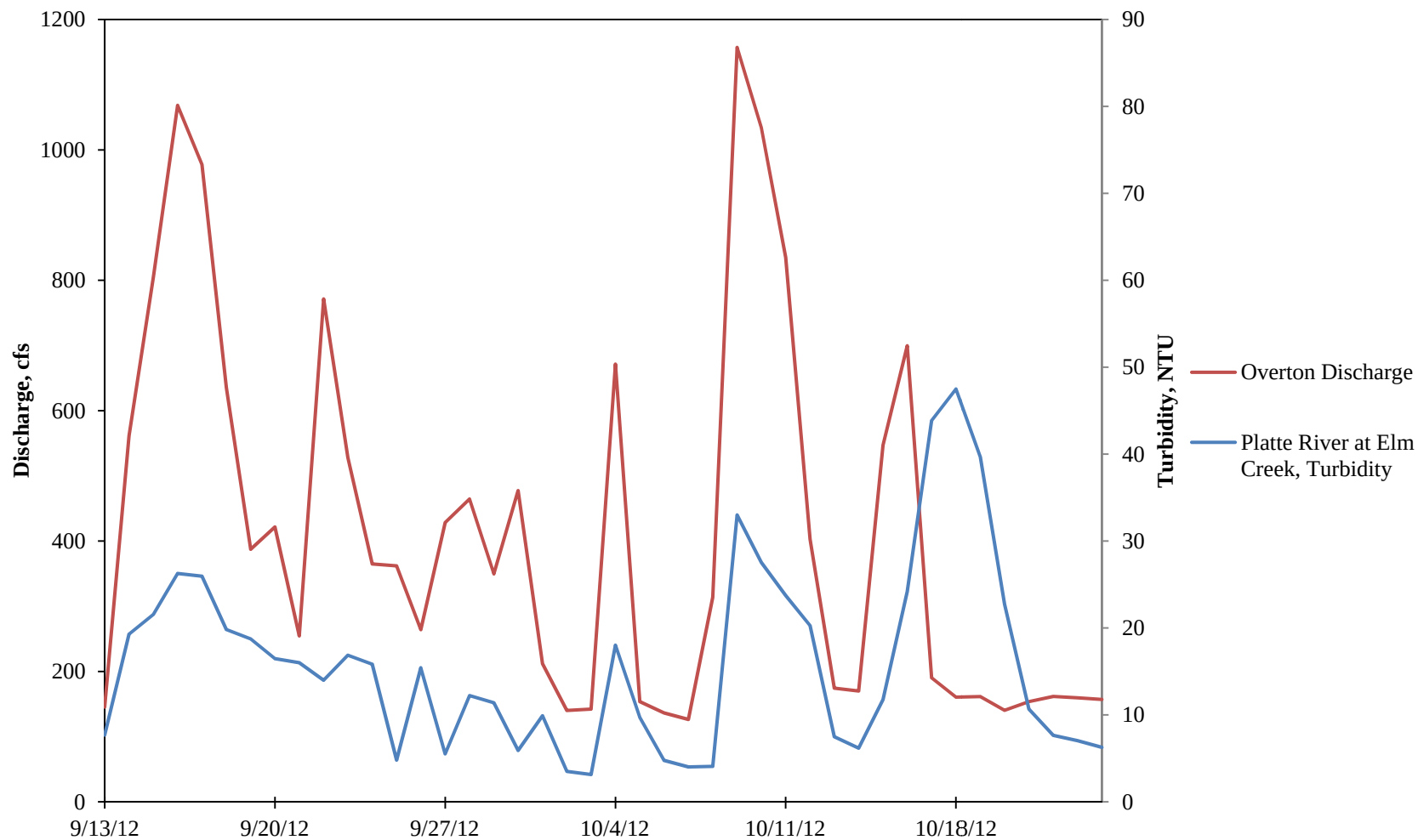




Figure B-31. Discharge at Overton and Kearney Canal Diversion Discharge and Turbidity, 2012

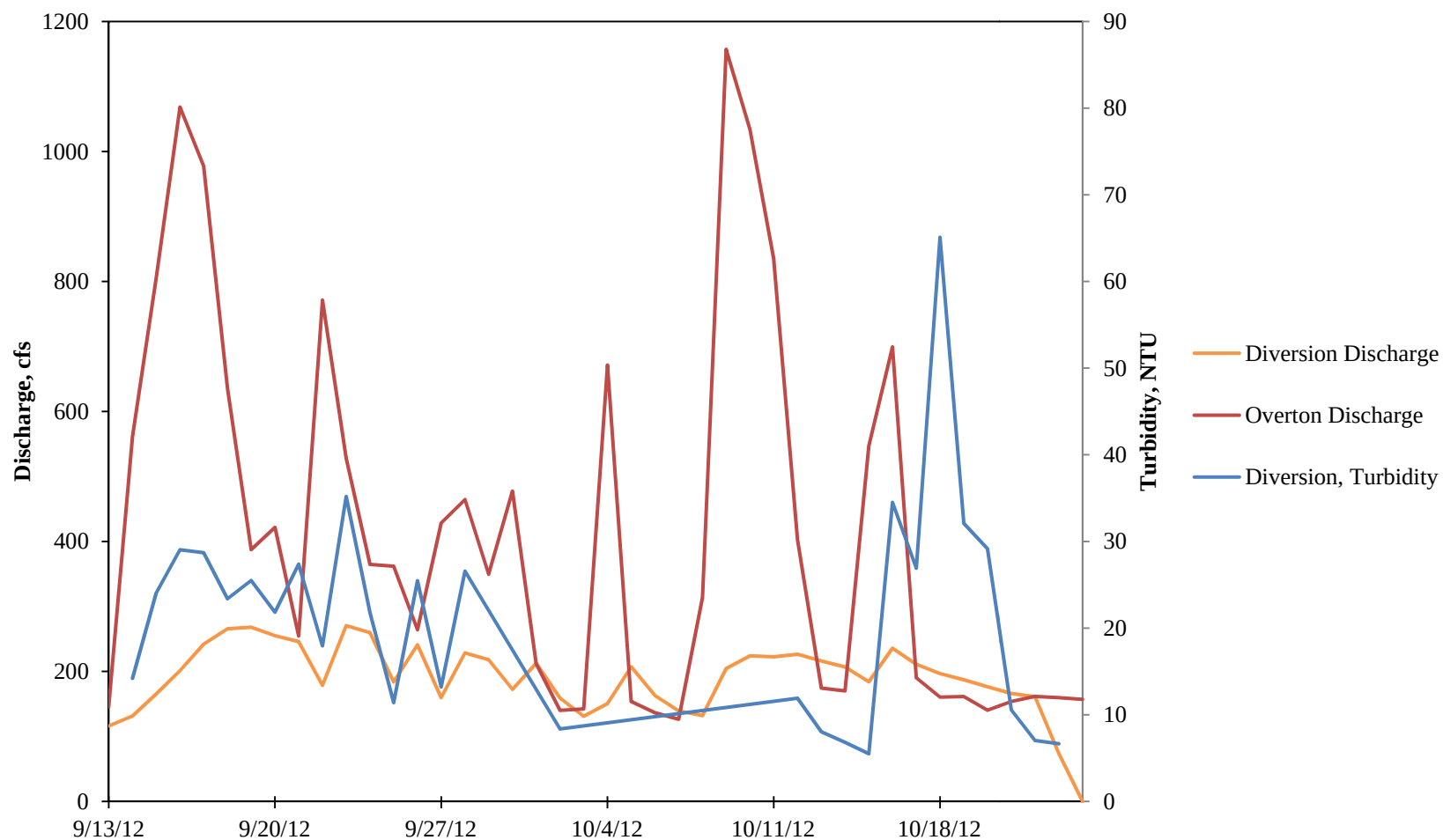




Figure B-32. Discharge at Overton and Kearney Canal Hydro Discharge and Turbidity, 2012

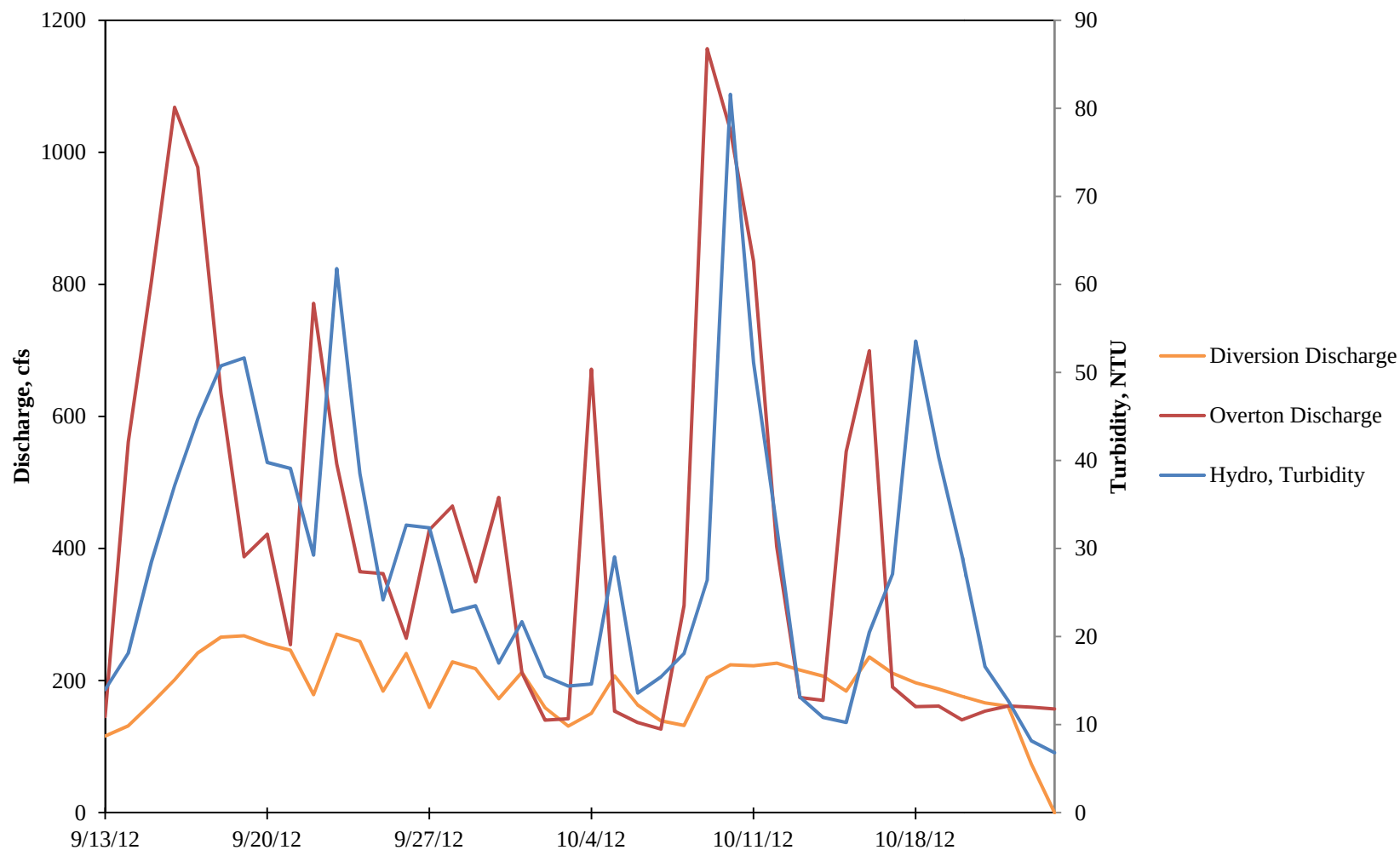




Figure B-33. Discharge at Overton, Dyer Property Sediment Augmentation Timeline, and Kearney Canal Hydro Turbidity, 2012

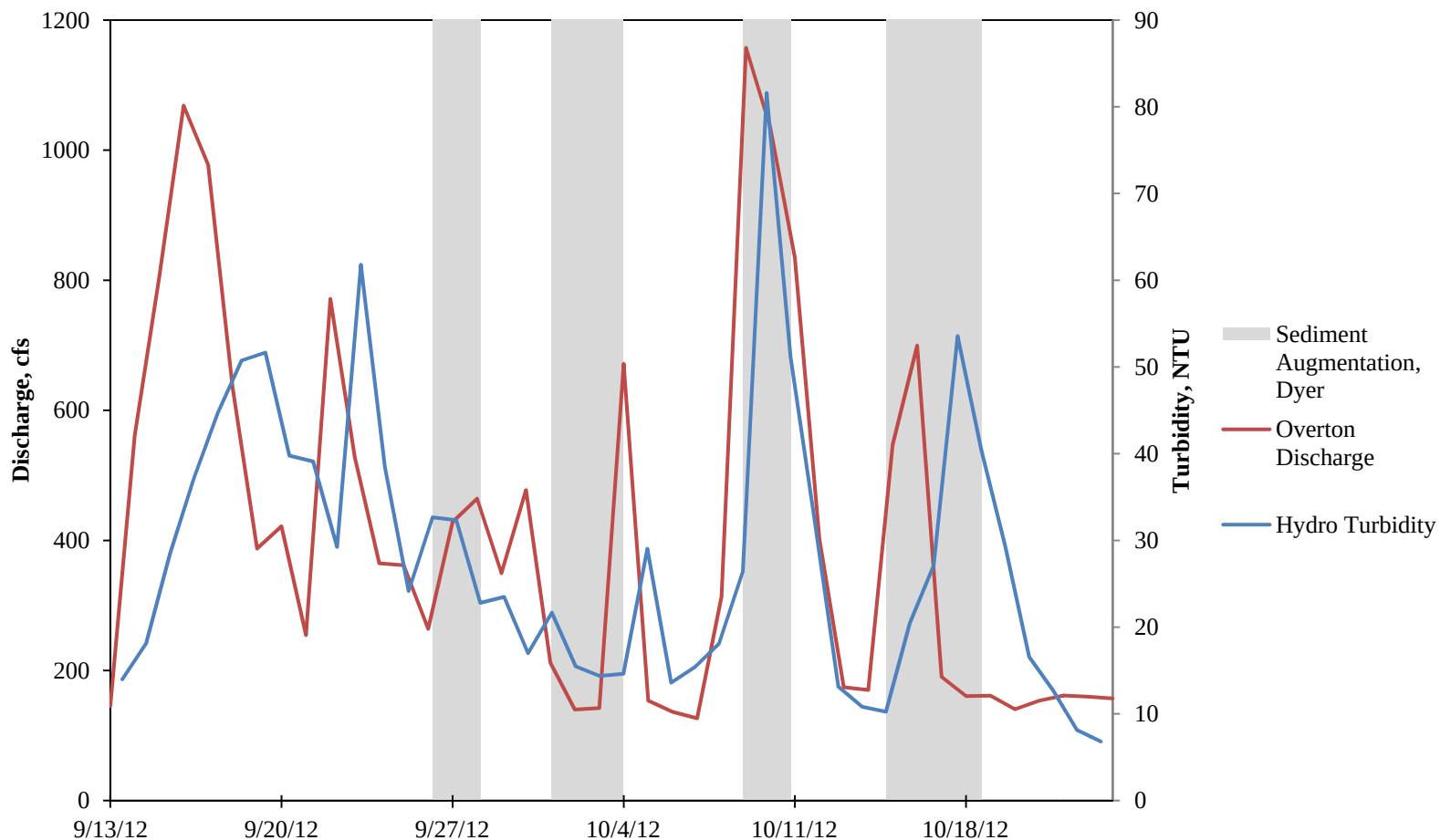
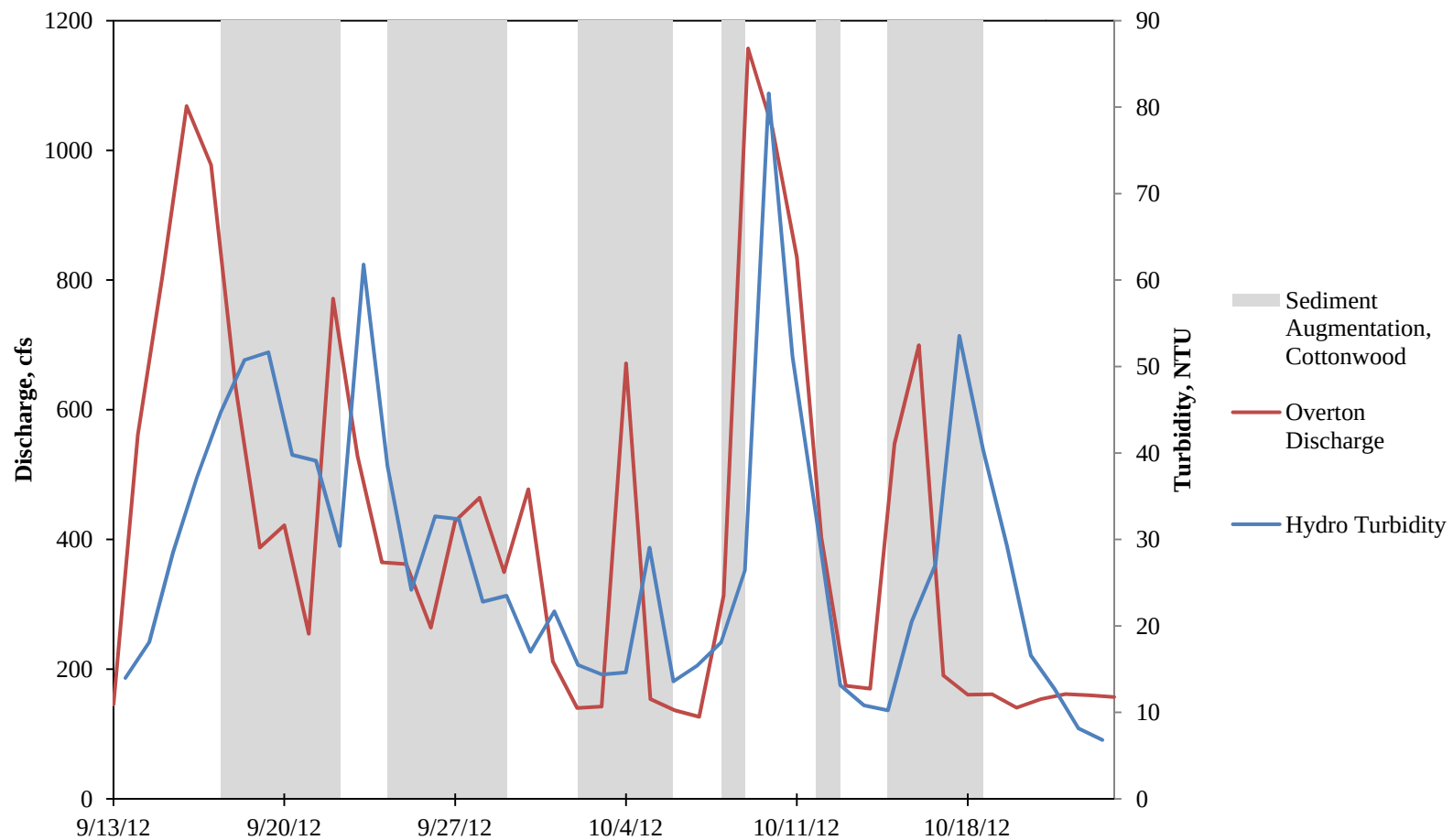




Figure B-34. Discharge at Overton, Cottonwood Ranch Sediment Augmentation Timeline, and Kearney Canal Hydro Turbidity, 2012





APPENDIX C

QA/QC Data



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I. QUALITY CONTROL SUMMARY

The Quality Control Summary describes the results of the data quality evaluation performed on the water quality parameters collected during the 2012 monitoring season. Water temperature, specific conductance, pH, turbidity, dissolved oxygen, and discharge data were collected in 2012. Analytical data included suspended sediment. The quality of the data collected and analyzed was assessed using the elements of precision, accuracy, representativeness, completeness, and comparability. Overall the quality of the Kearney Canal water quality data collected was found to be of sufficient quality to characterize water quality during the monitoring period. Data that was not representative was removed from the data base prior to summarization and evaluation of the data.

I.A. Precision

Measurement of precision was accomplished by collecting duplicate water quality readings and duplicate samples. The premise being that two samples collected simultaneously from the same location should yield similar results. The variation between duplicate samples that is accepted is a function of the monitoring objectives and the inherent variation around each parameter. Precision was measured during the Protocol in terms of Relative Percent Difference (RPD) which is calculated using the following formula:

$$RPD = (X_1 - X_2) / [(X_1 + X_2) / 2]$$

X_1 and X_2 = reported concentrations for each duplicate sample.

Data were considered acceptable if the RPD was less than or equal to 50% for each parameter.

I.A.1. Continuous Water Quality Data

Duplicate water quality readings were collected for continuous water quality data using hand-held meters for temperature, specific conductance, pH, turbidity, and dissolved oxygen at each location during each sonde maintenance event. A summary of duplicate readings that exceeded the 50% RPD threshold is presented in Table 1; all duplicate sample collection results are presented in Appendix C, Table C-4 through C-9.

Table C-1. Relative Percent Difference (RPD) Exceedances for Duplicate Samples

Parameter	Location	Date	Hand Held	Sonde	RPD
Turbidity	OVRPR	September 13, 2012	2.36	1.00	80.95%
Turbidity	OVRPR	September 19, 2012	3.60	1.30	93.88%
Turbidity	OVRPR	September 26, 2012	3.52	0.40	159.18%
Turbidity	ELMPR	October 04, 2012	6.20	2.30	92.27%
Turbidity	ELMCR	September 20, 2012	27.70	49.50	56.48%
Turbidity	ODSPR	September 13, 2012	1.86	0.00	200.00%
Turbidity	KCPH	October 12, 2012	14.30	28.10	65.09%



The procedure for collecting duplicate water samples was to retrieve the sonde from the water and immediately place it in a five gallon bucket of source water in the shade. The handheld instruments used for the paired readings were then immersed in the same bucket with the sonde and permitted to equilibrate. During the equilibration period, the sonde was connected to the laptop and set to display live readings of the water quality parameters being measured. Once parameters were stabilized, readings were recorded on the field data sheets.

- **Temperature** – All of the possible 32 duplicate readings were taken for temperature during the 2012 monitoring season. None of the paired readings exceeded the 50% RPD for duplicate temperature readings. The minimum RPD was 0.05%, and the maximum RPD was 5.80%.
- **Specific Conductance** – All of the possible 32 duplicate specific conductance readings were taken during the 2012 monitoring season. None of the paired readings exceeded the 50% RPD with a minimum RPD of 0.00% and maximum RPD of 2.61%.
- **pH** – All of the possible 32 duplicate pH readings were taken during the 2012 monitoring season. None of the paired readings exceeded the 50% RPD with a minimum RPD of 0.00% and maximum RPD of 7.51%.
- **Turbidity** – All of the possible 32 duplicate turbidity readings were taken during the 2012 monitoring season. Of the paired RPD readings, seven (22%) exceeded the 50% RPD for duplicate turbidity readings ranging from 56.48% to 200.00%. The minimum RPD for turbidity was 0.00%. High RPD values for turbidity resulted from biological fouling, algal growth and insect colonization on the optical lens for the turbidity probe.
- **Dissolved Oxygen** – All of the possible 32 duplicate dissolved oxygen readings were taken during the 2012 monitoring season. None of the paired readings exceeded the 50% RPD, with a minimum RPD of 0.36% and maximum RPD of 14.54%.

I.A.2. Discrete Water Quality Data

One duplicate water sample was collected for each discrete water sampling event. A summary of suspended sediment concentrations is presented below, and all duplicate sample collection results are presented in Appendix C, table C-10. A summary of duplicate readings that exceeded the 50% RPD threshold is presented in Table C-2.

Table C-2. Relative Percent Difference (RPD) Exceedances for Duplicate Samples

Date	Location	Concentration, ppm	RPD
09/20/12	DUP	36.45	70.81%
	KCPH	76.41	
09/27/12	DUP	139.07	50.36%
	ECPR	83.12	



- **Suspended Sediment Concentration** – Four water sampling events were performed during the 2012 monitoring season for the collection and analysis of suspended sediment. A duplicate water sample was collected during each sampling event for precision analysis. RPD exceeded 50% in 2 of the 4 (50%) duplicate analyses performed, ranging from 50.36% to 70.81%.

I.B. Accuracy

Measurement of accuracy was accomplished with sonde calibration standards and was quantified as the percent recovery from analysis of a known concentration. The data quality objective for accuracy for all measurements in the Protocol is:

$$\% \text{Recovery} = 85\% \text{ to } 115\%$$

Other checks for accuracy were accomplished through close adherence to instrument calibration procedures. A summary of duplicate readings that were outside the recovery range are presented in Table 3 and all duplicate sample collection results are presented in Appendix C, Table C-11 through C-16.

Table C-3. Percent Recovery Exceedances for Spiked Sample Recoveries

Parameter	Location	Date	Spike	Sonde	% Recovery
Turbidity	ELMPR	September 27, 2012	100	137.30	137.30%
Turbidity	KCDIV	September 27, 2012	100	115.19	115.19%
Turbidity	ELMPR	October 04, 2012	100	69.80	69.80%
pH	ELMCR	September 14, 2012	7	5.82	83.14%
pH	ELMPR	September 13, 2012	7	5.86	83.71%

Accuracy readings were collected after duplicate readings had been taken and the sonde and probes were cleaned. The sonde was placed in known (spiked) standards and the sonde parameter reading in the standard (spike) was recorded on the field data sheets to measure accuracy.

- **Specific Conductance** – All of the possible 33 accuracy readings were taken for specific conductance during the 2012 monitoring season. All of the spiked specific conductance readings for accuracy were within the 85 to 115% recovery range.
- **pH** – All of the possible 33 accuracy readings were taken for pH during the 2012 monitoring season. Two of the spiked pH readings for accuracy fell outside the accuracy range of 85 to 115%.



- **Turbidity** – All of the possible 33 accuracy readings were taken for turbidity during the 2012 monitoring season. Three of the spiked turbidity readings for accuracy fell outside the accuracy range of 85 to 115%.
- **Dissolved Oxygen** – All of the possible 33 accuracy readings were taken for dissolved oxygen during the 2012 monitoring season. All of the spiked dissolved oxygen readings for accuracy were within the 85 to 115% recovery range.

I.C. Representativeness

- **Continuous Water Quality Data**
Representativeness was addressed by adhering to the Protocol procedures, manufacturer calibration procedures, and a sampling plan that describes appropriate location, time, and conditions for data collection. Conditions that may result in a “non-representative sample” were noted on the field data sheet and were evaluated during the data review process. A review of the field data sheets (Appendix E) revealed several “conditions” which resulted in “non-representative” data points being collected.

Temperature and pH were found to be consistent and stable during the monitoring program and minimally affected by monitored environmental conditions. Environmental conditions resulting in non-representative data being collected, including: burial of the sonde in sediment, sediment accumulation in the specific conductance measurement cell, algal growth on the optical aperture of the dissolved oxygen and turbidity probes, and insect colonization on all the probes – particularly the dissolved oxygen and turbidity probes. The raw data in combination with the field data sheets was reviewed to determine “non-representative” data. Non-representative data were excluded from the summary data.

I.D. Comparability

Comparability of data can be affected by several factors including changes in sample location, parameters, collection, or analytical techniques, etc. Quality assurance procedures were incorporated throughout the Protocol to help assure that comparable data was obtained. These quality assurance procedures included written descriptions of all sample locations; assignment of sampling responsibilities to the same personnel or the appropriate training for new personnel; establishment of a set parameter list; and description of data collection, analysis, and assessment procedures. Adherence to these procedures was closely evaluated during the data quality review process.

I.E. Completeness

Completeness refers to the amount of data necessary to meet the monitoring objectives. To help ensure that all of the designed monitoring data and water samples were collected, a sampling schedule was prepared and distributed. An inventory and review process was implemented to



maintain data collected, and routinely checked for potential errors, missing data, and missing information on field data sheets. It was the responsibility of the sample collector to make sure field data sheets were completely and accurately filled out, and to report missing data from the sondes.

I.F. Deviations from Methods and Procedures

No deviations were identified from the methods and procedures listed in the Water Quality Monitoring Protocol.



Acronym List	
%R = Percent Recovery	LEXPR = Platte River, Lexington, NE
°C = degrees Celsius	mg/L = Milligrams per liter
DUP = Duplicate	mS/cm = milliSiemens per centimeter
ELMCR = Elm Creek, Elm Creek, NE	NTU = Nephelometric Turbidity Units
ELMPR = Platte River, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCDIV = Kearney Canal Diversion, Elm Creek, NE	OVRPR = Platte River, Overton, NE
KCPH = Kearney Canal Power House, Kearney, NE	RPD = Relative Percent Difference



Precision, Duplicate Continuous Water Quality Data, Relative Percent Difference



Table C-4. Duplicate Water Quality RPDs, Continuous Data, Platte River, Overton, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
09/13/12	21.85	21.84	0.05%	8.31	8.28	0.36%	7.88	8.40	6.39%	0.894	0.871	2.61%	2.36	1.00	80.95%
09/19/12	21.93	22.04	0.50%	8.27	8.37	1.20%	8.09	7.98	1.37%	0.873	0.863	1.15%	3.60	1.30	93.88%
09/26/12	23.09	23.13	0.17%	8.49	8.46	0.35%	8.37	8.40	0.36%	0.820	0.828	0.97%	3.52	0.40	159.18%
10/02/12	16.75	16.90	0.89%	8.35	8.47	1.43%	11.19	10.17	9.55%	0.823	0.811	1.47%	2.82	3.50	21.52%
10/11/12	14.54	14.61	0.48%	8.37	8.27	1.20%	10.34	10.15	1.85%	0.841	0.845	0.47%	6.81	7.70	12.27%
10/17/12	12.63	12.76	1.02%	8.43	8.64	2.46%	9.24	10.10	8.89%	0.815	0.825	1.22%	2.86	4.20	37.96%
10/24/12	11.26	11.42	1.41%	8.54	8.41	1.53%	10.86	10.24	5.88%	0.832	0.823	1.09%	2.24	1.60	33.33%

Table C-5. Duplicate Water Quality RPDs, Continuous Data, Platte River, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
09/20/12	17.64	17.78	0.79%	8.10	8.34	2.92%	9.76	9.70	0.62%	0.811	0.811	0.01%	10	7.15	33.24%
09/27/12	15.76	15.93	1.07%	8.18	8.32	1.70%	10.57	10.31	2.49%	0.848	0.856	0.94%	3.4	4.6	31.45%
10/04/12	10.26	10.27	0.10%	8.59	8.48	1.29%	12.07	11.20	7.48%	0.869	0.874	0.57%	6.2	2.3	92.27%
10/12/12	9.00	9.11	1.21%	8.47	8.30	2.03%	11.38	11.31	0.62%	0.780	0.799	2.42%	10.1	10.9	7.52%
10/25/12	5.56	5.64	1.43%	8.47	8.33	1.67%	12.16	12.21	0.41%	0.877	0.888	1.24%	4.5	4.0	12.18%



Table C-6. Duplicate Water Quality RPDs, Continuous Data, Elm Creek, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
09/20/12	18.59	19.70	5.80%	7.77	8.03	3.29%	8.18	8.43	3.01%	0.901	0.901	0.03%	27.7	49.5	56.48%
09/27/12	19.13	19.30	0.88%	7.89	7.82	0.89%	6.85	7.01	2.31%	1.017	1.027	0.98%	4.6	3.9	16.47%
10/04/12	15.28	15.38	0.65%	8.00	7.97	0.38%	11.67	10.37	11.80%	1.016	1.018	0.20%	14.3	14.3	0.00%
10/12/12	8.76	8.89	1.47%	8.34	8.29	0.60%	10.42	10.33	0.87%	0.834	0.848	1.66%	7.0	6.9	0.72%

Table C-7. Duplicate Water Quality RPDs, Continuous Data, Kearney Canal Diversion, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
09/20/12	19.78	19.95	0.86%	8.01	8.33	3.92%	8.73	8.95	2.49%	0.824	0.829	0.62%	7.40	11.40	42.55%
09/27/12	20.54	20.66	0.58%	8.33	8.33	0.00%	9.69	9.22	4.97%	0.864	0.867	0.39%	3.16	4.50	34.99%
10/04/12	15.12	15.20	0.53%	8.27	8.45	2.15%	12.25	10.59	14.54%	0.873	0.875	0.22%	6.06	4.50	29.55%
10/25/12	6.94	7.05	1.57%	8.84	8.20	7.51%	13.57	13.52	0.37%	0.874	0.874	0.00%	6.85	8.60	22.65%



Table C-8. Duplicate Water Quality RPDs, Continuous Data, Platte River, Odessa, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (µmhos)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
09/13/12	19.27	19.57	1.54%	8.25	8.48	2.75%	8.12	8.60	5.74%	0.857	0.842	1.77%	1.86	0.00	200.00%
09/19/12	22.24	22.44	0.90%	8.33	8.42	1.07%	8.55	8.47	0.94%	0.814	0.815	0.12%	9.72	8.40	14.57%
09/26/12	22.37	22.48	0.49%	8.44	8.47	0.35%	8.79	8.98	2.14%	0.790	0.785	0.63%	9.71	10.30	5.90%
10/02/12	21.89	21.97	0.36%	8.23	8.06	2.09%	8.63	8.00	7.58%	0.884	0.865	2.17%	1.40	1.40	0.00%
10/17/12	14.41	14.57	1.10%	8.37	8.56	2.24%	8.79	9.55	8.29%	0.863	0.858	0.58%	3.17	3.40	7.00%
10/25/12	9.91	10.13	2.20%	8.24	8.31	0.85%	11.22	11.29	0.62%	0.886	0.885	0.11%	15.90	15.50	2.55%

Table C-9. Duplicate Water Quality RPDs, Continuous Data, Kearney Canal Powerhouse, Kearney, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (µmhos)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
09/20/12	16.86	16.94	0.47%	7.89	8.39	6.14%	9.43	9.30	1.39%	0.858	0.860	0.27%	16.70	15.50	7.45%
09/27/12	18.71	18.73	0.11%	8.32	8.37	0.60%	9.98	9.54	4.51%	0.853	0.852	0.13%	8.25	8.70	5.31%
10/04/12	15.41	15.36	0.32%	8.42	8.43	0.12%	11.44	10.04	13.04%	0.865	0.866	0.12%	13.70	12.10	12.40%
10/12/12	8.65	8.66	0.12%	8.50	8.45	0.59%	11.28	10.97	2.79%	0.787	0.794	0.90%	14.30	28.10	65.09%
10/17/12	14.10	14.17	0.50%	8.32	8.39	0.84%	9.60	10.22	6.26%	0.813	0.824	1.32%	10.74	15.50	36.28%
10/25/12	9.14	9.03	1.21%	8.55	8.44	1.29%	11.07	10.86	1.92%	0.886	0.896	1.12%	10.34	15.40	39.32%



Precision, Duplicate Discrete Water Quality Data, Relative Percent Differences



Table C-10. Duplicate Water Quality Data, Suspended Sediment Concentration, (Platte River, Elm Creek, Kearney Canal, NE)

Date	Location	Concentration, ppm	RPD
09/20/12	DUP	36.45	70.81%
	KCPH	76.41	
09/27/12	DUP	139.07	50.36%
	ECPR	83.12	
10/04/12	DUP	123.12	21.22%
	KCPH	99.5	
10/12/12	DUP	298.82	25.46%
	KCDIV	231.34	



Accuracy, Continuous Water Quality Data, Percent Recovery

**Table C-11. Percent Recovery, Continuous Data, Platte River, Overton, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
09/13/12	7.06	100.86%	10.03	100.30%	8.67	8.85	97.97%	1.389	98.30%	102.30	102.30%
09/19/12	6.96	99.43%	9.96	99.60%	7.67	7.74	99.10%	1.412	99.93%	99.00	99.00%
09/26/12	7.03	100.43%	10.04	100.40%	7.77	8.03	96.76%	1.457	103.11%	100.50	100.50%
10/02/12	7.04	100.57%	10.04	100.40%	9.37	9.47	98.94%	1.400	99.08%	99.80	99.80%
10/11/12	6.88	98.29%	10.13	101.30%	9.60	9.72	98.77%	1.415	100.14%	98.30	98.30%
10/17/12	7.13	101.86%	9.90	99.00%	9.82	9.77	100.51%	1.415	100.14%	103.70	103.70%
10/24/12	7.09	101.29%	10.02	100.20%	9.58	10.19	94.01%	1.366	96.67%	98.40	98.40%

Table C-12. Percent Recovery, Continuous Data, Platte River, Elm Creek, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance, (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
09/13/12	5.86	83.71%	9.10	91.00%	8.70	8.70	100.00%	1.442	102.05%	100.80	100.80%
09/20/12	6.98	99.71%	9.90	99.00%	8.76	8.62	101.62%	1.419	100.42%	100.09	100.09%
09/27/12	6.92	98.86%	10.02	100.20%	9.11	9.26	98.38%	1.424	100.78%	137.30	137.30%
10/04/12	7.17	102.43%	10.18	101.80%	10.13	10.16	99.70%	1.402	99.22%	69.80	69.80%
10/12/12	6.98	99.71%	9.90	99.00%	10.83	10.60	102.17%	1.427	100.99%	106.20	106.20%
10/25/12	6.92	98.86%	9.97	99.70%	10.62	10.66	99.62%	1.409	99.72%	94.50	94.50%

**Table C-13. Percent Recovery, Continuous Data, Elm Creek, Elm Creek, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
09/14/12	5.82	83.14%	8.80	88.00%	10.00	9.92	100.81%	1.455	102.97%	101.02	101.02%
09/20/12	6.96	99.43%	9.89	98.90%	8.66	8.36	103.59%	1.420	100.50%	99.10	99.10%
09/27/12	7.03	100.43%	10.06	100.60%	8.83	8.83	100.00%	1.430	101.20%	101.50	101.50%
10/04/12	6.96	99.43%	9.98	99.80%	9.93	9.79	101.43%	1.404	99.36%	94.59	94.59%

Table C-14. Percent Recovery, Continuous Data, Kearney Canal Diversion, Elm Creek, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
09/14/12	6.84	97.71%	9.97	99.70%	10.11	9.96	101.51%	1.423	100.71%	101.80	101.80%
09/20/12	7.03	100.43%	9.85	98.50%	8.42	8.23	102.31%	1.443	102.12%	96.40	96.40%
09/27/12	6.94	99.14%	10.01	100.10%	8.59	8.64	99.42%	1.427	100.99%	115.19	115.19%
10/12/12	7.15	102.14%	9.93	99.30%	10.87	11.21	96.97%	1.389	98.30%	98.80	98.80%

**Table C-15. Percent Recovery, Continuous Data, Platte River, Odessa, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
09/13/12	7.00	100.00%	10.07	100.70%	9.78	9.28	105.39%	1.366	96.67%	101.90	101.90%
09/19/12	7.02	100.29%	9.89	98.90%	7.52	7.56	99.47%	1.457	103.11%	98.40	98.40%
09/26/12	7.06	100.86%	9.98	99.80%	7.64	7.85	97.32%	1.416	100.21%	103.00	103.00%
10/11/12	6.94	99.14%	10.12	101.20%	9.23	9.27	99.57%	1.400	99.08%	92.30	92.30%
10/17/12	7.09	101.29%	9.90	99.00%	8.90	9.17	97.06%	1.394	98.66%	101.30	101.30%
10/25/12	7.16	102.29%	10.12	101.20%	10.61	10.55	100.57%	1.400	99.08%	103.00	103.00%

Table C-16. Percent Recovery, Continuous Data, Kearney Canal Powerhouse, Kearney, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
09/13/12	6.84	97.71%	9.88	98.80%	9.12	8.80	103.64%	1.443	102.12%	96.09	96.09%
09/20/12	7.09	101.29%	10.00	100.00%	8.40	8.14	103.19%	1.433	101.42%	100.90	100.90%
09/27/12	7.01	100.14%	10.02	100.20%	8.58	8.45	101.54%	1.417	100.28%	99.30	99.30%
10/04/12	6.98	99.71%	10.01	100.10%	9.32	9.39	99.25%	1.406	99.50%	94.59	94.59%
10/12/12	7.03	100.43%	10.14	101.40%	10.92	10.97	99.54%	1.419	100.42%	101.80	101.80%
10/17/12	6.94	99.14%	9.80	98.00%	9.13	8.79	103.87%	1.399	99.01%	97.09	97.09%



APPENDIX D

Photo Log



1. No deployment due to low flow conditions at Lexington, NE.



2. Manta 2 sonde deployment at Platte River at Elm Creek, NE.



3. Manta 2 sonde deployment at Elm Creek near the confluence with the Platte River.



4. MS-5 sonde deployment in the Kearney Canal downstream of the diversion.



5. Manta 2 sonde deployment upstream of the Kearney Canal Hydro.



6. View of confluence with the Platte River looking north upstream of Elm Creek at the Manta 2 sampling location.



7. High water conditions in Elm Creek at Manta 2 sampling location.



8. Low water conditions in Elm Creek at Manta 2 sampling location.



9. Biofouling of the Manta 2 deployed in the Kearney Canal downstream of the diversion.



APPENDIX E

Field Data Sheets (CD only)

APPENDIX F

Raw Water Quality Data (CD only)

APPENDIX G

Flow Data (CD only)

Appendix D: 2013 EA Water Quality Report



PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Annual Data Summary Report

**Kearney Canal Water Quality
2013 Monitoring Season**

Draft

April 2014

Submitted to:

Platte River Recovery Implementation Program
4111 4th Avenue, Suite 6
Kearney, NE 68845

Submitted by:

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Appendices

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Appendix F – Raw Water Quality Parameter Data (CD only)
Appendix G – Flow Data (CD only)



I. INTRODUCTION

The Platte River Recovery Implementation Program (Program) was initiated on 1 January 2007 between Nebraska, Wyoming, Colorado, and the Department of the Interior to address endangered species issues in the central and lower Platte River Basin. The species considered in the Program, referred to as “target species”, are the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), interior least tern (*Sterna antillarum*), and pallid sturgeon (*Scaphirhynchus albus*).

EA Engineering, Science, and Technology, Inc. (EA) was contracted by the Program to develop the Kearney Canal Water Quality Monitoring Protocol [(Protocol) PRRIP 2010] that provided the guidance for water quality monitoring for the Kearney Canal. The Protocol was implemented in 2011 and 2012. In 2012, EA developed a Protocol Addendum (PRRIP 2012a) and an Annual Water Quality Monitoring Plan (PRRIP 2012b) and conducted water quality monitoring in 2013 following the Protocol Addendum and Annual Water Quality Monitoring Plan. This report presents the results of the water quality monitoring for the 2013 monitoring season (9 May through 27 June 2013). Data collected included discharge, five water quality parameters (temperature, turbidity, dissolved oxygen, pH, and specific conductance), and representative water quality samples for suspended sediment concentration (SSC) analysis. The project team was comprised of the Program, EA, and the Nebraska Public Power District (NPPD).

I.A. Purpose

The purpose of the project is to monitor suspended sediments and water quality at locations on the Platte River, Elm Creek, and Kearney Canal to determine if Program activities alter suspended sediment concentrations in the Kearney Canal.

The Protocol defined the data collection procedures to obtain scientifically credible data in order to:

- Monitor the Platte River, Elm Creek, and Kearney Canal to obtain data on suspended sediment concentrations.
- Sample and analyze weekly grab samples for suspended sediment concentration.
- Determine spatial variations in water quality between the Platte River, Elm Creek, and Kearney Canal.

Implementation of the Protocol included:

- Collection and evaluation of data.
- Summarization of results.
- Statistical analysis of possible variation of water quality by Program actions.



- Development of recommendations for subsequent water quality monitoring and/or research.

I.B. Program Activities

The Program completed one major event in the Central Platte River that required monitoring of the Kearney Canal in 2013 (Figure 1).

- Sediment Augmentation – Dyer Property. Action performed from 1 March through 14 June 2013 upstream of the Overton monitoring location. Augmentation material was produced by establishing a sand pumping operation at an existing sand pit at the Dyer property. The sand pumping operation produced augmentation material that was pumped to an active river channel for disbursement.

II. METHODS AND PROCEDURES

The Kearney Canal water quality monitoring program was designed to document water quality, detect water quality trends, and obtain representative samples for suspended sediment concentrations. The area of interest includes a reach of the Platte River from Lexington to Odessa, Elm Creek just to the west of the Kearney Canal Diversion, and the Kearney Canal from the diversion to the Kearney Hydro (Figure 1). Water quality was measured using *in-situ* continuous water quality sondes, water samples collected for suspended sediment analyses, and discharge measurements obtained from established gaging stations. Photographs of the field work are included in Appendix D.

II.A. Monitoring Locations

Monitoring locations on the Platte River, Elm Creek, and Kearney Canal were selected to determine if Program activities are impacting suspended sediment concentrations at the NPPD Kearney Hydro. Monitoring locations on the Platte River included the existing Program Water Quality Monitoring Protocol sondes at Lexington, Overton, and Odessa collocated at established stream gaging stations. An additional Kearney Canal study sonde was deployed in the Platte River from the Highway 183 Bridge south of Elm Creek, Nebraska. No stream gaging station exists at the Kearney Canal Hydro and Platte River at Elm Creek locations.

A sonde was deployed in Elm Creek upstream of its confluence with the Platte River and the Kearney Canal. Sondes on the Kearney Canal were located based upon accessibility to bridges across the canal including one just upstream of the Canal Parshall flume, located downstream of the Platte River diversion, and one upstream above the Kearney Hydro. The monitoring locations are listed in Table 1 and illustrated in Figure 1.



Table 1. Spatial Monitoring Matrix

Monitoring Location No.	Locations	Discharge	Water Quality	Analytical
1	Platte River near Lexington, NE	NDNR	EA	EA
2	Platte River near Overton, NE	USGS	EA	EA
2	Platte River near Elm Creek, NE	N/A	EA	EA
3	Elm Creek near confluence with the Platte River south of Elm Creek, NE	N/A	EA	EA
4	Kearney Canal downstream of the diversion south of Elm Creek, NE	NDNR	EA	EA
5	Platte River near Odessa, NE	NDNR	EA	EA
6	Kearney Canal near the Kearney Hydro in Kearney, NE	N/A	EA	EA

Notes:

NDNR – Nebraska Department of Natural Resources

USGS – United States Geological Survey

EA – EA Engineering, Science, and Technology, Inc.

Table 2. Monitoring Location Identification

Monitoring Location No.	Locations	Identification
1	Platte River near Lexington, NE	LEXPR
2	Platte River near Overton, NE	OVPR
3	Platte River near Elm Creek, NE	ELMPR
4	Elm Creek near confluence with the Platte River south of Elm Creek, NE	ELMCR
5	Kearney Canal downstream of the diversion south of Elm Creek, NE	KCDIV
6	Platte River near Odessa, NE	ODSPR
7	Kearney Canal near the Kearney Hydro in Kearney, NE	KCPH

II.B. Parameters of Interest

Water quality data was categorized into three groups:

- **Discharge** – Discharge is the measurement of stream flow and is expressed as the amount of water that passes a fixed point over time and is typically represented as cubic feet per second (cfs).
- **Continuous Water Quality Monitoring** – Continuous water quality data were collected for water temperature, turbidity (optical sensor), dissolved oxygen by optical and Luminescent Dissolved Oxygen (LDO) technology, pH, and specific conductance. Data were logged at set intervals and downloaded at regular intervals.



- **Discrete Water Quality Monitoring** – Representative and discrete water samples were collected by EA and analyzed by Ward Laboratories, Inc. Samples were analyzed for suspended sediment concentration (ppm).

II.B.1. Frequency and Duration

The frequency and duration of data collection for summarization and evaluation was based upon the time period for completion of Program actions in 2013 and flow in the Kearney Canal. Program actions were from 1 March to 14 June 2013 and Platte River water was diverted on 1 May 2013 into the Kearney Canal. The water quality monitoring index period was from the date the canal was operational to one week post Program activities: 9 May to 27 June 2013.

- **Discharge**
 - Existing gaging stations on the Platte River are operated continuously by the United States Geological Survey (USGS) and Nebraska Department of Natural Resources (NDNR) (Table 1). Discharge on the Kearney Canal was obtained from an existing NPPD gaging station maintained by the NDNR. Discharge was estimated by the agencies using rating curves at these stations. Periodic measurements of the depth and flow rate by the respective agencies are used to adjust the rating curves as needed. A data point was collected every 15 minutes at the USGS Overton gaging station. The NDNR gaging stations at Lexington, Odessa and Kearney Canal collected a data point every 30 minutes. For data comparability purposes, the USGS Overton gaging station was reported in 30 minute intervals (Appendix G).
- **Continuous Water Quality Monitoring**
 - EA installed sondes for the Kearney Canal water quality monitoring at four locations including the Highway 183 Bridge south of Elm Creek, Kearney Canal immediately upstream of the canal's Parshall flume, upstream of the Kearney Hydro in Kearney at the Kearney Country Club, and Elm Creek near its confluence with the Platte River. EA also provided operation and maintenance from 9 May to 27 June 2013. Sondes previously installed on the Platte River at Lexington, Overton, and Odessa provided data for the same time period. A data point was collected every 30 minutes.
 - Operation and maintenance of the sondes (including downloading of data) was conducted weekly from May through June as seen in Table 3.



Table 3. Dates of Major Events; Dates and Location of Operation and Maintenance Events (2013)

Date	Sites
1 March	Dyer Property Sediment Augmentation Initiated
1 May	Water Diverted to Fill Kearney Canal
7 May	Lexington, Overton, Odessa
9 May	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Hydro
15 May	Odessa
16 May	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Hydro, Overton Lexington Sonde removed due to low water condition
22 May	Odessa, Overton
23 May	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Hydro
30 May	Odessa, Overton
31 May	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Hydro
5 June	Odessa, Overton, Platte River at Elm Creek, Kearney Canal at Hydro
6 June	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek,
13 June	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Hydro, Odessa, Overton
14 June	Dyer Property Sediment Augmentation End
19 June	Platte River at Elm Creek, Overton, Odessa
20 June	Kearney Canal Diversion, Elm Creek, Kearney Canal at Hydro
27 June	Kearney Canal Diversion, Elm Creek, Platte River at Elm Creek, Kearney Canal at Hydro, Odessa, Overton

- **Discrete Water Quality Monitoring**

- The index period for the collection of discrete water quality data was determined by the Program actions initiated on 1 March 2013 and NPPD's initiation of Kearney Canal operations; which started 9 May 2013.
- Representative water samples for analytical analysis of SSC were collected weekly at five monitoring locations listed in Table 4 during maintenance activities of the sondes.



Table 4. Date and Location of Discrete Water Quality Sampling Events (2013)

Date	Sample Locations and Sonde Activity
9 May	Sondes deployed in Kearney Canal
16 May	Sample - ELMPR, ELMCR, KCDIV, KCPH
23 May	Sample – LEXPR, ELMPR, ELMCR, KCDIV, KCPH
31 May	Sample – LEXPR, ELMPR, ELMCR, KCDIV, KCPH
6 June	Sample – LEXPR, ELMPR, ELMCR, KCDIV, KCPH
13 June	Sample – LEXPR, ELMPR, ELMCR, KCDIV, KCPH
20 June	Sample – LEXPR, ELMPR, ELMCR, KCDIV, KCPH
27 June	Sample – LEXPR, ELMPR, ELMCR, KCDIV, KCPH
27 June	Sondes removed from Kearney Canal

II.C. Continuous Water Quality Data Sondes

Two different manufactures of sondes were used to collect water quality data. The sondes collect the same data but were purchased at different times. The Hydrolab MS-5 data sondes were purchased utilizing a grant from the Nebraska Department of Environmental Quality (NDEQ). The Eureka Manta 2 Sondes are owned by the Program and were purchased for the Kearney Canal water quality monitoring. The existing Hydrolab sondes at Lexington, Overton, and Odessa, installed as part of the Platte River monitoring program, were used for the Kearney Canal water quality monitoring. The Eureka Manta 2 sondes were deployed at four locations including the Platte River Highway 183 Bridge south of Elm Creek, Kearney Canal immediately upstream of the canal’s Parshall flume, upstream of the Kearney Hydro in Kearney at the Kearney Country Club, and Elm Creek near its confluence with the Platte River. The data and units of measure collected are listed in Table 5.


Table 5. Continuous Water Quality Parameters

Water Quality Parameter	Unit	Range	Accuracy	Resolution
Hydrolab MS-5				
Temperature	Degrees Celsius	-5 to +50°C	± 0.10 °C	0.01 °C
Turbidity	Nephelometric Turbidity Units	0 to 3,000 NTU	± 1% up to 100 NTU ± 3% up to 100–400 NTU ± 5% from 400–3,000 NTU	0.1 NTU from 0-400 NTU 1 NTU for >400-3,000 NTU
Luminescent Dissolved Oxygen	mg/L	0 to 30 mg/L	± 0.01 mg/L @ ≤ 8 mg/L ± 0.02 mg/L @ > 8 mg/L	0.01 or 0.1 mg/L
pH	Standard Units	0 to 14 units	± 0.2 units	0.01 units
Specific Conductance	mS/cm	0 to 100 mS/cm	± 1% of reading; + 0.001 mS/cm	0.0001 mS/cm
Eureka Manta 2				
Temperature	Degrees Celsius	-5 to +50°C	± 0.10 °C	0.01 °C
Turbidity	Nephelometric Turbidity Units	0 to 3,000 NTU	0-100 < 1% of reading 100-400 < 3% of reading over 400 < 5% of reading	0.1 NTU
Dissolved Oxygen	mg/L	0 to 25 mg/L	1% of reading or 0.02 mg/L, whichever is greater	± 0.01 mg/L
pH	Standard Units	0 to 14 units	± 0.2 units	0.01 units
Specific Conductance	mS/cm	0 to 100 mS/cm	1% of reading ± 1 count	0.1 mS/cm

II.C.1. Continuous Water Quality Sonde Installation

Prior to installation, each sonde was calibrated following the manufacturer's specification using calibration standards, as documented on the field data sheets (Appendix E). The sondes on the Platte River were suspended on the downstream side of bridges at selected monitoring locations. The sondes on the Kearney Canal were suspended on the downstream side of bridges; one off the 19th Street Bridge in Kearney at the entrance to the Kearney Country Club and the second off of an aluminum foot bridge used by NPPD staff upstream of the Parshall flume. An alternative method was used to deploy a sonde on Elm Creek due to the unavailability of a bridge for use in the target location. Access was granted by private landowners to construct a cable system across the creek just south of Interstate 80. Field staff used anchored wood fence post, ¼-inch cable, adjustable turn buckles and pulleys to hang the sonde in the center of the creek; allowing for the capability to pull the cable through the pulleys in order to retrieve the sonde for downloading and maintenance.



The sondes, which include the data logger and battery source, were housed in a section of PVC pipe (casing) for protection from floating debris and tethered to bridge railings or cable using heavy duty chain. The sonde was locked to the end of the chain and inserted into the casing. The cap for the casing had an opening large enough for the chain to pass through. The casing was attached to the chain by drilling a hole near the top of the casing and inserting a bolt through the casing, passing through the chain; eliminating stress to the sonde anchor point created by flowing water. The submerged section of the casing containing the sonde was slotted and/or perforated with circular holes, and the bottom was open to prevent sediment accumulation. A second bolt was placed at the bottom of the casing to prevent the sonde from falling through the casing. A football-sized float was attached to the bottom of the casing to keep the sonde suspended just below the water surface (approximately 6 inches) and minimize sedimentation of the sonde during decreasing flows and channel meandering. Sondes were retrievable for maintenance and data transfer by pulling up the chain to the bridge deck. Flagging tape was placed every 5 feet on the chains that were deployed from Platte River bridges to enhance visibility. The heavy duty chain was attached to the bridge by wrapping the chain around the railing and locking the chain to itself at four of the Platte River monitoring locations (Lexington, Overton, Elm Creek at Highway 183 bridge, and Odessa) and on the Kearney Canal off the 19th Street Bridge. At the Kearney Canal, downstream of the diversion, the sonde was attached by a cable that ran through a support brace on the aluminum bridge to an earth anchor in the bank. The Elm Creek sonde was retrieved through a cable system that allowed field staff to pull the sonde to the stream bank.

Flows on the Platte River were low during the 2013 water quality monitoring period. Platte River flow was too low for water quality monitoring at the Lexington location and was removed on 16 May 2013 and was not redeployed. Sondes were deployed continuously for the monitoring period at Overton, Odessa, Platte River at Elm Creek, Elm Creek, Kearney Canal Diversion, and Kearney Canal Hydro.

II.C.2. Continuous Water Quality Sonde Operation and Maintenance

Operation and maintenance was performed weekly which included data transfer and calibration of the sondes. During these visits, hand-held water quality meter measurements, sonde calibration records, and data transfer notes were recorded on the field data sheets.

Calibration, maintenance, and data transfer was completed based upon manufacturer's directions. Data was downloaded from the sonde to a field laptop onsite before the recorded data exceeded the memory capacity or battery life of the sonde. Files were named by location as listed in Table 2, followed by numerical year, month, and day of data transfer (e.g., KCPH25MAY). To ensure file integrity and provide backup, all files were saved to the laptop hard drive and a portable USB jump drive while in the field. Following the transfer process, files were opened and reviewed to ensure successful transfer of all data before creating a new log file in the sonde. The downloaded data were reviewed in the field for missing data, outlier data, and logging errors so corrections could be made immediately, if needed. A field data sheet was filled out for each monitoring location visit to document activities related to sonde maintenance, calibration, setup, and data transfer.



The processes for maintenance, data transfer, and calibration of the sondes are listed below:

- **Measurement Using Hand-Held Meter** – Prior to retrieval of data from the sondes, the field crew collected and recorded duplicate water quality parameters using hand-held water quality meters (YSI-556). A handheld barometric meter was used to collect site and time specific barometric pressure for calibration purposes.
- **Continuous Water Quality Sonde QA/QC** – Duplicate and known (spiked) parameter readings were taken for QC purposes. Duplicate water quality readings were collected by submerging hand-held meter probes in a 5-gallon bucket next to the sonde probes that were set to display real time readings; these values were recorded. Measurements of known (spiked) calibration standards were taken with the sonde during each maintenance visit to assess drift and/or accuracy of the sonde during the monitoring season. These QC measurements were recorded on the field data sheets.
- **Download Data From Continuous Sonde** – The field crew downloaded the data from the sonde to a laptop computer and a portable USB jump drive.
- **Review Continuous Water Quality Data** – After data transfer, data files were opened and reviewed for general data quality (i.e., proper logging interval, abnormal or missing data, data outliers, and missing parameters). If data recording issues were present, the deficiency was documented, the sonde adjusted/repared, and the corrective action documented.
- **Re-deploy the Sonde** – As a final step, the field crew cleaned and calibrated the sonde following the manufacturer's specification using calibration standards, and the calibration documented. The documentation included the drift of actual reading from the calibrated reading. Once calibrated, the datalogger was turned on and the sonde was re-deployed.

II.C.3. Hand-Held Water Quality Instrument Operation

As part of Quality Assurance (QA) and Quality Control (QC), a second set of hand-held water quality instruments (capable of reading temperature, dissolved oxygen, pH, specific conductance, and turbidity) were calibrated and maintained to enable the collection of duplicate water quality parameters during each site visit. Manufacturer directions for operation, calibration, and maintenance were followed and documented on the field data sheets. These instruments were calibrated at the beginning of each field day prior to monitoring.

The hand-held meter that was used for calibrating specific conductance was designated for checking the accuracy of the water temperature probe. The hand-held meter was checked for accuracy by comparison to a mercury-in-glass calibration thermometer that is traceable to the National Institute of Standards and Technology (NIST) certification of its accuracy (Service ID



Number 31010C; NIST 1988). A hand-held barometer was also used to collect barometric pressure.

II.D. Discrete Water Quality Monitoring

II.D.1. Discrete Water Sample Collection

Representative water samples were collected for analytical analysis of SSC. One grab sample was collected at two locations on the Platte River (Lexington and Highway 183 Bridge at Elm Creek) and at each location on Elm Creek and Kearney Canal in which sondes were deployed. Collection of the water sample occurred during maintenance of each sonde. The following procedures were used to collect representative samples using one of two methods during the discrete sampling events.

If water depth was shallow enough to wade:

- Sampler entered the water and stood downstream and within arms reach of the data sonde.
- After all disturbed sediments were washed away from the sonde, the sample container was submerged to the depth of the sonde probes, permitted to fill, removed and capped.
- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory.

If water depth was too deep to safely wade:

- A Van Dorn water bottle was lowered into the river/canal from the bridge and permitted to float downstream and adjacent to the sonde for sample collection.
- The water bottle was tripped via a messenger and the sampler retrieved to the bridge deck.
- The water was swirled in the water bottle and then discharged into a sample container.
- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory.

II.D.2. Analytical Method

The analytical method, required containers, volume, preservative, and holding times for the SSC samples are listed in Table 6.



Table 6. Discrete Sampling Handling and Analytical Methods

Analyte	Method	Sample Container	Reporting Limit	Preservation
Suspended Sediment Concentration	ASTM D3977-97	250 mL Plastic	1 mg/L	Cool, 4°C

II.D.3. Sample Labels

Every sample collected and submitted for analysis had a sample label uniquely identifying the sample and listing the parameters to be analyzed. Each label included the following information:

- Submitted by – EA Engineering
- Sample identification code – e.g., KCPH25MAY
 - Samples from the monitoring locations were identified as follows:

Table 7. Discrete Sampling Locations and Identification

Water body	Sonde Location	Location Identification
Platte River	Lexington	LEXPR
Platte River	Highway 183 bridge south of Elm Creek	ELMPR
Elm Creek	Near confluence with Platte River south of I-80	ELMCR
Kearney Canal	Downstream of the diversion	KCDIV
Kearney Canal	Upstream of the Kearney Hydro	KCPH

- Sample date for all samples (military format)
- Sample times for all samples (military format)
- Sample type (e.g. water)
- Samplers' initials

II.D.4. QC Sample Collection and Documentation

A duplicate water sample was collected at one randomly selected site during each discrete water quality sampling event. Duplicate samples were labeled as “DUP” followed by day and month sampled (e.g., DUP25MAY). An arbitrary sample time was placed on the container label and chain-of-custody form delivered to the laboratory so that it did not indicate which location the duplicate was taken. The actual location and sample time were recorded on the chain-of-custody copy received by EA staff after the samples were delivered to the laboratory.

- For wadeable duplicate collections, paired sample bottles were submerged to fill two sample containers simultaneously. For the collections from deep water, the Van Dorn water bottles contained adequate water to fill two sample containers – parent sample and a duplicate.



- The sample containers were placed in individual zip-seal bags, stored in a cooler with ice, and delivered by field staff to the laboratory. Duplicate samples were processed in the same manner as the environmental samples.

II.D.5. Chain-of-Custody

Every suite of samples collected was tracked and documented through a chain-of-custody record supplied by Ward Laboratories, Inc. A chain-of-custody was completed as samples were collected and was submitted with the samples. Each chain-of-custody record included the following:

- Submitted by – EA Engineering
- Sample identification code – e.g., ELMCR25MAY
- Sample date for all samples (military format)
- Sample times for all samples (military format)
- Sample type (e.g. water)
- Required analysis for containers
- Sampler signature for sample collection
- Signature, date, and time relinquished

II.D.6. Field Book

The following information was documented in the field book or on the field data sheets:

- Date of sampling
- Field crew member names
- Location and sampling beginning and ending time
- Samples collected/work performed in field
- The rationale for choosing each composite location during discrete water sampling
- Duplicates or blanks collected with the location and sampling time
- Weather and site conditions
- Any irregularities encountered and lessons learned during the field effort

II.D.7. Sample Control and Handling

Sample control and custody are critical to maintaining sample integrity for analysis and was achieved by tracking samples from time of collection to time of analysis. The following procedures were followed to maintain sample integrity:

- The sample containers were appropriately labeled and filled with a representative composite or grab water samples.
- The containers were placed in a zip-seal bag in an upright position in a cooler containing ice. The field crew kept the cooler out of direct sunlight and secured in the vehicle to



prevent loss of samples/cooler.

- After all samples were collected, the sample containers were cross-checked with the chain-of-custody to ensure required sample information matches.
- Samples were delivered directly to the laboratory

III. DATA SOURCE SUMMARY

The monitoring season for the 2013 Kearney Canal water quality monitoring program was initiated on 9 May 2013 and completed 27 June 2013. Water quality was monitored at seven locations, including the existing Platte River baseline water quality sondes at Lexington, Overton, and Odessa (Figure 1). A water quality sonde was deployed on 19 March 2013 at Lexington for the Platte River water quality monitoring and was removed on 16 May 2013 because of very low flows.

III.A. Data Obtained from USGS

The USGS maintains the National Water Information System (NWIS) website that provides access to water data for locations throughout the United States. EA accessed the USGS website on a monthly basis from September through October to download stage/discharge data from a gaging station located on the Platte River for Overton (06768000). Data that was obtained from USGS is considered provisional data and is subject to revision.

III.B. Data Obtained from NDNR

NDNR collects and reports flow data for streams, canal and pump diversions, and storage in reservoirs at locations throughout Nebraska. The data is gathered through Field Offices and the program is coordinated through NDNR's Planning and Assistance Division. EA utilized information from two gaging stations located on the Platte River near Lexington (228400) and Odessa (6770000) and from two gaging stations located on the Kearney Canal one downstream of the diversion (73000) and one downstream of the hydro (75000). Data was collected and provided to EA in 30 minute increments. Data that was obtained from NDNR is considered provisional data and is subject to revision.

III.C. Data Collected by EA

EA continued to maintain previously installed Hydrolab MS5s and installed Eureka Manta 2 sondes, initiating data collection 9 May 2013. Temperature, pH, dissolved oxygen, specific conductance, and turbidity data were collected at 30-minute intervals. Grab water samples were collected at five monitoring locations 4 times during the monitoring season for suspended sediment analyses.

As part of the data summarization process it was necessary to determine if water quality data collected was representative of river conditions. The field data sheets were reviewed to identify



variables which may have affected data quality. Several conditions were recorded that may have affected the sondes ability to collect representative water quality data. Issues which affected water quality data and were evident in the water quality values logged include:

- The measurement cell on the specific conductance probes was filling with sediments and/or air bubble(s) at the electrodes; decreasing the functionality of the probe resulting in depressed specific conductance readings.
- Aquatic insects of the Order Trichoptera colonized the probes affecting pH, specific conductance, dissolved oxygen, and turbidity.
- Parameter-specific probes on the sondes would malfunction or fail resulting in missing data.

Further discussions on the variables affecting water quality data are presented in Appendix C.

III.D. Data Quality Control Summary

The Quality Control Summary describes the results of the data quality evaluation performed on the water quality parameters collected during the 2013 monitoring season. Data quality for the 2011 water quality monitoring year was evaluated in its respective “Annual Data Summary Report” (PRRIP 2012). Data collected in 2013 included: temperature, specific conductance, pH, turbidity, dissolved oxygen, discharge, and total suspended solids. Overall the quality of the Kearney Canal water quality data collected was found to be of sufficient quality to characterize the water quality during the monitoring period. The quality of the data collected and analyzed was assessed using the elements of precision, accuracy, representativeness, completeness, and comparability. Results of the Data Quality Control Summary are presented in Appendix C.

IV. DATA SUMMARY

Summary statistics were completed following data review to ensure that summarized data was representative of water quality in the central Platte River and the Kearney Canal. The 2013 action-based water quality summary statistics were calculated for the index period of 9 May to 27 June 2013. This period is inclusive of the Kearney Canal operational dates: initiate canal filling on 1 May 2013, sufficient depth/flow for hydro-power operation, sonde deployment on 9 May 2013. Platte River Program actions were initiated on 1 March 2013 and terminated on 14 June 2013. Kearney Canal water quality data collected in 2011 was indexed from 9 May through 27 June 2011 for inter-year comparisons. All data were loaded into a Microsoft® Access 2010 database to generate summaries and queries for further analysis. Additional summaries, graphics, and statistical analyses were performed using R statistical software (<http://www.r-project.org/>) or Microsoft® Excel 2010. Summarization included tabular presentation of weekly and monthly observations (number (N), mean, maximum, minimum, and standard deviation) for each parameter. Graphs were generated to present observed temporal and spatial variations. Index period summary statistics for 2011 and 2013 are presented in Appendix A. Raw water quality and flow data from the 2013 monitoring year are presented on a CD referenced in Appendix F and G. Raw water quality and flow data for the 2011 monitoring year are presented



in “Annual Data Summary Report – Kearney Canal Water Quality 2011 Monitoring Season” (PRRIP 2013).

IV.A. 2013 Variations (intra-year)

Variations in the 2013 water quality data (daily means) were evaluated after raw data had been reviewed to ensure that the data was representative of water quality in the central Platte River, Elm Creek, and Kearney Canal. Data was assessed for temporal and spatial variations in context to Platte River Program actions.

IV.A.1. Temporal Variation

Temporal variation of water quality parameters were assessed using line graphs showing all monitoring locations (i.e., X-axis presents time, Y-axis presents parameter value) and are presented in Appendix B, Figures B-1 through B-6. The very low flows at Lexington resulted in the collection of only seven days of data from 9 to 16 May 2013.

- **Temperature** – Water temperature during the monitoring season exhibited the same seasonal temporal trend at the six monitoring locations. Water temperatures trended upward from when the monitoring program was initiated (early-May) with the onset of spring and warmer air temperatures. Kearney Canal and Platte River water temperature displayed no evidence of temporal variation as a result of Program-actions.
- **Specific Conductance** – Specific conductance exhibited no temporal trend at the six monitoring locations during the monitoring season. The daily mean of specific conductance were similar at all locations with the exception of Elm Creek and Odessa. Specific conductance daily mean at Elm Creek and Odessa closely tracked or varied by up to ~200 mS from the other five monitoring locations during the index period. The specific conductance variability at Elm Creek is a product of the water source and Platte River waters backing up into Elm Creek.
- **pH** – pH at the seven monitoring locations consistently ranged between 7.6 and 8.8 during the index period. Kearney Canal and Platte River water pH displayed no evidence of temporal variation as a result of Program-actions.
- **Turbidity** – Turbidity exhibited no temporal trends at the six monitoring locations and similar concentration trends were observed at the monitoring locations. Turbidity at Elm Creek was generally higher than the six other monitoring locations. The observed turbidity trend peaks are produced by Platte River discharge fluctuations (Appendix B: Figure B-6) produced by power generation at Central Nebraska Public Power and Irrigation District (CNPPID) J-2 hydro. A J-2 peaking discharge event on 25 May 2013 after several days of no discharge and a transition from cyclical peaking events to no discharge on 6 June 2013 resulted in corresponding turbidity peaks.



The cyclical power production at J-2 hydro results in the high discharges in the Platte River to travel upstream into Elm Creek, creating periods of low turbidity in Elm Creek. Likewise, when power production drops, water flows out of Elm Creek into the Platte River, which draws turbid water downstream creating periods of high turbidity in the creek that are more representative of overall Elm Creek water quality. The operation of the J-2 hydro is discussed in more detail in Section V.B. These events were noted on several occasions by the field crew.

- **Dissolved Oxygen** – The same temporal trend for dissolved oxygen was exhibited at the six monitoring locations during the monitoring season. Daily mean concentrations of dissolved oxygen decreased during the index period as water temperatures increased. That trend follows the inverse relationship between temperature and the solubility of gas in water.
- **Discharge** – The Lexington monitoring location exhibited a temporal trend for discharge that was not influenced by J-2 hydro discharge, was not influenced by a precipitation event, and is representative of Platte River discharge. The Overton and Odessa monitoring location discharge exhibit wide fluctuations as a result of J-2 hydro operations. The Kearney Canal diversion and hydro locations exhibit more stable discharges that are controlled by the Platte River diversion structure and the Parshall flume. Kearney Canal and Platte River discharge displayed no evidence of temporal variation as a result of Program-actions.

IV.A.2. Spatial Variation

Spatial variation was assessed using box plots of the water quality parameter values for all monitoring locations (i.e., X-axis presents monitoring location, Y-axis presents parameter value). Box plots present minimum, 25th percentile, median, 75th percentile, and maximum values of the parameter. Box plots for each water quality parameter monitored are presented in Appendix B, Figures B-7 through B-13.

- **Temperature** – No spatial variation was evident in the box plots presenting water temperature at the seven monitoring locations. Kearney Canal and Platte River temperature displayed no evidence of spatial variation as a result of Program-actions
- **Specific Conductance** – Spatial variation was evident in the specific conductance box plots with the 75th to 25th percentile range and median at Elm Creek and Odessa were lower than that observed at the other five monitoring locations. Specific conductance at Lexington, Overton, Platte River at Elm Creek, Kearney Canal Diversion and Hydro were similar for the index period. Kearney Canal and Platte River specific conductance displayed no evidence of spatial variation as a result of Program-actions.
- **pH** – No spatial variation was evident in the box plots presenting pH at the seven monitoring locations. The 25th to 75th percentile pH range exhibited at the seven



monitoring locations ranged between 8.0 and 8.5 pH units for the index period. Kearney Canal and Platte River pH displayed no evidence of spatial variation as a result of Program-actions.

- **Turbidity** – Spatial variation was evident in the log turbidity box plots (Appendix B, Figure B-11). Turbidity at the Elm Creek, Kearney Canal Diversion and Kearney Canal Hydro monitoring location were similar and higher than the other four monitoring locations. Turbidity at Overton, Platte River at Elm Creek, and Odessa were similar. Reported turbidity at Lexington was less than the other monitoring locations. The Lexington turbidity data consisted of 7-days versus 50 days of water quality observations and is not comparable to the six other monitoring locations. Turbidity concentrations in Elm Creek and the Kearney Canal were spatially different than what was observed at the Platte River locations. Program-actions on turbidity levels in the Platte River and Kearney Canal are discussed in Section V.
- **Dissolved Oxygen** – Spatial variation was not evident in the dissolved oxygen box plots. The 25th to 75th percentile dissolved oxygen range at Elm Creek is less than the six other monitoring locations. Dissolved oxygen concentrations at Lexington, Overton, Platte River at Elm Creek, Kearney Canal Diversion, Kearney Canal Hydro and Odessa were similar. Kearney Canal and Platte River dissolved oxygen displayed no evidence of spatial variation as a result of Program-actions.
- **Discharge** – Discharge was monitored by NDNR or the USGS at Lexington, Overton, Kearney Canal Diversion, and Odessa monitoring locations during the index period. J-2 discharge was monitored by Central Nebraska Public Power and Irrigation District. Discharge was not monitored at Platte River at Elm Creek, Elm Creek, and the Kearney Canal Hydro. Spatial variation is evident in the limited discharge data. The observed range of discharge at the Lexington monitoring location is narrow and indicates that discharge was stable during the monitoring period. The range of discharges at Overton and Odessa are a product of the J-2 hydro power production releases. The Kearney Canal discharge recorded at the flume is narrow as would be accepted for a closed canal system discharge. Kearney Canal and Platte River discharge displayed no evidence of spatial variation as a result of Program-actions.

IV.B. 2011 and 2013 Variations (inter-year)

The 2013 water quality data (daily means) collected during Program-actions on the central Platte River and Kearney Canal were compared to water quality data collected in 2011 (inter-year). Inter-year variations were assessed for temporal and spatial variations due to Program-actions during the index period of 9 May to 27 June 2011 and 2013.

IV.B.1. Inter-year Temporal Variation

Inter-year temporal variation of water quality parameters were assessed using line graphs showing the 2011 data and the 2013 Program-action data by monitoring locations (i.e., X-axis



presents time, Y-axis presents parameter value) and are presented in Appendix B, Figures B-14 through B-19.

- **Temperature** – Inter-year water temperature exhibited the same trends at all the monitoring locations. Water temperature increased from late spring to early summer, as expected. Daily mean water temperatures observed during the 2011 baseline index period were lower than 2013. The high 2011 discharge volumes (Figure B-19) would have lower mean temperatures than the smaller flows observed in 2013.
- **Specific Conductance** – Inter-year specific conductance exhibited similar trends and similar data ranges during the two years at the six monitoring locations. The 2013 specific conductance at Elm Creek was higher and exhibited more variability than the specific conductance observed in 2011. The 2013 specific conductance variation at the Elm Creek is a product of the low Platte River flows influenced by the J-2 discharges (Figure B-19).
- **pH** – Inter-year pH values exhibited similar trends and similar ranges for the two observation years at the seven monitoring locations. The 2013 pH observations were higher than the 2011 readings at Overton, Platte River at Elm Creek, Elm Creek, Kearney Canal Diversion and Odessa.
- **Turbidity** – Inter-year 2013 daily mean turbidity concentrations were lower at Overton, Platte River at Elm Creek, Elm Creek, Kearney Canal Hydro, and Odessa monitoring locations than turbidity observed in 2011. Daily mean 2013 turbidity concentration at the Kearney Canal Hydro was similar to turbidity concentrations observed in 2011.
- **Dissolved Oxygen** – Inter-year dissolved oxygen concentrations trended higher in 2013 than 2011 and the 2013 DO data exhibited similar high and low concentration trends at the seven monitoring locations.
- **Discharge** – Inter-year discharge was not similar for the two observation years at Lexington, Overton and Odessa where the 2013 discharge was significantly less than the 2011 discharge. Platte River discharge for the monitoring period in 2011 ranged from a low of 1,500 cfs at Lexington to a maximum of 10,000 cfs at Odessa. 2013 discharge ranged from a low of 30 cfs at Odessa to a high of 2,250 cfs at Overton (Appendix A; Table A-33 through A-40). Discharge at the Kearney Canal diversion was higher in 2011 than what was observed in 2013.

IV.B.2. Inter-year Spatial Variation

Inter-year spatial variation was assessed using boxplots of the water quality parameters' values for all monitoring locations (i.e., X-axis presents monitoring location, Y-axis presents parameter value). Box plots present Platte River, Elm Creek and Kearney Canal water quality data collected in 2011 and 2013 for the 2013 monitoring period of 9 May to 27 June 2013. Box plots



present weekly minimum, 25th percentile, median, 75th percentile, and maximum values of the parameter. Boxplot figures for each water quality parameter monitored are presented in Appendix B, Figures B-20 through B-25.

- **Temperature** – No spatial variation in water temperature was evident in the boxplots presenting weekly summaries by location at the seven monitoring locations. Temperature ranges (minimum and maximum) were larger in 2013 than what was observed in 2011. The low flows observed in 2013 (Appendix B: Figure B-25) compared to 2011 subjected the smaller water volume in the river to wider daily temperature ranges. Temperature displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **Specific Conductance** – Spatial variation was evident in the boxplots presenting weekly data by location at the seven monitoring locations. The 2013 specific conductance displayed a wider range of data (minimum to maximum) at all of the monitoring locations compared to what was seen in 2011. The increased weekly specific conductance range observed at the monitoring locations is the result of the very low flows in the Platte River and subsequent influence of the J-2 hydro releases. Specific conductance displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **pH** – No spatial variation in pH was evident in the boxplots presenting weekly data by location at the seven monitoring locations. pH ranges (minimum and maximum) observed at the seven locations were higher in 2013 than 2011. pH displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **Turbidity** – Turbidity variation was evident in the boxplots presenting weekly data by location at the seven monitoring locations. The 2013 weekly turbidity ranges at all of the monitoring locations (minimum to maximum as well as 25th to 75th percentiles) were wider than those observed in 2011. The increased weekly turbidity ranges observed at the monitoring locations are the result of the 2013 low flows in the Platte River as influenced by J-2 hydro releases. To determine if the observed increase in turbidity ranges observed in 2013 compared to 2011 are a result of Program-actions the data is discussed further and statistically evaluated Section V.
- **Dissolved Oxygen** – No spatial variation was evident in the boxplots presenting weekly data by location at the seven monitoring locations. Dissolved oxygen ranges (minimum to maximum) observed at the six locations were slightly higher in 2013 than 2011. Dissolved oxygen displayed no evidence of inter-year spatial variation as a result of Program-actions in the central Platte River.
- **Discharge** – Discharge variation was evident in the boxplots presenting weekly data by monitoring location at the five monitoring locations where discharge was monitored. The



J-2 hydropower cycling by Central Nebraska Public Power and Irrigation district return is discharged to the Platte River upstream of the Overton monitoring location and its effects are evident at Overton and Odessa. The increased boxplot ranges at Overton and Odessa in 2013 is reflective of the J-2 hydro releases and the low baseflow in the Platte River observed in 2013. Discharge at the Lexington monitoring location (upstream of the J-2 hydro) and at the Overton and Odessa monitoring location (downstream of the J-2 hydro) are demonstrably lower in 2013 than 2011. Discharge at the Kearney Canal diversion and hydro were similar to discharge ranges observed in 2011.

IV.C. Suspended Sediments and Turbidity Correlation

Suspended sediment concentrations determined by laboratory analyses of water samples (grabs) collected adjacent to the sondes and turbidity as measured by the sonde and hand-held meter were paired to determine if the two parameters were correlated. Pearson's r was used to measure the linear correlation between the two parameters (i.e., suspended sediments and turbidity). Correlation is dimensionless and scaled to lie in the range of $-1 \leq r \leq 1$. When $r = 0$ there is no correlation and when the increase or decrease in the variables is synchronous r is positive. If the variables vary in opposite directions, r is negative. A summary of paired statistics (count, minimum, maximum, average, Pearson's r , and R^2) for 2013 index period suspended sediment concentrations and turbidity at Lexington, Platte River at Elm Creek, Elm Creek, Kearney Canal Diversion and Hydro is presented in Table 8.

Table 8. 2013 Summary Statistics Suspended Sediments and Turbidity

	Count	Minimum	Maximum	Average	Pearson's r	R ²
Turbidity - LaMotte 2020 Turbidity Meter						
Turbidity, NTU	29	1.05	63.1	20.55	0.1618	0.0262
Suspended Sediment, ppm	29	0	1868.11	564.57		
Turbidity – Hydrolab MS5 or Eureka Manta 2						
Turbidity, NTU	27	4.1	126.1	42.77	0.0962	0.0093
Suspended Sediment, ppm	27	0	1868.11	582.11		

Suspended sediment and turbidity data were pooled for calculation of Pearson's r because of the small data sets (7 samples per location at five locations), eight 0 (zero) suspended sediment concentrations, an anomalous suspended sediment concentration (35,374 ppm removed from data set), and missing/anomalous turbidity data (Appendix A, Table A-36). Pearson's r for suspended sediment paired with turbidity determined with a LaMotte2020 Meter was 0.1618 and paired with the data sondes was 0.0962. The correlation coefficients for the 2013 data set are less than what was calculated by location in 2011 – Pearson's r ranged from 0.2045 to 0.3935 (Appendix A, Table A-37). This analysis of the 2013 suspended sediment and turbidity data supports the findings obtained in 2011 –that there is no linear association between suspended sediment concentrations and turbidity (Appendix B, Figures B-26 through B-28).



V. STATISTICAL ANALYSIS OF TURBIDITY DATA

Turbidity is quite variable in the Kearney Canal during the period of canal operation in 2013 (Figure B-4). The approach in this statistical portion of the study was to determine how likely it is that Program actions caused some of the higher turbidity observations by: (1) comparing turbidity between the two stations within the Kearney Canal (diversion v hydro), (2) comparing turbidity to discharge, and (3) comparing the turbidity time series to the dates of Program actions.

- A Wilcoxon Sign Rank Test can be used to determine if the mean of a sample set is significantly different from another. This test was used to evaluate if the mean turbidity observed at the Kearney Canal Diversion is significantly different or similar to the mean turbidity observed at the Kearney Canal Hydro.
- A series of linear regression models were fit to the Platte River discharge, turbidity and Program action dates data to evaluate if changes in discharge and/or program actions caused increased turbidity.

V.A. Wilcoxon Sign Rank Test

One overall pattern observed in both 2011 and 2013 is that turbidity appears to be higher at the Kearney Canal Hydro location than the Diversion location (Figure 1, Figure B-4 and B-23). This graphical observation was tested using the Wilcoxon Sign Rank test which is a non-parametric test to compare whether the mean of one sample set is significantly different from another. Test results showed that in 2011 and 2013 at the 95% confidence level ($p < 0.05$), the turbidity at the Hydro station is on average higher than at the Diversion (Table 9). The statistically significant turbidity increase in the Kearney Canal downstream of the Kearney Canal Diversion is likely due to several small drains originating from irrigated farmland that drain into the Kearney Canal. This turbidity increase cannot be due to Program actions, but instead appears to be a common feature in the canal.

Table 9. One-sided Wilcoxon Sign Rank Test Comparison of Kearney Canal Diversion and Kearney Canal Hydro Daily Turbidity

Year	Estimated Median Turbidity Difference (Hydro - Diversion)	p-value
2011	6.5 NTU	0.019
2013	5.5 NTU	0.045

V.B. Linear Regression Models

Turbidity is closely related to river discharge, and the river discharge in 2013 through this reach of the Platte River was dominated by a low base flow (< 200 cfs at Lexington) and periodic discharges from CNPPID J-2 Hydro. Figure B-29 presents the 2013 J-2 discharge returned to the Platte River and Platte River discharge at Overton, NE from 1 May to 30 June 2013. Platte River discharge at Overton in 2013 is a product of the J-2 discharge to the river and the J-2 return is located upstream of the Program-actions completed in 2013 (Figure 1). A series of plots was



developed to examine the relationship between discharge and turbidity in the Kearney Canal and nearby locations. It is clear that the variability in the Overton discharge is dominated by the J-2 Return. The Overton discharge was then compared to the turbidity observed along the Platte River at Elm Creek, the Kearney Canal Diversion, and the Kearney Canal Hydro (Figure B-30 through B-32). The discharge at the diversion in the canal is also shown and is muted, and slightly shifted, version of the Overton discharge. Examination of these figures suggests that the high variability in discharge observed in the river is correlated with the observed turbidity, with a possible lag at the Kearney Canal Hydro station because of the distance traveled.

To statistically evaluate these relationships between turbidity and discharge, regression models were fit to daily turbidity averages from 9 May to 27 June in both 2011 and 2013. Because this is a time series analysis with potential autocorrelation, a generalized least squares regression approach was used that accounted for autocorrelation, and “date” was included as a variable to identify any long-term temporal trends in the observations. Both turbidity and discharge were log scaled. Regression results are presented in Table 10.

Table 10. Regression model fit for daily average turbidity from 7 May to 27 June using the generalized least squares model: $\log(\text{Turbidity}) = \beta_0 + \beta_1 \text{ date} + \beta_2(\log(\text{discharge})) + \varepsilon$ (where errors are autocorrelated with lag of 1)

Location	Years	Sample Size (# days)	Date		log(Flow)	
			Coefficient (β_1)	Significant Relationship? ^a	Coefficient (β_2)	Significant Relationship? ^a
Lexington	2011	42	-0.007	yes, negative	0.69	yes, positive
	2013	8	0.018	no	0.81	no
Overton	2011	50	0.001	no	-0.08	no
	2013	50	0.007	no	0.52	yes, positive
Platte River at Elm Creek ^c	2011	50	0.001	no	0.11	no
	2013	50	0.008	yes, positive	0.76	yes, positive
Kearney Canal Diversion ^d	2011	50	0.002	no	0.09	no
	2013	50	0.020	yes, positive	-1.01	no
Kearney Canal Hydro	2011	50	0.007	no	0.52	yes, positive
	2013	50	0.017	yes, positive	0.15	no
Odessa	2011	50	-0.004	no	0.60	yes, positive
	2013	50	0.016	yes, positive	1.16	yes, positive

^aVariable is indicated as significant if generalized least squares fit indicates that the coefficient is different from zero based on the 95% confidence interval.

^bDischarge used for comparison at this location was measured at Overton.

^cDischarge used for comparison at this location was measured at the Kearney Canal Diversion.

The “coefficient” columns report the fitted model parameters, and the columns labeled “significant relationship?” indicates whether the fitted coefficient is significantly different from



zero. The results show that during this time period in 2011, turbidity did not vary and was stable and in 2013 was increasing at 4 of 6 locations. A consistent relationship (positive, negative or none) was not present in the regression model evaluating date and flow relationship to turbidity for the monitoring period. These results support the graphical findings from Figures B-23, B-30, B-31, and B-32 for an inclusive relationship between discharge and turbidity in the 2011 and 2013 datasets. Discharge in the Platte River were demonstrable different for the two data years, 2011 and 2013. Platte River flows in 2013 ranged from 100 to 1,000 cfs and were dominated by J-2 discharge flows and discharge in 2011 ranged from 1,500 to 10,000 cfs and exhibited no effects of the J-2 discharge (Figure B-19). The discharge turbidity relationship in 2011 and 2013 for the study period is inclusive and could be attributed to Program actions, so further analysis was performed using the specific 2013 Program action dates.

Figure B-33 shows the dates that Program actions occurred upstream of the Kearney Canal along with the turbidity at the Kearney Canal Hydro station. A visual inspection of the plots is inconclusive because some turbidity peaks occurred during Program actions, but some did not. For further examination, additional turbidity regression models were fit using both discharge and Program action dates as explanatory variables and is presented in Table 11.

Table 11. Regression model fit for daily average turbidity from 7 May to 27 June using the generalized least squares model: $\log(\text{Turbidity}) = \beta_0 + \beta_1(\log(\text{discharge})) + \beta_2(\text{Dyer Property activity yes/no}) + \varepsilon$ (where errors are autocorrelated with lag of 1)

Location	Year	log(Flow)		Dyer Property Activity		Cottonwood Property Activity*	
		Coefficient (β_1)	Significant Relationship? ^a	Coefficient (β_2)	Significant Relationship? ^a	Coefficient (β_3)	Significant Relationship? ^a
Lexington	2013	0.454	yes, positive	-0.032	yes, negative	--	--
Overton	2013	0.528	yes, positive	0.096	yes, positive	--	--
Platte River at Elm Creek ^b	2013	0.801	yes, positive	0.032	no	--	--
Kearney Canal Diversion ^c	2013	-0.073	no	-0.127	yes, negative	--	--
Kearney Canal Hydro ^c	2013	0.519	no	-0.041	yes, negative	--	--
Odessa	2013	0.897	yes, positive	-0.137	yes, negative	--	--

*There were no Cottonwood Property activities during the May-June 2013 time period.

^aVariable is indicated as significant if generalized least squares fit indicates that the coefficient is different from zero based on the 95% confidence interval.

^bDischarge used for comparison at this location was measured at Overton.

^cDischarge used for comparison at this location was measured at the Kearney Canal Diversion.

-- No data available



The models presented in Table 11 confirm the significant, positive relationship between discharge and turbidity at the Platte River monitoring locations during this time period. There was no significant relationship (negative or positive) between discharge and flow at the two canal monitoring locations. A positive significant relationship exists at the Overton location between the dates of Dyer Property Program actions and turbidity. The Dyer Property is approximately one mile upstream of the Overton monitoring location. The positive relationship at Overton did not carry downstream where the next location (Platte River at Elm Creek) had no significant relationship and at Kearney Canal Diversion, Hydro and Odessa the significant relationship was negative. At one location, Platte River at Elm Creek, the dates of sediment augmentation at the Dyer Property are significantly, positively correlated with observed turbidity.

VI. SUMMARY

The Kearney Canal water quality monitoring was performed to monitor the water quality of the Kearney Canal during Program sediment augmentation at the Dyer property in 2012. No Program actions were completed at the Cottonwood Ranch during the Kearney Canal water quality monitoring period. The inclusive water quality monitoring period was from when the Kearney Canal was filled (initiated 1 May 2013) and operational on 7 May to 27 June 2013 the termination of Program actions on the Platte River. Water quality data was collected at Lexington, Overton, Platte River at Elm Creek, Elm Creek, Kearney Canal Diversion and Hydro, and Odessa monitoring locations. Lexington water quality data was collected from 7 to 16 May 2013 when the sonde was removed due to low flow conditions. Kearney Canal water quality data was summarized and studied to determine if Program-actions altered intra-year water quality (upstream v. downstream) and inter-year water quality (2011 vs. 2013).

The Program completed one major sediment augmentation event upstream of the Kearney Canal diversion in 2013 (Table A-38 and A-39).

- Sediment Augmentation – Dyer Property. Action performed from 1 March through 14 June 2013 upstream of the Overton monitoring location. Augmentation material was produced by establishing a sand pumping operation at an existing sand pit at the Dyer property. The sand pumping operation produced augmentation material that was pumped to an active river channel for disbursement.
- Sediment Augmentation – Cottonwood Ranch. No sediment augmentation was completed at that Cottonwood Ranch that coincided with the operation of the Kearney Canal in 2013.

The graphical and statistical evaluation of the Kearney Canal turbidity data suggests that the observed peaks in turbidity are not statistically significant and cannot be attributed to peaks in river discharge (driven by the J-2 Return discharge) or Program actions. Kearney Canal turbidity and flow had no significant relationship, and Canal turbidity and Program actions had a negative significant relationship. Graphically (Figure 33) Program actions and peak river discharge frequently coincided and made it difficult to completely distinguish between these forces that



could influence turbidity. However, (1) flows had no significant effects on Canal turbidity, (2) Program actions had a negative significant relationship with Canal turbidity, and (3) flows had no significant effects on turbidities significant increase downstream of the Kearney Canal diversion (Table 11). The Program actions completed in 2013 are not impacting turbidity in the Kearney Canal.

VII. REFERENCES

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F:\State & Local\Other\Platte River Recovery Program\Projects\6225301 - Water Quality Monitoring\Figures\ArcMap\Figure 2 - Sediment Augmentation Locations 2013.mxd EA-Lincoln mwallman

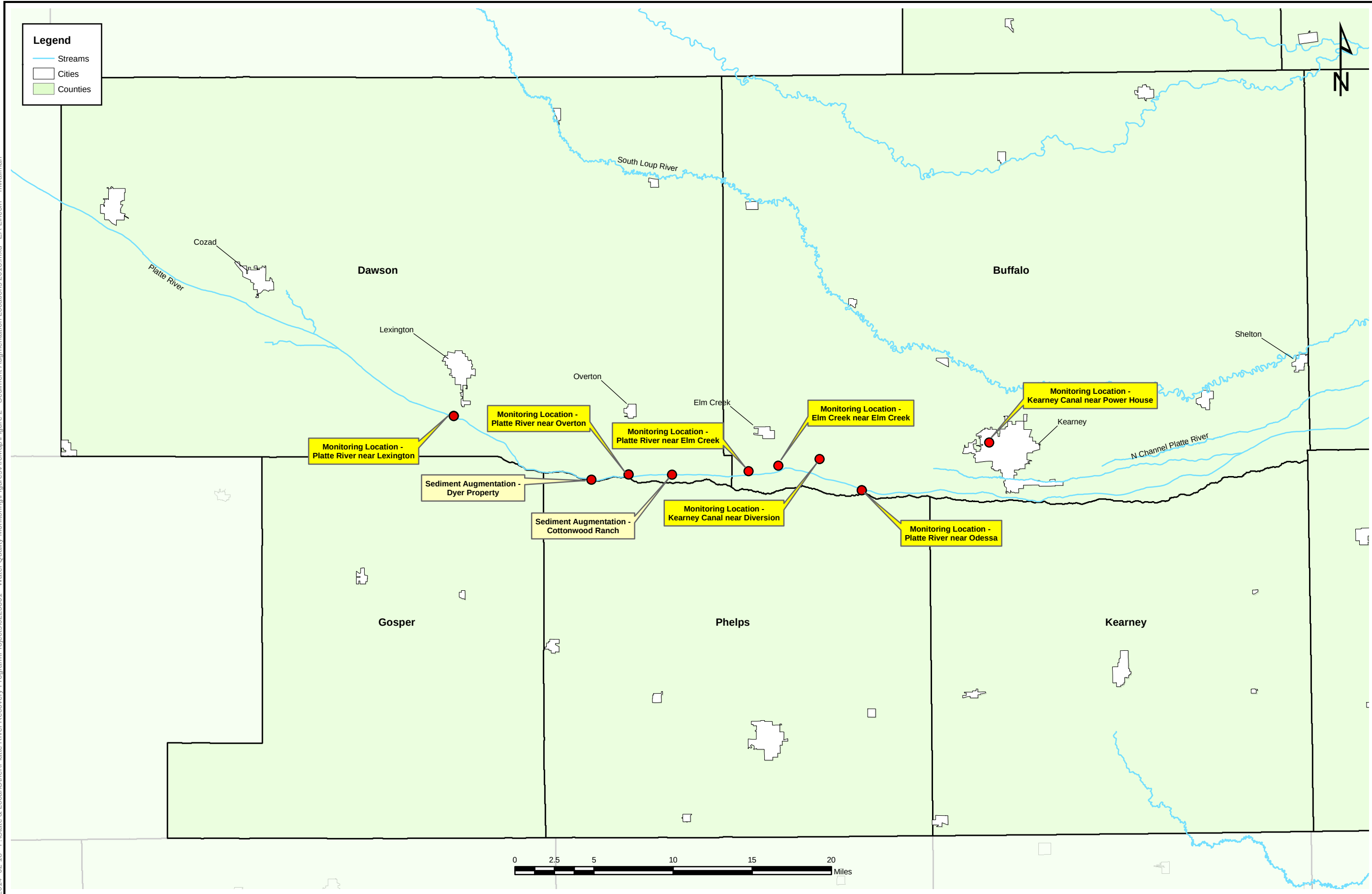


FIGURE 1

**2013 KEARNEY CANAL WATER QUALITY MONITORING AND
SEDIMENT AUGMENTATION LOCATIONS**



APPENDIX A

Summary Statistics



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Acronym List	
°C = degrees Celsius	mS/cm = milliSiemens per centimeter
cfs = cubic feet per second	NA = Not Applicable
ELMCR = Elm Creek, Elm Creek, NE	NTU = Nephelometric Turbidity Units
ELMPR = Platte River, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCDIV = Kearney Canal Diversion, Elm Creek, NE	OVRPR = Platte River, Overton, NE
KCPH = Kearney Canal Power House, Kearney, NE	ppm = parts per million
LEXPR = Platte River, Lexington, NE	SSC = Suspended Sediment Concentration
mg/L = milligrams per liter	-- = No data Available



Continuous Water Quality Data Weekly Average

**Table A-1. Temperature, Weekly Average, Platte River, Lexington, NE**

Middle Day of Week	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.6	10.7	27.3	17.0	240	4.3
5/17/2013	20.0	14.6	29.3	19.2	115	4.0
5/24/2013	--	--	--	--	--	--
5/31/2013	--	--	--	--	--	--
6/7/2013	--	--	--	--	--	--
6/14/2013	--	--	--	--	--	--
6/21/2013	--	--	--	--	--	--
6/28/2013	--	--	--	--	--	--

Table A-2. Temperature, Weekly Average, Platte River, Overton, NE

Middle Day of Week	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	15.9	11.0	23.8	14.9	240	3.4
5/17/2013	18.4	14.3	26.1	17.7	334	2.9
5/24/2013	17.8	10.9	28.2	18.2	334	4.2
5/31/2013	19.3	13.5	26.7	18.9	334	3.3
6/7/2013	20.2	14.7	29.6	19.5	335	3.7
6/14/2013	23.6	16.9	31.0	22.9	334	3.9
6/21/2013	23.9	18.1	31.6	23.3	333	3.5
6/28/2013	25.4	20.5	32.7	24.1	118	4.0

Table A-3. Temperature, Weekly Average, Platte River, Elm Creek, NE

Middle Day of Week	Temperature, °C					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.1	11.0	26.3	16.2	213	4.2
5/17/2013	19.7	14.6	28.7	18.9	333	3.5
5/24/2013	18.1	10.8	28.9	18.4	333	4.3
5/31/2013	19.6	13.6	25.9	19.1	334	3.1
6/7/2013	20.6	15.0	29.4	19.7	329	3.4
6/14/2013	24.3	16.6	32.6	23.5	333	4.1
6/21/2013	24.5	19.0	31.7	24.1	333	3.5
6/28/2013	26.6	21.2	34.3	25.5	119	4.2

**Table A-4. Temperature; Weekly Average; Elm Creek at Elm Creek, NE**

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	16.8	11.7	21.3	16.4	212	2.4
5/17/2013	20.2	16.0	24.0	20.1	335	1.4
5/24/2013	17.7	13.4	23.6	17.0	334	2.7
5/31/2013	19.0	14.4	23.0	19.1	334	2.0
6/7/2013	19.2	15.9	22.7	18.9	334	1.5
6/14/2013	23.3	21.0	26.3	23.3	334	1.3
6/21/2013	23.8	21.6	26.5	23.7	334	1.1
6/28/2013	24.9	23.1	27.0	24.9	122	1.1

Table A-5. Temperature, Weekly Average, Kearney Canal Diversion, NE

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.3	11.6	25.5	16.4	212	3.8
5/17/2013	20.0	15.2	27.6	19.6	334	3.0
5/24/2013	18.4	11.3	28.3	18.9	334	4.2
5/31/2013	19.9	14.1	27.1	19.5	334	3.3
6/7/2013	20.8	15.6	29.1	20.0	333	3.5
6/14/2013	24.5	17.3	32.2	23.8	334	3.8
6/21/2013	24.9	19.7	30.8	24.4	333	3.1
6/28/2013	26.7	21.9	33.1	25.7	124	3.5

Table A-6. Temperature, Weekly Average, Kearney Canal Hydro, NE

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.7	13.8	21.2	17.7	210	2.1
5/17/2013	20.9	18.0	24.6	20.8	333	1.5
5/24/2013	18.8	13.3	24.7	18.1	334	3.2
5/31/2013	20.2	15.5	23.4	20.4	333	1.9
6/7/2013	21.3	18.0	26.3	21.2	334	1.7
6/14/2013	25.0	22.0	27.7	25.0	334	1.3
6/21/2013	25.3	23.6	27.2	25.3	333	0.9
6/28/2013	27.4	24.9	29.2	27.4	128	1.3

**Table A-7. Temperature, Weekly Average, Platte River, Odessa, NE**

Temperature, °C						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	16.7	10.3	25.2	15.9	240	3.6
5/17/2013	19.6	14.4	28.1	19.0	334	3.2
5/24/2013	18.0	10.4	29.3	18.2	334	4.6
5/31/2013	19.4	13.5	26.9	18.9	335	3.4
6/7/2013	20.7	14.3	29.6	19.8	334	3.8
6/14/2013	23.8	14.7	33.7	22.4	334	4.8
6/21/2013	24.3	17.8	33.2	23.4	335	4.1
6/28/2013	26.3	20.2	35.7	24.6	125	5.1

**Table A-8. Specific Conductivity, Weekly Average, Platte River, Lexington, NE**

Middle Day of Week	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.83	0.82	0.84	0.83	240	0.01
5/17/2013	0.88	0.84	0.91	0.88	115	0.02
5/24/2013	--	--	--	--	--	--
5/31/2013	--	--	--	--	--	--
6/7/2013	--	--	--	--	--	--
6/14/2013	--	--	--	--	--	--
6/21/2013	--	--	--	--	--	--
6/28/2013	--	--	--	--	--	--

Table A-9. Specific Conductance, Weekly Average, Platte River, Overton, NE

Middle Day of Week	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.83	0.74	0.93	0.86	239	0.05
5/17/2013	0.85	0.75	0.90	0.86	334	0.04
5/24/2013	0.85	0.76	0.89	0.86	315	0.03
5/31/2013	0.82	0.75	0.91	0.82	334	0.04
6/7/2013	0.84	0.76	0.89	0.85	335	0.03
6/14/2013	0.83	0.78	0.87	0.83	334	0.01
6/21/2013	0.81	0.64	0.87	0.83	333	0.04
6/28/2013	0.83	0.82	0.86	0.83	118	0.01

Table A-10. Specific Conductance, Weekly Average, Platte River at Elm Creek, NE

Middle Day of Week	Specific Conductance, mS/cm					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.84	0.76	0.89	0.85	213	0.03
5/17/2013	0.85	0.78	0.89	0.85	333	0.02
5/24/2013	0.81	0.74	0.87	0.80	321	0.04
5/31/2013	0.81	0.74	0.89	0.81	334	0.03
6/7/2013	0.84	0.78	0.88	0.86	329	0.03
6/14/2013	0.83	0.76	0.86	0.83	321	0.02
6/21/2013	0.81	0.76	0.87	0.81	333	0.02
6/28/2013	0.83	0.81	0.85	0.83	119	0.01

**Table A-11. Specific Conductance, Weekly Average, Elm Creek at Elm Creek, NE**

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.96	0.75	1.29	1.01	212	.10
5/17/2013	0.67	0.59	0.88	0.63	335	0.07
5/24/2013	0.66	0.41	0.79	0.65	334	0.09
5/31/2013	0.72	0.63	0.79	0.73	328	0.03
6/7/2013	0.73	0.62	0.80	0.74	330	0.04
6/14/2013	0.79	0.72	0.82	0.79	334	0.02
6/21/2013	0.78	0.72	0.81	0.79	334	0.02
6/28/2013	0.80	0.77	0.83	0.81	122	0.01

Table A-12. Specific Conductance, Weekly Average, Kearney Canal Diversion, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.86	0.80	0.94	0.87	212	0.03
5/17/2013	0.85	0.80	0.88	0.85	334	0.02
5/24/2013	0.83	0.70	0.87	0.85	334	0.05
5/31/2013	0.82	0.72	0.91	0.83	334	0.04
6/7/2013	0.86	0.80	0.91	0.86	333	0.03
6/14/2013	0.82	0.73	0.88	0.83	321	0.03
6/21/2013	0.81	0.70	0.86	0.82	333	0.04
6/28/2013	0.84	0.81	0.86	0.84	124	0.01

Table A-13. Specific Conductance, Weekly Average, Kearney Canal Hydro, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.85	0.79	0.92	0.86	210	0.03
5/17/2013	0.84	0.80	0.88	0.85	333	0.02
5/24/2013	0.82	0.70	0.88	0.84	325	0.05
5/31/2013	0.81	0.75	0.90	0.82	327	0.03
6/7/2013	0.84	0.77	0.89	0.84	332	0.03
6/14/2013	0.81	0.68	0.88	0.82	202	0.05
6/21/2013	0.77	0.62	0.85	0.82	206	0.09
6/28/2013	0.79	0.65	0.85	0.81	108	0.05



Table A-14. Specific Conductance, Weekly Average, Platte River, Odessa, NE

Specific Conductance, mS/cm						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	0.82	0.81	0.83	0.82	14	0.01
5/17/2013	0.82	0.74	0.87	0.82	199	0.03
5/24/2013	0.89	0.70	1.12	0.83	251	0.13
5/31/2013	0.74	0.67	0.85	0.74	260	0.03
6/7/2013	0.67	0.62	0.83	0.66	293	0.04
6/14/2013	0.76	0.63	0.84	0.76	334	0.05
6/21/2013	0.77	0.62	0.83	0.78	325	0.04
6/28/2013	0.70	0.63	0.81	0.69	112	0.05



Table A-15. pH, Weekly Average, Platte River, Lexington, NE

pH						
week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.3	8.2	8.6	8.3	240	0.1
5/17/2013	8.2	8.1	8.4	8.2	115	0.1
5/24/2013	--	--	--	--	--	--
5/31/2013	--	--	--	--	--	--
6/7/2013	--	--	--	--	--	--
6/14/2013	--	--	--	--	--	--
6/21/2013	--	--	--	--	--	--
6/28/2013	--	--	--	--	--	--

Table A-16. pH, Weekly Average, Platte River, Overton, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.2	8.0	8.5	8.2	240	0.1
5/17/2013	8.3	8.0	8.8	8.2	334	0.2
5/24/2013	8.4	8.0	8.9	8.3	334	0.2
5/31/2013	8.3	8.1	8.5	8.3	334	0.1
6/7/2013	8.3	8.1	8.5	8.3	335	0.1
6/14/2013	8.3	8.0	8.7	8.3	334	0.2
6/21/2013	8.3	8.0	8.5	8.3	333	0.1
6/28/2013	8.2	8.0	8.5	8.2	118	0.2

Table A-17. pH, Weekly Average, Platte River at Elm Creek, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.4	8.2	8.6	8.4	213	0.1
5/17/2013	8.4	8.1	8.8	8.4	333	0.2
5/24/2013	8.2	7.8	8.7	8.2	333	0.2
5/31/2013	8.1	7.8	8.4	8.1	334	0.2
6/7/2013	8.4	8.1	8.7	8.5	288	0.1
6/14/2013	8.6	8.2	8.9	8.6	333	0.2
6/21/2013	8.4	8.2	8.7	8.5	333	0.1
6/28/2013	8.4	8.2	8.6	8.4	119	0.1

**Table A-18. pH, Weekly Average, Elm Creek at Elm Creek, NE**

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.6	8.2	8.9	8.6	212	0.2
5/17/2013	8.5	8.2	8.8	8.5	335	0.1
5/24/2013	8.3	7.8	8.6	8.4	334	0.3
5/31/2013	8.1	7.9	8.3	8.1	334	0.1
6/7/2013	8.2	8.0	8.4	8.2	334	0.1
6/14/2013	8.0	7.8	8.3	8.0	334	0.1
6/21/2013	8.0	7.8	8.2	8.1	334	0.1
6/28/2013	8.1	8.0	8.2	8.1	122	0.1

Table A-19. pH, Weekly Average, Kearney Canal Diversion, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.4	8.1	8.8	8.4	212	0.1
5/17/2013	8.4	8.1	8.7	8.4	334	0.1
5/24/2013	8.3	7.8	8.8	8.3	334	0.3
5/31/2013	8.1	7.8	8.4	8.2	334	0.2
6/7/2013	8.2	8.0	8.4	8.2	333	0.1
6/14/2013	7.9	7.5	8.4	8.0	334	0.3
6/21/2013	8.0	7.4	8.5	8.2	333	0.3
6/28/2013	8.3	8.1	8.4	8.2	124	0.1

Table A-20. pH, Weekly Average, Kearney Canal Hydro, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.5	8.3	8.6	8.5	210	0.1
5/17/2013	8.3	8.1	8.6	8.3	333	0.1
5/24/2013	8.1	7.7	8.5	8.2	334	0.2
5/31/2013	8.0	7.8	8.3	8.0	333	0.1
6/7/2013	8.1	8.0	8.3	8.1	334	0.1
6/14/2013	8.3	8.1	8.6	8.3	334	0.1
6/21/2013	8.2	8.1	8.4	8.2	333	0.1
6/28/2013	8.2	8.1	8.3	8.2	128	0.0



Table A-21. pH, Weekly Average, Platte River, Odessa, NE

pH						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.5	8.3	9.1	8.4	334	0.2
5/17/2013	8.5	8.3	9.0	8.5	334	0.1
5/24/2013	8.4	7.9	8.8	8.4	334	0.2
5/31/2013	8.3	8.2	8.5	8.3	335	0.1
6/7/2013	8.4	8.3	8.5	8.4	334	0.1
6/14/2013	8.4	8.1	8.7	8.3	334	0.2
6/21/2013	8.5	8.1	8.9	8.5	335	0.2
6/28/2013	8.4	8.1	8.7	8.4	125	0.2

**Table A-22. Turbidity, Weekly Average, Platte River, Lexington, NE**

Middle Day of Week	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	8.3	3.7	62.0	7.4	234	4.8
5/17/2013	6.8	2.8	19.9	6.3	109	2.8
5/24/2013	--	--	--	--	--	--
5/31/2013	--	--	--	--	--	--
6/7/2013	--	--	--	--	--	--
6/14/2013	--	--	--	--	--	--
6/21/2013	--	--	--	--	--	--
6/28/2013	--	--	--	--	--	--

Table A-23. Turbidity, Weekly Average, Platte River, Overton, NE

Middle Day of Week	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	16.2	4.7	44.8	13.7	203	9.9
5/17/2013	20.6	4.9	73.2	15.5	332	15.2
5/24/2013	16.2	1.9	55.6	10.6	255	12.2
5/31/2013	27.0	6.0	67.1	25.0	299	13.8
6/7/2013	12.8	4.0	47.3	9.0	334	8.2
6/14/2013	13.6	3.7	55.2	13.6	226	8.1
6/21/2013	28.3	12.5	118.3	23.3	308	16.2
6/28/2013	23.6	15.3	41.6	22.3	118	5.9

Table A-24. Turbidity, Weekly Average, Platte River at Elm Creek, NE

Middle Day of Week	Turbidity, NTU					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.6	4.9	62.9	10.9	213	14.1
5/17/2013	13.4	3.6	60.8	8.5	331	11.5
5/24/2013	14.3	2.7	166.3	8.3	318	21.9
5/31/2013	26.7	5.4	97.2	17.5	332	19.6
6/7/2013	15.8	3.9	45.1	10.2	329	11.3
6/14/2013	9.4	4.1	41.3	8.3	327	4.5
6/21/2013	21.3	7.7	64.4	19.1	322	10.0
6/28/2013	16.7	6.8	71.0	14.5	117	9.0

**Table A-25. Turbidity, Weekly Average, Elm Creek at Elm Creek, NE**

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	32.6	3.3	108.5	28.0	210	20.9
5/17/2013	71.7	7.9	268.0	51.1	326	49.7
5/24/2013	131.7	18.8	976.0	47.4	329	200.5
5/31/2013	48.7	24.9	91.1	45.2	330	13.3
6/7/2013	94.9	33.0	240.0	62.9	328	57.4
6/14/2013	71.2	43.9	116.5	70.5	333	12.0
6/21/2013	83.0	59.5	130.2	81.9	329	12.2
6/28/2013	84.0	55.2	123.2	83.2	121	12.8

Table A-26. Turbidity, Weekly Average, Kearney Canal Diversion, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.7	6.4	64.5	13.9	203	10.9
5/17/2013	31.5	3.8	98.8	28.0	331	18.6
5/24/2013	46.1	5.2	314.1	15.7	334	65.3
5/31/2013	36.8	12.0	97.6	37.3	288	13.1
6/7/2013	45.0	9.5	120.3	37.5	333	24.6
6/14/2013	25.5	9.6	72.0	26.2	331	8.6
6/21/2013	49.8	15.3	136.3	48.1	293	16.6
6/28/2013	91.3	45.0	197.0	89.7	43	30.9

Table A-27. Turbidity, Weekly Average, Kearney Canal Hydro, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	14.1	5.9	31.6	12.7	208	6.2
5/17/2013	18.3	7.0	75.4	16.4	323	9.0
5/24/2013	35.0	5.0	195.6	9.6	329	45.6
5/31/2013	42.2	21.4	190.0	36.4	332	23.0
6/7/2013	49.0	19.2	109.0	47.1	333	15.5
6/14/2013	52.7	29.7	125.6	50.4	328	14.7
6/21/2013	73.1	38.2	120.1	74.4	326	16.6
6/28/2013	98.2	69.2	131	97.5	128	12.6



Table A-28. Turbidity, Weekly Average, Platte River, Odessa, NE

Turbidity, NTU						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	17.5	4.8	59.3	10.2	240	13.9
5/17/2013	10.7	0.3	62.0	7.9	315	10.1
5/24/2013	28.6	0.5	331.3	7.0	258	54.5
5/31/2013	34.2	5.0	107.6	27.0	332	24.0
6/7/2013	17.1	0.3	76.6	9.8	331	15.3
6/14/2013	3.6	0.3	19.2	2.5	329	3.6
6/21/2013	9.0	0.3	37.9	7.8	323	6.8
6/28/2013	13.9	2.2	112.6	7.2	119	19.9

**Table A-29. Dissolved Oxygen, Weekly Average, Platte River, Lexington, NE**

Middle Day of Week	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	9.4	7.2	11.2	9.4	240	0.9
5/17/2013	8.5	6.8	10.1	8.4	115	0.9
5/24/2013	--	--	--	--	--	--
5/31/2013	--	--	--	--	--	--
6/7/2013	--	--	--	--	--	--
6/14/2013	--	--	--	--	--	--
6/21/2013	--	--	--	--	--	--
6/28/2013	--	--	--	--	--	--

Table A-30. Dissolved Oxygen, Weekly Average, Platte River, Overton, NE

Middle Day of Week	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	9.6	8.2	14.8	9.3	240	1.0
5/17/2013	8.8	7.8	10.8	8.6	334	0.7
5/24/2013	9.7	7.4	14.1	9.0	322	1.7
5/31/2013	8.5	7.6	9.7	8.5	334	0.5
6/7/2013	8.4	7.4	9.3	8.4	335	0.4
6/14/2013	8.5	7.0	10.8	8.3	334	1.1
6/21/2013	7.9	6.8	9.0	7.9	333	0.6
6/28/2013	7.9	6.8	9.8	7.6	118	1.0

Table A-31. Dissolved Oxygen, Weekly Average, Platte River at Elm Creek, NE

Middle Day of Week	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	9.2	7.5	11.0	9.2	213	0.8
5/17/2013	8.5	7.3	10.0	8.5	333	0.6
5/24/2013	9.1	6.2	11.8	9.0	331	1.2
5/31/2013	8.2	7.3	9.1	8.1	333	0.5
6/7/2013	8.3	7.7	9.3	8.3	325	0.4
6/14/2013	8.7	7.0	10.7	8.5	333	1.1
6/21/2013	7.7	6.4	9.7	7.5	333	0.8
6/28/2013	7.3	5.9	8.6	7.3	100	0.8



Table A-32. Dissolved Oxygen, Weekly Average, Elm Creek at Elm Creek, NE

Middle Day of Week	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	11.1	6.8	15.6	10.9	186	2.1
5/17/2013	7.5	4.8	11.9	7.4	335	1.5
5/24/2013	8.1	5.6	12.1	7.9	334	1.9
5/31/2013	7.1	5.2	9.4	7.0	334	1.0
6/7/2013	7.7	6.0	12.1	7.4	334	1.3
6/14/2013	6.6	5.4	8.2	6.5	334	0.7
6/21/2013	6.8	5.9	8.2	6.6	334	0.6
6/28/2013	6.4	5.5	7.7	6.3	122	0.7

Table A-33. Dissolved Oxygen, Weekly Average, Kearney Canal Diversion, NE

Middle Day of Week	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	10.0	7.8	12.3	9.6	211	1.2
5/17/2013	8.5	6.0	10.6	8.4	333	1.1
5/24/2013	9.2	5.3	13.3	8.8	333	1.9
5/31/2013	7.7	5.5	9.2	7.7	334	0.9
6/7/2013	8.0	6.9	9.0	8.1	332	0.5
6/14/2013	8.4	5.1	13.3	7.7	334	2.1
6/21/2013	7.3	5.0	10.0	7.1	331	1.2
6/28/2013	7.2	5.7	9.1	6.8	124	1.1

Table A-34. Dissolved Oxygen, Weekly Average, Kearney Canal Hydro, NE

Middle Day of Week	Dissolved Oxygen, mg/L					
	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	11.3	9.0	13.9	10.8	167	1.2
5/17/2013	9.4	7.0	12.1	9.3	234	1.5
5/24/2013	9.3	6.0	13.4	9.3	333	2.1
5/31/2013	8.1	6.6	10.3	7.8	333	0.9
6/7/2013	8.1	6.7	9.9	8.0	334	0.8
6/14/2013	7.6	6.0	9.2	7.6	334	0.8
6/21/2013	7.2	5.8	8.8	7.2	332	0.8
6/28/2013	6.7	5.6	7.9	6.7	127	0.7



Table A-35. Dissolved Oxygen, Weekly Average, Platte River Odessa, NE

Dissolved Oxygen, mg/L						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	9.2	7.6	11.1	9.2	240	0.8
5/17/2013	8.5	7.4	10.2	8.4	334	0.6
5/24/2013	9.0	6.7	11.7	9.0	331	1.1
5/31/2013	8.4	7.4	9.8	8.4	335	0.6
6/7/2013	8.1	6.8	9.3	8.2	334	0.6
6/14/2013	8.2	6.5	10.7	7.8	334	1.1
6/21/2013	8.4	6.4	11.6	8.1	335	1.4
6/28/2013	8.0	6.1	10.0	8.0	108	1.2

**Table A-36. Discharge, Weekly Average, Platte River, Lexington, NE**

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	174	145	196	174	240	13
5/17/2013	91	72	148	85	336	17
5/24/2013	84	66	131	76	336	17
5/31/2013	139	67	201	146	336	44
6/7/2013	92	72	133	90	336	12
6/14/2013	74	62	91	73	336	8
6/21/2013	89	62	144	86	336	15
6/28/2013	73	62	96	70	144	11

Table A-37. Discharge, Weekly Average, Platte River, Overton, NE

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	552	264	1960	324	240	462
5/17/2013	313	154	1630	221	336	271
5/24/2013	333	130	2250	150	335	512
5/31/2013	766	186	2040	394	336	620
6/7/2013	447	77	1310	177	336	460
6/14/2013	160	77	230	181	336	50
6/21/2013	212	154	318	201	336	36
6/28/2013	185	154	221	181	142	15

Table A-38. Discharge, Weekly Average, Kearney Canal Diversion, NE

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	99	79	160	86	336	26
5/17/2013	124	44	153	137	336	28
5/24/2013	138	130	149	139	336	4
5/31/2013	135	125	146	134	336	4
6/7/2013	163	104	211	144	336	34
6/14/2013	189	172	207	195	336	8
6/21/2013	220	205	232	221	336	7
6/28/2013	212	195	219	215	288	6

**Table A-39. Discharge, Weekly Average, Platte River, Odessa, NE**

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	378	222	916	294	240	174
5/17/2013	234	117	589	240	336	98
5/24/2013	220	88	1354	110	336	280
5/31/2013	497	160	1244	376	336	306
6/7/2013	267	42	692	160	336	217
6/14/2013	46	30	173	41	336	24
6/21/2013	68	37	174	59	336	33
6/28/2013	57	38	91	50	144	16

Table A-40. Discharge, Weekly Average, Discharge Site J-2, NE

Discharge, cfs						
Middle Day of Week	Weekly					
	Mean	Min	Max	Median	N	STD
5/10/2013	225	0	1688	0	120	533
5/17/2013	69	0	1347	0	168	271
5/24/2013	147	0	1583	0	168	441
5/31/2013	452	0	1692	0	168	628
6/7/2013	202	0	855	0	168	341
6/14/2013	80	0	151	105	168	48
6/21/2013	70	0	95	73	168	26
6/28/2013	69	68	73	68	72	2



Discrete Water Quality Data



Table A-41. 2013 Discrete Water Quality Data, Suspended Sediment Concentration, (Platte River, Elm Creek, Kearney Canal), NE

Date	LEXPR	ELMPR	ELMCR	KCDIV	KCPH
	SSC, ppm	SSC, ppm	SSC, ppm	SSC, ppm	SSC, ppm
May 16	--	0	179.63	181.36	0
May 23	0	0	0	0	191.94
May 31	184.30	35,374.87	181.65	0	0
June 6	1,746.42	1,668.52	1,772.74	1,868.11	1,832.62
June 13	635.42	785.55	829.05	654.45	978.47
June 20	558.14	528.73	1,021.79	1,054.67	1,102.94
June 27	19.82	227.07	239.41	278.37	140.10

Table A-42. 2011 Summary Statistics Suspended Sediments and Turbidity

	Count	Minimum	Maximum	Average	Pearson's r	R ²
Platte River near Lexington, NE						
Turbidity, NTU	21	11.20	75.20	35.95	0.3594	0.1292
Suspended Sediment, ppm	21	9.48	381.86	79.81		
Platte River near Elm Creek, NE						
Turbidity, NTU	23	16.20	76.20	35.77	0.3935	0.1548
Suspended Sediment, ppm	23	0.00	360.63	60.86		
Elm Creek						
Turbidity, NTU	23	78.70	398.40	209.27	0.2384	0.0568
Suspended Sediment, ppm	23	12.86	674.42	146.73		
Kearney Canal Diversion						
Turbidity, NTU	23	19.10	97.40	54.06	0.2045	0.0418
Suspended Sediment, ppm	23	0.00	532.23	68.68		
Kearney Canal Hydro						
Turbidity, NTU	23	16.90	231.50	86.23	0.3292	0.1083
Suspended Sediment, ppm	21	1.52	464.15	86.63		

**Table A-43. Pilot Scale Sediment Augmentation Management Action, 2013 Augmentation Days, Dyer Property**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
March	X			X	X		X	X			X	X	X	X	X			X	X	X	X	X				X	X	X	X		
April	X	X	X	X	X															X		X	X	X	X	X			X	X	
May		X	X			X	X	X	X	X			X	X	X	X	X			X	X	X	X	X				X	X	X	X
June			X	X	X	X	X			X	X	X	X	X																	

Table A-44. Pilot Scale Sediment Augmentation Management Action, 2013 Augmentation Days, Cottonwood Ranch

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
March																		X	X	X	X	X	X		X	X	X	X	X	X	
April	X	X			X	X																									
May																															
June																															



APPENDIX B

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Acronym List	
°C = degrees Celsius	LEXPR = Platte River, Lexington, NE
cfs = cubic feet per second	mg/L = milligrams per liter
ELMCR = Elm Creek, Elm Creek, NE	mS/cm = milliSiemens per centimeter
ELMPR = Platte River, Elm Creek, NE	NTU = Nephelometric Turbidity Units
KCDIV = Kearney Canal Diversion, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
KCPH = Kearney Canal Power House, Kearney, NE	OVPR = Platte River, Overton, NE



Intra- Year Temporal Variations



Figure B-1. Temporal Variation, Temperature, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

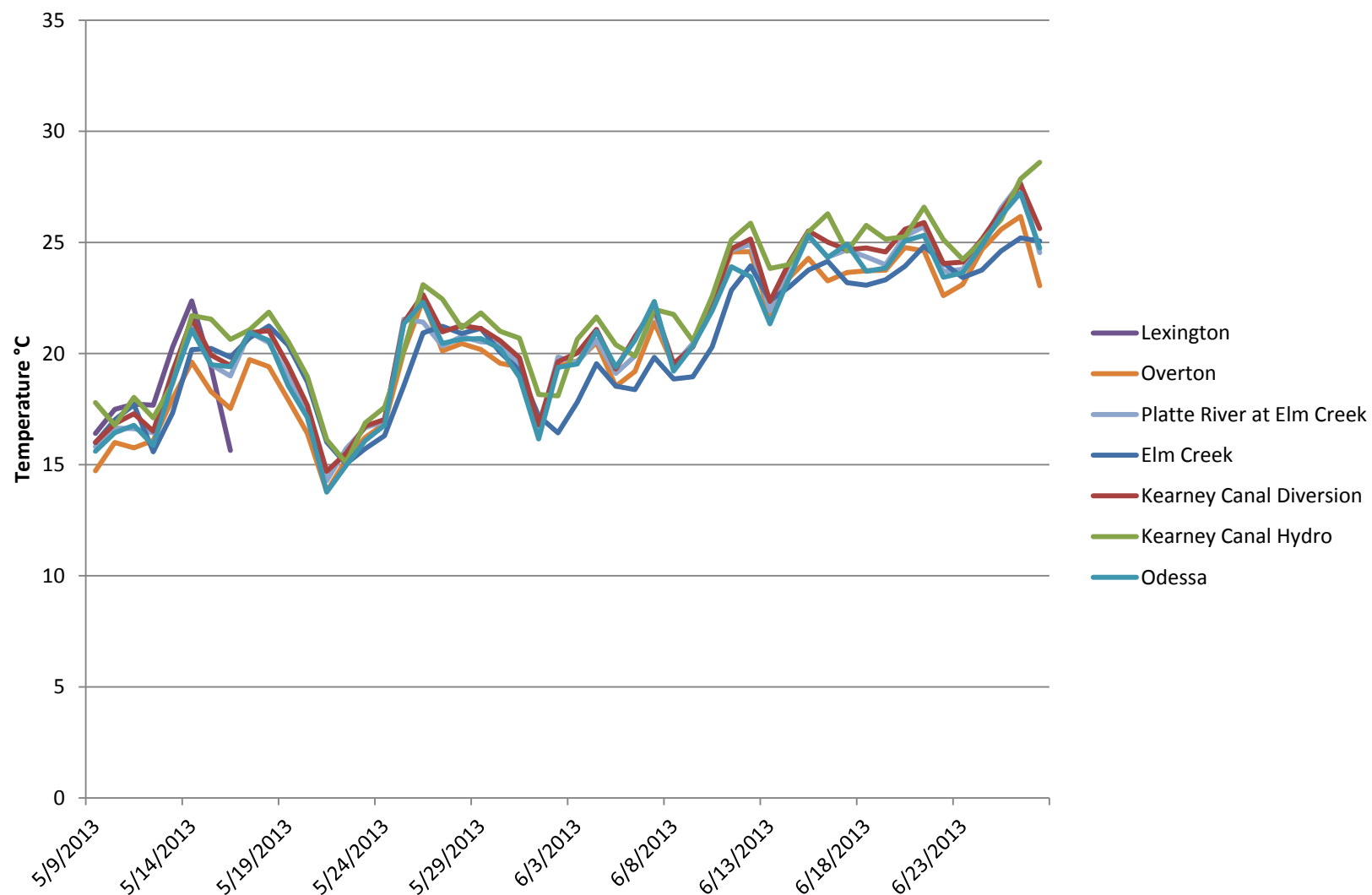




Figure B-2. Temporal Variation, Specific Conductance, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

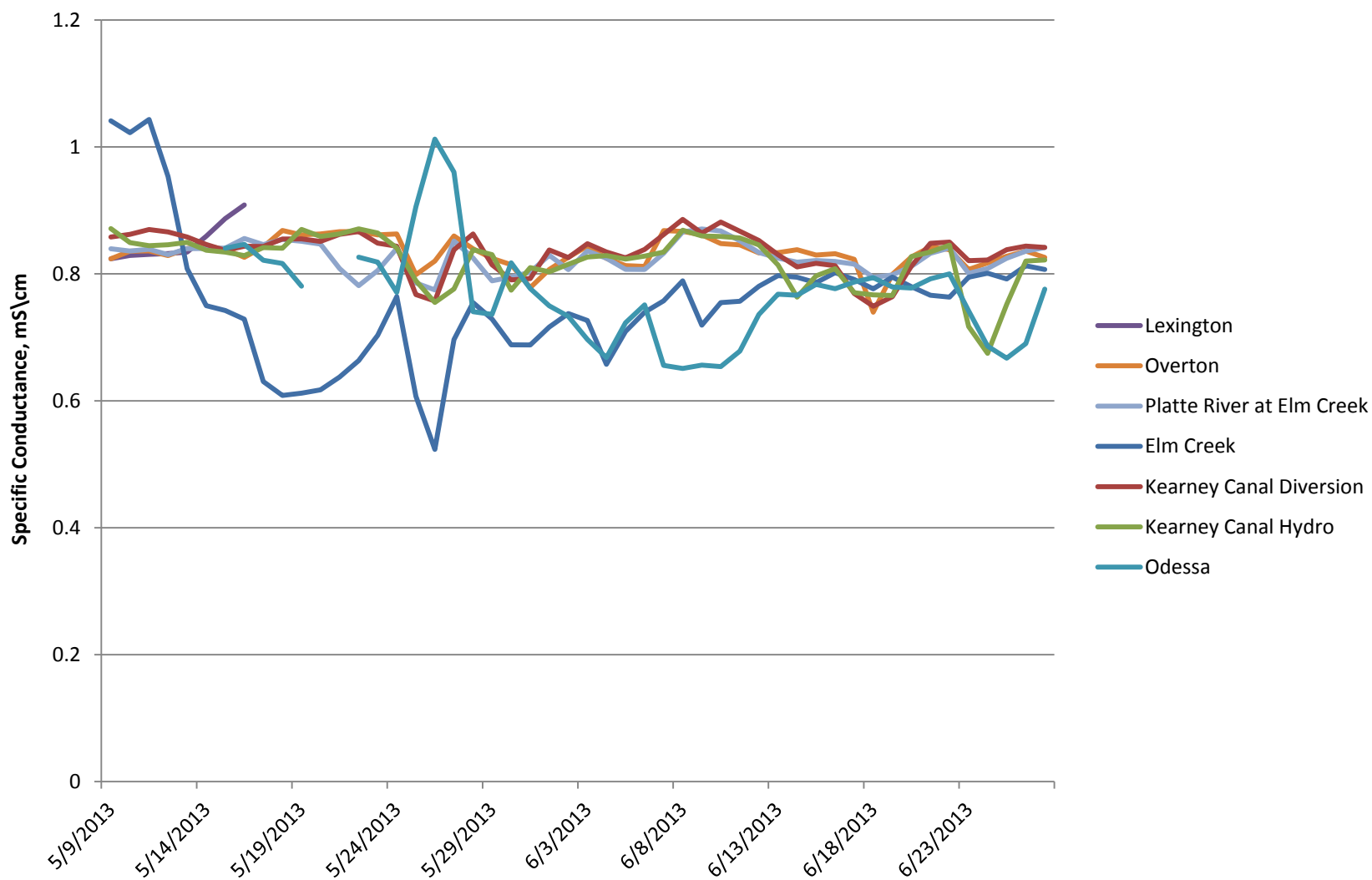




Figure B-3. Temporal Variation, pH, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

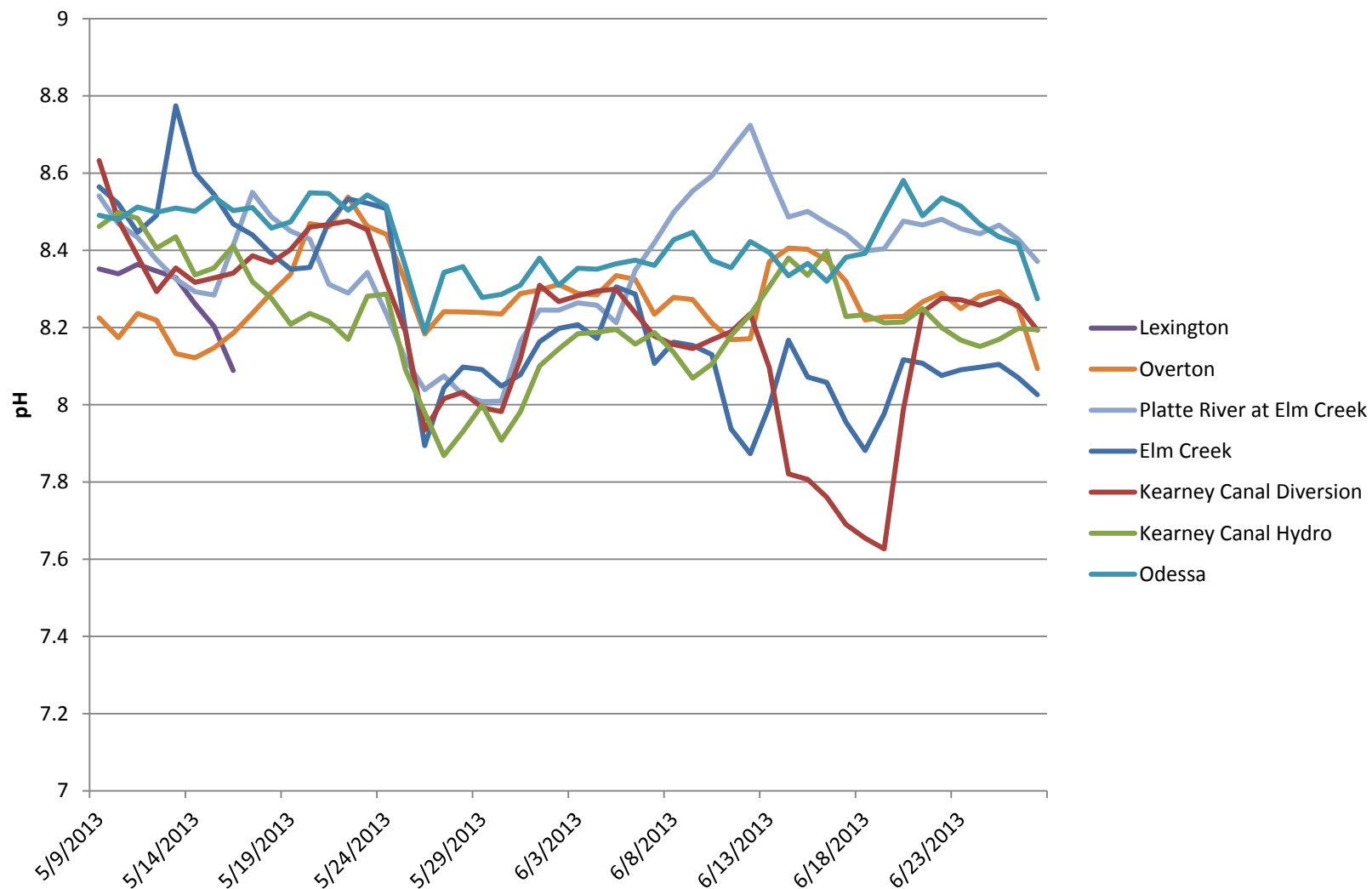




Figure B-4. Temporal Variation, Turbidity, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

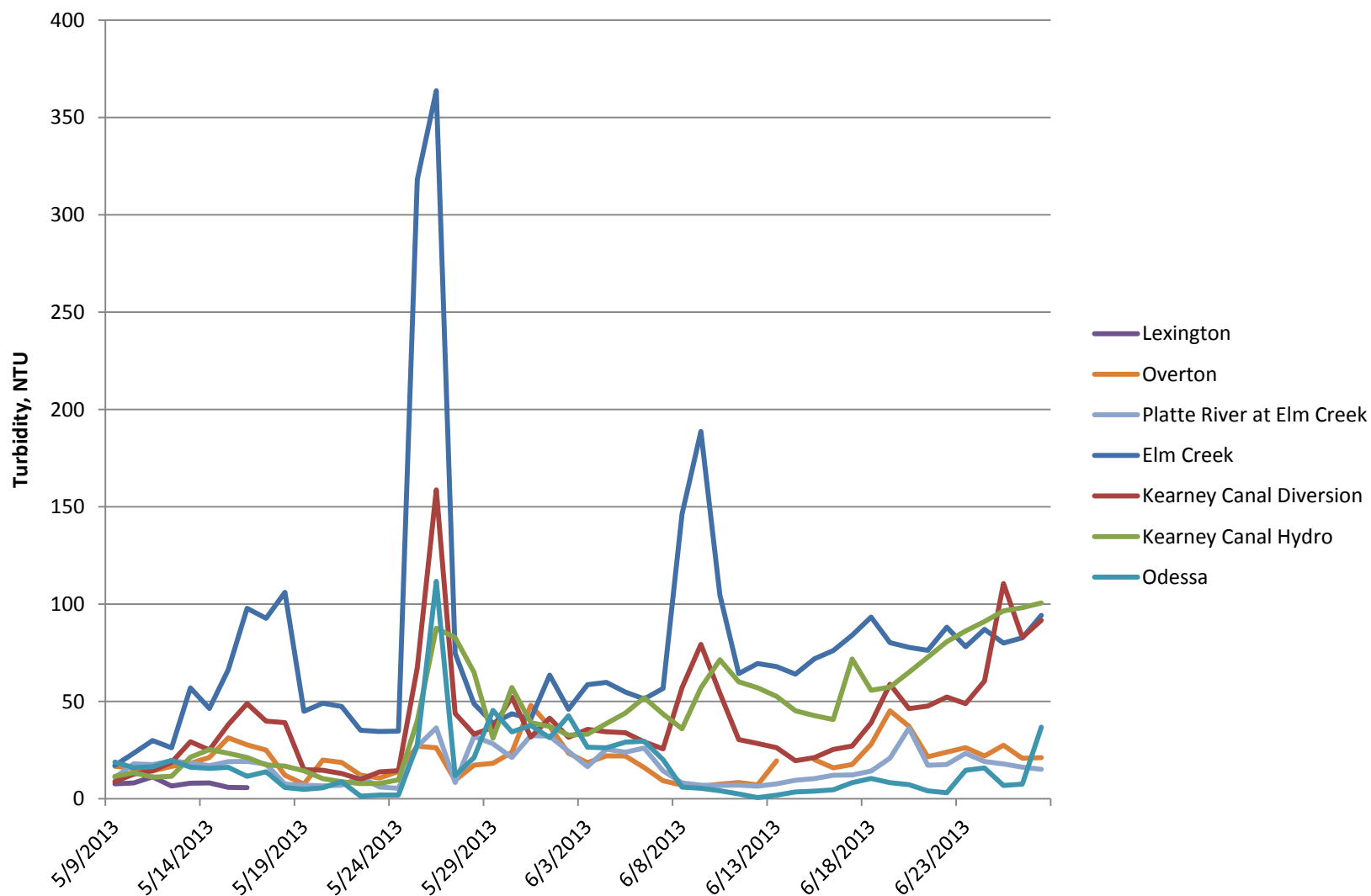




Figure B-5. Temporal Variation, Dissolved Oxygen, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

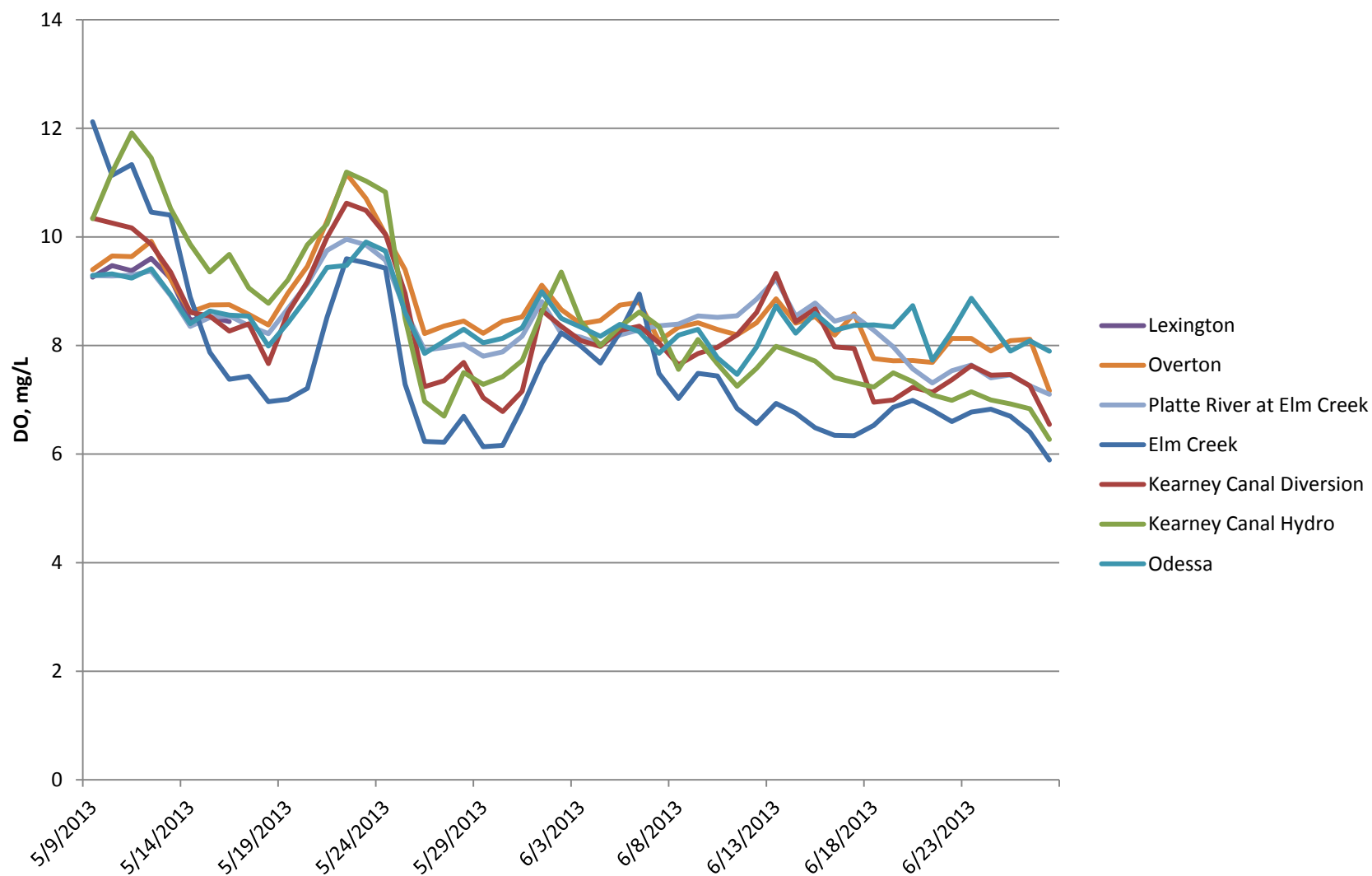
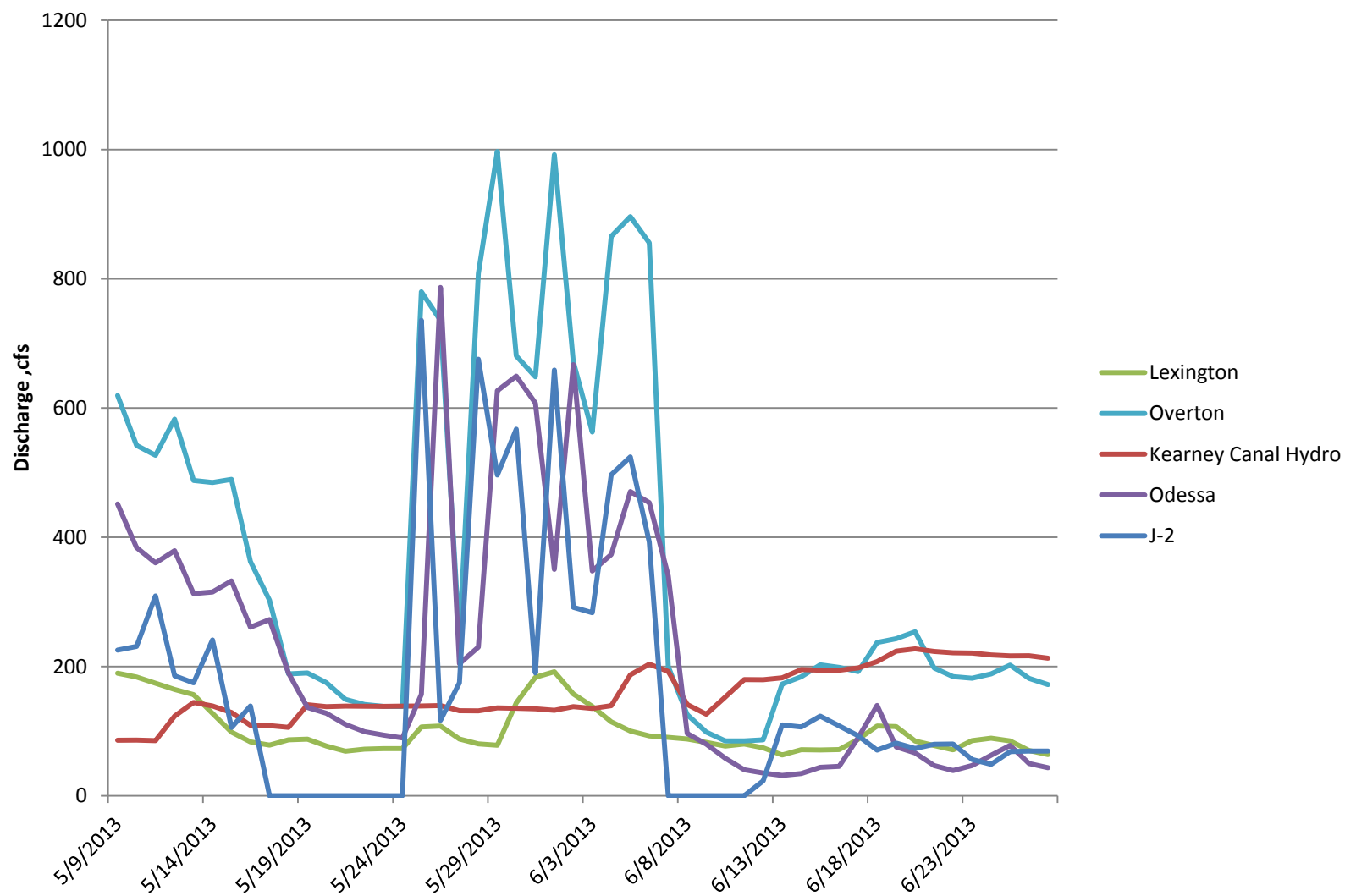




Figure B-6. Temporal Variation, Discharge, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)





Intra-Year Spatial Variation



Figure B-7. Spatial Variation, Temperature, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

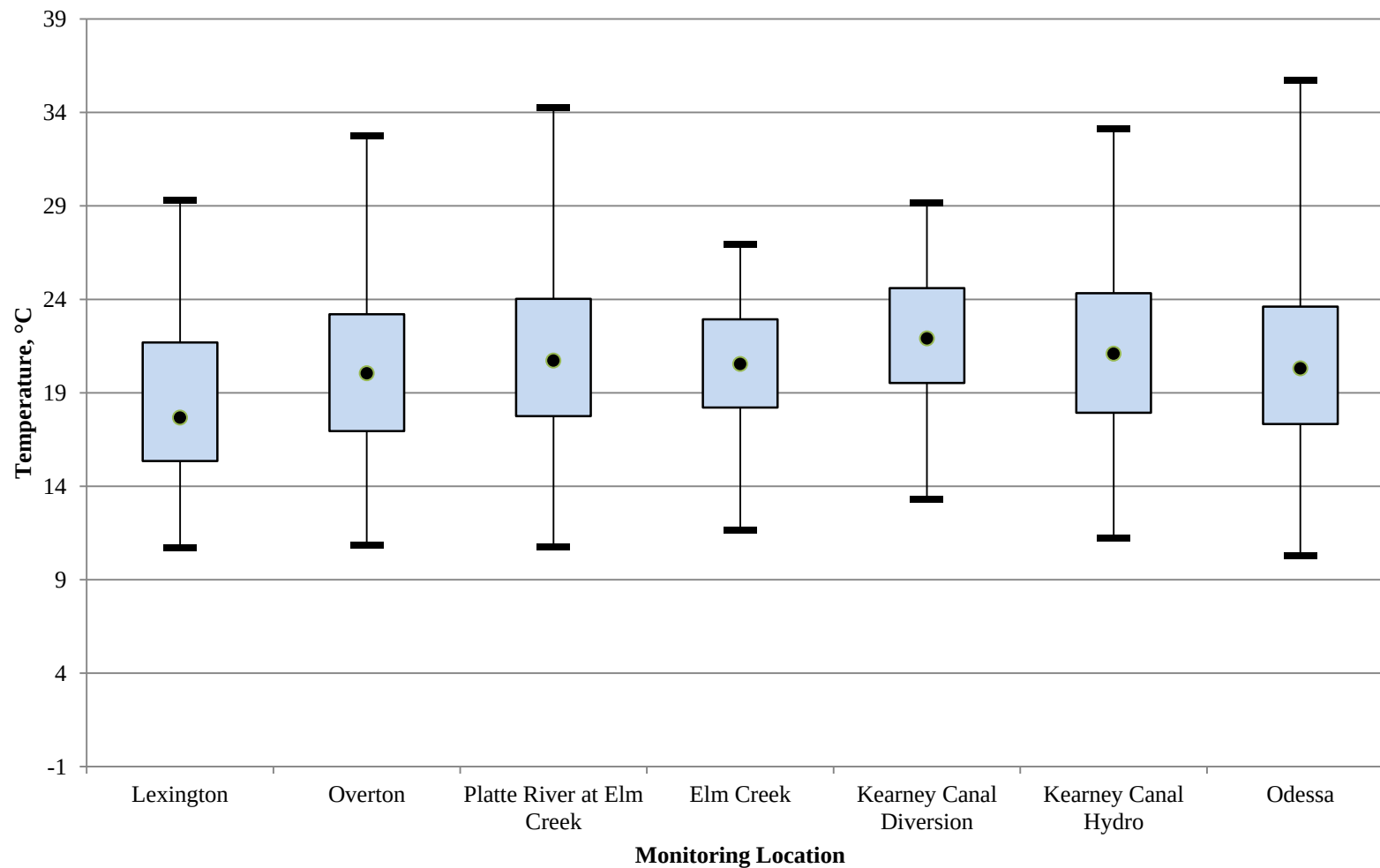




Figure B-8. Spatial Variation, Specific Conductance, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

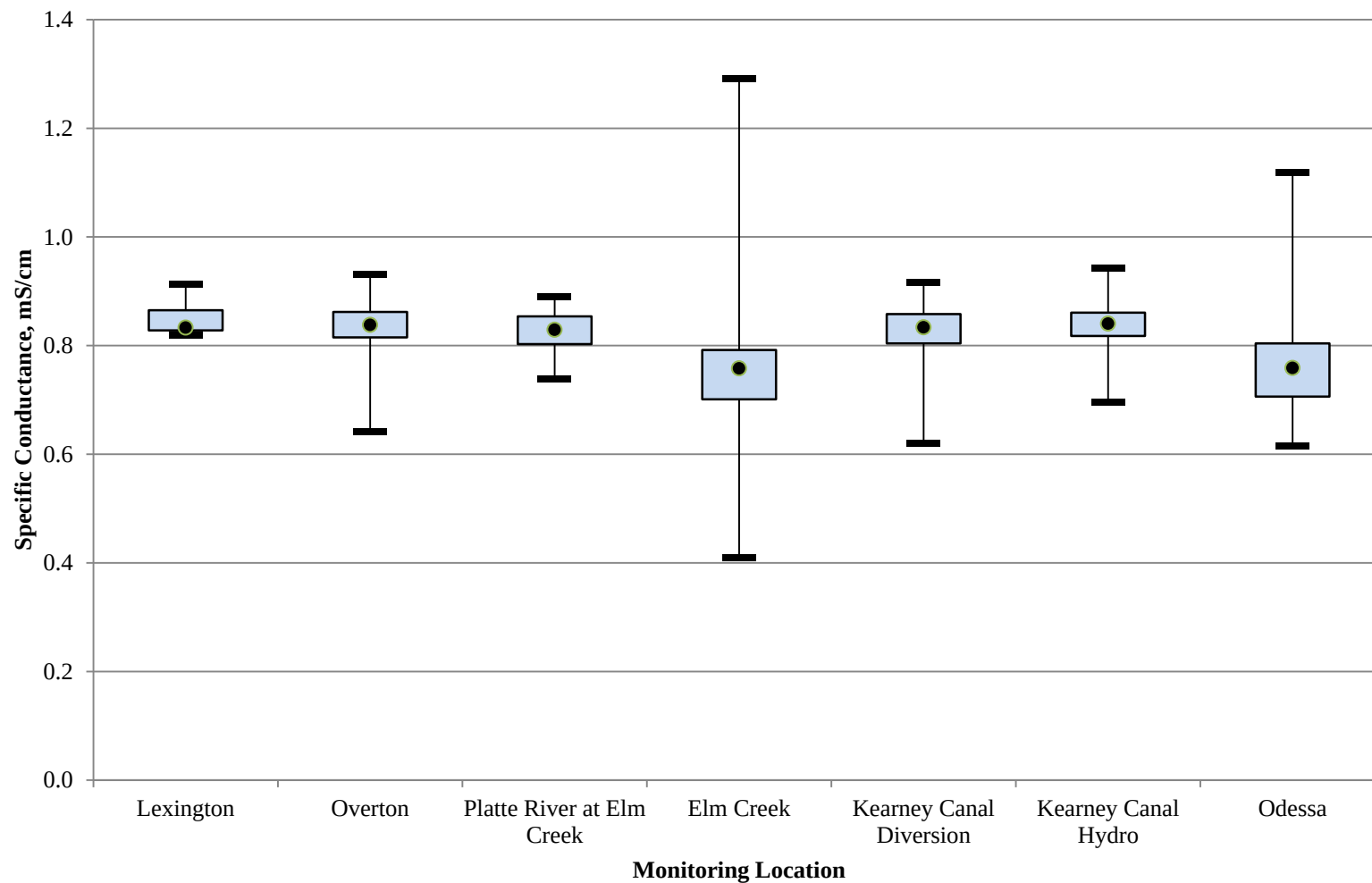




Figure B-9. Spatial Variation, pH, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

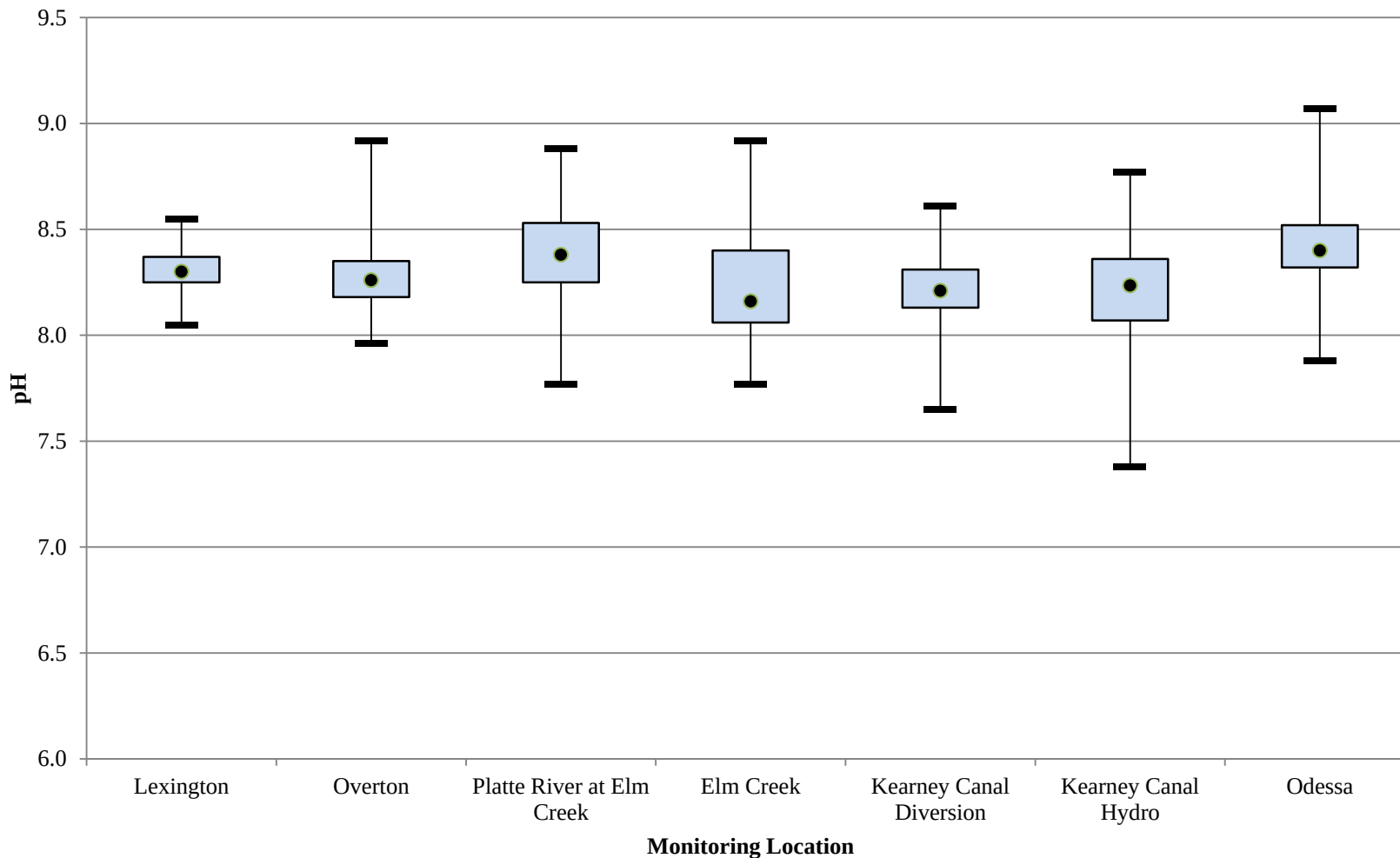




Figure B-10. Spatial Variation, Turbidity, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

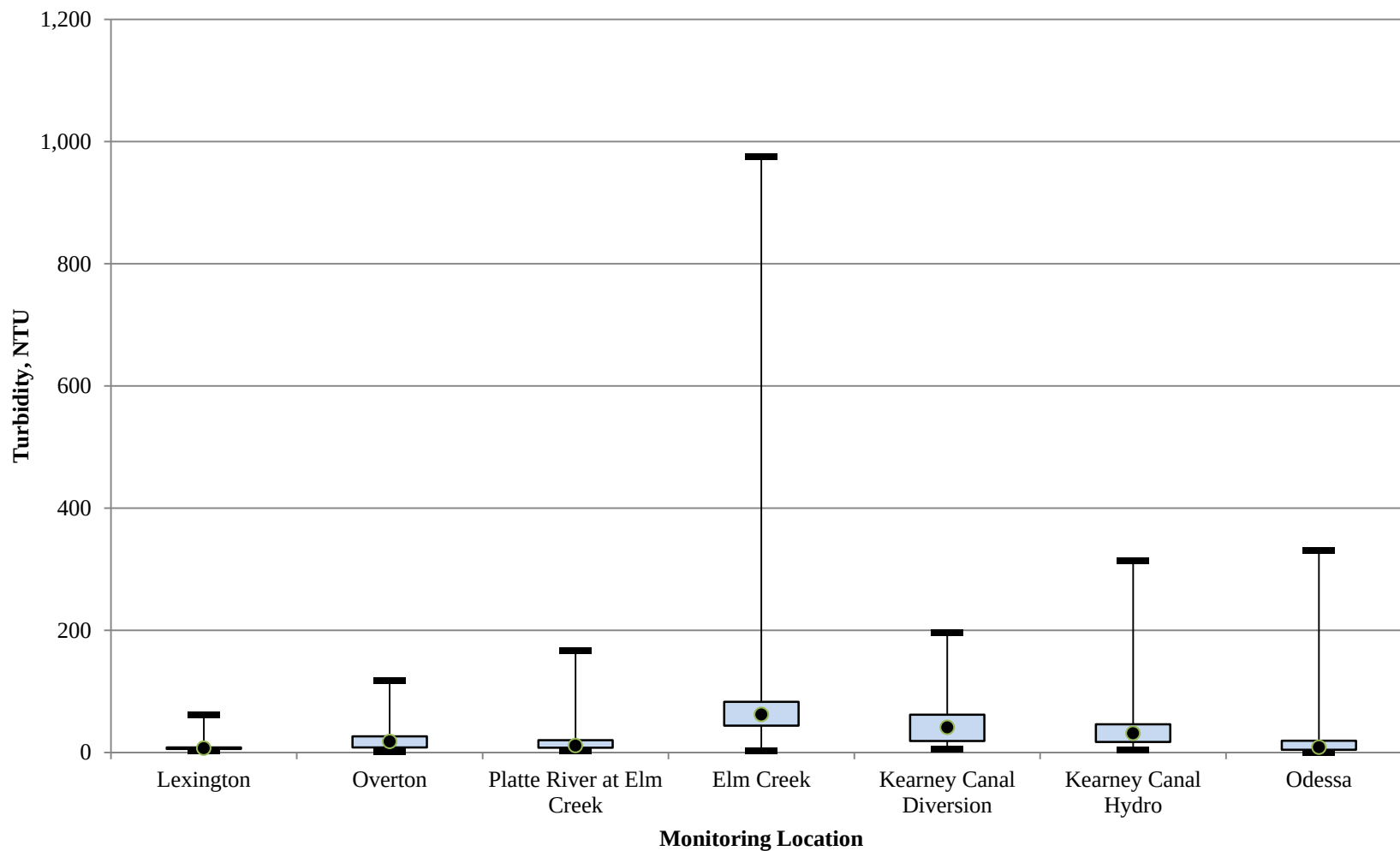




Figure B-11. Spatial Variation, Log Turbidity, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

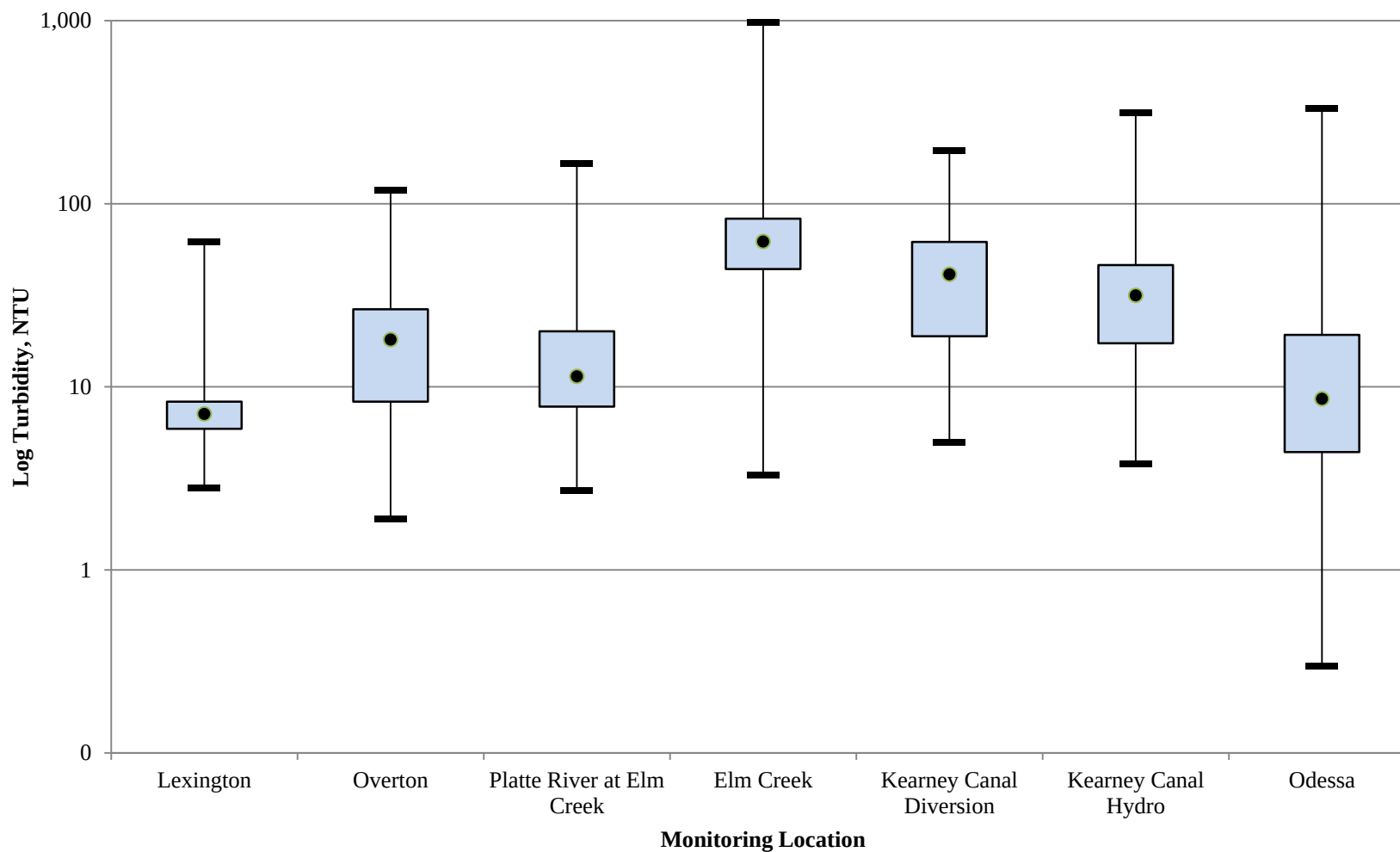




Figure B-12. Spatial Variation, Dissolved Oxygen, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

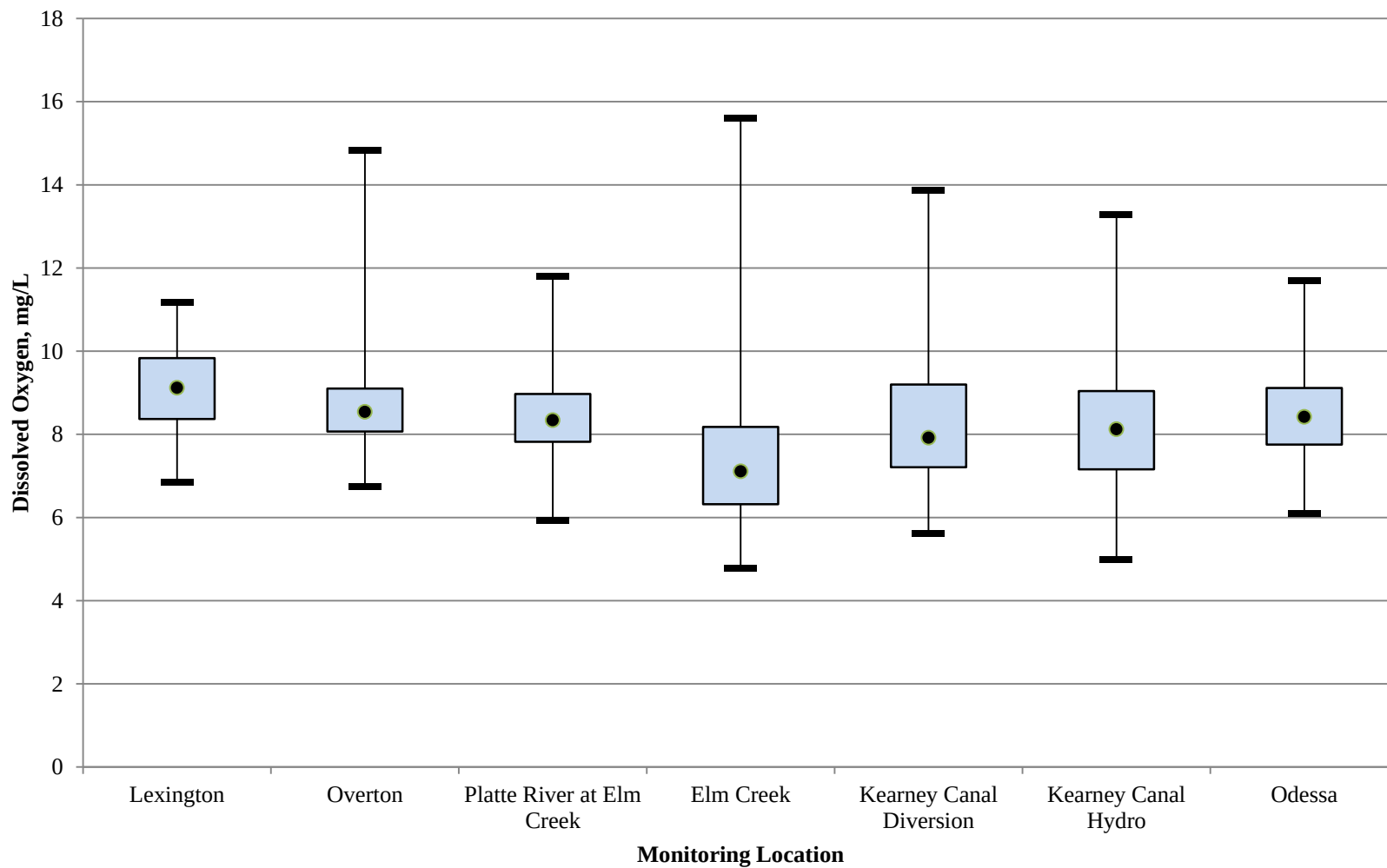
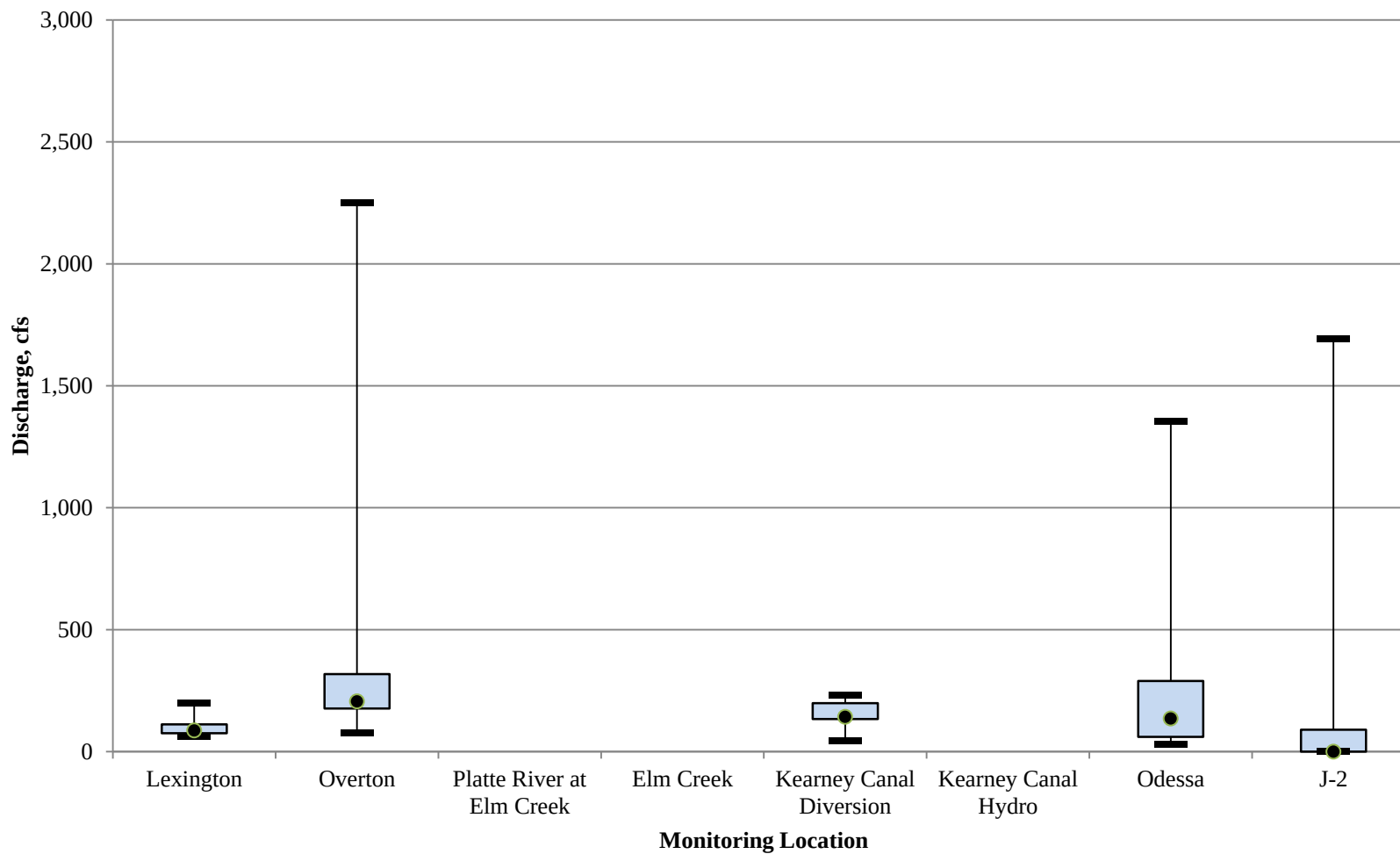




Figure B-13. Spatial Variation, Discharge, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)





Inter-Year Temporal Variation



Figure B-14. Temporal Variation, Temperature, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

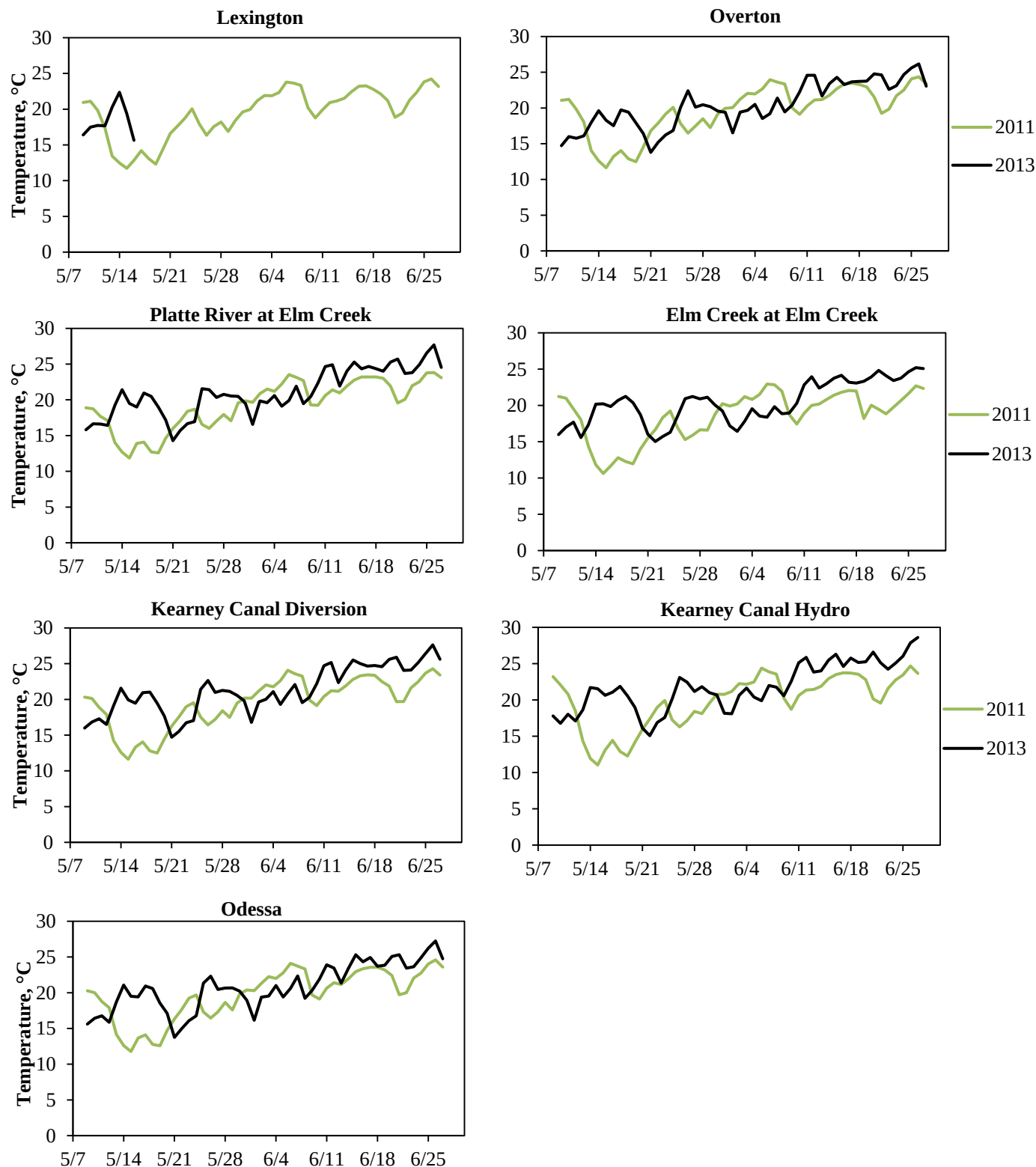




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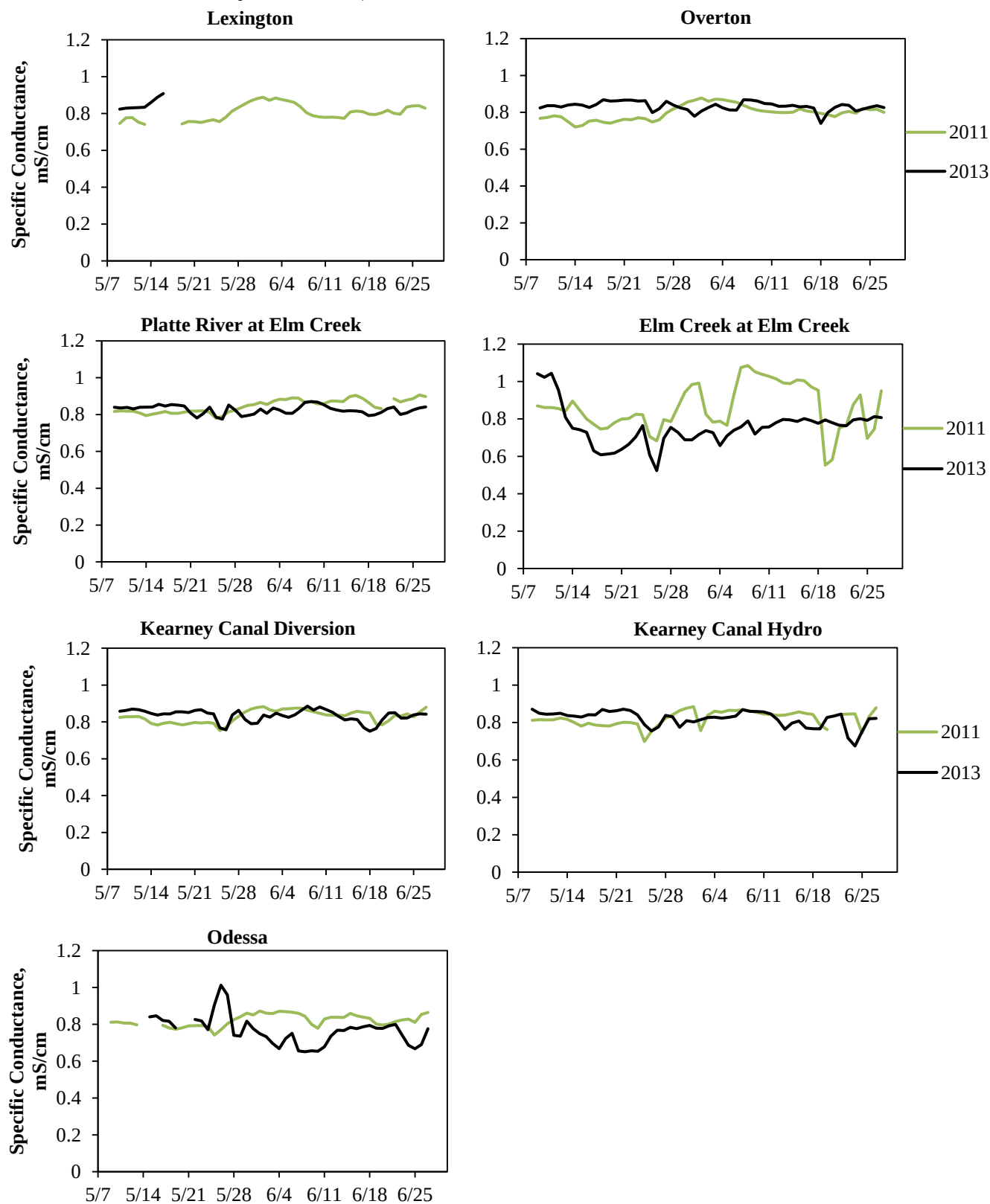




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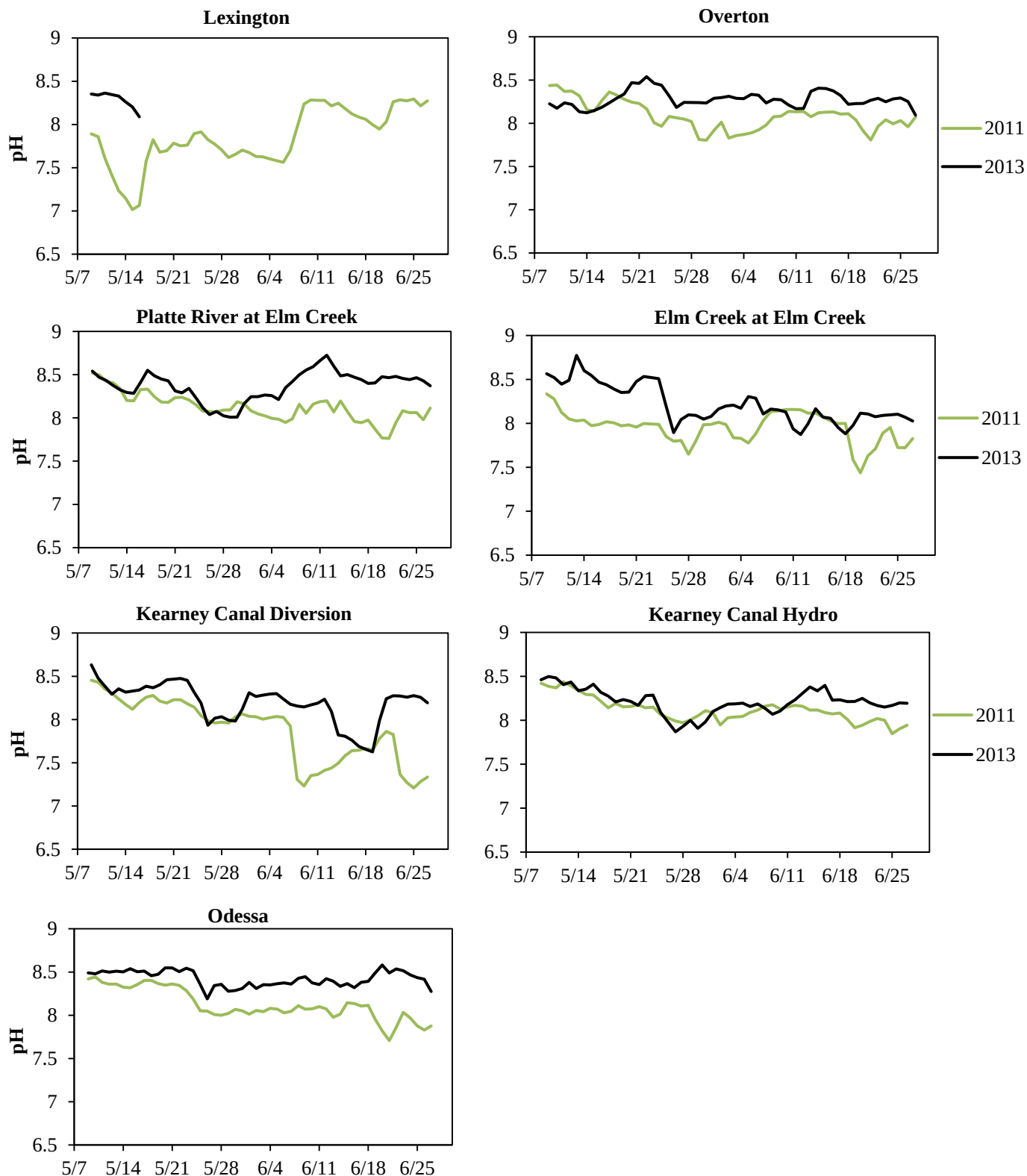




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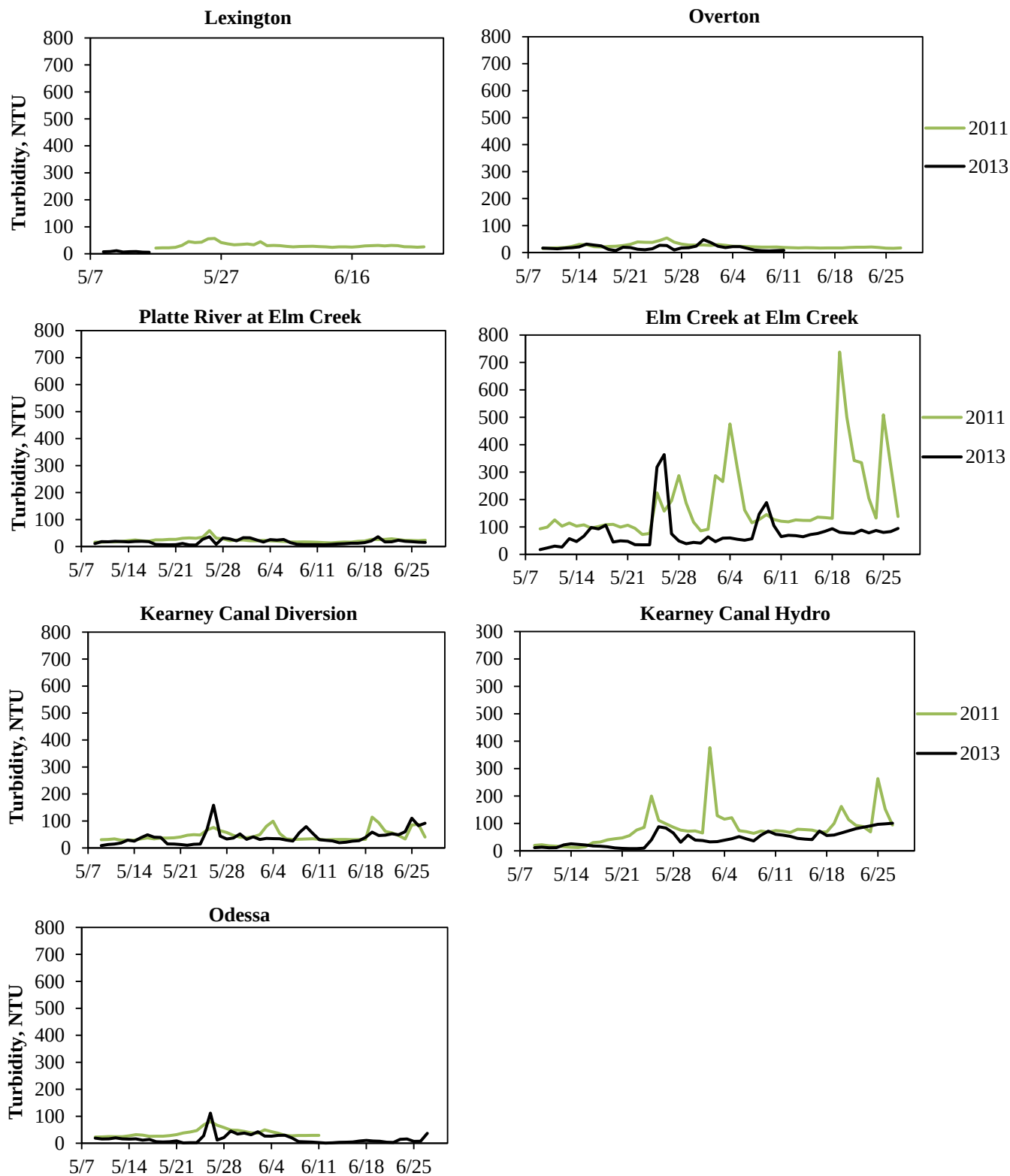




Figure B-18. Temporal Variation, Dissolved Oxygen, Daily Mean, (Platte River, Elm Creek, Kearney Canal, NE)

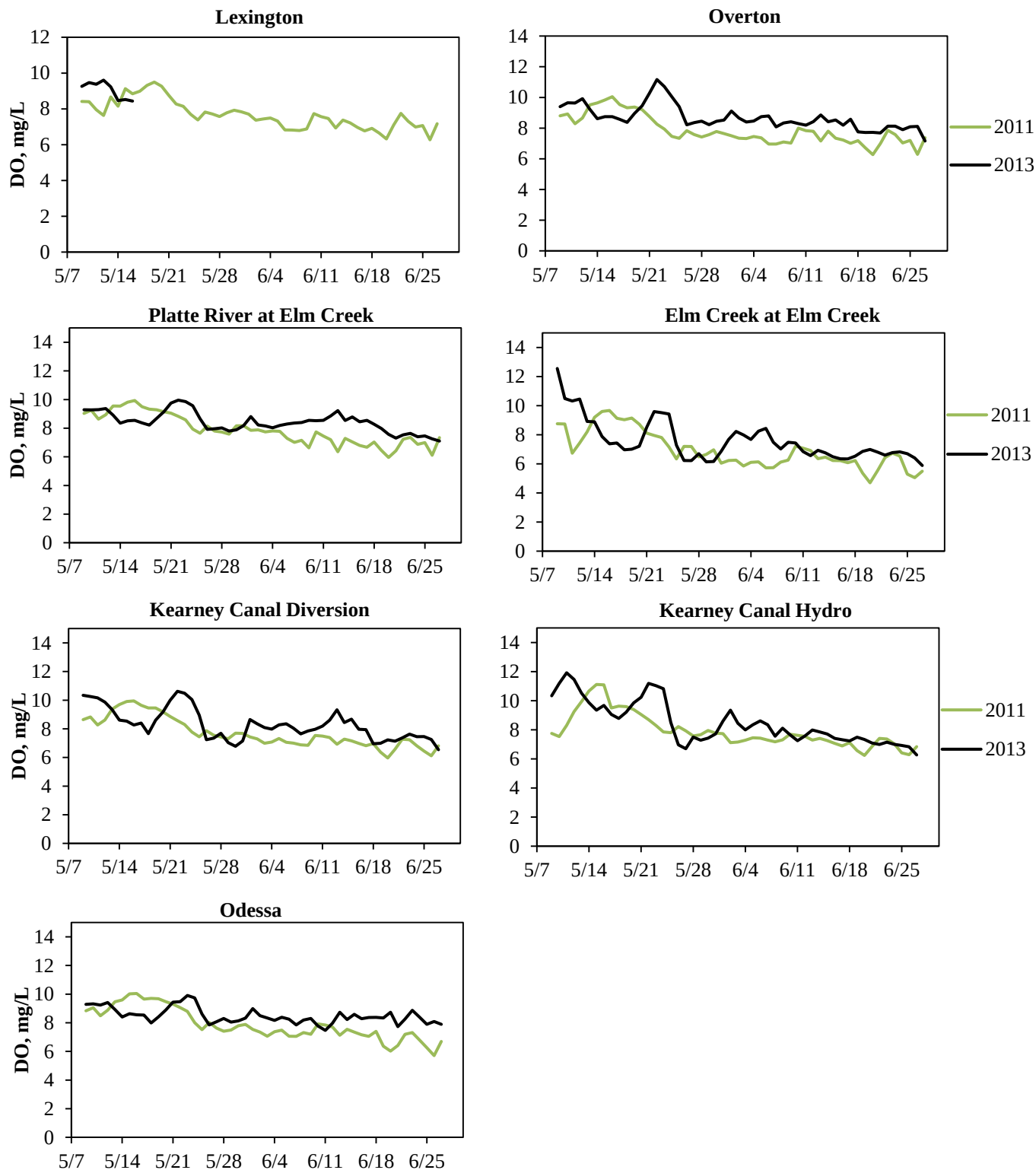
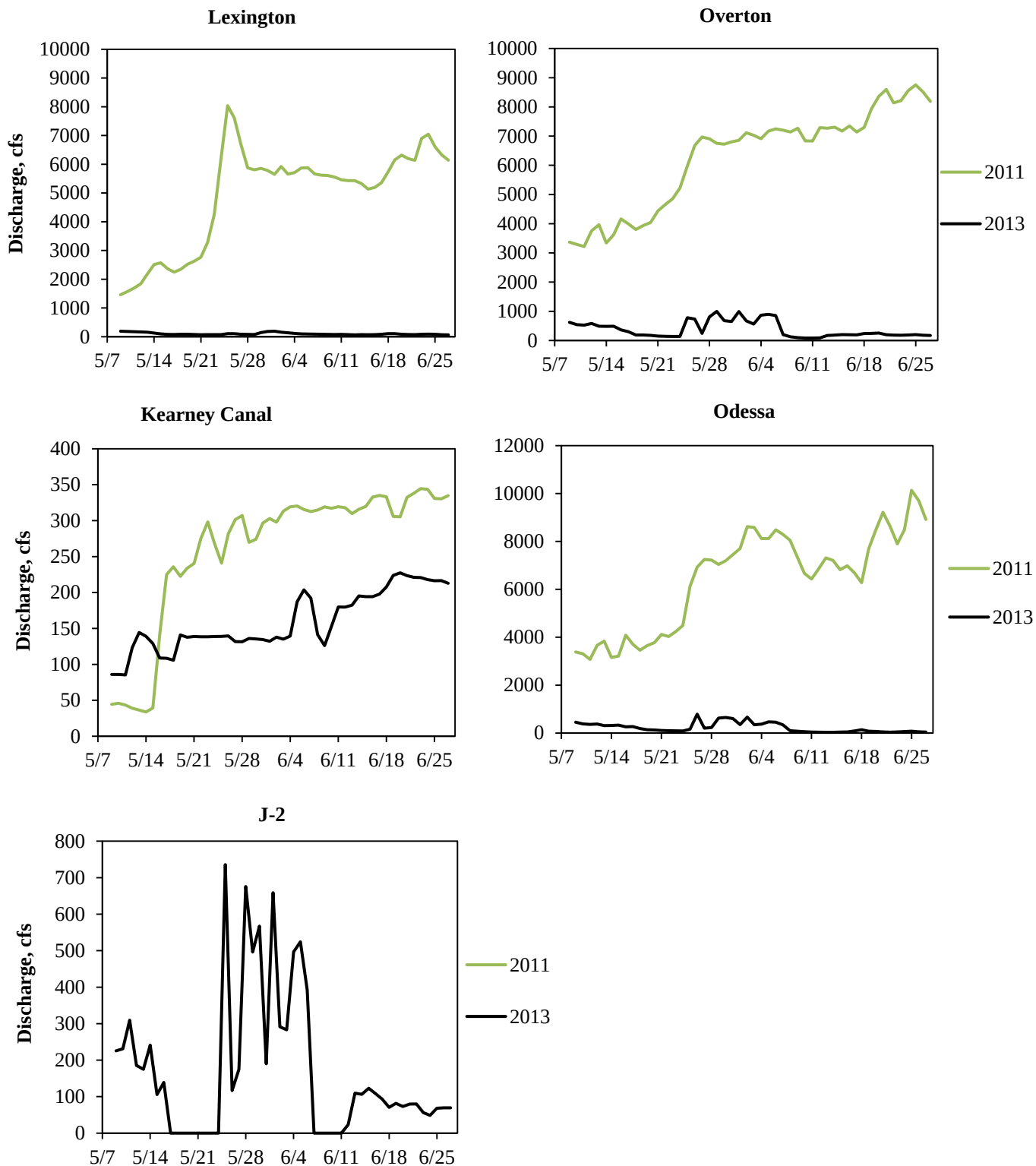




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Inter-Year Spatial Variation



Figure B-20. Spatial Variation, Temperature, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

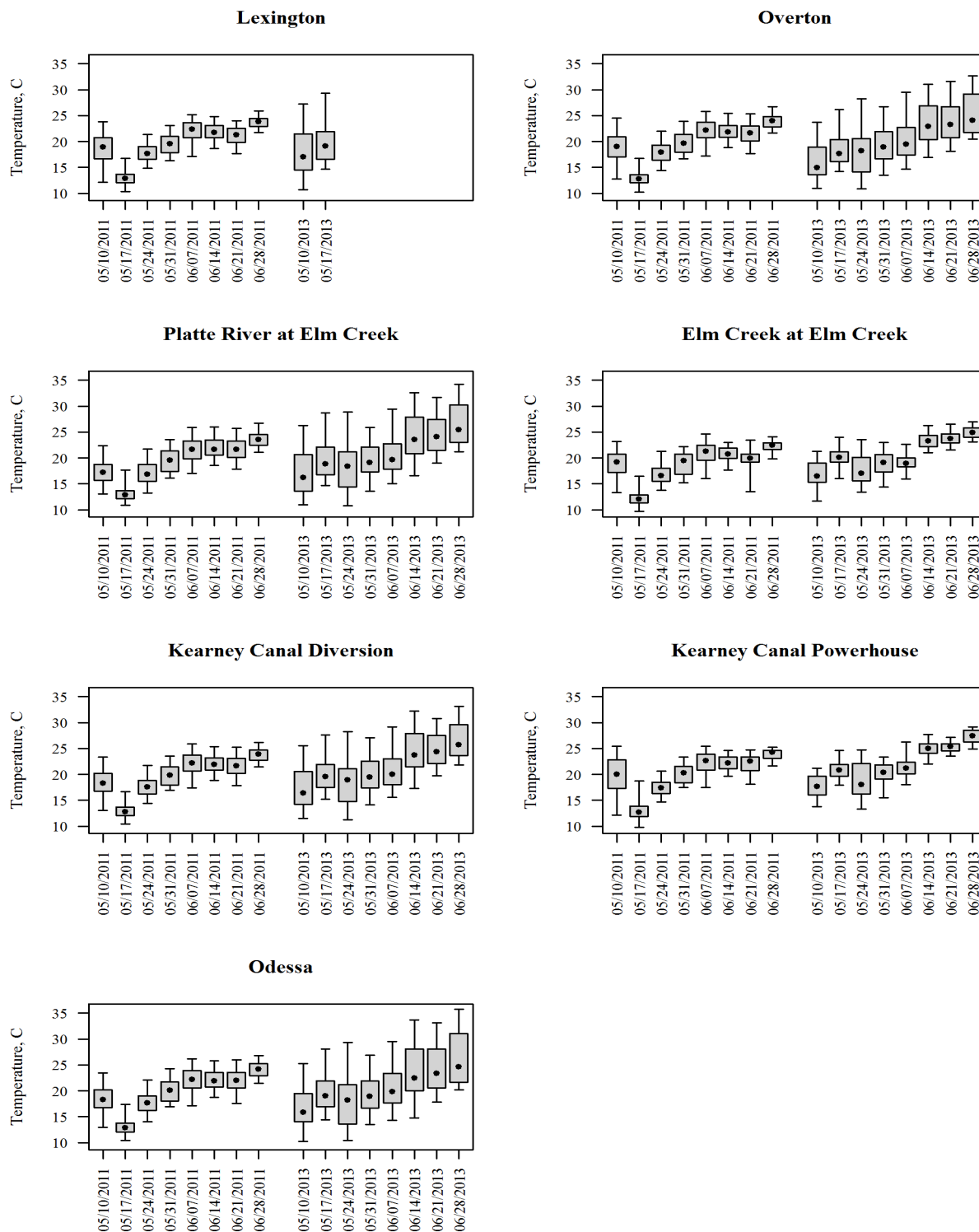




Figure B-21. Spatial Variation, Specific Conductance, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

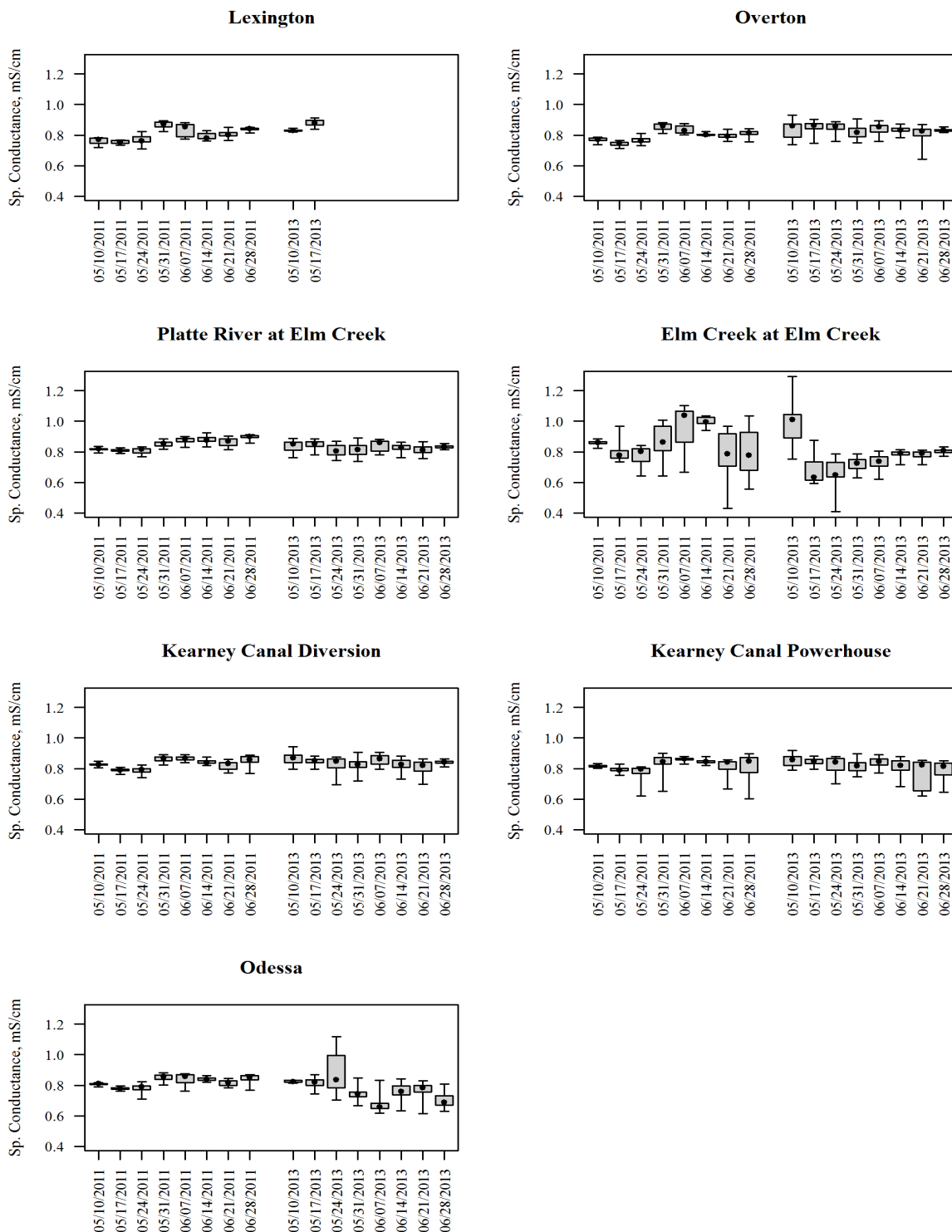




Figure B-22. Spatial Variation, pH, Interquartile Ranges, (Platte River, Elm Creek, Kearney Canal, NE)

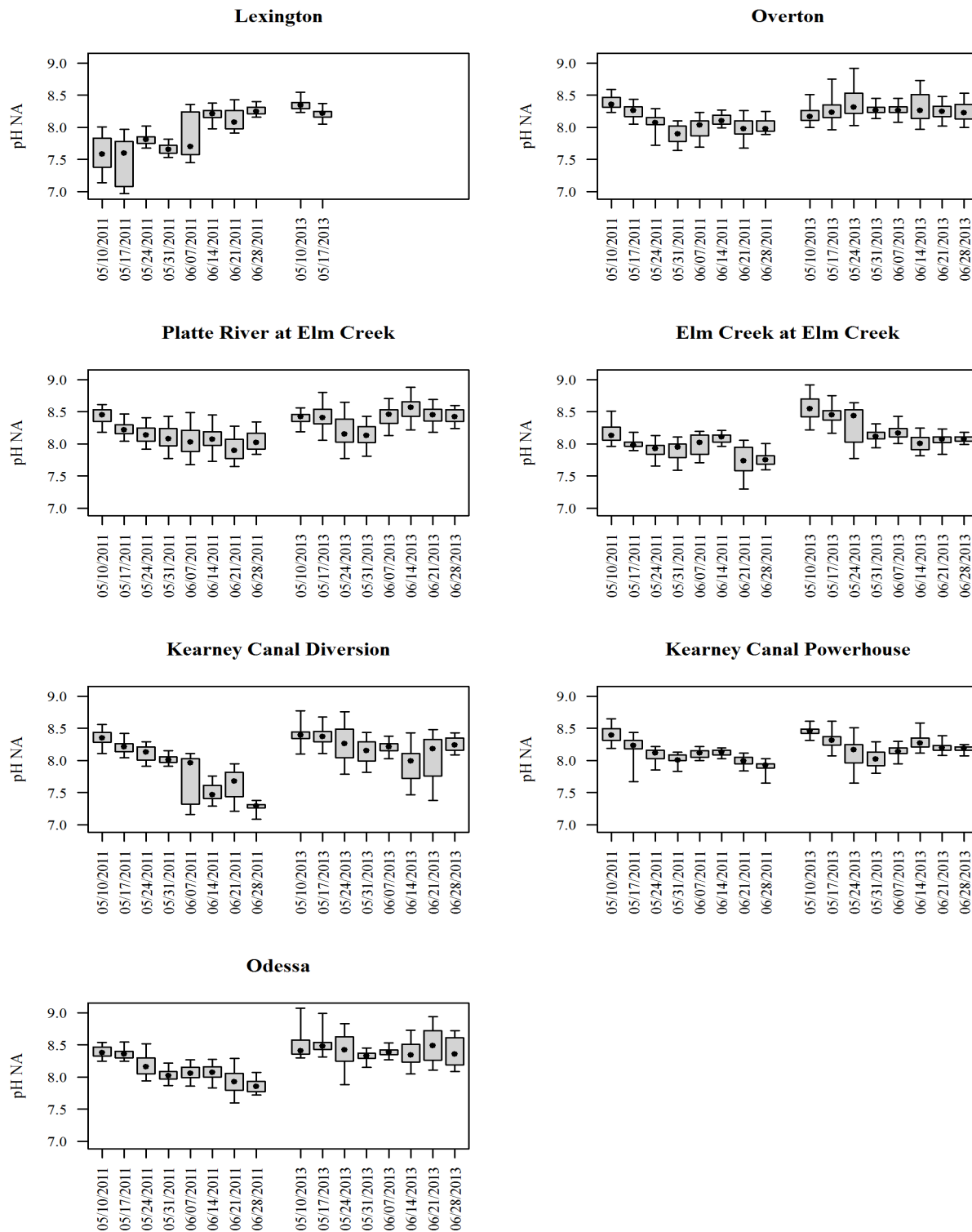




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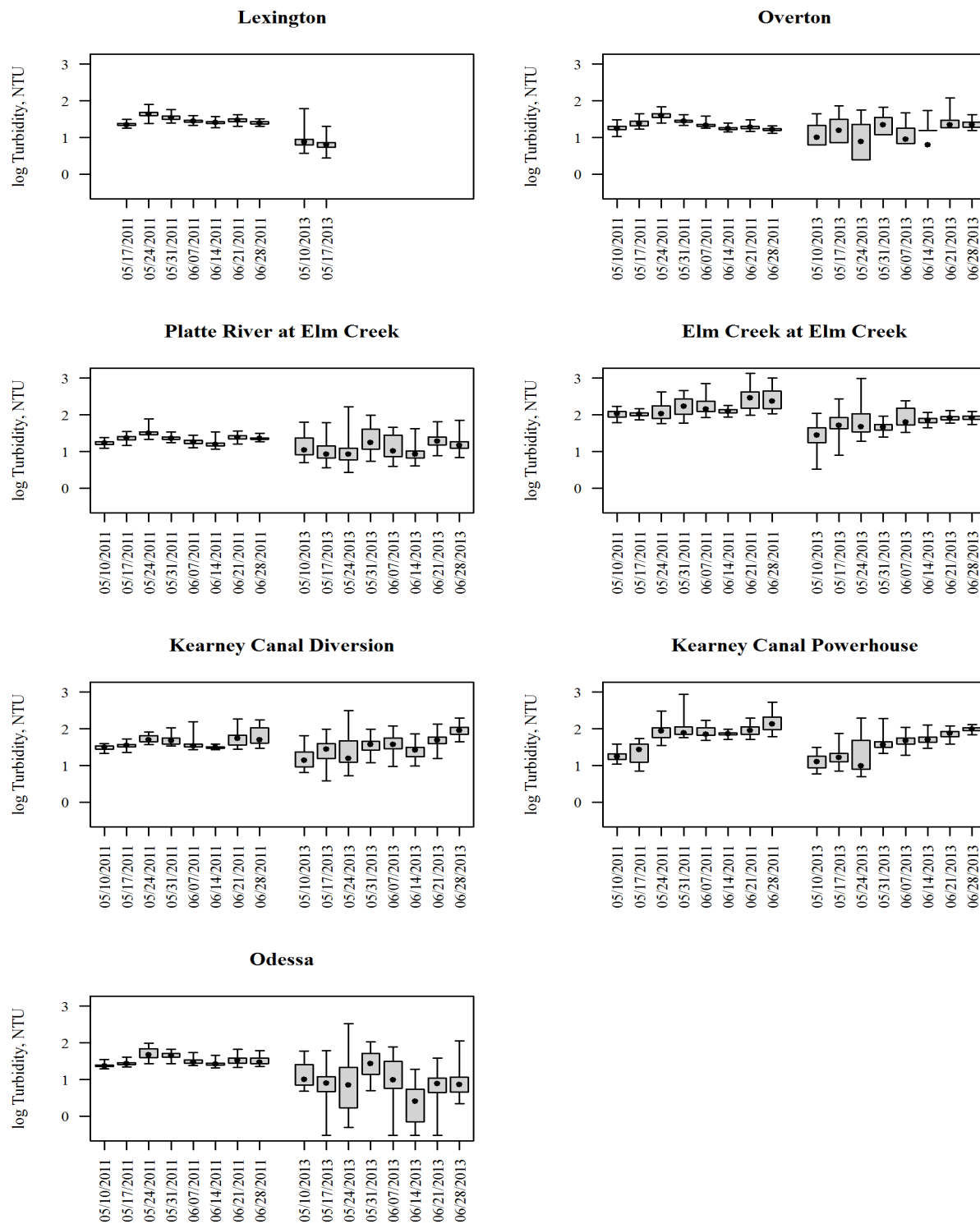




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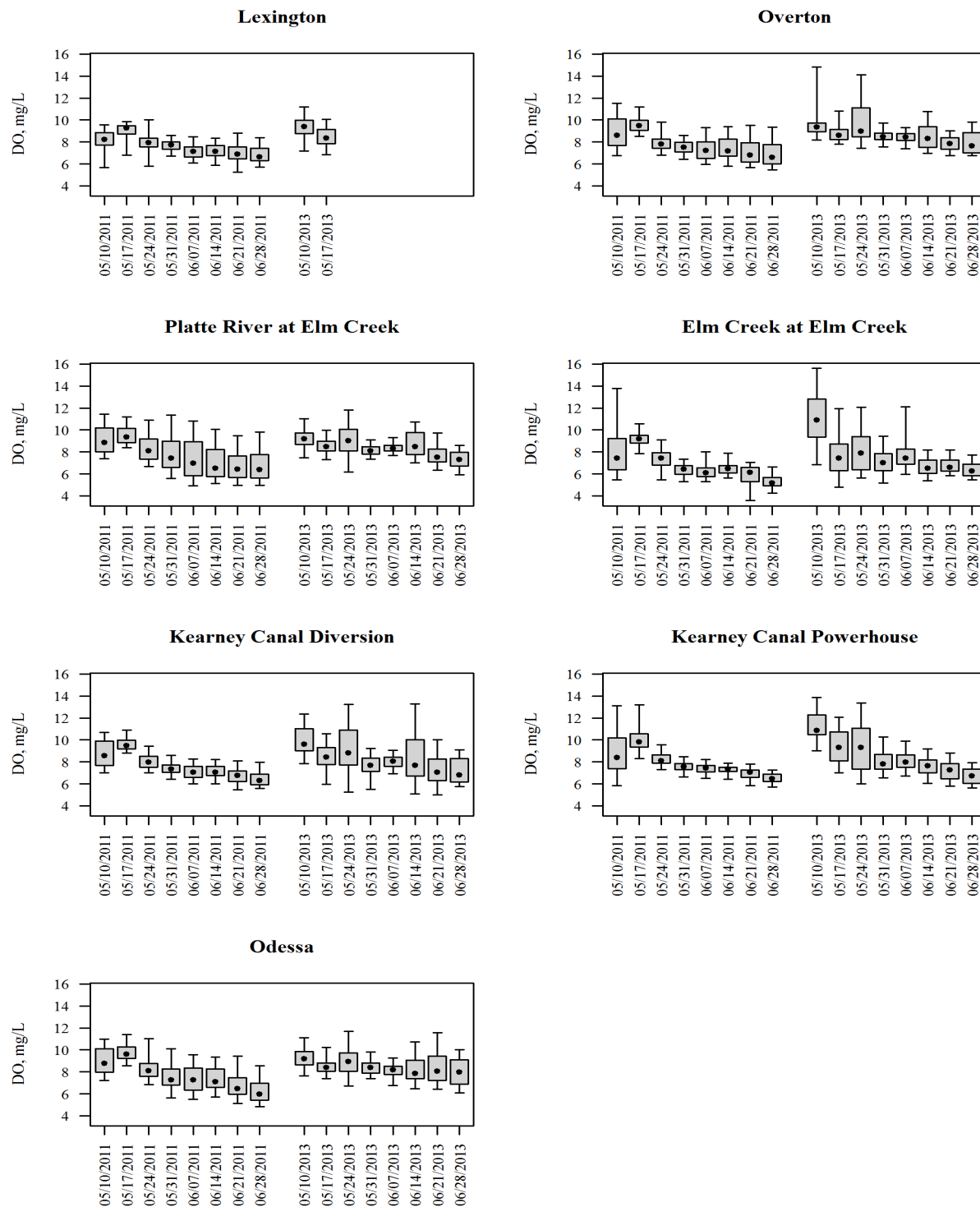
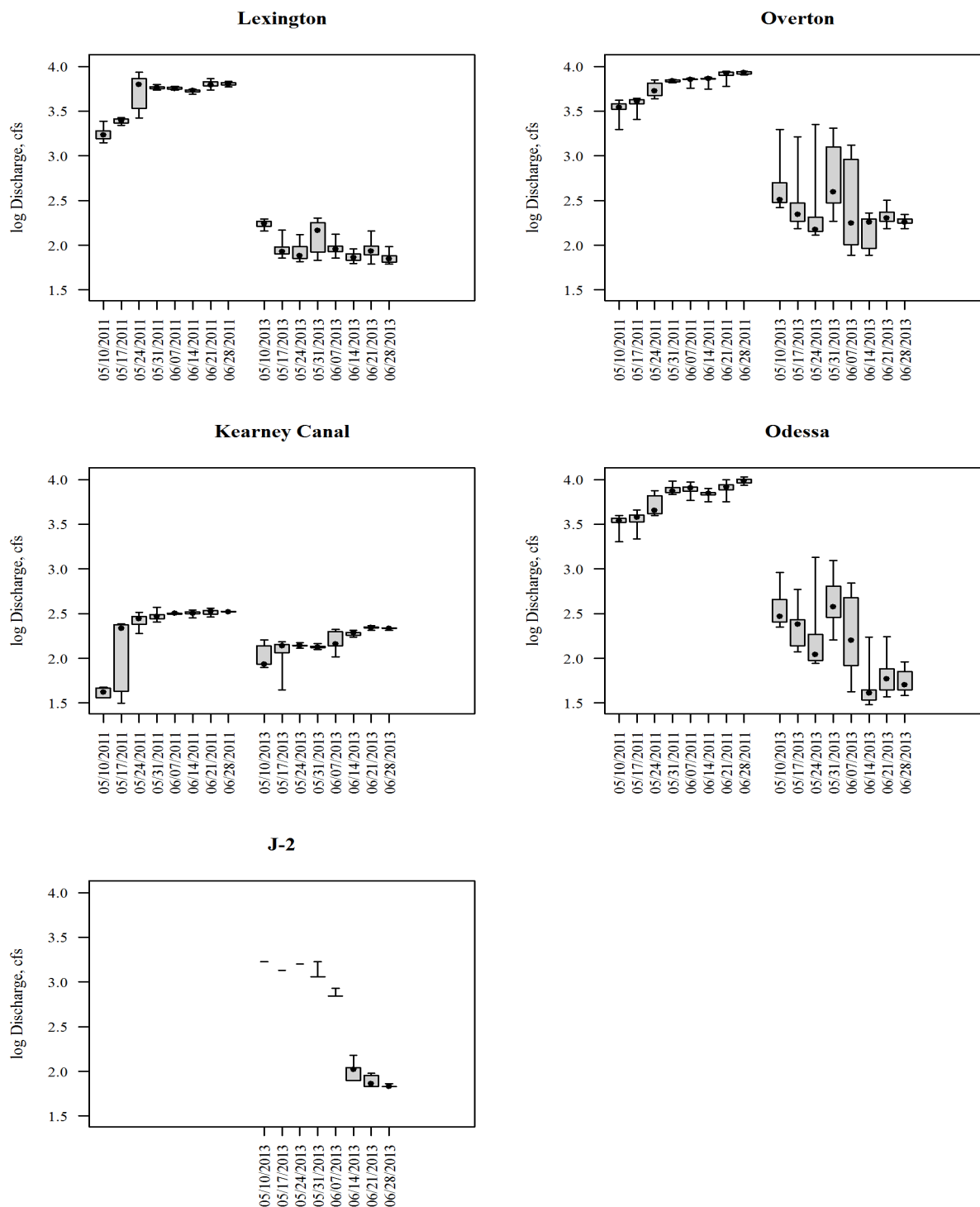




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Correlation of Total Suspended Sediments and Turbidity



Figure B-26. 2013 Linear Correlation, Suspended Sediments and Sonde Determined Turbidity

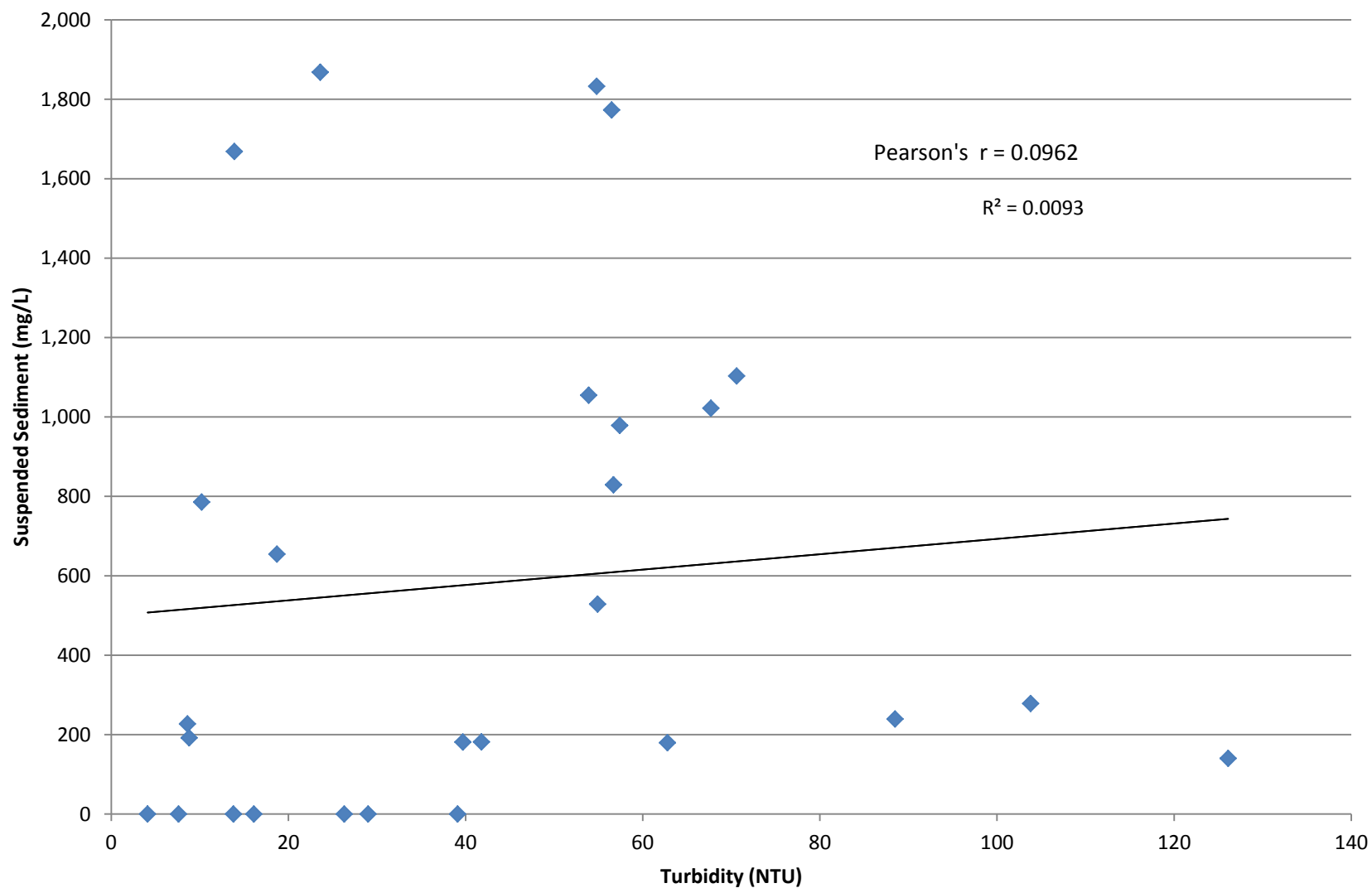




Figure B-27. 2013 Linear Correlation, Suspended Sediments and LaMotte Determined Turbidity

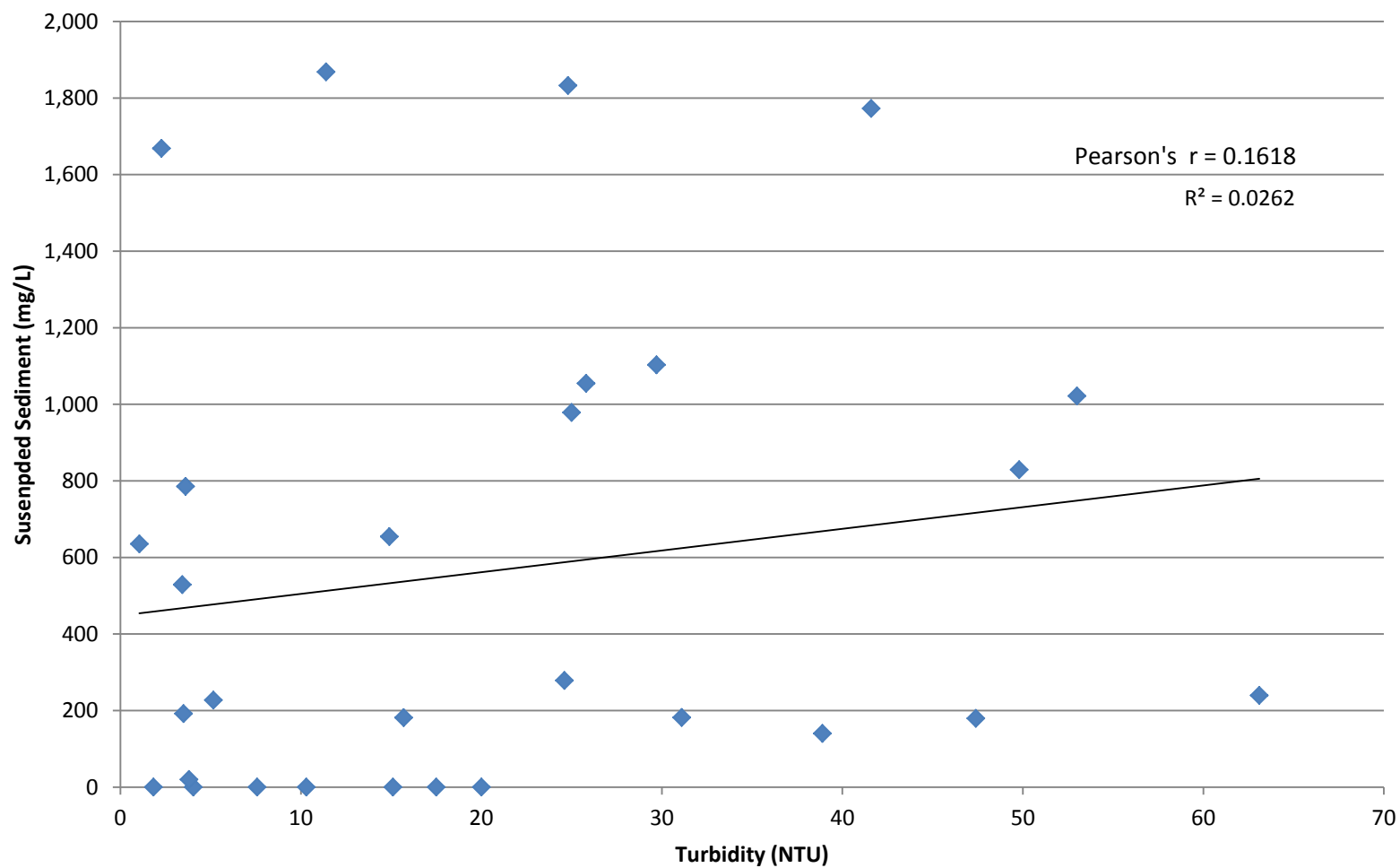
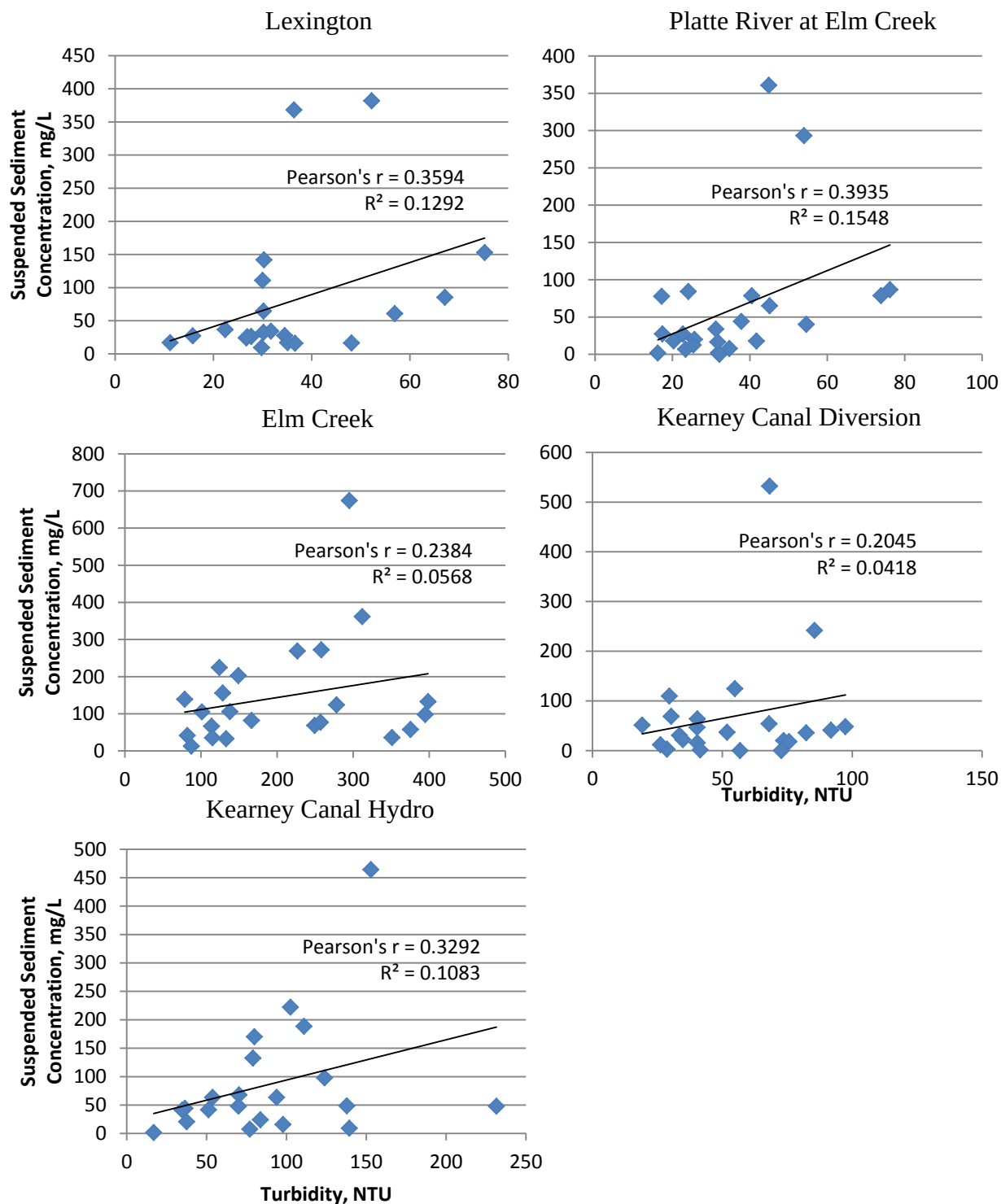




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Statistical Analysis of Turbidity



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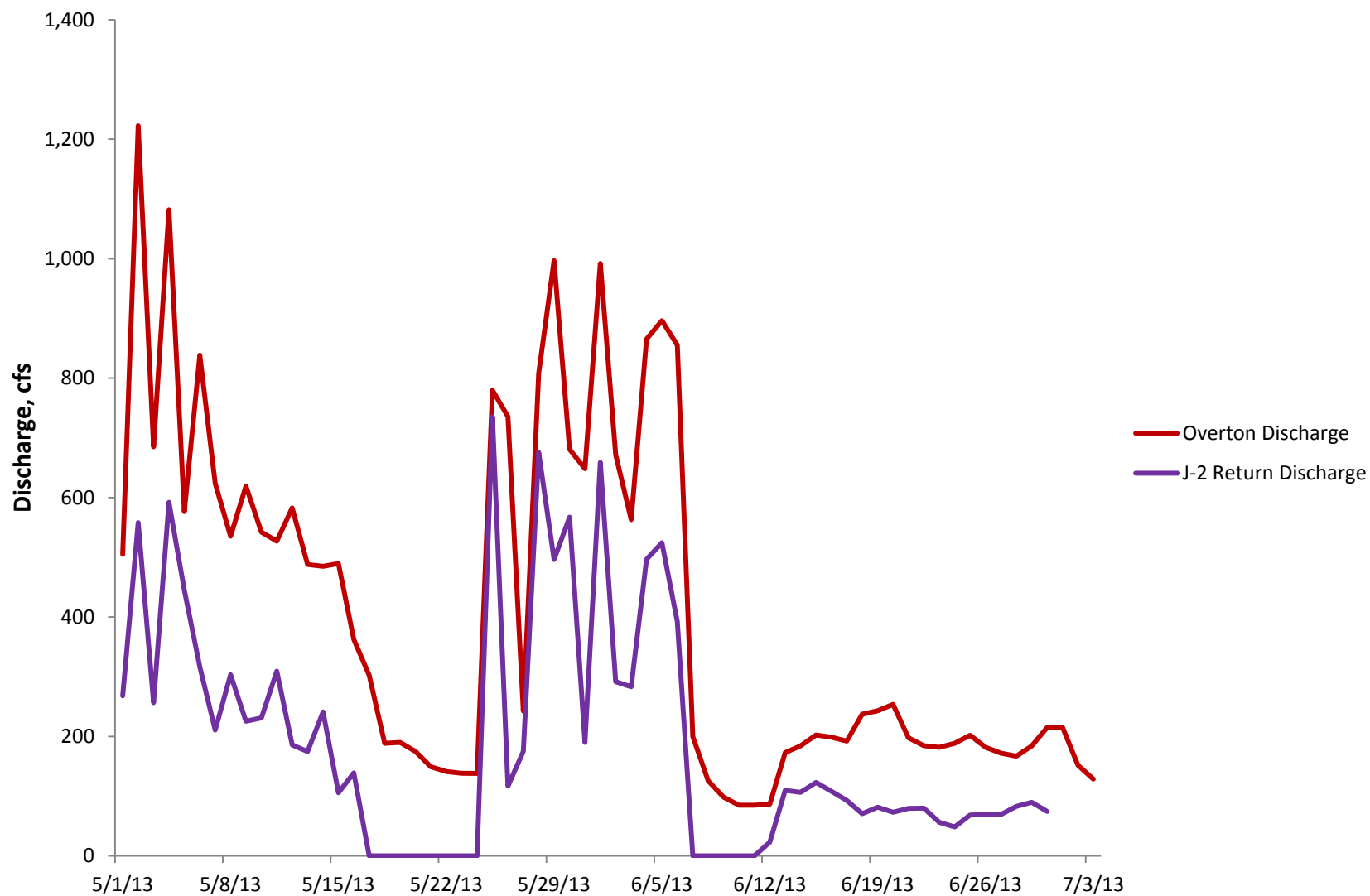




Figure B-30. Discharge at Overton and Platte River at Elm Creek, Turbidity, 2013

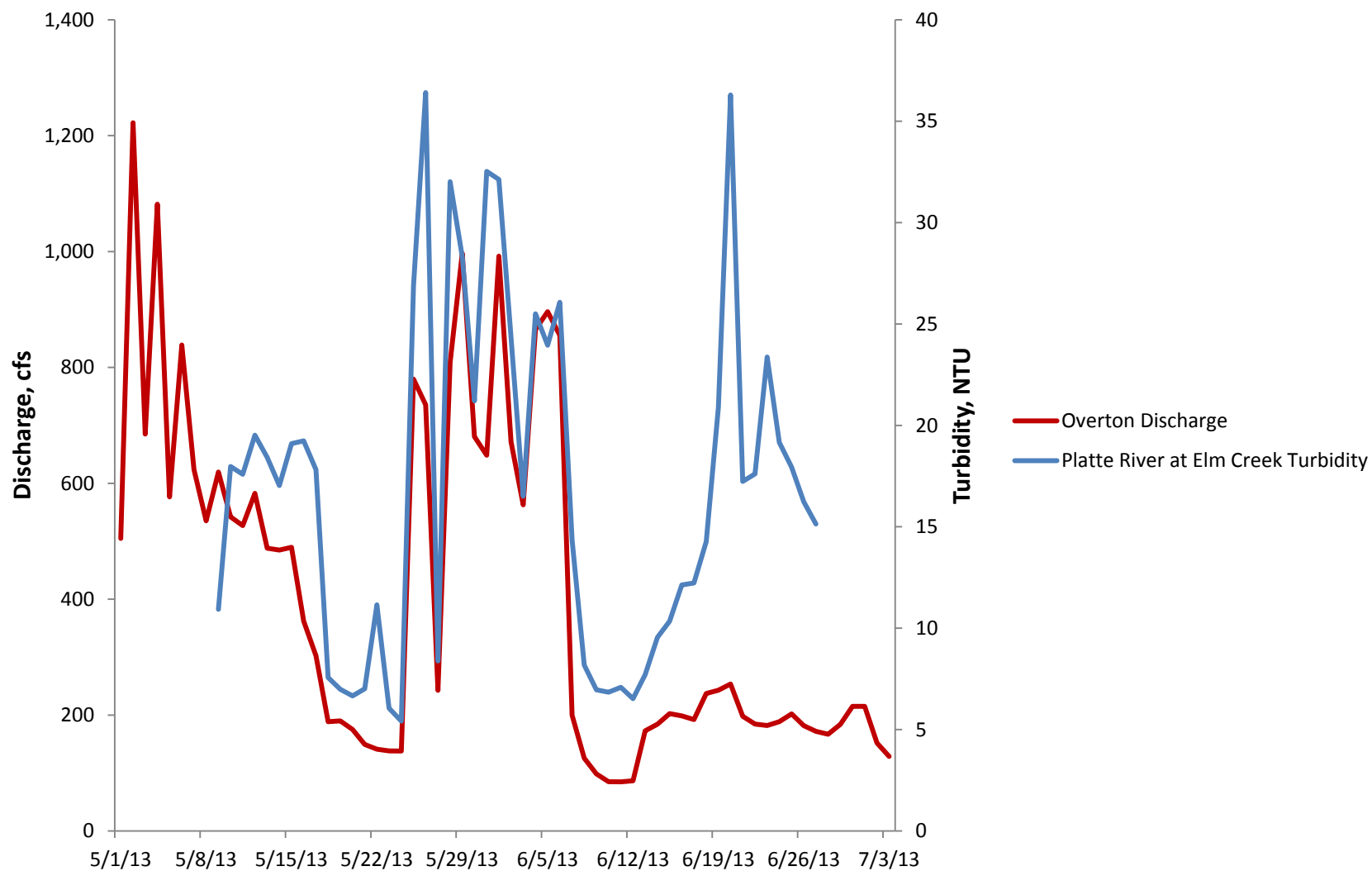




Figure B-31. Discharge at Overton and Kearney Canal Diversion Discharge and Turbidity, 2013

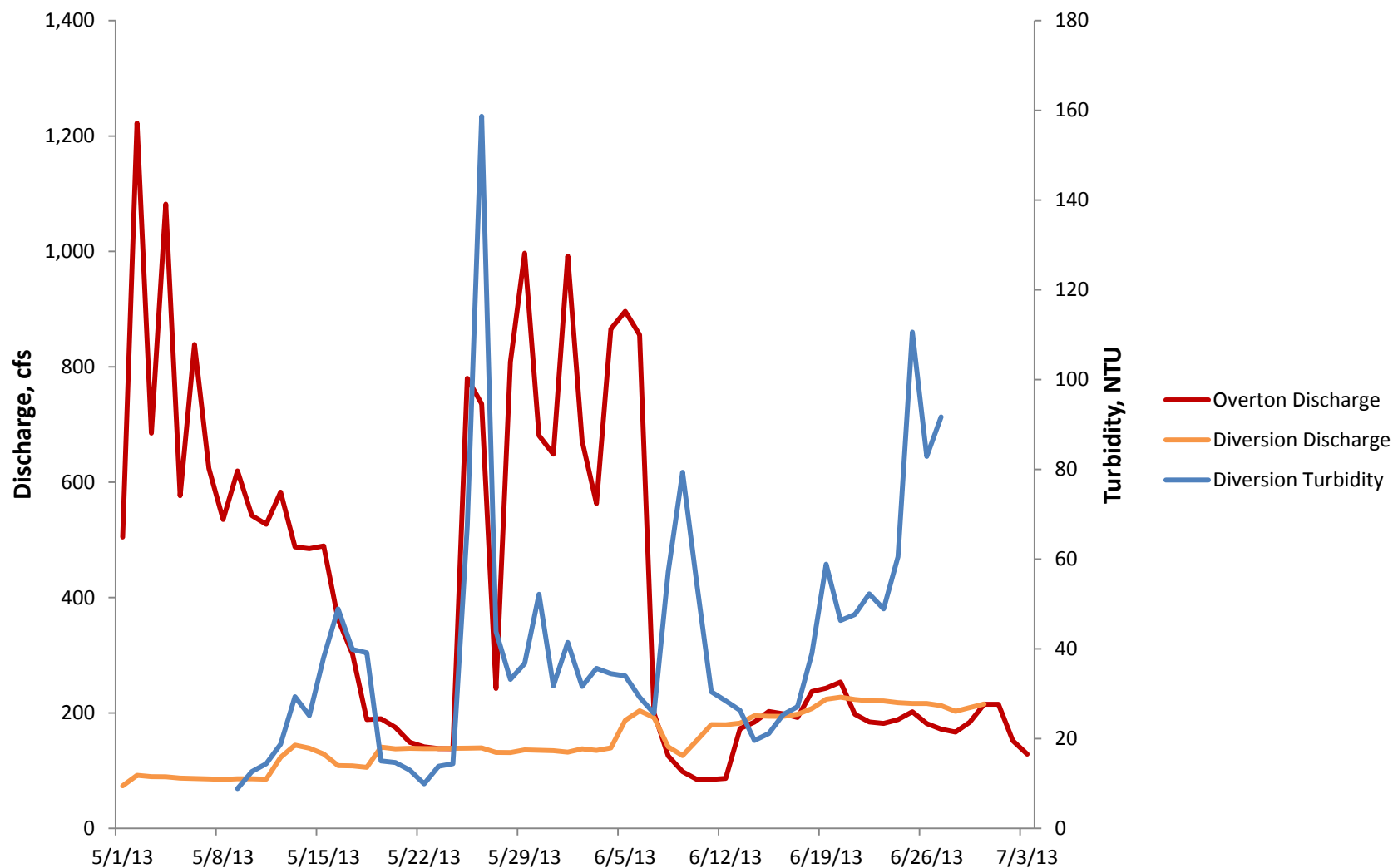




Figure B-32. Discharge at Overton and Kearney Canal Hydro Discharge and Turbidity, 2013

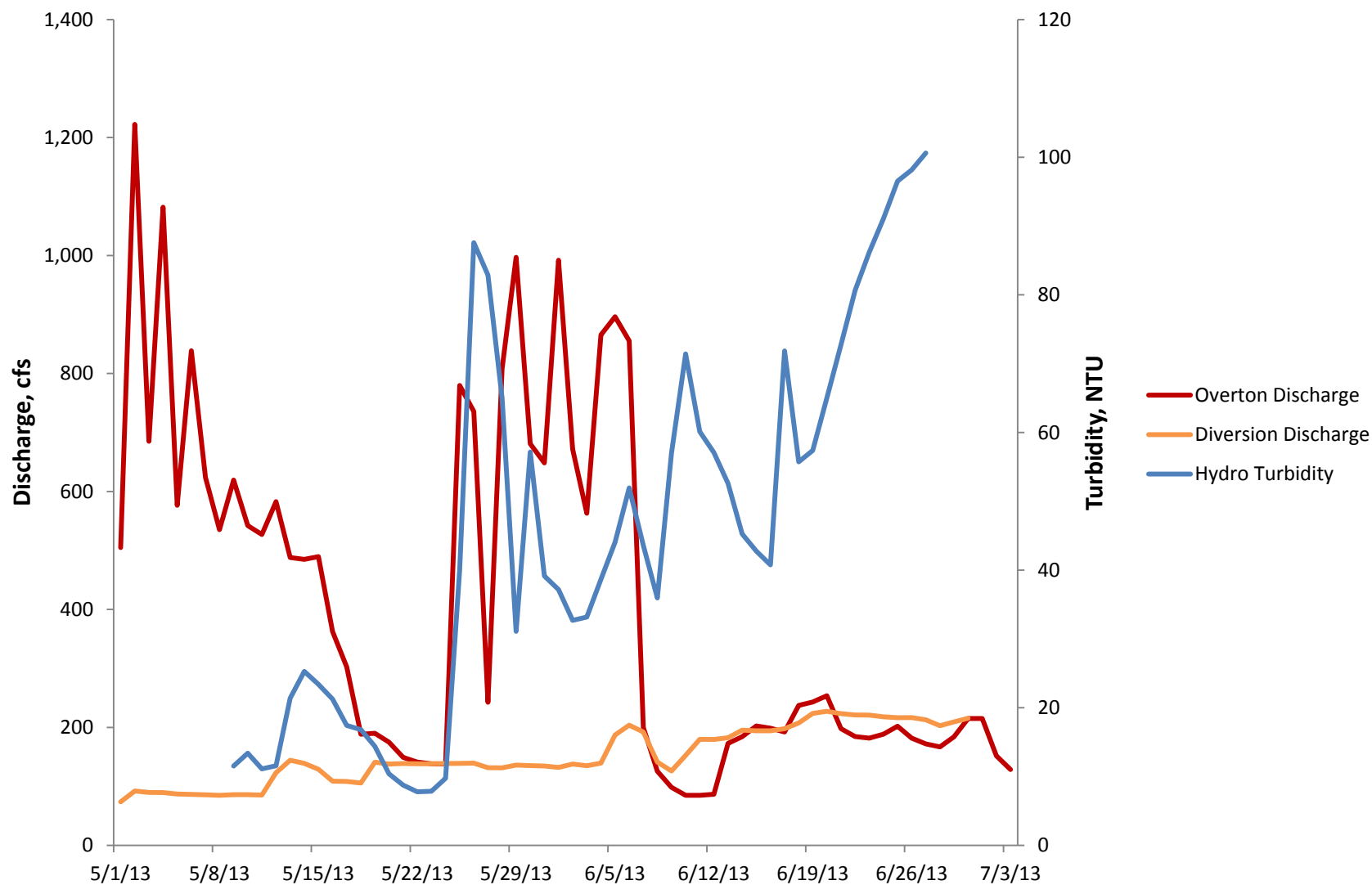
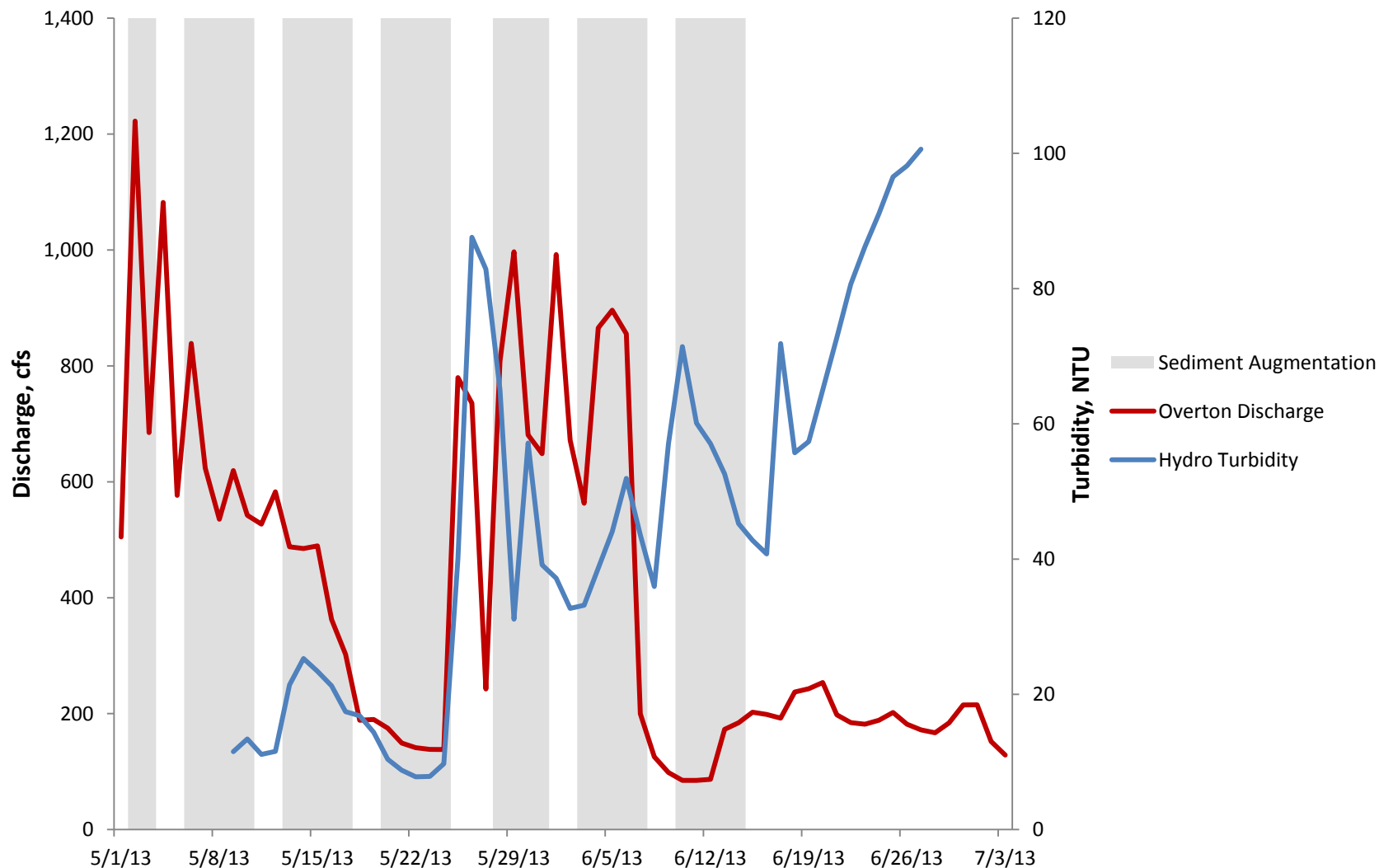




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APPENDIX C

QA/QC Data



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I. QUALITY CONTROL SUMMARY

The Quality Control Summary describes the results of the data quality evaluation performed on the water quality parameters collected during the 2013 monitoring season. Water temperature, specific conductance, pH, turbidity, dissolved oxygen, and discharge data were collected in 2013. Analytical data included suspended sediment. The quality of the data collected and analyzed was assessed using the elements of precision, accuracy, representativeness, completeness, and comparability. Overall the quality of the Kearney Canal water quality data collected was found to be of sufficient quality to characterize water quality during the monitoring period. Data that was not representative was removed from the data base prior to summarization and evaluation of the data.

I.A. Precision

Measurement of precision was accomplished by collecting duplicate water quality readings and duplicate samples. The premise being that two samples collected simultaneously from the same location should yield similar results. The variation between duplicate samples that is accepted is a function of the monitoring objectives and the inherent variation around each parameter. Precision was measured during the Protocol in terms of Relative Percent Difference (RPD) which is calculated using the following formula:

$$RPD = (X_1 - X_2) / [(X_1 + X_2) / 2]$$

X_1 and X_2 = reported concentrations for each duplicate sample.

Data were considered acceptable if the RPD was less than or equal to 50% for each parameter.

I.A.1. Continuous Water Quality Data

Duplicate water quality readings were collected for continuous water quality data using hand-held meters for temperature, specific conductance, pH, turbidity, and dissolved oxygen at each location during each sonde maintenance event. A summary of duplicate readings that exceeded the 50% RPD threshold is presented in Table 1; all duplicate sample collection results are presented in Appendix C, Table C-4 through C-10.

Table C-1. Relative Percent Difference (RPD) Exceedances for Duplicate Samples

Parameter	Location	Date	Hand Held	Sonde	RPD
Turbidity	OVRPR	22 May 2013	2.57	0.30	158.19%
Turbidity	OVRPR	19 June 2013	5.20	8.80	51.43%
Turbidity	ELMPR	16 May 2013	13.5	53.6	119.52%
Turbidity	ELMPR	23 May 2013	2.4	9.4	119.73%
Turbidity	KCDIV	20 June 2013	24.3	50.2	69.53%
Turbidity	KCPH	23 May 2013	12.63	6.90	58.68%
Turbidity	ODSPR	22 May 2013	1.76	0.30	141.75%



The procedure for collecting duplicate water samples was to retrieve the sonde from the water and immediately place it in a five gallon bucket of source water in the shade. The handheld instruments used for the paired readings were then immersed in the same bucket with the sonde and permitted to equilibrate. During the equilibration period, the sonde was connected to the laptop and set to display live readings of the water quality parameters being measured. Once parameters were stabilized, readings were recorded on the field data sheets.

- **Temperature** – All of the possible 47 duplicate readings were taken for temperature during the 2013 monitoring season. None of the paired readings exceeded the 50% RPD for duplicate temperature readings. The minimum RPD was 0.00%, and the maximum RPD was 4.64%.
- **Specific Conductance** – All of the possible 47 duplicate specific conductance readings were taken during the 2013 monitoring season. None of the paired readings exceeded the 50% RPD with a minimum RPD of 0.00% and maximum RPD of 11.41%.
- **pH** – One pH readings out of the possible 47 duplicate readings was not taken due to probe failure during the 2013 monitoring season. None of the remaining 46 paired readings exceeded the 50% RPD with a minimum RPD of 0.00% and maximum RPD of 7.39%.
- **Turbidity** – All of the possible 47 duplicate turbidity readings were taken during the 2013 monitoring season. Of the paired RPD readings, seven (15%) exceeded the 50% RPD for duplicate turbidity readings ranging from 51.43% to 158.19%. The minimum RPD for turbidity was 0.74%. High RPD values for turbidity resulted from biological fouling, algal growth and insect colonization on the optical lens for the turbidity probe.
- **Dissolved Oxygen** – All of the possible 47 duplicate dissolved oxygen readings were taken during the 2013 monitoring season. None of the paired readings exceeded the 50% RPD, with a minimum RPD of 0.10% and maximum RPD of 13.40%.

I.A.2. Discrete Water Quality Data

One duplicate water sample was collected for each discrete water sampling event. A summary of suspended sediment concentrations is presented below, and all duplicate sample collection results are presented in Appendix C, table C-11. A summary of duplicate readings that exceeded the 50% RPD threshold is presented in Table C-2.

Table C-2. Relative Percent Difference (RPD) Exceedances for Duplicate Samples

Date	Location	Concentration, ppm	RPD
05/23/13	DUP	179.60	200.00%
	KCDIV	0.00	
05/31/13	DUP	190.04	197.86%
	ELMPR	35374.87	



- **Suspended Sediment Concentration** – Seven water sampling events were performed during the 2013 monitoring season for the collection and analysis of suspended sediment. A duplicate water sample was collected during each sampling event for precision analysis. RPD exceeded 50% in 2 of the 7 (29%) duplicate analyses performed, ranging from 197.86% to 200.00%.

I.B. Accuracy

Measurement of accuracy was accomplished with sonde calibration standards and was quantified as the percent recovery from analysis of a known concentration. The data quality objective for accuracy for all measurements in the Protocol is:

$$\% \text{Recovery} = 85\% \text{ to } 115\%$$

Other checks for accuracy were accomplished through close adherence to instrument calibration procedures. A summary of duplicate readings that were outside the recovery range are presented in Table 3 and all duplicate sample collection results are presented in Appendix C, Table C-12 through C-18.

Table C-3. Percent Recovery Exceedances for Spiked Sample Recoveries

Parameter	Location	Date	Spike	Sonde	% Recovery
Dissolved Oxygen	ELMPR	8 May 2013	10.82	9.22	117.35%
Turbidity	ELMCR	8 May 2013	100	115.50	115.50%

Accuracy readings were collected after duplicate readings had been taken and the sonde and probes were cleaned. The sonde was placed in known (spiked) standards and the sonde parameter reading in the standard (spike) was recorded on the field data sheets to measure accuracy.

- **Specific Conductance** – All of the possible 43 accuracy readings were taken for specific conductance during the 2013 monitoring season. All of the spiked specific conductance readings for accuracy were within the 85 to 115% recovery range.
- **pH** – All of the possible 43 accuracy readings were taken for pH during the 2013 monitoring season. All of the spiked pH readings for accuracy were within the 85 to 115% recovery range.
- **Turbidity** – All of the possible 43 accuracy readings were taken for turbidity during the 2013 monitoring season. One of the spiked turbidity readings for accuracy fell outside the accuracy range of 85 to 115%.



- **Dissolved Oxygen** – All of the possible 43 accuracy readings were taken for dissolved oxygen during the 2013 monitoring season. One of the spiked dissolved oxygen readings for accuracy fell outside the accuracy range of 85% to 115%.

I.C. Representativeness

Representativeness was addressed by adhering to the Protocol procedures, manufacturer calibration procedures, and a sampling plan that describes appropriate location, time, and conditions for data collection. Conditions that may result in a “non-representative sample” were noted on the field data sheet and were evaluated during the data review process. A review of the field data sheets (Appendix E) revealed several “conditions” which resulted in “non-representative” data points being collected.

Temperature and pH were found to be consistent and stable during the monitoring program and minimally affected by monitored environmental conditions. Environmental conditions resulting in non-representative data being collected, including: burial of the sonde in sediment, sediment accumulation in the specific conductance measurement cell, algal growth on the optical aperture of the dissolved oxygen and turbidity probes, and insect colonization on all the probes – particularly the dissolved oxygen and turbidity probes. The raw data in combination with the field data sheets was reviewed to determine “non-representative” data. Non-representative data were excluded from the summary data.

I.D. Comparability

Comparability of data can be affected by several factors including changes in sample location, parameters, collection, or analytical techniques, etc. Quality assurance procedures were incorporated throughout the Protocol to help assure that comparable data was obtained. These quality assurance procedures included written descriptions of all sample locations; assignment of sampling responsibilities to the same personnel or the appropriate training for new personnel; establishment of a set parameter list; and description of data collection, analysis, and assessment procedures. Adherence to these procedures was closely evaluated during the data quality review process.

I.E. Completeness

Completeness refers to the amount of data necessary to meet the monitoring objectives. To help ensure that all of the designed monitoring data and water samples were collected, a sampling schedule was prepared and distributed. An inventory and review process was implemented to maintain data collected, and routinely checked for potential errors, missing data, and missing information on field data sheets. It was the responsibility of the sample collector to make sure field data sheets were completely and accurately filled out, and to report missing data from the sondes.

The data completeness necessary to meet the monitoring objectives identified in the 2013 Kearney Canal Water Quality Monitoring Plan (EA 2013) were met. Data was found to be of



sufficient quality and quantity to characterize water quality during the monitoring period. Incomplete or no water quality data was collected at the following monitoring locations.

- **Elm Creek, Platte River** – No pH readings were collected from 5-6 June 2013 due to malfunctioning pH probe. The other monitored water quality data (DO, temperature, specific conductivity, and turbidity) was collected during this time period.
- **Platte River at Lexington** – Platte River water depth at Lexington was too shallow to fully immerse the data sonde because of very low river flows. The sonde was removed from the Lexington monitoring location on 16 May 2013 and was not redeployed.

I.F. Deviations from Methods and Procedures

No deviations were identified from the methods and procedures listed in the Water Quality Monitoring Protocol.



Acronym List	
-- = No Data Available	LEXPR = Platte River, Lexington, NE
%R = Percent Recovery	mg/L = Milligrams per liter
°C = degrees Celsius	mS/cm = milliSiemens per centimeter
DUP = Duplicate	NTU = Nephelometric Turbidity Units
ELMCR = Elm Creek, Elm Creek, NE	ODSPR = Platte River, Odessa, NE
ELMPR = Platte River, Elm Creek, NE	OVRPR = Platte River, Overton, NE
KCDIV = Kearney Canal Diversion, Elm Creek, NE	ppm = parts per million
KCPH = Kearney Canal Power House, Kearney, NE	RPD = Relative Percent Difference



Precision, Duplicate Continuous Water Quality Data, Relative Percent Difference



Table C-4. Duplicate Water Quality RPDs, Continuous Data, Platte River, Lexington, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/07/13	12.94	12.80	1.09%	8.29	8.32	0.36%	9.61	9.60	0.10%	0.812	0.811	0.12%	19.30	14.30	29.76%
05/16/13	16.89	17.09	1.18%	8.29	8.13	1.95%	9.43	9.33	1.07%	0.917	0.911	0.66%	30.40	39.50	26.04%

Table C-5. Duplicate Water Quality RPDs, Continuous Data, Platte River, Overton, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/07/13	14.22	14.37	1.05%	8.37	8.40	0.36%	9.63	9.58	0.52%	0.827	0.823	0.48%	19.80	17.10	14.63%
05/16/13	17.73	17.88	0.84%	8.34	8.32	0.24%	9.30	9.31	0.11%	0.890	0.894	0.45%	11.90	16.00	29.39%
05/22/13	20.96	21.14	0.86%	8.60	8.65	0.58%	10.88	10.77	1.02%	0.878	0.871	0.80%	2.57	0.30	158.19%
05/30/13	22.85	22.91	0.26%	8.38	8.39	0.12%	8.68	8.74	0.69%	0.867	0.871	0.46%	10.92	8.00	30.87%
06/05/13	22.59	22.71	0.53%	8.48	8.42	0.71%	8.86	8.80	0.68%	0.870	0.859	1.27%	6.85	6.10	11.58%
06/13/13	18.95	18.09	4.64%	8.31	8.30	0.12%	9.00	9.52	5.62%	0.890	0.845	5.19%	8.09	10.30	24.03%
06/19/13	28.70	28.64	0.21%	8.45	8.45	0.00%	8.04	8.07	0.37%	0.874	0.861	1.50%	5.20	8.80	51.43%
06/27/13	25.89	26.04	0.58%	8.05	8.24	2.33%	8.31	8.23	0.97%	0.869	0.866	0.35%	13.30	12.40	7.00%



Table C-6. Duplicate Water Quality RPDs, Continuous Data, Platte River, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/16/13	20.39	20.51	0.59%	8.66	8.63	0.35%	11.72	11.36	3.12%	0.808	0.804	0.50%	13.5	53.6	119.52%
05/23/13	12.93	13.02	0.69%	8.25	8.31	0.72%	10.55	10.42	1.24%	0.867	0.857	1.20%	2.4	9.4	119.73%
05/31/13	18.47	18.64	0.92%	8.30	8.22	0.97%	8.31	8.33	0.24%	0.782	0.784	0.26%	7.6	10.3	29.78%
06/05/13	21.72	21.85	0.60%	8.37	8.42	0.60%	8.61	8.54	0.82%	0.861	0.859	0.23%	9.2	11.4	21.36%
06/06/13	21.65	21.78	0.60%	8.33	--	--	8.89	8.78	1.25%	0.820	0.820	0.05%	6.2	7.1	13.37%
06/13/13	22.52	22.66	0.62%	8.51	8.74	2.67%	10.47	10.64	1.61%	0.871	0.855	1.87%	4.9	6.8	32.28%
06/19/13	28.83	29.03	0.69%	8.56	7.95	7.39%	8.32	8.25	0.84%	0.819	0.818	0.17%	9.0	7.9	12.91%
06/27/13	28.41	28.59	0.63%	8.25	8.49	2.87%	8.65	8.48	1.98%	0.828	0.831	0.31%	10.5	15.8	40.21%

Table C-7. Duplicate Water Quality RPDs, Continuous Data, Elm Creek, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/16/13	22.54	22.57	0.13%	8.57	8.40	2.00%	8.32	8.39	0.84%	0.767	0.760	0.92%	679	640	5.91%
05/23/13	16.10	16.10	0.00%	8.44	8.51	0.83%	10.53	10.44	0.86%	0.795	0.772	2.94%	23.4	30.1	25.05%
05/31/13	20.50	20.33	0.83%	8.06	8.14	0.99%	7.18	7.23	0.69%	0.699	0.695	0.57%	40.8	39.4	3.49%
06/06/13	17.74	17.75	0.06%	8.23	8.31	0.97%	8.42	8.38	0.48%	0.762	0.738	3.20%	45.0	53.2	16.70%
06/13/13	23.94	24.03	0.38%	8.21	8.11	1.23%	7.31	8.36	13.40%	0.825	0.802	2.83%	73.5	82.3	11.30%
06/20/13	23.90	24.02	0.50%	8.10	8.16	0.74%	7.23	7.14	1.25%	0.800	0.796	0.50%	58.7	73.2	21.99%
06/27/13	28.59	28.72	0.45%	8.25	8.34	1.08%	8.35	8.32	0.36%	0.829	0.836	0.84%	84.0	94.5	11.76%



Table C-8. Duplicate Water Quality RPDs, Continuous Data, Kearney Canal Diversion, Elm Creek, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/16/13	21.71	21.54	0.79%	8.43	8.39	0.48%	8.73	9.20	5.24%	0.841	0.841	0.01%	52.4	58.2	10.49%
05/23/13	13.73	13.82	0.65%	8.40	8.60	2.35%	11.89	11.93	0.34%	0.880	0.857	2.71%	7.8	7.6	1.95%
05/31/13	18.83	19.02	1.00%	8.18	8.08	1.23%	8.36	8.34	0.24%	0.790	0.791	0.13%	22.0	23.1	4.88%
06/06/13	16.72	16.86	0.83%	8.32	8.35	0.36%	9.37	8.83	5.93%	0.830	0.817	1.64%	14.6	18.3	22.49%
06/13/13	22.65	22.83	0.79%	8.44	8.45	0.12%	10.60	10.62	0.19%	0.872	0.861	1.27%	21.1	29.7	33.86%
06/20/13	22.17	22.33	0.72%	8.16	7.60	7.11%	7.94	7.57	4.77%	0.828	0.826	0.21%	24.3	50.2	69.53%
06/27/13	28.25	28.41	0.56%	8.26	8.34	0.96%	8.39	8.06	4.01%	0.837	0.854	1.98%	37.5	41.5	10.13%

Table C-9. Duplicate Water Quality RPDs, Continuous Data, Platte River, Odessa, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/07/13	14.86	15.12	1.73%	8.51	8.57	0.70%	10.63	10.73	0.94%	0.788	0.769	2.44%	18.40	17.50	5.01%
05/15/13	22.94	23.10	0.70%	8.47	8.48	0.12%	8.59	8.27	3.80%	0.831	0.831	0.00%	39.80	55.10	32.24%
05/22/13	20.77	20.85	0.38%	8.72	8.70	0.23%	9.60	9.45	1.57%	0.853	0.850	0.35%	1.76	0.30	141.75%
05/30/13	23.90	23.96	0.25%	8.28	8.27	0.12%	7.43	7.54	1.47%	0.812	0.809	0.37%	6.96	9.00	25.56%
06/05/13	21.87	22.03	0.73%	8.37	8.33	0.48%	8.59	8.35	2.83%	0.819	0.806	1.60%	7.45	11.50	42.74%
06/13/13	16.63	16.80	1.02%	8.18	8.31	1.58%	9.12	8.77	3.91%	0.857	0.849	0.94%	7.31	7.40	1.22%
06/19/13	29.49	29.38	0.37%	8.75	8.74	0.11%	9.95	10.25	2.97%	0.793	0.788	0.63%	4.09	4.00	2.22%
06/27/13	32.78	32.88	0.30%	8.65	8.71	0.69%	8.59	8.66	0.81%	0.827	0.821	0.73%	18.20	17.30	5.07%



Table C-10. Duplicate Water Quality RPDs, Continuous Data, Kearney Canal Hydro, Kearney, NE

Date	Temperature (°C)			pH (pH units)			Dissolved Oxygen (mg/L)			Specific Conductance (mS/cm)			Turbidity (NTU)		
	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD	Hand Held	Sonde	RPD
05/16/13	18.52	18.69	0.91%	8.49	8.44	0.59%	7.85	7.92	0.89%	0.821	0.820	0.15%	27.20	27.00	0.74%
05/23/13	17.58	17.74	0.91%	8.70	8.54	1.86%	11.70	11.57	1.12%	0.868	0.861	0.76%	12.63	6.90	58.68%
05/31/13	21.18	21.34	0.75%	8.25	8.07	2.21%	7.87	7.88	0.13%	0.861	0.861	0.06%	15.40	12.60	20.00%
06/05/13	20.16	20.31	0.74%	8.49	8.40	1.07%	9.71	9.56	1.56%	0.820	0.814	0.69%	23.30	24.90	6.64%
06/13/13	23.94	24.14	0.83%	8.38	8.33	0.60%	7.80	8.19	4.88%	0.845	0.827	2.15%	84.30	112.70	28.83%
06/20/13	25.07	25.26	0.76%	8.33	8.22	1.33%	7.35	7.00	4.88%	0.936	0.835	11.41%	30.50	28.60	6.43%
06/27/13	28.45	28.67	0.77%	8.20	8.27	0.85%	7.21	7.17	0.56%	0.839	0.846	0.80%	59.10	67.30	12.97%



Precision, Duplicate Discrete Water Quality Data, Relative Percent Differences



Table C-11. Duplicate Water Quality Data, Suspended Sediment Concentration, (Platte River, Elm Creek, Kearney Canal, NE)

Date	Location	Concentration, ppm	RPD
05/16/13	DUP	159.16	12.08%
	ELMCR	179.63	
05/23/13	DUP	179.60	200.00%
	KCDIV	0.00	
05/31/13	DUP	190.04	197.86%
	ELMPR	35,374.87	
06/06/13	DUP	1,811.23	1.17%
	KCPH	1,832.62	
06/13/13	DUP	805.80	20.73%
	KCDIV	654.45	
06/20/13	DUP	879.20	49.79%
	ELMPR	528.73	
06/27/13	DUP	18.03	9.48%
	LEXPR	19.82	



Accuracy, Continuous Water Quality Data, Percent Recovery

**Table C-12. Percent Recovery, Continuous Data, Platte River, Lexington, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/07/13	7.03	100.43%	10.00	100.00%	9.87	9.80	100.71%	1.406	99.50%	99.80	99.80%

Table C-13. Percent Recovery, Continuous Data, Platte River, Overton, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/07/13	7.02	100.29%	9.99	99.90%	9.69	9.62	100.73%	1.401	99.15%	99.10	99.10%
05/16/13	6.94	99.14%	9.97	99.70%	8.39	8.36	100.36%	1.430	101.20%	96.70	96.70%
05/22/13	7.13	101.86%	9.97	99.70%	8.25	8.57	96.27%	1.400	99.08%	100.60	100.60%
05/30/13	7.07	101.00%	9.96	99.60%	7.91	8.06	98.14%	1.440	101.91%	98.80	98.80%
06/05/13	6.99	99.86%	10.02	100.20%	7.99	8.23	97.08%	1.423	100.71%	100.10	100.10%
06/13/13	6.96	99.43%	10.04	100.40%	8.54	8.52	100.23%	1.392	98.51%	100.70	100.70%
06/19/13	7.05	100.71%	9.94	99.40%	7.12	7.48	95.19%	1.437	101.70%	98.20	98.20%

**Table C-14. Percent Recovery, Continuous Data, Platte River, Elm Creek, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance, (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/08/13	7.13	101.86%	10.14	101.40%	10.82	9.22	117.35%	1.422	100.64%	95.80	95.80%
05/16/13	6.92	98.86%	9.86	98.60%	8.13	8.04	101.12%	1.420	100.50%	100.40	100.40%
05/23/13	7.13	101.86%	10.15	101.50%	10.08	10.05	100.30%	1.391	98.44%	102.50	102.50%
05/31/13	6.71	95.86%	9.89	98.90%	8.62	8.57	100.58%	1.420	100.50%	99.59	99.59%
06/06/13	7	100.00%	10.01	100.10%	8.38	8.11	103.33%	1.420	100.50%	98.80	98.80%
06/13/13	7.19	102.71%	10.18	101.80%	7.74	7.80	99.23%	1.419	100.42%	100.80	100.80%
06/19/13	6.9	98.57%	9.81	98.10%	7.28	7.14	101.96%	1.436	101.63%	97.20	97.20%

Table C-15. Percent Recovery, Continuous Data, Elm Creek, Elm Creek, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/08/13	7.18	102.57%	10.22	102.20%	8.59	9.17	93.68%	1.384	97.95%	115.50	115.50%
05/16/13	7.03	100.43%	10.02	100.20%	8.04	8.01	100.37%	1.432	101.34%	98.00	98.00%
05/23/13	7.02	100.29%	9.97	99.70%	8.74	8.87	98.53%	1.387	98.16%	103.20	103.20%
05/31/13	7.04	100.57%	9.95	99.50%	8.02	7.96	100.75%	1.448	102.48%	96.10	96.10%
06/06/13	7.01	100.14%	10.03	100.30%	8.90	8.98	99.11%	1.390	98.37%	102.80	102.80%
06/13/13	6.99	99.86%	9.92	99.20%	7.00	6.85	102.19%	1.428	101.06%	95.80	95.80%
06/20/13	7.05	100.71%	10.02	100.20%	7.45	7.59	98.16%	1.428	101.06%	100.90	100.90%

**Table C-16. Percent Recovery, Continuous Data, Kearney Canal Diversion, Elm Creek, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/08/13	7.17	102.43%	10.19	101.90%	9.13	9.40	97.13%	1.409	99.72%	106.40	106.40%
05/16/13	6.96	99.43%	9.89	98.90%	7.67	7.60	100.92%	1.437	101.70%	99.40	99.40%
05/23/13	7.17	102.43%	10.19	101.90%	11.89	11.93	99.66%	1.381	97.74%	103.30	103.30%
05/31/13	6.84	97.71%	9.82	98.20%	8.50	8.31	102.29%	1.435	101.56%	99.80	99.80%
06/06/13	6.67	95.29%	9.97	99.70%	9.02	9.16	98.47%	1.395	98.73%	101.09	101.09%
06/13/13	7.51	107.29%	10.38	103.80%	7.30	6.91	105.64%	1.448	102.48%	96.59	96.59%
06/20/13	6.23	89.00%	9.34	93.40%	7.46	7.66	97.39%	1.417	100.28%	101.30	101.30%

Table C-17. Percent Recovery, Continuous Data, Platte River, Odessa, NE

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/07/13	7.02	100.29%	10.01	100.10%	8.88	8.85	100.34%	1.376	97.38%	102.40	102.40%
05/15/13	7.02	100.29%	9.97	99.70%	7.27	7.28	99.86%	1.415	100.14%	95.20	95.20%
05/22/13	7.08	101.14%	10.00	100.00%	8.26	8.36	98.80%	1.417	100.28%	103.50	103.50%
05/30/13	7.05	100.71%	9.99	99.90%	7.97	8.08	98.64%	1.422	100.64%	99.30	99.30%
06/05/13	6.96	99.43%	9.99	99.90%	7.73	7.81	98.98%	1.420	100.50%	100.20	100.20%
06/13/13	7.06	100.86%	10.06	100.60%	8.73	8.86	98.53%	1.421	100.57%	101.30	101.30%
06/19/13	7.00	100.00%	9.94	99.40%	7.29	7.30	99.86%	1.454	102.90%	97.00	97.00%

**Table C-18. Percent Recovery, Continuous Data, Kearney Canal Hydro, Kearney, NE**

Date	pH, Standard 7		pH, Standard 10		Dissolved Oxygen (mg/L)			Specific Conductance (1.413 mS/cm)		Turbidity (100 NTU)	
	Sonde	% R	Sonde	% R	Sonde	Cal Point	% R	Sonde	% R	Sonde	% R
05/08/13	6.88	98.29%	9.69	96.90%	9.19	9.31	98.71%	1.432	101.34%	96.59	96.59%
05/16/13	7.09	101.29%	10.03	100.30%	8.71	8.62	101.04%	1.414	100.07%	99.59	99.59%
05/23/13	7.05	100.71%	10.05	100.50%	8.80	8.75	100.57%	1.408	99.65%	100.40	100.40%
05/31/13	6.94	99.14%	9.92	99.20%	8.33	7.85	106.11%	1.425	100.85%	98.40	98.40%
06/05/13	7.01	100.14%	10.02	100.20%	8.35	8.12	102.83%	1.416	100.21%	101.90	101.90%
06/13/13	6.94	99.14%	9.90	99.00%	7.13	6.77	105.32%	1.438	101.77%	98.00	98.00%
06/20/13	6.94	99.14%	9.98	99.80%	7.16	7.26	98.62%	1.417	100.28%	97.59	97.59%



APPENDIX D

Photo Log



1. Manta 2 sonde deployment at Platte River at Elm Creek, NE (chain with flagging).



2. Manta 2 sonde deployment at Elm Creek near the confluence with the Platte River.



3. Manta 2 sonde deployment in the Kearney Canal downstream of the diversion.



4. Manta 2 sonde deployment upstream of the Kearney Canal Hydro.



5. View of confluence with the Platte River looking northwest. Manta 2 sampling location is located to the north upstream of Elm Creek.



6. Low water conditions in Platte River at Elm Creek, NE.



7. Biofouling of the Manta 2 deployed upstream of the Kearney Canal Hydro.



8. Biofouling of the Manta 2 deployed in the Platte River at Elm Creek, NE.



9. Biofouling of the Manta 2 deployed in Elm Creek near the confluence with the Platte River.



APPENDIX E

Field Data Sheets (CD only)

APPENDIX F

Raw Water Quality Data (CD only)

APPENDIX G

Flow Data (CD only)