EE&T, Inc.

ENVIRONMENTAL ENGINEERING & TECHNOLOGY, INC.

March 6, 2013

Metropolitan Utilities District of Omaha
Engineering Memorandum No. 9
NPDES Studies
EE&T Project No. 12501

Subject: Florence Site Specific Field Studies

The Florence Potable Water Treatment Plant (PWTP), operated by the Metropolitan Utilities District of Omaha (M.U.D.), is a split-treatment softening facility that currently discharges residuals that are generated during treatment to the Missouri River. This discharge is permitted under NPDES Permit No. NE0000914, which went into effect as of October 1, 2009. As part of this NPDES permit, the Nebraska Department of Environmental Quality (NDEQ) directed M.U.D. to conduct Site Specific Field Studies including Water Column measurements to determine the extent of the discharge plume and the amount of residuals mixing achieved in the mixing zone, suspended solids and sediment evaluations upstream and downstream of the Florence PWTP, and evaluation of benthic macroinvertebrates upstream and downstream of the Florence PWTP.

A Study Plan for Evaluation of Water Quality Impacts from the Discharge of Solids and Solids Reduction Technologies at the Florence PWTP (Study Plan) was submitted to NDEQ in September 2010. Personnel from EE&T, Tennessee Technological University (TTU), M.U.D, and NDEQ met in November 2010 to refine the plan, which was subsequently modified to allow for use of artificial substrates for benthic invertebrate collection. The plan was also modified, due to the historic flooding of the Missouri River in Summer 2011, to extend the permit deadlines in order to delay on-river work until Summer 2012.

Water column and suspended solids samples were collected June 25, 2012. A report detailing the methodology used for the sample collection and analysis, as well as the data collected, has been prepared by TTU and is attached to the memorandum as Attachment A. Artificial substrates were placed on June 25, 2012 for benthic invertebrate accumulation and were subsequently retrieved on August 13, 2012. A report detailing the benthic invertebrate collection and analytical procedures, as well as the data collected, has been prepared by Pennington & Associates (P&A) and is attached to the memorandum as Attachment B.

Water Column and Solids Studies

The NPDES Permit did not specifically state which of the Florence PWTP's outfalls were to be investigated. Therefore, analysis was centered on Outfall 005, where the highest concentration of PWTP residual solids is released to the river. As described in the Study Plan, seven transects were made of the river to collect water column samples for analysis: two transects upstream of the plant, two transects downstream of the plant, and three transects within the mixing zone downstream of Outfall 005. The transect and sample locations are shown in Figure 1.

Samples were collected at three locations along each transect, as can be seen in Figure 1. Samples were collected at three different depths at each sample location: at 20 percent of the total depth at that location (0.2D), at 50 percent of the total depth at that location (0.5D), and at 80 percent of the total depth at that location (0.8D). Collected water samples were packed in ice and shipped via overnight deliver to TTU's Environmental Analytical Laboratory for analysis. Additional in-situ water quality data was collected with Hydrolab H2O® datasonde at each sample location and depth. The water quality parameters analyzed for this study are shown in Table 1. The sampling methodology is described in detail in Attachment A.

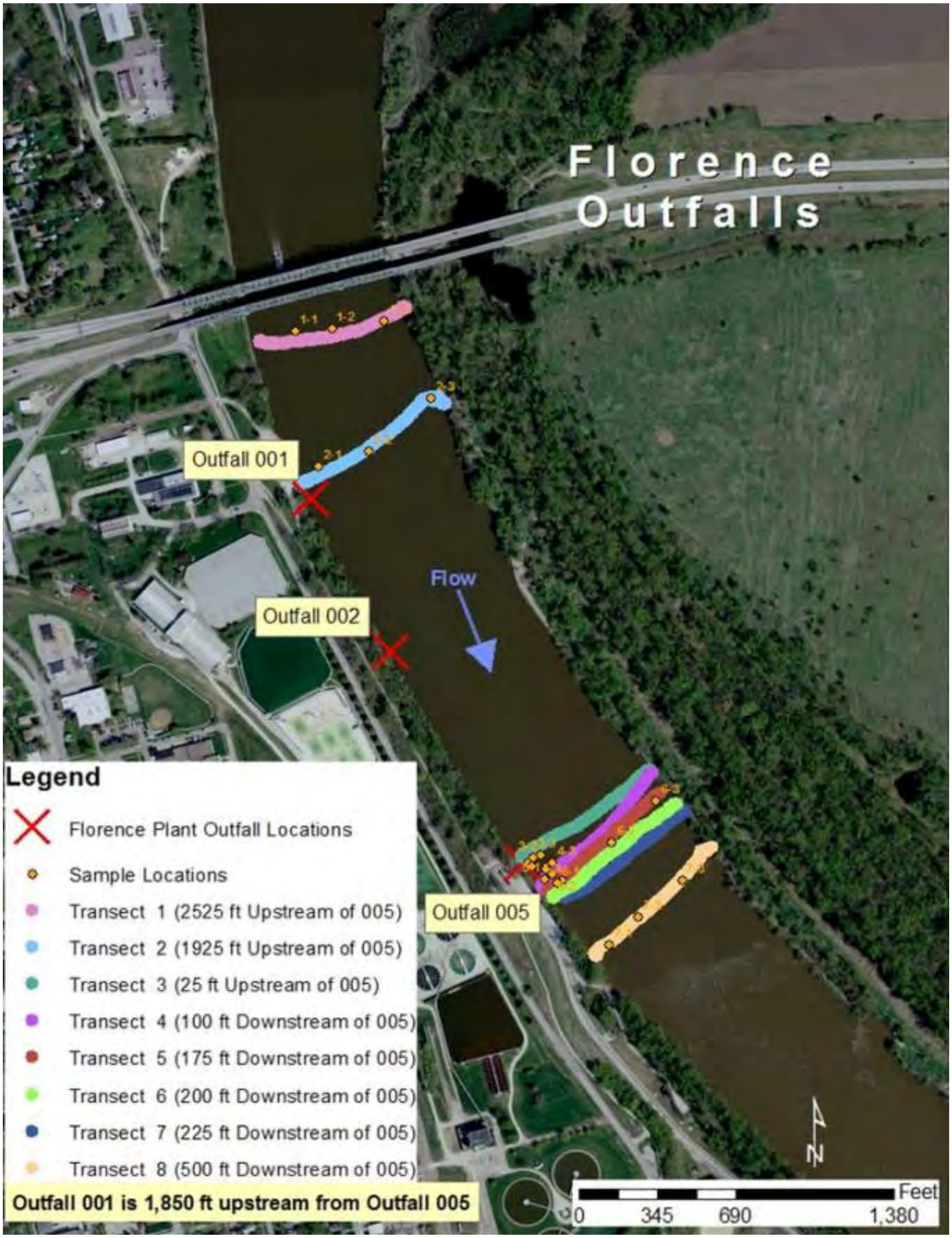

Figure 1. **River transect and water column sample locations**

Table 1. Water quality parameters analyzed for this study

Parameter	Method	MDL	Analysis Location
Total Suspended Solids (TSS)	SM2540D	2.5 mg/L	TTU
Settlable Solids (SS)	ASTM D3977	1mg/L	TTU
Dissolved Oxygen (DO)	Probe	0.1 mg/L	Field
pH	Probe	NA	Field
Temperature (T)	Probe	NA	Field
Specific Conductance (EC)	Probe	NA	Field
Hardness	SM 2340 B	0.5 mg/L	TTU
Alkalinity	SM2320B	5 mg/L as $CaCO_3$	TTU
Aluminum- Total & Dissolved	EPA 200.7	0.05 mg/L	TTU
Iron – Total & Dissolved	EPA 200.7	0.05 mg/L	TTU
Copper – Total and Dissolved	EPA 200.7	0.007 mg/L	TTU
Manganese – Total and Dissolved	EPA 200.7	0.01 mg/L	TTU
Nickel – Total & Dissolved	EPA 200.7	0.015 mg/L	TTU
Selenium – Total & Dissolved	EPA 200.7	0.05 mg/L	TTU
Zinc – Total & Dissolved	EPA 200.7	0.05 mg/L	TTU

The results of the water column and solids studies at Florence PWTP are presented in full in Attachment A. The following subsections summarize the findings for each of the water quality parameters that were investigated. All discussions of statistical significance are in terms of an 0.05 significance level ($\alpha = 0.05$).

Total Suspended Solids

TSS measurements ranged from a low of 31 mg/L (at 0.5D, 500 feet downstream of Outfall 005) to a high of 269 mg/L (at 0.8D, 100 feet downstream of Outfall 005). However, there was no statistically significant difference between the average TSS measurements at the different sample locations. Even at the outfall, and within the immediate mixing zone, an increase in TSS above the river's baseline loading due to the discharge of PWTP residuals could not be detected.

Settleable Solids

Settleable solids concentrations for all locations were below the detection limit, indicating that the majority of the TSS found were most likely silts, clays, or other fine particles with low settling rates.

Dissolved Oxygen

DO levels at Outfall 005 were significantly higher than upstream, increasing from an average DO of 7.74 mg/L upstream of Outfall 005 to 8.25 mg/L at Outfall 005. DO remains significantly higher through the mixing zone (to 100 feet downstream of Outfall 005), at which point it begins to decrease back towards the background level. At 500 feet downstream of Outfall 005, the average DO concentration is 7.67 mg/L, essentially the same as the upstream levels.

The elevated DO levels at the discharge and in the mixing zone are most likely attributable to the aeration of the residuals during the blow down process, as they are collected and pumped to the river. The influence of the discharge on river DO levels appears to be limited to the mixing zone.

pH

There were no statistically significant differences between pH values observed at the different sample locations. Overall, pH values ranged from 8.44 to 8.60. All pH measurements were below the 9.0 maximum pH limit specified in the permit.

Temperature

Water temperature did not vary significantly by location or by depth during the period when measurements were collected. The average water temperature was approximately 25°C.

Specific Conductance

Specific conductance did not vary significantly by location or by depth during the period when measurements were collected. The average specific conductance was approximately 0.87 mS/m.

Hardness

Measured hardness values ranged from 254 mg/L as $CaCO_3$ to 308 mg/L as $CaCO_3$. When comparing the average hardness at each location, the only statistically significant difference was between the average hardness concentration1,925 feet upstream of the plant (291 mg/L as $CaCO_3$) and the average concentration 150 feet downstream of Outfall 005 (265 mg/L as $CaCO_3$).

Alkalinity

Corresponding to the hardness measurements, alkalinity ranged from 179 mg/L as $CaCO_3$ to 273 mg/L as $CaCO_3$. However, due to the variability of the data, there were no statistically significant differences in alkalinity concentrations.

Aluminum

The average total aluminum concentration observed at Outfall 005 was significantly lower than the average total aluminum concentrations observed upstream and downstream of the outfall. Measured total aluminum concentrations ranged from 1.300 mg/L to 2.569 mg/L. The highest total aluminum concentrations were measured at 150 feet downstream of Outfall 005, where the average total aluminum concentration was 2.210 mg/L. However, the average aluminum concentrations upstream of Outfall 005 were not significantly greater than average concentration observed 500 feet downstream of Outfall 005. In light of these data, it cannot be concluded that Outfall 005 is contributing aluminum to the Missouri River.

Aluminum is very insoluble at circumneutral pH; as the river pH was slightly basic, low levels of dissolved aluminum were present in the river. Dissolved aluminum levels ranged from below detection limits to 0.288 mg/L, indicating that the majority of aluminum present was in particulate form. Although the dissolved aluminum levels remain low, the average concentration of dissolved aluminum at Outfall 005 (0.216 mg/L) was significantly higher than dissolved aluminum concentrations upstream and downstream (0.144 mg/L).

As described in greater detail in Attachment A, aluminum may be toxic to aquatic life when mobilized in surface water. However, previous toxicity testing of M.U.D.'s Florence PWTP residual solids was conducted by Dr. Dennis George in the mid-1990's. That testing found that growth inhibition of *S. capricornutum* occurred only when the residuals were highly concentrated. Considering the high dilution factor of the river to the discharge flow (>1,000:1), the discharge of residual solids from the Florence PWTP is not anticipated to significantly inhibit aquatic organisms.

Iron

Measured iron concentrations ranged from 1.433 mg/L to 2.521 mg/L during the period when samples were collected. There was no significant difference between iron concentrations at the upstream sample locations and the furthest downstream sample locations (150 feet and 500 feet downstream of Outfall 005). However, the iron levels in the mixing zone at Outfall 005 (1.464 mg/L to 1.741 mg/L) were significantly lower than the upstream and downstream iron concentrations (>2.000 mg/L). Based on these measurements, it appears the discharge from Outfall 005 may have diluted the iron concentration immediately downstream from the discharge.

Copper

Copper concentrations were less than instrumental detection limits (<0.007 mg/L) in all collected samples.

Manganese

Measured manganese concentrations were relatively low, ranging from 0.128 mg/L to 0.186 mg/L. There were no significant differences between manganese concentrations at different locations.

Nickel

Nickel concentrations were less than instrumental detection limits (<0.015 mg/L) in all collected samples.

Selenium

Selenium concentrations were less than instrumental detection limits (<0.05 mg/L) in all collected samples.

Zinc

Measured zinc concentrations were low, ranging from <0.006 mg/L to 0.019 mg/L. There were no significant differences between manganese concentrations at different locations.

Summary of Water Column and Solids Measurements

The overall impact of the Florence PWTP on the Missouri River appears to be very minor. Due to the aeration of the residuals during the blow down process, DO levels are slightly elevated above background levels in the mixing zone below Outfall 005. Likewise, the discharge from Outfall 005 appears to be slightly diluting the iron concentration within the mixing zone. Elevated levels of dissolved aluminum were measured at Outfall 005, but overall the concentration of dissolved aluminum was very low and the concentrations downstream of Outfall 005 were not significantly different from concentrations above Outfall 005. The discharge from Outfall 005, which carries the highest load of process residuals at Florence PWTP, did not appear to significantly increase TSS in the river.

Benthic Study

Benthic macroinvertebrates were collected form the Missouri River using artificial substrate samplers. On June 25, 2012, duplicate sets containing three artificial substrate samplers each were set at three different locations at Florence PWTP: one location upstream of the plant (FU), one location approximately 125 feet downstream of Outfall 005 (F125D), and one location approximately 600 feet downstream of Outfall 005 (F600D). These locations are shown in Figure 2.

The artificial substrate samplers were retrieved on August 13, 2012, after a 6-week time lapse. The samplers were cleaned in the field, and all materials that had accumulated in the sample were transferred to plastic containers, labeled, preserved in formalin, and returned to P&A's laboratory for analysis. All 18 artificial substrate samplers were successfully retrieved and analyzed. Details regarding the sample retrieval, collection, and analytical methods can be found in Attachment B.

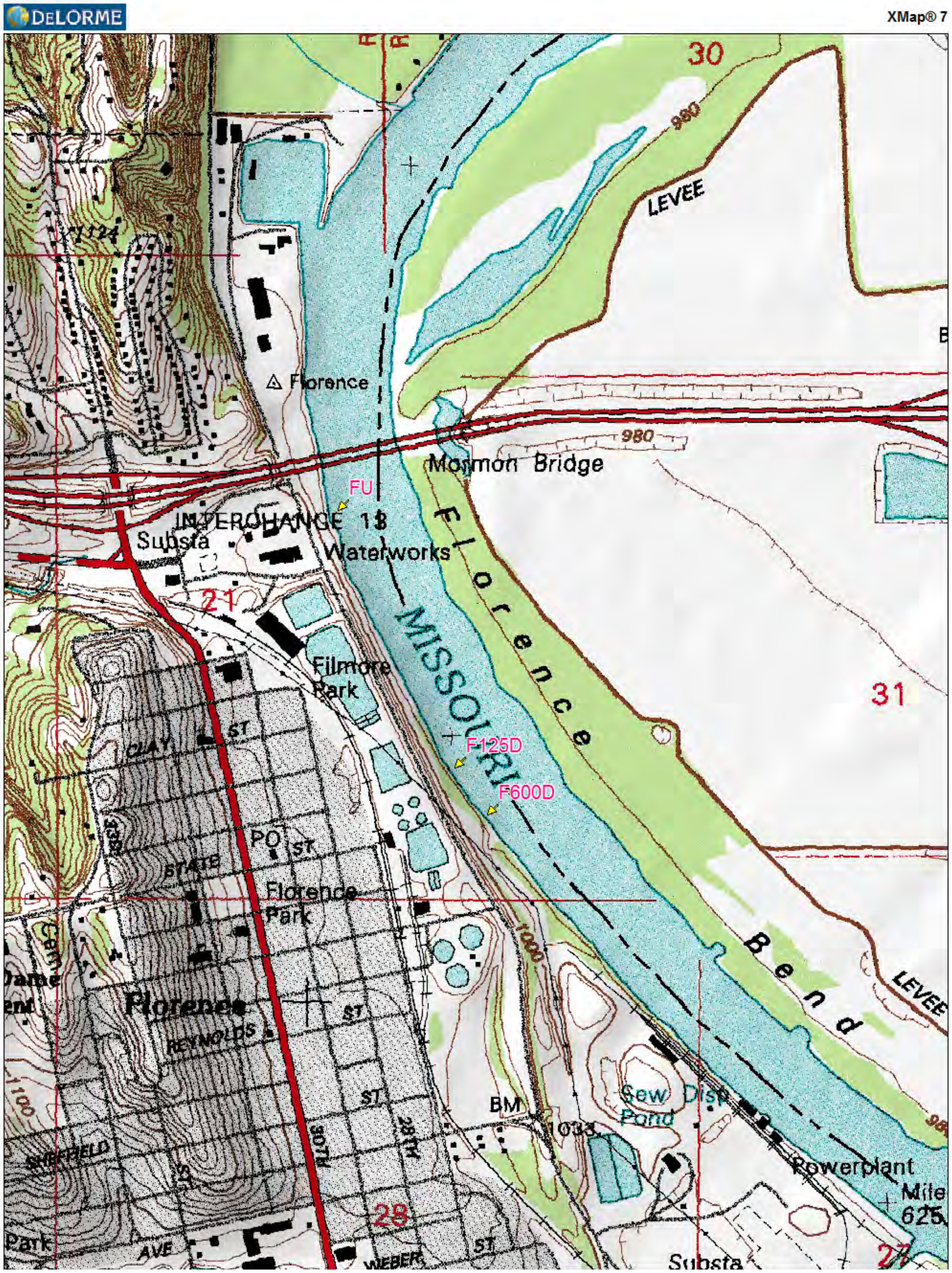

Figure 2. **Benthic Macroinvertebrate Sampling Sites, Florence PWTP, August, 2012.**

One of the core benthic macroinvertebrate community metrics is taxa richness, or the total number of distinct taxa. The benthic macroinvertebrate fauna in the vicinity of the Florence PWTP discharge were represented by a minimum of 25 species upstream (FU), with 27 (F125D) and 23 (F600D) found downstream of the discharges. Statistically, there is no significant difference in taxa richness when comparing upstream to downstream of Florence PWTP. The discharge of residuals from Florence PWTP does not appear to have adversely impacted the richness of the benthic macroinvertebrate community in the vicinity of the plant.

A related benthic macroinvertebrate community metric is Ephemeroptera, Plecoptera, and Trichoptera Richness (EPT). This index measures the total number of distinct taxa within the generally pollution sensitive insect orders of EPT, and generally correlates with water quality and habitat stability. Although EPT increased slightly from 12 at FU to 14 at F600D, again there was no significant difference between upstream and downstream EPT values.

In terms of other benthic macroinvertebrate community metrics, there is no change in community health from upstream of Florence PWTP to downstream of the plant. One measure of evaluating water quality is the Hilsenhoff Biotic Index (HBI), which measures the tolerance of the biotic community to organic enrichment. The State of Nebraska Water Quality Division follows the Hilsenhoff Wisconsin scoring criteria with values less than 3.5 indicating excellent water quality, values of 3.51 to 5 indicating good water quality, 5.01 to 7.5 indicating fair water quality, 7.51 to 8 indicating poor water quality and values greater than 8 would indicate serious water quality problems. The HBI in all locations was "fair", ranging from a low of 5.57 at F125D to a high of 5.77 at FU. Based on HBI, the discharges of residuals from Florence PWTP are not adversely impacting the Missouri River.

There was, however, one significant difference between the upstream and downstream benthic macroinvertebrate communities at Florence PWTP. The density of benthic macroinvertebrates decreased downstream of Outfall 005, with a mean number of 20,904.5 individuals per $0.15m^2$ at the upstream location, while F125D had 10,570.7 per $0.15m^2$ and F600D had 9,470.5 per $0.15m^2$. While this change in density is statistically significant, it should be noted that the F125D and F600D densities are still relatively high. It is not clear what mechanism may have been reducing or slowing colonization of the substrate during the 6-week collection period; there is nothing in the water quality data discussed previously that would suggest impairment of the benthic community.

Table 2 summarizes the core benthic macroinvertebrate community metrics discussed above. These metrics, along with other statistical measures of the benthic macroinvertebrates at Florence PWTP and a comparison of the benthic macroinvertebrate communities at Florence PWTP and Platte South PWTP, are discussed in greater detail in Attachment B.

Table 2. Summary of core benthic macroinvertebrate community metrics

Date	Station	Total No. of Taxa	EPT Taxa	HBI	No. of Individuals per 0.15 m^2
8/13/12	FU	25	12	5.77	20,904.5
8/13/12	F 125 D	27	13	5.57	10,570.7
8/13/12	F 600 D	23	14	5.69	9,470.5

Summary

Based on the water quality data from the water column samples, the discharges of residuals from Florence PWTP appear to have minimal impact on Missouri River water quality. A small increase in dissolved oxygen levels in the mixing zone downstream of Outfall 005 was observed, as was a decrease in total iron concentrations in the mixing zone. Total and dissolved aluminum data were inconclusive regarding the influence of Outfall 005 on the Missouri River water levels. Outfall 005 did not significantly add TSS to the river, and there was generally no difference between upstream and downstream concentrations for other water quality parameters.

Three core benthic macroinvertebrate community metrics, taxa richness, EPT taxa richness, and HBI, showed no significant difference from upstream to downstream of Florence PWTP. However, there was a statistically significant decrease in overall benthic macroinvertebrate density at both downstream locations, when compared to the upstream location. This decrease may be related to the discharge of residuals from Florence PWTP, although the water quality data collected did not suggest any mechanism that may be causing this change in benthic macroinvertebrate density. Despite the decrease in density downstream of Outfall 005, the overall benthic macroinvertebrate community density downstream of the outfall was still relatively high at approximately 10,000 individuals per 0.15 m^2.

Attachment A

Water Quality Assessment at the Florence and Platte South Potable Water Treatment Plants Discharge

By
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BACKGROUND

The Omaha, NE, Metropolitan Utilities District (M.U.D.) operates the Florence Potable Water Treatment Plant (FWTP) and the Platte South Potable Water Treatment Plant (PSWTP). These plants discharge residuals from the water treatment plants into the Missouri River under NPDES Permit No's. NE0000914 and NE0000906, respectively. The residuals from the FWTP are discharged through Outfalls 001 and 005. Residuals from the PSWTP are discharged through outfall 002. EE&T Inc. contracted with M.U.D. to collect and analyze an adequate number of water and benthic samples to determine the impact (if any) of the discharged solids residuals from FWTP Outfalls 001 and 005 and PSWTP Outfall 002 on water quality and benthic macroinvertebrate communities. To satisfy these requirements Tennessee Technological University's (TTU's) Center for the Management, Utilization, and Protection of Water Resources (CMUPWR), in conjunction with EE&T Inc., collected water samples and performed in situ water column monitoring at the discharge sites June 25-26, 2012. The results of in situ monitoring and laboratory water quality analysis on samples collected at the sites are presented in this report.

The sampling sites are graphically presented in Figures 1 and 2 below. Discharge and gage height during the sampling period are presented in Figures 3 and 4. At the two sampling locations, velocity and streambed morphology data were obtained using the SonTek YSI RiverSurveyor®. Water samples were collected and in situ monitoring was performed at each site that was representative of water quality upstream, within the outfall influence zone and downstream of outfalls.

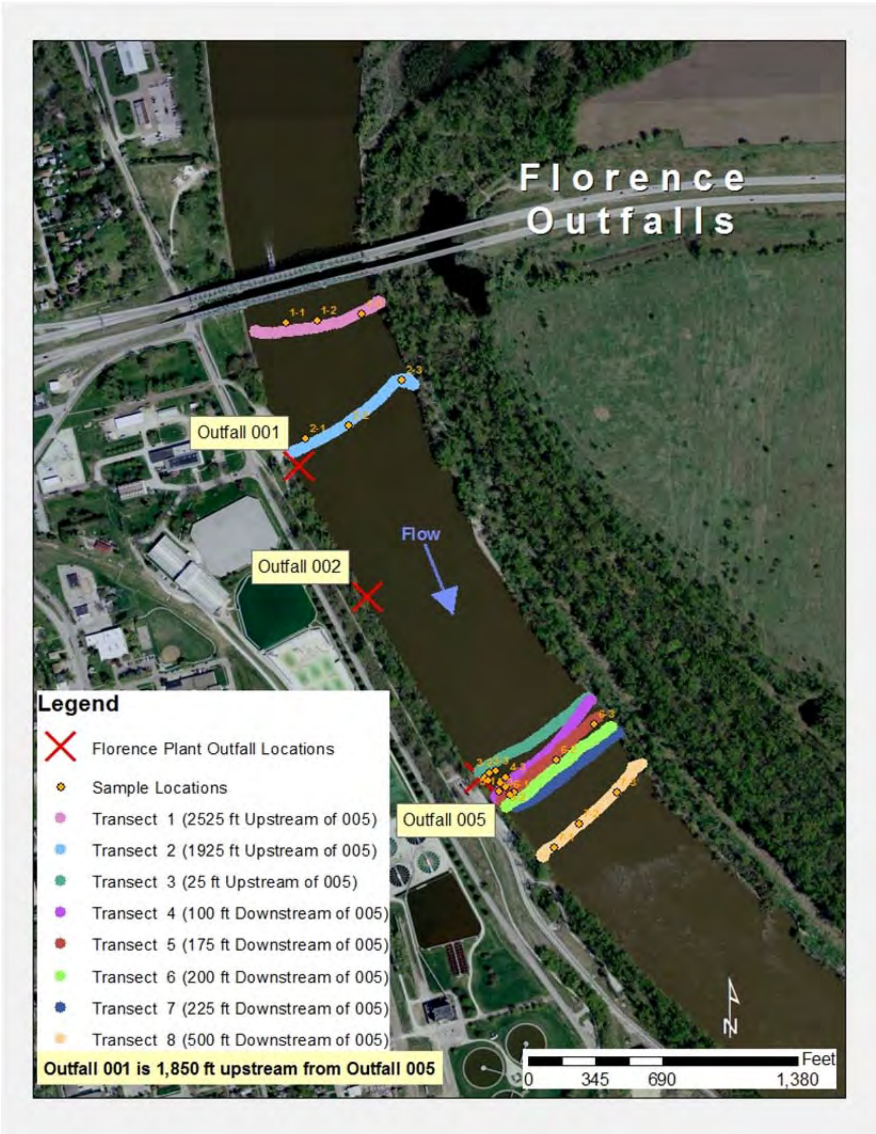


Figure 1. Florence outfalls.

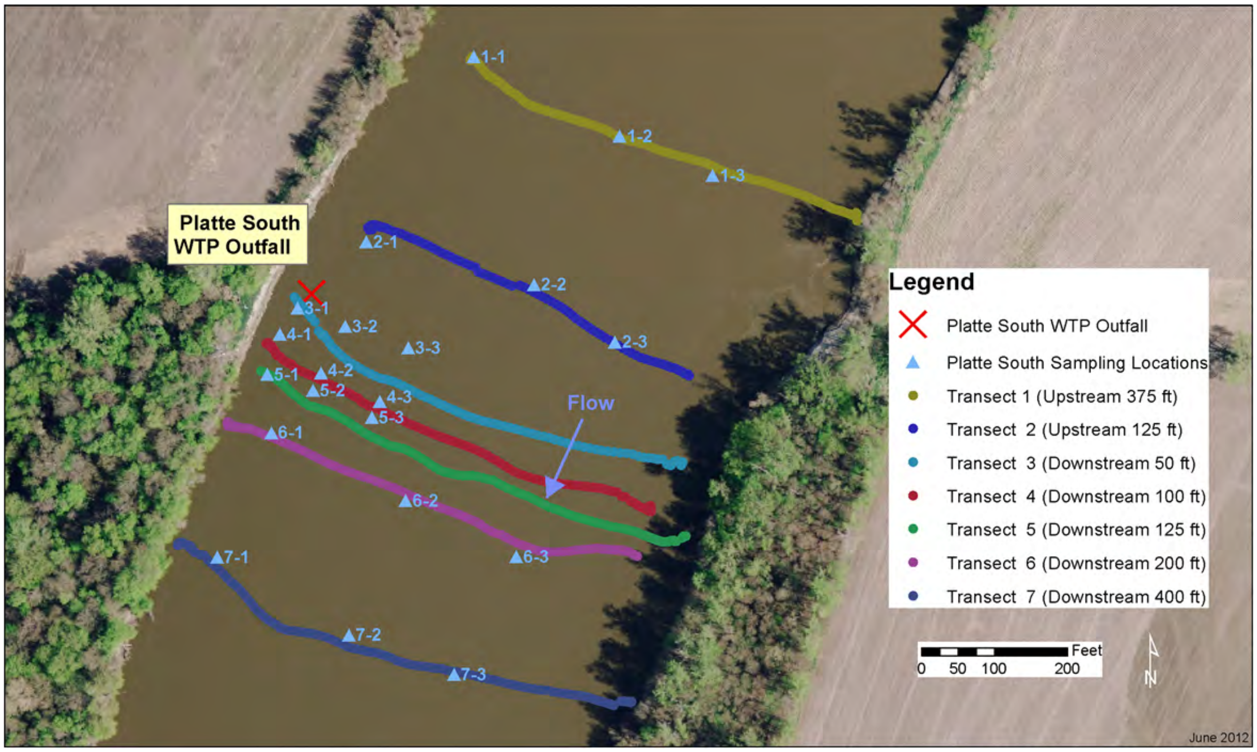


Figure 2. Platte South outfalls.

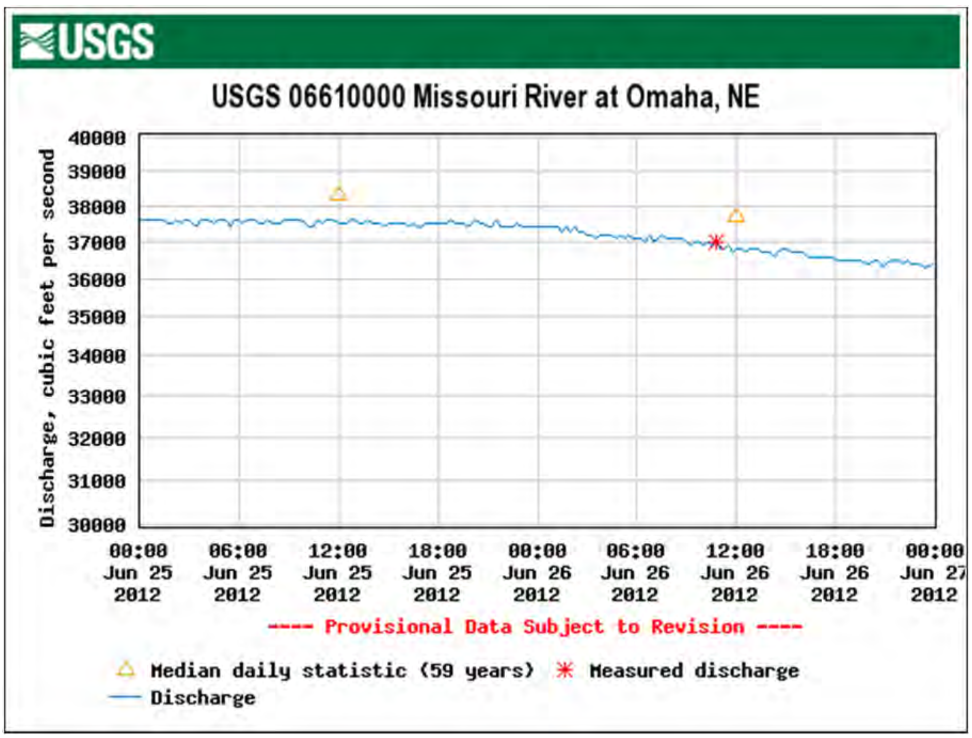


Figure 3. Discharge ft^3/sec.

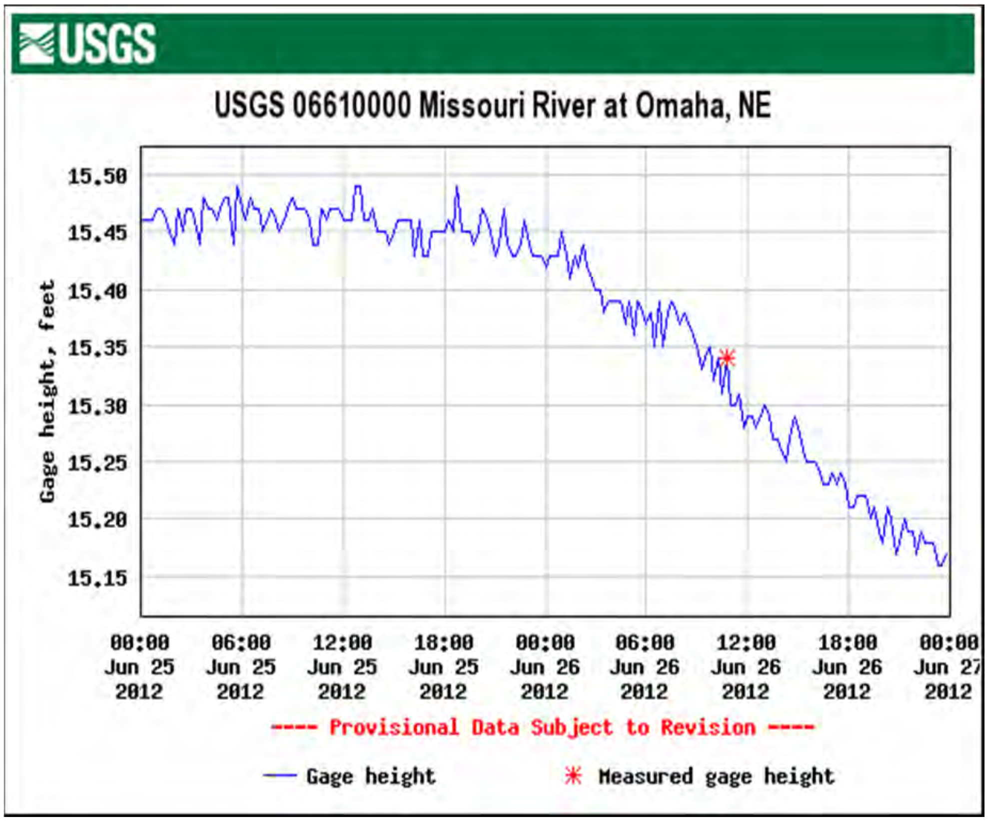


Figure 4. Gage height, ft.

METHODOLOGY

On June 25, 2012, researchers monitored and collected water samples from the Missouri River upstream and downstream from the residual solids discharge Outfall 001 at the FWTP. The monitoring encompassed residual solids discharges from Outfall 002 and Outfall 005. Water samples from the Missouri River were also collected upstream and downstream from the residual solids discharge Outfall 001 at the PSWTP on June 26, 2012. At the FWTP outfall and the PSWTP outfall, seven transects were obtained to define river geomorphology and stream velocity using the SonTek YSI River Surveyor® Acoustic Doppler Profiler (ADP). The locations of the FWTP profiles are represented in Figure 1. The locations of the PSWTP are represented graphically in Figure 2. The SonTek® ADP georeference position was recorded using the Trimble GeoXH GPS system. Water monitoring and sample collection occurred along transects. Streambed morphologies extracted from the SonTek® ADP data are presented in Appendix C for FWPT and PSWTP.

The georeference positions for monitoring and collection of samples were programmed into the Trimble GeoXH GPS system. Grab samples were collected across the width of the upstream and downstream transects. Sample collection points in the outfall influence zone covered approximately one-third of the stream width. Samples were collected by navigating the water craft to a location that corresponded to the reference point stored in the Trimble GeoXH

GPS system. The locations of the sampling positions for the FWTP are shown in Figure 1 and sampling positions for the PSWTP are shown in Figure 2. Once the boat arrived at the desired monitoring position, water samples were collected at three depths (0.8, 0.5 and 0.2) using a modified pull-ring sampler (Wheaton, Model#EW-99152-20). Field duplicates were collected at a 10% level (i.e., every 10th sample). After water was sampled, pH, temperature, dissolved oxygen (DO), and conductivity were collected by deploying a Hydrolab H20® datasonde (HACH) at the location. The Hydrolab H2O® datasonde also records depth so that collected data were obtained at the prescribed depths of 0.2, 0.5, and 0.8. Stream depth at each location was determined using an electronic stream depth finder.   Collected water samples were packed in ice and shipped via FedEx courier overnight to TTU's Environmental Analytical Laboratory in the CMUPWR for analysis.   All samples were preserved according to EPA criteria and were analyzed for the parameters listed in Table 1 within acceptable time limits.

Table 1. Water quality parameters measured.

Parameter	**Method**	**Analysis Location**
Total Suspended Solids (TSS)	SM2540D	TTU
Settable Solids(SS)	ASTM D3977	TTU
Aluminum- Total & Dissolved	EPA 200.7	TTU
Iron – Total & Dissolved	EPA 200.7	TTU
Copper – Total and Dissolved	EPA 200.7	TTU
Manganese – Total and Dissolved	EPA 200.7	TTU
Nickel – Total & Dissolved	EPA 200.7	TTU
Selenium – Total & Dissolved	EPA 200.7	TTU
Zinc – Total & Dissolved	EPA 200.7	TTU
Hardness	SM 2340 B	TTU
Alkalinity	SM2320B	TTU

All the water quality data collected for the FWTP are presented in Appendix A. Similarly, all the water quality data for the PSWTP are presented in Appendix B. All the transect and velocity data are presented in Appendix C for each water treatment plant. Tukey's (SAS, 2012) statistical comparison of water quality parameter mean concentrations was conducted on all data to determine significant differences upstream and downstream of the residual solids discharge Outfall 005 for the FWTP and Outfall 002 for the PSWTP.

RESULTS AND DISCUSSION

Missouri River Hydrology at the FWTP and PSWTP Residual Solids Discharge Outfalls

Velocity and Profile Measurement. At the two sampling locations (FWTP and PSWTP), velocity and streambed morphology data were obtained using the SonTek YSI RiverSurveyor®. This instrumentation belongs to a group of instruments known as acoustic Doppler current profilers (ADCPs). This system is a robust and accurate Acoustic Doppler Profiler Flow Measurement system designed to quickly measure river discharge from a moving vessel. Real-time data collection is accomplished using the Windows XP® compatible RiverSurveryor software program.

An Acoustic Doppler Profiler (ADP) is an instrument that measures the velocity of water using a physical principle called the Doppler shift. The ADP is the principle component of every River-Surveyor system. A SonTek ADP has three transducers mounted in the transducer head of the system. Each of these transducers has a different orientation and generates a narrow beam of sound that is projected through the water. Reflections from particles or "scatterers" (such as suspended sediment, biological matter, or bubbles) in the water column are used to determine the water velocity. The geometric orientation of each of the transducers allows the ADP to calculate the velocity of the water using a Cartesian (XYZ) coordinate system relative to the position and orientation of the instrument. The internal compass and tilt sensor (roll/pitch) used with all RiverSurveyor systems is able to calculate the water velocities in Earth coordinates (East-North-Up or ENU) independent of the system's location. The following describes the ADP sampling strategy:

- An individual measurement of the 3D velocity profile is called a "ping."
- The ADP pings as rapidly as possible (4 to 20 times per second depending upon frequency).
- Pings are averaged over the user-specified averaging interval to produce a mean 3D velocity profile.

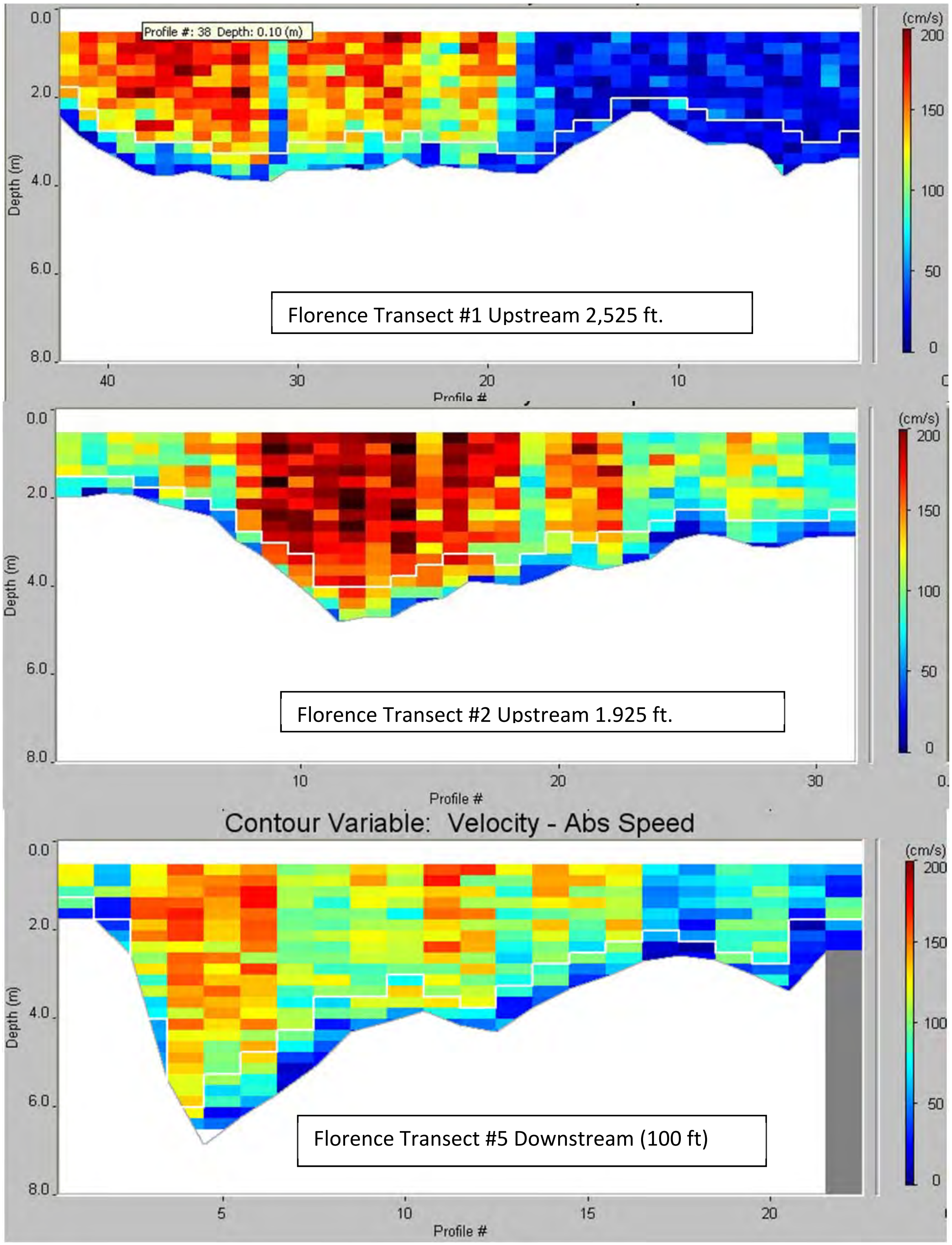
The SonTek River Surveyor is available in frequencies shown in the Table 2. A 1500 kHz instrument was used by TTU.

Table 2. Available SonTek instrument configurations.

ADP Frequency	Maximum	Typical	Blanking	Minimum
	Profiling Range	Resolution		Depth
3.0 MHz	0.6 – 6 m	0.15 – 2 m	0.2 m	10 m
1500 kHz	15-25 m	0.25 - 1.0 m	0.4 m	0.9 m
1000 kHz	25-40 m	0.4 - 2.0 m	0.5 m	1.3 m
500 kHz	0-120 m	1.0 - 5.0 m	1.0 m	3.0 m
250 kHz	20-180 m	1.0 - 10 m	1.5 m	3.5 m

The measurement location is a function of the time at which the return signal is sampled. The time since the pulse was transmitted determines how far the pulse has traveled and specifies the location of the particles that are the source of the reflected signal. By measuring the return signal at different times, the ADP measures the water velocity at different distances from the transducer. The profile of water velocity is divided into range cells, where each cell represents the average of the return signal for a given period. ADPs measure water current velocities along each of the transducer beams and transform these velocities into Cartesian (XYZ) or Earth (ENU) coordinates. The beams are divided into discrete increments or *cells* (also known as *range cells* or *depth cells*) of a specific length.   Current profiling can be thought of as dividing a river or stream into several horizontal slices (rows) from top to bottom (columns). The "rows" represent individual cells, and the "columns" represent vertical profiles. Each slice (row of cells) will contain water flowing at a certain velocity. Slices/rows/cells closer to the bottom will tend to flow slower than cells at mid-depth due to friction. The cells at the left and right edges of each row also tend to flow slower than cells in the center of the row. The ADP measures the velocity of the water in each of these cells and produces a velocity profile from the top of the column to the bottom of the column. By moving the ADP from one side of a river to the other, all the adjacent profiles can be added together and the average velocity for all the water in the river can be determined. The cell velocity profiles for representative transects are presented graphically in Figure 5.

Figure 5. Florence transects.



The calculated discharge results and stream width were relatively consistent for the three locations Table 3. Average velocity was significantly higher at the upstream locations since the channel depth was less.

Table 3. FWTP discharge results.

Florence Computed Discharge Results			
Transect #	1	2	5
Width m	216.2	210.6	225.8
Area m^2	741.8	743.1	878.9
Mean Velocity m/s	1.35	1.25	1.06
Discharge m^3/sec	-999.6	-926.45	-934.79
% Measured	70.3	70.2	73.1

Figure 6 shows the typical transects for the Missouri River at the PSWTP residual solids discharge outfalls. In general, the river channel was deeper at the PSWTP (2-4 m) than river channel at the FWTP (2-8 m). This results in lower mean river velocities at the PSWTP (Table 4) than at the FWTP.

Figure 6. Platte transects.

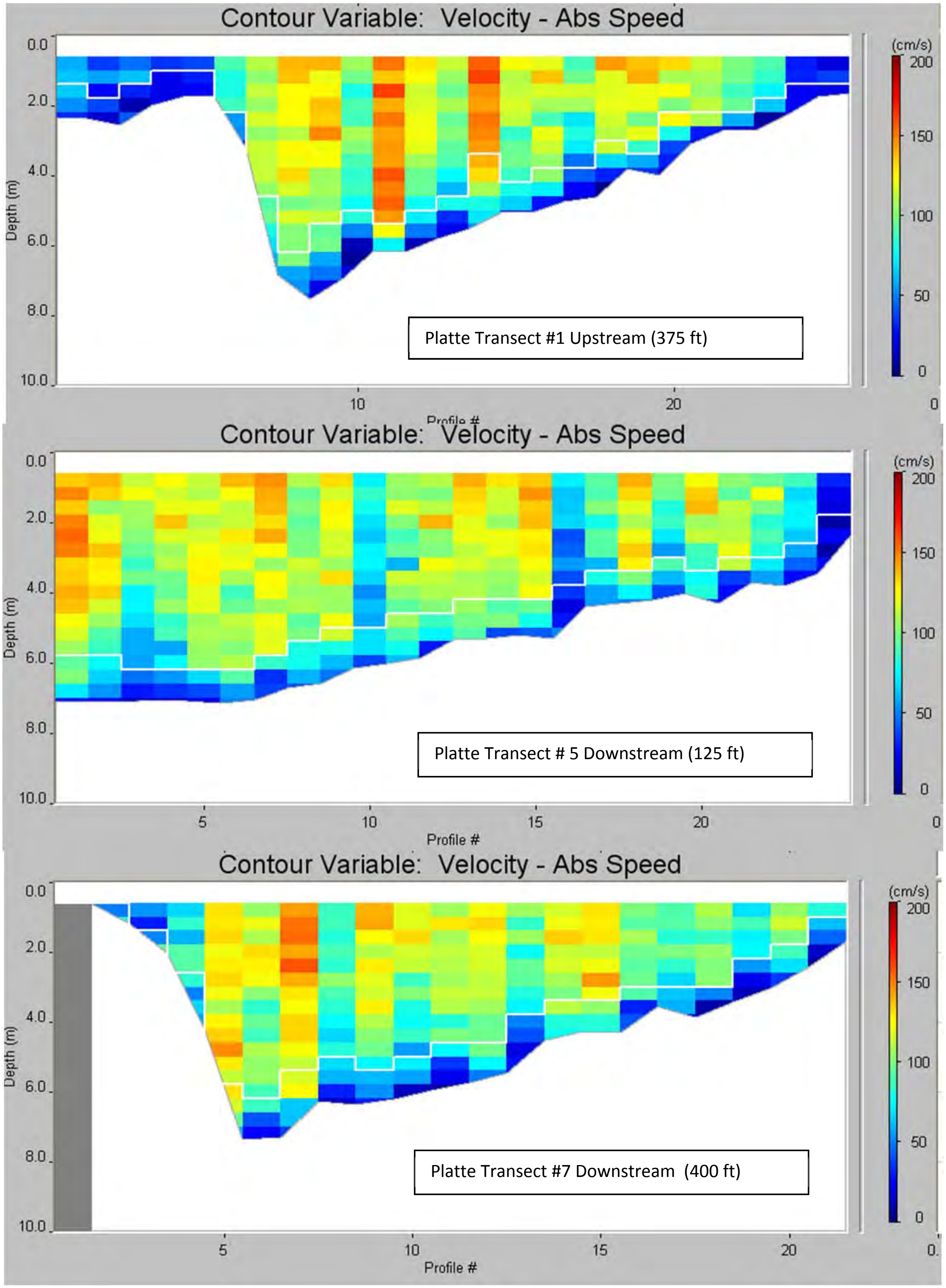


Table 4. Missouri River flow characteristics at the PSWTP residual discharge outfall area.

Computed Discharge Results Platte Transects			
Transect #	#1	#5	#7
Width m	227.1	196.6	198.1
Area m^2	1082.4	857.5	878
Mean Velocity m/sec	0.92	0.98	1.05
Discharge m^3/sec	-992.63	-837.67	-918.51
% Measured	65.2	71	70

Estimating Flow for Non-Gaged Locations (FWTP and the PSWTP). The sampling areas for the two outflow locations were not located at a stream gage. There were gages upstream and downstream from the sample location. Therefore, the flow was estimated using weighted average ratios of gage drainage areas to outfall drainage area (http://ks.water.usgs.gov/pubs/reports/wrir.02-4292.tab03.pdf, 2012).

$$Q_s = \frac{Q_u(DA_d - DA_s) + Q_d(DA_s - DA_u)}{DA_d - DA_u} \qquad (1)$$

Where

Q = Median Flow,

DA = Drainage Area,

s = Segment Ungaged

u = Upstream gaging station, and

d = Downstream gaging station.

Estimated flows at the Florence and Platte outfalls are presented in Table 5.

Table 5. Estimated flows for outfall locations.

Location	June 25, 2012	June 26, 2012
Platte Outfall	37,544 cfs	36,848 cfs
Florence Outfall	37,408 cfs	36,725 cfs

Missouri River Water Quality at the FWTP and PSWTP Residual Solids Discharge Outfalls Area

Florence Water Treatment Plant. Historically, discharging water treatment residuals to surface waters has been commonly practiced as an acceptable disposal method. The M.U.D.'s FWTP is a lime-softening facility. Residual solids from pre-sedimentation basins are continuously pumped to the Missouri River, whereas solids from four 20-million gal (75,700 m^3) sedimentation basins are discharged to the river twice each year. In addition, primary residual solids in the split-treatment reactors are continuously pumped to the river. Also, filter bed backwash water is wasted to the Missouri River. Residual solids from the FWTP are discharged to the Missouri River at three locations (Figure 1). Discharge Outfall 001 is at georeference point 95º 57' 26" W 41º 20' 35" N. Outfall 002 is 95º 57' 22" W 41º 20' 28" N. Outfall 005 is 95º 57' 15" W 41º 20' 19" N. Each outfall was located at the river's right edge, when looking in direction of flow, and near the water surface. The average water temperature was approximately 25^{o}C. The DO levels in the river upstream and downstream of the residual solids discharge outfalls ranged from 7.45 mg/L to 9.48 mg/L. Average DO concentrations for each transect position and depth are presented in Table 6. Upstream monitoring locations are above Outfall 001, and downstream monitoring locations are below Outfall 005. The discharge from Outfall 005 apparently created surface turbulence in the water surface, thereby increasing the reaeration rate at the point that yielded an average DO of 8.25 mg/L, which was significantly (α = 0.05) higher than average upstream levels and average DO concentrations obtained 150 ft (46 m) (7.81 mg/L) and 500 ft (152 m) (7.67 mg/L) downstream from Outfall 005. Higher Dos were observed at deeper locations, probably due to cooler water temperatures.

Table 6. Average dissolved oxygen concentration (mg/L) upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream -2,525ft (770m)	0.2	3	7.58	0.16	7.46	7.76
	0.5	3	7.9	0.36	7.52	8.23
	0.8	3	7.89	0.34	7.51	8.16
Upstream -1,925ft (587m)	0.2	3	7.7	0.12	7.56	7.8
	0.5	3	7.69	0.12	7.59	7.83
	0.8	3	7.67	0.08	7.61	7.76
Outfall - 0.0ft (0.0m)	0.2	3	8	0.04	7.97	8.05
	0.5	3	8.53	0.82	8.02	9.48
	0.8	3	8.23	0.29	7.96	8.54
Downstream-50ft (15.2m)	0.2	3	7.93	0.21	7.8	8.17
	0.5	3	8.04	0.22	7.83	8.27
	0.8	3	8.18	0.32	7.85	8.48
Downstream-100ft(30.5 m)	0.2	3	7.81	0.2	7.61	8.01
	0.5	3	8.46	0.57	7.93	9.07
	0.8	3	8.03	0.24	7.8	8.27
Downstream-150ft (61 m)	0.2	3	7.55	0.05	7.5	7.6
	0.5	3	7.86	0.35	7.51	8.2
	0.8	3	8.03	0.46	7.53	8.43
Downstream-500ft (152m)	0.2	3	7.55	0.11	7.45	7.66
	0.5	3	7.76	0.27	7.5	8.03
	0.8	3	7.7	0.11	7.59	7.8

*Outfall 001 is 1,850 ft (564m) upstream from Outfall 005

The drier areas of the Missouri River watershed are located above Omaha, where a greater percentage of the rainfall infiltrates into the calcareous soils and geological formations, and a disproportionately lower amount of rainfall surface runoff occurs compared to runoff amounts observed in the lower portions of the watershed (USAE, 2009). The Missouri River normally has an alkaline pH with values above the FWTP residual solids discharge point, normally ranging from 8 to 9 (USGS, 2010, EPA Storet Data). The river pH values upstream and downstream from the residual solids discharge outfalls ranged from 8.44 SU to 8.60 SU. Differences in pH of less than 0.5 SU are normally insignificant.

With a greater percentage of the Missouri River above Omaha fed from interflow and baseflow through calcareous soils and geological formations, the water of the Missouri River is hard. Hardness values upstream and downstream of the FWTP outfalls ranged from 254 mg $CaCO_3$/L to 302 mg $CaCO_3$/L (Table 7). While the hardness concentration 1,925 ft (587m) upstream (291 mg $CaCO_3$/L) from Outfall 005 was significantly ($\alpha = 0.05$) higher than the average concentration 150 ft downstream (265 mg $CaCO_3$/L) from Outfall 005, there were no significant differences among levels at other distances monitored. Corresponding alkalinity ranged from 179 mg $CaCO_3$/L to 273 mg $CaCO_3$/L (Table 8). Due to the variability of the data, there were no statistically significant ($\alpha = 0.05$) differences in alkalinity concentrations.

Table 7. Average hardness concentrations (mg CaCO3/L) upstream and downstream from the FWTP residual solids discharge Outfall 005.

Position		Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft	(770m)	0.2	4	278	17	261	297
		0.5	3	277	18	261	297
		0.8	3	291	15	274	302
Upstream-1,926ft	(587m)	0.2	4	296	9	287	308
		0.5	3	288	3	284	290
		0.8	3	289	8	281	297
Outfall-0.0ft	(0.0m)	0.2	4	289	4	284	293
		0.5	3	290	1	289	290
		0.8	3	292	2	291	294
Downstream-50ft	(15.2m)	0.2	3	272	23	257	298
		0.5	4	269	19	256	297
		0.8	3	263	5	259	268
Downstream-100ft	(30.5m)	0.2	3	261	1	260	262
		0.5	3	262	5	256	266
		0.8	4	292	68	254	394
Downstream-150ft	(61m)	0.2	3	266	3	262	268
		0.5	3	267	4	262	270
		0.8	4	264	4	259	268
Downstream-500ft	(152m)	0.2	3	273	16	258	290
		0.5	4	265	4	260	269
		0.8	3	269	2	267	271

*Outfall 001 is 1,850 ff (564) upstream from 005

Table 8. Average alkalinity concentrations (mg $CaCO_3$/L) upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	185	5	179	190
	0.5	3	187	2	185	189
	0.8	3	186	1	185	187
Upstream-1,925ft (587m)	0.2	4	186	1	184	187
	0.5	3	184	5	179	188
	0.8	3	177	10	165	184
Outfall-0.0ft (0.0m)	0.2	4	183	3	180	186
	0.5	3	185	2	183	186
	0.8	3	184	1	183	184
Downstream-50ft (15.2m)	0.2	3	185	1	184	186
	0.5	4	183	2	182	185
	0.8	3	184	4	179	186
Downstream-100ft (30.5m)	0.2	3	185	1	184	186
	0.5	3	183	2	181	185
	0.8	4	206	45	180	273
Downstream-150ft (61m)	0.2	3	186	3	184	190
	0.5	3	187	2	185	189
	0.8	4	185	2	183	187
Downstream-500ft from	0.2	3	185	3	183	188
	0.5	4	186	1	184	187
	0.8	3	186	2	185	189

*Outfall 001 is 1,850 ft (564m) upstream from outfall 005.

Average total suspended solids (TSS) concentrations upstream and downstream from Outfall 001 are presented in Table 9. TSS values ranged from 31 mg/L (500 ft downstream from Outfall 005 at 0.5 depth) to 269 mg/L (100 ft downstream from Outfall 005 at 0.8 depth). No statistically significant ($\alpha = 0.05$) differences were computed between average TSS levels at different locations. Therefore, no significant increases in average TSS were observed during the discharge of residual solids at the FWTP during the monitoring period. Settleable solids (SS) concentrations were all <1.0 mg/L (detection limit), indicating the bulk of the solids were probably silt, clay particles or other fine particles with low settling rates.

Table 9. Average total suspended solids concentrations (mg/L) upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	79	6	70	85
	0.5	3	75	19	53	87
	0.8	3	81	8	73	89
Upstream-1,925ft (587m)	0.2	4	74	6	66	81
	0.5	3	78	11	68	89
	0.8	3	82	14	67	95
Outfall-0.0ft (0.0m)	0.2	4	73	4	70	78
	0.5	3	69	2	67	71
	0.8	3	68	4	65	73
Dwonstream-50ft (15m)	0.2	3	72	5	67	76
	0.5	4	70	4	67	76
	0.8	3	74	5	69	78
Downstream-100ft (30.5m)	0.2	3	71	4	68	76
	0.5	3	78	2	76	79
	0.8	4	127	95	76	269
Downstream-150ft (46m)	0.2	3	80	10	72	92
	0.5	3	82	12	69	91
	0.8	4	82	10	70	93
Downstream-500ft (152m)	0.2	3	76	9	70	86
	0.5	4	69	26	31	87
	0.8	3	80	8	71	86

*Outfall 001 is 1,850 ft (564m) upstream from Outfall 005.

While no significant change in TSS was observed in the Missouri River from the discharge of residual solids, there was a significant difference in the aluminum concentrations (Table 10). The average total aluminum concentration at a distance of 150 ft (46 m) from residual solids Outfall 005 (2.210 mg/L) was significantly different ($\alpha = 0.05$) than the average concentration measured at Outfall 005 (1.468 mg/L). The overall average aluminum concentration (1.938 mg/L) at 2,525 ft (770 m) upstream from Outfall 005 also was significantly greater ($\alpha = 0.05$) than the levels measured at Outfall 005. There were no significant differences ($\alpha = 0.05$) between average aluminum concentration at 2,525 ft (770 m) upstream and 1,925 ft (587 m) upstream of Outfall 005. Adding uncertainty to the issue is the mean aluminum concentrations upstream from the outfall were not significantly different ($\alpha=0.05$) than the mean concentration obtained at position 500 ft (152m) downstream from Outfall 005. It is inconclusive, that the concentration of aluminum at 150 ft and 500 ft (152 m) downstream from

Outfall 005 reflected the contribution of FWTP residual solids introduced at Outfall 005.

Aluminum is amphoteric-soluble in acidic and basic solutions, but very insoluble at circumneutral pH. Since the pH was slightly basic, low levels of dissolved aluminum were present in the river (Table 11). The bulk of the aluminum in the water was in particulate form, which ranged from <0.063 mg/L to 0.288 mg/L.

Table 10. Average total aluminum concentration upstream and downstream from the FWTP residual solids Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	1.812	0.465	1.300	2.253
	0.5	3	2.026	0.280	1.703	2.196
	0.8	3	2.017	0.173	1.851	2.196
Upstream-1,925ft (587m)	0.2	4	1.898	0.304	1.592	2.186
	0.5	3	1.865	0.188	1.651	2.005
	0.8	3	1.678	0.162	1.567	1.864
Outfall-0.0ft (0.0m)	0.2	4	1.338	0.031	1.300	1.368
	0.5	3	1.583	0.078	1.493	1.630
	0.8	3	1.525	0.081	1.469	1.618
Downstream-50ft (15m)	0.2	3	1.757	0.125	1.641	1.889
	0.5	4	1.742	0.111	1.590	1.853
	0.8	3	1.813	0.108	1.703	1.919
Downstream-100ft (30.5m)	0.2	3	1.710	0.092	1.637	1.814
	0.5	3	1.845	0.024	1.824	1.871
	0.8	4	1.949	0.264	1.712	2.326
Downstream-150ft (46m)	0.2	3	2.208	0.385	1.802	2.569
	0.5	3	2.293	0.314	1.945	2.556
	0.8	4	2.151	0.405	1.781	2.595
Downstream-500ft (152m)	0.2	3	2.100	0.121	1.962	2.185
	0.5	4	1.992	0.150	1.883	2.213
	0.8	3	2.073	0.185	1.906	2.271

Table 11. Average dissolved aluminum (mg/L) upstream and downstream from FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	0.096	0.053	< 0.063	0.156
	0.5	3	0.187	0.027	0.156	0.208
	0.8	3	0.104	0.065	0.031	0.157
Upstream-1,925ft (587m)	0.2	4	0.165	0.045	0.119	0.214
	0.5	3	0.152	0.046	0.107	0.199
	0.8	3	0.163	0.082	0.083	0.246
Outfall-0.0ft (0.0m)	0.2	4	0.203	0.034	0.166	0.248
	0.5	3	0.222	0.018	0.205	0.24
	0.8	3	0.222	0.067	0.154	0.288
Downstream-50ft (15.2m)	0.2	3	0.156	0.054	0.115	0.217
	0.5	4	0.155	0.086	0.078	0.275
	0.8	3	0.125	0.022	0.1	0.141
Downstream-100ft (30m)	0.2	3	0.157	0.014	0.147	0.173
	0.5	3	0.137	0.037	0.114	0.18
	0.8	4	0.162	0.017	0.143	0.182
Downstream-150ft (61m)	0.2	3	0.165	0.016	0.146	0.176
	0.5	3	0.135	0.037	0.103	0.176
	0.8	4	0.131	0.06	0.072	0.209
Downstream-500ft (152m)	0.2	3	0.11	0.076	<0.063	0.183
	0.5	4	<0.063	0.033	<0.063	0.099
	0.8	3	0.082	0.088	<0.063	0.183

**Outfall 001 is 1,850 ft (564) upstream from Outfall 005.*

Aluminum salts can dissociate in water and Al^{+3} bonds with water molecules, hydroxide ions, other inorganic ions, and organic ions or molecules. At pH levels ranging from 4.0 to 8.5, aluminum-phosphate and aluminum-organic complexes are formed that are very insoluble and consequently precipitate from solution (EPA, 1988; Driscoll and Schecker, 1988).

When aluminum is mobilized in surface water, it may be toxic to aquatic life (Burrows, 1977; Schofield and Trojnar, 1980; Freeman and Everhart, 1971, 1973, George et al., 1991). The water hardness and the alkalinity, however, will decrease the toxicity of soluble aluminum on aquatic life (George et al., 1991, 1995). Lime-softening water treatment plants may not adversely aquatic life due to high calcium concentrations and associated high alkalinity.

The mean calcium concentrations upstream and downstream of Outfall 005 are presented in Table 12. While calcium concentrations ranged from 60.162 mg/L to 101.940 mg/L, no statistical differences ($\alpha = 0.05$) were computed between average calcium concentrations throughout the river reach monitored. Aluminum interactions with calcium may reduce the solubility of aluminum in circumneutral and basic solutions (Sposito, 1989). Previous toxicity testing of the M.U.D.'s FWTP residual solids discharged to the Missouri River was conducted by George et al. (1995). Residual solids and associated receiving water were obtained from the FWTP. The residual solids were divided into three parts, and the pH of each aliquot was altered to either an acidic, a circumneutral, or a basic condition. The residual solids were mixed for 24 hrs and filtered with a 0.45μm membrane filter. The extracts were diluted with receiving water at corresponding solids extract pH conditions. The extracts were subjected to a series of bioassays. Growth inhibition of *S. capricornutum* only occurred when the organism were subjected to 50 and 100% of extract solutions at pH 6, and only 100% filter extracts inhibited growth at pH 8.3 (George et al., 1995). With the tremendous dilution factor of the river to discharge flow of more than 1000:1, along with the high calcium and alkalinity concentrations, the solids residual discharge into the river should not significantly inhibit aquatic organisms.

Table 12. Average total calcium concentrations upstream and downstream of the FWTP residual solids Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	66.582	3.978	62.996	70.517
	0.5	3	66.005	4.386	62.327	70.859
	0.8	3	69.214	4.320	64.267	72.247
Upstream-1,925ft (587m)	0.2	4	69.772	1.448	67.913	71.432
	0.5	3	68.537	0.582	67.897	69.034
	0.8	3	68.265	1.791	66.750	70.242
Outfall-0.0ft (0.0m)	0.2	4	69.142	0.496	68.572	69.757
	0.5	3	68.928	0.711	68.136	69.510
	0.8	3	69.774	1.320	68.524	71.155
Downstream-50ft (15.2m)	0.2	3	64.765	5.899	60.162	71.415
	0.5	4	63.649	4.995	60.634	71.120
	0.8	3	62.146	1.211	60.784	63.102
Downstream-100ft (30.5)	0.2	3	61.861	0.147	61.716	62.009
	0.5	3	61.744	1.138	60.635	62.908
	0.8	4	71.441	20.348	60.338	101.940
Downstream-150ft (61m)	0.2	3	63.049	0.954	61.949	63.650
	0.5	3	62.885	1.115	61.617	63.710
	0.8	4	62.631	1.029	61.585	63.602
Downstream-500ft (152m)	0.2	3	66.051	5.975	61.279	72.752
	0.5	4	62.255	0.994	60.986	63.414
	0.8	3	63.872	0.650	63.359	64.603

*Outfall 001 is 1,850 ft (564m) upstream from Outfall 005.

The chemistry of iron and aluminum in water are similar; however, iron species are less soluble than aluminum species over a wider pH range. Mean iron concentrations are presented in Table 13. Average iron concentrations upstream (> 2.000 mg/L) from Outfall 5 were significantly greater than the average concentration in water samples collected at Outfall 005 (1.464 mg/L to 1.741 mg/L). The upstream iron concentrations were not significantly different ($\alpha = 0.05$) than the mean iron concentrations at 150 ft (61m) and 500 ft (152m) downstream from Outfall 005. Similarly, there were no significant differences ($\alpha = 0.05$) between the mean iron concentrations at Outfall 005, 50 ft (15.2m) and 100 ft (30.5m) downstream. The residual solids discharge may have diluted the iron concentration immediately downstream from the discharge.

Table 13. Average total iron concentrations upstream and downstream from the FWTP residual solids Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	2.184	0.404	1.599	2.497
	0.5	3	2.038	0.513	1.464	2.452
	0.8	3	2.272	0.299	1.940	2.521
Upstream-1,925ft (587m)	0.2	4	2.098	0.345	1.741	2.432
	0.5	3	2.073	0.233	1.824	2.285
	0.8	3	1.896	0.174	1.768	2.094
Outfall-0.0ft (0.0m)	0.2	4	1.464	0.028	1.433	1.500
	0.5	3	1.741	0.057	1.675	1.774
	0.8	3	1.695	0.097	1.594	1.788
Downstream-50ft (15.2m)	0.2	3	1.680	0.128	1.555	1.811
	0.5	4	1.658	0.128	1.529	1.830
	0.8	3	1.622	0.083	1.554	1.714
Downstream-100ft (30.5m)	0.2	3	1.545	0.090	1.469	1.645
	0.5	3	1.631	0.029	1.597	1.649
	0.8	4	1.726	0.180	1.585	1.987
Downstream-150ft (61m)	0.2	3	2.004	0.423	1.554	2.394
	0.5	3	2.111	0.315	1.767	2.385
	0.8	4	1.999	0.404	1.622	2.440
Downstream-500ft (152m)	0.2	3	2.004	0.267	1.754	2.285
	0.5	4	2.033	0.217	1.796	2.322
	0.8	3	2.089	0.297	1.824	2.410

The average magnesium concentrations at Outfall 005 (28.307 mg/L to 28.683 mg/L) were significantly higher than levels measured at 150 ft (46 m) and 500 ft (152 m) downstream from Outfall 005 (Table 14). There were no significant differences between average magnesium concentrations at Outfall 005 and upstream levels, which were greater than 27 mg/L. Similar to observations with iron, the residual solids discharge may have diluted the magnesium levels in the plume from Outfall 005.

Table 14. Average total magnesium concentrations upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	27.154	1.801	25.235	29.310
	0.5	3	27.112	1.874	25.516	29.175
	0.8	3	28.536	0.994	27.458	29.417
Upstream-1,925ft (587m)	0.2	4	29.466	1.407	28.523	31.561
	0.5	3	28.331	0.419	27.893	28.728
	0.8	3	28.692	0.839	27.770	29.409
Outfall-0.0ft (0.0m)	0.2	4	28.307	0.573	27.486	28.817
	0.5	3	28.533	0.260	28.289	28.807
	0.8	3	28.683	0.772	27.795	29.197
Downstream-50ft (15m)	0.2	3	26.865	2.032	25.378	29.180
	0.5	4	26.815	1.566	25.334	29.017
	0.8	3	26.229	0.558	25.794	26.859
Downstream-100ft (30.5m)	0.2	3	25.861	0.234	25.602	26.057
	0.5	2	25.894	0.684	25.410	26.377
	0.8	4	27.642	4.208	25.163	33.941
Downstream-150ft (46m)	0.2	3	26.386	0.264	26.083	26.564
	0.5	3	26.621	0.452	26.242	27.121
	0.8	4	26.091	0.514	25.357	26.522
Downstream-500ft (152m)	0.2	3	26.338	0.925	25.434	27.283
	0.5	4	26.484	0.352	26.151	26.956
	0.8	3	26.474	0.103	26.372	26.578

Manganese concentrations were relatively low, ranging from 0.128 mg/L to 0.186 mg/L Table 15. No significant differences ($\alpha = 0.05$) between manganese concentrations at various positions upstream and downstream of Outfall 005 were computed. Similarly, average zinc concentrations were low (Table 16.) Statistical comparison of data between different positions upstream and downstream of Outfall 005 indicated no significant differences ($\alpha = 0.05$) between average zinc concentrations. Trace metals such as copper (Table A.5), nickel (Table A.9) and selenium (Table A.10) were less than instrumental detection limits.

Table 15. Average total manganese concentrations upstream and downstream of FWTP solids residuals discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	0.166	0.023	0.134	0.186
	0.5	3	0.158	0.024	0.131	0.176
	0.8	3	0.172	0.012	0.159	0.181
Upstream-1,925ft (587m)	0.2	4	0.163	0.016	0.146	0.177
	0.5	3	0.161	0.009	0.150	0.167
	0.8	3	0.153	0.011	0.142	0.164
Outfall-0.0ft (0.0m)	0.2	4	0.132	0.003	0.129	0.136
	0.5	3	0.148	0.001	0.147	0.149
	0.8	3	0.147	0.006	0.141	0.153
Downstream-50ft (15.2m)	0.2	3	0.141	0.011	0.132	0.154
	0.5	4	0.140	0.011	0.130	0.156
	0.8	3	0.137	0.005	0.132	0.141
Downstream-100ft (30.5m)	0.2	3	0.133	0.005	0.128	0.138
	0.5	3	0.138	0.001	0.137	0.139
	0.8	4	0.145	0.015	0.134	0.168
Downstream-150ft (61m)	0.2	3	0.155	0.019	0.134	0.171
	0.5	3	0.160	0.017	0.141	0.174
	0.8	4	0.154	0.021	0.134	0.177
Downstream-500ft (152m)	0.2	3	0.155	0.009	0.145	0.162
	0.5	4	0.153	0.008	0.147	0.165
	0.8	3	0.156	0.009	0.148	0.166

Table 16. Average total zinc concentrations upstream and downstream of FTWP solids residual discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	0.012	0.003	0.010	0.016
	0.5	3	0.010	0.003	0.008	0.013
	0.8	3	0.011	0.001	0.011	0.012
Ustream-1,925ft (587m)	0.2	4	0.016	0.010	0.008	0.031
	0.5	3	0.009	0.001	0.009	0.010
	0.8	3	0.009	0.002	0.007	0.010
Outfall-0.0ft (0.0m)	0.2	4	0.007	0.003	<0.006	0.009
	0.5	3	0.008	0.002	0.006	0.010
	0.8	3	0.007	0.000	0.007	0.007
Downstream-50ft (15.2m)	0.2	3	0.011	0.003	0.008	0.013
	0.5	4	0.010	0.002	0.007	0.012
	0.8	3	0.011	0.001	0.010	0.012
Downstream-100ft (30.5m)	0.2	3	0.011	0.001	0.010	0.012
	0.5	3	0.011	0.001	0.010	0.012
	0.8	4	0.011	0.002	0.010	0.014
Downstream-150ft (61m)	0.2	3	0.016	0.003	0.014	0.019
	0.5	3	0.013	0.002	0.011	0.015
	0.8	4	0.011	0.002	0.009	0.014
Downstream-500ft (152m)	0.2	3	0.011	0.004	0.007	0.014
	0.5	4	0.005	0.005	<0.006	0.012
	0.8	3	0.007	0.006	<0.006	0.014

Platte South Water Treatment Plant. The PSWTP is a lime-softening facility that uses iron or aluminum salts as the primary coagulant. Upstream from the PSWTP and downstream from the FWTP, a major subwatershed flows into the Missouri River (Figure 7). This additional flow affected water quality immediately upstream for the PSWTP residual solids discharge.

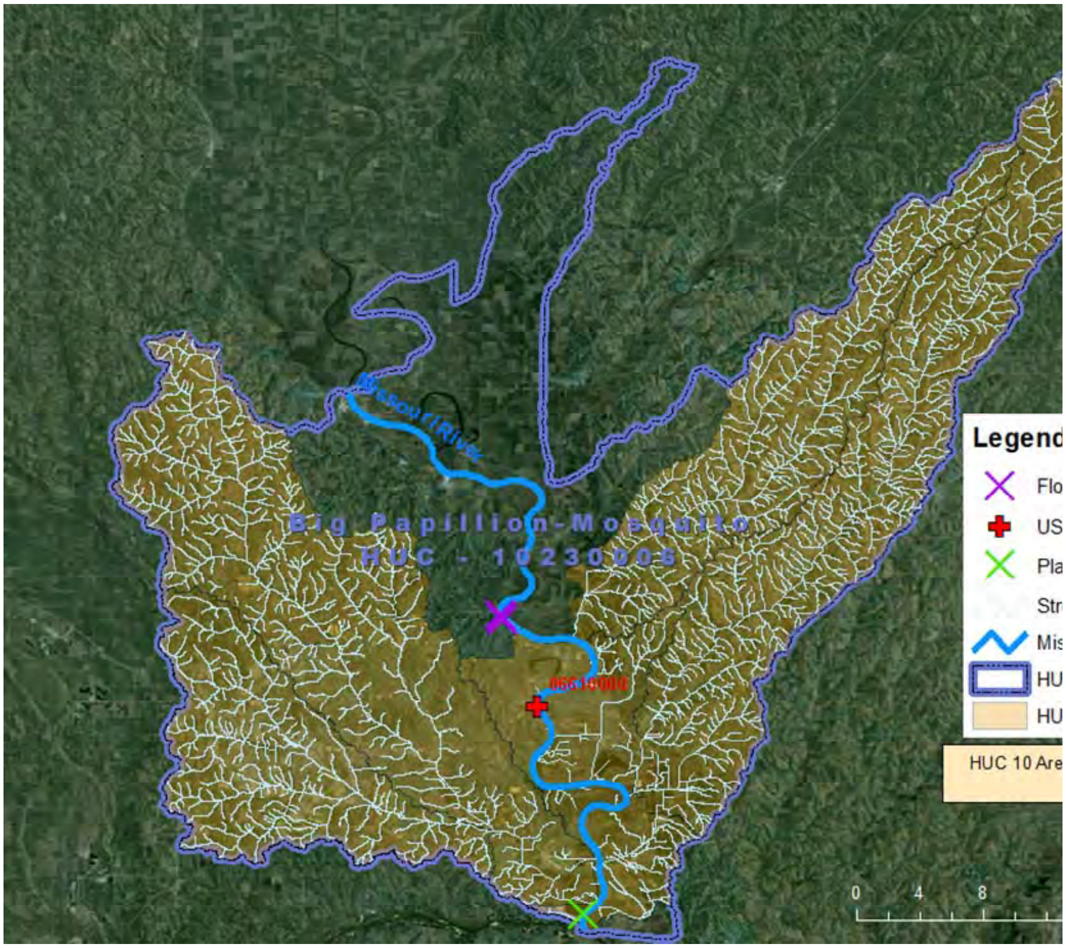


Figure 7. Subwatershed drainage area flowing into the Missouri River upstream of the PSWTP residual solids outfall.

Figure 2 shows the locations upstream and downstream from the PSWTP residual solids discharge point, Outfall 002, where river transects and water quality data were obtained. Outfall 002 was located near the river edge at georeferenced coordinates 476,601.28ft N, 2,775,327.96 ft. E. Residual solids were discharged beneath the water surface. DO levels varied from 7.47 mg/L to 11.44 mg/L. Average TSS concentrations at each location are presented in Table 17. These values represent the average TSS concentrations obtained in water samples collected along each transect width and depth. TSS concentrations ranged from 75 mg/L to 163 mg/L. Statistical analysis of the data indicated that average TSS concentrations at 375 ft upstream from the discharge point (94-141 mg/L) were significantly ($\alpha = 0.05$) greater than the downstream concentrations at 50 ft (88 -92 mg/L), 100 ft (92-109 mg/L) and 200 ft (87-100 mg/L). The average TSS concentrations upstream from the discharge were not significantly different ($\alpha = 0.05$) than the average concentration measured at 400 ft downstream from the discharge. Statistical analysis of the data also showed that at each depth there was no significant difference

(α = 0.05) in average TSS between locations. Therefore, no significant increases in average TSS were observed during the discharge of residual solids at the PSWTP during the monitoring period.

Table 17. Average total suspended solids at each location and depth related to the PSWTP solids residual discharge.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	141	30	99	169
	0.5	3	94	9	88	104
	0.8	3	114	32	94	151
Upstream (125ft/38m)	0.2	3	122	36	95	163
	0.5	4	95	5	91	102
	0.8	3	98	1	97	99
Downstream-50ft(15m)	0.2	3	92	5	88	97
	0.5	3	88	14	75	103
	0.8	4	90	4	84	93
Downstream-100ft(30.5m)	0.2	4	109	21	90	138
	0.5	3	92	6	85	97
	0.8	3	94	6	88	100
Downstream-125ft(38m)	0.2	3	90	6	85	96
	0.5	4	90	4	84	93
	0.8	3	94	5	90	99
Downstream-200ft(61m)	0.2	3	87	9	82	97
	0.5	3	100	9	90	108
	0.8	4	97	6	90	104
Downstream-400ft(122m)	0.2	3	106	39	82	151
	0.5	4	90	7	83	100
	0.8	2	97	11	89	105

The chemical composition of the TSS, however, did vary significantly (α = 0.05) from upstream to downstream. Aluminum, which is commonly used as a coagulant in water treatment to remove colloidal solids, may be present in residual solids that are discharged to surface waters. Downstream from the PSWTP, discharged outfall aluminum concentrations were significantly (α = 0.05) higher than upstream levels (Table 18). Similarly, for each specific water depth upstream, average aluminum concentrations were significantly (α = 0.05) less than concentrations measured downstream from Outfall 002. Aluminum is amphoteric-soluble in acidic and basic solutions, but very insoluble at circumneutral pH. Table 19 presents the mean pH values upstream and downstream of the PSWTP outfall. In general, the pH of the river was approximately 8.5, which was within the historic pH range of the river and was less than the acceptable level of 9.0 that was stated in the PSWTP's NPDES discharge permit. Since the pH was slightly basic, low levels of dissolved aluminum were present in the river (Table 20). Aluminum salts can dissociate in water and Al^{+3} bonds with water molecules, hydroxide ions, other inorganic ions and organic ions, or molecules. At pH levels ranging from 4.0 to 8.5, aluminum-phosphate and aluminum-organic complexes are formed that are very insoluble and consequently precipitate from solution (EPA, 1988; Driscoll and Schecker, 1988).

Table 18. Average total aluminum concentrations upstream and downstream from the PSWTP solids residual discharge outfall into the Missouri River.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.450	0.048	0.396	0.509
	0.5	3	0.422	0.049	0.384	0.477
	0.8	3	0.392	0.052	0.338	0.441
Upstream (125ft/38m)	0.2	3	0.428	0.048	0.393	0.483
	0.5	4	0.430	0.055	0.385	0.501
	0.8	3	0.481	0.030	0.459	0.515
Downstream-50ft(15m)	0.2	3	0.498	0.077	0.446	0.587
	0.5	3	0.511	0.083	0.422	0.585
	0.8	4	0.567	0.067	0.513	0.657
Downstream-100ft(30.5m)	0.2	4	0.853	0.212	0.653	1.040
	0.5	3	0.742	0.249	0.555	1.025
	0.8	3	0.770	0.292	0.575	1.106
Downstream-125ft(38m)	0.2	3	1.085	0.035	1.051	1.120
	0.5	4	1.134	0.044	1.094	1.197
	0.8	3	1.089	0.041	1.044	1.123
Downstream-200ft(61m)	0.2	3	0.904	0.213	0.674	1.095
	0.5	3	0.986	0.223	0.729	1.117
	0.8	4	0.746	0.152	0.626	0.963
Downstream-400ft(122m)	0.2	3	0.664	0.008	0.659	0.673
	0.5	4	0.733	0.097	0.610	0.817
	0.8	2	0.576	0.045	0.544	0.608

Table 19. Average pH values in the Missouri River upstream and downstream from PSWTP residuals discharge outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	3	8.47	0.03	8.44	8.50
	0.5	3	8.44	0.04	8.41	8.48
	0.8	3	8.39	0.04	8.36	8.43
Upstream (125ft/38m)	0.2	3	8.48	0.01	8.47	8.49
	0.5	3	8.43	0.04	8.41	8.48
	0.8	3	8.42	0.06	8.35	8.45
Downstream-50ft(15m)	0.2	3	8.50	0.03	8.47	8.52
	0.5	3	8.45	0.03	8.42	8.48
	0.8	3	8.43	0.03	8.41	8.47
Downstream-100ft(30.5m)	0.2	3	8.53	0.01	8.52	8.53
	0.5	3	8.49	0.06	8.43	8.55
	0.8	3	8.50	0.07	8.45	8.58
Downstream-125ft(38m)	0.2	3	8.53	0.01	8.53	8.54
	0.5	3	8.51	0.01	8.50	8.52
	0.8	3	8.47	0.02	8.45	8.48
Downstream-200ft(61m)	0.2	3	8.55	0.01	8.54	8.56
	0.5	3	8.52	0.02	8.50	8.54
	0.8	3	8.48	0.01	8.48	8.49
Downstream-400ft(122m)	0.2	3	8.56	0.01	8.55	8.57
	0.5	3	8.53	0.02	8.51	8.55
	0.8	2	8.50	0.02	8.48	8.51

Table 20. Mean dissolved aluminum concentrations upstream and downstream of the PSWTP residual solids discharge outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.120	0.022	0.100	0.152
	0.5	3	0.077	0.043	0.031	0.117
	0.8	3	0.061	0.051	0.031	0.120
Upstream (125ft/38m)	0.2	3	0.171	0.059	0.118	0.234
	0.5	4	0.118	0.055	0.065	0.181
	0.8	3	0.116	0.088	0.031	0.207
Downstream-50ft(15m)	0.2	3	0.097	0.030	0.067	0.126
	0.5	3	0.113	0.072	0.031	0.163
	0.8	4	0.124	0.078	0.031	0.204
Downstream-100ft(30.5m)	0.2	4	0.059	0.037	0.031	0.108
	0.5	3	0.073	0.046	0.031	0.123
	0.8	3	0.044	0.023	0.031	0.070
Downstream-125ft(38m)	0.2	3	0.074	0.046	0.031	0.123
	0.5	4	0.042	0.022	0.031	0.075
	0.8	3	0.055	0.042	0.031	0.104
Downstream-200ft(61m)	0.2	3	0.049	0.031	0.031	0.085
	0.5	3	0.046	0.027	0.031	0.077
	0.8	4	0.095	0.043	0.031	0.122
Downstream-400ft(122m)	0.2	3	0.138	0.011	0.128	0.150
	0.5	4	0.149	0.016	0.137	0.172
	0.8	2	0.119	0.016	0.107	0.130

As mentioned in the FWTP discussion (Page 21), when aluminum is mobilized in surface water, it may be toxic to aquatic life (Burrows, 1977; Schofield and Trojnar, 1980; Freeman and Everhart, 1971,1973; George et al., 1991). The water hardness and the alkalinity, however, will decrease the toxicity of soluble aluminum on aquatic life (George et al., 1991,1995). Lime-softening water treatment plants may not adversely aquatic life due to high calcium concentrations and associated high alkalinity.

The mean calcium concentrations present in the Missouri River upstream and downstream of the PSWTP solids residuals discharge outfall are provided in Table 21. In general, there were no significant differences ($\alpha = 0.05$) in average calcium concentrations between any of the upstream or downstream locations. Aluminum interactions with calcium may reduce the solubility of aluminum in circumneutral and basic solutions (Sposito, 1989). The Missouri River mean alkalinity levels upstream and downstream of the PSWTP outfall ranged from 177 to 188 mg $CaCO_3$/L (Table 22). As previously mentioned, previous toxicity testing of the M.U.D.'s FWTP showed growth inhibition of *S. capricornutum* only in 50 and 100% of extract solutions obtained from the plant's solids residual at pH 6.0 (George et al., 1995). With the tremendous estimated dilution factor of the river to residual solids discharge flow of greater than 13,000:1, along with the high calcium and alkalinity concentrations, the solids residual discharge into the river should not significantly inhibit aquatic organisms at a pH range from 8.0 to 9.0.

Table 21. Average total calcium concentrations in the Missouri River upstream and downstream of PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	62.033	1.796	59.530	63.435
	0.5	3	62.534	1.612	60.706	63.750
	0.8	3	61.657	0.913	60.735	62.561
Upstream (125ft/38m)	0.2	3	61.591	1.691	59.710	62.984
	0.5	4	62.094	1.063	60.530	62.907
	0.8	3	61.658	0.944	60.977	62.736
Downstream-50ft(15m)	0.2	3	63.058	1.906	61.081	64.884
	0.5	3	62.584	2.862	59.332	64.720
	0.8	4	64.509	0.953	63.531	65.682
Downstream-100ft(30.5m)	0.2	4	63.177	2.189	60.832	66.063
	0.5	3	64.080	2.418	61.380	66.045
	0.8	3	62.867	1.489	61.151	63.820
Downstream-125ft(38m)	0.2	3	63.251	3.951	59.973	67.638
	0.5	4	64.258	2.063	62.742	67.298
	0.8	3	63.489	2.597	61.658	66.461
Downstream-200ft(61m)	0.2	3	66.424	2.523	63.757	68.772
	0.5	3	65.831	2.818	63.039	68.675
	0.8	4	63.504	1.188	62.140	64.631
Downstream-400ft(122m)	0.2	3	62.071	0.461	61.539	62.350
	0.5	4	62.221	0.879	61.149	63.031
	0.8	2	61.958	1.312	61.030	62.885

Table 22. Mean total alkalinity (as mg $CaCO_3$/L) concentrations upstream and downstream of the PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	183	1	182	184
	0.5	3	183	1	182	184
	0.8	3	181	2	180	183
Upstream (125ft/38m)	0.2	3	182	2	181	184
	0.5	4	181	1	179	182
	0.8	3	182	2	180	183
Downstream-50ft(15m)	0.2	3	184	2	182	186
	0.5	3	183	1	182	184
	0.8	4	183	2	181	185
Downstream-100ft(30.5m)	0.2	4	182	4	178	187
	0.5	3	183	1	183	184
	0.8	3	183	2	182	185
Downstream-125ft(38m)	0.2	3	183	2	181	184
	0.5	4	183	2	181	184
	0.8	3	186	2	184	188
Downstream-200ft(61m)	0.2	3	181	1	180	182
	0.5	3	181	4	177	184
	0.8	4	182	2	180	184
Downstream-400ft(122m)	0.2	3	183	2	181	185
	0.5	4	183	2	180	185
	0.8	3	181	1	180	182

The chemistry of iron and aluminum in water are similar; however, iron species are less soluble than aluminum species over a wider pH range. Table 23 provides the mean total iron, Fe, concentrations upstream and downstream of the PSWTP outfall. As observed with aluminum, the average total iron concentrations in the Missouri River significantly ($\alpha = 0.05$) increased up to 125 ft (38 m) downstream of the PSWTP outfall at all depths. Average iron concentration at 200 ft (61 m) and 400 ft (122 m),while significantly ($\alpha = 0.05$) less than the mean values at 125 ft (38 m), were significantly higher than mean iron concentration upstream of the outfall.

Table 23. Average total iron concentrations upstream and downstream from the PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.396	0.063	0.325	0.465
	0.5	3	0.381	0.031	0.345	0.403
	0.8	3	0.328	0.027	0.311	0.359
Upstream (125ft/38m)	0.2	3	0.386	0.051	0.354	0.445
	0.5	4	0.367	0.071	0.292	0.462
	0.8	3	0.385	0.043	0.342	0.427
Downstream-50ft(15m)	0.2	3	0.438	0.048	0.396	0.491
	0.5	3	0.450	0.050	0.396	0.493
	0.8	4	0.505	0.069	0.444	0.599
Downstream-100ft(30.5m)	0.2	4	0.738	0.214	0.532	0.929
	0.5	3	0.611	0.258	0.406	0.900
	0.8	3	0.640	0.275	0.480	0.957
Downstream-125ft(38m)	0.2	3	0.974	0.010	0.967	0.986
	0.5	4	1.013	0.074	0.932	1.093
	0.8	3	0.994	0.032	0.966	1.028
Downstream-200ft(61m)	0.2	3	0.796	0.220	0.561	0.996
	0.5	3	0.900	0.247	0.615	1.043
	0.8	4	0.670	0.141	0.555	0.871
Downstream-400ft(122m)	0.2	3	0.612	0.014	0.603	0.628
	0.5	4	0.674	0.105	0.537	0.783
	0.8	2	0.560	0.037	0.533	0.586

While manganese concentrations were relatively low, ranging from 0.027 mg/L to 0.101 mg/L, downstream average total manganese concentrations at locations 100 ft (31 m), 125 ft (38 m), 200 ft (61 m), and 400 ft (122 m) also were significantly higher than average upstream levels (Table 24). With respect to depth, upstream average concentrations were significantly (α = 0.05) less than average concentrations at 100 ft (31 m), 125 ft (38 m), 200 ft (61 m) downstream from the outfall.

Table 24. Average total manganese concentrations upstream and downstream of PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.035	0.006	0.028	0.041
	0.5	3	0.034	0.002	0.031	0.035
	0.8	3	0.030	0.002	0.028	0.032
Upstream (125ft/38m)	0.2	3	0.035	0.004	0.032	0.039
	0.5	4	0.033	0.006	0.027	0.041
	0.8	3	0.034	0.003	0.031	0.037
Downstream-50ft(15m)	0.2	3	0.043	0.009	0.037	0.053
	0.5	3	0.045	0.008	0.039	0.054
	0.8	4	0.049	0.010	0.038	0.061
Downstream-100ft(30.5m)	0.2	4	0.072	0.016	0.056	0.086
	0.5	3	0.063	0.020	0.047	0.085
	0.8	3	0.064	0.019	0.052	0.086
Downstream-125ft(38m)	0.2	3	0.091	0.001	0.090	0.092
	0.5	4	0.095	0.006	0.089	0.101
	0.8	3	0.093	0.003	0.090	0.096
Downstream-200ft(61m)	0.2	3	0.078	0.019	0.058	0.095
	0.5	3	0.086	0.019	0.064	0.098
	0.8	4	0.062	0.018	0.046	0.085
Downstream-400ft(122m)	0.2	3	0.050	0.003	0.047	0.053
	0.5	4	0.056	0.008	0.046	0.063
	0.8	2	0.047	0.004	0.044	0.049

Upstream average magnesium concentrations, however, were only significantly less than the average magnesium concentration at 200 ft (61 m) downstream from outfall (Table 25). Magnesium levels ranged from 24.599 mg/L to 28.073 mg/L. Magnesium salts precipitated out of the drinking water during the lime-softening process and then were reintroduced to the Missouri River with the residuals discharge. Other metals such as copper, nickel, selenium were not present above detection limits (Table B.5, Table B.9, Table B.10).

Table 25. Average total magnesium concentrations in the Missouri River upstream and downstream of PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	25.956	1.327	24.599	27.778
	0.5	3	25.727	0.266	25.445	25.974
	0.8	3	25.519	0.016	25.503	25.534
Upstream (125ft/38m)	0.2	3	25.679	0.528	25.209	26.250
	0.5	4	25.774	0.610	25.076	26.394
	0.8	3	26.356	0.767	25.632	27.160
Downstream-50ft(15m)	0.2	3	26.548	0.552	26.034	27.131
	0.5	3	26.205	0.415	25.780	26.609
	0.8	4	26.477	0.416	26.086	26.969
Downstream-100ft(30.5m)	0.2	4	26.237	1.048	25.148	27.639
	0.5	3	26.167	0.457	25.651	26.520
	0.8	3	25.955	0.024	25.928	25.970
Downstream-125ft(38m)	0.2	3	26.164	1.250	25.308	27.599
	0.5	4	26.654	1.086	25.402	28.041
	0.8	3	25.992	0.899	25.397	27.026
Downstream-200ft(61m)	0.2	3	27.616	0.581	26.962	28.073
	0.5	3	27.154	0.095	27.096	27.263
	0.8	4	26.384	0.629	25.712	27.017
Downstream-400ft(122m)	0.2	3	25.656	0.492	25.225	26.192
	0.5	4	25.670	0.198	25.434	25.914
	0.8	2	25.630	0.021	25.615	25.645

CONCLUSION

The investigation of the Missouri River water quality upstream and downstream of the residual solids outfalls from the FWTP and the PSWTP was to determine if the residual solids discharged by either facility impacted the water quality of the Missouri River. Data analysis indicated that the solids discharge at both facilities did not significantly affect the TSS concentrations in the river. The chemical composition of the solids, i.e., aluminum and iron, at the PSWTP apparently increased downstream from the residual solids discharge due to the introduction of solids mass from the facility. However, the calcium and pH levels of the Missouri River should prevent any inhibitory effect by aluminum on aquatic life in the water column. Trace metals such as copper, nickel, and selenium were measured at detection limits and, therefore, pose no concern.

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APPENDIX A

FLORENCE WATER TREATMENT PLANT

MISSOURI RIVER WATER QUALITY DATA

Table A.1. Sonde data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No.	Position along Transect	Depth (Fraction of Total Depth)	Specific Conductance (mS/m)	Dissolved O_2 (mg/L)	pH (SU)	Temperature (^oC)
Upstream (2,525 ft)	1	1	.2	0.876	7.53	8.5	25.13
Upstream (2,525 ft)	1	1	.5	0.876	8.23	8.48	25.12
Upstream (2,525 ft)	1	1	.8	0.876	8.16	8.47	25.12
Upstream (2,525 ft)	1	2	.2	0.869	7.46	8.49	25.17
Upstream (2,525 ft)	1	2	.5	0.869	7.52	8.47	25.17
Upstream (2,525 ft)	1	2	.8	0.868	7.51	8.44	25.17
Upstream (2,525 ft)	1	3	.2	0.865	7.76	8.49	25.24
Upstream (2,525 ft)	1	3	.5	0.865	7.95	8.47	25.23
Upstream (2,525 ft)	1	3	.8	0.865	8	8.45	25.23
Upstream (1,925 ft)	2	1	.2	0.877	7.8	8.49	25.16
Upstream (1,925 ft)	2	1	.5	0.877	7.83	8.47	25.17
Upstream (1,925 ft)	2	1	.8	0.877	7.76	8.46	25.16
Upstream (1,925 ft)	2	2	.2	0.872	7.74	8.47	25.18
Upstream (1,925 ft)	2	2	.5	0.87	7.59	8.48	25.25
Upstream (1,925 ft)	2	2	.8	0.87	7.65	8.46	25.25
Upstream (1,925 ft)	2	3	.2	0.863	7.56	8.5	25.49
Upstream (1,925 ft)	2	3	.5	0.863	7.66	8.5	25.48
Upstream (1,925 ft)	2	3	.8	0.863	7.61	8.48	25.5
Outfall 005	3	1	.2	0.875	7.97	8.55	25.55
Outfall 005	3	1	.5	0.875	8.1	8.53	25.55
Outfall 005	3	1	.8	0.875	8.18	8.5	25.55
Outfall 005	3	2	.2	0.874	7.98	8.57	25.56
Outfall 005	3	2	.5	0.874	8.02	8.52	25.56
Outfall 005	3	2	.8	0.875	7.96	8.5	25.56
Outfall 005	3	3	.2	0.874	8.05	8.56	25.56
Outfall 005	3	3	.5	0.874	9.48	8.5	25.56
Outfall 005	3	3	.8	0.874	8.54	8.48	25.56
Downstream (50 ft)	4	1	.2	0.875	7.81	8.57	25.48
Downstream (50 ft)	4	1	.5	0.875	7.83	8.55	25.49
Downstream (50 ft)	4	1	.8	0.875	7.85	8.52	25.49
Downstream (50 ft)	4	2	.2	0.874	8.17	8.56	25.5
Downstream (50 ft)	4	2	.5	0.875	8.27	8.55	25.5

Downstream (50 ft)	4	2	08	0.874	8.2	8.5	25.49
Downstream (50 ft)	4	3	.2	0.874	7.8	8.55	25.49
Downstream (50 ft)	4	3	.5	0.874	8.02	8.53	25.49
Downstream (50 ft)	4	3	.8	0.874	8.48	8.5	25.5
Downstream (100 ft)	5	1	.2	0.874	7.61	8.57	25.42
Downstream (100 ft)	5	1	.5	0.874	9.07	8.53	25.41
Downstream (100 ft)	5	1	.8	0.871	8.03	8.6	25.44
Downstream (100 ft)	5	2	.2	0.874	7.81	8.54	25.42
Downstream (100 ft)	5	2	.5	0.874	7.93	8.53	25.42
Downstream (100 ft)	5	2	.8	0.875	7.8	8.47	25.42
Downstream (100 ft)	5	3	.2	0.874	8.01	8.55	25.44
Downstream (100 ft)	5	3	.5	0.874	8.37	8.52	25.43
Downstream (100 ft)	5	3	.8	0.874	8.27	8.5	25.43
Downstream (150 ft)	6	1	.2	0.874	7.55	8.53	25.35
Downstream (150 ft)	6	1	.5	0.875	7.86	8.52	25.34
Downstream (150 ft)	6	1	.8	0.875	8.43	8.48	25.35
Downstream (150 ft)	6	2	.2	0.866	7.6	8.51	25.38
Downstream (150 ft)	6	2	.5	0.866	7.51	8.5	25.38
Downstream (150 ft)	6	2	.8	0.866	7.53	8.47	25.38
Downstream (150 ft)	6	3	.2	0.862	7.5	8.51	25.55
Downstream (150 ft)	6	3	.5	0.862	8.2	8.49	25.54
Downstream (150 ft)	6	3	.8	0.862	8.12	8.48	25.53
Downstream (500 ft)	7	1	.2	0.875	7.66	8.55	25.34
Downstream (500 ft)	7	1	.5	0.875	7.74	8.52	25.32
Downstream (500 ft)	7	1	.8	0.875	7.71	8.51	25.32
Downstream (500 ft)	7	2	.2	0.87	7.45	8.51	25.31
Downstream (500 ft)	7	2	.5	0.87	7.5	8.5	25.31
Downstream (500 ft)	7	2	.8	0.87	7.59	8.47	25.31
Downstream (500 ft)	7	3	.2	0.863	7.55	8.5	25.43
Downstream (500 ft)	7	3	.5	0.783	8.03	8.48	25.81
Downstream (500 ft)	7	3	.8	0.863	7.8	8.45	25.45

Table A.2. Total suspended solids, alkalinity, hardness and settable solids data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No#	Position along Transect	Depth (Fraction of Total Depth)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)	Settable Solids (mg/L)	TSS (mg/L)
Upstream (2,525 ft)	1	1	.2	179	261	< 1	70
Upstream (2,525 ft)	1	1	.5	185	261	< 1	53
Upstream (2,525 ft)	1	1	.8	185	274	< 1	73
Upstream (2,525 ft)	1	2	.2	183	266	< 1	80
Upstream (2,525 ft)	1	2	.5	186	272	< 1	85
Upstream (2,525 ft)	1	2	.8	185	296	< 1	82
Upstream (2,525 ft)	1	3	.2	187	288	< 1	81
Upstream (2,525 ft)	1	3	.5	189	297	< 1	87
Upstream (2,525 ft)	1	3	.8	187	302	< 1	89
Upstream (1,925 ft)	2	1	.2	186	294	< 1	72
Upstream (1,925 ft)	2	1	.5	186	289	< 1	68
Upstream (1,925 ft)	2	1	.8	165	297	< 1	67
Upstream (1,925 ft)	2	2	.2	184	308	< 1	76
Upstream (1,925 ft)	2	2	.5	179	284	< 1	78
Upstream (1,925 ft)	2	2	.8	182	288	< 1	83
Upstream (1,925 ft)	2	3	.2	187	293	< 1	81
Upstream (1,925 ft)	2	3	.5	188	290	< 1	89
Upstream (1,925 ft)	2	3	.8	184	281	< 1	95
Outfall 005	3	1	.2	185	293	< 1	74
Outfall 005	3	1	.5	186	290	< 1	71
Outfall 005	3	1	.8	183	294	< 1	73
Outfall 005	3	2	.2	180	290	< 1	70
Outfall 005	3	2	.5	186	290	< 1	67
Outfall 005	3	2	.8	184	291	< 1	65
Outfall 005	3	3	.2	180	290	< 1	70
Outfall 005	3	3	.5	183	289	< 1	68
Outfall 005	3	3	.8	184	292	< 1	67
Downstream (50 ft)	4	1	.2	185	298	< 1	74
Downstream (50 ft)	4	1	.5	182	297	< 1	70
Downstream (50 ft)	4	1	.8	186	268	< 1	69
Downstream (50 ft)	4	2	.2	184	257	< 1	67
Downstream (50 ft)	4	2	.5	185	263	< 1	68
Downstream (50 ft)	4	2	08	179	262	< 1	74
Downstream (50 ft)	4	3	.2	186	261	< 1	76
Downstream (50 ft)	4	3	.5	182	256	< 1	76
Downstream (50 ft)	4	3	.8	186	259	< 1	78

Downstream (100 ft)	5	1	.2	184	260	< 1	76
Downstream (100 ft)	5	1	.5	184	263	< 1	76
Downstream (100 ft)	5	1	.8	273	394	< 1	269
Downstream (100 ft)	5	2	.2	184	261	< 1	70
Downstream (100 ft)	5	2	.5	185	266	< 1	79
Downstream (100 ft)	5	2	.8	186	262	< 1	79
Downstream (100 ft)	5	3	.2	186	262	< 1	68
Downstream (100 ft)	5	3	.5	181	256	< 1	79
Downstream (100 ft)	5	3	.8	180	254	< 1	83
Downstream (150 ft)	6	1	.2	184	262	< 1	72
Downstream (150 ft)	6	1	.5	185	262	< 1	69
Downstream (150 ft)	6	1	.8	185	261	< 1	70
Downstream (150 ft)	6	2	.2	185	268	< 1	77
Downstream (150 ft)	6	2	.5	186	268	< 1	86
Downstream (150 ft)	6	2	.8	187	268	< 1	87
Downstream (150 ft)	6	3	.2	190	268	< 1	92
Downstream (150 ft)	6	3	.5	189	270	< 1	91
Downstream (150 ft)	6	3	.8	183	267	< 1	93
Downstream (500 ft)	7	1	.2	183	258	< 1	70
Downstream (500 ft)	7	1	.5	186	269	< 1	76
Downstream (500 ft)	7	1	.8	185	271	< 1	71
Downstream (500 ft)	7	2	.2	185	272	< 1	71
Downstream (500 ft)	7	2	.5	184	264	< 1	82
Downstream (500 ft)	7	2	.8	185	268	< 1	86
Downstream (500 ft)	7	3	.2	188	290	< 1	86
Downstream (500 ft)	7	3	.5	187	265	< 1	87
Downstream (500 ft)	7	3	.8	189	267	< 1	84

Table A.3 Aluminum data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Al Total	1.539
	1	1	Al Total	1.409
	1	1	Al Total	1.929
	1	2	Al Total	2.174
	1	2	Al Total	2.062
	1	2	Al Total	1.972
	1	3	Al Total	2.083
	1	3	Al Total	2.185
	1	3	Al Total	2.178
	1	3	Al Total	2.196
Upstream (1,925 ft)	2	1	Al Total	1.682
	2	1	Al Total	1.592
	2	1	Al Total	1.651
	2	1	Al Total	1.603
	2	2	Al Total	2.131
	2	2	Al Total	1.94
	2	2	Al Total	1.864
	2	3	Al Total	2.186
	2	3	Al Total	2.005
	2	3	Al Total	1.567
Outfall 005	3	1	Al Total	1.357
	3	1	Al Total	1.325
	3	1	Al Total	1.63
	3	1	Al Total	1.618
	3	2	Al Total	1.368
	3	2	Al Total	1.493
	3	2	Al Total	1.488
	3	3	Al Total	1.3
	3	3	Al Total	1.627
	3	3	Al Total	1.469
Downstream (50 ft)	4	1	Al Total	1.641
	4	1	Al Total	1.59
	4	1	Al Total	1.853
	4	1	Al Total	1.919
	4	2	Al Total	1.889
	4	2	Al Total	1.784
	4	2	Al Total	1.703
	4	3	Al Total	1.741
	4	3	Al Total	1.741
	4	3	Al Total	1.818
Downstream (100 ft)	5	1	Al Total	1.637
	5	1	Al Total	1.824
	5	1	Al Total	2.326
	5	2	Al Total	1.68
	5	2	Al Total	1.84
	5	2	Al Total	1.851
	5	2	Al Total	1.712
	5	3	Al Total	1.814
	5	3	Al Total	1.871

	5	3	Al Total	1.905
Downstream (150 ft)	6	1	Al Total	1.802
	6	1	Al Total	1.945
	6	1	Al Total	1.834
	6	1	Al Total	1.781
	6	2	Al Total	2.253
	6	2	Al Total	2.378
	6	2	Al Total	2.392
	6	3	Al Total	2.569
	6	3	Al Total	2.556
	6	3	Al Total	2.595
Downstream (500 ft)	7	1	Al Total	1.962
	7	1	Al Total	1.946
	7	1	Al Total	2.041
	7	2	Al Total	2.154
	7	2	Al Total	1.883
	7	2	Al Total	1.925
	7	2	Al Total	1.906
	7	3	Al Total	2.185
	7	3	Al Total	2.213
	7	3	Al Total	2.271
Upstream (2,525 ft)	1	1	Al Dissolved	0.116
	1	1	Al Dissolved	0.156
	1	1	Al Dissolved	0.157
	1	2	Al Dissolved	<0.063
	1	2	Al Dissolved	0.196
	1	2	Al Dissolved	0.123
	1	3	Al Dissolved	0.082
	1	3	Al Dissolved	0.156
	1	3	Al Dissolved	0.208
	1	3	Al Dissolved	<0.063
Upstream (1,925 ft)	2	1	Al Dissolved	0.191
	2	1	Al Dissolved	0.135
	2	1	Al Dissolved	0.199
	2	1	Al Dissolved	0.083
	2	2	Al Dissolved	0.119
	2	2	Al Dissolved	0.107
	2	2	Al Dissolved	0.159
	2	3	Al Dissolved	0.214
	2	3	Al Dissolved	0.151
	2	3	Al Dissolved	0.246
Outfall 005	3	1	Al Dissolved	0.202
	3	1	Al Dissolved	0.248
	3	1	Al Dissolved	0.22
	3	1	Al Dissolved	0.154
	3	2	Al Dissolved	0.166
	3	2	Al Dissolved	0.205
	3	2	Al Dissolved	0.225
	3	3	Al Dissolved	0.195
	3	3	Al Dissolved	0.24
	3	3	Al Dissolved	0.288
Downstream (50 ft)	4	1	Al Dissolved	0.217
	4	1	Al Dissolved	0.275
	4	1	Al Dissolved	0.111

	4	1	Al Dissolved	0.141
	4	2	Al Dissolved	0.115
	4	2	Al Dissolved	0.157
	4	2	Al Dissolved	0.133
	4	3	Al Dissolved	0.137
	4	3	Al Dissolved	0.078
	4	3	Al Dissolved	0.1
Downstream (100 ft)	5	1	Al Dissolved	0.147
	5	1	Al Dissolved	0.117
	5	1	Al Dissolved	0.182
	5	2	Al Dissolved	0.152
	5	2	Al Dissolved	0.114
	5	2	Al Dissolved	0.143
	5	2	Al Dissolved	0.167
	5	3	Al Dissolved	0.173
	5	3	Al Dissolved	0.18
	5	3	Al Dissolved	0.156
Downstream (150 ft)	6	1	Al Dissolved	0.176
	6	1	Al Dissolved	0.103
	6	1	Al Dissolved	0.099
	6	1	Al Dissolved	0.145
	6	2	Al Dissolved	0.146
	6	2	Al Dissolved	0.126
	6	2	Al Dissolved	0.209
	6	3	Al Dissolved	0.172
	6	3	Al Dissolved	0.176
	6	3	Al Dissolved	0.072
Downstream (500 ft)	7	1	Al Dissolved	0.183
	7	1	Al Dissolved	0.099
	7	1	Al Dissolved	0.183
	7	2	Al Dissolved	0.116
	7	2	Al Dissolved	<0.063
	7	2	Al Dissolved	<0.063
	7	2	Al Dissolved	<0.063
	7	3	Al Dissolved	<0.063
	7	3	Al Dissolved	0.072
	7	3	Al Dissolved	<0.063

Table A.4. Calcium data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Ca Total	62.996
	1	1	Ca Total	62.327
	1	1	Ca Total	64.267
	1	2	Ca Total	63.321
	1	2	Ca Total	64.829
	1	2	Ca Total	71.127
	1	3	Ca Total	69.495
	1	3	Ca Total	70.517
	1	3	Ca Total	70.859
	1	3	Ca Total	72.247
Upstream (1,925 ft)	2	1	Ca Total	70.044
	2	1	Ca Total	67.913
	2	1	Ca Total	69.034
	2	1	Ca Total	70.242
	2	2	Ca Total	71.432
	2	2	Ca Total	67.897
	2	2	Ca Total	67.802
	2	3	Ca Total	69.698
	2	3	Ca Total	68.68
	2	3	Ca Total	66.75
Outfall 005	3	1	Ca Total	69.757
	3	1	Ca Total	68.572
	3	1	Ca Total	69.138
	3	1	Ca Total	69.643
	3	2	Ca Total	68.986
	3	2	Ca Total	69.51
	3	2	Ca Total	68.524
	3	3	Ca Total	69.251
	3	3	Ca Total	68.136
	3	3	Ca Total	71.155
Downstream (50 ft)	4	1	Ca Total	71.415
	4	1	Ca Total	71.12
	4	1	Ca Total	61.36
	4	1	Ca Total	63.102
	4	2	Ca Total	60.162
	4	2	Ca Total	61.482
	4	2	Ca Total	62.553
	4	3	Ca Total	62.718
	4	3	Ca Total	60.634
	4	3	Ca Total	60.784
Downstream (100 ft)	5	1	Ca Total	61.857
	5	1	Ca Total	61.688
	5	1	Ca Total	101.949
	5	2	Ca Total	61.716
	5	2	Ca Total	62.908
	5	2	Ca Total	62.266
	5	2	Ca Total	61.221

	5	3	Ca Total	62.009
	5	3	Ca Total	60.635
	5	3	Ca Total	60.338
Downstream (150 ft)	6	1	Ca Total	61.949
	6	1	Ca Total	61.617
	6	1	Ca Total	61.585
	6	1	Ca Total	61.914
	6	2	Ca Total	63.65
	6	2	Ca Total	63.71
	6	2	Ca Total	63.423
	6	3	Ca Total	63.548
	6	3	Ca Total	63.329
	6	3	Ca Total	63.602
Downstream (500 ft)	7	1	Ca Total	61.279
	7	1	Ca Total	63.414
	7	1	Ca Total	64.603
	7	2	Ca Total	64.122
	7	2	Ca Total	62.257
	7	2	Ca Total	60.986
	7	2	Ca Total	63.654
	7	3	Ca Total	72.752
	7	3	Ca Total	62.364
	7	3	Ca Total	63.359
Upstream (2,525 ft)	1	1	Ca Dissolved	64.605
	1	1	Ca Dissolved	74.708
	1	1	Ca Dissolved	66.291
	1	2	Ca Dissolved	66.459
	1	2	Ca Dissolved	100.093
	1	2	Ca Dissolved	64.638
	1	3	Ca Dissolved	67.36
	1	3	Ca Dissolved	67.768
	1	3	Ca Dissolved	66.436
	1	3	Ca Dissolved	73.712
Upstream (1,925 ft)	2	1	Ca Dissolved	66.267
	2	1	Ca Dissolved	64.775
	2	1	Ca Dissolved	64.586
	2	1	Ca Dissolved	64.374
	2	2	Ca Dissolved	64.389
	2	2	Ca Dissolved	66.041
	2	2	Ca Dissolved	69.167
	2	3	Ca Dissolved	68.621
	2	3	Ca Dissolved	68.565
	2	3	Ca Dissolved	70.4
Outfall 005	3	1	Ca Dissolved	65.559
	3	1	Ca Dissolved	65.946
	3	1	Ca Dissolved	66.377
	3	1	Ca Dissolved	66.197
	3	2	Ca Dissolved	66.341
	3	2	Ca Dissolved	68.071
	3	2	Ca Dissolved	68.316
	3	3	Ca Dissolved	66.502
	3	3	Ca Dissolved	67.949
	3	3	Ca Dissolved	68.153
Downstream (50 ft)	4	1	Ca Dissolved	66.746

	4	1	Ca Dissolved	67.656
	4	1	Ca Dissolved	63.792
	4	1	Ca Dissolved	65.168
	4	2	Ca Dissolved	64.181
	4	2	Ca Dissolved	66.732
	4	2	Ca Dissolved	63.891
	4	3	Ca Dissolved	62.477
	4	3	Ca Dissolved	63.376
	4	3	Ca Dissolved	63.039
Downstream (100 ft)	5	1	Ca Dissolved	62.293
	5	1	Ca Dissolved	64.225
	5	1	Ca Dissolved	48.435
	5	2	Ca Dissolved	61.846
	5	2	Ca Dissolved	63.692
	5	2	Ca Dissolved	65.378
	5	2	Ca Dissolved	63.807
	5	3	Ca Dissolved	65.789
	5	3	Ca Dissolved	61.98
	5	3	Ca Dissolved	64.353
Downstream (150 ft)	6	1	Ca Dissolved	64.318
	6	1	Ca Dissolved	61.46
	6	1	Ca Dissolved	63.491
	6	1	Ca Dissolved	63.023
	6	2	Ca Dissolved	61.897
	6	2	Ca Dissolved	65.005
	6	2	Ca Dissolved	62.241
	6	3	Ca Dissolved	64.826
	6	3	Ca Dissolved	66.612
	6	3	Ca Dissolved	64.05
Downstream (500 ft)	7	1	Ca Dissolved	64.331
	7	1	Ca Dissolved	63.825
	7	1	Ca Dissolved	62.817
	7	2	Ca Dissolved	64.012
	7	2	Ca Dissolved	61.67
	7	2	Ca Dissolved	59.77
	7	2	Ca Dissolved	60.629
	7	3	Ca Dissolved	62.65
	7	3	Ca Dissolved	62.518
	7	3	Ca Dissolved	62.175

Table A.5. Copper data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Cu Total	<0.008
	1	1	Cu Total	0.008
	1	1	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	3	Cu Total	<0.008
Upstream (1,925 ft)	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
Outfall 005	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
Downstream (50 ft)	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	0.008
Downstream (100 ft)	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	0.008
	5	2	Cu Total	<0.008
	5	3	Cu Total	<0.008
	5	3	Cu Total	<0.008

	5	3	Cu Total	<0.008
Downstream (150 ft)	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	2	Cu Total	0.008
	6	2	Cu Total	<0.008
	6	2	Cu Total	<0.008
	6	3	Cu Total	0.008
	6	3	Cu Total	0.008
	6	3	Cu Total	<0.008
Downstream (500 ft)	7	1	Cu Total	<0.008
	7	1	Cu Total	0.009
	7	1	Cu Total	<0.008
	7	2	Cu Total	0.012
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
Upstream (2,525 ft)	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
Upstream (1,925 ft)	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
Outfall 005	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
Downstream (50 ft)	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008

	4	1	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
Downstream (100 ft)	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
Downstream (150 ft)	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
Downstream (500 ft)	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008

Table A.6. Iron data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Fe Total	1.599
	1	1	Fe Total	1.464
	1	1	Fe Total	1.94
	1	2	Fe Total	2.238
	1	2	Fe Total	2.197
	1	2	Fe Total	2.354
	1	3	Fe Total	2.401
	1	3	Fe Total	2.497
	1	3	Fe Total	2.452
	1	3	Fe Total	2.521
Upstream (1,925 ft)	2	1	Fe Total	1.865
	2	1	Fe Total	1.741
	2	1	Fe Total	1.824
	2	1	Fe Total	1.825
	2	2	Fe Total	2.352
	2	2	Fe Total	2.11
	2	2	Fe Total	2.094
	2	3	Fe Total	2.432
	2	3	Fe Total	2.285
	2	3	Fe Total	1.768
Outfall 005	3	1	Fe Total	1.469
	3	1	Fe Total	1.433
	3	1	Fe Total	1.774
	3	1	Fe Total	1.788
	3	2	Fe Total	1.5
	3	2	Fe Total	1.675
	3	2	Fe Total	1.594
	3	3	Fe Total	1.454
	3	3	Fe Total	1.773
	3	3	Fe Total	1.704
Downstream (50 ft)	4	1	Fe Total	1.811
	4	1	Fe Total	1.83
	4	1	Fe Total	1.666
	4	1	Fe Total	1.714
	4	2	Fe Total	1.673
	4	2	Fe Total	1.608
	4	2	Fe Total	1.554
	4	3	Fe Total	1.555
	4	3	Fe Total	1.529
	4	3	Fe Total	1.597
Downstream (100 ft)	5	1	Fe Total	1.469
	5	1	Fe Total	1.597
	5	1	Fe Total	1.987
	5	2	Fe Total	1.521
	5	2	Fe Total	1.647
	5	2	Fe Total	1.633
	5	2	Fe Total	1.585

	5	3	Fe Total	1.645
	5	3	Fe Total	1.649
	5	3	Fe Total	1.697
Downstream (150 ft)	6	1	Fe Total	1.554
	6	1	Fe Total	1.767
	6	1	Fe Total	1.692
	6	1	Fe Total	1.622
	6	2	Fe Total	2.065
	6	2	Fe Total	2.18
	6	2	Fe Total	2.243
	6	3	Fe Total	2.394
	6	3	Fe Total	2.385
	6	3	Fe Total	2.44
Downstream (500 ft)	7	1	Fe Total	1.754
	7	1	Fe Total	1.796
	7	1	Fe Total	1.824
	7	2	Fe Total	1.973
	7	2	Fe Total	2.004
	7	2	Fe Total	2.01
	7	2	Fe Total	2.033
	7	3	Fe Total	2.285
	7	3	Fe Total	2.322
	7	3	Fe Total	2.41
Upstream (2,525 ft)	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
Upstream (1,925 ft)	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
Outfall 005	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
Downstream (50 ft)	4	1	Fe Dissolved	<0.063

	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
Downstream (100 ft)	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
Downstream (150 ft)	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
Downstream (500 ft)	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063

Table A.7. Magnesium data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Mg Total	25.235
	1	1	Mg Total	25.516
	1	1	Mg Total	27.458
	1	2	Mg Total	26.208
	1	2	Mg Total	26.644
	1	2	Mg Total	28.732
	1	3	Mg Total	27.864
	1	3	Mg Total	29.31
	1	3	Mg Total	29.175
	1	3	Mg Total	29.417
Upstream (1,925 ft)	2	1	Mg Total	28.914
	2	1	Mg Total	28.523
	2	1	Mg Total	28.373
	2	1	Mg Total	29.409
	2	2	Mg Total	31.561
	2	2	Mg Total	27.893
	2	2	Mg Total	28.898
	2	3	Mg Total	28.867
	2	3	Mg Total	28.728
	2	3	Mg Total	27.77
Outfall 005	3	1	Mg Total	28.817
	3	1	Mg Total	27.486
	3	1	Mg Total	28.504
	3	1	Mg Total	29.197
	3	2	Mg Total	28.489
	3	2	Mg Total	28.289
	3	2	Mg Total	29.057
	3	3	Mg Total	28.436
	3	3	Mg Total	28.807
	3	3	Mg Total	27.795
Downstream (50 ft)	4	1	Mg Total	29.18
	4	1	Mg Total	29.017
	4	1	Mg Total	26.282
	4	1	Mg Total	26.859
	4	2	Mg Total	26.036
	4	2	Mg Total	26.627
	4	2	Mg Total	25.794
	4	3	Mg Total	25.378
	4	3	Mg Total	25.334
	4	3	Mg Total	26.035
Downstream (100 ft)	5	1	Mg Total	25.602
	5	1	Mg Total	26.579
	5	1	Mg Total	33.941
	5	2	Mg Total	25.924
	5	2	Mg Total	26.377
	5	2	Mg Total	25.756
	5	2	Mg Total	25.709
	5	3	Mg Total	26.057
	5	3	Mg Total	25.41

	5	3	Mg Total	25.163
Downstream (150 ft)	6	1	Mg Total	26.083
	6	1	Mg Total	26.242
	6	1	Mg Total	26.136
	6	1	Mg Total	25.357
	6	2	Mg Total	26.564
	6	2	Mg Total	26.501
	6	2	Mg Total	26.522
	6	3	Mg Total	26.511
	6	3	Mg Total	27.121
	6	3	Mg Total	26.348
Downstream (500 ft)	7	1	Mg Total	25.434
	7	1	Mg Total	26.956
	7	1	Mg Total	26.578
	7	2	Mg Total	27.283
	7	2	Mg Total	26.294
	7	2	Mg Total	26.151
	7	2	Mg Total	26.472
	7	3	Mg Total	26.296
	7	3	Mg Total	26.536
	7	3	Mg Total	26.372
Upstream (2,525 ft)	1	1	Mg Dissolved	27.478
	1	1	Mg Dissolved	30.127
	1	1	Mg Dissolved	28.015
	1	2	Mg Dissolved	27.407
	1	2	Mg Dissolved	27.511
	1	2	Mg Dissolved	26.688
	1	3	Mg Dissolved	27.445
	1	3	Mg Dissolved	28.516
	1	3	Mg Dissolved	27.672
	1	3	Mg Dissolved	29.614
Upstream (1,925 ft)	2	1	Mg Dissolved	26.962
	2	1	Mg Dissolved	26.596
	2	1	Mg Dissolved	28.817
	2	1	Mg Dissolved	26.329
	2	2	Mg Dissolved	27.444
	2	2	Mg Dissolved	27.172
	2	2	Mg Dissolved	28.741
	2	3	Mg Dissolved	27.924
	2	3	Mg Dissolved	28.246
	2	3	Mg Dissolved	28.605
Outfall 005	3	1	Mg Dissolved	27.275
	3	1	Mg Dissolved	28.625
	3	1	Mg Dissolved	28.131
	3	1	Mg Dissolved	27.75
	3	2	Mg Dissolved	27.433
	3	2	Mg Dissolved	29.205
	3	2	Mg Dissolved	27.804
	3	3	Mg Dissolved	27.991
	3	3	Mg Dissolved	28.945
	3	3	Mg Dissolved	29.586
Downstream (50 ft)	4	1	Mg Dissolved	28.982
	4	1	Mg Dissolved	28.496
	4	1	Mg Dissolved	26.588

	4	1	Mg Dissolved	26.407
	4	2	Mg Dissolved	26.406
	4	2	Mg Dissolved	26.018
	4	2	Mg Dissolved	26.114
	4	3	Mg Dissolved	25.768
	4	3	Mg Dissolved	26.386
	4	3	Mg Dissolved	27.191
Downstream (100 ft)	5	1	Mg Dissolved	26.479
	5	1	Mg Dissolved	26.699
	5	1	Mg Dissolved	32.214
	5	2	Mg Dissolved	25.382
	5	2	Mg Dissolved	26.257
	5	2	Mg Dissolved	26.404
	5	2	Mg Dissolved	26.146
	5	3	Mg Dissolved	25.831
	5	3	Mg Dissolved	25.833
	5	3	Mg Dissolved	26.203
Downstream (150 ft)	6	1	Mg Dissolved	26.882
	6	1	Mg Dissolved	25.178
	6	1	Mg Dissolved	26.039
	6	1	Mg Dissolved	26
	6	2	Mg Dissolved	25.521
	6	2	Mg Dissolved	25.126
	6	2	Mg Dissolved	25.814
	6	3	Mg Dissolved	26.06
	6	3	Mg Dissolved	26.122
	6	3	Mg Dissolved	25.079
Downstream (500 ft)	7	1	Mg Dissolved	26.948
	7	1	Mg Dissolved	25.925
	7	1	Mg Dissolved	27.129
	7	2	Mg Dissolved	26.187
	7	2	Mg Dissolved	28.128
	7	2	Mg Dissolved	25.644
	7	2	Mg Dissolved	26.893
	7	3	Mg Dissolved	26.824
	7	3	Mg Dissolved	26.44
	7	3	Mg Dissolved	26.758

Table A.8. Manganese data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)				
	1	1	Mn Total	0.134
	1	1	Mn Total	0.131
	1	1	Mn Total	0.159
	1	2	Mn Total	0.17
	1	2	Mn Total	0.168
	1	2	Mn Total	0.176
	1	3	Mn Total	0.175
	1	3	Mn Total	0.186
	1	3	Mn Total	0.176
	1	3	Mn Total	0.181
Upstream (1,925 ft)				
	2	1	Mn Total	0.152
	2	1	Mn Total	0.146
	2	1	Mn Total	0.15
	2	1	Mn Total	0.152
	2	2	Mn Total	0.177
	2	2	Mn Total	0.165
	2	2	Mn Total	0.164
	2	3	Mn Total	0.177
	2	3	Mn Total	0.167
	2	3	Mn Total	0.142
Outfall 005				
	3	1	Mn Total	0.134
	3	1	Mn Total	0.13
	3	1	Mn Total	0.149
	3	1	Mn Total	0.153
	3	2	Mn Total	0.136
	3	2	Mn Total	0.147
	3	2	Mn Total	0.141
	3	3	Mn Total	0.129
	3	3	Mn Total	0.148
	3	3	Mn Total	0.146
Downstream (50 ft)				
	4	1	Mn Total	0.154
	4	1	Mn Total	0.156
	4	1	Mn Total	0.138
	4	1	Mn Total	0.141
	4	2	Mn Total	0.138
	4	2	Mn Total	0.136
	4	2	Mn Total	0.132
	4	3	Mn Total	0.132
	4	3	Mn Total	0.13
	4	3	Mn Total	0.137
Downstream (100 ft)				
	5	1	Mn Total	0.128

	5	1	Mn Total	0.137
	5	1	Mn Total	0.168
	5	2	Mn Total	0.132
	5	2	Mn Total	0.139
	5	2	Mn Total	0.139
	5	2	Mn Total	0.134
	5	3	Mn Total	0.138
	5	3	Mn Total	0.138
	5	3	Mn Total	0.14
Downstream (150 ft)				
	6	1	Mn Total	0.134
	6	1	Mn Total	0.141
	6	1	Mn Total	0.139
	6	1	Mn Total	0.134
	6	2	Mn Total	0.16
	6	2	Mn Total	0.165
	6	2	Mn Total	0.166
	6	3	Mn Total	0.171
	6	3	Mn Total	0.174
	6	3	Mn Total	0.177
Downstream (500 ft)				
	7	1	Mn Total	0.145
	7	1	Mn Total	0.147
	7	1	Mn Total	0.148
	7	2	Mn Total	0.158
	7	2	Mn Total	0.15
	7	2	Mn Total	0.151
	7	2	Mn Total	0.153
	7	3	Mn Total	0.162
	7	3	Mn Total	0.165
	7	3	Mn Total	0.166
Upstream (2,525 ft)				
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
Upstream (1,925 ft)				
	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006

	2	3	Mn Dissolved	<0.006
Outfall 005				
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
Downstream (50 ft)				
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
Downstream (100 ft)				
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
Downstream (150 ft)				
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
Downstream (500 ft)				
	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006

	7	2	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
Upstream (2,525 ft)				
	7	3	Mn Dissolved	<0.006

Table A.9. Nickel data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	3	Ni Total	<0.019
Upstream (1,925 ft)	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
Outfall 005	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
Downstream (50 ft)	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
Downstream (100 ft)	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	3	Ni Total	<0.019
	5	3	Ni Total	<0.019

	5	3	Ni Total	<0.019
Downstream (150 ft)	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
Downstream (500 ft)	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
Upstream 001 (675ft)	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
Upstream (1,925 ft)	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
Outfall 005	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
Downstream (50 ft)	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019

	4	1	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
Downstream (100 ft)	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
Downstream (150 ft)	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
Downstream (500 ft)	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019

Table A.10. Selenium data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	3	Se Total	<0.063
	1	3	Se Total	<0.063
	1	3	Se Total	<0.063
	1	3	Se Total	<0.063
Upstream (1,925 ft)	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
Outfall 005	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
Downstream (50 ft)	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063
Downstream (100 ft)	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	3	Se Total	<0.063
	5	3	Se Total	<0.063

	5	3	Se Total	<0.063
Downstream (150 ft)	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
Downstream (500 ft)	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
Upstream (2,525 ft)	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
Upstream (1,925 ft)	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
Outfall 005	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
Downstream (50 ft)	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063

	4	1	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
Downstream (100 ft)	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
Downstream (150 ft)	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
Downstream (500 ft)	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063

Table A.11. Zinc data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream- (2,525ft)	1	1	Zn Total	0.011
	1	1	Zn Total	0.008
	1	1	Zn Total	0.011
	1	2	Zn Total	0.01
	1	2	Zn Total	0.009
	1	2	Zn Total	0.011
	1	3	Zn Total	0.016
	1	3	Zn Total	0.011
	1	3	Zn Total	0.013
	1	3	Zn Total	0.012
Upstream (1,925ft)	2	1	Zn Total	0.011
	2	1	Zn Total	0.008
	2	1	Zn Total	0.009
	2	1	Zn Total	0.01
	2	2	Zn Total	0.012
	2	2	Zn Total	0.009
	2	2	Zn Total	0.01
	2	3	Zn Total	0.031
	2	3	Zn Total	0.01
	2	3	Zn Total	0.007
OUTFALL 005	3	1	Zn Total	0.009
	3	1	Zn Total	<0.006
	3	1	Zn Total	0.006
	3	1	Zn Total	0.007
	3	2	Zn Total	0.007
	3	2	Zn Total	0.009
	3	2	Zn Total	0.007
	3	3	Zn Total	0.008
	3	3	Zn Total	0.01
	3	3	Zn Total	0.007
Downstream (50ft)	4	1	Zn Total	0.008
	4	1	Zn Total	0.007
	4	1	Zn Total	0.009
	4	1	Zn Total	0.012
	4	2	Zn Total	0.012
	4	2	Zn Total	0.012
	4	2	Zn Total	0.01
	4	3	Zn Total	0.013
	4	3	Zn Total	0.01
	4	3	Zn Total	0.011
Downstream (100 ft)	5	1	Zn Total	0.011
	5	1	Zn Total	0.01
	5	1	Zn Total	0.014
	5	2	Zn Total	0.01
	5	2	Zn Total	0.012
	5	2	Zn Total	0.011
	5	2	Zn Total	0.01
	5	3	Zn Total	0.012
	5	3	Zn Total	0.01

	5	3	Zn Total	0.01
Downstream (150 ft)	6	1	Zn Total	0.015
	6	1	Zn Total	0.011
	6	1	Zn Total	0.009
	6	1	Zn Total	0.01
	6	2	Zn Total	0.014
	6	2	Zn Total	0.012
	6	2	Zn Total	0.014
	6	3	Zn Total	0.019
	6	3	Zn Total	0.015
	6	3	Zn Total	0.012
Downstream (500 ft)	7	1	Zn Total	0.013
	7	1	Zn Total	0.012
	7	1	Zn Total	0.014
	7	2	Zn Total	0.014
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	3	Zn Total	0.007
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
Upstream (2,525ft)	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
Upstream (1,925 ft)	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	0.007
	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	3	Zn Dissolved	0.009
	2	3	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
Outfall 005	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
Downstream (50 ft)	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006

	4	1	Zn Dissolved	<0.006
	4	2	Zn Dissolved	0.064
	4	2	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
Downstream (100 ft)	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
Downstream (150 ft)	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
Downstream (500 ft)	7	1	Zn Dissolved	<0.006
	7	1	Zn Dissolved	<0.006
	7	1	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	3	Zn Dissolved	<0.006
	7	3	Zn Dissolved	<0.006
	7	3	Zn Dissolved	<0.006

APPENDIX B

PLATTE SOUTH WATER TREATMENT PLANT

MISSOURI RIVER WATER QUALITY

Table B.1. Sonde data Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No#	Position along Transect	Depth (Fraction of Total Depth)	Specific Conductance (mS/m)	Dissolved O_2 (mg/L)	pH (SU)	Temp (^oC)
Upstream (375 ft)	1	1	.2	0.869	7.62	8.44	25.31
Upstream (375 ft)	1	1	.5	0.869	7.82	8.41	25.29
Upstream (375 ft)	1	1	.8	0.869	7.98	8.36	25.3
Upstream (375 ft)	1	2	.2	0.867	7.71	8.47	25.4
Upstream (375 ft)	1	2	.5	0.867	7.85	8.44	25.39
Upstream (375 ft)	1	2	.8	0.867	8.28	8.37	25.39
Upstream (375 ft)	1	3	.2	0.865	7.54	8.5	25.42
Upstream (375 ft)	1	3	.8	0.866	7.95	8.43	25.41
Upstream (125 ft)	2	1	.2	0.869	8.53	8.47	25.29
Upstream (125 ft)	2	1	.5	0.869	9.53	8.41	25.27
Upstream (125 ft)	2	1	.8	0.871	8.43	8.45	25.15
Upstream (125 ft)	2	2	.2	0.866	7.54	8.49	25.42
Upstream (125 ft)	2	2	.5	0.866	7.56	8.48	25.42
Upstream (125 ft)	2	2	.8	0.866	7.49	8.45	25.42
Upstream (125 ft)	2	3	.2	0.865	7.7	8.47	25.42
Upstream (125 ft)	2	3	.5	0.865	8.08	8.41	25.41
Upstream (125 ft)	2	3	.8	0.846	8.19	8.35	25.23
Downstream (50 ft)	3	1	.2	0.875	7.58	8.47	24.88
Downstream (50 ft)	3	1	.5	0.875	7.75	8.42	24.88
Downstream (50 ft)	3	1	.8	0.826	8.74	8.42	24.81
Downstream (50 ft)	3	2	.2	0.867	7.47	8.5	25.36
Downstream (50 ft)	3	2	.5	0.867	7.54	8.48	25.35
Downstream (50 ft)	3	2	.8	0.868	7.62	8.41	25.35
Downstream (50 ft)	3	3	.2	0.912	8.67	8.52	22.8
Downstream (50 ft)	3	3	.5	0.913	9.86	8.46	22.68
Downstream (50 ft)	3	3	.8	0.98	11.44	8.47	18.5
Downstream (100 ft)	4	1	.2	0.866	7.82	8.53	25.32
Downstream (100 ft)	4	1	.5	0.865	7.95	8.55	25.32
Downstream (100 ft)	4	1	.8	0.864	9.59	8.58	25.32
Downstream (100 ft)	4	2	.2	0.867	8.37	8.53	25.4
Downstream (100 ft)	4	2	.5	0.804	8.77	8.43	24.28
Downstream (100 ft)	4	2	.8	0.867	9.74	8.45	25.36

Downstream (100 ft)	4	3	.2	0.865	7.49	8.52	25.52
Downstream (100 ft)	4	3	.5	0.865	7.69	8.48	25.5
Downstream (100 ft)	4	3	.8	0.867	8.31	8.47	25.34
Downstream (125 ft)	5	1	.2	0.868	7.75	8.53	25.41
Downstream (125 ft)	5	1	.5	0.868	7.72	8.51	25.41
Downstream (125 ft)	5	1	.8	0.868	7.75	8.48	25.39
Downstream (125 ft)	5	2	.2	0.879	8.01	8.53	24.77
Downstream (125 ft)	5	2	.5	0.879	8.57	8.5	24.75
Downstream (125 ft)	5	2	.8	0.879	8.76	8.45	24.78
Downstream (125 ft)	5	3	.2	0.866	8.45	8.54	25.54
Downstream (125 ft)	5	3	.5	0.866	8.72	8.52	25.52
Downstream (125 ft)	5	3	.8	0.866	8.76	8.48	25.51
Downstream (200 ft)	6	1	.2	0.866	7.91	8.55	25.53
Downstream (200 ft)	6	1	.5	0.867	7.91	8.5	25.52
Downstream (200 ft)	6	1	.8	0.867	8.51	8.48	25.51
Downstream (200 ft)	6	2	.2	0.864	7.71	8.56	25.65
Downstream (200 ft)	6	2	.5	0.864	7.87	8.54	25.65
Downstream (200 ft)	6	2	.8	0.864	7.91	8.49	25.63
Downstream (200 ft)	6	3	.2	0.867	7.99	8.54	25.49
Downstream (200 ft)	6	3	.5	0.867	8.01	8.51	25.49
Downstream (200 ft)	6	3	.8	0.868	8.1	8.48	25.5
Downstream (400 ft)	7	1	.2	0.929	9.35	8.55	22.05
Downstream (400 ft)	7	1	.5	0.918	9.29	8.51	22.66
Downstream (400 ft)	7	1	.8	0.922	10.04	8.51	22.57
Downstream (400 ft)	7	2	.2	0.867	7.84	8.55	25.52
Downstream (400 ft)	7	2	.5	0.867	7.81	8.53	25.53
Downstream (400 ft)	7	2	.8	0.867	8.05	8.48	25.52
Downstream (400 ft)	7	3	.2	0.865	7.9	8.57	25.64
Downstream (400 ft)	7	3	.5	0.866	8	8.55	25.64
Downstream (400 ft)	7	3	.8	0.865	8	8.5	25.64

Table B. 2. Solids, alkalinity, and hardness data Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No	Position along Transect	Depth (Fraction of Total Depth)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)	Settable Solids (mg/L)	TSS (mg/L)
Upstream (375 ft)	1	1	.2	182	261	< 1	99
Upstream (375 ft)	1	1	.5	184	256	< 1	104
Upstream (375 ft)	1	1	.8	183	259	< 1	94
Upstream (375 ft)	1	2	.2	182	272	< 1	169
Upstream (375 ft)	1	2	.5	183	265	< 1	88
Upstream (375 ft)	1	2	.8	181	257	< 1	98
Upstream (375 ft)	1	3	.2	184	264	< 1	142
Upstream (375 ft)	1	3	.8	180	261	< 1	151
Upstream (125 ft)	2	1	.2	182	263	< 1	95
Upstream (125 ft)	2	1	.5	181	261	< 1	93
Upstream (125 ft)	2	1	.8	183	262	< 1	98
Upstream (125 ft)	2	2	.2	181	263	< 1	108
Upstream (125 ft)	2	2	.5	179	254	< 1	102
Upstream (125 ft)	2	2	.8	180	265	< 1	99
Upstream (125 ft)	2	3	.2	184	253	< 1	163
Upstream (125 ft)	2	3	.5	182	264	< 1	91
Upstream (125 ft)	2	3	.8	183	260	< 1	97
Downstream (50 ft)	3	1	.2	186	267	< 1	97
Downstream (50 ft)	3	1	.5	182	267	< 1	103
Downstream (50 ft)	3	1	.8	185	266	< 1	93
Downstream (50 ft)	3	2	.2	183	260	< 1	91
Downstream (50 ft)	3	2	.5	184	254	< 1	75
Downstream (50 ft)	3	2	.8	182	268	< 1	89
Downstream (50 ft)	3	3	.2	182	274	< 1	88
Downstream (50 ft)	3	3	.5	184	271	< 1	87
Downstream (50 ft)	3	3	.8	185	273	< 1	92
Downstream (100 ft)	4	1	.2	187	279	< 1	105
Downstream (100 ft)	4	1	.5	183	274	< 1	94
Downstream (100 ft)	4	1	.8	182	260	< 1	95
Downstream (100 ft)	4	2	.2	180	255	< 1	101
Downstream (100 ft)	4	2	.5	184	270	< 1	97
Downstream (100 ft)	4	2	.8	185	266	< 1	100
Downstream (100 ft)	4	3	.2	178	266	< 1	90
Downstream (100 ft)	4	3	.5	183	259	< 1	85
Downstream (100 ft)	4	3	.8	183	266	< 1	88
Downstream (125 ft)	5	1	.2	183	261	< 1	96

Downstream (125 ft)	5	1	.5	184	268	< 1	93
Downstream (125 ft)	5	1	.8	188	259	< 1	90
Downstream (125 ft)	5	2	.2	184	254	< 1	85
Downstream (125 ft)	5	2	.5	181	266	< 1	84
Downstream (125 ft)	5	2	.8	184	261	< 1	93
Downstream (125 ft)	5	3	.2	181	283	< 1	88
Downstream (125 ft)	5	3	.5	181	284	< 1	91
Downstream (125 ft)	5	3	.8	187	277	< 1	99
Downstream (200 ft)	6	1	.2	180	286	< 1	82
Downstream (200 ft)	6	1	.5	177	276	< 1	90
Downstream (200 ft)	6	1	.8	180	262	< 1	90
Downstream (200 ft)	6	2	.2	182	270	< 1	82
Downstream (200 ft)	6	2	.5	184	284	< 1	108
Downstream (200 ft)	6	2	.8	183	272	< 1	97
Downstream (200 ft)	6	3	.2	182	282	< 1	97
Downstream (200 ft)	6	3	.5	181	268	< 1	101
Downstream (200 ft)	6	3	.8	184	272	< 1	104
Downstream (400 ft)	7	1	.2	181	259	< 1	84
Downstream (400 ft)	7	1	.5	182	258	< 1	86
Downstream (400 ft)	7	1	.8	180	258	< 1	89
Downstream (400 ft)	7	2	.2	182	260	< 1	82
Downstream (400 ft)	7	2	.5	180	264	< 1	83
Downstream (400 ft)	7	2	.8	182	263	< 1	105
Downstream (400 ft)	7	3	.2	185	264	< 1	151
Downstream (400 ft)	7	3	.5	185	259	< 1	100
Downstream (400 ft)	7	3	.8	182	266	< 1	86

Table B.3. Aluminum data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Al Total	0.464
	1	1	Al Total	0.396
	1	1	Al Total	0.384
	1	1	Al Total	0.338
	1	2	Al Total	0.509
	1	2	Al Total	0.477
	1	2	Al Total	0.441
	1	3	Al Total	0.429
	1	2	Al Total	0.406
	1	3	Al Total	0.398
Upstream (125 ft)	2	1	Al Total	0.393
	2	1	Al Total	0.446
	2	1	Al Total	0.385
	2	1	Al Total	0.47
	2	2	Al Total	0.408
	2	2	Al Total	0.388
	2	2	Al Total	0.459
	2	3	Al Total	0.483
	2	3	Al Total	0.501
	2	3	Al Total	0.515
Downstream (50 ft)	3	1	Al Total	0.446
	3	1	Al Total	0.422
	3	1	Al Total	0.513
	3	2	Al Total	0.462
	3	2	Al Total	0.526
	3	2	Al Total	0.518
	3	2	Al Total	0.579
	3	3	Al Total	0.587
	3	3	Al Total	0.585
	3	3	Al Total	0.657
Downstream (100 ft)	4	1	Al Total	0.687
	4	1	Al Total	0.646
	4	1	Al Total	0.628
	4	2	Al Total	0.653
	4	2	Al Total	0.555
	4	2	Al Total	0.575
	4	3	Al Total	1.04
	4	3	Al Total	1.032
	4	3	Al Total	1.025

	4	3	Al Total	1.106
Downstream (125 ft)	5	1	Al Total	1.083
	5	1	Al Total	1.128
	5	1	Al Total	1.117
	5	1	Al Total	1.123
	5	2	Al Total	1.12
	5	2	Al Total	1.094
	5	2	Al Total	1.044
	5	3	Al Total	1.051
	5	3	Al Total	1.197
	5	3	Al Total	1.101
Downstream (200 ft)	6	1	Al Total	1.095
	6	1	Al Total	1.112
	6	1	Al Total	0.963
	6	2	Al Total	0.942
	6	2	Al Total	1.117
	6	2	Al Total	0.734
	6	3	Al Total	0.674
	6	3	Al Total	0.729
	6	3	Al Total	0.661
	6	3	Al Total	0.626
Downstream (400 ft)	7	1	Al Total	0.673
	7	1	Al Total	0.702
	7	1	Al Total	0.608
	7	2	Al Total	0.659
	7	2	Al Total	0.61
	7	2	Al Total	0.544
	7	3	Al Total	0.659
	7	3	Al Total	0.817
	7	3	Al Total	0.804
	7	3	Al Total	0.683
Upstream (375 ft)	1	1	Al Dissolved	0.112
	1	1	Al Dissolved	0.115
	1	1	Al Dissolved	0.117
	1	1	Al Dissolved	0.12
	1	2	Al Dissolved	0.1
	1	2	Al Dissolved	0.082
	1	2	Al Dissolved	<0.063
	1	3	Al Dissolved	0.152
	1	2	Al Dissolved	<0.063
	1	3	Al Dissolved	<0.063
Upstream (125 ft)	2	1	Al Dissolved	0.118
	2	1	Al Dissolved	0.065

	2	1	Al Dissolved	0.147
	2	1	Al Dissolved	0.109
	2	2	Al Dissolved	0.162
	2	2	Al Dissolved	0.078
	2	2	Al Dissolved	<0.063
	2	3	Al Dissolved	0.234
	2	3	Al Dissolved	0.181
	2	3	Al Dissolved	0.207
Downstream (50 ft)	3	1	Al Dissolved	0.099
	3	1	Al Dissolved	0.163
	3	1	Al Dissolved	0.17
	3	2	Al Dissolved	0.126
	3	2	Al Dissolved	0.145
	3	2	Al Dissolved	0.204
	3	2	Al Dissolved	0.089
	3	3	Al Dissolved	0.067
	3	3	Al Dissolved	<0.063
	3	3	Al Dissolved	<0.063
Downstream (100 ft)	4	1	Al Dissolved	0.108
	4	1	Al Dissolved	0.123
	4	1	Al Dissolved	<0.063
	4	2	Al Dissolved	0.065
	4	2	Al Dissolved	0.066
	4	2	Al Dissolved	0.07
	4	3	Al Dissolved	<0.063
	4	3	Al Dissolved	<0.063
	4	3	Al Dissolved	<0.063
	4	3	Al Dissolved	<0.063
Downstream (125 ft)	5	1	Al Dissolved	0.123
	5	1	Al Dissolved	<0.063
	5	1	Al Dissolved	<0.063
	5	1	Al Dissolved	0.104
	5	2	Al Dissolved	<0.063
	5	2	Al Dissolved	0.075
	5	2	Al Dissolved	<0.063
	5	3	Al Dissolved	0.068
	5	3	Al Dissolved	<0.063
	5	3	Al Dissolved	<0.063
Downstream (200 ft)	6	1	Al Dissolved	<0.063
	6	1	Al Dissolved	0.077
	6	1	Al Dissolved	<0.063
	6	2	Al Dissolved	<0.063
	6	2	Al Dissolved	<0.063

	6	2	Al Dissolved	0.122
	6	3	Al Dissolved	0.085
	6	3	Al Dissolved	<0.063
	6	3	Al Dissolved	0.119
	6	3	Al Dissolved	0.108
Downstream (400 ft)	7	1	Al Dissolved	0.128
	7	1	Al Dissolved	0.138
	7	1	Al Dissolved	0.13
	7	2	Al Dissolved	0.15
	7	2	Al Dissolved	0.15
	7	2	Al Dissolved	0.107
	7	3	Al Dissolved	0.135
	7	3	Al Dissolved	0.137
	7	3	Al Dissolved	0.172
	7	3	Al Dissolved	0.102

Table B.4. Calcium data , Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Ca Total	61.936
	1	1	Ca Total	59.53
	1	1	Ca Total	60.706
	1	1	Ca Total	61.676
	1	2	Ca Total	63.231
	1	2	Ca Total	63.75
	1	2	Ca Total	60.735
	1	3	Ca Total	63.435
	1	2	Ca Total	63.147
	1	3	Ca Total	62.561
Upstream (125 ft)	2	1	Ca Total	62.984
	2	1	Ca Total	62.429
	2	1	Ca Total	62.907
	2	1	Ca Total	62.736
	2	2	Ca Total	62.078
	2	2	Ca Total	60.53
	2	2	Ca Total	61.262
	2	3	Ca Total	59.71
	2	3	Ca Total	62.51
	2	3	Ca Total	60.977
Downstream (50 ft)	3	1	Ca Total	63.21
	3	1	Ca Total	63.699
	3	1	Ca Total	63.531
	3	2	Ca Total	61.081
	3	2	Ca Total	59.332
	3	2	Ca Total	63.98
	3	2	Ca Total	65.682
	3	3	Ca Total	64.884
	3	3	Ca Total	64.72
	3	3	Ca Total	64.841
Downstream (100 ft)	4	1	Ca Total	66.063
	4	1	Ca Total	66.045
	4	1	Ca Total	61.151
	4	2	Ca Total	60.832
	4	2	Ca Total	64.814
	4	2	Ca Total	63.63
	4	3	Ca Total	63.355
	4	3	Ca Total	62.457
	4	3	Ca Total	61.38
	4	3	Ca Total	63.82

Downstream (125 ft)	5	1	Ca Total	62.142
	5	1	Ca Total	63.308
	5	1	Ca Total	63.685
	5	1	Ca Total	61.658
	5	2	Ca Total	59.973
	5	2	Ca Total	62.742
	5	2	Ca Total	62.348
	5	3	Ca Total	67.638
	5	3	Ca Total	67.298
	5	3	Ca Total	66.461
Downstream (200 ft)	6	1	Ca Total	68.772
	6	1	Ca Total	65.78
	6	1	Ca Total	62.14
	6	2	Ca Total	63.757
	6	2	Ca Total	68.675
	6	2	Ca Total	64.356
	6	3	Ca Total	66.744
	6	3	Ca Total	63.039
	6	3	Ca Total	64.631
	6	3	Ca Total	62.888
Downstream (400 ft)	7	1	Ca Total	61.539
	7	1	Ca Total	61.149
	7	1	Ca Total	61.03
	7	2	Ca Total	62.325
	7	2	Ca Total	63.031
	7	2	Ca Total	62.885
	7	3	Ca Total	62.35
	7	3	Ca Total	61.863
	7	3	Ca Total	62.84
	7	3	Ca Total	63.061
Upstream (375 ft)	1	1	Ca Dissolved	59.894
	1	1	Ca Dissolved	61.606
	1	1	Ca Dissolved	61.602
	1	1	Ca Dissolved	60.683
	1	2	Ca Dissolved	61.996
	1	2	Ca Dissolved	61.97
	1	2	Ca Dissolved	63.811
	1	3	Ca Dissolved	59.412
	1	2	Ca Dissolved	60.543
	1	3	Ca Dissolved	60.589
Upstream (125 ft)	2	1	Ca Dissolved	61.555
	2	1	Ca Dissolved	68.473
	2	1	Ca Dissolved	60.535

	2	1	Ca Dissolved	60.761
	2	2	Ca Dissolved	62.37
	2	2	Ca Dissolved	60.73
	2	2	Ca Dissolved	61.571
	2	3	Ca Dissolved	66.698
	2	3	Ca Dissolved	70.837
	2	3	Ca Dissolved	69.451
Downstream (50 ft)	3	1	Ca Dissolved	67.478
	3	1	Ca Dissolved	71.437
	3	1	Ca Dissolved	71.413
	3	2	Ca Dissolved	69.537
	3	2	Ca Dissolved	65.956
	3	2	Ca Dissolved	67.866
	3	2	Ca Dissolved	64.336
	3	3	Ca Dissolved	61.148
	3	3	Ca Dissolved	63.536
	3	3	Ca Dissolved	62.105
Downstream (100 ft)	4	1	Ca Dissolved	63.741
	4	1	Ca Dissolved	62.775
	4	1	Ca Dissolved	61.703
	4	2	Ca Dissolved	62.738
	4	2	Ca Dissolved	62.967
	4	2	Ca Dissolved	63.183
	4	3	Ca Dissolved	61.995
	4	3	Ca Dissolved	62.895
	4	3	Ca Dissolved	61.752
	4	3	Ca Dissolved	62.599
Downstream (125 ft)	5	1	Ca Dissolved	62.269
	5	1	Ca Dissolved	62.072
	5	1	Ca Dissolved	62.513
	5	1	Ca Dissolved	61.542
	5	2	Ca Dissolved	65.716
	5	2	Ca Dissolved	61.08
	5	2	Ca Dissolved	62.649
	5	3	Ca Dissolved	62.065
	5	3	Ca Dissolved	61.289
	5	3	Ca Dissolved	60.325
Downstream (200 ft)	6	1	Ca Dissolved	61.922
	6	1	Ca Dissolved	62.157
	6	1	Ca Dissolved	62.407
	6	2	Ca Dissolved	62.289
	6	2	Ca Dissolved	60.464
	6	2	Ca Dissolved	61.936

	6	3	Ca Dissolved	62.62
	6	3	Ca Dissolved	61.923
	6	3	Ca Dissolved	61.277
	6	3	Ca Dissolved	61.447
Downstream (400 ft)	7	1	Ca Dissolved	60.815
	7	1	Ca Dissolved	61.792
	7	1	Ca Dissolved	60.781
	7	2	Ca Dissolved	60.745
	7	2	Ca Dissolved	60.881
	7	2	Ca Dissolved	61.056
	7	3	Ca Dissolved	61.854
	7	3	Ca Dissolved	63.023
	7	3	Ca Dissolved	62.319
	7	3	Ca Dissolved	62.66

Table B.5. Copper data , Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Cu Total	<0.008
	1	1	Cu Total	<0.008
	1	1	Cu Total	<0.008
	1	1	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	3	Cu Total	<0.008
Upstream (125 ft)	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
Downstream (50 ft)	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
Downstream (100 ft)	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008

Downstream (125 ft)	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	3	Cu Total	<0.008
	5	3	Cu Total	<0.008
	5	3	Cu Total	<0.008
Downstream (200 ft)	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	2	Cu Total	<0.008
	6	2	Cu Total	<0.008
	6	2	Cu Total	0.015
	6	3	Cu Total	<0.008
	6	3	Cu Total	<0.008
	6	3	Cu Total	<0.008
	6	3	Cu Total	<0.008
Downstream (400 ft)	7	1	Cu Total	<0.008
	7	1	Cu Total	<0.008
	7	1	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
Upstream (375 ft)	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
Upstream (125 ft)	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008

	2	1	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
Downstream (50 ft)	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
Downstream (100 ft)	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
Downstream (125 ft)	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
Downstream (200 ft)	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008

	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
Downstream (400 ft)	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008

Table B.6. Iron data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Fe Total	0.428
	1	1	Fe Total	0.366
	1	1	Fe Total	0.345
	1	1	Fe Total	0.311
	1	2	Fe Total	0.465
	1	2	Fe Total	0.403
	1	2	Fe Total	0.359
	1	3	Fe Total	0.325
	1	2	Fe Total	0.395
	1	3	Fe Total	0.313
Upstream (125 ft)	2	1	Fe Total	0.358
	2	1	Fe Total	0.366
	2	1	Fe Total	0.292
	2	1	Fe Total	0.386
	2	2	Fe Total	0.354
	2	2	Fe Total	0.347
	2	2	Fe Total	0.342
	2	3	Fe Total	0.445
	2	3	Fe Total	0.462
	2	3	Fe Total	0.427
Downstream (50 ft)	3	1	Fe Total	0.396
	3	1	Fe Total	0.396
	3	1	Fe Total	0.444
	3	2	Fe Total	0.428
	3	2	Fe Total	0.462
	3	2	Fe Total	0.463
	3	2	Fe Total	0.515
	3	3	Fe Total	0.491
	3	3	Fe Total	0.493
	3	3	Fe Total	0.599
Downstream (100 ft)	4	1	Fe Total	0.574
	4	1	Fe Total	0.526
	4	1	Fe Total	0.48
	4	2	Fe Total	0.532
	4	2	Fe Total	0.406
	4	2	Fe Total	0.482
	4	3	Fe Total	0.929
	4	3	Fe Total	0.915
	4	3	Fe Total	0.9
	4	3	Fe Total	0.957

Downstream (125 ft)	5	1	Fe Total	0.967
	5	1	Fe Total	1.054
	5	1	Fe Total	0.973
	5	1	Fe Total	0.966
	5	2	Fe Total	0.986
	5	2	Fe Total	0.932
	5	2	Fe Total	0.987
	5	3	Fe Total	0.969
	5	3	Fe Total	1.093
	5	3	Fe Total	1.028
Downstream (200 ft)	6	1	Fe Total	0.996
	6	1	Fe Total	1.043
	6	1	Fe Total	0.871
	6	2	Fe Total	0.832
	6	2	Fe Total	1.043
	6	2	Fe Total	0.661
	6	3	Fe Total	0.561
	6	3	Fe Total	0.615
	6	3	Fe Total	0.592
	6	3	Fe Total	0.555
Downstream (400 ft)	7	1	Fe Total	0.628
	7	1	Fe Total	0.654
	7	1	Fe Total	0.586
	7	2	Fe Total	0.603
	7	2	Fe Total	0.537
	7	2	Fe Total	0.533
	7	3	Fe Total	0.606
	7	3	Fe Total	0.783
	7	3	Fe Total	0.722
	7	3	Fe Total	0.581
Upstream (375 ft)	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
Upstream (125 ft)	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063

	2	1	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
Downstream (50 ft)	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
Downstream (100 ft)	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
Downstream (125 ft)	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
Downstream (200 ft)	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063

	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
Downstream (400 ft)	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063

Table B.7. Magnesium data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Mg Total	25.806
	1	1	Mg Total	24.599
	1	1	Mg Total	25.445
	1	1	Mg Total	25.519
	1	2	Mg Total	27.778
	1	2	Mg Total	25.762
	1	2	Mg Total	25.503
	1	3	Mg Total	25.642
	1	2	Mg Total	25.974
	1	3	Mg Total	25.534
Upstream (125 ft)	2	1	Mg Total	25.579
	2	1	Mg Total	25.465
	2	1	Mg Total	26.394
	2	1	Mg Total	25.632
	2	2	Mg Total	26.25
	2	2	Mg Total	25.076
	2	2	Mg Total	27.16
	2	3	Mg Total	25.209
	2	3	Mg Total	26.16
	2	3	Mg Total	26.275
Downstream (50 ft)	3	1	Mg Total	26.48
	3	1	Mg Total	26.225
	3	1	Mg Total	26.086
	3	2	Mg Total	26.034
	3	2	Mg Total	25.78
	3	2	Mg Total	26.182
	3	2	Mg Total	26.669
	3	3	Mg Total	27.131
	3	3	Mg Total	26.609
	3	3	Mg Total	26.969
Downstream (100 ft)	4	1	Mg Total	27.639
	4	1	Mg Total	26.52
	4	1	Mg Total	25.97
	4	2	Mg Total	25.148
	4	2	Mg Total	26.331
	4	2	Mg Total	25.968
	4	3	Mg Total	26.299
	4	3	Mg Total	25.863
	4	3	Mg Total	25.651

	4	3	Mg Total	25.928
Downstream (125 ft)	5	1	Mg Total	25.585
	5	1	Mg Total	26.721
	5	1	Mg Total	25.402
	5	1	Mg Total	25.397
	5	2	Mg Total	25.308
	5	2	Mg Total	26.453
	5	2	Mg Total	25.552
	5	3	Mg Total	27.599
	5	3	Mg Total	28.041
	5	3	Mg Total	27.026
Downstream (200 ft)	6	1	Mg Total	27.813
	6	1	Mg Total	27.096
	6	1	Mg Total	25.995
	6	2	Mg Total	26.962
	6	2	Mg Total	27.263
	6	2	Mg Total	27.017
	6	3	Mg Total	28.073
	6	3	Mg Total	27.102
	6	3	Mg Total	26.813
	6	3	Mg Total	25.712
Downstream (400 ft)	7	1	Mg Total	25.551
	7	1	Mg Total	25.629
	7	1	Mg Total	25.615
	7	2	Mg Total	25.225
	7	2	Mg Total	25.914
	7	2	Mg Total	25.645
	7	3	Mg Total	26.192
	7	3	Mg Total	25.434
	7	3	Mg Total	25.701
	7	3	Mg Total	26.42
Upstream (375 ft)	1	1	Mg Dissolved	25.112
	1	1	Mg Dissolved	25.609
	1	1	Mg Dissolved	26.383
	1	1	Mg Dissolved	24.975
	1	2	Mg Dissolved	26.924
	1	2	Mg Dissolved	27.321
	1	2	Mg Dissolved	26.354
	1	3	Mg Dissolved	26.502
	1	2	Mg Dissolved	24.149
	1	3	Mg Dissolved	26.293
Upstream (125 ft)	2	1	Mg Dissolved	24.805
	2	1	Mg Dissolved	25.136

	2	1	Mg Dissolved	28.55
	2	1	Mg Dissolved	25.829
	2	2	Mg Dissolved	26.171
	2	2	Mg Dissolved	25.887
	2	2	Mg Dissolved	25.681
	2	3	Mg Dissolved	29.119
	2	3	Mg Dissolved	27.699
	2	3	Mg Dissolved	29.035
Downstream (50 ft)	3	1	Mg Dissolved	26.383
	3	1	Mg Dissolved	25.967
	3	1	Mg Dissolved	28.607
	3	2	Mg Dissolved	28.702
	3	2	Mg Dissolved	27.851
	3	2	Mg Dissolved	27.626
	3	2	Mg Dissolved	27.212
	3	3	Mg Dissolved	26.663
	3	3	Mg Dissolved	26.759
	3	3	Mg Dissolved	26.803
Downstream (100 ft)	4	1	Mg Dissolved	26.266
	4	1	Mg Dissolved	28.423
	4	1	Mg Dissolved	25.562
	4	2	Mg Dissolved	27.269
	4	2	Mg Dissolved	26.041
	4	2	Mg Dissolved	27.123
	4	3	Mg Dissolved	26.195
	4	3	Mg Dissolved	26.634
	4	3	Mg Dissolved	25.785
	4	3	Mg Dissolved	25.76
Downstream (125 ft)	5	1	Mg Dissolved	26.094
	5	1	Mg Dissolved	25.312
	5	1	Mg Dissolved	26.28
	5	1	Mg Dissolved	26.471
	5	2	Mg Dissolved	24.693
	5	2	Mg Dissolved	26.154
	5	2	Mg Dissolved	25.639
	5	3	Mg Dissolved	26.068
	5	3	Mg Dissolved	25.396
	5	3	Mg Dissolved	25.978
Downstream (200 ft)	6	1	Mg Dissolved	25.853
	6	1	Mg Dissolved	26.324
	6	1	Mg Dissolved	26.206
	6	2	Mg Dissolved	25.887
	6	2	Mg Dissolved	26.067

	6	2	Mg Dissolved	26.591
	6	3	Mg Dissolved	25.837
	6	3	Mg Dissolved	25.977
	6	3	Mg Dissolved	25.913
	6	3	Mg Dissolved	26.567
Downstream (400 ft)	7	1	Mg Dissolved	25.803
	7	1	Mg Dissolved	25.354
	7	1	Mg Dissolved	25.457
	7	2	Mg Dissolved	26.357
	7	2	Mg Dissolved	26.249
	7	2	Mg Dissolved	25.876
	7	3	Mg Dissolved	26.406
	7	3	Mg Dissolved	26.516
	7	3	Mg Dissolved	26.097
	7	3	Mg Dissolved	26.299

Table B.8. Manganese data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Mn Total	0.039
	1	1	Mn Total	0.033
	1	1	Mn Total	0.031
	1	1	Mn Total	0.029
	1	2	Mn Total	0.041
	1	2	Mn Total	0.035
	1	2	Mn Total	0.032
	1	3	Mn Total	0.028
	1	2	Mn Total	0.035
	1	3	Mn Total	0.028
Upstream (125 ft)	2	1	Mn Total	0.033
	2	1	Mn Total	0.033
	2	1	Mn Total	0.027
	2	1	Mn Total	0.035
	2	2	Mn Total	0.032
	2	2	Mn Total	0.031
	2	2	Mn Total	0.031
	2	3	Mn Total	0.039
	2	3	Mn Total	0.041
	2	3	Mn Total	0.037
Downstream (50 ft)	3	1	Mn Total	0.037
	3	1	Mn Total	0.039
	3	1	Mn Total	0.043
	3	2	Mn Total	0.04
	3	2	Mn Total	0.041
	3	2	Mn Total	0.038
	3	2	Mn Total	0.054
	3	3	Mn Total	0.053
	3	3	Mn Total	0.054
	3	3	Mn Total	0.061
Downstream (100 ft)	4	1	Mn Total	0.061
	4	1	Mn Total	0.056
	4	1	Mn Total	0.054
	4	2	Mn Total	0.056
	4	2	Mn Total	0.047
	4	2	Mn Total	0.052
	4	3	Mn Total	0.086
	4	3	Mn Total	0.085
	4	3	Mn Total	0.085

	4	3	Mn Total	0.086
Downstream (125 ft)	5	1	Mn Total	0.09
	5	1	Mn Total	0.097
	5	1	Mn Total	0.091
	5	1	Mn Total	0.09
	5	2	Mn Total	0.092
	5	2	Mn Total	0.089
	5	2	Mn Total	0.092
	5	3	Mn Total	0.091
	5	3	Mn Total	0.101
	5	3	Mn Total	0.096
Downstream (200 ft)	6	1	Mn Total	0.095
	6	1	Mn Total	0.098
	6	1	Mn Total	0.085
	6	2	Mn Total	0.08
	6	2	Mn Total	0.097
	6	2	Mn Total	0.067
	6	3	Mn Total	0.058
	6	3	Mn Total	0.064
	6	3	Mn Total	0.048
	6	3	Mn Total	0.046
Downstream (400 ft)	7	1	Mn Total	0.053
	7	1	Mn Total	0.054
	7	1	Mn Total	0.049
	7	2	Mn Total	0.049
	7	2	Mn Total	0.046
	7	2	Mn Total	0.044
	7	3	Mn Total	0.047
	7	3	Mn Total	0.063
	7	3	Mn Total	0.06
	7	3	Mn Total	0.048
Upstream (375 ft)	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
Upstream (125 ft)	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006

	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
Downstream (50 ft)	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
Downstream (100 ft)	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
Downstream (125 ft)	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
Downstream (200 ft)	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006

	6	2	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
Downstream (400 ft)	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006

Table B.9. Nickel data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	3	Ni Total	<0.019
Upstream (125 ft)	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
Downstream (50 ft)	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
Downstream (100 ft)	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019

Downstream (125 ft)	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	3	Ni Total	<0.019
	5	3	Ni Total	<0.019
	5	3	Ni Total	<0.019
Downstream (200 ft)	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
Downstream (400 ft)	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
Upstream (375 ft)	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
Upstream (125 ft)	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019

	2	1	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
Downstream (50 ft)	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
Downstream (100 ft)	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
Downstream (125 ft)	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
Downstream (200 ft)	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019

	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
Downstream (400 ft)	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019

Table B.10. Selenium data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	3	Se Total	<0.063
	1	2	Se Total	<0.063
	1	3	Se Total	<0.063
Upstream (125 ft)	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
Downstream (50 ft)	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
Downstream (100 ft)	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063

	4	3	Se Total	<0.063
Downstream (125 ft)	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	3	Se Total	<0.063
	5	3	Se Total	<0.063
	5	3	Se Total	<0.063
Downstream (200 ft)	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
Downstream (400 ft)	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
Upstream (375 ft)	1	1	Se Dissolved	<0.063
Upstream (375 ft)	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
Upstream (125 ft)	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063

	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
Downstream (50 ft)	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
Downstream (100 ft)	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
Downstream (125 ft)	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
Downstream (200 ft)	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063

	6	2	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
Downstream (400 ft)	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063

Table B.11. Zinc data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

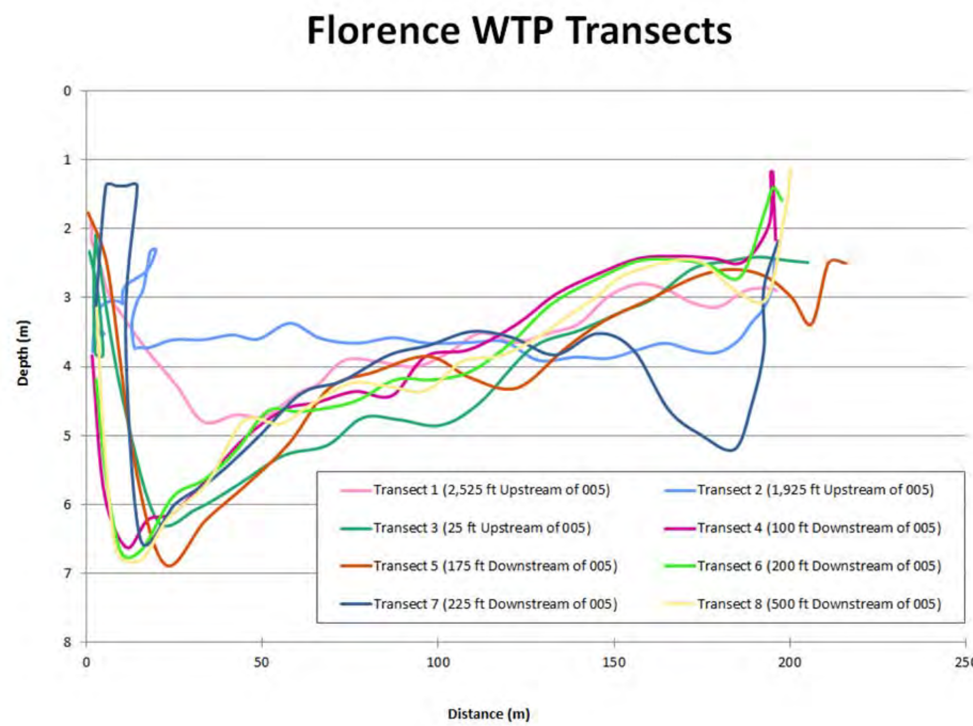
Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Zn Total	<0.006
	1	1	Zn Total	<0.006
	1	1	Zn Total	<0.006
	1	1	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	3	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	3	Zn Total	<0.006
Upstream (125 ft)	2	1	Zn Total	<0.006
	2	1	Zn Total	<0.006
	2	1	Zn Total	<0.006
	2	1	Zn Total	<0.006
	2	2	Zn Total	<0.006
	2	2	Zn Total	<0.006
	2	2	Zn Total	<0.006
	2	3	Zn Total	<0.006
	2	3	Zn Total	<0.006
	2	3	Zn Total	<0.006
Downstream (50 ft)	3	1	Zn Total	<0.006
	3	1	Zn Total	<0.006
	3	1	Zn Total	<0.006
	3	2	Zn Total	<0.006
	3	2	Zn Total	<0.006
	3	2	Zn Total	<0.006
	3	2	Zn Total	0.008
	3	3	Zn Total	0.008
	3	3	Zn Total	<0.006
	3	3	Zn Total	0.007
Downstream (100 ft)	4	1	Zn Total	0.01
	4	1	Zn Total	0.009
	4	1	Zn Total	0.008
	4	2	Zn Total	0.011
	4	2	Zn Total	0.008
	4	2	Zn Total	0.009
	4	3	Zn Total	0.009
	4	3	Zn Total	0.01
	4	3	Zn Total	0.01
	4	3	Zn Total	0.01

Downstream (125 ft)	5	1	Zn Total	0.009
	5	1	Zn Total	0.017
	5	1	Zn Total	0.01
	5	1	Zn Total	0.015
	5	2	Zn Total	0.011
	5	2	Zn Total	0.012
	5	2	Zn Total	0.01
	5	3	Zn Total	0.013
	5	3	Zn Total	0.012
	5	3	Zn Total	0.01
Downstream (200 ft)	6	1	Zn Total	0.011
	6	1	Zn Total	0.01
	6	1	Zn Total	0.009
	6	2	Zn Total	0.009
	6	2	Zn Total	0.011
	6	2	Zn Total	0.007
	6	3	Zn Total	0.007
	6	3	Zn Total	0.009
	6	3	Zn Total	<0.006
	6	3	Zn Total	<0.006
Downstream (400 ft)	7	1	Zn Total	<0.006
	7	1	Zn Total	<0.006
	7	1	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
Upstream (375 ft)	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
Upstream (125 ft)	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	<0.006

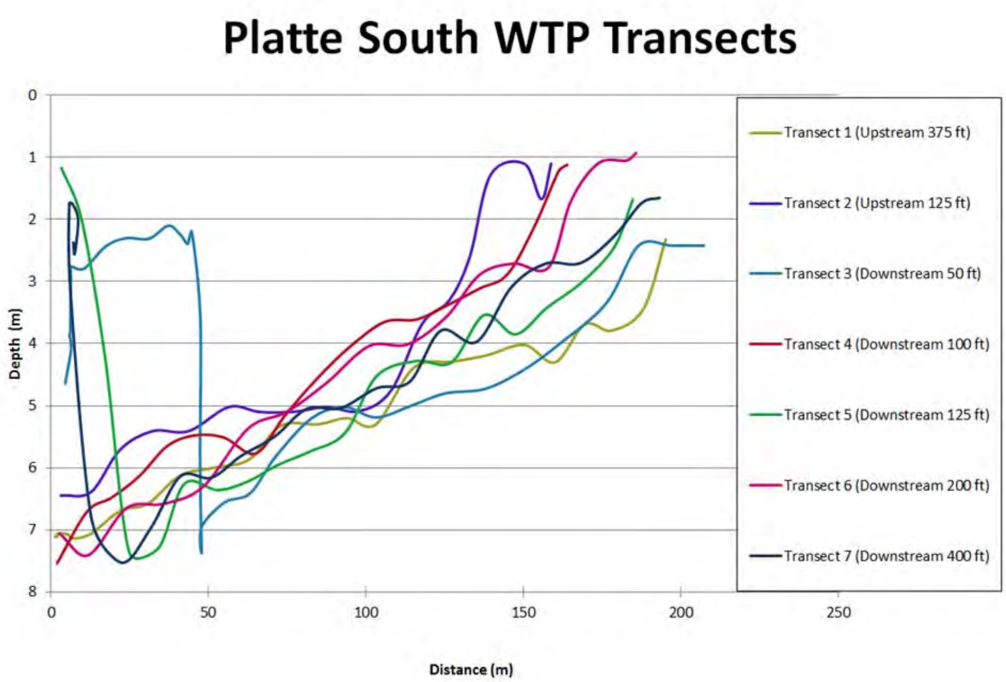
	2	1	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
Downstream (50 ft)	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
Downstream (100 ft)	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
Downstream (125 ft)	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
Downstream (200 ft)	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006

	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	0.007
	6	3	Zn Dissolved	0.012
Downstream (400 ft)	7	1	Zn Dissolved	0.008
	7	1	Zn Dissolved	0.007
	7	1	Zn Dissolved	0.01
	7	2	Zn Dissolved	0.007
	7	2	Zn Dissolved	0.008
	7	2	Zn Dissolved	0.01
	7	3	Zn Dissolved	0.007
	7	3	Zn Dissolved	0.011
	7	3	Zn Dissolved	<0.006
	7	3	Zn Dissolved	0.007

APPENDIX C



Florence WTP Transects
Depth (m)
Distance (m)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
Transect 1 (2,525 ft Upstream of 005)
Transect 2 (1,925 ft Upstream of 005)
Transect 3 (25 ft Upstream of 005)
Transect 4 (100 ft Downstream of 005)
Transect 5 (175 ft Downstream of 005)
Transect 6 (200 ft Downstream of 005)
Transect 7 (225 ft Downstream of 005)
Transect 8 (500 ft Downstream of 005)



Platte South WTP Transects
Depth (m)
Distance (m)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
Transect 1 (Upstream 375 ft)
Transect 2 (Upstream 125 ft)
Transect 3 (Downstream 50 ft)
Transect 4 (Downstream 100 ft)
Transect 5 (Downstream 125 ft)
Transect 6 (Downstream 200 ft)
Transect 7 (Downstream 400 ft)

Attachment B

Benthic Macroinvertebrate Community Analyses
Missouri River in the Vicinity of the Florence and Platte South
Potable Water Treatment Plants
Omaha, Nebraska

By
Pennington and Associates, Inc.
Cookeville, Tennessee

BENTHIC MACROINVERTEBRATE COMMUNITY ANALYSES
MISSOURI RIVER IN THE VICINITY OF THE FLORENCE AND PLATTE SOUTH POTABLE WATER TREATMENT PLANTS
OMAHA, NEBRASKA

PREPARED FOR

EE & T, INC.
NEWPORT NEWS, VIRGINIA

AUGUST 2012

PREPARED BY

PENNINGTON AND ASSOCIATES, INC.
COOKEVILLE, TENNESSEE

EXECUTIVE SUMMARY

Benthic macroinvertebrates were collected from the Missouri River in the vicinity of the Florence Potable Water Treatment Plant's (PWTP) and Platte South PWTP for the Omaha Nebraska Municipal Utility District. One location was established upstream and two downstream (125' and 600') of the permitted discharges. At each of the six locations, six artificial substrate samplers were placed on June 25 and 26 and retrieved on August 13 and 14, 2012. Analyses of the substrate samplers included taxa richness, density, EPT taxa, Hilsenhoff Biotic Index, species diversity, evenness, Jaccard's Coefficient and percent similarity. A minimum of 57 species was found on the substrates with the net-spinning caddisfly *Potamyia flava* and the midge *Rheotanytarsus exiguus gp.* dominant. The most significant differences included a statistically measurable drop in density from the upstream substrates to the downstream substrates below the Florence PWTP discharges and significantly higher numbers of taxa at Platt South when compared to the Florence locations.

TABLE OF CONTENTS

INTRODUCTION

Pennington and Associates, Inc. was contracted in May 2012 by EE & T, Inc. to conduct benthic macroinvertebrate surveys in the Missouri River using artificial substrate samplers in the vicinity of the Florence PWTP outfalls (NPDES Permit No. NE0000914) and the Platte South PWTP outfall (NPDES Permit No. NE0000906). The two facilities are operated by Omaha's Metropolitan Utilities District (M.U.D.). The artificial substrate samplers were placed on June 25, 2012 at the Florence PWTP and retrieved on August 13, 2012. At the Platte South locations the artificial substrate samplers (Photo 1) were placed on June 26 and retrieved on August 14, 2012. The approximate 6 week duration allowed for maximum colonization (Photo 2 and 3) of the substrates by benthic macroinvertebrates that exist in the river.

Attention is normally focused on the benthic macroinvertebrate community because it is more indicative of the relative health of the aquatic ecosystem. Macroinvertebrates are found in all habitats, are less mobile than some other groups of aquatic organisms such as fish, and most species of macroinvertebrates have relatively long periods of development in the aquatic environment. It is because of these factors that macroinvertebrate species can be used to indicate deleterious events that may occur in an aquatic environment over a period of time (OEPA 1987).

LOCATIONS

The locations selected for benthic macroinvertebrate community analyses in the Missouri River for the Florence PWTP and the Platte South PWTP are shown in Figures 1 and 2 and described as follows:

F 600 D – Approximately 600 feet downstream of Florence PWTP most downstream discharge, approximately 50 feet off right descending bank.

F 125 D – Approximately 125 feet downstream of Florence PWTP most downstream discharge, approximately 50 feet off right descending bank.

F U – Approximately 50 feet off right descending bank just upstream of Florence PWTP discharges.

P 600 D – Approximately 600 feet downstream of Platte South PWTP discharge, approximately 50 feet off right descending bank.

P 125 D - Approximately 125 feet downstream of Platte South PWTP discharge, approximately 50 feet off right descending bank.

PU – Just upstream of Platte South PWTP discharge at approximately 50 feet off right descending bank.

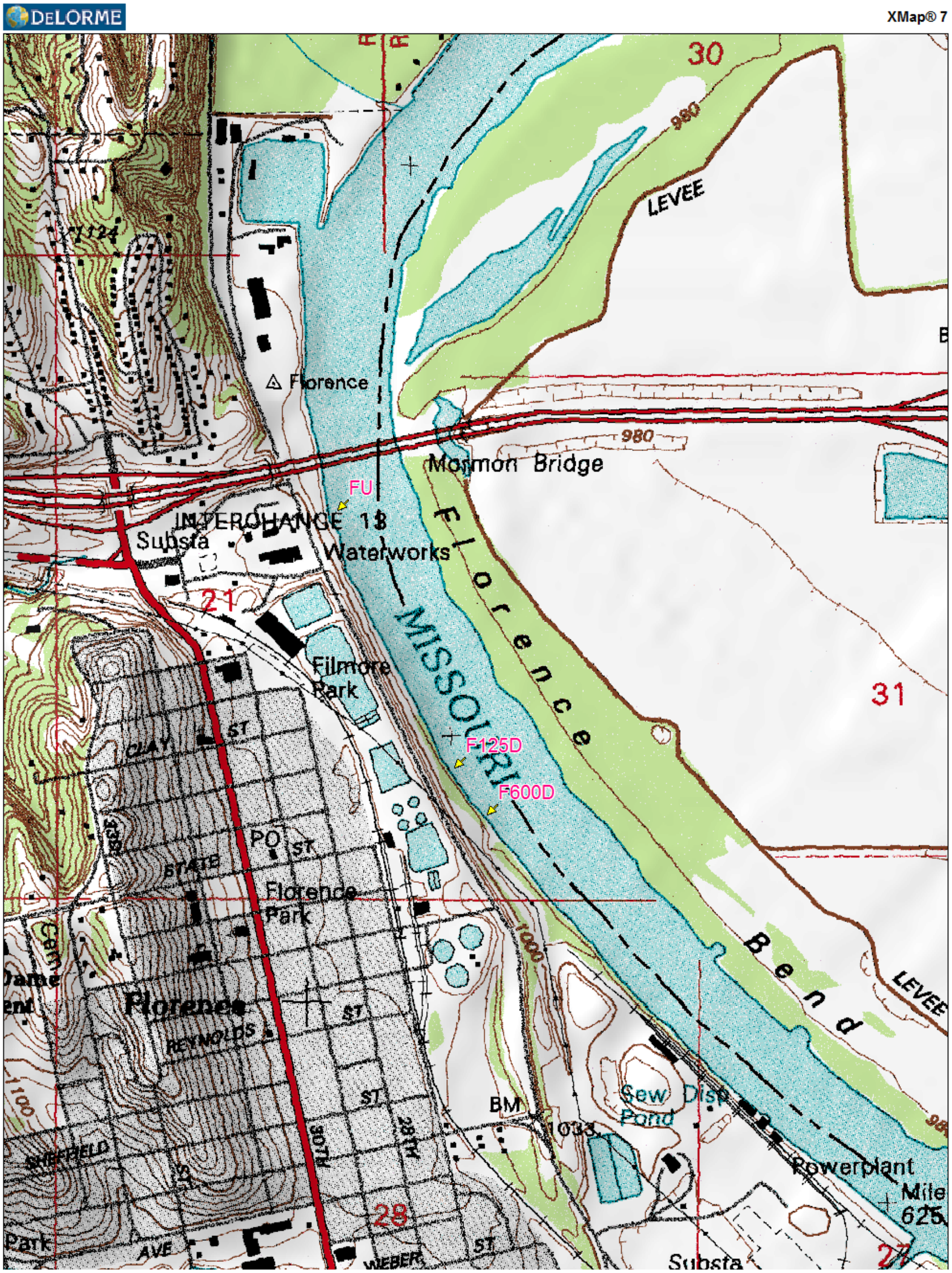


Figure 1. Benthic Macroinvertebrate Sampling Sites, Florence PWTP, August, 2012.

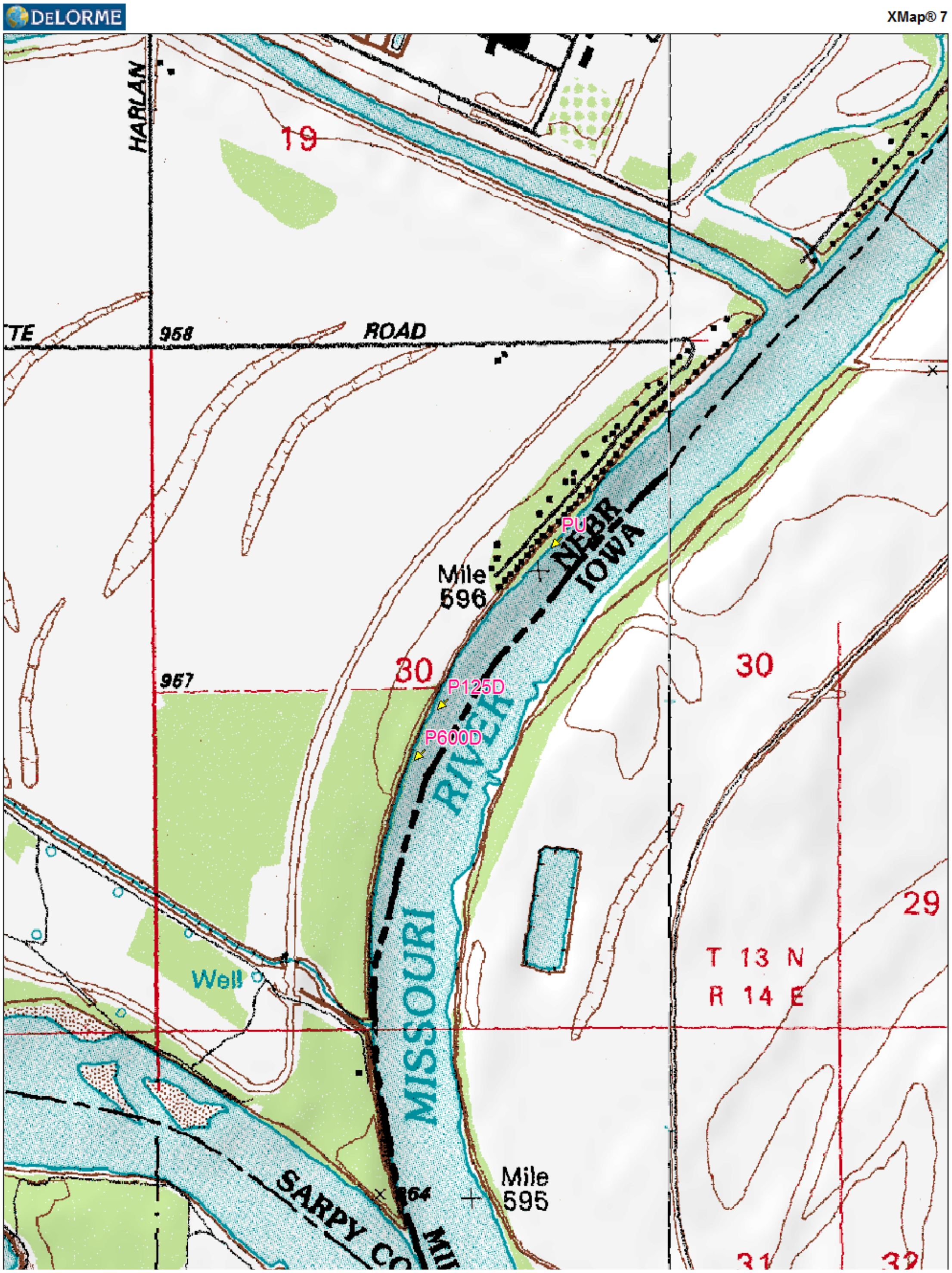


Figure 2. Benthic Macroinvertebrate Sampling Sites, Platte South PWTP, August, 2012.

Photo 1. Artificial substrate sampler prior to placement, June 25, 2012.

Photo 2. Artificial substrate sampler approximately 6 weeks after placement, August 13, 2012.

Photo 3. Individual artificial substrate approximately 6 weeks after placement, August 13, 2012.

MATERIALS AND METHODS

Collection Methods

Benthic macroinvertebrates were collected from the Missouri River using artificial substrate samplers (concrete forms in baskets) (Merritt et al. 2008). The substrate samplers were placed on June 25 and 26 retrieved on August 13 and 14, 2012. At the six sites, duplicate sets of three artificial substrate samplers were placed in the river for a total of 36. As stipulated in the work plan a minimum of one set of three from each location was to be processed. The artificial substrate samplers were constructed of 1" welded wire, based on the design of the barbecue basket sampler (Mason et al. 1967; Merritt et al. 2008). They were 11" (length) X 7" (diameter) (28 X 18 cm). Substrates were constructed by filling 7 ounce paper cups with concrete. After the mixture hardened the paper was removed to expose the hard surface and the substrates were seasoned in water. Ten concrete substrates were placed in each basket. The surface area of each substrate was approximately 150 cm^2 (10 x .015m^2 = 0.15m^2/Basket).

The artificial substrate samplers were attached to the riverbank with a plastic coated steel cable to reduce oxidation and breakage. Survey tape was used to mark bank locations. After a 6-week time lapse, each sampler was retrieved from the river by lifting the cable and placing a 250-micron net under it below the water surface to capture any animals dislodged when the substrates broke the surface. The substrates were removed from the baskets and cleaned in the field. All materials (detritus, organisms, etc.) were transferred to plastic containers, labeled, preserved in formalin and returned to the laboratory for analyses. All 18 substrates were retrieved in the vicinity of the Florence PWTP discharge. At the Platte South location 3 substrates were found upstream, 5 from 125 feet downstream and 6 from the 600 feet downstream location.

Laboratory Methods

In the laboratory, all benthic samples were washed in a 250-micron mesh sieve, manually separated from the detritus using a stereomicroscope, and preserved in 70-80% ethanol. If sub-sampling of large numbers of certain groups was required a Water's (1969) sub-sampling device was used. Identifications were made with a stereomicroscope (0.8X to 4X). Chironomids were cleared for 24 hours in cold 10% KOH and temporary mounts were made in glycerine. Slide mounts of chironomids, oligochaetes, small crustaceans, and others were identified with a compound microscope (4X to 40X). Once identified, the animals were returned to 80% ethanol. Permanent mounts were made with CMC-10 and euperol (Pennak 1989). Identifications were made to the lowest practical taxonomic level (species or genus) using taxonomic keys listed in Pennington & Associates, Inc. Standard Operating Procedures, Benthic Macroinvertebrates (2006).

COMMUNITY STRUCTURE MEASURES

Core benthic macroinvertebrate community metrics were calculated for each location and include:

1. **Taxa Richness (TR)** – Total number of distinct taxa. In general, increasing taxa richness reflects increasing water quality, habitat diversity and habitat suitability (KDOW 2002).

2. **Ephemeroptera, Plecoptera, and Trichoptera Richness (EPT)** – Total number of distinct taxa within the generally pollution sensitive insect orders of EPT. This index value will usually increase with increasing water quality, habitat diversity and habitat stability (Plafkin et al. 1989).

3. **Hilsenhoff Biotic Index (HBI)** – The Biotic Index was originally developed by Hilsenhoff (1982) as a rapid method for evaluating water quality in Wisconsin streams by

summarizing the overall pollution tolerance of a benthic arthropod community with a single value from 0-5. Hilsenhoff (1987) later refined the index and expanded the scale from 0-10. The biotic index is an average of tolerance values, and measures saprobity (pertaining to tolerance of organic enrichment) and to some extent tropism. Range of the index ranges from 0 (no apparent organic pollution) to 10 (severe organic pollution). An increasing Biotic Index value indicates decreasing water quality. The formula for the Biotic Index is as follows:

$$\text{HBI} = \sum \frac{x_i t_i}{n}$$

Where: x_i = number of individuals within a taxon
t_i = tolerance value of a taxon
n = total number of individuals in the sample

According to Hilsenhoff (1987) the calculated Biotic Index values for Wisconsin streams reflect the following:

Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00 - 3.50	Excellent	No apparent organic pollution
3.51 - 4.50	Very Good	Possibly slight organic pollution
4.51 - 5.50	Good	Some organic pollution
5.51 - 6.50	Fair	Fairly significant organic pollution
6.51 - 7.50	Fairly Poor	Significant organic pollution
7.51 - 8.50	Poor	Very significant organic pollution
8.51 - 10.00	Very Poor	Severe organic pollution

The State of Nebraska Water Quality Division (1997) follows the Hilsenhoff (1987) Wisconsin scoring criteria with values less than 3.5 indicating excellent water quality, values of 3.51 to 5 indicating good water quality, 5.01 to 7.5 indicating fair water quality, 7.51 to 8 indicating poor water quality and values greater than 8 would indicate serious water quality problems.

Brower and Zar (1984) provide a detailed discussion of a variety of techniques for measuring community structure. The use of diversity indices is based upon the observation that normally undisturbed environments support communities with large numbers of species having no individuals present in overwhelming abundance. If the species of a disturbed community are ranked by numerical abundance, there may be relatively few species with large numbers of individuals. Mean diversity is affected by both "richness" of species (or abundance of different species) and by the distribution of individuals among the species. High species diversity indicates a highly complex community.

Species diversity was estimated using Shannon's Index of Diversity (H):

$$H = -\sum p_i \log p_i$$

where p_i is the proportion of the total number of individuals occurring in species i ($p_i = n_i/N$), N is the total number of individuals in all species.

Diversity indices take into account both the species richness and the evenness of the individuals' distribution among the species. Separate measures of these two components of diversity are often desirable. Species richness can be expressed simply as the number of species in the community. Evenness may be expressed by considering how close a set of observed species abundance are to those from an aggregation of species having maximum possible diversity for a given N and S (Brower and Zar 1984).

Evenness is calculated as follows:

$$\text{Pielou } J' = H/H_{max}$$

where H is calculated diversity and H_{max} is maximum possible diversity.

Community similarity between sites is measured by Jaccards Coefficient, Percent Similarity and Bray-Curtis Percent Dissimilarity.

$$\text{Jaccards Coefficient} = \frac{C}{S_1 + S_2 - C}$$

where S = Species in each community (S_1 is reference Community)

and C = Species common to both communities

Percent Similarity, for a two-community comparison, is calculated as follows: The number of individuals in each species is calculated as a fractional portion of the total community. The value for species i in community 1 is compared to the value for species i in community 2. The lower of the two is tabulated. This procedure is followed for each species. The tabulated list (of the lower of each pair of values) is summed. The sum is defined as the Percent Similarity of the two communities.

Bray-Curtis Percent Dissimilarity (PD) is based on species abundance compared between any two communities. The index is expressed as

$$PD = 1 - PS/100$$

where PS = Percent similarity. Boyle et al. (1990) indicated the index was insensitive to low and moderate level structural changes.

Cluster analysis sorts sampling units into groups based on the overall resemblance to each other (Ludwig and Reynolds 1988). By using the PD, sampling units are sorted to permit grouping. The cluster analysis combines the distances between sampling units into a matrix table, and two strategies of clustering are used to calculate a distance for N-1 cycles (N=number of sampling units). The cluster analysis is interpreted graphically on a dendrogram to relate the similar communities (Eckblad 1989, Ludwig and Reynolds 1988).

Community indices were calculated at log base 2 where applicable using the software package ECOL ANAL (Eckbland 1989). Statistical analyses, using the software package Number Cruncher Statistical Systems, were used to compare the number of taxa and the relative numbers between each location.

Statistical Evaluation

Sampling efficiency of the field techniques was calculated via a statistical analysis of the quantitative samples. The mean number of organisms per sample, the standard deviation, the standard error, and the sampling precision of the mean were calculated for the benthic samples from each station (Elliot 1977). The sampling precision is the primary parameter evaluated and represents the percentage of the actual mean of the population within which the sample mean lies and indicates how accurately the macroinvertebrate community was sampled. According to Elliot (1977), a sampling precision of 20% (80% confidence) or less is usually acceptable in biological studies. The sampling precision (D) is the ratio of the standard error to the arithmetic mean:

$$D = (S.E./Mean)\ 100$$

Since six artificial substrate samples were taken in each area (5 at Platte South 125' downstream and 3 at Platte South upstream), some of the population estimates may not be sampled with 80%

or greater confidence. As stated by Elliot (1977), the simplest solution to this problem is to take many samples (over 50 samples), but this is not usually an acceptable allocation of resources.

An analysis of variance (F test) was used to compare the stations using the number of organisms and species per sample. According to Sokal and Rohlf (1981), analysis of variance is a technique in statistics where the total variation in a set of data is partitioned into components associated with possible sources of variability. The relative importance of the different sources is then assessed by F-tests between each component of variation and the "error" variation. If the calculated F-value is greater than the tabular F-value at the 0.05 level of significance, then a difference between data sets is greater than the variation within a data set. Following the approach of Chew (1977), mean separation tests were applied to separate and rank the mean values of each data set developed from benthic enumeration.

RESULTS AND DISCUSSION

A summary of the benthic macroinvertebrate communities including species, tolerance values, functional feeding groups and habit at each of the six locations in the Missouri River is presented in Table 1. All data for each individual substrate is found in Table 1A in the Appendix. Summaries of Benthic Macroinvertebrate Community Indices are presented in Table 2. Graphic examples of community clusters are found in Figures 3 and 4. Statistical comparisons of the locations based on density are found in Tables 3, 4 and 5 while similar comparisons based on number of species are found in Tables 6, 7 and 8.

Benthic macroinvertebrate populations found in the vicinity of Florence PWTP and Platte South PWTP on the artificial substrates consisted of a minimum of 57 species, 41 families and 18 orders (Table 1). Most of the species taken (40) were aquatic insects. The dominant groups at all locations were net-spinning caddisflies, especially *Potamyia flava*, and midges belonging to the *Rheotanytarsus exiguus* group. *Potamyia flava* is a species common to the upper Mississippi River where larvae built nets in high concentrations on rocks in sandy, silt-free bottom materials exposed to current (Wiggins 1996). Larvae of midges belonging to the *Rheotanytarsus exiguus* group are basically filter-feeders and strain organic debris from passing water with strands of salivary secretions strung between arms of their cases (Simpson and Bode 1980). Larvae belonging to the group are dominant in aquatic systems with moderate flows and high amounts of suspended organic particulates.

FLORENCE PWTP

The benthic macroinvertebrate fauna in the vicinity of the Florence PWTP discharge were represented by a minimum of 25 species upstream (FU), with 27 (F125D) and 23 (F600D) found downstream of the discharges (Table 1). *Potamyia flava* (33.0% at FU, 36.7% at F125D and 35.8% at F600D) and *Rheotanytarsus exiguus gp*. (11.9% at FU, 19.6% at F125D and 17.7% at F600D) were dominant on all of the substrates. When compared statistically (Table 6) the differences between mean number of taxa upstream to downstream were not significant at the 0.05 confidence level. In terms of density (mean number per 0.15m^2), the upstream location had a mean number of 20904.5 individuals per 0.15m^2 while F125D had 10570.7/0.15m^2 and F600D had 9470.5/0.15m^2, a statistically measurable drop in density from upstream to downstream with no significant differences in the two downstream locations (Table 3). The Hilsenhoff's Biotic

Index values for all locations are indicative of "Fair" water quality with "fairly significant organic pollution" (Table 2). The diversity values may also indicate some organic pollution at all locations (Weber 1973). In terms of species shared (Jaccard's Coefficient), the locations were 0.524 to 0.581 comparable or shared slightly more than ½ their species between sites (Table 2). When a density component was added (percent similarity, Table 2) the two downstream locations were 92.5% comparable while the upstream (FU) location was slightly less comparable, (85.1% to F125D and 81.4% to F600D).

PLATTE SOUTH PWTP

The benthic macroinvertebrate community upstream and downstream of the Platte South PWTP was represented by a minimum of 27 species upstream (PU), 33 just downstream (P125D) and 30 species 600 feet downstream of the discharge (Table 1). The benthic macroinvertebrate populations at all three locations were dominated by individuals belonging to the *Rheotanytarsus exiguus* gp (59.2% at PU, 52.0% at P125D and 48.2% at P600D). The caddisfly *Potamyia flava* and immature hydropsychids were also abundant on the substrates at the two downstream locations. A statistical comparison of the mean number of taxa (Table 7) found no differences between the three locations. In terms of density, the upstream (PU) location had a mean number of 15677.7 individuals per $0.15m^2$ while the two downstream locations ($20753.6/015m^2$ at P125D and $22752.7/0.15m^2$ at P600D) showed an increase in populations density (Table 1). When compared statistically (Table 4) the increase in density was not significant at the 0.05 confidence level. As found at the Florence sites, the Hilsenhoff Biotic Index values calculated from the Platte South substrates yielded a benthic macroinvertebrate fauna representative of "Fair" water quality conditions (Table 2). In terms of species shared (Jaccard's Coefficient) values ranged from 0.542 to 0.634 with the higher values indicating greater similarity. The two downstream locations (P125D and P600D) had the highest percent similarity (88.4%) while the upstream site (PU) and the most downstream site (P600D) were the least similar (71.4%).

ALL SITES

A comparison of both the Florence PWTP and Platte South PWTP locations using mean number of taxa per substrate shown in Table 8 has the Platte South substrates with significant higher numbers of taxa than the Florence PWTP locations. A similar comparison using mean number of individuals per substrate (Table 5) has the downstream Platte South and the Florence PWTP upstream location (FU) with significantly higher numbers of individuals than the Florence PWTP downstream sites (F125D and F600D). Cluster analyses of the substrates using species shared as shown in Figure 3 has the Platte South locations and Florence locations forming separate and distinct clusters. Similar clusters were found when a density component was added (Figure 4).

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

				Florence 600' Downstream	Florence 125' Downstream	Florence Upstream	Platte S. 600' Downstream	[a]Platte S. 125' Downstream	[b] Platte S. Upstream
				Total	Total	Total	Total	Total	Total
PLATYHELMINTHES									
Turbellaria									
Tricladida									
Dugesiidae									
Girardia (Dugesia) tigrina	**8**	**CG**	**SP**	1698	796	2287	1044	2024	2463
NEMERTEA					1				
MOLLUSCA									
Bivalvia									
Veneroida									
Sphaeriidae						81			
Musculium transversum	**8**	**CF**	**BU**		1	217	386	164	21
Pisidium sp.	**7**	**CF**	**BU**		1				
Gastropoda									
Basommatophora									
Ancylidae									
Ferrissia rivularis	**8**	**SC**	**CN**					1	
Physidae									
Physella sp.	**9**	**SC**	**SP**					80	
ANNELIDA									
Oligochaeta									
Tubificida									
Naididae								160	200
Nais barbata	**8**	**CG**	**CN**				80		
Nais behningi	**6**	**CG**	**CN**			130	180	740	1020
Nais pardalis	**8**	**CG**	**CN**				80		80
Nais sp.	**9**	**CG**	**BU**					60	
Pristina sp.	**4**	**CG**	**CN**						60
ARTHROPODA									
Arachnoidea									
Acariformes				350	560		240	460	240
Crustacea									
Copepoda									
Cyclopoida						40			
Ostracoda					20				
Cladocera									
Sidaidae									

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

				Florence 600' Downstream Total	Florence 125' Downstream Total	Florence Upstream Total	Platte S. 600' Downstream Total	[a]Platte S. 125' Downstream Total	[b] Platte S. Upstream Total
Sida crystillina								240	
Amphipoda									
Crangonyctidae									
Crangonyx sp.	**2**	**CG**	**SW**		80				
Decapoda									
Cambaridae									
Orconectes sp.	**8**	**SC**	**SP**					1	
Insecta									
Ephemeroptera									
Baetidae	**4**	**CG**	**SP**	1460	1772	2241	1000	420	
Baetis sp.	**5**	**CG**	**SP**				921		
Labiobaetis longipalpus				1426	1460	9732	2604	1196	161
Caenidae								480	60
Americaenis ridens	**7**	**CG**	**SP**	240	100	321	720	201	140
Caenis sp.	**7**	**CG**	**SP**				40	321	
Heptageniidae				470	263	360	400	740	80
Heptagenia sp.	**4**	**SC**	**CN**					1	
Maccaffertium mexicanum	**5**	**SC**	**CN**					3	80
Maccaffertium sp.	**3**	**SC**	**CN**	100	2	240	261	740	
Isonychiidae									
Isonychia sp.	**2**	**CG**	**SW**	1		711	172	174	1
Leptophlebiidae	**2**	**CG**					160	80	
Odonata									
Coenagrionidae	**9**	**PR**	**CB**						
Argia sp.	**8**	**PR**	**CB**						21
Enallagma sp.	**9**	**PR**	**CB**		50				
Libellulidae	**9**	**PR**	**SP**						
Neurocordulia molesta	**4**	**PR**	**SP**					1	
Plecoptera									
Perlidae									
Acroneuria sp.	**1**	**PR**	**CN**		1				
Megaloptera									
Corydalidae	**4**	**PR**	**CB**						
Corydalus cornutus	**4**	**PR**	**CB**	1			1	1	1
Trichoptera									
Brachycentridae									
Brachycentrus sp.	**3**	**CG**	**SP**			1			
Hydropsychidae	**5**	**CF**	**CN**	20363	23268	41433	24368	14321	2900

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

				Florence 600' Downstream	Florence 125' Downstream	Florence Upstream	Platte S. 600' Downstream	[a]Platte S. 125' Downstream	[b] Platte S. Upstream
				Total	**Total**	**Total**	**Total**	**Total**	**Total**
Cheumatopsyche sp.	**5**	**CF**	**CN**	90	70	650	322	480	422
Hydropsyche cf. bidens	**5**	**CF**	**CN**	40	120	400	300		61
Hydropsyche orris	**8**	**CF**	**CN**	4002	3645	13421	6446	2845	641
Hydropsyche simulians	**4**	**CF**	**CN**	1426	2248	1596	2629	1189	501
Hydropsyche sp.	**5**	**CF**	**CN**	60	80			160	
Potamyia flava	**6**	**CF**	**CN**	12312	12556	30613	17868	15489	3188
Hydroptilidae	**4**	**SC**	**cn**	50	80	560	480		20
Hydroptila sp.	**6**	**SC**	**CN**	250					
Mayatrichia sp.	**6**	**SC**	**CN**	430	350	1121	2020	1000	1142
Leptoceridae	**4**	**CG**	**CN**		320	100	80		
Ceraclea sp.	**4**	**CG**	**CB**				40		
Mystacides sp.				120					
Oecetis sp.	**3**	**PR**	**SP**		50				
Polycentropodidae					80				
Cyrnellus fraternus				22	40				
Neureclipsis sp.	**6**	**FC**	**CN**	75	6		43	4	2
Coleoptera									
Elmidae									
Stenelmis sp.	**5**	**SC**	**CN**	50	1	60			
Diptera									
Ceratopogonidae				80					
Chironomidae									
Conchapelopia sp.	**6**	**PR**	**SP**	2	401	1090	2103	1221	402
Corynoneura sp.	**3**	**CG**	**SP**					80	
Cryptochironomus sp.	**8**	**PR**	**SP**					100	60
Glyptotendipes sp.	**10**	**CF**	**BU**				400		20
Nanocladius distinctus	**2**	**CG**	**SP**			60	80	220	260
Paratendipes albimanus	**6**	**CG**	**SP**			80			
Polypedilum flavum (convictum)	**4**	**SH**	**SP**	750	1241	1760	2921	1802	781
Polypedilum halterale gp.	**7**	**SH**	**SP**				220		
Rheotanytarsus exiguus gp.	**6**	**FC**	**CN**	10043	12420	14981	65827	53968	27843
Tanytarsus sp.	**6**	**CF**	**CB**	610	1180	601	1520	1860	4000
Empididae	**8**	**CG**	**SP**	1					62
Hemerodromia sp.	**6**	**PR**	**CN**	221	161	500	560	741	100
Simuliidae									
Simulium sp.	**6**	**FC**	**CN**	80		40			
TOTAL NO. OF ORGANISMS				**56823**	**63424**	**125427**	**136516**	**103768**	**47033**

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

	Florence 600' Downstream	Florence 125' Downstream	Florence Upstream	Platte S. 600' Downstream	[a]Platte S. 125' Downstream	[b] Platte S. Upstream
	Total	Total	Total	Total	Total	Total
AVERAGE NO. PER 0.15 M^2	9470.5	10570.7	20904.5	22752.7	20753.6	15677.7
[c]TOTAL NO. OF TAXA	23	27	25	30	33	27
[c]EPT TAXA	14	13	12	15	14	11

[a] Five baskets retrieved.
[b] Three baskets retrieved.
[c] Families represented by species or genera (or a lower taxonomic unit) not included in the taxa count.

Table 2. Benthic Macroinvertebrate Community Analyses.

Date	Station	No. of Taxa	HBI	No. of Individuals per 0.15 m^2	Shannon Diversity (H')	Pielou (J')
8/13/12	F 600 D	23	5.69	9470.5	2.81	0.57
8/13/12	F 125 D	27	5.57	10570.7	2.79	0.55
8/13/12	FU	25	5.77	20904.5	2.86	0.58
8/14/12	P 600 D	30	5.82	22752.7	2.62	0.51
8/14/12	P 125 D	33	5.85	20753.6	2.57	0.49
8/14/12	PU	27	5.99	15677.7	2.42	0.48

Jaccards Coefficient

STATION	F 600 D	F 125 D	FU	P 600 D	P 125 D	PU
F 600 D	1	0.585	0.564	0.535	0.458	0.537
F 125 D	0.585	1	0.524	0.5	0.404	0.435
FU	0.564	0.524	1	0.585	0.438	0.512
P 600 D	0.535	0.5	0.585	1	0.542	0.634
P 125 D	0.458	0.404	0.438	0.542	1	0.578
PU	0.537	0.435	0.512	0.634	0.578	1

more similar   least similar

Percent similarity

STATION	F 600 D	F 125 D	FU	P 600 D	P 125 D	PU
F 600 D	100	92.5	85.1	63.6	59.1	41
F 125 D	92.5	100	81.4	66.2	61.2	42.6
FU	85.1	81.4	100	58.4	53.6	34.7
P 600 D	63.6	66.2	58.4	100	88.4	71.4
P 125 D	59.1	61.2	53.6	88.4	100	77.8
PU	41	42.6	34.7	71.4	77.8	100

highest similarity

Table 3. Statistical Comparison of Community Structure (Florence PWTP) Using Mean Number of Organisms per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	9470.5	3726.26	1525.32	16.11%
8/13/2012	F125D	6	10570.7	2857.87	1166.72	11.04%
8/13/2012	FU	6	20904.5	8204.33	3349.03	16.02%

F - ratio = 8.01

Duncan's Multiple Range Test

	F 125D	F 600D
F U 20904.5	10570.7	9470.5

Means comparable at the 0.05 confidence levels are underlined.

Table 4. Statistical Comparison of Community Structure (Platte South PWTP) Using Mean Number of Organisms per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/14/2012	P 600 D	6	22752.7	8512.29	3475.13	15.27%
8/14/2012	P125 D	5	20753.6	6154.03	2752.17	13.26%
8/14/2012	PU	3	15677.7	6784.81	3917.21	24.99%

F - ratio = 0.91

Duncan's Multiple Range Test

P 600 D	P125 D	PU
22752.7	Downstream 20753.6	15677.7

Means comparable at the 0.05 confidence levels are underlined.

Table 5. Statistical Comparison of Community Structure (All Sites) Using Mean Number of Organisms per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	9470.5	3726.26	1525.32	16.11%
8/13/2012	F125D	6	10570.7	2857.87	1166.72	11.04%
8/13/2012	FU	6	20904.5	8204.33	3349.03	16.02%
8/14/2012	P 600 D	6	22752.7	8512.29	3475.13	15.27%
8/14/2012	P125 D	5	20753.6	6154.03	2752.17	13.26%
8/14/2012	PU	3	15677.7	6784.81	3917.21	24.99%

F - ratio = 4.69

P600D	FU	P125D	PU	F125D	F600D
22752.7	20904.5	20753.6	15677.7	10570.7	9470.5

Means comparable at the 0.05 confidence levels are underlined.

Table 6. Statistical Comparison of Community Structure (Florence PWTP) Using Mean Number of Taxa per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	15.83	1.17	0.48	0.03%
8/13/2012	F125D	6	16.83	0.41	0.17	0.09%
8/13/2012	FU	6	17.5	1.76	0.72	4.10%

F - ratio = 2.73

Duncan's Multiple Range Test

FU	F125D	F600D
17.5	16.83	15.83

Means comparable at the 0.05 confidence levels are underlined.

Table 7. Statistical Comparison of Community Structure (Platte South PWTP) Using Mean Number of Taxa per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/14/2012	P 600 D	6	21	2.83	1.15	5.50%
8/14/2012	P125 D	5	21.4	3.13	1.4	6.54%
8/14/2012	PU	3	22	1.73	1	4.54%

F - ratio = 0.13

Duncan's Multiple Range Test

PU	P125 D	P 600 D
22	21.4	21

Means comparable at the 0.05 confidence levels are underlined.

Table 8. Statistical Comparison of Community Structure (All Sites) Using Mean Number of Taxa per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	15.83	1.17	0.48	0.03%
8/13/2012	F125D	6	16.83	0.41	0.17	0.09%
8/13/2012	FU	6	17.5	1.76	0.72	4.10%
8/14/2012	P600D	6	21	2.83	1.15	5.50%
8/14/2012	P125D	5	21.4	3.13	1.4	6.54%
8/14/2012	PU	3	22	1.73	1	4.54%

F - ratio = 8.62

PU	P125D	P600D	FU	F125D	F600D
22	21.4	21	17.5	16.83	15.83

Means comparable at the 0.05 confidence levels are underlined.

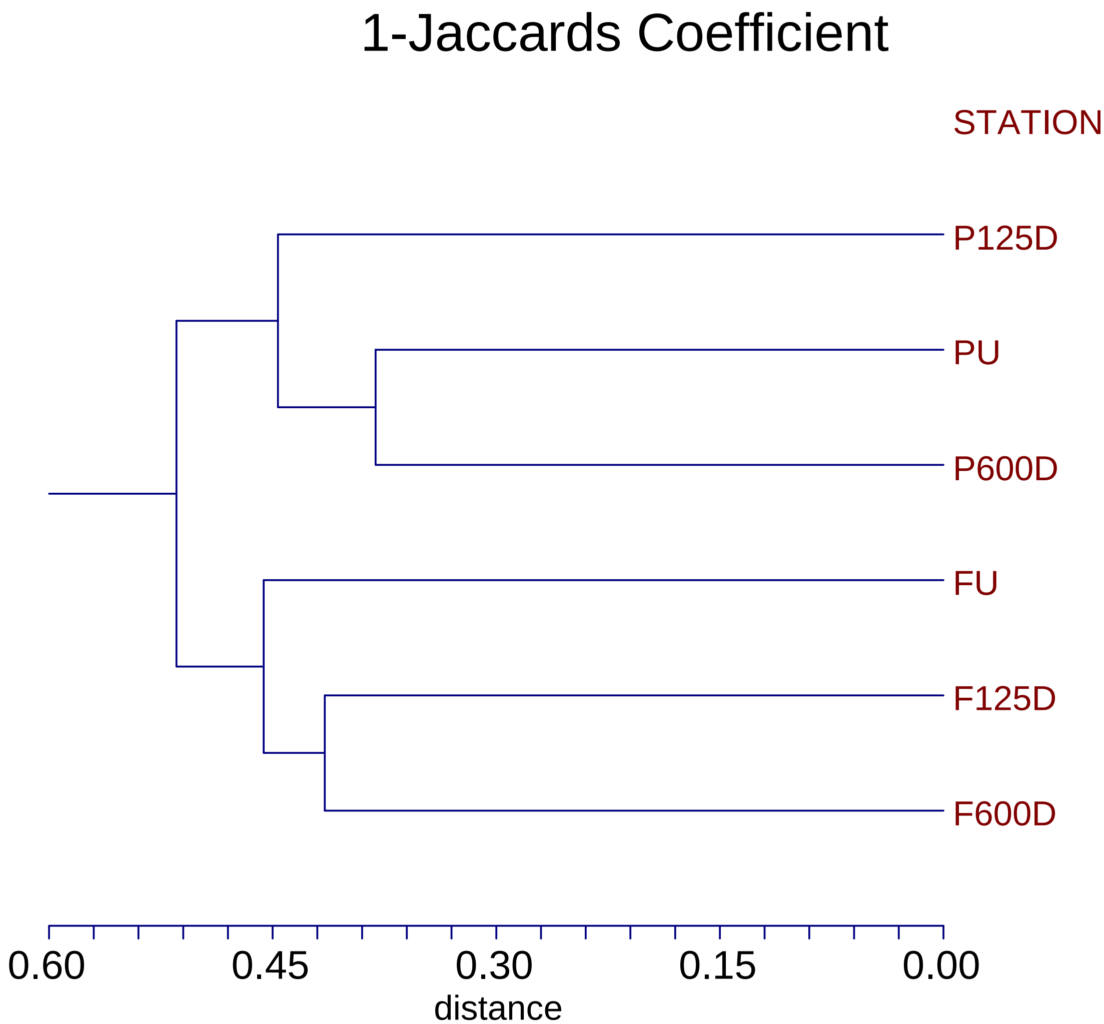


Figure 3. Cluster analyses of artificial substrate samples based on 1-Jaccard's Coefficient (b=0.25).

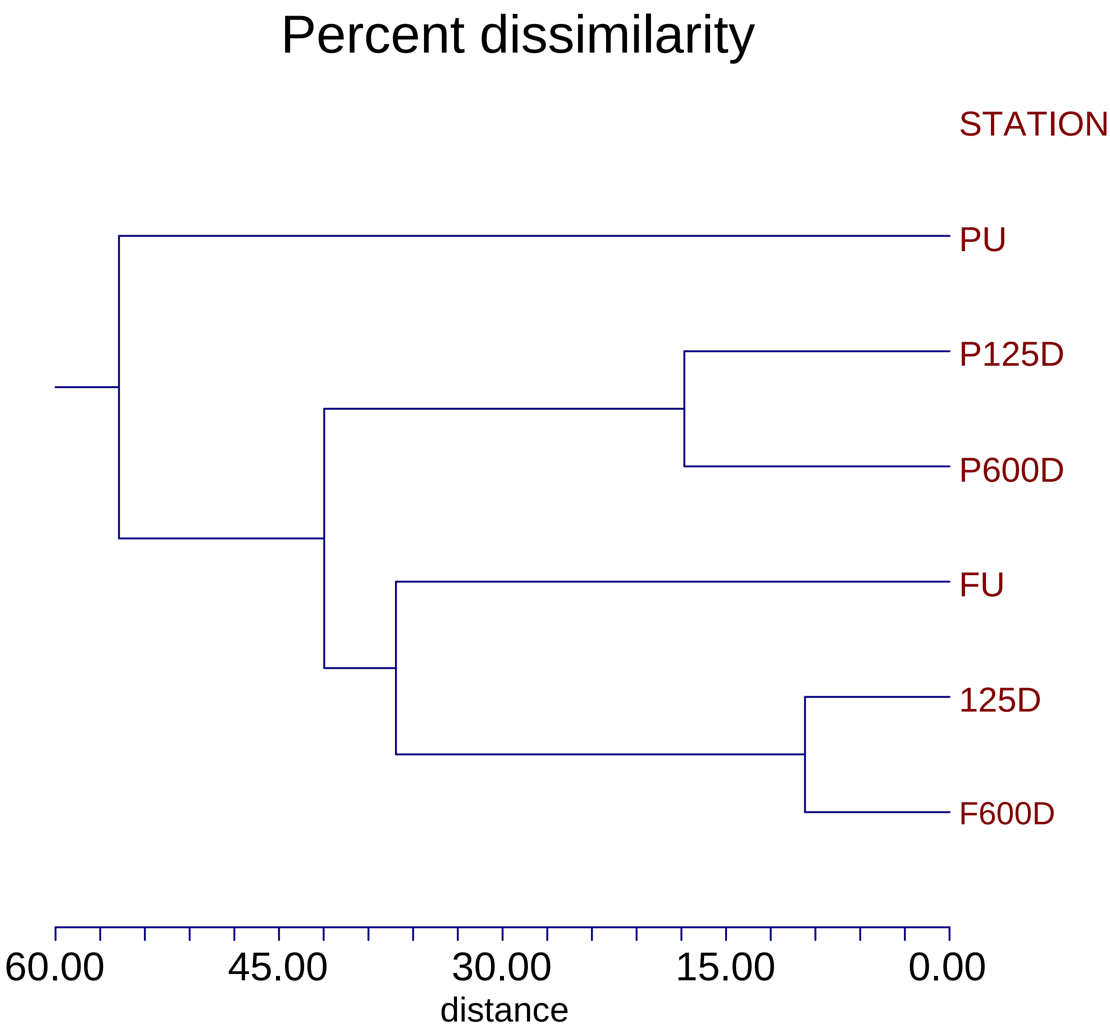


Figure 4. Cluster analyses of artificial substrate samples based on Percent Dissimilarity (b=0.25).

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APPENDIX

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP	551	81	281	182	241	362	1698
NEMERTEA										
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae										
Musculium transversum	8	CF	BU							
Pisidium sp.	7	CF	BU							
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN							
Nais behningi	6	CG	CN							
Nais pardalis	8	CG	CN							
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes				150	60		60		80	350
Crustacea										
Copepoda										
Cyclopoida										
Ostracoda										
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW							
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Ephemeroptera										
Baetidae	4	CG	SP	250	160	200	210	640		1460
Baetis sp.	5	CG	SP							
Labiobaetis longipalpus				202	104	40	32	321	727	1426
Caenidae										
Americaenis ridens	7	CG	SP					160	80	240
Caenis sp.	7	CG	SP							
Heptageniidae				250	20			80	120	470
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN			100				100
Isonychiidae										
Isonychia sp.	2	CG	SW					1		1
Leptophlebiidae	2	CG								
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB							
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN							
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB				1			1
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP							
Hydropsychidae	5	CF	CN	3300	2420	1640	1921	6160	4922	20363
Cheumatopsyche sp.	5	CF	CN	50	40					90
Hydropsyche cf. bidens	5	CF	CN			40				40
Hydropsyche orris	8	CF	CN	1253	883	321	482	421	642	4002
Hydropsyche simulians	4	CF	CN	302	140	60	121	481	322	1426
Hydropsyche sp.	5	CF	CN			60				60
Potamyia flava	6	CF	CN	3902	983	1681	1023	2881	1842	12312
Hydroptilidae	4	SC	cn			20	30			50
Hydroptila sp.	6	SC	CN	250						250
Mayatrichia sp.	6	SC	CN				30	400		430
Leptoceridae	4	CG	CN							
Ceraclea sp.	4	CG	CB							
Mystacides sp.					80	40				120
Oecetis sp.	3	PR	SP							
Polycentropodidae										
Cyrnellus fraternus					22					22

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Neureclipsis sp.	6	FC	CN	52		21	2			75
Coleoptera										
Elmidae										
Stenelmis sp.	5	SC	CN	50						50
Diptera										
Ceratopogonidae								80		80
Chironomidae										
Conchapelopia sp.	6	PR	SP						2	2
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU							
Nanocladius distinctus	2	CG	SP							
Paratendipes albimanus	6	CG	SP							
Polypedilum flavum (convictum)	4	SH	SP	200	120	80	30	160	160	750
Polypedilum halterale gp.	7	SH	SP							
Rheotanytarsus exiguus gp.	6	FC	CN	1900	1282	2461	840	1680	1880	10043
Tanytarsus sp.	6	CF	CB	150	20	160		240	40	610
Empididae	8	CG	SP				1			1
Hemerodromia sp.	6	PR	CN	100		20	60		41	221
Simuliidae										
Simulium sp.	6	FC	CN					80		80
TOTAL NO. OF ORGANISMS				**12912**	**6415**	**7225**	**5025**	**14026**	**11220**	**56823**
TOTAL NO. OF TAXA				**17**	**15**	**17**	**16**	**16**	**14**	**31**
EPT TAXA										**19**
HBI										**5.69**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 125' Downstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP		52	481	81	81	101	796
NEMERTEA				1						1
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae										
Musculium transversum	8	CF	BU		1					1
Pisidium sp.	7	CF	BU	1						1
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN							
Nais behningi	6	CG	CN							
Nais pardalis	8	CG	CN							
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes				280		80		100	100	560
Crustacea										
Copepoda										
Cyclopoida										
Ostracoda								20		20
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW				80			80
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										
Ephemeroptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 125' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Baetidae	4	CG	SP	201	500	480	160	81	350	1772
Baetis sp.	5	CG	SP							
Labiobaetis longipalpus				122	200	481	82	62	513	1460
Caenidae										
Americaenis ridens	7	CG	SP		50				50	100
Caenis sp.	7	CG	SP							
Heptageniidae						80	80		103	263
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN			1		1		2
Isonychiidae										
Isonychia sp.	2	CG	SW							
Leptophlebiidae	2	CG								
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB		50					50
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN				1			1
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB							
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP							
Hydropsychidae	5	CF	CN	4562	3201	4880	3440	2985	4200	23268
Cheumatopsyche sp.	5	CF	CN		50			20		70
Hydropsyche cf. bidens	5	CF	CN			80		40		120
Hydropsyche orris	8	CF	CN	681	500	881	640	542	401	3645
Hydropsyche simulians	4	CF	CN	483	51	801	320	241	352	2248
Hydropsyche sp.	5	CF	CN				80			80
Potamyia flava	6	CF	CN	1521	2604	2400	2641	540	2850	12556
Hydroptilidae	4	SC	cn			80				80
Hydroptila sp.	6	SC	CN							
Mayatrichia sp.	6	SC	CN	200	150					350
Leptoceridae	4	CG	CN				80	140	100	320
Ceraclea sp.	4	CG	CB							
Mystacides sp.										
Oecetis sp.	3	PR	SP						50	50
Polycentropodidae							80			80
Cyrnellus fraternus				40						40
Neureclipsis sp.	6	FC	CN	1		1	1	2	1	6
Coleoptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 125' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Elmidae										
Stenelmis sp.	5	SC	CN						1	1
Diptera										
Ceratopogonidae										
Chironomidae										
Conchapelopia sp.	6	PR	SP		350	1			50	401
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU							
Nanocladius distinctus	2	CG	SP							
Paratendipes albimanus	6	CG	SP							
Polypedilum flavum (convictum)	4	SH	SP	40	200	320	240	41	400	1241
Polypedilum halterale gp.	7	SH	SP							
Rheotanytarsus exiguus gp.	6	FC	CN	1720	2750	3200	3600		1150	12420
Tanytarsus sp.	6	CF	CB	40	300	80	80	680		1180
Empididae	8	CG	SP							
Hemerodromia sp.	6	PR	CN	41	100			20		161
Simuliidae										
Simulium sp.	6	FC	CN							
TOTAL NO. OF ORGANISMS				**9934**	**11109**	**14327**	**11686**	**5596**	**10772**	**63424**
TOTAL NO. OF TAXA				**16**	**17**	**17**	**17**	**17**	**17**	**34**
EPT TAXA										**20**
HBI										**5.57**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence Upstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP	401	801	322	362	321	80	2287
NEMERTEA										
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae					81					81
Musculium transversum	8	CF	BU	53			2	161	1	217
Pisidium sp.	7	CF	BU							
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN							
Nais behningi	6	CG	CN	50					80	130
Nais pardalis	8	CG	CN							
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes										
Crustacea										
Copepoda										
Cyclopoida						40				40
Ostracoda										
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW							
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										
Ephemeroptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence Upstream						
				B1	B2	B3	B4	B5	B6	Total
Baetidae	4	CG	SP	400		760	120		961	2241
Baetis sp.	5	CG	SP							
Labiobaetis longipalpus				353	1285	765	846	5281	1202	9732
Caenidae										
Americaenis ridens	7	CG	SP					321		321
Caenis sp.	7	CG	SP							
Heptageniidae					80		120	160		360
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN		80			160		240
Isonychiidae										
Isonychia sp.	2	CG	SW		161	2	66	321	161	711
Leptophlebiidae	2	CG								
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB							
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN							
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB							
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP		1					1
Hydropsychidae	5	CF	CN	5650	8480	5361	4981	8320	8641	41433
Cheumatopsyche sp.	5	CF	CN	50	160		120	160	160	650
Hydropsyche cf. bidens	5	CF	CN		80			320		400
Hydropsyche orris	8	CF	CN	1255	2000	1523	1441	2881	4321	13421
Hydropsyche simulians	4	CF	CN	50	241	202	60	481	562	1596
Hydropsyche sp.	5	CF	CN							
Potamyia flava	6	CF	CN	2704	5521	4241	2225	10721	5201	30613
Hydroptilidae	4	SC	cn		240			320		560
Hydroptila sp.	6	SC	CN							
Mayatrichia sp.	6	SC	CN		240	200	120	160	401	1121
Leptoceridae	4	CG	CN	100						100
Ceraclea sp.	4	CG	CB							
Mystacides sp.										
Oecetis sp.	3	PR	SP							
Polycentropodidae										
Cyrnellus fraternus										
Neureclipsis sp.	6	FC	CN							
Coleoptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence Upstream						
				B1	**B2**	**B3**	**B4**	**B5**	**B6**	**Total**
Elmidae										
Stenelmis sp.	**5**	**SC**	**CN**				60			60
Diptera										
Ceratopogonidae										
Chironomidae										
Conchapelopia sp.	**6**	**PR**	**SP**	50	240	80	240	480		1090
Corynoneura sp.	**3**	**CG**	**SP**							
Cryptochironomus sp.	**8**	**PR**	**SP**							
Glyptotendipes sp.	**10**	**CF**	**BU**							
Nanocladius distinctus	**2**	**CG**	**SP**				60			60
Paratendipes albimanus	**6**	**CG**	**SP**		80					80
Polypedilum flavum (convictum)	**4**	**SH**	**SP**	200	400	480	360	160	160	1760
Polypedilum halterale gp.	**7**	**SH**	**SP**							
Rheotanytarsus exiguus gp.	**6**	**FC**	**CN**	2800	2160	2401	1140	3680	2800	14981
Tanytarsus sp.	**6**	**CF**	**CB**	100	80	41	300		80	601
Empididae	**8**	**CG**	**SP**							
Hemerodromia sp.	**6**	**PR**	**CN**	100		80		160	160	500
Simuliidae										
Simulium sp.	**6**	**FC**	**CN**			40				40
TOTAL NO. OF ORGANISMS				**14316**	**22411**	**16538**	**12623**	**34568**	**24971**	**125427**
TOTAL NO. OF TAXA				**16**	**20**	**16**	**18**	**19**	**16**	**30**
EPT TAXA										**16**
HBI										**5.77**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP	400	161	1	481	1		1044
NEMERTEA										
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae										
Musculium transversum	8	CF	BU	1		82	241	61	1	386
Pisidium sp.	7	CF	BU							
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN				80			80
Nais behningi	6	CG	CN			80			100	180
Nais pardalis	8	CG	CN				80			80
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes				100		80		60		240
Crustacea										
Copepoda										
Cyclopoida										
Ostracoda										
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW							
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Ephemeroptera										
Baetidae	4	CG	SP	200		400			400	1000
Baetis sp.	5	CG	SP	600			321			921
Labiobaetis longipalpus				1	363	805	321	609	505	2604
Caenidae										
Americaenis ridens	7	CG	SP	100	40	240	80	60	200	720
Caenis sp.	7	CG	SP		40					40
Heptageniidae						320	80			400
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN		200	1		60		261
Isonychiidae										
Isonychia sp.	2	CG	SW	1	1	3	1	64	102	172
Leptophlebiidae	2	CG			80		80			160
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB							
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN							
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB					1		1
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP							
Hydropsychidae	5	CF	CN	4500	2800	6401	2160	3005	5502	24368
Cheumatopsyche sp.	5	CF	CN	100	40	80	1	1	100	322
Hydropsyche cf. bidens	5	CF	CN	100	200					300
Hydropsyche orris	8	CF	CN	1401	721	1361	160	603	2200	6446
Hydropsyche simulians	4	CF	CN	501	321	962		241	604	2629
Hydropsyche sp.	5	CF	CN							
Potamyia flava	6	CF	CN	4001	1401	4641	1681	1143	5001	17868
Hydroptilidae	4	SC	cn	400	80					480
Hydroptila sp.	6	SC	CN							
Mayatrichia sp.	6	SC	CN	200	240	720	80	180	600	2020
Leptoceridae	4	CG	CN				80			80
Ceraclea sp.	4	CG	CB		40					40
Mystacides sp.										
Oecetis sp.	3	PR	SP							
Polycentropodidae										
Cyrnellus fraternus										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Neureclipsis sp.	6	FC	CN		40	2	1			43
Coleoptera										
Elmidae										
Stenelmis sp.	5	SC	CN							
Diptera										
Ceratopogonidae										
Chironomidae										
Conchapelopia sp.	6	PR	SP	500	202	400	640	61	300	2103
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU				400			400
Nanocladius distinctus	2	CG	SP			80				80
Paratendipes albimanus	6	CG	SP							
Polypedilum flavum (convictum)	4	SH	SP	900	241	800	160	120	700	2921
Polypedilum halterale gp.	7	SH	SP	100	40		80			220
Rheotanytarsus exiguus gp.	6	FC	CN	12000	7400	13200	11520	5705	16002	65827
Tanytarsus sp.	6	CF	CB	200	200		800	120	200	1520
Empididae	8	CG	SP							
Hemerodromia sp.	6	PR	CN	100	40	240	80		100	560
Simuliidae										
Simulium sp.	6	FC	CN							
TOTAL NO. OF ORGANISMS				**26406**	**14891**	**30899**	**19608**	**12095**	**32617**	**136516**
TOTAL NO. OF TAXA				**22**	**23**	**22**	**24**	**18**	**17**	**35**
EPT TAXA										**20**
HBI										**5.82**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 125' Downstream					
				B1	B2	B3	B5	B6	Total
PLATYHELMINTHES									
Turbellaria									
Tricladida									
Dugesiidae									
Girardia (Dugesia) tigrina	8	CG	SP	541	321	241	600	321	2024
NEMERTEA									
MOLLUSCA									
Bivalvia									
Veneroida									
Sphaeriidae									
Musculium transversum	8	CF	BU	62			102		164
Pisidium sp.	7	CF	BU						
Gastropoda									
Basommatophora									
Ancylidae									
Ferrissia rivularis	8	SC	CN			1			1
Physidae									
Physella sp.	9	SC	SP			80			80
ANNELIDA									
Oligochaeta									
Tubificida									
Naididae								160	160
Nais barbata	8	CG	CN						
Nais behningi	6	CG	CN	240		320	100	80	740
Nais pardalis	8	CG	CN						
Nais sp.	9	CG	BU	60					60
Pristina sp.	4	CG	CN						
ARTHROPODA									
Arachnoidea									
Acariformes				120	80	80	100	80	460
Crustacea									
Copepoda									
Cyclopoida									
Ostracoda									
Cladocera									
Sidaidae									
Sida crystillina						240			240
Amphipoda									
Crangonyctidae									
Crangonyx sp.	2	CG	SW						
Decapoda									
Cambaridae									
Orconectes sp.	8	SC	SP			1			1
Insecta									
Ephemeroptera									

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 125' Downstream					
				B1	B2	B3	B5	B6	Total
Baetidae	4	CG	SP				100	320	420
Baetis sp.	5	CG	SP						
Labiobaetis longipalpus				301	5		407	483	1196
Caenidae					80	400			480
Americaenis ridens	7	CG	SP	121				80	201
Caenis sp.	7	CG	SP			321			321
Heptageniidae				60			200	480	740
Heptagenia sp.	4	SC	CN					1	1
Maccaffertium mexicanum	5	SC	CN			1		2	3
Maccaffertium sp.	3	SC	CN		80	320	100	240	740
Isonychiidae									
Isonychia sp.	2	CG	SW	1	4	1	4	164	174
Leptophlebiidae	2	CG				80			80
Odonata									
Coenagrionidae	9	PR	CB						
Argia sp.	8	PR	CB						
Enallagma sp.	9	PR	CB						
Libellulidae	9	PR	SP						
Neurocordulia molesta	4	PR	SP			1			1
Plecoptera									
Perlidae									
Acroneuria sp.	1	PR	CN						
Megaloptera									
Corydalidae	4	PR	CB						
Corydalus cornutus	4	PR	CB				1		1
Trichoptera									
Brachycentridae									
Brachycentrus sp.	3	CG	SP						
Hydropsychidae	5	CF	CN	3420	2561	320	3300	4720	14321
Cheumatopsyche sp.	5	CF	CN		160			320	480
Hydropsyche cf. bidens	5	CF	CN						
Hydropsyche orris	8	CF	CN	721	721		601	802	2845
Hydropsyche simulians	4	CF	CN	781	2		5	401	1189
Hydropsyche sp.	5	CF	CN		160				160
Potamyia flava	6	CF	CN	2521	3840	321	3605	5202	15489
Hydroptilidae	4	SC	cn						
Hydroptila sp.	6	SC	CN						
Mayatrichia sp.	6	SC	CN	300		80	300	320	1000
Leptoceridae	4	CG	CN						
Ceraclea sp.	4	CG	CB						
Mystacides sp.									
Oecetis sp.	3	PR	SP						
Polycentropodidae									
Cyrnellus fraternus									
Neureclipsis sp.	6	FC	CN	1	2			1	4
Coleoptera									

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 125' Downstream					
				B1	**B2**	**B3**	**B5**	**B6**	**Total**
Elmidae									
Stenelmis sp.	5	SC	CN						
Diptera									
Ceratopogonidae									
Chironomidae									
Conchapelopia sp.	6	PR	SP	120	81	160	300	560	1221
Corynoneura sp.	3	CG	SP					80	80
Cryptochironomus sp.	8	PR	SP				100		100
Glyptotendipes sp.	10	CF	BU						
Nanocladius distinctus	2	CG	SP	60		80		80	220
Paratendipes albimanus	6	CG	SP						
Polypedilum flavum (convictum)	4	SH	SP	180	561	80	501	480	1802
Polypedilum halterale gp.	7	SH	SP						
Rheotanytarsus exiguus gp.	6	FC	CN	8160	10962	10240	9805	14801	53968
Tanytarsus sp.	6	CF	CB	180	240	1120		320	1860
Empididae	8	CG	SP						
Hemerodromia sp.	6	PR	CN		80	81	100	480	741
Simuliidae									
Simulium sp.	6	FC	CN						
TOTAL NO. OF ORGANISMS				**17950**	**19940**	**14569**	**20331**	**30978**	**103768**
TOTAL NO. OF TAXA				**20**	**18**	**23**	**20**	**26**	**39**
EPT TAXA									**19**
HBI									**5.85**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South Upstream B2	B3	B4	Total
PLATYHELMINTHES							
Turbellaria							
Tricladida							
Dugesiidae							
Girardia (Dugesia) tigrina	8	CG	SP	21	1601	841	2463
NEMERTEA							
MOLLUSCA							
Bivalvia							
Veneroida							
Sphaeriidae							
Musculium transversum	8	CF	BU	20		1	21
Pisidium sp.	7	CF	BU				
Gastropoda							
Basommatophora							
Ancylidae							
Ferrissia rivularis	8	SC	CN				
Physidae							
Physella sp.	9	SC	SP				
ANNELIDA							
Oligochaeta							
Tubificida							
Naididae				40	160		200
Nais barbata	8	CG	CN				
Nais behningi	6	CG	CN	120	480	420	1020
Nais pardalis	8	CG	CN		80		80
Nais sp.	9	CG	BU				
Pristina sp.	4	CG	CN			60	60
ARTHROPODA							
Arachnoidea							
Acariformes						240	240
Crustacea							
Copepoda							
Cyclopoida							
Ostracoda							
Cladocera							
Sidaidae							
Sida crystillina							
Amphipoda							
Crangonyctidae							
Crangonyx sp.	2	CG	SW				
Decapoda							
Cambaridae							
Orconectes sp.	8	SC	SP				
Insecta							
Ephemeroptera							

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South Upstream B2	B3	B4	Total
Baetidae	4	CG	SP				
Baetis sp.	5	CG	SP				
Labiobaetis longipalpus					161		161
Caenidae						60	60
Americaenis ridens	7	CG	SP		80	60	140
Caenis sp.	7	CG	SP				
Heptageniidae				20		60	80
Heptagenia sp.	4	SC	CN				
Maccaffertium mexicanum	5	SC	CN		80		80
Maccaffertium sp.	3	SC	CN				
Isonychiidae							
Isonychia sp.	2	CG	SW		1		1
Leptophlebiidae	2	CG					
Odonata							
Coenagrionidae	9	PR	CB				
Argia sp.	8	PR	CB	21			21
Enallagma sp.	9	PR	CB				
Libellulidae	9	PR	SP				
Neurocordulia molesta	4	PR	SP				
Plecoptera							
Perlidae							
Acroneuria sp.	1	PR	CN				
Megaloptera							
Corydalidae	4	PR	CB				
Corydalus cornutus	4	PR	CB			1	1
Trichoptera							
Brachycentridae							
Brachycentrus sp.	3	CG	SP				
Hydropsychidae	5	CF	CN	320	1200	1380	2900
Cheumatopsyche sp.	5	CF	CN	20	161	241	422
Hydropsyche cf. bidens	5	CF	CN			61	61
Hydropsyche orris	8	CF	CN	20	561	60	641
Hydropsyche simulians	4	CF	CN	60	81	360	501
Hydropsyche sp.	5	CF	CN				
Potamyia flava	6	CF	CN	367	1201	1620	3188
Hydroptilidae	4	SC	cn	20			20
Hydroptila sp.	6	SC	CN				
Mayatrichia sp.	6	SC	CN	160	560	422	1142
Leptoceridae	4	CG	CN				
Ceraclea sp.	4	CG	CB				
Mystacides sp.							
Oecetis sp.	3	PR	SP				
Polycentropodidae							
Cyrnellus fraternus							
Neureclipsis sp.	6	FC	CN		1	1	2
Coleoptera							

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South Upstream B2	B3	B4	Total
Elmidae							
Stenelmis sp.	**5**	**SC**	**CN**				
Diptera							
Ceratopogonidae							
Chironomidae							
Conchapelopia sp.	**6**	**PR**	**SP**	142	80	180	402
Corynoneura sp.	**3**	**CG**	**SP**				
Cryptochironomus sp.	**8**	**PR**	**SP**			60	60
Glyptotendipes sp.	**10**	**CF**	**BU**	20			20
Nanocladius distinctus	**2**	**CG**	**SP**	40	160	60	260
Paratendipes albimanus	**6**	**CG**	**SP**				
Polypedilum flavum (convictum)	**4**	**SH**	**SP**	61	480	240	781
Polypedilum halterale gp.	**7**	**SH**	**SP**				
Rheotanytarsus exiguus gp.	**6**	**FC**	**CN**	6523	12800	8520	27843
Tanytarsus sp.	**6**	**CF**	**CB**	680	2240	1080	4000
Empididae	**8**	**CG**	**SP**	2		60	62
Hemerodromia sp.	**6**	**PR**	**CN**	20	80		100
Simuliidae							
Simulium sp.	**6**	**FC**	**CN**				
TOTAL NO. OF ORGANISMS				**8697**	**22248**	**16088**	**47033**
TOTAL NO. OF TAXA				**21**	**21**	**24**	**33**
EPT TAXA							**15**
HBI							**5.99**

Attachment A

Water Quality Assessment at the Florence and Platte South Potable Water Treatment Plants Discharge

By

Dennis B. George
Dan Dodson
Yvette Clark

The Center for the Management, Utilization, and
Protection of Water Resources,
Tennessee Technological University

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BACKGROUND

The Omaha, NE, Metropolitan Utilities District (M.U.D.) operates the Florence Potable Water Treatment Plant (FWTP) and the Platte South Potable Water Treatment Plant (PSWTP). These plants discharge residuals from the water treatment plants into the Missouri River under NPDES Permit No's. NE0000914 and NE0000906, respectively. The residuals from the FWTP are discharged through Outfalls 001 and 005. Residuals from the PSWTP are discharged through outfall 002. EE&T Inc. contracted with M.U.D. to collect and analyze an adequate number of water and benthic samples to determine the impact (if any) of the discharged solids residuals from FWTP Outfalls 001 and 005 and PSWTP Outfall 002 on water quality and benthic macroinvertebrate communities. To satisfy these requirements Tennessee Technological University's (TTU's) Center for the Management, Utilization, and Protection of Water Resources (CMUPWR), in conjunction with EE&T Inc., collected water samples and performed in situ water column monitoring at the discharge sites June 25-26, 2012. The results of in situ monitoring and laboratory water quality analysis on samples collected at the sites are presented in this report.

The sampling sites are graphically presented in Figures 1 and 2 below. Discharge and gage height during the sampling period are presented in Figures 3 and 4. At the two sampling locations, velocity and streambed morphology data were obtained using the SonTek YSI RiverSurveyor®. Water samples were collected and in situ monitoring was performed at each site that was representative of water quality upstream, within the outfall influence zone and downstream of outfalls.

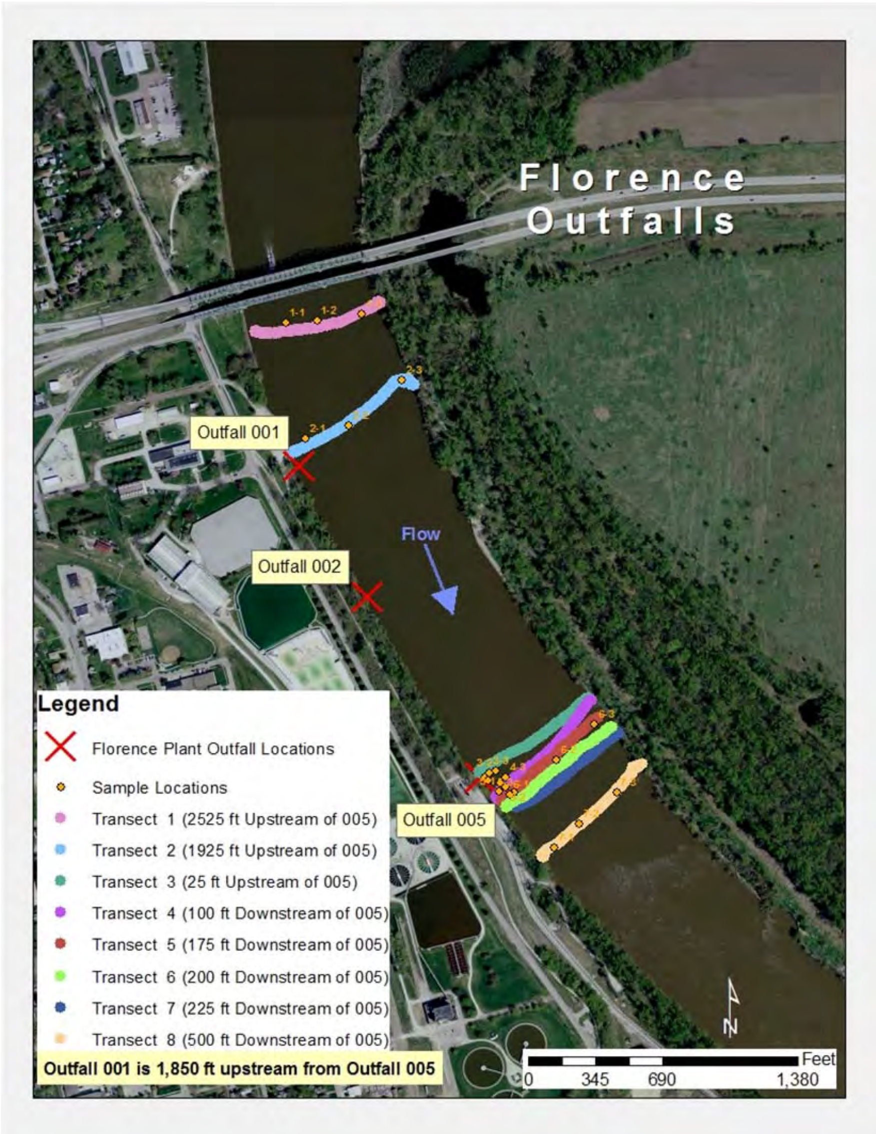


Figure 1. Florence outfalls.

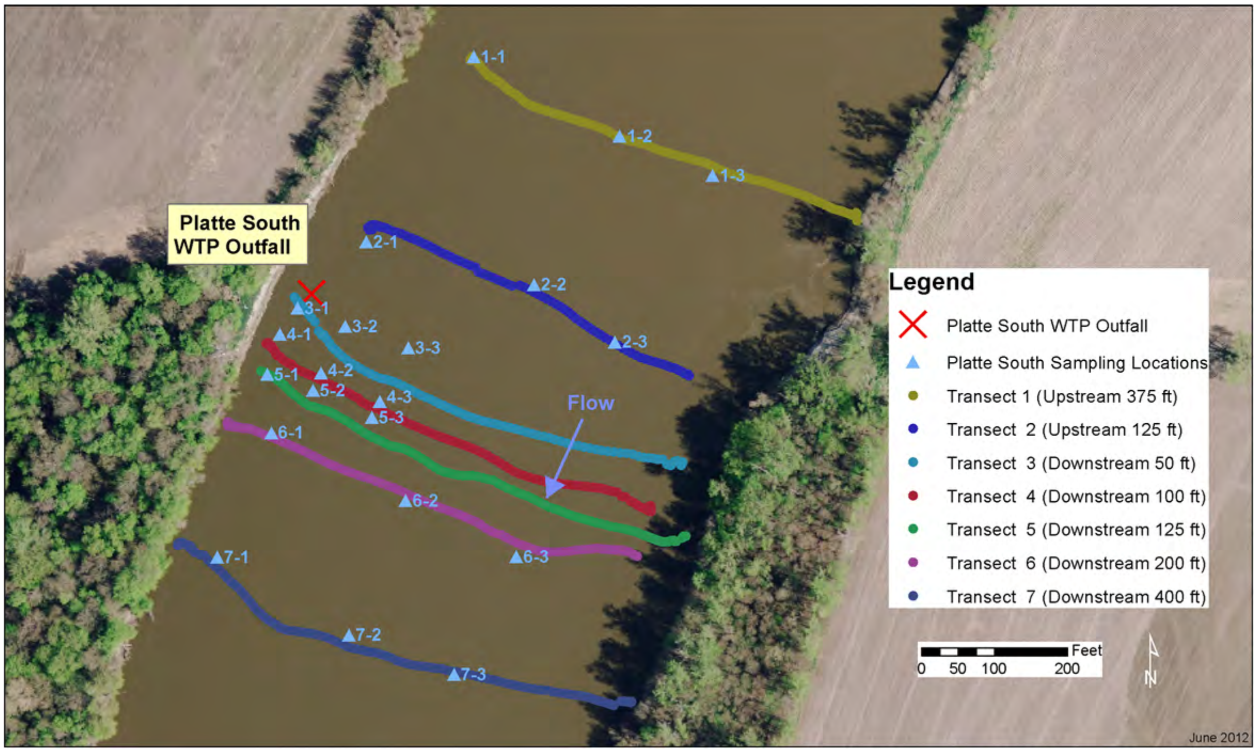


Figure 2. Platte South outfalls.

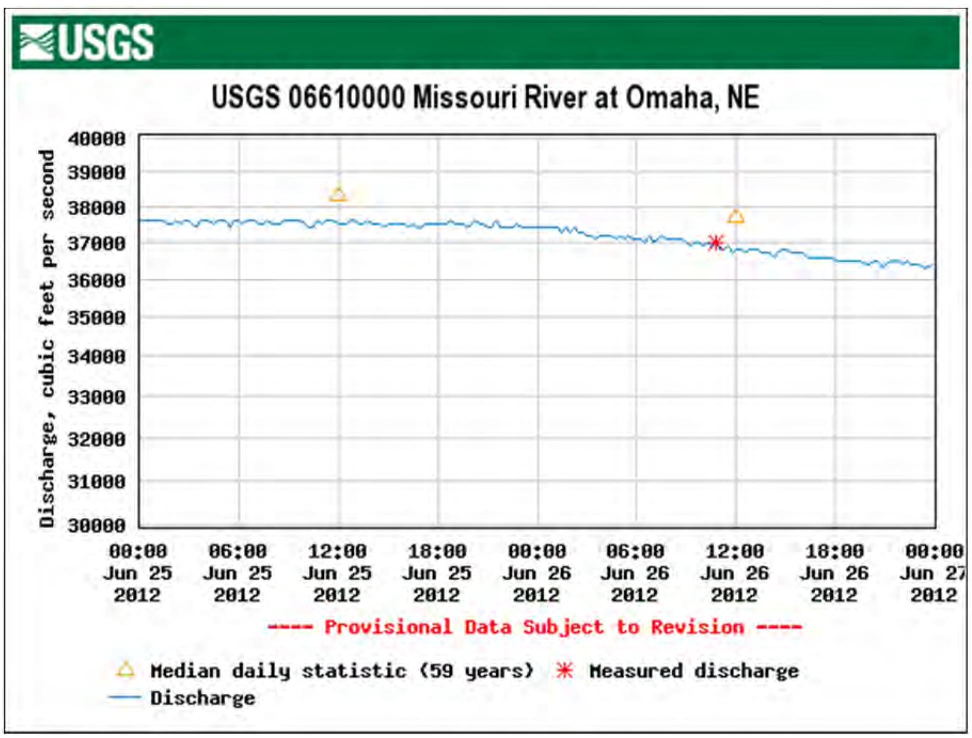


Figure 3. Discharge ft^3/sec.

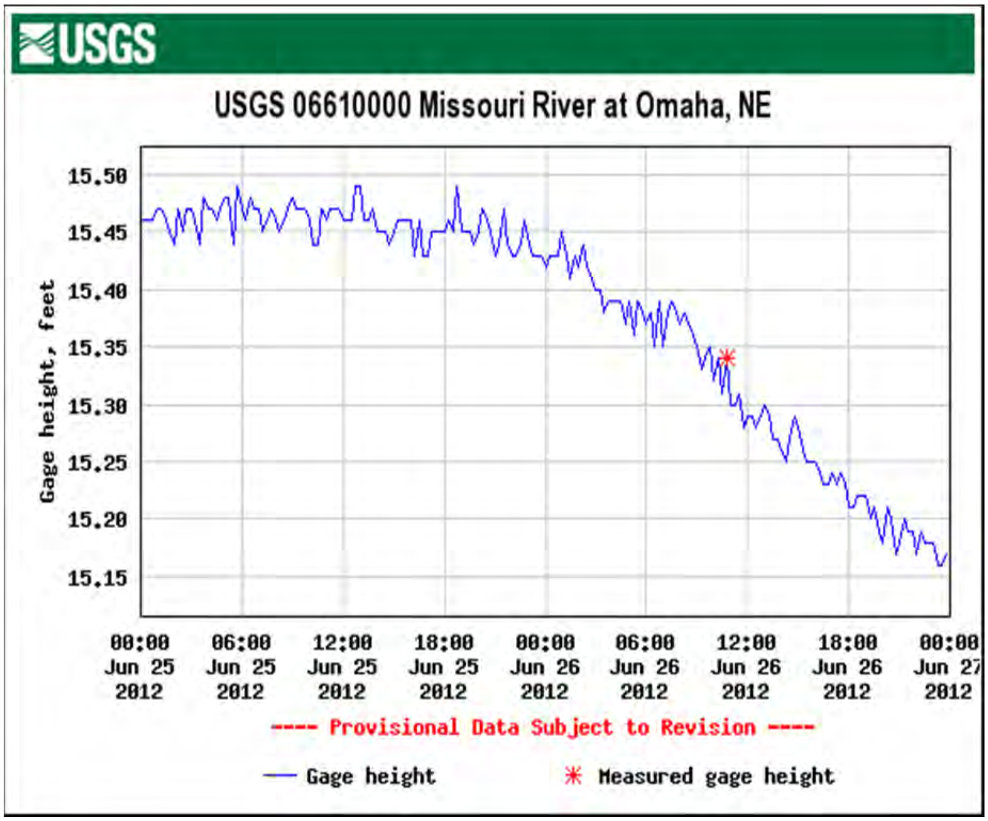


Figure 4. Gage height, ft.

METHODOLOGY

On June 25, 2012, researchers monitored and collected water samples from the Missouri River upstream and downstream from the residual solids discharge Outfall 001 at the FWTP. The monitoring encompassed residual solids discharges from Outfall 002 and Outfall 005. Water samples from the Missouri River were also collected upstream and downstream from the residual solids discharge Outfall 001 at the PSWTP on June 26, 2012. At the FWTP outfall and the PSWTP outfall, seven transects were obtained to define river geomorphology and stream velocity using the SonTek YSI River Surveyor® Acoustic Doppler Profiler (ADP). The locations of the FWTP profiles are represented in Figure 1. The locations of the PSWTP are represented graphically in Figure 2. The SonTek® ADP georeference position was recorded using the Trimble GeoXH GPS system. Water monitoring and sample collection occurred along transects. Streambed morphologies extracted from the SonTek® ADP data are presented in Appendix C for FWPT and PSWTP.

The georeference positions for monitoring and collection of samples were programmed into the Trimble GeoXH GPS system. Grab samples were collected across the width of the upstream and downstream transects. Sample collection points in the outfall influence zone covered approximately one-third of the stream width. Samples were collected by navigating the water craft to a location that corresponded to the reference point stored in the Trimble GeoXH

GPS system. The locations of the sampling positions for the FWTP are shown in Figure 1 and sampling positions for the PSWTP are shown in Figure 2. Once the boat arrived at the desired monitoring position, water samples were collected at three depths (0.8, 0.5 and 0.2) using a modified pull-ring sampler (Wheaton, Model#EW-99152-20). Field duplicates were collected at a 10% level (i.e., every 10th sample). After water was sampled, pH, temperature, dissolved oxygen (DO), and conductivity were collected by deploying a Hydrolab H20® datasonde (HACH) at the location. The Hydrolab H2O® datasonde also records depth so that collected data were obtained at the prescribed depths of 0.2, 0.5, and 0.8. Stream depth at each location was determined using an electronic stream depth finder. Collected water samples were packed in ice and shipped via FedEx courier overnight to TTU's Environmental Analytical Laboratory in the CMUPWR for analysis. All samples were preserved according to EPA criteria and were analyzed for the parameters listed in Table 1 within acceptable time limits.

Table 1. Water quality parameters measured.

Parameter	Method	Analysis Location
Total Suspended Solids (TSS)	SM2540D	TTU
Settable Solids(SS)	ASTM D3977	TTU
Aluminum- Total & Dissolved	EPA 200.7	TTU
Iron – Total & Dissolved	EPA 200.7	TTU
Copper – Total and Dissolved	EPA 200.7	TTU
Manganese – Total and Dissolved	EPA 200.7	TTU
Nickel – Total & Dissolved	EPA 200.7	TTU
Selenium – Total & Dissolved	EPA 200.7	TTU
Zinc – Total & Dissolved	EPA 200.7	TTU
Hardness	SM 2340 B	TTU
Alkalinity	SM2320B	TTU

All the water quality data collected for the FWTP are presented in Appendix A. Similarly, all the water quality data for the PSWTP are presented in Appendix B. All the transect and velocity data are presented in Appendix C for each water treatment plant. Tukey's (SAS, 2012) statistical comparison of water quality parameter mean concentrations was conducted on all data to determine significant differences upstream and downstream of the residual solids discharge Outfall 005 for the FWTP and Outfall 002 for the PSWTP.

RESULTS AND DISCUSSION

Missouri River Hydrology at the FWTP and PSWTP Residual Solids Discharge Outfalls

Velocity and Profile Measurement. At the two sampling locations (FWTP and PSWTP), velocity and streambed morphology data were obtained using the SonTek YSI RiverSurveyor®. This instrumentation belongs to a group of instruments known as acoustic Doppler current profilers (ADCPs). This system is a robust and accurate Acoustic Doppler Profiler Flow Measurement system designed to quickly measure river discharge from a moving vessel. Real-time data collection is accomplished using the Windows XP® compatible RiverSurveryor software program.

An Acoustic Doppler Profiler (ADP) is an instrument that measures the velocity of water using a physical principle called the Doppler shift. The ADP is the principle component of every River-Surveyor system. A SonTek ADP has three transducers mounted in the transducer head of the system. Each of these transducers has a different orientation and generates a narrow beam of sound that is projected through the water. Reflections from particles or "scatterers" (such as suspended sediment, biological matter, or bubbles) in the water column are used to determine the water velocity. The geometric orientation of each of the transducers allows the ADP to calculate the velocity of the water using a Cartesian (XYZ) coordinate system relative to the position and orientation of the instrument. The internal compass and tilt sensor (roll/pitch) used with all RiverSurveyor systems is able to calculate the water velocities in Earth coordinates (East-

North-Up or ENU) independent of the system's location. The following describes the ADP sampling strategy:

- An individual measurement of the 3D velocity profile is called a "ping."
- The ADP pings as rapidly as possible (4 to 20 times per second depending upon frequency).
- Pings are averaged over the user-specified averaging interval to produce a mean 3D velocity profile.

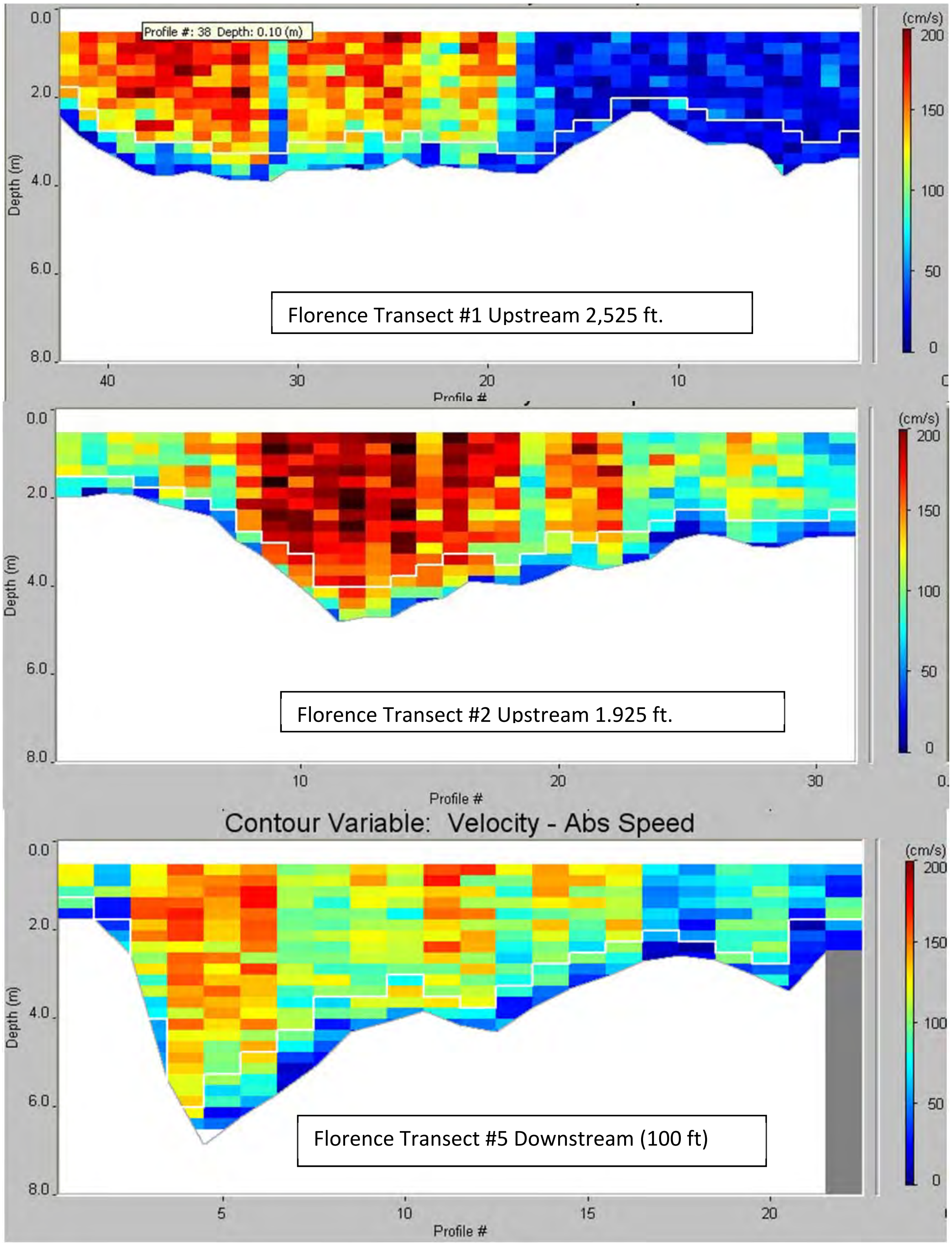
The SonTek River Surveyor is available in frequencies shown in the Table 2. A 1500 kHz instrument was used by TTU.

Table 2. Available SonTek instrument configurations.

ADP Frequency	Maximum	Typical	Blanking	Minimum
	Profiling Range	Resolution		Depth
3.0 MHz	0.6 – 6 m	0.15 – 2 m	0.2 m	10 m
1500 kHz	15-25 m	0.25 - 1.0 m	0.4 m	0.9 m
1000 kHz	25-40 m	0.4 - 2.0 m	0.5 m	1.3 m
500 kHz	0-120 m	1.0 - 5.0 m	1.0 m	3.0 m
250 kHz	20-180 m	1.0 - 10 m	1.5 m	3.5 m

The measurement location is a function of the time at which the return signal is sampled. The time since the pulse was transmitted determines how far the pulse has traveled and specifies the location of the particles that are the source of the reflected signal. By measuring the return signal at different times, the ADP measures the water velocity at different distances from the transducer. The profile of water velocity is divided into range cells, where each cell represents the average of the return signal for a given period. ADPs measure water current velocities along each of the transducer beams and transform these velocities into Cartesian (XYZ) or Earth (ENU) coordinates. The beams are divided into discrete increments or *cells* (also known as *range cells* or *depth cells*) of a specific length. Current profiling can be thought of as dividing a river or stream into several horizontal slices (rows) from top to bottom (columns). The “rows” represent individual cells, and the “columns” represent vertical profiles. Each slice (row of cells) will contain water flowing at a certain velocity. Slices/rows/cells closer to the bottom will tend to flow slower than cells at mid-depth due to friction. The cells at the left and right edges of each row also tend to flow slower than cells in the center of the row. The ADP measures the velocity of the water in each of these cells and produces a velocity profile from the top of the column to the bottom of the column. By moving the ADP from one side of a river to the other, all the adjacent profiles can be added together and the average velocity for all the water in the river can be determined. The cell velocity profiles for representative transects are presented graphically in Figure 5.

Figure 5. Florence transects.



The calculated discharge results and stream width were relatively consistent for the three locations Table 3. Average velocity was significantly higher at the upstream locations since the channel depth was less.

Table 3. FWTP discharge results.

Florence Computed Discharge Results			
Transect #	1	2	5
Width m	216.2	210.6	225.8
Area m^2	741.8	743.1	878.9
Mean Velocity m/s	1.35	1.25	1.06
Discharge m^3/sec	-999.6	-926.45	-934.79
% Measured	70.3	70.2	73.1

Figure 6 shows the typical transects for the Missouri River at the PSWTP residual solids discharge outfalls. In general, the river channel was deeper at the PSWTP (2-4 m) than river channel at the FWTP (2-8 m). This results in lower mean river velocities at the PSWTP (Table 4) than at the FWTP.

Figure 6. Platte transects.

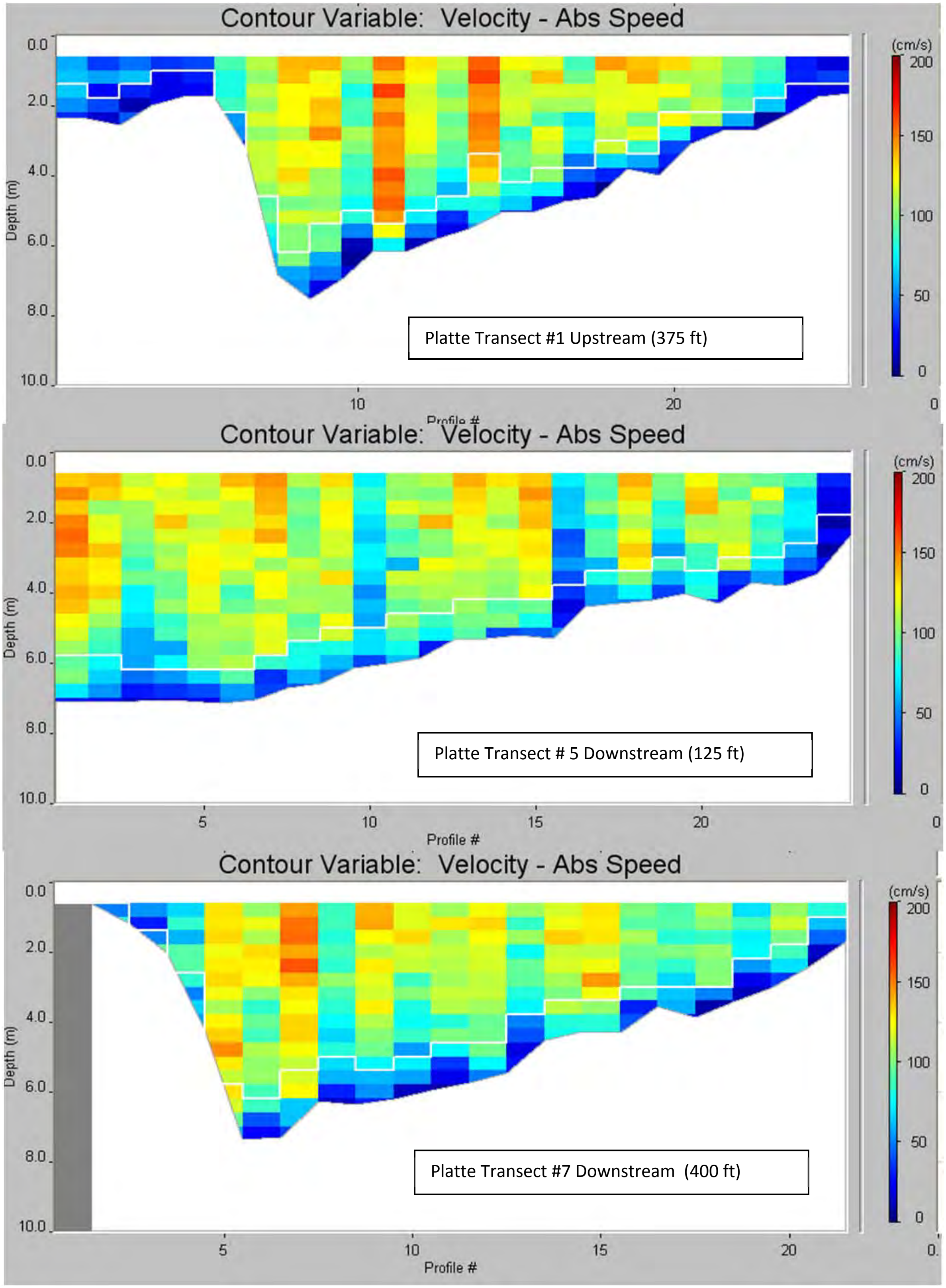


Table 4. Missouri River flow characteristics at the PSWTP residual discharge outfall area.

Computed Discharge Results Platte Transects			
Transect #	#1	#5	#7
Width m	227.1	196.6	198.1
Area m^2	1082.4	857.5	878
Mean Velocity m/sec	0.92	0.98	1.05
Discharge m^3/sec	-992.63	-837.67	-918.51
% Measured	65.2	71	70

Estimating Flow for Non-Gaged Locations (FWTP and the PSWTP). The sampling areas for the two outflow locations were not located at a stream gage. There were gages upstream and downstream from the sample location. Therefore, the flow was estimated using weighted average ratios of gage drainage areas to outfall drainage area (http://ks.water.usgs.gov/pubs/reports/wrir.02-4292.tab03.pdf, 2012).

$$Q_s = \frac{Q_u(DA_d - DA_s) + Q_d(DA_s - DA_u)}{DA_d - DA_u} \qquad (1)$$

Where

Q = Median Flow,

DA = Drainage Area,

s = Segment Ungaged

u = Upstream gaging station, and

d = Downstream gaging station.

Estimated flows at the Florence and Platte outfalls are presented in Table 5.

Table 5. Estimated flows for outfall locations.

Location	June 25, 2012	June 26, 2012
Platte Outfall	37,544 cfs	36,848 cfs
Florence Outfall	37,408 cfs	36,725 cfs

Missouri River Water Quality at the FWTP and PSWTP Residual Solids Discharge Outfalls Area

Florence Water Treatment Plant. Historically, discharging water treatment residuals to surface waters has been commonly practiced as an acceptable disposal method. The M.U.D.'s FWTP is a lime-softening facility. Residual solids from pre-sedimentation basins are continuously pumped to the Missouri River, whereas solids from four 20-million gal (75,700 m^3) sedimentation basins are discharged to the river twice each year. In addition, primary residual solids in the split-treatment reactors are continuously pumped to the river. Also, filter bed backwash water is wasted to the Missouri River. Residual solids from the FWTP are discharged to the Missouri River at three locations (Figure 1). Discharge Outfall 001 is at georeference point 95º 57' 26" W 41º 20' 35" N. Outfall 002 is 95º 57' 22" W 41º 20' 28" N. Outfall 005 is 95º 57' 15" W 41º 20' 19" N. Each outfall was located at the river's right edge, when looking in direction of flow, and near the water surface. The average water temperature was approximately 25^{o}C. The DO levels in the river upstream and downstream of the residual solids discharge outfalls ranged from 7.45 mg/L to 9.48 mg/L. Average DO concentrations for each transect position and depth are presented in Table 6. Upstream monitoring locations are above Outfall 001, and downstream monitoring locations are below Outfall 005. The discharge from Outfall 005 apparently created surface turbulence in the water surface, thereby increasing the reaeration rate at the point that yielded an average DO of 8.25 mg/L, which was significantly (α = 0.05) higher than average upstream levels and average DO concentrations obtained 150 ft (46 m) (7.81 mg/L) and 500 ft (152 m) (7.67 mg/L) downstream from Outfall 005. Higher Dos were observed at deeper locations, probably due to cooler water temperatures.

Table 6. Average dissolved oxygen concentration (mg/L) upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream -2,525ft (770m)	0.2	3	7.58	0.16	7.46	7.76
	0.5	3	7.9	0.36	7.52	8.23
	0.8	3	7.89	0.34	7.51	8.16
Upstream -1,925ft (587m)	0.2	3	7.7	0.12	7.56	7.8
	0.5	3	7.69	0.12	7.59	7.83
	0.8	3	7.67	0.08	7.61	7.76
Outfall - 0.0ft (0.0m)	0.2	3	8	0.04	7.97	8.05
	0.5	3	8.53	0.82	8.02	9.48
	0.8	3	8.23	0.29	7.96	8.54
Downstream-50ft (15.2m)	0.2	3	7.93	0.21	7.8	8.17
	0.5	3	8.04	0.22	7.83	8.27
	0.8	3	8.18	0.32	7.85	8.48
Downstream-100ft(30.5 m)	0.2	3	7.81	0.2	7.61	8.01
	0.5	3	8.46	0.57	7.93	9.07
	0.8	3	8.03	0.24	7.8	8.27
Downstream-150ft (61 m)	0.2	3	7.55	0.05	7.5	7.6
	0.5	3	7.86	0.35	7.51	8.2
	0.8	3	8.03	0.46	7.53	8.43
Downstream-500ft (152m)	0.2	3	7.55	0.11	7.45	7.66
	0.5	3	7.76	0.27	7.5	8.03
	0.8	3	7.7	0.11	7.59	7.8

*Outfall 001 is 1,850 ft (564m) upstream from Outfall 005

The drier areas of the Missouri River watershed are located above Omaha, where a greater percentage of the rainfall infiltrates into the calcareous soils and geological formations, and a disproportionately lower amount of rainfall surface runoff occurs compared to runoff amounts observed in the lower portions of the watershed (USAE, 2009). The Missouri River normally has an alkaline pH with values above the FWTP residual solids discharge point, normally ranging from 8 to 9 (USGS, 2010, EPA Storet Data). The river pH values upstream and downstream from the residual solids discharge outfalls ranged from 8.44 SU to 8.60 SU. Differences in pH of less than 0.5 SU are normally insignificant.

With a greater percentage of the Missouri River above Omaha fed from interflow and baseflow through calcareous soils and geological formations, the water of the Missouri River is hard. Hardness values upstream and downstream of the FWTP outfalls ranged from 254 mg $CaCO_3$/L to 302 mg $CaCO_3$/L (Table 7). While the hardness concentration 1,925 ft (587m) upstream (291 mg $CaCO_3$/L) from Outfall 005 was significantly ($\alpha = 0.05$) higher than the average concentration 150 ft downstream (265 mg $CaCO_3$/L) from Outfall 005, there were no significant differences among levels at other distances monitored. Corresponding alkalinity ranged from 179 mg $CaCO_3$/L to 273 mg $CaCO_3$/L (Table 8). Due to the variability of the data, there were no statistically significant ($\alpha = 0.05$) differences in alkalinity concentrations.

Table 7. Average hardness concentrations (mg CaCO3/L) upstream and downstream from the FWTP residual solids discharge Outfall 005.

Position		Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft	(770m)	0.2	4	278	17	261	297
		0.5	3	277	18	261	297
		0.8	3	291	15	274	302
Upstream-1,926ft	(587m)	0.2	4	296	9	287	308
		0.5	3	288	3	284	290
		0.8	3	289	8	281	297
Outfall-0.0ft	(0.0m)	0.2	4	289	4	284	293
		0.5	3	290	1	289	290
		0.8	3	292	2	291	294
Downstream-50ft	(15.2m)	0.2	3	272	23	257	298
		0.5	4	269	19	256	297
		0.8	3	263	5	259	268
Downstream-100ft	(30.5m)	0.2	3	261	1	260	262
		0.5	3	262	5	256	266
		0.8	4	292	68	254	394
Downstream-150ft	(61m)	0.2	3	266	3	262	268
		0.5	3	267	4	262	270
		0.8	4	264	4	259	268
Downstream-500ft	(152m)	0.2	3	273	16	258	290
		0.5	4	265	4	260	269
		0.8	3	269	2	267	271

*Outfall 001 is 1,850 ff (564) upstream from 005

Table 8. Average alkalinity concentrations (mg $CaCO_3$/L) upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	185	5	179	190
	0.5	3	187	2	185	189
	0.8	3	186	1	185	187
Upstream-1,925ft (587m)	0.2	4	186	1	184	187
	0.5	3	184	5	179	188
	0.8	3	177	10	165	184
Outfall-0.0ft (0.0m)	0.2	4	183	3	180	186
	0.5	3	185	2	183	186
	0.8	3	184	1	183	184
Downstream-50ft (15.2m)	0.2	3	185	1	184	186
	0.5	4	183	2	182	185
	0.8	3	184	4	179	186
Downstream-100ft (30.5m)	0.2	3	185	1	184	186
	0.5	3	183	2	181	185
	0.8	4	206	45	180	273
Downstream-150ft (61m)	0.2	3	186	3	184	190
	0.5	3	187	2	185	189
	0.8	4	185	2	183	187
Downstream-500ft from	0.2	3	185	3	183	188
	0.5	4	186	1	184	187
	0.8	3	186	2	185	189

*Outfall 001 is 1,850 ft (564m) upstream from outfall 005.

Average total suspended solids (TSS) concentrations upstream and downstream from Outfall 001 are presented in Table 9. TSS values ranged from 31 mg/L (500 ft downstream from Outfall 005 at 0.5 depth) to 269 mg/L (100 ft downstream from Outfall 005 at 0.8 depth). No statistically significant ($\alpha = 0.05$) differences were computed between average TSS levels at different locations. Therefore, no significant increases in average TSS were observed during the discharge of residual solids at the FWTP during the monitoring period. Settleable solids (SS) concentrations were all <1.0 mg/L (detection limit), indicating the bulk of the solids were probably silt, clay particles or other fine particles with low settling rates.

Table 9. Average total suspended solids concentrations (mg/L) upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	79	6	70	85
	0.5	3	75	19	53	87
	0.8	3	81	8	73	89
Upstream-1,925ft (587m)	0.2	4	74	6	66	81
	0.5	3	78	11	68	89
	0.8	3	82	14	67	95
Outfall-0.0ft (0.0m)	0.2	4	73	4	70	78
	0.5	3	69	2	67	71
	0.8	3	68	4	65	73
Dwonstream-50ft (15m)	0.2	3	72	5	67	76
	0.5	4	70	4	67	76
	0.8	3	74	5	69	78
Downstream-100ft (30.5m)	0.2	3	71	4	68	76
	0.5	3	78	2	76	79
	0.8	4	127	95	76	269
Downstream-150ft (46m)	0.2	3	80	10	72	92
	0.5	3	82	12	69	91
	0.8	4	82	10	70	93
Downstream-500ft (152m)	0.2	3	76	9	70	86
	0.5	4	69	26	31	87
	0.8	3	80	8	71	86

*Outfall 001 is 1,850 ft (564m) upstream from Outfall 005.

While no significant change in TSS was observed in the Missouri River from the discharge of residual solids, there was a significant difference in the aluminum concentrations (Table 10). The average total aluminum concentration at a distance of 150 ft (46 m) from residual solids Outfall 005 (2.210 mg/L) was significantly different ($\alpha = 0.05$) than the average concentration measured at Outfall 005 (1.468 mg/L). The overall average aluminum concentration (1.938 mg/L) at 2,525 ft (770 m) upstream from Outfall 005 also was significantly greater ($\alpha = 0.05$) than the levels measured at Outfall 005. There were no significant differences ($\alpha = 0.05$) between average aluminum concentration at 2,525 ft (770 m) upstream and 1,925 ft (587 m) upstream of Outfall 005. Adding uncertainty to the issue is the mean aluminum concentrations upstream from the outfall were not significantly different (α=0.05) than the mean concentration obtained at position 500 ft (152m) downstream from Outfall 005. It is inconclusive, that the concentration of aluminum at 150 ft and 500 ft (152 m) downstream from

Outfall 005 reflected the contribution of FWTP residual solids introduced at Outfall 005.

Aluminum is amphoteric-soluble in acidic and basic solutions, but very insoluble at circumneutral pH. Since the pH was slightly basic, low levels of dissolved aluminum were present in the river (Table 11). The bulk of the aluminum in the water was in particulate form, which ranged from <0.063 mg/L to 0.288 mg/L.

Table 10. Average total aluminum concentration upstream and downstream from the FWTP residual solids Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	1.812	0.465	1.300	2.253
	0.5	3	2.026	0.280	1.703	2.196
	0.8	3	2.017	0.173	1.851	2.196
Upstream-1,925ft (587m)	0.2	4	1.898	0.304	1.592	2.186
	0.5	3	1.865	0.188	1.651	2.005
	0.8	3	1.678	0.162	1.567	1.864
Outfall-0.0ft (0.0m)	0.2	4	1.338	0.031	1.300	1.368
	0.5	3	1.583	0.078	1.493	1.630
	0.8	3	1.525	0.081	1.469	1.618
Downstream-50ft (15m)	0.2	3	1.757	0.125	1.641	1.889
	0.5	4	1.742	0.111	1.590	1.853
	0.8	3	1.813	0.108	1.703	1.919
Downstream-100ft (30.5m)	0.2	3	1.710	0.092	1.637	1.814
	0.5	3	1.845	0.024	1.824	1.871
	0.8	4	1.949	0.264	1.712	2.326
Downstream-150ft (46m)	0.2	3	2.208	0.385	1.802	2.569
	0.5	3	2.293	0.314	1.945	2.556
	0.8	4	2.151	0.405	1.781	2.595
Downstream-500ft (152m)	0.2	3	2.100	0.121	1.962	2.185
	0.5	4	1.992	0.150	1.883	2.213
	0.8	3	2.073	0.185	1.906	2.271

Table 11. Average dissolved aluminum (mg/L) upstream and downstream from FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	0.096	0.053	< 0.063	0.156
	0.5	3	0.187	0.027	0.156	0.208
	0.8	3	0.104	0.065	0.031	0.157
Upstream-1,925ft (587m)	0.2	4	0.165	0.045	0.119	0.214
	0.5	3	0.152	0.046	0.107	0.199
	0.8	3	0.163	0.082	0.083	0.246
Outfall-0.0ft (0.0m)	0.2	4	0.203	0.034	0.166	0.248
	0.5	3	0.222	0.018	0.205	0.24
	0.8	3	0.222	0.067	0.154	0.288
Downstream-50ft (15.2m)	0.2	3	0.156	0.054	0.115	0.217
	0.5	4	0.155	0.086	0.078	0.275
	0.8	3	0.125	0.022	0.1	0.141
Downstream-100ft (30m)	0.2	3	0.157	0.014	0.147	0.173
	0.5	3	0.137	0.037	0.114	0.18
	0.8	4	0.162	0.017	0.143	0.182
Downstream-150ft (61m)	0.2	3	0.165	0.016	0.146	0.176
	0.5	3	0.135	0.037	0.103	0.176
	0.8	4	0.131	0.06	0.072	0.209
Downstream-500ft (152m)	0.2	3	0.11	0.076	<0.063	0.183
	0.5	4	<0.063	0.033	<0.063	0.099
	0.8	3	0.082	0.088	<0.063	0.183

**Outfall 001 is 1,850 ft (564) upstream from Outfall 005.*

Aluminum salts can dissociate in water and Al^{+3} bonds with water molecules, hydroxide ions, other inorganic ions, and organic ions or molecules. At pH levels ranging from 4.0 to 8.5, aluminum-phosphate and aluminum-organic complexes are formed that are very insoluble and consequently precipitate from solution (EPA, 1988; Driscoll and Schecker, 1988).

When aluminum is mobilized in surface water, it may be toxic to aquatic life (Burrows, 1977; Schofield and Trojnar, 1980; Freeman and Everhart, 1971, 1973, George et al., 1991). The water hardness and the alkalinity, however, will decrease the toxicity of soluble aluminum on aquatic life (George et al., 1991, 1995). Lime-softening water treatment plants may not adversely aquatic life due to high calcium concentrations and associated high alkalinity.

The mean calcium concentrations upstream and downstream of Outfall 005 are presented in Table 12. While calcium concentrations ranged from 60.162 mg/L to 101.940 mg/L, no statistical differences ($\alpha = 0.05$) were computed between average calcium concentrations throughout the river reach monitored. Aluminum interactions with calcium may reduce the solubility of aluminum in circumneutral and basic solutions (Sposito, 1989). Previous toxicity testing of the M.U.D.'s FWTP residual solids discharged to the Missouri River was conducted by George et al. (1995). Residual solids and associated receiving water were obtained from the FWTP. The residual solids were divided into three parts, and the pH of each aliquot was altered to either an acidic, a circumneutral, or a basic condition. The residual solids were mixed for 24 hrs and filtered with a 0.45μm membrane filter. The extracts were diluted with receiving water at corresponding solids extract pH conditions. The extracts were subjected to a series of bioassays. Growth inhibition of *S. capricornutum* only occurred when the organism were subjected to 50 and 100% of extract solutions at pH 6, and only 100% filter extracts inhibited growth at pH 8.3 (George et al., 1995). With the tremendous dilution factor of the river to discharge flow of more than 1000:1, along with the high calcium and alkalinity concentrations, the solids residual discharge into the river should not significantly inhibit aquatic organisms.

Table 12. Average total calcium concentrations upstream and downstream of the FWTP residual solids Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	66.582	3.978	62.996	70.517
	0.5	3	66.005	4.386	62.327	70.859
	0.8	3	69.214	4.320	64.267	72.247
Upstream-1,925ft (587m)	0.2	4	69.772	1.448	67.913	71.432
	0.5	3	68.537	0.582	67.897	69.034
	0.8	3	68.265	1.791	66.750	70.242
Outfall-0.0ft (0.0m)	0.2	4	69.142	0.496	68.572	69.757
	0.5	3	68.928	0.711	68.136	69.510
	0.8	3	69.774	1.320	68.524	71.155
Downstream-50ft (15.2m)	0.2	3	64.765	5.899	60.162	71.415
	0.5	4	63.649	4.995	60.634	71.120
	0.8	3	62.146	1.211	60.784	63.102
Downstream-100ft (30.5)	0.2	3	61.861	0.147	61.716	62.009
	0.5	3	61.744	1.138	60.635	62.908
	0.8	4	71.441	20.348	60.338	101.940
Downstream-150ft (61m)	0.2	3	63.049	0.954	61.949	63.650
	0.5	3	62.885	1.115	61.617	63.710
	0.8	4	62.631	1.029	61.585	63.602
Downstream-500ft (152m)	0.2	3	66.051	5.975	61.279	72.752
	0.5	4	62.255	0.994	60.986	63.414
	0.8	3	63.872	0.650	63.359	64.603

*Outfall 001 is 1,850 ft (564m) upstream from Outfall 005.

The chemistry of iron and aluminum in water are similar; however, iron species are less soluble than aluminum species over a wider pH range. Mean iron concentrations are presented in Table 13. Average iron concentrations upstream (> 2.000 mg/L) from Outfall 5 were significantly greater than the average concentration in water samples collected at Outfall 005 (1.464 mg/L to 1.741 mg/L). The upstream iron concentrations were not significantly different ($\alpha = 0.05$) than the mean iron concentrations at 150 ft (61m) and 500 ft (152m) downstream from Outfall 005. Similarly, there were no significant differences ($\alpha = 0.05$) between the mean iron concentrations at Outfall 005, 50 ft (15.2m) and 100 ft (30.5m) downstream. The residual solids discharge may have diluted the iron concentration immediately downstream from the discharge.

Table 13. Average total iron concentrations upstream and downstream from the FWTP residual solids Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	2.184	0.404	1.599	2.497
	0.5	3	2.038	0.513	1.464	2.452
	0.8	3	2.272	0.299	1.940	2.521
Upstream-1,925ft (587m)	0.2	4	2.098	0.345	1.741	2.432
	0.5	3	2.073	0.233	1.824	2.285
	0.8	3	1.896	0.174	1.768	2.094
Outfall-0.0ft (0.0m)	0.2	4	1.464	0.028	1.433	1.500
	0.5	3	1.741	0.057	1.675	1.774
	0.8	3	1.695	0.097	1.594	1.788
Downstream-50ft (15.2m)	0.2	3	1.680	0.128	1.555	1.811
	0.5	4	1.658	0.128	1.529	1.830
	0.8	3	1.622	0.083	1.554	1.714
Downstream-100ft (30.5m)	0.2	3	1.545	0.090	1.469	1.645
	0.5	3	1.631	0.029	1.597	1.649
	0.8	4	1.726	0.180	1.585	1.987
Downstream-150ft (61m)	0.2	3	2.004	0.423	1.554	2.394
	0.5	3	2.111	0.315	1.767	2.385
	0.8	4	1.999	0.404	1.622	2.440
Downstream-500ft (152m)	0.2	3	2.004	0.267	1.754	2.285
	0.5	4	2.033	0.217	1.796	2.322
	0.8	3	2.089	0.297	1.824	2.410

The average magnesium concentrations at Outfall 005 (28.307 mg/L to 28.683 mg/L) were significantly higher than levels measured at 150 ft (46 m) and 500 ft (152 m) downstream from Outfall 005 (Table 14). There were no significant differences between average magnesium concentrations at Outfall 005 and upstream levels, which were greater than 27 mg/L. Similar to observations with iron, the residual solids discharge may have diluted the magnesium levels in the plume from Outfall 005.

Table 14. Average total magnesium concentrations upstream and downstream of FWTP residual solids discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	27.154	1.801	25.235	29.310
	0.5	3	27.112	1.874	25.516	29.175
	0.8	3	28.536	0.994	27.458	29.417
Upstream-1,925ft (587m)	0.2	4	29.466	1.407	28.523	31.561
	0.5	3	28.331	0.419	27.893	28.728
	0.8	3	28.692	0.839	27.770	29.409
Outfall-0.0ft (0.0m)	0.2	4	28.307	0.573	27.486	28.817
	0.5	3	28.533	0.260	28.289	28.807
	0.8	3	28.683	0.772	27.795	29.197
Downstream-50ft (15m)	0.2	3	26.865	2.032	25.378	29.180
	0.5	4	26.815	1.566	25.334	29.017
	0.8	3	26.229	0.558	25.794	26.859
Downstream-100ft (30.5m)	0.2	3	25.861	0.234	25.602	26.057
	0.5	2	25.894	0.684	25.410	26.377
	0.8	4	27.642	4.208	25.163	33.941
Downstream-150ft (46m)	0.2	3	26.386	0.264	26.083	26.564
	0.5	3	26.621	0.452	26.242	27.121
	0.8	4	26.091	0.514	25.357	26.522
Downstream-500ft (152m)	0.2	3	26.338	0.925	25.434	27.283
	0.5	4	26.484	0.352	26.151	26.956
	0.8	3	26.474	0.103	26.372	26.578

Manganese concentrations were relatively low, ranging from 0.128 mg/L to 0.186 mg/L Table 15. No significant differences ($\alpha = 0.05$) between manganese concentrations at various positions upstream and downstream of Outfall 005 were computed. Similarly, average zinc concentrations were low (Table 16.) Statistical comparison of data between different positions upstream and downstream of Outfall 005 indicated no significant differences ($\alpha = 0.05$) between average zinc concentrations. Trace metals such as copper (Table A.5), nickel (Table A.9) and selenium (Table A.10) were less than instrumental detection limits.

Table 15. Average total manganese concentrations upstream and downstream of FWTP solids residuals discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	0.166	0.023	0.134	0.186
	0.5	3	0.158	0.024	0.131	0.176
	0.8	3	0.172	0.012	0.159	0.181
Upstream-1,925ft (587m)	0.2	4	0.163	0.016	0.146	0.177
	0.5	3	0.161	0.009	0.150	0.167
	0.8	3	0.153	0.011	0.142	0.164
Outfall-0.0ft (0.0m)	0.2	4	0.132	0.003	0.129	0.136
	0.5	3	0.148	0.001	0.147	0.149
	0.8	3	0.147	0.006	0.141	0.153
Downstream-50ft (15.2m)	0.2	3	0.141	0.011	0.132	0.154
	0.5	4	0.140	0.011	0.130	0.156
	0.8	3	0.137	0.005	0.132	0.141
Downstream-100ft (30.5m)	0.2	3	0.133	0.005	0.128	0.138
	0.5	3	0.138	0.001	0.137	0.139
	0.8	4	0.145	0.015	0.134	0.168
Downstream-150ft (61m)	0.2	3	0.155	0.019	0.134	0.171
	0.5	3	0.160	0.017	0.141	0.174
	0.8	4	0.154	0.021	0.134	0.177
Downstream-500ft (152m)	0.2	3	0.155	0.009	0.145	0.162
	0.5	4	0.153	0.008	0.147	0.165
	0.8	3	0.156	0.009	0.148	0.166

Table 16. Average total zinc concentrations upstream and downstream of FTWP solids residual discharge Outfall 005.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream-2,525ft (770m)	0.2	4	0.012	0.003	0.010	0.016
	0.5	3	0.010	0.003	0.008	0.013
	0.8	3	0.011	0.001	0.011	0.012
Ustream-1,925ft (587m)	0.2	4	0.016	0.010	0.008	0.031
	0.5	3	0.009	0.001	0.009	0.010
	0.8	3	0.009	0.002	0.007	0.010
Outfall-0.0ft (0.0m)	0.2	4	0.007	0.003	<0.006	0.009
	0.5	3	0.008	0.002	0.006	0.010
	0.8	3	0.007	0.000	0.007	0.007
Downstream-50ft (15.2m)	0.2	3	0.011	0.003	0.008	0.013
	0.5	4	0.010	0.002	0.007	0.012
	0.8	3	0.011	0.001	0.010	0.012
Downstream-100ft (30.5m)	0.2	3	0.011	0.001	0.010	0.012
	0.5	3	0.011	0.001	0.010	0.012
	0.8	4	0.011	0.002	0.010	0.014
Downstream-150ft (61m)	0.2	3	0.016	0.003	0.014	0.019
	0.5	3	0.013	0.002	0.011	0.015
	0.8	4	0.011	0.002	0.009	0.014
Downstream-500ft (152m)	0.2	3	0.011	0.004	0.007	0.014
	0.5	4	0.005	0.005	<0.006	0.012
	0.8	3	0.007	0.006	<0.006	0.014

Platte South Water Treatment Plant. The PSWTP is a lime-softening facility that uses iron or aluminum salts as the primary coagulant. Upstream from the PSWTP and downstream from the FWTP, a major subwatershed flows into the Missouri River (Figure 7). This additional flow affected water quality immediately upstream for the PSWTP residual solids discharge.

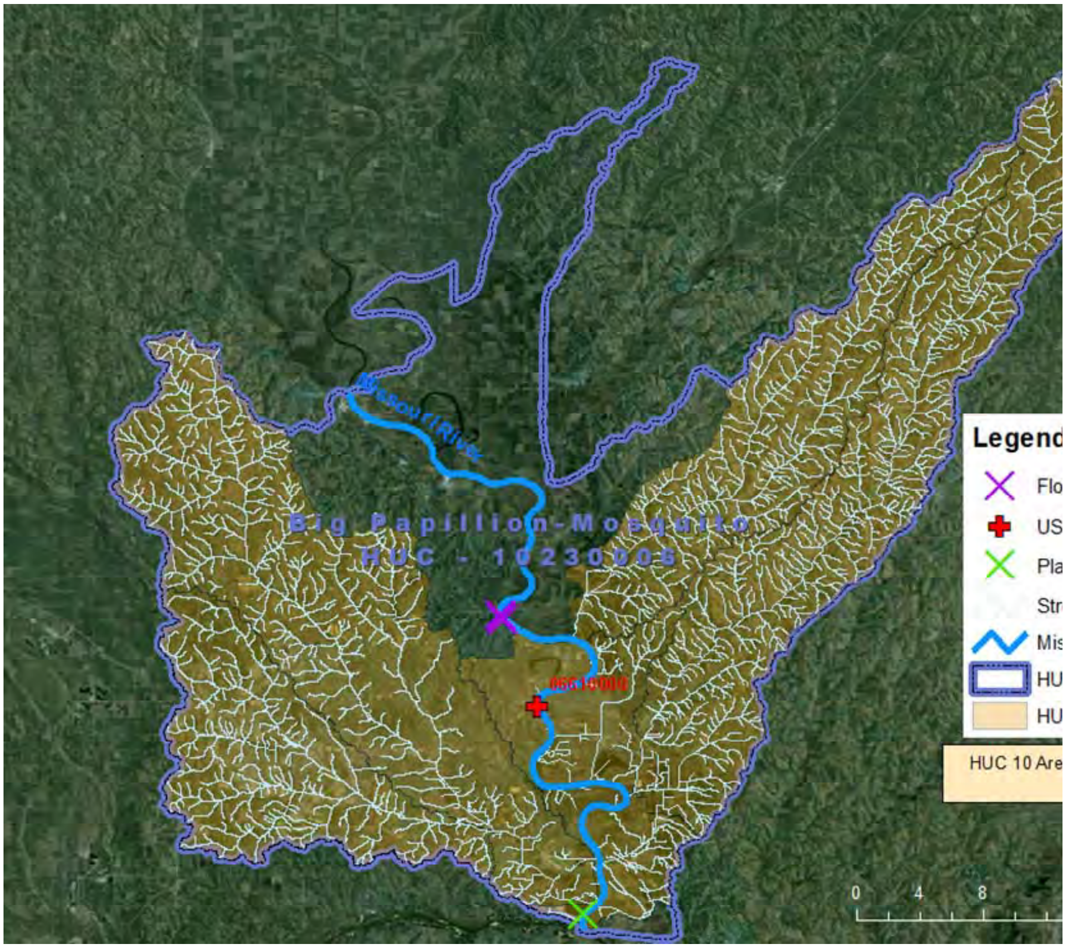


Figure 7. Subwatershed drainage area flowing into the Missouri River upstream of the PSWTP residual solids outfall.

Figure 2 shows the locations upstream and downstream from the PSWTP residual solids discharge point, Outfall 002, where river transects and water quality data were obtained. Outfall 002 was located near the river edge at georeferenced coordinates 476,601.28ft N, 2,775,327.96 ft. E. Residual solids were discharged beneath the water surface. DO levels varied from 7.47 mg/L to 11.44 mg/L. Average TSS concentrations at each location are presented in Table 17. These values represent the average TSS concentrations obtained in water samples collected along each transect width and depth. TSS concentrations ranged from 75 mg/L to 163 mg/L. Statistical analysis of the data indicated that average TSS concentrations at 375 ft upstream from the discharge point (94-141 mg/L) were significantly ($\alpha = 0.05$) greater than the downstream concentrations at 50 ft (88 -92 mg/L), 100 ft (92-109 mg/L) and 200 ft (87-100 mg/L). The average TSS concentrations upstream from the discharge were not significantly different ($\alpha = 0.05$) than the average concentration measured at 400 ft downstream from the discharge. Statistical analysis of the data also showed that at each depth there was no significant difference

(α = 0.05) in average TSS between locations. Therefore, no significant increases in average TSS were observed during the discharge of residual solids at the PSWTP during the monitoring period.

Table 17. Average total suspended solids at each location and depth related to the PSWTP solids residual discharge.

Position	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	141	30	99	169
	0.5	3	94	9	88	104
	0.8	3	114	32	94	151
Upstream (125ft/38m)	0.2	3	122	36	95	163
	0.5	4	95	5	91	102
	0.8	3	98	1	97	99
Downstream-50ft(15m)	0.2	3	92	5	88	97
	0.5	3	88	14	75	103
	0.8	4	90	4	84	93
Downstream-100ft(30.5m)	0.2	4	109	21	90	138
	0.5	3	92	6	85	97
	0.8	3	94	6	88	100
Downstream-125ft(38m)	0.2	3	90	6	85	96
	0.5	4	90	4	84	93
	0.8	3	94	5	90	99
Downstream-200ft(61m)	0.2	3	87	9	82	97
	0.5	3	100	9	90	108
	0.8	4	97	6	90	104
Downstream-400ft(122m)	0.2	3	106	39	82	151
	0.5	4	90	7	83	100
	0.8	2	97	11	89	105

The chemical composition of the TSS, however, did vary significantly (α = 0.05) from upstream to downstream. Aluminum, which is commonly used as a coagulant in water treatment to remove colloidal solids, may be present in residual solids that are discharged to surface waters. Downstream from the PSWTP, discharged outfall aluminum concentrations were significantly (α = 0.05) higher than upstream levels (Table 18). Similarly, for each specific water depth upstream, average aluminum concentrations were significantly (α = 0.05) less than concentrations measured downstream from Outfall 002. Aluminum is amphoteric-soluble in acidic and basic solutions, but very insoluble at circumneutral pH. Table 19 presents the mean pH values upstream and downstream of the PSWTP outfall. In general, the pH of the river was approximately 8.5, which was within the historic pH range of the river and was less than the acceptable level of 9.0 that was stated in the PSWTP's NPDES discharge permit. Since the pH was slightly basic, low levels of dissolved aluminum were present in the river (Table 20). Aluminum salts can dissociate in water and Al^{+3} bonds with water molecules, hydroxide ions, other inorganic ions and organic ions, or molecules. At pH levels ranging from 4.0 to 8.5, aluminum-phosphate and aluminum-organic complexes are formed that are very insoluble and consequently precipitate from solution (EPA, 1988; Driscoll and Schecker, 1988).

Table 18. Average total aluminum concentrations upstream and downstream from the PSWTP solids residual discharge outfall into the Missouri River.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.450	0.048	0.396	0.509
	0.5	3	0.422	0.049	0.384	0.477
	0.8	3	0.392	0.052	0.338	0.441
Upstream (125ft/38m)	0.2	3	0.428	0.048	0.393	0.483
	0.5	4	0.430	0.055	0.385	0.501
	0.8	3	0.481	0.030	0.459	0.515
Downstream-50ft(15m)	0.2	3	0.498	0.077	0.446	0.587
	0.5	3	0.511	0.083	0.422	0.585
	0.8	4	0.567	0.067	0.513	0.657
Downstream-100ft(30.5m)	0.2	4	0.853	0.212	0.653	1.040
	0.5	3	0.742	0.249	0.555	1.025
	0.8	3	0.770	0.292	0.575	1.106
Downstream-125ft(38m)	0.2	3	1.085	0.035	1.051	1.120
	0.5	4	1.134	0.044	1.094	1.197
	0.8	3	1.089	0.041	1.044	1.123
Downstream-200ft(61m)	0.2	3	0.904	0.213	0.674	1.095
	0.5	3	0.986	0.223	0.729	1.117
	0.8	4	0.746	0.152	0.626	0.963
Downstream-400ft(122m)	0.2	3	0.664	0.008	0.659	0.673
	0.5	4	0.733	0.097	0.610	0.817
	0.8	2	0.576	0.045	0.544	0.608

Table 19. Average pH values in the Missouri River upstream and downstream from PSWTP residuals discharge outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	3	8.47	0.03	8.44	8.50
	0.5	3	8.44	0.04	8.41	8.48
	0.8	3	8.39	0.04	8.36	8.43
Upstream (125ft/38m)	0.2	3	8.48	0.01	8.47	8.49
	0.5	3	8.43	0.04	8.41	8.48
	0.8	3	8.42	0.06	8.35	8.45
Downstream-50ft(15m)	0.2	3	8.50	0.03	8.47	8.52
	0.5	3	8.45	0.03	8.42	8.48
	0.8	3	8.43	0.03	8.41	8.47
Downstream-100ft(30.5m)	0.2	3	8.53	0.01	8.52	8.53
	0.5	3	8.49	0.06	8.43	8.55
	0.8	3	8.50	0.07	8.45	8.58
Downstream-125ft(38m)	0.2	3	8.53	0.01	8.53	8.54
	0.5	3	8.51	0.01	8.50	8.52
	0.8	3	8.47	0.02	8.45	8.48
Downstream-200ft(61m)	0.2	3	8.55	0.01	8.54	8.56
	0.5	3	8.52	0.02	8.50	8.54
	0.8	3	8.48	0.01	8.48	8.49
Downstream-400ft(122m)	0.2	3	8.56	0.01	8.55	8.57
	0.5	3	8.53	0.02	8.51	8.55
	0.8	2	8.50	0.02	8.48	8.51

Table 20. Mean dissolved aluminum concentrations upstream and downstream of the PSWTP residual solids discharge outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.120	0.022	0.100	0.152
	0.5	3	0.077	0.043	0.031	0.117
	0.8	3	0.061	0.051	0.031	0.120
Upstream (125ft/38m)	0.2	3	0.171	0.059	0.118	0.234
	0.5	4	0.118	0.055	0.065	0.181
	0.8	3	0.116	0.088	0.031	0.207
Downstream-50ft(15m)	0.2	3	0.097	0.030	0.067	0.126
	0.5	3	0.113	0.072	0.031	0.163
	0.8	4	0.124	0.078	0.031	0.204
Downstream-100ft(30.5m)	0.2	4	0.059	0.037	0.031	0.108
	0.5	3	0.073	0.046	0.031	0.123
	0.8	3	0.044	0.023	0.031	0.070
Downstream-125ft(38m)	0.2	3	0.074	0.046	0.031	0.123
	0.5	4	0.042	0.022	0.031	0.075
	0.8	3	0.055	0.042	0.031	0.104
Downstream-200ft(61m)	0.2	3	0.049	0.031	0.031	0.085
	0.5	3	0.046	0.027	0.031	0.077
	0.8	4	0.095	0.043	0.031	0.122
Downstream-400ft(122m)	0.2	3	0.138	0.011	0.128	0.150
	0.5	4	0.149	0.016	0.137	0.172
	0.8	2	0.119	0.016	0.107	0.130

As mentioned in the FWTP discussion (Page 21), when aluminum is mobilized in surface water, it may be toxic to aquatic life (Burrows, 1977; Schofield and Trojnar, 1980; Freeman and Everhart, 1971,1973; George et al., 1991). The water hardness and the alkalinity, however, will decrease the toxicity of soluble aluminum on aquatic life (George et al., 1991,1995). Lime-softening water treatment plants may not adversely aquatic life due to high calcium concentrations and associated high alkalinity.

The mean calcium concentrations present in the Missouri River upstream and downstream of the PSWTP solids residuals discharge outfall are provided in Table 21. In general, there were no significant differences ($\alpha = 0.05$) in average calcium concentrations between any of the upstream or downstream locations. Aluminum interactions with calcium may reduce the solubility of aluminum in circumneutral and basic solutions (Sposito, 1989). The Missouri River mean alkalinity levels upstream and downstream of the PSWTP outfall ranged from 177 to 188 mg $CaCO_3$/L (Table 22). As previously mentioned, previous toxicity testing of the M.U.D.'s FWTP showed growth inhibition of *S. capricornutum* only in 50 and 100% of extract solutions obtained from the plant's solids residual at pH 6.0 (George et al., 1995). With the tremendous estimated dilution factor of the river to residual solids discharge flow of greater than 13,000:1, along with the high calcium and alkalinity concentrations, the solids residual discharge into the river should not significantly inhibit aquatic organisms at a pH range from 8.0 to 9.0.

Table 21. Average total calcium concentrations in the Missouri River upstream and downstream of PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	62.033	1.796	59.530	63.435
	0.5	3	62.534	1.612	60.706	63.750
	0.8	3	61.657	0.913	60.735	62.561
Upstream (125ft/38m)	0.2	3	61.591	1.691	59.710	62.984
	0.5	4	62.094	1.063	60.530	62.907
	0.8	3	61.658	0.944	60.977	62.736
Downstream-50ft(15m)	0.2	3	63.058	1.906	61.081	64.884
	0.5	3	62.584	2.862	59.332	64.720
	0.8	4	64.509	0.953	63.531	65.682
Downstream-100ft(30.5m)	0.2	4	63.177	2.189	60.832	66.063
	0.5	3	64.080	2.418	61.380	66.045
	0.8	3	62.867	1.489	61.151	63.820
Downstream-125ft(38m)	0.2	3	63.251	3.951	59.973	67.638
	0.5	4	64.258	2.063	62.742	67.298
	0.8	3	63.489	2.597	61.658	66.461
Downstream-200ft(61m)	0.2	3	66.424	2.523	63.757	68.772
	0.5	3	65.831	2.818	63.039	68.675
	0.8	4	63.504	1.188	62.140	64.631
Downstream-400ft(122m)	0.2	3	62.071	0.461	61.539	62.350
	0.5	4	62.221	0.879	61.149	63.031
	0.8	2	61.958	1.312	61.030	62.885

Table 22. Mean total alkalinity (as mg $CaCO_3$/L) concentrations upstream and downstream of the PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	183	1	182	184
	0.5	3	183	1	182	184
	0.8	3	181	2	180	183
Upstream (125ft/38m)	0.2	3	182	2	181	184
	0.5	4	181	1	179	182
	0.8	3	182	2	180	183
Downstream-50ft(15m)	0.2	3	184	2	182	186
	0.5	3	183	1	182	184
	0.8	4	183	2	181	185
Downstream-100ft(30.5m)	0.2	4	182	4	178	187
	0.5	3	183	1	183	184
	0.8	3	183	2	182	185
Downstream-125ft(38m)	0.2	3	183	2	181	184
	0.5	4	183	2	181	184
	0.8	3	186	2	184	188
Downstream-200ft(61m)	0.2	3	181	1	180	182
	0.5	3	181	4	177	184
	0.8	4	182	2	180	184
Downstream-400ft(122m)	0.2	3	183	2	181	185
	0.5	4	183	2	180	185
	0.8	3	181	1	180	182

The chemistry of iron and aluminum in water are similar; however, iron species are less soluble than aluminum species over a wider pH range. Table 23 provides the mean total iron, Fe, concentrations upstream and downstream of the PSWTP outfall. As observed with aluminum, the average total iron concentrations in the Missouri River significantly ($\alpha = 0.05$) increased up to 125 ft (38 m) downstream of the PSWTP outfall at all depths. Average iron concentration at 200 ft (61 m) and 400 ft (122 m),while significantly ($\alpha = 0.05$) less than the mean values at 125 ft (38 m), were significantly higher than mean iron concentration upstream of the outfall.

Table 23. Average total iron concentrations upstream and downstream from the PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.396	0.063	0.325	0.465
	0.5	3	0.381	0.031	0.345	0.403
	0.8	3	0.328	0.027	0.311	0.359
Upstream (125ft/38m)	0.2	3	0.386	0.051	0.354	0.445
	0.5	4	0.367	0.071	0.292	0.462
	0.8	3	0.385	0.043	0.342	0.427
Downstream-50ft(15m)	0.2	3	0.438	0.048	0.396	0.491
	0.5	3	0.450	0.050	0.396	0.493
	0.8	4	0.505	0.069	0.444	0.599
Downstream-100ft(30.5m)	0.2	4	0.738	0.214	0.532	0.929
	0.5	3	0.611	0.258	0.406	0.900
	0.8	3	0.640	0.275	0.480	0.957
Downstream-125ft(38m)	0.2	3	0.974	0.010	0.967	0.986
	0.5	4	1.013	0.074	0.932	1.093
	0.8	3	0.994	0.032	0.966	1.028
Downstream-200ft(61m)	0.2	3	0.796	0.220	0.561	0.996
	0.5	3	0.900	0.247	0.615	1.043
	0.8	4	0.670	0.141	0.555	0.871
Downstream-400ft(122m)	0.2	3	0.612	0.014	0.603	0.628
	0.5	4	0.674	0.105	0.537	0.783
	0.8	2	0.560	0.037	0.533	0.586

While manganese concentrations were relatively low, ranging from 0.027 mg/L to 0.101 mg/L, downstream average total manganese concentrations at locations 100 ft (31 m), 125 ft (38 m), 200 ft (61 m), and 400 ft (122 m) also were significantly higher than average upstream levels (Table 24). With respect to depth, upstream average concentrations were significantly (α = 0.05) less than average concentrations at 100 ft (31 m), 125 ft (38 m), 200 ft (61 m) downstream from the outfall.

Table 24. Average total manganese concentrations upstream and downstream of PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	0.035	0.006	0.028	0.041
	0.5	3	0.034	0.002	0.031	0.035
	0.8	3	0.030	0.002	0.028	0.032
Upstream (125ft/38m)	0.2	3	0.035	0.004	0.032	0.039
	0.5	4	0.033	0.006	0.027	0.041
	0.8	3	0.034	0.003	0.031	0.037
Downstream-50ft(15m)	0.2	3	0.043	0.009	0.037	0.053
	0.5	3	0.045	0.008	0.039	0.054
	0.8	4	0.049	0.010	0.038	0.061
Downstream-100ft(30.5m)	0.2	4	0.072	0.016	0.056	0.086
	0.5	3	0.063	0.020	0.047	0.085
	0.8	3	0.064	0.019	0.052	0.086
Downstream-125ft(38m)	0.2	3	0.091	0.001	0.090	0.092
	0.5	4	0.095	0.006	0.089	0.101
	0.8	3	0.093	0.003	0.090	0.096
Downstream-200ft(61m)	0.2	3	0.078	0.019	0.058	0.095
	0.5	3	0.086	0.019	0.064	0.098
	0.8	4	0.062	0.018	0.046	0.085
Downstream-400ft(122m)	0.2	3	0.050	0.003	0.047	0.053
	0.5	4	0.056	0.008	0.046	0.063
	0.8	2	0.047	0.004	0.044	0.049

Upstream average magnesium concentrations, however, were only significantly less than the average magnesium concentration at 200 ft (61 m) downstream from outfall (Table 25). Magnesium levels ranged from 24.599 mg/L to 28.073 mg/L. Magnesium salts precipitated out of the drinking water during the lime-softening process and then were reintroduced to the Missouri River with the residuals discharge. Other metals such as copper, nickel, selenium were not present above detection limits (Table B.5, Table B.9, Table B.10).

Table 25. Average total magnesium concentrations in the Missouri River upstream and downstream of PSWTP solids residual outfall.

Pos	Depth	N	Mean	Std Dev	Minimum	Maximum
Upstream (375ft/144m)	0.2	4	25.956	1.327	24.599	27.778
	0.5	3	25.727	0.266	25.445	25.974
	0.8	3	25.519	0.016	25.503	25.534
Upstream (125ft/38m)	0.2	3	25.679	0.528	25.209	26.250
	0.5	4	25.774	0.610	25.076	26.394
	0.8	3	26.356	0.767	25.632	27.160
Downstream-50ft(15m)	0.2	3	26.548	0.552	26.034	27.131
	0.5	3	26.205	0.415	25.780	26.609
	0.8	4	26.477	0.416	26.086	26.969
Downstream-100ft(30.5m)	0.2	4	26.237	1.048	25.148	27.639
	0.5	3	26.167	0.457	25.651	26.520
	0.8	3	25.955	0.024	25.928	25.970
Downstream-125ft(38m)	0.2	3	26.164	1.250	25.308	27.599
	0.5	4	26.654	1.086	25.402	28.041
	0.8	3	25.992	0.899	25.397	27.026
Downstream-200ft(61m)	0.2	3	27.616	0.581	26.962	28.073
	0.5	3	27.154	0.095	27.096	27.263
	0.8	4	26.384	0.629	25.712	27.017
Downstream-400ft(122m)	0.2	3	25.656	0.492	25.225	26.192
	0.5	4	25.670	0.198	25.434	25.914
	0.8	2	25.630	0.021	25.615	25.645

CONCLUSION

The investigation of the Missouri River water quality upstream and downstream of the residual solids outfalls from the FWTP and the PSWTP was to determine if the residual solids discharged by either facility impacted the water quality of the Missouri River. Data analysis indicated that the solids discharge at both facilities did not significantly affect the TSS concentrations in the river. The chemical composition of the solids, i.e., aluminum and iron, at the PSWTP apparently increased downstream from the residual solids discharge due to the introduction of solids mass from the facility. However, the calcium and pH levels of the Missouri River should prevent any inhibitory effect by aluminum on aquatic life in the water column. Trace metals such as copper, nickel, and selenium were measured at detection limits and, therefore, pose no concern.

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APPENDIX A

FLORENCE WATER TREATMENT PLANT

MISSOURI RIVER WATER QUALITY DATA

Table A.1. Sonde data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No.	Position along Transect	Depth (Fraction of Total Depth)	Specific Conductance (mS/m)	Dissolved O_2 (mg/L)	pH (SU)	Temperature (^oC)
Upstream (2,525 ft)	1	1	.2	0.876	7.53	8.5	25.13
Upstream (2,525 ft)	1	1	.5	0.876	8.23	8.48	25.12
Upstream (2,525 ft)	1	1	.8	0.876	8.16	8.47	25.12
Upstream (2,525 ft)	1	2	.2	0.869	7.46	8.49	25.17
Upstream (2,525 ft)	1	2	.5	0.869	7.52	8.47	25.17
Upstream (2,525 ft)	1	2	.8	0.868	7.51	8.44	25.17
Upstream (2,525 ft)	1	3	.2	0.865	7.76	8.49	25.24
Upstream (2,525 ft)	1	3	.5	0.865	7.95	8.47	25.23
Upstream (2,525 ft)	1	3	.8	0.865	8	8.45	25.23
Upstream (1,925 ft)	2	1	.2	0.877	7.8	8.49	25.16
Upstream (1,925 ft)	2	1	.5	0.877	7.83	8.47	25.17
Upstream (1,925 ft)	2	1	.8	0.877	7.76	8.46	25.16
Upstream (1,925 ft)	2	2	.2	0.872	7.74	8.47	25.18
Upstream (1,925 ft)	2	2	.5	0.87	7.59	8.48	25.25
Upstream (1,925 ft)	2	2	.8	0.87	7.65	8.46	25.25
Upstream (1,925 ft)	2	3	.2	0.863	7.56	8.5	25.49
Upstream (1,925 ft)	2	3	.5	0.863	7.66	8.5	25.48
Upstream (1,925 ft)	2	3	.8	0.863	7.61	8.48	25.5
Outfall 005	3	1	.2	0.875	7.97	8.55	25.55
Outfall 005	3	1	.5	0.875	8.1	8.53	25.55
Outfall 005	3	1	.8	0.875	8.18	8.5	25.55
Outfall 005	3	2	.2	0.874	7.98	8.57	25.56
Outfall 005	3	2	.5	0.874	8.02	8.52	25.56
Outfall 005	3	2	.8	0.875	7.96	8.5	25.56
Outfall 005	3	3	.2	0.874	8.05	8.56	25.56
Outfall 005	3	3	.5	0.874	9.48	8.5	25.56
Outfall 005	3	3	.8	0.874	8.54	8.48	25.56
Downstream (50 ft)	4	1	.2	0.875	7.81	8.57	25.48
Downstream (50 ft)	4	1	.5	0.875	7.83	8.55	25.49
Downstream (50 ft)	4	1	.8	0.875	7.85	8.52	25.49
Downstream (50 ft)	4	2	.2	0.874	8.17	8.56	25.5
Downstream (50 ft)	4	2	.5	0.875	8.27	8.55	25.5

Downstream (50 ft)	4	2	08	0.874	8.2	8.5	25.49
Downstream (50 ft)	4	3	.2	0.874	7.8	8.55	25.49
Downstream (50 ft)	4	3	.5	0.874	8.02	8.53	25.49
Downstream (50 ft)	4	3	.8	0.874	8.48	8.5	25.5
Downstream (100 ft)	5	1	.2	0.874	7.61	8.57	25.42
Downstream (100 ft)	5	1	.5	0.874	9.07	8.53	25.41
Downstream (100 ft)	5	1	.8	0.871	8.03	8.6	25.44
Downstream (100 ft)	5	2	.2	0.874	7.81	8.54	25.42
Downstream (100 ft)	5	2	.5	0.874	7.93	8.53	25.42
Downstream (100 ft)	5	2	.8	0.875	7.8	8.47	25.42
Downstream (100 ft)	5	3	.2	0.874	8.01	8.55	25.44
Downstream (100 ft)	5	3	.5	0.874	8.37	8.52	25.43
Downstream (100 ft)	5	3	.8	0.874	8.27	8.5	25.43
Downstream (150 ft)	6	1	.2	0.874	7.55	8.53	25.35
Downstream (150 ft)	6	1	.5	0.875	7.86	8.52	25.34
Downstream (150 ft)	6	1	.8	0.875	8.43	8.48	25.35
Downstream (150 ft)	6	2	.2	0.866	7.6	8.51	25.38
Downstream (150 ft)	6	2	.5	0.866	7.51	8.5	25.38
Downstream (150 ft)	6	2	.8	0.866	7.53	8.47	25.38
Downstream (150 ft)	6	3	.2	0.862	7.5	8.51	25.55
Downstream (150 ft)	6	3	.5	0.862	8.2	8.49	25.54
Downstream (150 ft)	6	3	.8	0.862	8.12	8.48	25.53
Downstream (500 ft)	7	1	.2	0.875	7.66	8.55	25.34
Downstream (500 ft)	7	1	.5	0.875	7.74	8.52	25.32
Downstream (500 ft)	7	1	.8	0.875	7.71	8.51	25.32
Downstream (500 ft)	7	2	.2	0.87	7.45	8.51	25.31
Downstream (500 ft)	7	2	.5	0.87	7.5	8.5	25.31
Downstream (500 ft)	7	2	.8	0.87	7.59	8.47	25.31
Downstream (500 ft)	7	3	.2	0.863	7.55	8.5	25.43
Downstream (500 ft)	7	3	.5	0.783	8.03	8.48	25.81
Downstream (500 ft)	7	3	.8	0.863	7.8	8.45	25.45

Table A.2. Total suspended solids, alkalinity, hardness and settable solids data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No#	Position along Transect	Depth (Fraction of Total Depth)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)	Settable Solids (mg/L)	TSS (mg/L)
Upstream (2,525 ft)	1	1	.2	179	261	< 1	70
Upstream (2,525 ft)	1	1	.5	185	261	< 1	53
Upstream (2,525 ft)	1	1	.8	185	274	< 1	73
Upstream (2,525 ft)	1	2	.2	183	266	< 1	80
Upstream (2,525 ft)	1	2	.5	186	272	< 1	85
Upstream (2,525 ft)	1	2	.8	185	296	< 1	82
Upstream (2,525 ft)	1	3	.2	187	288	< 1	81
Upstream (2,525 ft)	1	3	.5	189	297	< 1	87
Upstream (2,525 ft)	1	3	.8	187	302	< 1	89
Upstream (1,925 ft)	2	1	.2	186	294	< 1	72
Upstream (1,925 ft)	2	1	.5	186	289	< 1	68
Upstream (1,925 ft)	2	1	.8	165	297	< 1	67
Upstream (1,925 ft)	2	2	.2	184	308	< 1	76
Upstream (1,925 ft)	2	2	.5	179	284	< 1	78
Upstream (1,925 ft)	2	2	.8	182	288	< 1	83
Upstream (1,925 ft)	2	3	.2	187	293	< 1	81
Upstream (1,925 ft)	2	3	.5	188	290	< 1	89
Upstream (1,925 ft)	2	3	.8	184	281	< 1	95
Outfall 005	3	1	.2	185	293	< 1	74
Outfall 005	3	1	.5	186	290	< 1	71
Outfall 005	3	1	.8	183	294	< 1	73
Outfall 005	3	2	.2	180	290	< 1	70
Outfall 005	3	2	.5	186	290	< 1	67
Outfall 005	3	2	.8	184	291	< 1	65
Outfall 005	3	3	.2	180	290	< 1	70
Outfall 005	3	3	.5	183	289	< 1	68
Outfall 005	3	3	.8	184	292	< 1	67
Downstream (50 ft)	4	1	.2	185	298	< 1	74
Downstream (50 ft)	4	1	.5	182	297	< 1	70
Downstream (50 ft)	4	1	.8	186	268	< 1	69
Downstream (50 ft)	4	2	.2	184	257	< 1	67
Downstream (50 ft)	4	2	.5	185	263	< 1	68
Downstream (50 ft)	4	2	08	179	262	< 1	74
Downstream (50 ft)	4	3	.2	186	261	< 1	76
Downstream (50 ft)	4	3	.5	182	256	< 1	76
Downstream (50 ft)	4	3	.8	186	259	< 1	78

Downstream (100 ft)	5	1	.2	184	260	< 1	76
Downstream (100 ft)	5	1	.5	184	263	< 1	76
Downstream (100 ft)	5	1	.8	273	394	< 1	269
Downstream (100 ft)	5	2	.2	184	261	< 1	70
Downstream (100 ft)	5	2	.5	185	266	< 1	79
Downstream (100 ft)	5	2	.8	186	262	< 1	79
Downstream (100 ft)	5	3	.2	186	262	< 1	68
Downstream (100 ft)	5	3	.5	181	256	< 1	79
Downstream (100 ft)	5	3	.8	180	254	< 1	83
Downstream (150 ft)	6	1	.2	184	262	< 1	72
Downstream (150 ft)	6	1	.5	185	262	< 1	69
Downstream (150 ft)	6	1	.8	185	261	< 1	70
Downstream (150 ft)	6	2	.2	185	268	< 1	77
Downstream (150 ft)	6	2	.5	186	268	< 1	86
Downstream (150 ft)	6	2	.8	187	268	< 1	87
Downstream (150 ft)	6	3	.2	190	268	< 1	92
Downstream (150 ft)	6	3	.5	189	270	< 1	91
Downstream (150 ft)	6	3	.8	183	267	< 1	93
Downstream (500 ft)	7	1	.2	183	258	< 1	70
Downstream (500 ft)	7	1	.5	186	269	< 1	76
Downstream (500 ft)	7	1	.8	185	271	< 1	71
Downstream (500 ft)	7	2	.2	185	272	< 1	71
Downstream (500 ft)	7	2	.5	184	264	< 1	82
Downstream (500 ft)	7	2	.8	185	268	< 1	86
Downstream (500 ft)	7	3	.2	188	290	< 1	86
Downstream (500 ft)	7	3	.5	187	265	< 1	87
Downstream (500 ft)	7	3	.8	189	267	< 1	84

Table A.3 Aluminum data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Al Total	1.539
	1	1	Al Total	1.409
	1	1	Al Total	1.929
	1	2	Al Total	2.174
	1	2	Al Total	2.062
	1	2	Al Total	1.972
	1	3	Al Total	2.083
	1	3	Al Total	2.185
	1	3	Al Total	2.178
	1	3	Al Total	2.196
Upstream (1,925 ft)	2	1	Al Total	1.682
	2	1	Al Total	1.592
	2	1	Al Total	1.651
	2	1	Al Total	1.603
	2	2	Al Total	2.131
	2	2	Al Total	1.94
	2	2	Al Total	1.864
	2	3	Al Total	2.186
	2	3	Al Total	2.005
	2	3	Al Total	1.567
Outfall 005	3	1	Al Total	1.357
	3	1	Al Total	1.325
	3	1	Al Total	1.63
	3	1	Al Total	1.618
	3	2	Al Total	1.368
	3	2	Al Total	1.493
	3	2	Al Total	1.488
	3	3	Al Total	1.3
	3	3	Al Total	1.627
	3	3	Al Total	1.469
Downstream (50 ft)	4	1	Al Total	1.641
	4	1	Al Total	1.59
	4	1	Al Total	1.853
	4	1	Al Total	1.919
	4	2	Al Total	1.889
	4	2	Al Total	1.784
	4	2	Al Total	1.703
	4	3	Al Total	1.741
	4	3	Al Total	1.741
	4	3	Al Total	1.818
Downstream (100 ft)	5	1	Al Total	1.637
	5	1	Al Total	1.824
	5	1	Al Total	2.326
	5	2	Al Total	1.68
	5	2	Al Total	1.84
	5	2	Al Total	1.851
	5	2	Al Total	1.712
	5	3	Al Total	1.814
	5	3	Al Total	1.871

	5	3	Al Total	1.905
Downstream (150 ft)	6	1	Al Total	1.802
	6	1	Al Total	1.945
	6	1	Al Total	1.834
	6	1	Al Total	1.781
	6	2	Al Total	2.253
	6	2	Al Total	2.378
	6	2	Al Total	2.392
	6	3	Al Total	2.569
	6	3	Al Total	2.556
	6	3	Al Total	2.595
Downstream (500 ft)	7	1	Al Total	1.962
	7	1	Al Total	1.946
	7	1	Al Total	2.041
	7	2	Al Total	2.154
	7	2	Al Total	1.883
	7	2	Al Total	1.925
	7	2	Al Total	1.906
	7	3	Al Total	2.185
	7	3	Al Total	2.213
	7	3	Al Total	2.271
Upstream (2,525 ft)	1	1	Al Dissolved	0.116
	1	1	Al Dissolved	0.156
	1	1	Al Dissolved	0.157
	1	2	Al Dissolved	<0.063
	1	2	Al Dissolved	0.196
	1	2	Al Dissolved	0.123
	1	3	Al Dissolved	0.082
	1	3	Al Dissolved	0.156
	1	3	Al Dissolved	0.208
	1	3	Al Dissolved	<0.063
Upstream (1,925 ft)	2	1	Al Dissolved	0.191
	2	1	Al Dissolved	0.135
	2	1	Al Dissolved	0.199
	2	1	Al Dissolved	0.083
	2	2	Al Dissolved	0.119
	2	2	Al Dissolved	0.107
	2	2	Al Dissolved	0.159
	2	3	Al Dissolved	0.214
	2	3	Al Dissolved	0.151
	2	3	Al Dissolved	0.246
Outfall 005	3	1	Al Dissolved	0.202
	3	1	Al Dissolved	0.248
	3	1	Al Dissolved	0.22
	3	1	Al Dissolved	0.154
	3	2	Al Dissolved	0.166
	3	2	Al Dissolved	0.205
	3	2	Al Dissolved	0.225
	3	3	Al Dissolved	0.195
	3	3	Al Dissolved	0.24
	3	3	Al Dissolved	0.288
Downstream (50 ft)	4	1	Al Dissolved	0.217
	4	1	Al Dissolved	0.275
	4	1	Al Dissolved	0.111

	4	1	Al Dissolved	0.141
	4	2	Al Dissolved	0.115
	4	2	Al Dissolved	0.157
	4	2	Al Dissolved	0.133
	4	3	Al Dissolved	0.137
	4	3	Al Dissolved	0.078
	4	3	Al Dissolved	0.1
Downstream (100 ft)	5	1	Al Dissolved	0.147
	5	1	Al Dissolved	0.117
	5	1	Al Dissolved	0.182
	5	2	Al Dissolved	0.152
	5	2	Al Dissolved	0.114
	5	2	Al Dissolved	0.143
	5	2	Al Dissolved	0.167
	5	3	Al Dissolved	0.173
	5	3	Al Dissolved	0.18
	5	3	Al Dissolved	0.156
Downstream (150 ft)	6	1	Al Dissolved	0.176
	6	1	Al Dissolved	0.103
	6	1	Al Dissolved	0.099
	6	1	Al Dissolved	0.145
	6	2	Al Dissolved	0.146
	6	2	Al Dissolved	0.126
	6	2	Al Dissolved	0.209
	6	3	Al Dissolved	0.172
	6	3	Al Dissolved	0.176
	6	3	Al Dissolved	0.072
Downstream (500 ft)	7	1	Al Dissolved	0.183
	7	1	Al Dissolved	0.099
	7	1	Al Dissolved	0.183
	7	2	Al Dissolved	0.116
	7	2	Al Dissolved	<0.063
	7	2	Al Dissolved	<0.063
	7	2	Al Dissolved	<0.063
	7	3	Al Dissolved	<0.063
	7	3	Al Dissolved	0.072
	7	3	Al Dissolved	<0.063

Table A.4. Calcium data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Ca Total	62.996
	1	1	Ca Total	62.327
	1	1	Ca Total	64.267
	1	2	Ca Total	63.321
	1	2	Ca Total	64.829
	1	2	Ca Total	71.127
	1	3	Ca Total	69.495
	1	3	Ca Total	70.517
	1	3	Ca Total	70.859
	1	3	Ca Total	72.247
Upstream (1,925 ft)	2	1	Ca Total	70.044
	2	1	Ca Total	67.913
	2	1	Ca Total	69.034
	2	1	Ca Total	70.242
	2	2	Ca Total	71.432
	2	2	Ca Total	67.897
	2	2	Ca Total	67.802
	2	3	Ca Total	69.698
	2	3	Ca Total	68.68
	2	3	Ca Total	66.75
Outfall 005	3	1	Ca Total	69.757
	3	1	Ca Total	68.572
	3	1	Ca Total	69.138
	3	1	Ca Total	69.643
	3	2	Ca Total	68.986
	3	2	Ca Total	69.51
	3	2	Ca Total	68.524
	3	3	Ca Total	69.251
	3	3	Ca Total	68.136
	3	3	Ca Total	71.155
Downstream (50 ft)	4	1	Ca Total	71.415
	4	1	Ca Total	71.12
	4	1	Ca Total	61.36
	4	1	Ca Total	63.102
	4	2	Ca Total	60.162
	4	2	Ca Total	61.482
	4	2	Ca Total	62.553
	4	3	Ca Total	62.718
	4	3	Ca Total	60.634
	4	3	Ca Total	60.784
Downstream (100 ft)	5	1	Ca Total	61.857
	5	1	Ca Total	61.688
	5	1	Ca Total	101.949
	5	2	Ca Total	61.716
	5	2	Ca Total	62.908
	5	2	Ca Total	62.266
	5	2	Ca Total	61.221

	5	3	Ca Total	62.009
	5	3	Ca Total	60.635
	5	3	Ca Total	60.338
Downstream (150 ft)	6	1	Ca Total	61.949
	6	1	Ca Total	61.617
	6	1	Ca Total	61.585
	6	1	Ca Total	61.914
	6	2	Ca Total	63.65
	6	2	Ca Total	63.71
	6	2	Ca Total	63.423
	6	3	Ca Total	63.548
	6	3	Ca Total	63.329
	6	3	Ca Total	63.602
Downstream (500 ft)	7	1	Ca Total	61.279
	7	1	Ca Total	63.414
	7	1	Ca Total	64.603
	7	2	Ca Total	64.122
	7	2	Ca Total	62.257
	7	2	Ca Total	60.986
	7	2	Ca Total	63.654
	7	3	Ca Total	72.752
	7	3	Ca Total	62.364
	7	3	Ca Total	63.359
Upstream (2,525 ft)	1	1	Ca Dissolved	64.605
	1	1	Ca Dissolved	74.708
	1	1	Ca Dissolved	66.291
	1	2	Ca Dissolved	66.459
	1	2	Ca Dissolved	100.093
	1	2	Ca Dissolved	64.638
	1	3	Ca Dissolved	67.36
	1	3	Ca Dissolved	67.768
	1	3	Ca Dissolved	66.436
	1	3	Ca Dissolved	73.712
Upstream (1,925 ft)	2	1	Ca Dissolved	66.267
	2	1	Ca Dissolved	64.775
	2	1	Ca Dissolved	64.586
	2	1	Ca Dissolved	64.374
	2	2	Ca Dissolved	64.389
	2	2	Ca Dissolved	66.041
	2	2	Ca Dissolved	69.167
	2	3	Ca Dissolved	68.621
	2	3	Ca Dissolved	68.565
	2	3	Ca Dissolved	70.4
Outfall 005	3	1	Ca Dissolved	65.559
	3	1	Ca Dissolved	65.946
	3	1	Ca Dissolved	66.377
	3	1	Ca Dissolved	66.197
	3	2	Ca Dissolved	66.341
	3	2	Ca Dissolved	68.071
	3	2	Ca Dissolved	68.316
	3	3	Ca Dissolved	66.502
	3	3	Ca Dissolved	67.949
	3	3	Ca Dissolved	68.153
Downstream (50 ft)	4	1	Ca Dissolved	66.746

	4	1	Ca Dissolved	67.656
	4	1	Ca Dissolved	63.792
	4	1	Ca Dissolved	65.168
	4	2	Ca Dissolved	64.181
	4	2	Ca Dissolved	66.732
	4	2	Ca Dissolved	63.891
	4	3	Ca Dissolved	62.477
	4	3	Ca Dissolved	63.376
	4	3	Ca Dissolved	63.039
Downstream (100 ft)	5	1	Ca Dissolved	62.293
	5	1	Ca Dissolved	64.225
	5	1	Ca Dissolved	48.435
	5	2	Ca Dissolved	61.846
	5	2	Ca Dissolved	63.692
	5	2	Ca Dissolved	65.378
	5	2	Ca Dissolved	63.807
	5	3	Ca Dissolved	65.789
	5	3	Ca Dissolved	61.98
	5	3	Ca Dissolved	64.353
Downstream (150 ft)	6	1	Ca Dissolved	64.318
	6	1	Ca Dissolved	61.46
	6	1	Ca Dissolved	63.491
	6	1	Ca Dissolved	63.023
	6	2	Ca Dissolved	61.897
	6	2	Ca Dissolved	65.005
	6	2	Ca Dissolved	62.241
	6	3	Ca Dissolved	64.826
	6	3	Ca Dissolved	66.612
	6	3	Ca Dissolved	64.05
Downstream (500 ft)	7	1	Ca Dissolved	64.331
	7	1	Ca Dissolved	63.825
	7	1	Ca Dissolved	62.817
	7	2	Ca Dissolved	64.012
	7	2	Ca Dissolved	61.67
	7	2	Ca Dissolved	59.77
	7	2	Ca Dissolved	60.629
	7	3	Ca Dissolved	62.65
	7	3	Ca Dissolved	62.518
	7	3	Ca Dissolved	62.175

Table A.5. Copper data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	**Transverse No.**	**Position along Transect**	**Parameter**	**Results (mg/L)**
Upstream (2,525 ft)	1	1	Cu Total	<0.008
	1	1	Cu Total	0.008
	1	1	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	3	Cu Total	<0.008
Upstream (1,925 ft)	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
Outfall 005	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
Downstream (50 ft)	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	0.008
Downstream (100 ft)	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	0.008
	5	2	Cu Total	<0.008
	5	3	Cu Total	<0.008
	5	3	Cu Total	<0.008

	5	3	Cu Total	<0.008
Downstream (150 ft)	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	2	Cu Total	0.008
	6	2	Cu Total	<0.008
	6	2	Cu Total	<0.008
	6	3	Cu Total	0.008
	6	3	Cu Total	0.008
	6	3	Cu Total	<0.008
Downstream (500 ft)	7	1	Cu Total	<0.008
	7	1	Cu Total	0.009
	7	1	Cu Total	<0.008
	7	2	Cu Total	0.012
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
Upstream (2,525 ft)	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
Upstream (1,925 ft)	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
Outfall 005	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
Downstream (50 ft)	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008

	4	1	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
Downstream (100 ft)	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
Downstream (150 ft)	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
Downstream (500 ft)	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008

Table A.6. Iron data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Fe Total	1.599
	1	1	Fe Total	1.464
	1	1	Fe Total	1.94
	1	2	Fe Total	2.238
	1	2	Fe Total	2.197
	1	2	Fe Total	2.354
	1	3	Fe Total	2.401
	1	3	Fe Total	2.497
	1	3	Fe Total	2.452
	1	3	Fe Total	2.521
Upstream (1,925 ft)	2	1	Fe Total	1.865
	2	1	Fe Total	1.741
	2	1	Fe Total	1.824
	2	1	Fe Total	1.825
	2	2	Fe Total	2.352
	2	2	Fe Total	2.11
	2	2	Fe Total	2.094
	2	3	Fe Total	2.432
	2	3	Fe Total	2.285
	2	3	Fe Total	1.768
Outfall 005	3	1	Fe Total	1.469
	3	1	Fe Total	1.433
	3	1	Fe Total	1.774
	3	1	Fe Total	1.788
	3	2	Fe Total	1.5
	3	2	Fe Total	1.675
	3	2	Fe Total	1.594
	3	3	Fe Total	1.454
	3	3	Fe Total	1.773
	3	3	Fe Total	1.704
Downstream (50 ft)	4	1	Fe Total	1.811
	4	1	Fe Total	1.83
	4	1	Fe Total	1.666
	4	1	Fe Total	1.714
	4	2	Fe Total	1.673
	4	2	Fe Total	1.608
	4	2	Fe Total	1.554
	4	3	Fe Total	1.555
	4	3	Fe Total	1.529
	4	3	Fe Total	1.597
Downstream (100 ft)	5	1	Fe Total	1.469
	5	1	Fe Total	1.597
	5	1	Fe Total	1.987
	5	2	Fe Total	1.521
	5	2	Fe Total	1.647
	5	2	Fe Total	1.633
	5	2	Fe Total	1.585

	5	3	Fe Total	1.645
	5	3	Fe Total	1.649
	5	3	Fe Total	1.697
Downstream (150 ft)	6	1	Fe Total	1.554
	6	1	Fe Total	1.767
	6	1	Fe Total	1.692
	6	1	Fe Total	1.622
	6	2	Fe Total	2.065
	6	2	Fe Total	2.18
	6	2	Fe Total	2.243
	6	3	Fe Total	2.394
	6	3	Fe Total	2.385
	6	3	Fe Total	2.44
Downstream (500 ft)	7	1	Fe Total	1.754
	7	1	Fe Total	1.796
	7	1	Fe Total	1.824
	7	2	Fe Total	1.973
	7	2	Fe Total	2.004
	7	2	Fe Total	2.01
	7	2	Fe Total	2.033
	7	3	Fe Total	2.285
	7	3	Fe Total	2.322
	7	3	Fe Total	2.41
Upstream (2,525 ft)	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
Upstream (1,925 ft)	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
Outfall 005	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
Downstream (50 ft)	4	1	Fe Dissolved	<0.063

	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
Downstream (100 ft)	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
Downstream (150 ft)	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
Downstream (500 ft)	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063

Table A.7. Magnesium data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Mg Total	25.235
	1	1	Mg Total	25.516
	1	1	Mg Total	27.458
	1	2	Mg Total	26.208
	1	2	Mg Total	26.644
	1	2	Mg Total	28.732
	1	3	Mg Total	27.864
	1	3	Mg Total	29.31
	1	3	Mg Total	29.175
	1	3	Mg Total	29.417
Upstream (1,925 ft)	2	1	Mg Total	28.914
	2	1	Mg Total	28.523
	2	1	Mg Total	28.373
	2	1	Mg Total	29.409
	2	2	Mg Total	31.561
	2	2	Mg Total	27.893
	2	2	Mg Total	28.898
	2	3	Mg Total	28.867
	2	3	Mg Total	28.728
	2	3	Mg Total	27.77
Outfall 005	3	1	Mg Total	28.817
	3	1	Mg Total	27.486
	3	1	Mg Total	28.504
	3	1	Mg Total	29.197
	3	2	Mg Total	28.489
	3	2	Mg Total	28.289
	3	2	Mg Total	29.057
	3	3	Mg Total	28.436
	3	3	Mg Total	28.807
	3	3	Mg Total	27.795
Downstream (50 ft)	4	1	Mg Total	29.18
	4	1	Mg Total	29.017
	4	1	Mg Total	26.282
	4	1	Mg Total	26.859
	4	2	Mg Total	26.036
	4	2	Mg Total	26.627
	4	2	Mg Total	25.794
	4	3	Mg Total	25.378
	4	3	Mg Total	25.334
	4	3	Mg Total	26.035
Downstream (100 ft)	5	1	Mg Total	25.602
	5	1	Mg Total	26.579
	5	1	Mg Total	33.941
	5	2	Mg Total	25.924
	5	2	Mg Total	26.377
	5	2	Mg Total	25.756
	5	2	Mg Total	25.709
	5	3	Mg Total	26.057
	5	3	Mg Total	25.41

	5	3	Mg Total	25.163
Downstream (150 ft)	6	1	Mg Total	26.083
	6	1	Mg Total	26.242
	6	1	Mg Total	26.136
	6	1	Mg Total	25.357
	6	2	Mg Total	26.564
	6	2	Mg Total	26.501
	6	2	Mg Total	26.522
	6	3	Mg Total	26.511
	6	3	Mg Total	27.121
	6	3	Mg Total	26.348
Downstream (500 ft)	7	1	Mg Total	25.434
	7	1	Mg Total	26.956
	7	1	Mg Total	26.578
	7	2	Mg Total	27.283
	7	2	Mg Total	26.294
	7	2	Mg Total	26.151
	7	2	Mg Total	26.472
	7	3	Mg Total	26.296
	7	3	Mg Total	26.536
	7	3	Mg Total	26.372
Upstream (2,525 ft)	1	1	Mg Dissolved	27.478
	1	1	Mg Dissolved	30.127
	1	1	Mg Dissolved	28.015
	1	2	Mg Dissolved	27.407
	1	2	Mg Dissolved	27.511
	1	2	Mg Dissolved	26.688
	1	3	Mg Dissolved	27.445
	1	3	Mg Dissolved	28.516
	1	3	Mg Dissolved	27.672
	1	3	Mg Dissolved	29.614
Upstream (1,925 ft)	2	1	Mg Dissolved	26.962
	2	1	Mg Dissolved	26.596
	2	1	Mg Dissolved	28.817
	2	1	Mg Dissolved	26.329
	2	2	Mg Dissolved	27.444
	2	2	Mg Dissolved	27.172
	2	2	Mg Dissolved	28.741
	2	3	Mg Dissolved	27.924
	2	3	Mg Dissolved	28.246
	2	3	Mg Dissolved	28.605
Outfall 005	3	1	Mg Dissolved	27.275
	3	1	Mg Dissolved	28.625
	3	1	Mg Dissolved	28.131
	3	1	Mg Dissolved	27.75
	3	2	Mg Dissolved	27.433
	3	2	Mg Dissolved	29.205
	3	2	Mg Dissolved	27.804
	3	3	Mg Dissolved	27.991
	3	3	Mg Dissolved	28.945
	3	3	Mg Dissolved	29.586
Downstream (50 ft)	4	1	Mg Dissolved	28.982
	4	1	Mg Dissolved	28.496
	4	1	Mg Dissolved	26.588

	4	1	Mg Dissolved	26.407
	4	2	Mg Dissolved	26.406
	4	2	Mg Dissolved	26.018
	4	2	Mg Dissolved	26.114
	4	3	Mg Dissolved	25.768
	4	3	Mg Dissolved	26.386
	4	3	Mg Dissolved	27.191
Downstream (100 ft)	5	1	Mg Dissolved	26.479
	5	1	Mg Dissolved	26.699
	5	1	Mg Dissolved	32.214
	5	2	Mg Dissolved	25.382
	5	2	Mg Dissolved	26.257
	5	2	Mg Dissolved	26.404
	5	2	Mg Dissolved	26.146
	5	3	Mg Dissolved	25.831
	5	3	Mg Dissolved	25.833
	5	3	Mg Dissolved	26.203
Downstream (150 ft)	6	1	Mg Dissolved	26.882
	6	1	Mg Dissolved	25.178
	6	1	Mg Dissolved	26.039
	6	1	Mg Dissolved	26
	6	2	Mg Dissolved	25.521
	6	2	Mg Dissolved	25.126
	6	2	Mg Dissolved	25.814
	6	3	Mg Dissolved	26.06
	6	3	Mg Dissolved	26.122
	6	3	Mg Dissolved	25.079
Downstream (500 ft)	7	1	Mg Dissolved	26.948
	7	1	Mg Dissolved	25.925
	7	1	Mg Dissolved	27.129
	7	2	Mg Dissolved	26.187
	7	2	Mg Dissolved	28.128
	7	2	Mg Dissolved	25.644
	7	2	Mg Dissolved	26.893
	7	3	Mg Dissolved	26.824
	7	3	Mg Dissolved	26.44
	7	3	Mg Dissolved	26.758

Table A.8. Manganese data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)				
	1	1	Mn Total	0.134
	1	1	Mn Total	0.131
	1	1	Mn Total	0.159
	1	2	Mn Total	0.17
	1	2	Mn Total	0.168
	1	2	Mn Total	0.176
	1	3	Mn Total	0.175
	1	3	Mn Total	0.186
	1	3	Mn Total	0.176
	1	3	Mn Total	0.181
Upstream (1,925 ft)				
	2	1	Mn Total	0.152
	2	1	Mn Total	0.146
	2	1	Mn Total	0.15
	2	1	Mn Total	0.152
	2	2	Mn Total	0.177
	2	2	Mn Total	0.165
	2	2	Mn Total	0.164
	2	3	Mn Total	0.177
	2	3	Mn Total	0.167
	2	3	Mn Total	0.142
Outfall 005				
	3	1	Mn Total	0.134
	3	1	Mn Total	0.13
	3	1	Mn Total	0.149
	3	1	Mn Total	0.153
	3	2	Mn Total	0.136
	3	2	Mn Total	0.147
	3	2	Mn Total	0.141
	3	3	Mn Total	0.129
	3	3	Mn Total	0.148
	3	3	Mn Total	0.146
Downstream (50 ft)				
	4	1	Mn Total	0.154
	4	1	Mn Total	0.156
	4	1	Mn Total	0.138
	4	1	Mn Total	0.141
	4	2	Mn Total	0.138
	4	2	Mn Total	0.136
	4	2	Mn Total	0.132
	4	3	Mn Total	0.132
	4	3	Mn Total	0.13
	4	3	Mn Total	0.137
Downstream (100 ft)				
	5	1	Mn Total	0.128

	5	1	Mn Total	0.137
	5	1	Mn Total	0.168
	5	2	Mn Total	0.132
	5	2	Mn Total	0.139
	5	2	Mn Total	0.139
	5	2	Mn Total	0.134
	5	3	Mn Total	0.138
	5	3	Mn Total	0.138
	5	3	Mn Total	0.14
Downstream (150 ft)				
	6	1	Mn Total	0.134
	6	1	Mn Total	0.141
	6	1	Mn Total	0.139
	6	1	Mn Total	0.134
	6	2	Mn Total	0.16
	6	2	Mn Total	0.165
	6	2	Mn Total	0.166
	6	3	Mn Total	0.171
	6	3	Mn Total	0.174
	6	3	Mn Total	0.177
Downstream (500 ft)				
	7	1	Mn Total	0.145
	7	1	Mn Total	0.147
	7	1	Mn Total	0.148
	7	2	Mn Total	0.158
	7	2	Mn Total	0.15
	7	2	Mn Total	0.151
	7	2	Mn Total	0.153
	7	3	Mn Total	0.162
	7	3	Mn Total	0.165
	7	3	Mn Total	0.166
Upstream (2,525 ft)				
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
Upstream (1,925 ft)				
	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006

	2	3	Mn Dissolved	<0.006
Outfall 005				
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
Downstream (50 ft)				
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
Downstream (100 ft)				
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
Downstream (150 ft)				
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
Downstream (500 ft)				
	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006

	7	2	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
Upstream (2,525 ft)	7	3	Mn Dissolved	<0.006

Table A.9. Nickel data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	3	Ni Total	<0.019
Upstream (1,925 ft)	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
Outfall 005	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
Downstream (50 ft)	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
Downstream (100 ft)	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	3	Ni Total	<0.019
	5	3	Ni Total	<0.019

	5	3	Ni Total	<0.019
Downstream (150 ft)	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
Downstream (500 ft)	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
Upstream 001 (675ft)	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
Upstream (1,925 ft)	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
Outfall 005	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
Downstream (50 ft)	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019

	4	1	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
Downstream (100 ft)	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
Downstream (150 ft)	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
Downstream (500 ft)	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019

Table A.10. Selenium data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (2,525 ft)	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	3	Se Total	<0.063
	1	3	Se Total	<0.063
	1	3	Se Total	<0.063
	1	3	Se Total	<0.063
Upstream (1,925 ft)	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
Outfall 005	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
Downstream (50 ft)	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063
Downstream (100 ft)	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	3	Se Total	<0.063
	5	3	Se Total	<0.063

	5	3	Se Total	<0.063
Downstream (150 ft)	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
Downstream (500 ft)	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
Upstream (2,525 ft)	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
Upstream (1,925 ft)	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
Outfall 005	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
Downstream (50 ft)	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063

	4	1	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
Downstream (100 ft)	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
Downstream (150 ft)	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
Downstream (500 ft)	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063

Table A.11. Zinc data Florence Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream- (2,525ft)	1	1	Zn Total	0.011
	1	1	Zn Total	0.008
	1	1	Zn Total	0.011
	1	2	Zn Total	0.01
	1	2	Zn Total	0.009
	1	2	Zn Total	0.011
	1	3	Zn Total	0.016
	1	3	Zn Total	0.011
	1	3	Zn Total	0.013
	1	3	Zn Total	0.012
Upstream (1,925ft)	2	1	Zn Total	0.011
	2	1	Zn Total	0.008
	2	1	Zn Total	0.009
	2	1	Zn Total	0.01
	2	2	Zn Total	0.012
	2	2	Zn Total	0.009
	2	2	Zn Total	0.01
	2	3	Zn Total	0.031
	2	3	Zn Total	0.01
	2	3	Zn Total	0.007
OUTFALL 005	3	1	Zn Total	0.009
	3	1	Zn Total	<0.006
	3	1	Zn Total	0.006
	3	1	Zn Total	0.007
	3	2	Zn Total	0.007
	3	2	Zn Total	0.009
	3	2	Zn Total	0.007
	3	3	Zn Total	0.008
	3	3	Zn Total	0.01
	3	3	Zn Total	0.007
Downstream (50ft)	4	1	Zn Total	0.008
	4	1	Zn Total	0.007
	4	1	Zn Total	0.009
	4	1	Zn Total	0.012
	4	2	Zn Total	0.012
	4	2	Zn Total	0.012
	4	2	Zn Total	0.01
	4	3	Zn Total	0.013
	4	3	Zn Total	0.01
	4	3	Zn Total	0.011
Downstream (100 ft)	5	1	Zn Total	0.011
	5	1	Zn Total	0.01
	5	1	Zn Total	0.014
	5	2	Zn Total	0.01
	5	2	Zn Total	0.012
	5	2	Zn Total	0.011
	5	2	Zn Total	0.01
	5	3	Zn Total	0.012
	5	3	Zn Total	0.01

	5	3	Zn Total	0.01
Downstream (150 ft)	6	1	Zn Total	0.015
	6	1	Zn Total	0.011
	6	1	Zn Total	0.009
	6	1	Zn Total	0.01
	6	2	Zn Total	0.014
	6	2	Zn Total	0.012
	6	2	Zn Total	0.014
	6	3	Zn Total	0.019
	6	3	Zn Total	0.015
	6	3	Zn Total	0.012
Downstream (500 ft)	7	1	Zn Total	0.013
	7	1	Zn Total	0.012
	7	1	Zn Total	0.014
	7	2	Zn Total	0.014
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	3	Zn Total	0.007
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
Upstream (2,525ft)	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
Upstream (1,925 ft)	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	0.007
	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	3	Zn Dissolved	0.009
	2	3	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
Outfall 005	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
Downstream (50 ft)	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006

	4	1	Zn Dissolved	<0.006
	4	2	Zn Dissolved	0.064
	4	2	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
Downstream (100 ft)	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
Downstream (150 ft)	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
Downstream (500 ft)	7	1	Zn Dissolved	<0.006
	7	1	Zn Dissolved	<0.006
	7	1	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	2	Zn Dissolved	<0.006
	7	3	Zn Dissolved	<0.006
	7	3	Zn Dissolved	<0.006
	7	3	Zn Dissolved	<0.006

APPENDIX B

PLATTE SOUTH WATER TREATMENT PLANT

MISSOURI RIVER WATER QUALITY

Table B.1. Sonde data Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No#	Position along Transect	Depth (Fraction of Total Depth)	Specific Conductance (mS/m)	Dissolved O_2 (mg/L)	pH (SU)	Temp (^oC)
Upstream (375 ft)	1	1	.2	0.869	7.62	8.44	25.31
Upstream (375 ft)	1	1	.5	0.869	7.82	8.41	25.29
Upstream (375 ft)	1	1	.8	0.869	7.98	8.36	25.3
Upstream (375 ft)	1	2	.2	0.867	7.71	8.47	25.4
Upstream (375 ft)	1	2	.5	0.867	7.85	8.44	25.39
Upstream (375 ft)	1	2	.8	0.867	8.28	8.37	25.39
Upstream (375 ft)	1	3	.2	0.865	7.54	8.5	25.42
Upstream (375 ft)	1	3	.8	0.866	7.95	8.43	25.41
Upstream (125 ft)	2	1	.2	0.869	8.53	8.47	25.29
Upstream (125 ft)	2	1	.5	0.869	9.53	8.41	25.27
Upstream (125 ft)	2	1	.8	0.871	8.43	8.45	25.15
Upstream (125 ft)	2	2	.2	0.866	7.54	8.49	25.42
Upstream (125 ft)	2	2	.5	0.866	7.56	8.48	25.42
Upstream (125 ft)	2	2	.8	0.866	7.49	8.45	25.42
Upstream (125 ft)	2	3	.2	0.865	7.7	8.47	25.42
Upstream (125 ft)	2	3	.5	0.865	8.08	8.41	25.41
Upstream (125 ft)	2	3	.8	0.846	8.19	8.35	25.23
Downstream (50 ft)	3	1	.2	0.875	7.58	8.47	24.88
Downstream (50 ft)	3	1	.5	0.875	7.75	8.42	24.88
Downstream (50 ft)	3	1	.8	0.826	8.74	8.42	24.81
Downstream (50 ft)	3	2	.2	0.867	7.47	8.5	25.36
Downstream (50 ft)	3	2	.5	0.867	7.54	8.48	25.35
Downstream (50 ft)	3	2	.8	0.868	7.62	8.41	25.35
Downstream (50 ft)	3	3	.2	0.912	8.67	8.52	22.8
Downstream (50 ft)	3	3	.5	0.913	9.86	8.46	22.68
Downstream (50 ft)	3	3	.8	0.98	11.44	8.47	18.5
Downstream (100 ft)	4	1	.2	0.866	7.82	8.53	25.32
Downstream (100 ft)	4	1	.5	0.865	7.95	8.55	25.32
Downstream (100 ft)	4	1	.8	0.864	9.59	8.58	25.32
Downstream (100 ft)	4	2	.2	0.867	8.37	8.53	25.4
Downstream (100 ft)	4	2	.5	0.804	8.77	8.43	24.28
Downstream (100 ft)	4	2	.8	0.867	9.74	8.45	25.36

Downstream (100 ft)	4	3	.2	0.865	7.49	8.52	25.52
Downstream (100 ft)	4	3	.5	0.865	7.69	8.48	25.5
Downstream (100 ft)	4	3	.8	0.867	8.31	8.47	25.34
Downstream (125 ft)	5	1	.2	0.868	7.75	8.53	25.41
Downstream (125 ft)	5	1	.5	0.868	7.72	8.51	25.41
Downstream (125 ft)	5	1	.8	0.868	7.75	8.48	25.39
Downstream (125 ft)	5	2	.2	0.879	8.01	8.53	24.77
Downstream (125 ft)	5	2	.5	0.879	8.57	8.5	24.75
Downstream (125 ft)	5	2	.8	0.879	8.76	8.45	24.78
Downstream (125 ft)	5	3	.2	0.866	8.45	8.54	25.54
Downstream (125 ft)	5	3	.5	0.866	8.72	8.52	25.52
Downstream (125 ft)	5	3	.8	0.866	8.76	8.48	25.51
Downstream (200 ft)	6	1	.2	0.866	7.91	8.55	25.53
Downstream (200 ft)	6	1	.5	0.867	7.91	8.5	25.52
Downstream (200 ft)	6	1	.8	0.867	8.51	8.48	25.51
Downstream (200 ft)	6	2	.2	0.864	7.71	8.56	25.65
Downstream (200 ft)	6	2	.5	0.864	7.87	8.54	25.65
Downstream (200 ft)	6	2	.8	0.864	7.91	8.49	25.63
Downstream (200 ft)	6	3	.2	0.867	7.99	8.54	25.49
Downstream (200 ft)	6	3	.5	0.867	8.01	8.51	25.49
Downstream (200 ft)	6	3	.8	0.868	8.1	8.48	25.5
Downstream (400 ft)	7	1	.2	0.929	9.35	8.55	22.05
Downstream (400 ft)	7	1	.5	0.918	9.29	8.51	22.66
Downstream (400 ft)	7	1	.8	0.922	10.04	8.51	22.57
Downstream (400 ft)	7	2	.2	0.867	7.84	8.55	25.52
Downstream (400 ft)	7	2	.5	0.867	7.81	8.53	25.53
Downstream (400 ft)	7	2	.8	0.867	8.05	8.48	25.52
Downstream (400 ft)	7	3	.2	0.865	7.9	8.57	25.64
Downstream (400 ft)	7	3	.5	0.866	8	8.55	25.64
Downstream (400 ft)	7	3	.8	0.865	8	8.5	25.64

Table B. 2. Solids, alkalinity, and hardness data Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transect No	Position along Transect	Depth (Fraction of Total Depth)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)	Settable Solids (mg/L)	TSS (mg/L)
Upstream (375 ft)	1	1	.2	182	261	< 1	99
Upstream (375 ft)	1	1	.5	184	256	< 1	104
Upstream (375 ft)	1	1	.8	183	259	< 1	94
Upstream (375 ft)	1	2	.2	182	272	< 1	169
Upstream (375 ft)	1	2	.5	183	265	< 1	88
Upstream (375 ft)	1	2	.8	181	257	< 1	98
Upstream (375 ft)	1	3	.2	184	264	< 1	142
Upstream (375 ft)	1	3	.8	180	261	< 1	151
Upstream (125 ft)	2	1	.2	182	263	< 1	95
Upstream (125 ft)	2	1	.5	181	261	< 1	93
Upstream (125 ft)	2	1	.8	183	262	< 1	98
Upstream (125 ft)	2	2	.2	181	263	< 1	108
Upstream (125 ft)	2	2	.5	179	254	< 1	102
Upstream (125 ft)	2	2	.8	180	265	< 1	99
Upstream (125 ft)	2	3	.2	184	253	< 1	163
Upstream (125 ft)	2	3	.5	182	264	< 1	91
Upstream (125 ft)	2	3	.8	183	260	< 1	97
Downstream (50 ft)	3	1	.2	186	267	< 1	97
Downstream (50 ft)	3	1	.5	182	267	< 1	103
Downstream (50 ft)	3	1	.8	185	266	< 1	93
Downstream (50 ft)	3	2	.2	183	260	< 1	91
Downstream (50 ft)	3	2	.5	184	254	< 1	75
Downstream (50 ft)	3	2	.8	182	268	< 1	89
Downstream (50 ft)	3	3	.2	182	274	< 1	88
Downstream (50 ft)	3	3	.5	184	271	< 1	87
Downstream (50 ft)	3	3	.8	185	273	< 1	92
Downstream (100 ft)	4	1	.2	187	279	< 1	105
Downstream (100 ft)	4	1	.5	183	274	< 1	94
Downstream (100 ft)	4	1	.8	182	260	< 1	95
Downstream (100 ft)	4	2	.2	180	255	< 1	101
Downstream (100 ft)	4	2	.5	184	270	< 1	97
Downstream (100 ft)	4	2	.8	185	266	< 1	100
Downstream (100 ft)	4	3	.2	178	266	< 1	90
Downstream (100 ft)	4	3	.5	183	259	< 1	85
Downstream (100 ft)	4	3	.8	183	266	< 1	88
Downstream (125 ft)	5	1	.2	183	261	< 1	96

Downstream (125 ft)	5	1	.5	184	268	< 1	93
Downstream (125 ft)	5	1	.8	188	259	< 1	90
Downstream (125 ft)	5	2	.2	184	254	< 1	85
Downstream (125 ft)	5	2	.5	181	266	< 1	84
Downstream (125 ft)	5	2	.8	184	261	< 1	93
Downstream (125 ft)	5	3	.2	181	283	< 1	88
Downstream (125 ft)	5	3	.5	181	284	< 1	91
Downstream (125 ft)	5	3	.8	187	277	< 1	99
Downstream (200 ft)	6	1	.2	180	286	< 1	82
Downstream (200 ft)	6	1	.5	177	276	< 1	90
Downstream (200 ft)	6	1	.8	180	262	< 1	90
Downstream (200 ft)	6	2	.2	182	270	< 1	82
Downstream (200 ft)	6	2	.5	184	284	< 1	108
Downstream (200 ft)	6	2	.8	183	272	< 1	97
Downstream (200 ft)	6	3	.2	182	282	< 1	97
Downstream (200 ft)	6	3	.5	181	268	< 1	101
Downstream (200 ft)	6	3	.8	184	272	< 1	104
Downstream (400 ft)	7	1	.2	181	259	< 1	84
Downstream (400 ft)	7	1	.5	182	258	< 1	86
Downstream (400 ft)	7	1	.8	180	258	< 1	89
Downstream (400 ft)	7	2	.2	182	260	< 1	82
Downstream (400 ft)	7	2	.5	180	264	< 1	83
Downstream (400 ft)	7	2	.8	182	263	< 1	105
Downstream (400 ft)	7	3	.2	185	264	< 1	151
Downstream (400 ft)	7	3	.5	185	259	< 1	100
Downstream (400 ft)	7	3	.8	182	266	< 1	86

Table B.3. Aluminum data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Al Total	0.464
	1	1	Al Total	0.396
	1	1	Al Total	0.384
	1	1	Al Total	0.338
	1	2	Al Total	0.509
	1	2	Al Total	0.477
	1	2	Al Total	0.441
	1	3	Al Total	0.429
	1	2	Al Total	0.406
	1	3	Al Total	0.398
Upstream (125 ft)	2	1	Al Total	0.393
	2	1	Al Total	0.446
	2	1	Al Total	0.385
	2	1	Al Total	0.47
	2	2	Al Total	0.408
	2	2	Al Total	0.388
	2	2	Al Total	0.459
	2	3	Al Total	0.483
	2	3	Al Total	0.501
	2	3	Al Total	0.515
Downstream (50 ft)	3	1	Al Total	0.446
	3	1	Al Total	0.422
	3	1	Al Total	0.513
	3	2	Al Total	0.462
	3	2	Al Total	0.526
	3	2	Al Total	0.518
	3	2	Al Total	0.579
	3	3	Al Total	0.587
	3	3	Al Total	0.585
	3	3	Al Total	0.657
Downstream (100 ft)	4	1	Al Total	0.687
	4	1	Al Total	0.646
	4	1	Al Total	0.628
	4	2	Al Total	0.653
	4	2	Al Total	0.555
	4	2	Al Total	0.575
	4	3	Al Total	1.04
	4	3	Al Total	1.032
	4	3	Al Total	1.025

	4	3	Al Total	1.106
Downstream (125 ft)	5	1	Al Total	1.083
	5	1	Al Total	1.128
	5	1	Al Total	1.117
	5	1	Al Total	1.123
	5	2	Al Total	1.12
	5	2	Al Total	1.094
	5	2	Al Total	1.044
	5	3	Al Total	1.051
	5	3	Al Total	1.197
	5	3	Al Total	1.101
Downstream (200 ft)	6	1	Al Total	1.095
	6	1	Al Total	1.112
	6	1	Al Total	0.963
	6	2	Al Total	0.942
	6	2	Al Total	1.117
	6	2	Al Total	0.734
	6	3	Al Total	0.674
	6	3	Al Total	0.729
	6	3	Al Total	0.661
	6	3	Al Total	0.626
Downstream (400 ft)	7	1	Al Total	0.673
	7	1	Al Total	0.702
	7	1	Al Total	0.608
	7	2	Al Total	0.659
	7	2	Al Total	0.61
	7	2	Al Total	0.544
	7	3	Al Total	0.659
	7	3	Al Total	0.817
	7	3	Al Total	0.804
	7	3	Al Total	0.683
Upstream (375 ft)	1	1	Al Dissolved	0.112
	1	1	Al Dissolved	0.115
	1	1	Al Dissolved	0.117
	1	1	Al Dissolved	0.12
	1	2	Al Dissolved	0.1
	1	2	Al Dissolved	0.082
	1	2	Al Dissolved	<0.063
	1	3	Al Dissolved	0.152
	1	2	Al Dissolved	<0.063
	1	3	Al Dissolved	<0.063
Upstream (125 ft)	2	1	Al Dissolved	0.118
	2	1	Al Dissolved	0.065

	2	1	Al Dissolved	0.147
	2	1	Al Dissolved	0.109
	2	2	Al Dissolved	0.162
	2	2	Al Dissolved	0.078
	2	2	Al Dissolved	<0.063
	2	3	Al Dissolved	0.234
	2	3	Al Dissolved	0.181
	2	3	Al Dissolved	0.207
Downstream (50 ft)	3	1	Al Dissolved	0.099
	3	1	Al Dissolved	0.163
	3	1	Al Dissolved	0.17
	3	2	Al Dissolved	0.126
	3	2	Al Dissolved	0.145
	3	2	Al Dissolved	0.204
	3	2	Al Dissolved	0.089
	3	3	Al Dissolved	0.067
	3	3	Al Dissolved	<0.063
	3	3	Al Dissolved	<0.063
Downstream (100 ft)	4	1	Al Dissolved	0.108
	4	1	Al Dissolved	0.123
	4	1	Al Dissolved	<0.063
	4	2	Al Dissolved	0.065
	4	2	Al Dissolved	0.066
	4	2	Al Dissolved	0.07
	4	3	Al Dissolved	<0.063
	4	3	Al Dissolved	<0.063
	4	3	Al Dissolved	<0.063
	4	3	Al Dissolved	<0.063
Downstream (125 ft)	5	1	Al Dissolved	0.123
	5	1	Al Dissolved	<0.063
	5	1	Al Dissolved	<0.063
	5	1	Al Dissolved	0.104
	5	2	Al Dissolved	<0.063
	5	2	Al Dissolved	0.075
	5	2	Al Dissolved	<0.063
	5	3	Al Dissolved	0.068
	5	3	Al Dissolved	<0.063
	5	3	Al Dissolved	<0.063
Downstream (200 ft)	6	1	Al Dissolved	<0.063
	6	1	Al Dissolved	0.077
	6	1	Al Dissolved	<0.063
	6	2	Al Dissolved	<0.063
	6	2	Al Dissolved	<0.063

	6	2	Al Dissolved	0.122
	6	3	Al Dissolved	0.085
	6	3	Al Dissolved	<0.063
	6	3	Al Dissolved	0.119
	6	3	Al Dissolved	0.108
Downstream (400 ft)	7	1	Al Dissolved	0.128
	7	1	Al Dissolved	0.138
	7	1	Al Dissolved	0.13
	7	2	Al Dissolved	0.15
	7	2	Al Dissolved	0.15
	7	2	Al Dissolved	0.107
	7	3	Al Dissolved	0.135
	7	3	Al Dissolved	0.137
	7	3	Al Dissolved	0.172
	7	3	Al Dissolved	0.102

Table B.4. Calcium data , Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Ca Total	61.936
	1	1	Ca Total	59.53
	1	1	Ca Total	60.706
	1	1	Ca Total	61.676
	1	2	Ca Total	63.231
	1	2	Ca Total	63.75
	1	2	Ca Total	60.735
	1	3	Ca Total	63.435
	1	2	Ca Total	63.147
	1	3	Ca Total	62.561
Upstream (125 ft)	2	1	Ca Total	62.984
	2	1	Ca Total	62.429
	2	1	Ca Total	62.907
	2	1	Ca Total	62.736
	2	2	Ca Total	62.078
	2	2	Ca Total	60.53
	2	2	Ca Total	61.262
	2	3	Ca Total	59.71
	2	3	Ca Total	62.51
	2	3	Ca Total	60.977
Downstream (50 ft)	3	1	Ca Total	63.21
	3	1	Ca Total	63.699
	3	1	Ca Total	63.531
	3	2	Ca Total	61.081
	3	2	Ca Total	59.332
	3	2	Ca Total	63.98
	3	2	Ca Total	65.682
	3	3	Ca Total	64.884
	3	3	Ca Total	64.72
	3	3	Ca Total	64.841
Downstream (100 ft)	4	1	Ca Total	66.063
	4	1	Ca Total	66.045
	4	1	Ca Total	61.151
	4	2	Ca Total	60.832
	4	2	Ca Total	64.814
	4	2	Ca Total	63.63
	4	3	Ca Total	63.355
	4	3	Ca Total	62.457
	4	3	Ca Total	61.38
	4	3	Ca Total	63.82

Downstream (125 ft)	5	1	Ca Total	62.142
	5	1	Ca Total	63.308
	5	1	Ca Total	63.685
	5	1	Ca Total	61.658
	5	2	Ca Total	59.973
	5	2	Ca Total	62.742
	5	2	Ca Total	62.348
	5	3	Ca Total	67.638
	5	3	Ca Total	67.298
	5	3	Ca Total	66.461
Downstream (200 ft)	6	1	Ca Total	68.772
	6	1	Ca Total	65.78
	6	1	Ca Total	62.14
	6	2	Ca Total	63.757
	6	2	Ca Total	68.675
	6	2	Ca Total	64.356
	6	3	Ca Total	66.744
	6	3	Ca Total	63.039
	6	3	Ca Total	64.631
	6	3	Ca Total	62.888
Downstream (400 ft)	7	1	Ca Total	61.539
	7	1	Ca Total	61.149
	7	1	Ca Total	61.03
	7	2	Ca Total	62.325
	7	2	Ca Total	63.031
	7	2	Ca Total	62.885
	7	3	Ca Total	62.35
	7	3	Ca Total	61.863
	7	3	Ca Total	62.84
	7	3	Ca Total	63.061
Upstream (375 ft)	1	1	Ca Dissolved	59.894
	1	1	Ca Dissolved	61.606
	1	1	Ca Dissolved	61.602
	1	1	Ca Dissolved	60.683
	1	2	Ca Dissolved	61.996
	1	2	Ca Dissolved	61.97
	1	2	Ca Dissolved	63.811
	1	3	Ca Dissolved	59.412
	1	2	Ca Dissolved	60.543
	1	3	Ca Dissolved	60.589
Upstream (125 ft)	2	1	Ca Dissolved	61.555
	2	1	Ca Dissolved	68.473
	2	1	Ca Dissolved	60.535

	2	1	Ca Dissolved	60.761
	2	2	Ca Dissolved	62.37
	2	2	Ca Dissolved	60.73
	2	2	Ca Dissolved	61.571
	2	3	Ca Dissolved	66.698
	2	3	Ca Dissolved	70.837
	2	3	Ca Dissolved	69.451
Downstream (50 ft)	3	1	Ca Dissolved	67.478
	3	1	Ca Dissolved	71.437
	3	1	Ca Dissolved	71.413
	3	2	Ca Dissolved	69.537
	3	2	Ca Dissolved	65.956
	3	2	Ca Dissolved	67.866
	3	2	Ca Dissolved	64.336
	3	3	Ca Dissolved	61.148
	3	3	Ca Dissolved	63.536
	3	3	Ca Dissolved	62.105
Downstream (100 ft)	4	1	Ca Dissolved	63.741
	4	1	Ca Dissolved	62.775
	4	1	Ca Dissolved	61.703
	4	2	Ca Dissolved	62.738
	4	2	Ca Dissolved	62.967
	4	2	Ca Dissolved	63.183
	4	3	Ca Dissolved	61.995
	4	3	Ca Dissolved	62.895
	4	3	Ca Dissolved	61.752
	4	3	Ca Dissolved	62.599
Downstream (125 ft)	5	1	Ca Dissolved	62.269
	5	1	Ca Dissolved	62.072
	5	1	Ca Dissolved	62.513
	5	1	Ca Dissolved	61.542
	5	2	Ca Dissolved	65.716
	5	2	Ca Dissolved	61.08
	5	2	Ca Dissolved	62.649
	5	3	Ca Dissolved	62.065
	5	3	Ca Dissolved	61.289
	5	3	Ca Dissolved	60.325
Downstream (200 ft)	6	1	Ca Dissolved	61.922
	6	1	Ca Dissolved	62.157
	6	1	Ca Dissolved	62.407
	6	2	Ca Dissolved	62.289
	6	2	Ca Dissolved	60.464
	6	2	Ca Dissolved	61.936

	6	3	Ca Dissolved	62.62
	6	3	Ca Dissolved	61.923
	6	3	Ca Dissolved	61.277
	6	3	Ca Dissolved	61.447
Downstream (400 ft)	7	1	Ca Dissolved	60.815
	7	1	Ca Dissolved	61.792
	7	1	Ca Dissolved	60.781
	7	2	Ca Dissolved	60.745
	7	2	Ca Dissolved	60.881
	7	2	Ca Dissolved	61.056
	7	3	Ca Dissolved	61.854
	7	3	Ca Dissolved	63.023
	7	3	Ca Dissolved	62.319
	7	3	Ca Dissolved	62.66

Table B.5. Copper data , Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Cu Total	<0.008
	1	1	Cu Total	<0.008
	1	1	Cu Total	<0.008
	1	1	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	3	Cu Total	<0.008
	1	2	Cu Total	<0.008
	1	3	Cu Total	<0.008
Upstream (125 ft)	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	1	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	2	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
	2	3	Cu Total	<0.008
Downstream (50 ft)	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	1	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	2	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
	3	3	Cu Total	<0.008
Downstream (100 ft)	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	1	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	2	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008
	4	3	Cu Total	<0.008

Downstream (125 ft)	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	1	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	2	Cu Total	<0.008
	5	3	Cu Total	<0.008
	5	3	Cu Total	<0.008
	5	3	Cu Total	<0.008
Downstream (200 ft)	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	1	Cu Total	<0.008
	6	2	Cu Total	<0.008
	6	2	Cu Total	<0.008
	6	2	Cu Total	0.015
	6	3	Cu Total	<0.008
	6	3	Cu Total	<0.008
	6	3	Cu Total	<0.008
	6	3	Cu Total	<0.008
Downstream (400 ft)	7	1	Cu Total	<0.008
	7	1	Cu Total	<0.008
	7	1	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	2	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
	7	3	Cu Total	<0.008
Upstream (375 ft)	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	1	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
	1	2	Cu Dissolved	<0.008
	1	3	Cu Dissolved	<0.008
Upstream (125 ft)	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008
	2	1	Cu Dissolved	<0.008

	2	1	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	2	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
	2	3	Cu Dissolved	<0.008
Downstream (50 ft)	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	1	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	2	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
	3	3	Cu Dissolved	<0.008
Downstream (100 ft)	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008
	4	1	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	2	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
	4	3	Cu Dissolved	<0.008
Downstream (125 ft)	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	1	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	2	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
	5	3	Cu Dissolved	<0.008
Downstream (200 ft)	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	1	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008
	6	2	Cu Dissolved	<0.008

	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
	6	3	Cu Dissolved	<0.008
Downstream (400 ft)	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	1	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	2	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008
	7	3	Cu Dissolved	<0.008

Table B.6. Iron data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Fe Total	0.428
	1	1	Fe Total	0.366
	1	1	Fe Total	0.345
	1	1	Fe Total	0.311
	1	2	Fe Total	0.465
	1	2	Fe Total	0.403
	1	2	Fe Total	0.359
	1	3	Fe Total	0.325
	1	2	Fe Total	0.395
	1	3	Fe Total	0.313
Upstream (125 ft)	2	1	Fe Total	0.358
	2	1	Fe Total	0.366
	2	1	Fe Total	0.292
	2	1	Fe Total	0.386
	2	2	Fe Total	0.354
	2	2	Fe Total	0.347
	2	2	Fe Total	0.342
	2	3	Fe Total	0.445
	2	3	Fe Total	0.462
	2	3	Fe Total	0.427
Downstream (50 ft)	3	1	Fe Total	0.396
	3	1	Fe Total	0.396
	3	1	Fe Total	0.444
	3	2	Fe Total	0.428
	3	2	Fe Total	0.462
	3	2	Fe Total	0.463
	3	2	Fe Total	0.515
	3	3	Fe Total	0.491
	3	3	Fe Total	0.493
	3	3	Fe Total	0.599
Downstream (100 ft)	4	1	Fe Total	0.574
	4	1	Fe Total	0.526
	4	1	Fe Total	0.48
	4	2	Fe Total	0.532
	4	2	Fe Total	0.406
	4	2	Fe Total	0.482
	4	3	Fe Total	0.929
	4	3	Fe Total	0.915
	4	3	Fe Total	0.9
	4	3	Fe Total	0.957

Downstream (125 ft)	5	1	Fe Total	0.967
	5	1	Fe Total	1.054
	5	1	Fe Total	0.973
	5	1	Fe Total	0.966
	5	2	Fe Total	0.986
	5	2	Fe Total	0.932
	5	2	Fe Total	0.987
	5	3	Fe Total	0.969
	5	3	Fe Total	1.093
	5	3	Fe Total	1.028
Downstream (200 ft)	6	1	Fe Total	0.996
	6	1	Fe Total	1.043
	6	1	Fe Total	0.871
	6	2	Fe Total	0.832
	6	2	Fe Total	1.043
	6	2	Fe Total	0.661
	6	3	Fe Total	0.561
	6	3	Fe Total	0.615
	6	3	Fe Total	0.592
	6	3	Fe Total	0.555
Downstream (400 ft)	7	1	Fe Total	0.628
	7	1	Fe Total	0.654
	7	1	Fe Total	0.586
	7	2	Fe Total	0.603
	7	2	Fe Total	0.537
	7	2	Fe Total	0.533
	7	3	Fe Total	0.606
	7	3	Fe Total	0.783
	7	3	Fe Total	0.722
	7	3	Fe Total	0.581
Upstream (375 ft)	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	1	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
	1	2	Fe Dissolved	<0.063
	1	3	Fe Dissolved	<0.063
Upstream (125 ft)	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063
	2	1	Fe Dissolved	<0.063

	2	1	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	2	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
	2	3	Fe Dissolved	<0.063
Downstream (50 ft)	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	1	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	2	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
	3	3	Fe Dissolved	<0.063
Downstream (100 ft)	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	1	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	2	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
	4	3	Fe Dissolved	<0.063
Downstream (125 ft)	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	1	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	2	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
	5	3	Fe Dissolved	<0.063
Downstream (200 ft)	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	1	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063
	6	2	Fe Dissolved	<0.063

	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
	6	3	Fe Dissolved	<0.063
Downstream (400 ft)	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	1	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	2	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063
	7	3	Fe Dissolved	<0.063

Table B.7. Magnesium data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Mg Total	25.806
	1	1	Mg Total	24.599
	1	1	Mg Total	25.445
	1	1	Mg Total	25.519
	1	2	Mg Total	27.778
	1	2	Mg Total	25.762
	1	2	Mg Total	25.503
	1	3	Mg Total	25.642
	1	2	Mg Total	25.974
	1	3	Mg Total	25.534
Upstream (125 ft)	2	1	Mg Total	25.579
	2	1	Mg Total	25.465
	2	1	Mg Total	26.394
	2	1	Mg Total	25.632
	2	2	Mg Total	26.25
	2	2	Mg Total	25.076
	2	2	Mg Total	27.16
	2	3	Mg Total	25.209
	2	3	Mg Total	26.16
	2	3	Mg Total	26.275
Downstream (50 ft)	3	1	Mg Total	26.48
	3	1	Mg Total	26.225
	3	1	Mg Total	26.086
	3	2	Mg Total	26.034
	3	2	Mg Total	25.78
	3	2	Mg Total	26.182
	3	2	Mg Total	26.669
	3	3	Mg Total	27.131
	3	3	Mg Total	26.609
	3	3	Mg Total	26.969
Downstream (100 ft)	4	1	Mg Total	27.639
	4	1	Mg Total	26.52
	4	1	Mg Total	25.97
	4	2	Mg Total	25.148
	4	2	Mg Total	26.331
	4	2	Mg Total	25.968
	4	3	Mg Total	26.299
	4	3	Mg Total	25.863
	4	3	Mg Total	25.651

	4	3	Mg Total	25.928
Downstream (125 ft)	5	1	Mg Total	25.585
	5	1	Mg Total	26.721
	5	1	Mg Total	25.402
	5	1	Mg Total	25.397
	5	2	Mg Total	25.308
	5	2	Mg Total	26.453
	5	2	Mg Total	25.552
	5	3	Mg Total	27.599
	5	3	Mg Total	28.041
	5	3	Mg Total	27.026
Downstream (200 ft)	6	1	Mg Total	27.813
	6	1	Mg Total	27.096
	6	1	Mg Total	25.995
	6	2	Mg Total	26.962
	6	2	Mg Total	27.263
	6	2	Mg Total	27.017
	6	3	Mg Total	28.073
	6	3	Mg Total	27.102
	6	3	Mg Total	26.813
	6	3	Mg Total	25.712
Downstream (400 ft)	7	1	Mg Total	25.551
	7	1	Mg Total	25.629
	7	1	Mg Total	25.615
	7	2	Mg Total	25.225
	7	2	Mg Total	25.914
	7	2	Mg Total	25.645
	7	3	Mg Total	26.192
	7	3	Mg Total	25.434
	7	3	Mg Total	25.701
	7	3	Mg Total	26.42
Upstream (375 ft)	1	1	Mg Dissolved	25.112
	1	1	Mg Dissolved	25.609
	1	1	Mg Dissolved	26.383
	1	1	Mg Dissolved	24.975
	1	2	Mg Dissolved	26.924
	1	2	Mg Dissolved	27.321
	1	2	Mg Dissolved	26.354
	1	3	Mg Dissolved	26.502
	1	2	Mg Dissolved	24.149
	1	3	Mg Dissolved	26.293
Upstream (125 ft)	2	1	Mg Dissolved	24.805
	2	1	Mg Dissolved	25.136

	2	1	Mg Dissolved	28.55
	2	1	Mg Dissolved	25.829
	2	2	Mg Dissolved	26.171
	2	2	Mg Dissolved	25.887
	2	2	Mg Dissolved	25.681
	2	3	Mg Dissolved	29.119
	2	3	Mg Dissolved	27.699
	2	3	Mg Dissolved	29.035
Downstream (50 ft)	3	1	Mg Dissolved	26.383
	3	1	Mg Dissolved	25.967
	3	1	Mg Dissolved	28.607
	3	2	Mg Dissolved	28.702
	3	2	Mg Dissolved	27.851
	3	2	Mg Dissolved	27.626
	3	2	Mg Dissolved	27.212
	3	3	Mg Dissolved	26.663
	3	3	Mg Dissolved	26.759
	3	3	Mg Dissolved	26.803
Downstream (100 ft)	4	1	Mg Dissolved	26.266
	4	1	Mg Dissolved	28.423
	4	1	Mg Dissolved	25.562
	4	2	Mg Dissolved	27.269
	4	2	Mg Dissolved	26.041
	4	2	Mg Dissolved	27.123
	4	3	Mg Dissolved	26.195
	4	3	Mg Dissolved	26.634
	4	3	Mg Dissolved	25.785
	4	3	Mg Dissolved	25.76
Downstream (125 ft)	5	1	Mg Dissolved	26.094
	5	1	Mg Dissolved	25.312
	5	1	Mg Dissolved	26.28
	5	1	Mg Dissolved	26.471
	5	2	Mg Dissolved	24.693
	5	2	Mg Dissolved	26.154
	5	2	Mg Dissolved	25.639
	5	3	Mg Dissolved	26.068
	5	3	Mg Dissolved	25.396
	5	3	Mg Dissolved	25.978
Downstream (200 ft)	6	1	Mg Dissolved	25.853
	6	1	Mg Dissolved	26.324
	6	1	Mg Dissolved	26.206
	6	2	Mg Dissolved	25.887
	6	2	Mg Dissolved	26.067

	6	2	Mg Dissolved	26.591
	6	3	Mg Dissolved	25.837
	6	3	Mg Dissolved	25.977
	6	3	Mg Dissolved	25.913
	6	3	Mg Dissolved	26.567
Downstream (400 ft)	7	1	Mg Dissolved	25.803
	7	1	Mg Dissolved	25.354
	7	1	Mg Dissolved	25.457
	7	2	Mg Dissolved	26.357
	7	2	Mg Dissolved	26.249
	7	2	Mg Dissolved	25.876
	7	3	Mg Dissolved	26.406
	7	3	Mg Dissolved	26.516
	7	3	Mg Dissolved	26.097
	7	3	Mg Dissolved	26.299

Table B.8. Manganese data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Mn Total	0.039
	1	1	Mn Total	0.033
	1	1	Mn Total	0.031
	1	1	Mn Total	0.029
	1	2	Mn Total	0.041
	1	2	Mn Total	0.035
	1	2	Mn Total	0.032
	1	3	Mn Total	0.028
	1	2	Mn Total	0.035
	1	3	Mn Total	0.028
Upstream (125 ft)	2	1	Mn Total	0.033
	2	1	Mn Total	0.033
	2	1	Mn Total	0.027
	2	1	Mn Total	0.035
	2	2	Mn Total	0.032
	2	2	Mn Total	0.031
	2	2	Mn Total	0.031
	2	3	Mn Total	0.039
	2	3	Mn Total	0.041
	2	3	Mn Total	0.037
Downstream (50 ft)	3	1	Mn Total	0.037
	3	1	Mn Total	0.039
	3	1	Mn Total	0.043
	3	2	Mn Total	0.04
	3	2	Mn Total	0.041
	3	2	Mn Total	0.038
	3	2	Mn Total	0.054
	3	3	Mn Total	0.053
	3	3	Mn Total	0.054
	3	3	Mn Total	0.061
Downstream (100 ft)	4	1	Mn Total	0.061
	4	1	Mn Total	0.056
	4	1	Mn Total	0.054
	4	2	Mn Total	0.056
	4	2	Mn Total	0.047
	4	2	Mn Total	0.052
	4	3	Mn Total	0.086
	4	3	Mn Total	0.085
	4	3	Mn Total	0.085

	4	3	Mn Total	0.086
Downstream (125 ft)	5	1	Mn Total	0.09
	5	1	Mn Total	0.097
	5	1	Mn Total	0.091
	5	1	Mn Total	0.09
	5	2	Mn Total	0.092
	5	2	Mn Total	0.089
	5	2	Mn Total	0.092
	5	3	Mn Total	0.091
	5	3	Mn Total	0.101
	5	3	Mn Total	0.096
Downstream (200 ft)	6	1	Mn Total	0.095
	6	1	Mn Total	0.098
	6	1	Mn Total	0.085
	6	2	Mn Total	0.08
	6	2	Mn Total	0.097
	6	2	Mn Total	0.067
	6	3	Mn Total	0.058
	6	3	Mn Total	0.064
	6	3	Mn Total	0.048
	6	3	Mn Total	0.046
Downstream (400 ft)	7	1	Mn Total	0.053
	7	1	Mn Total	0.054
	7	1	Mn Total	0.049
	7	2	Mn Total	0.049
	7	2	Mn Total	0.046
	7	2	Mn Total	0.044
	7	3	Mn Total	0.047
	7	3	Mn Total	0.063
	7	3	Mn Total	0.06
	7	3	Mn Total	0.048
Upstream (375 ft)	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	1	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
	1	2	Mn Dissolved	<0.006
	1	3	Mn Dissolved	<0.006
Upstream (125 ft)	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006

	2	1	Mn Dissolved	<0.006
	2	1	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	2	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
	2	3	Mn Dissolved	<0.006
Downstream (50 ft)	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	1	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	2	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
	3	3	Mn Dissolved	<0.006
Downstream (100 ft)	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	1	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	2	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
	4	3	Mn Dissolved	<0.006
Downstream (125 ft)	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	1	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	2	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
	5	3	Mn Dissolved	<0.006
Downstream (200 ft)	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	1	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006
	6	2	Mn Dissolved	<0.006

	6	2	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
	6	3	Mn Dissolved	<0.006
Downstream (400 ft)	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	1	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	2	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006
	7	3	Mn Dissolved	<0.006

Table B.9. Nickel data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	1	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	3	Ni Total	<0.019
	1	2	Ni Total	<0.019
	1	3	Ni Total	<0.019
Upstream (125 ft)	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	1	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	2	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
	2	3	Ni Total	<0.019
Downstream (50 ft)	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	1	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	2	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
	3	3	Ni Total	<0.019
Downstream (100 ft)	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	1	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	2	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019
	4	3	Ni Total	<0.019

Downstream (125 ft)	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	1	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	2	Ni Total	<0.019
	5	3	Ni Total	<0.019
	5	3	Ni Total	<0.019
	5	3	Ni Total	<0.019
Downstream (200 ft)	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	1	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	2	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
	6	3	Ni Total	<0.019
Downstream (400 ft)	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	1	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	2	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
	7	3	Ni Total	<0.019
Upstream (375 ft)	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	1	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
	1	2	Ni Dissolved	<0.019
	1	3	Ni Dissolved	<0.019
Upstream (125 ft)	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019
	2	1	Ni Dissolved	<0.019

	2	1	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	2	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
	2	3	Ni Dissolved	<0.019
Downstream (50 ft)	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	1	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	2	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
	3	3	Ni Dissolved	<0.019
Downstream (100 ft)	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019
	4	1	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	2	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
	4	3	Ni Dissolved	<0.019
Downstream (125 ft)	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	1	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	2	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
	5	3	Ni Dissolved	<0.019
Downstream (200 ft)	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	1	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019
	6	2	Ni Dissolved	<0.019

	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
	6	3	Ni Dissolved	<0.019
Downstream (400 ft)	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	1	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	2	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019
	7	3	Ni Dissolved	<0.019

Table B.10. Selenium data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	1	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	2	Se Total	<0.063
	1	3	Se Total	<0.063
	1	2	Se Total	<0.063
	1	3	Se Total	<0.063
Upstream (125 ft)	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	1	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	2	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
	2	3	Se Total	<0.063
Downstream (50 ft)	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	1	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	2	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
	3	3	Se Total	<0.063
Downstream (100 ft)	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	1	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	2	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063
	4	3	Se Total	<0.063

	4	3	Se Total	<0.063
Downstream (125 ft)	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	1	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	2	Se Total	<0.063
	5	3	Se Total	<0.063
	5	3	Se Total	<0.063
	5	3	Se Total	<0.063
Downstream (200 ft)	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	1	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	2	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
	6	3	Se Total	<0.063
Downstream (400 ft)	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	1	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	2	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
	7	3	Se Total	<0.063
Upstream (375 ft)	1	1	Se Dissolved	<0.063
Upstream (375 ft)	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	1	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
	1	2	Se Dissolved	<0.063
	1	3	Se Dissolved	<0.063
Upstream (125 ft)	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063

	2	1	Se Dissolved	<0.063
	2	1	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	2	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
	2	3	Se Dissolved	<0.063
Downstream (50 ft)	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	1	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	2	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
	3	3	Se Dissolved	<0.063
Downstream (100 ft)	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063
	4	1	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	2	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
	4	3	Se Dissolved	<0.063
Downstream (125 ft)	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	1	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	2	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
	5	3	Se Dissolved	<0.063
Downstream (200 ft)	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	1	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063
	6	2	Se Dissolved	<0.063

	6	2	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
	6	3	Se Dissolved	<0.063
Downstream (400 ft)	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	1	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	2	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063
	7	3	Se Dissolved	<0.063

Table B.11. Zinc data, Platte South Water Treatment Plant, Metropolitan Utility District, Omaha, NE.

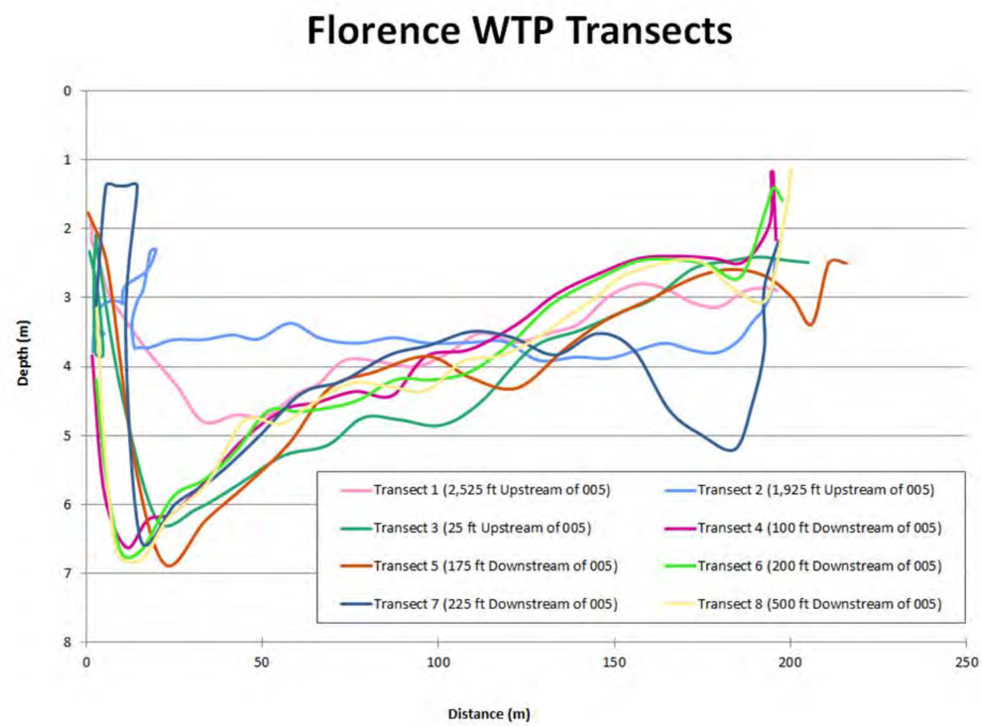
Location From Reference Discharge	Transverse No.	Position along Transect	Parameter	Results (mg/L)
Upstream (375 ft)	1	1	Zn Total	<0.006
	1	1	Zn Total	<0.006
	1	1	Zn Total	<0.006
	1	1	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	3	Zn Total	<0.006
	1	2	Zn Total	<0.006
	1	3	Zn Total	<0.006
Upstream (125 ft)	2	1	Zn Total	<0.006
	2	1	Zn Total	<0.006
	2	1	Zn Total	<0.006
	2	1	Zn Total	<0.006
	2	2	Zn Total	<0.006
	2	2	Zn Total	<0.006
	2	2	Zn Total	<0.006
	2	3	Zn Total	<0.006
	2	3	Zn Total	<0.006
	2	3	Zn Total	<0.006
Downstream (50 ft)	3	1	Zn Total	<0.006
	3	1	Zn Total	<0.006
	3	1	Zn Total	<0.006
	3	2	Zn Total	<0.006
	3	2	Zn Total	<0.006
	3	2	Zn Total	<0.006
	3	2	Zn Total	0.008
	3	3	Zn Total	0.008
	3	3	Zn Total	<0.006
	3	3	Zn Total	0.007
Downstream (100 ft)	4	1	Zn Total	0.01
	4	1	Zn Total	0.009
	4	1	Zn Total	0.008
	4	2	Zn Total	0.011
	4	2	Zn Total	0.008
	4	2	Zn Total	0.009
	4	3	Zn Total	0.009
	4	3	Zn Total	0.01
	4	3	Zn Total	0.01
	4	3	Zn Total	0.01

Downstream (125 ft)	5	1	Zn Total	0.009
	5	1	Zn Total	0.017
	5	1	Zn Total	0.01
	5	1	Zn Total	0.015
	5	2	Zn Total	0.011
	5	2	Zn Total	0.012
	5	2	Zn Total	0.01
	5	3	Zn Total	0.013
	5	3	Zn Total	0.012
	5	3	Zn Total	0.01
Downstream (200 ft)	6	1	Zn Total	0.011
	6	1	Zn Total	0.01
	6	1	Zn Total	0.009
	6	2	Zn Total	0.009
	6	2	Zn Total	0.011
	6	2	Zn Total	0.007
	6	3	Zn Total	0.007
	6	3	Zn Total	0.009
	6	3	Zn Total	<0.006
	6	3	Zn Total	<0.006
Downstream (400 ft)	7	1	Zn Total	<0.006
	7	1	Zn Total	<0.006
	7	1	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	2	Zn Total	<0.006
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
	7	3	Zn Total	<0.006
Upstream (375 ft)	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	1	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
	1	2	Zn Dissolved	<0.006
	1	3	Zn Dissolved	<0.006
Upstream (125 ft)	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	<0.006
	2	1	Zn Dissolved	<0.006

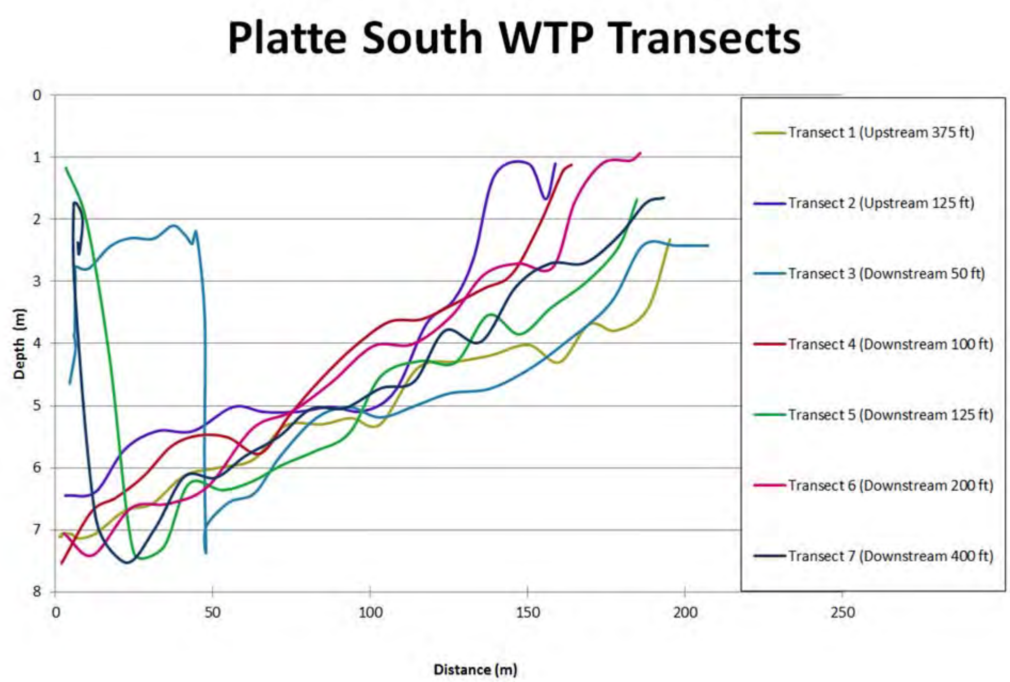
	2	1	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	2	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
	2	3	Zn Dissolved	<0.006
Downstream (50 ft)	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	1	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	2	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
	3	3	Zn Dissolved	<0.006
Downstream (100 ft)	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006
	4	1	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	2	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
	4	3	Zn Dissolved	<0.006
Downstream (125 ft)	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	1	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	2	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
	5	3	Zn Dissolved	<0.006
Downstream (200 ft)	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	1	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006
	6	2	Zn Dissolved	<0.006

	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	<0.006
	6	3	Zn Dissolved	0.007
	6	3	Zn Dissolved	0.012
Downstream (400 ft)	7	1	Zn Dissolved	0.008
	7	1	Zn Dissolved	0.007
	7	1	Zn Dissolved	0.01
	7	2	Zn Dissolved	0.007
	7	2	Zn Dissolved	0.008
	7	2	Zn Dissolved	0.01
	7	3	Zn Dissolved	0.007
	7	3	Zn Dissolved	0.011
	7	3	Zn Dissolved	<0.006
	7	3	Zn Dissolved	0.007

APPENDIX C



Florence WTP Transects
Depth (m)
Distance (m)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
Transect 1 (2,525 ft Upstream of 005)
Transect 2 (1,925 ft Upstream of 005)
Transect 3 (25 ft Upstream of 005)
Transect 4 (100 ft Downstream of 005)
Transect 5 (175 ft Downstream of 005)
Transect 6 (200 ft Downstream of 005)
Transect 7 (225 ft Downstream of 005)
Transect 8 (500 ft Downstream of 005)



Platte South WTP Transects
Depth (m)
Distance (m)
0
1
2
3
4
5
6
7
8
0
50
100
150
200
250
Transect 1 (Upstream 375 ft)
Transect 2 (Upstream 125 ft)
Transect 3 (Downstream 50 ft)
Transect 4 (Downstream 100 ft)
Transect 5 (Downstream 125 ft)
Transect 6 (Downstream 200 ft)
Transect 7 (Downstream 400 ft)

Attachment B

Benthic Macroinvertebrate Community Analyses
Missouri River in the Vicinity of the Florence and Platte South
Potable Water Treatment Plants
Omaha, Nebraska

By
Pennington and Associates, Inc.
Cookeville, Tennessee

BENTHIC MACROINVERTEBRATE COMMUNITY ANALYSES
MISSOURI RIVER IN THE VICINITY OF THE FLORENCE AND PLATTE SOUTH POTABLE WATER TREATMENT PLANTS
OMAHA, NEBRASKA

PREPARED FOR

EE & T, INC.
NEWPORT NEWS, VIRGINIA

AUGUST 2012

PREPARED BY

PENNINGTON AND ASSOCIATES, INC.
COOKEVILLE, TENNESSEE

EXECUTIVE SUMMARY

Benthic macroinvertebrates were collected from the Missouri River in the vicinity of the Florence Potable Water Treatment Plant's (PWTP) and Platte South PWTP for the Omaha Nebraska Municipal Utility District. One location was established upstream and two downstream (125' and 600') of the permitted discharges. At each of the six locations, six artificial substrate samplers were placed on June 25 and 26 and retrieved on August 13 and 14, 2012. Analyses of the substrate samplers included taxa richness, density, EPT taxa, Hilsenhoff Biotic Index, species diversity, evenness, Jaccard's Coefficient and percent similarity. A minimum of 57 species was found on the substrates with the net-spinning caddisfly *Potamyia flava* and the midge *Rheotanytarsus exiguus gp.* dominant. The most significant differences included a statistically measurable drop in density from the upstream substrates to the downstream substrates below the Florence PWTP discharges and significantly higher numbers of taxa at Platt South when compared to the Florence locations.

TABLE OF CONTENTS

INTRODUCTION

Pennington and Associates, Inc. was contracted in May 2012 by EE & T, Inc. to conduct benthic macroinvertebrate surveys in the Missouri River using artificial substrate samplers in the vicinity of the Florence PWTP outfalls (NPDES Permit No. NE0000914) and the Platte South PWTP outfall (NPDES Permit No. NE0000906). The two facilities are operated by Omaha's Metropolitan Utilities District (M.U.D.). The artificial substrate samplers were placed on June 25, 2012 at the Florence PWTP and retrieved on August 13, 2012. At the Platte South locations the artificial substrate samplers (Photo 1) were placed on June 26 and retrieved on August 14, 2012. The approximate 6 week duration allowed for maximum colonization (Photo 2 and 3) of the substrates by benthic macroinvertebrates that exist in the river.

Attention is normally focused on the benthic macroinvertebrate community because it is more indicative of the relative health of the aquatic ecosystem. Macroinvertebrates are found in all habitats, are less mobile than some other groups of aquatic organisms such as fish, and most species of macroinvertebrates have relatively long periods of development in the aquatic environment. It is because of these factors that macroinvertebrate species can be used to indicate deleterious events that may occur in an aquatic environment over a period of time (OEPA 1987).

LOCATIONS

The locations selected for benthic macroinvertebrate community analyses in the Missouri River for the Florence PWTP and the Platte South PWTP are shown in Figures 1 and 2 and described as follows:

F 600 D – Approximately 600 feet downstream of Florence PWTP most downstream discharge, approximately 50 feet off right descending bank.

F 125 D – Approximately 125 feet downstream of Florence PWTP most downstream discharge, approximately 50 feet off right descending bank.

F U – Approximately 50 feet off right descending bank just upstream of Florence PWTP discharges.

P 600 D – Approximately 600 feet downstream of Platte South PWTP discharge, approximately 50 feet off right descending bank.

P 125 D - Approximately 125 feet downstream of Platte South PWTP discharge, approximately 50 feet off right descending bank.

PU – Just upstream of Platte South PWTP discharge at approximately 50 feet off right descending bank.

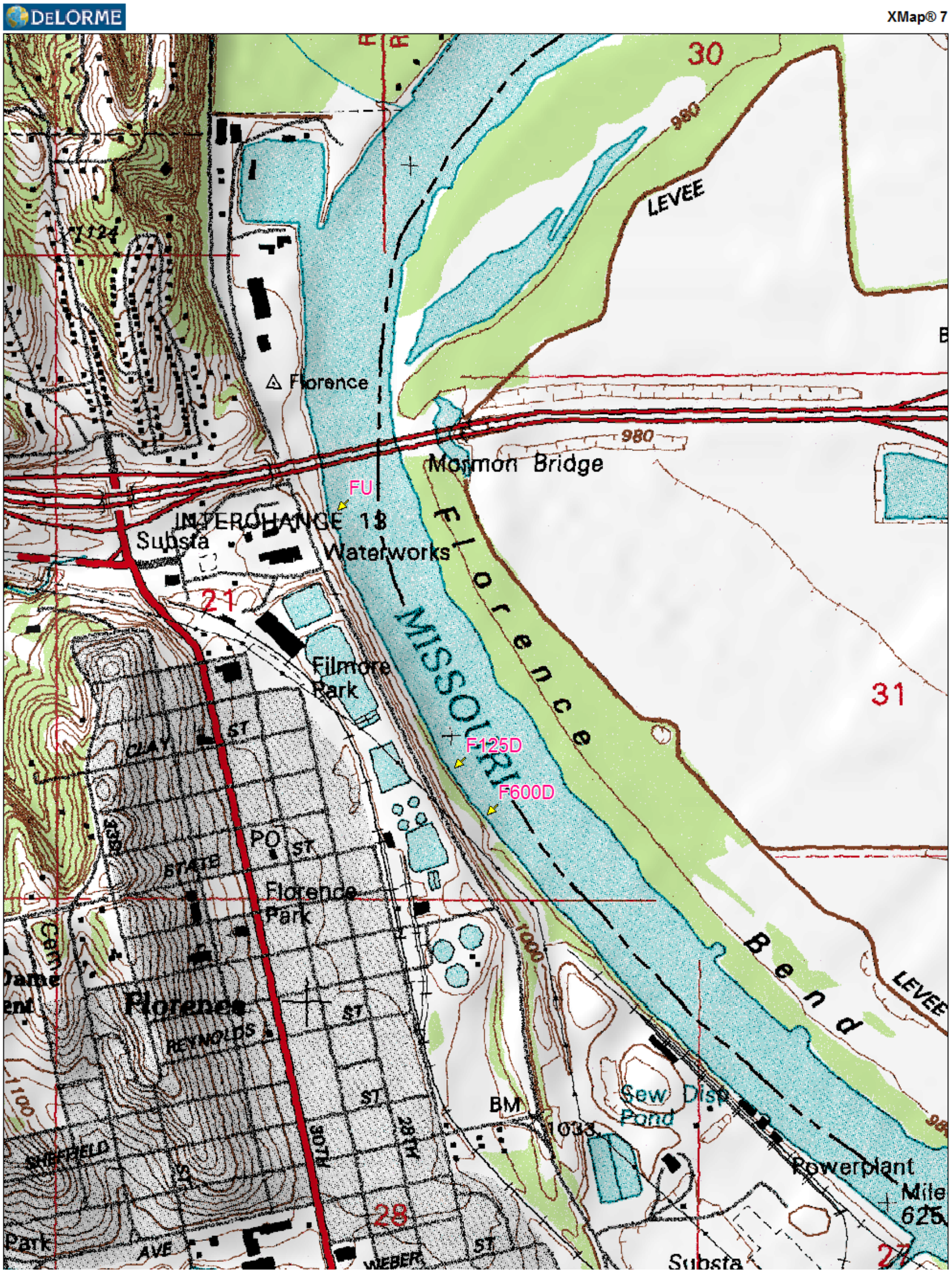


Figure 1. Benthic Macroinvertebrate Sampling Sites, Florence PWTP, August, 2012.

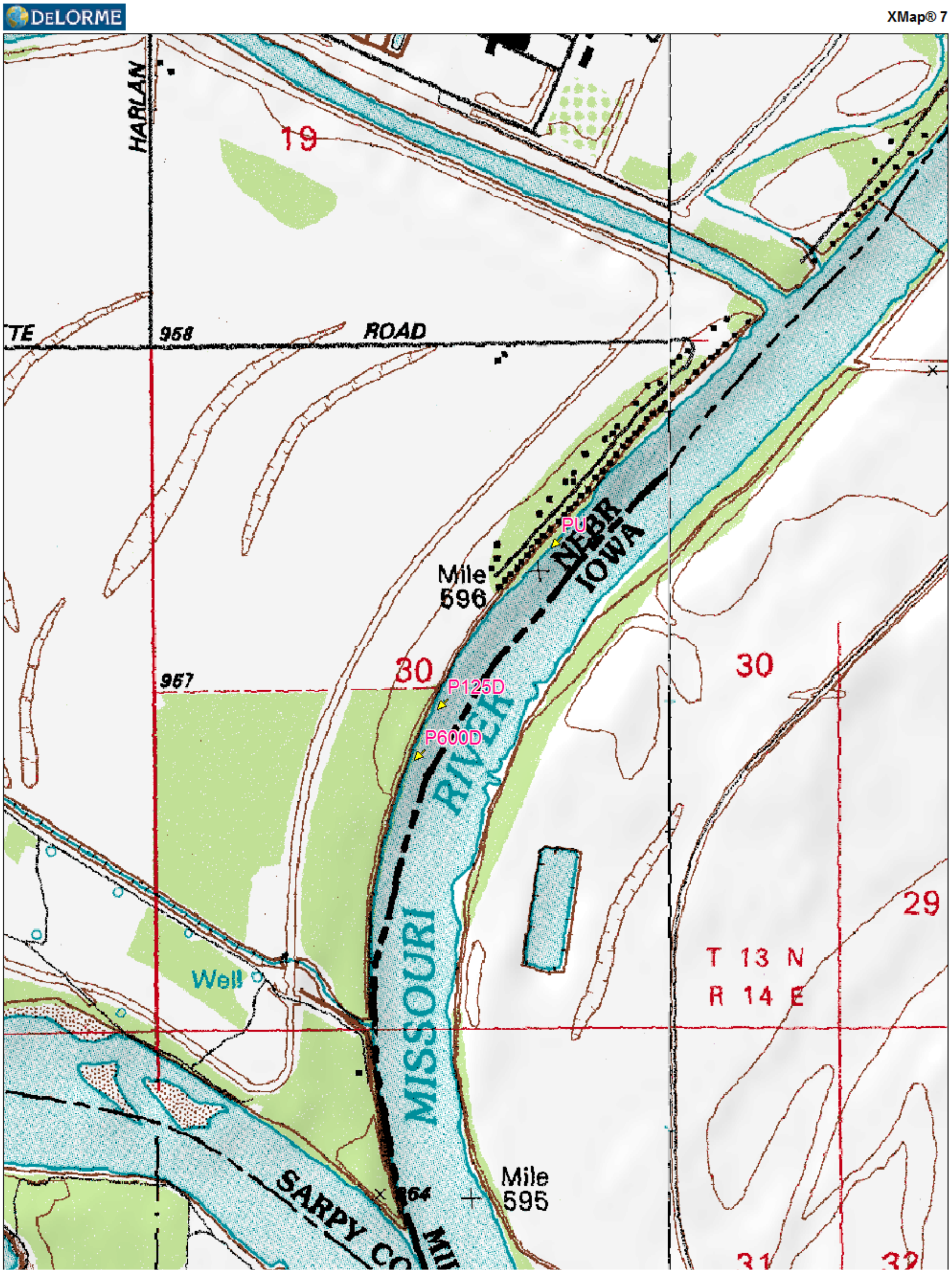


Figure 2. Benthic Macroinvertebrate Sampling Sites, Platte South PWTP, August, 2012.

Photo 1. Artificial substrate sampler prior to placement, June 25, 2012.

Photo 2. Artificial substrate sampler approximately 6 weeks after placement, August 13, 2012.

Photo 3. Individual artificial substrate approximately 6 weeks after placement, August 13, 2012.

MATERIALS AND METHODS

Collection Methods

Benthic macroinvertebrates were collected from the Missouri River using artificial substrate samplers (concrete forms in baskets) (Merritt et al. 2008). The substrate samplers were placed on June 25 and 26 retrieved on August 13 and 14, 2012. At the six sites, duplicate sets of three artificial substrate samplers were placed in the river for a total of 36. As stipulated in the work plan a minimum of one set of three from each location was to be processed. The artificial substrate samplers were constructed of 1" welded wire, based on the design of the barbecue basket sampler (Mason et al. 1967; Merritt et al. 2008). They were 11" (length) X 7" (diameter) (28 X 18 cm). Substrates were constructed by filling 7 ounce paper cups with concrete. After the mixture hardened the paper was removed to expose the hard surface and the substrates were seasoned in water. Ten concrete substrates were placed in each basket. The surface area of each substrate was approximately 150 cm^2 (10 x .015m^2 = 0.15m^2/Basket).

The artificial substrate samplers were attached to the riverbank with a plastic coated steel cable to reduce oxidation and breakage. Survey tape was used to mark bank locations. After a 6-week time lapse, each sampler was retrieved from the river by lifting the cable and placing a 250-micron net under it below the water surface to capture any animals dislodged when the substrates broke the surface. The substrates were removed from the baskets and cleaned in the field. All materials (detritus, organisms, etc.) were transferred to plastic containers, labeled, preserved in formalin and returned to the laboratory for analyses. All 18 substrates were retrieved in the vicinity of the Florence PWTP discharge. At the Platte South location 3 substrates were found upstream, 5 from 125 feet downstream and 6 from the 600 feet downstream location.

Laboratory Methods

In the laboratory, all benthic samples were washed in a 250-micron mesh sieve, manually separated from the detritus using a stereomicroscope, and preserved in 70-80% ethanol. If sub-sampling of large numbers of certain groups was required a Water's (1969) sub-sampling device was used. Identifications were made with a stereomicroscope (0.8X to 4X). Chironomids were cleared for 24 hours in cold 10% KOH and temporary mounts were made in glycerine. Slide mounts of chironomids, oligochaetes, small crustaceans, and others were identified with a compound microscope (4X to 40X). Once identified, the animals were returned to 80% ethanol. Permanent mounts were made with CMC-10 and euperol (Pennak 1989). Identifications were made to the lowest practical taxonomic level (species or genus) using taxonomic keys listed in Pennington & Associates, Inc. Standard Operating Procedures, Benthic Macroinvertebrates (2006).

COMMUNITY STRUCTURE MEASURES

Core benthic macroinvertebrate community metrics were calculated for each location and include:

1. **Taxa Richness (TR)** – Total number of distinct taxa. In general, increasing taxa richness reflects increasing water quality, habitat diversity and habitat suitability (KDOW 2002).

2. **Ephemeroptera, Plecoptera, and Trichoptera Richness (EPT)** – Total number of distinct taxa within the generally pollution sensitive insect orders of EPT. This index value will usually increase with increasing water quality, habitat diversity and habitat stability (Plafkin et al. 1989).

3. **Hilsenhoff Biotic Index (HBI)** – The Biotic Index was originally developed by Hilsenhoff (1982) as a rapid method for evaluating water quality in Wisconsin streams by

summarizing the overall pollution tolerance of a benthic arthropod community with a single value from 0-5. Hilsenhoff (1987) later refined the index and expanded the scale from 0-10. The biotic index is an average of tolerance values, and measures saprobity (pertaining to tolerance of organic enrichment) and to some extent tropism. Range of the index ranges from 0 (no apparent organic pollution) to 10 (severe organic pollution). An increasing Biotic Index value indicates decreasing water quality. The formula for the Biotic Index is as follows:

$$\text{HBI} = \sum \frac{x_i t_i}{n}$$

Where: x_i = number of individuals within a taxon
t_i = tolerance value of a taxon
n = total number of individuals in the sample

According to Hilsenhoff (1987) the calculated Biotic Index values for Wisconsin streams reflect the following:

Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00 - 3.50	Excellent	No apparent organic pollution
3.51 - 4.50	Very Good	Possibly slight organic pollution
4.51 - 5.50	Good	Some organic pollution
5.51 - 6.50	Fair	Fairly significant organic pollution
6.51 - 7.50	Fairly Poor	Significant organic pollution
7.51 - 8.50	Poor	Very significant organic pollution
8.51 - 10.00	Very Poor	Severe organic pollution

The State of Nebraska Water Quality Division (1997) follows the Hilsenhoff (1987) Wisconsin scoring criteria with values less than 3.5 indicating excellent water quality, values of 3.51 to 5 indicating good water quality, 5.01 to 7.5 indicating fair water quality, 7.51 to 8 indicating poor water quality and values greater than 8 would indicate serious water quality problems.

Brower and Zar (1984) provide a detailed discussion of a variety of techniques for measuring community structure. The use of diversity indices is based upon the observation that normally undisturbed environments support communities with large numbers of species having no individuals present in overwhelming abundance. If the species of a disturbed community are ranked by numerical abundance, there may be relatively few species with large numbers of individuals. Mean diversity is affected by both "richness" of species (or abundance of different species) and by the distribution of individuals among the species. High species diversity indicates a highly complex community.

Species diversity was estimated using Shannon's Index of Diversity (H):

$$H = -\sum p_i \log p_i$$

where p_i is the proportion of the total number of individuals occurring in species i ($p_i=n_i/N$), N is the total number of individuals in all species.

Diversity indices take into account both the species richness and the evenness of the individuals' distribution among the species. Separate measures of these two components of diversity are often desirable. Species richness can be expressed simply as the number of species in the community. Evenness may be expressed by considering how close a set of observed species abundance are to those from an aggregation of species having maximum possible diversity for a given N and S (Brower and Zar 1984).

Evenness is calculated as follows:

$$\text{Pielou } J' = H/H_{max}$$

where H is calculated diversity and H_{max} is maximum possible diversity.

Community similarity between sites is measured by Jaccards Coefficient, Percent Similarity and Bray-Curtis Percent Dissimilarity.

$$\text{Jaccards Coefficient} = \frac{C}{S_1 + S_2 - C}$$

where S = Species in each community (S_1 is reference Community)

and C = Species common to both communities

Percent Similarity, for a two-community comparison, is calculated as follows: The number of individuals in each species is calculated as a fractional portion of the total community. The value for species i in community 1 is compared to the value for species i in community 2. The lower of the two is tabulated. This procedure is followed for each species. The tabulated list (of the lower of each pair of values) is summed. The sum is defined as the Percent Similarity of the two communities.

Bray-Curtis Percent Dissimilarity (PD) is based on species abundance compared between any two communities. The index is expressed as

$$PD = 1 - PS/100$$

where PS = Percent similarity. Boyle et al. (1990) indicated the index was insensitive to low and moderate level structural changes.

Cluster analysis sorts sampling units into groups based on the overall resemblance to each other (Ludwig and Reynolds 1988). By using the PD, sampling units are sorted to permit grouping. The cluster analysis combines the distances between sampling units into a matrix table, and two strategies of clustering are used to calculate a distance for N-1 cycles (N=number of sampling units). The cluster analysis is interpreted graphically on a dendrogram to relate the similar communities (Eckblad 1989, Ludwig and Reynolds 1988).

Community indices were calculated at log base 2 where applicable using the software package ECOL ANAL (Eckbland 1989). Statistical analyses, using the software package Number Cruncher Statistical Systems, were used to compare the number of taxa and the relative numbers between each location.

Statistical Evaluation

Sampling efficiency of the field techniques was calculated via a statistical analysis of the quantitative samples. The mean number of organisms per sample, the standard deviation, the standard error, and the sampling precision of the mean were calculated for the benthic samples from each station (Elliot 1977). The sampling precision is the primary parameter evaluated and represents the percentage of the actual mean of the population within which the sample mean lies and indicates how accurately the macroinvertebrate community was sampled. According to Elliot (1977), a sampling precision of 20% (80% confidence) or less is usually acceptable in biological studies. The sampling precision (D) is the ratio of the standard error to the arithmetic mean:

$$D = (S.E./Mean)\ 100$$

Since six artificial substrate samples were taken in each area (5 at Platte South 125' downstream and 3 at Platte South upstream), some of the population estimates may not be sampled with 80%

or greater confidence. As stated by Elliot (1977), the simplest solution to this problem is to take many samples (over 50 samples), but this is not usually an acceptable allocation of resources.

An analysis of variance (F test) was used to compare the stations using the number of organisms and species per sample. According to Sokal and Rohlf (1981), analysis of variance is a technique in statistics where the total variation in a set of data is partitioned into components associated with possible sources of variability. The relative importance of the different sources is then assessed by F-tests between each component of variation and the "error" variation. If the calculated F-value is greater than the tabular F-value at the 0.05 level of significance, then a difference between data sets is greater than the variation within a data set. Following the approach of Chew (1977), mean separation tests were applied to separate and rank the mean values of each data set developed from benthic enumeration.

RESULTS AND DISCUSSION

A summary of the benthic macroinvertebrate communities including species, tolerance values, functional feeding groups and habit at each of the six locations in the Missouri River is presented in Table 1. All data for each individual substrate is found in Table 1A in the Appendix. Summaries of Benthic Macroinvertebrate Community Indices are presented in Table 2. Graphic examples of community clusters are found in Figures 3 and 4. Statistical comparisons of the locations based on density are found in Tables 3, 4 and 5 while similar comparisons based on number of species are found in Tables 6, 7 and 8.

Benthic macroinvertebrate populations found in the vicinity of Florence PWTP and Platte South PWTP on the artificial substrates consisted of a minimum of 57 species, 41 families and 18 orders (Table 1). Most of the species taken (40) were aquatic insects. The dominant groups at all locations were net-spinning caddisflies, especially *Potamyia flava*, and midges belonging to the *Rheotanytarsus exiguus* group. *Potamyia flava* is a species common to the upper Mississippi River where larvae built nets in high concentrations on rocks in sandy, silt-free bottom materials exposed to current (Wiggins 1996). Larvae of midges belonging to the *Rheotanytarsus exiguus* group are basically filter-feeders and strain organic debris from passing water with strands of salivary secretions strung between arms of their cases (Simpson and Bode 1980). Larvae belonging to the group are dominant in aquatic systems with moderate flows and high amounts of suspended organic particulates.

FLORENCE PWTP

The benthic macroinvertebrate fauna in the vicinity of the Florence PWTP discharge were represented by a minimum of 25 species upstream (FU), with 27 (F125D) and 23 (F600D) found downstream of the discharges (Table 1). *Potamyia flava* (33.0% at FU, 36.7% at F125D and 35.8% at F600D) and *Rheotanytarsus exiguus gp*. (11.9% at FU, 19.6% at F125D and 17.7% at F600D) were dominant on all of the substrates. When compared statistically (Table 6) the differences between mean number of taxa upstream to downstream were not significant at the 0.05 confidence level. In terms of density (mean number per $0.15m^2$), the upstream location had a mean number of 20904.5 individuals per $0.15m^2$ while F125D had $10570.7/0.15m^2$ and F600D had $9470.5/0.15m^2$, a statistically measurable drop in density from upstream to downstream with no significant differences in the two downstream locations (Table 3). The Hilsenhoff's Biotic

Index values for all locations are indicative of “Fair” water quality with “fairly significant organic pollution” (Table 2). The diversity values may also indicate some organic pollution at all locations (Weber 1973). In terms of species shared (Jaccard’s Coefficient), the locations were 0.524 to 0.581 comparable or shared slightly more than ½ their species between sites (Table 2). When a density component was added (percent similarity, Table 2) the two downstream locations were 92.5% comparable while the upstream (FU) location was slightly less comparable, (85.1% to F125D and 81.4% to F600D).

PLATTE SOUTH PWTP

The benthic macroinvertebrate community upstream and downstream of the Platte South PWTP was represented by a minimum of 27 species upstream (PU), 33 just downstream (P125D) and 30 species 600 feet downstream of the discharge (Table 1). The benthic macroinvertebrate populations at all three locations were dominated by individuals belonging to the *Rheotanytarsus exiguus* gp (59.2% at PU, 52.0% at P125D and 48.2% at P600D). The caddisfly *Potamyia flava* and immature hydropsychids were also abundant on the substrates at the two downstream locations. A statistical comparison of the mean number of taxa (Table 7) found no differences between the three locations. In terms of density, the upstream (PU) location had a mean number of 15677.7 individuals per $0.15m^2$ while the two downstream locations ($20753.6/015m^2$ at P125D and $22752.7/0.15m^2$ at P600D) showed an increase in populations density (Table 1). When compared statistically (Table 4) the increase in density was not significant at the 0.05 confidence level. As found at the Florence sites, the Hilsenhoff Biotic Index values calculated from the Platte South substrates yielded a benthic macroinvertebrate fauna representative of “Fair” water quality conditions (Table 2). In terms of species shared (Jaccard’s Coefficient) values ranged from 0.542 to 0.634 with the higher values indicating greater similarity. The two downstream locations (P125D and P600D) had the highest percent similarity (88.4%) while the upstream site (PU) and the most downstream site (P600D) were the least similar (71.4%).

ALL SITES

A comparison of both the Florence PWTP and Platte South PWTP locations using mean number of taxa per substrate shown in Table 8 has the Platte South substrates with significant higher numbers of taxa than the Florence PWTP locations. A similar comparison using mean number of individuals per substrate (Table 5) has the downstream Platte South and the Florence PWTP upstream location (FU) with significantly higher numbers of individuals than the Florence PWTP downstream sites (F125D and F600D). Cluster analyses of the substrates using species shared as shown in Figure 3 has the Platte South locations and Florence locations forming separate and distinct clusters. Similar clusters were found when a density component was added (Figure 4).

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

				Florence 600' Downstream	Florence 125' Downstream	Florence Upstream	Platte S. 600' Downstream	[a]Platte S. 125' Downstream	[b] Platte S. Upstream
				Total	Total	Total	Total	Total	Total
PLATYHELMINTHES									
Turbellaria									
Tricladida									
Dugesiidae									
Girardia (Dugesia) tigrina	**8**	**CG**	**SP**	1698	796	2287	1044	2024	2463
NEMERTEA					1				
MOLLUSCA									
Bivalvia									
Veneroida									
Sphaeriidae						81			
Musculium transversum	**8**	**CF**	**BU**		1	217	386	164	21
Pisidium sp.	**7**	**CF**	**BU**		1				
Gastropoda									
Basommatophora									
Ancylidae									
Ferrissia rivularis	**8**	**SC**	**CN**					1	
Physidae									
Physella sp.	**9**	**SC**	**SP**					80	
ANNELIDA									
Oligochaeta									
Tubificida									
Naididae								160	200
Nais barbata	**8**	**CG**	**CN**				80		
Nais behningi	**6**	**CG**	**CN**			130	180	740	1020
Nais pardalis	**8**	**CG**	**CN**				80		80
Nais sp.	**9**	**CG**	**BU**					60	
Pristina sp.	**4**	**CG**	**CN**						60
ARTHROPODA									
Arachnoidea									
Acariformes				350	560		240	460	240
Crustacea									
Copepoda									
Cyclopoida						40			
Ostracoda					20				
Cladocera									
Sidaidae									

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

				Florence 600’ Downstream	Florence 125’ Downstream	Florence Upstream	Platte S. 600’ Downstream	[a]Platte S. 125’ Downstream	[b] Platte S. Upstream
				Total	**Total**	**Total**	**Total**	**Total**	**Total**
Sida crystillina								240	
Amphipoda									
Crangonyctidae									
Crangonyx sp.	**2**	**CG**	**SW**		80				
Decapoda									
Cambaridae									
Orconectes sp.	**8**	**SC**	**SP**					1	
Insecta									
Ephemeroptera									
Baetidae	**4**	**CG**	**SP**	1460	1772	2241	1000	420	
Baetis sp.	**5**	**CG**	**SP**				921		
Labiobaetis longipalpus				1426	1460	9732	2604	1196	161
Caenidae								480	60
Americaenis ridens	**7**	**CG**	**SP**	240	100	321	720	201	140
Caenis sp.	**7**	**CG**	**SP**				40	321	
Heptageniidae				470	263	360	400	740	80
Heptagenia sp.	**4**	**SC**	**CN**					1	
Maccaffertium mexicanum	**5**	**SC**	**CN**					3	80
Maccaffertium sp.	**3**	**SC**	**CN**	100	2	240	261	740	
Isonychiidae									
Isonychia sp.	**2**	**CG**	**SW**	1		711	172	174	1
Leptophlebiidae	**2**	**CG**					160	80	
Odonata									
Coenagrionidae	**9**	**PR**	**CB**						
Argia sp.	**8**	**PR**	**CB**						21
Enallagma sp.	**9**	**PR**	**CB**		50				
Libellulidae	**9**	**PR**	**SP**						
Neurocordulia molesta	**4**	**PR**	**SP**					1	
Plecoptera									
Perlidae									
Acroneuria sp.	**1**	**PR**	**CN**		1				
Megaloptera									
Corydalidae	**4**	**PR**	**CB**						
Corydalus cornutus	**4**	**PR**	**CB**	1			1	1	1
Trichoptera									
Brachycentridae									
Brachycentrus sp.	**3**	**CG**	**SP**			1			
Hydropsychidae	**5**	**CF**	**CN**	20363	23268	41433	24368	14321	2900

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

				Florence 600' Downstream	Florence 125' Downstream	Florence Upstream	Platte S. 600' Downstream	[a]Platte S. 125' Downstream	[b] Platte S. Upstream
				Total	**Total**	**Total**	**Total**	**Total**	**Total**
Cheumatopsyche sp.	**5**	**CF**	**CN**	90	70	650	322	480	422
Hydropsyche cf. bidens	**5**	**CF**	**CN**	40	120	400	300		61
Hydropsyche orris	**8**	**CF**	**CN**	4002	3645	13421	6446	2845	641
Hydropsyche simulians	**4**	**CF**	**CN**	1426	2248	1596	2629	1189	501
Hydropsyche sp.	**5**	**CF**	**CN**	60	80			160	
Potamyia flava	**6**	**CF**	**CN**	12312	12556	30613	17868	15489	3188
Hydroptilidae	**4**	**SC**	**cn**	50	80	560	480		20
Hydroptila sp.	**6**	**SC**	**CN**	250					
Mayatrichia sp.	**6**	**SC**	**CN**	430	350	1121	2020	1000	1142
Leptoceridae	**4**	**CG**	**CN**		320	100	80		
Ceraclea sp.	**4**	**CG**	**CB**				40		
Mystacides sp.				120					
Oecetis sp.	**3**	**PR**	**SP**		50				
Polycentropodidae					80				
Cyrnellus fraternus				22	40				
Neureclipsis sp.	**6**	**FC**	**CN**	75	6		43	4	2
Coleoptera									
Elmidae									
Stenelmis sp.	**5**	**SC**	**CN**	50	1	60			
Diptera									
Ceratopogonidae				80					
Chironomidae									
Conchapelopia sp.	**6**	**PR**	**SP**	2	401	1090	2103	1221	402
Corynoneura sp.	**3**	**CG**	**SP**					80	
Cryptochironomus sp.	**8**	**PR**	**SP**					100	60
Glyptotendipes sp.	**10**	**CF**	**BU**				400		20
Nanocladius distinctus	**2**	**CG**	**SP**			60	80	220	260
Paratendipes albimanus	**6**	**CG**	**SP**			80			
Polypedilum flavum (convictum)	**4**	**SH**	**SP**	750	1241	1760	2921	1802	781
Polypedilum halterale gp.	**7**	**SH**	**SP**				220		
Rheotanytarsus exiguus gp.	**6**	**FC**	**CN**	10043	12420	14981	65827	53968	27843
Tanytarsus sp.	**6**	**CF**	**CB**	610	1180	601	1520	1860	4000
Empididae	**8**	**CG**	**SP**	1					62
Hemerodromia sp.	**6**	**PR**	**CN**	221	161	500	560	741	100
Simuliidae									
Simulium sp.	**6**	**FC**	**CN**	80		40			
TOTAL NO. OF ORGANISMS				**56823**	**63424**	**125427**	**136516**	**103768**	**47033**

Table 1. Benthic Macroinvertebrates Collected from the Missouri River, Omaha, Nebraska on August 13 and 14, 2012.

	Florence 600' Downstream	Florence 125' Downstream	Florence Upstream	Platte S. 600' Downstream	[a]Platte S. 125' Downstream	[b] Platte S. Upstream
	Total	**Total**	**Total**	**Total**	**Total**	**Total**
AVERAGE NO. PER 0.15 M^2	**9470.5**	**10570.7**	**20904.5**	**22752.7**	**20753.6**	**15677.7**
[c]TOTAL NO. OF TAXA	**23**	**27**	**25**	**30**	**33**	**27**
[c]EPT TAXA	**14**	**13**	**12**	**15**	**14**	**11**

[a] Five baskets retrieved.
[b] Three baskets retrieved.
[c] Families represented by species or genera (or a lower taxonomic unit) not included in the taxa count.

Table 2. Benthic Macroinvertebrate Community Analyses.

Date	Station	No. of Taxa	HBI	No. of Individuals per 0.15 m^2	Shannon Diversity (H')	Pielou (J')
8/13/12	F 600 D	23	5.69	9470.5	2.81	0.57
8/13/12	F 125 D	27	5.57	10570.7	2.79	0.55
8/13/12	FU	25	5.77	20904.5	2.86	0.58
8/14/12	P 600 D	30	5.82	22752.7	2.62	0.51
8/14/12	P 125 D	33	5.85	20753.6	2.57	0.49
8/14/12	PU	27	5.99	15677.7	2.42	0.48

Jaccards Coefficient

STATION	F 600 D	F 125 D	FU	P 600 D	P 125 D	PU
F 600 D	1	0.585	0.564	0.535	0.458	0.537
F 125 D	0.585	1	0.524	0.5	0.404	0.435
FU	0.564	0.524	1	0.585	0.438	0.512
P 600 D	0.535	0.5	0.585	1	0.542	0.634
P 125 D	0.458	0.404	0.438	0.542	1	0.578
PU	0.537	0.435	0.512	0.634	0.578	1

more similar   least similar

Percent similarity

STATION	F 600 D	F 125 D	FU	P 600 D	P 125 D	PU
F 600 D	100	92.5	85.1	63.6	59.1	41
F 125 D	92.5	100	81.4	66.2	61.2	42.6
FU	85.1	81.4	100	58.4	53.6	34.7
P 600 D	63.6	66.2	58.4	100	88.4	71.4
P 125 D	59.1	61.2	53.6	88.4	100	77.8
PU	41	42.6	34.7	71.4	77.8	100

highest similarity

Table 3. Statistical Comparison of Community Structure (Florence PWTP) Using Mean Number of Organisms per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	9470.5	3726.26	1525.32	16.11%
8/13/2012	F125D	6	10570.7	2857.87	1166.72	11.04%
8/13/2012	FU	6	20904.5	8204.33	3349.03	16.02%

F - ratio = 8.01

Duncan's Multiple Range Test

F U	F 125D	F 600D
20904.5	10570.7	9470.5

Means comparable at the 0.05 confidence levels are underlined.

Table 4. Statistical Comparison of Community Structure (Platte South PWTP) Using Mean Number of Organisms per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/14/2012	P 600 D	6	22752.7	8512.29	3475.13	15.27%
8/14/2012	P125 D	5	20753.6	6154.03	2752.17	13.26%
8/14/2012	PU	3	15677.7	6784.81	3917.21	24.99%

F - ratio = 0.91

Duncan's Multiple Range Test

P 600 D	P125 D	PU
22752.7	Downstream 20753.6	15677.7

Means comparable at the 0.05 confidence levels are underlined.

Table 5. Statistical Comparison of Community Structure (All Sites) Using Mean Number of Organisms per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	9470.5	3726.26	1525.32	16.11%
8/13/2012	F125D	6	10570.7	2857.87	1166.72	11.04%
8/13/2012	FU	6	20904.5	8204.33	3349.03	16.02%
8/14/2012	P 600 D	6	22752.7	8512.29	3475.13	15.27%
8/14/2012	P125 D	5	20753.6	6154.03	2752.17	13.26%
8/14/2012	PU	3	15677.7	6784.81	3917.21	24.99%

F - ratio = 4.69

P600D	FU	P125D	PU	F125D	F600D
22752.7	20904.5	20753.6	15677.7	10570.7	9470.5

Means comparable at the 0.05 confidence levels are underlined.

Table 6. Statistical Comparison of Community Structure (Florence PWTP) Using Mean Number of Taxa per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	15.83	1.17	0.48	0.03%
8/13/2012	F125D	6	16.83	0.41	0.17	0.09%
8/13/2012	FU	6	17.5	1.76	0.72	4.10%

F - ratio = 2.73

Duncan's Multiple Range Test

FU	F125D	F600D
17.5	16.83	15.83

Means comparable at the 0.05 confidence levels are underlined.

Table 7. Statistical Comparison of Community Structure (Platte South PWTP) Using Mean Number of Taxa per Artificial Substrate Sample (0.15m^2).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/14/2012	P 600 D	6	21	2.83	1.15	5.50%
8/14/2012	P125 D	5	21.4	3.13	1.4	6.54%
8/14/2012	PU	3	22	1.73	1	4.54%

F - ratio = 0.13

Duncan's Multiple Range Test

PU	P125 D	P 600 D
22	21.4	21

Means comparable at the 0.05 confidence levels are underlined.

Table 8. Statistical Comparison of Community Structure (All Sites) Using Mean Number of Taxa per Artificial Substrate Sample ($0.15m^2$).

Date	Station	No. of Samples	Mean	Standard Deviation	Standard Error	Precision of the Sampling Mean
8/13/2012	F600D	6	15.83	1.17	0.48	0.03%
8/13/2012	F125D	6	16.83	0.41	0.17	0.09%
8/13/2012	FU	6	17.5	1.76	0.72	4.10%
8/14/2012	P600D	6	21	2.83	1.15	5.50%
8/14/2012	P125D	5	21.4	3.13	1.4	6.54%
8/14/2012	PU	3	22	1.73	1	4.54%

F - ratio = 8.62

PU	P125D	P600D	FU	F125D	F600D
22	21.4	21	17.5	16.83	15.83

Means comparable at the 0.05 confidence levels are underlined.

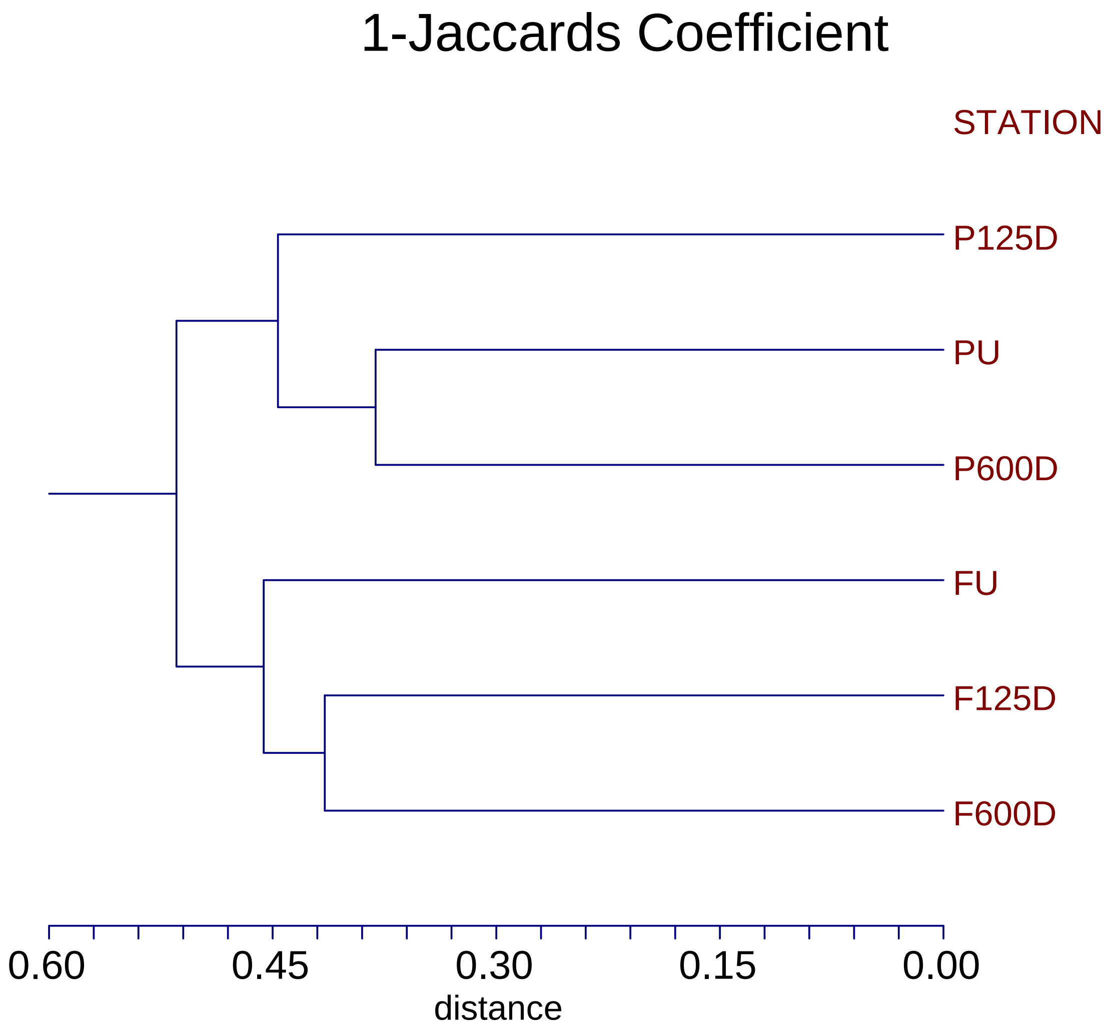


Figure 3. Cluster analyses of artificial substrate samples based on 1-Jaccard's Coefficient (b=0.25).

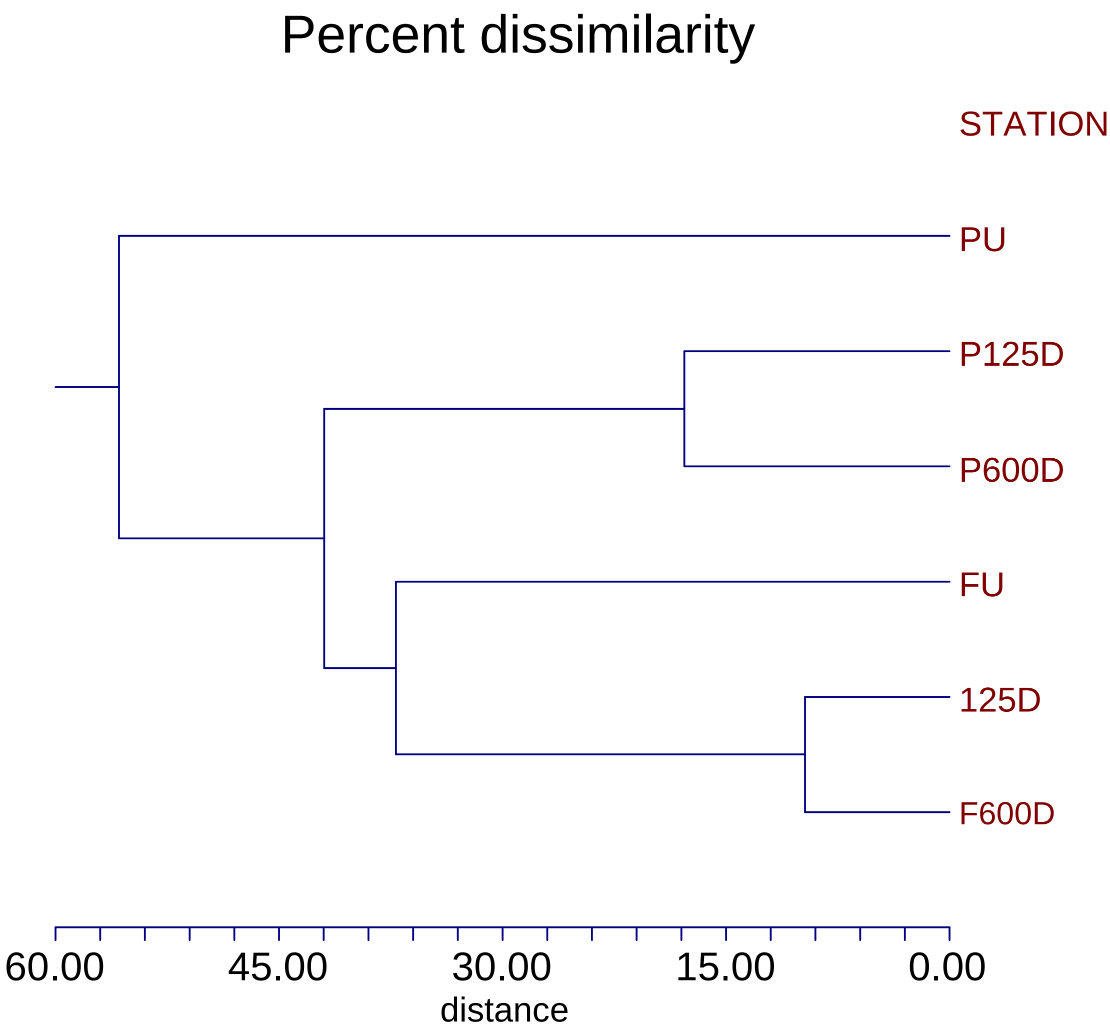


Figure 4. Cluster analyses of artificial substrate samples based on Percent Dissimilarity (b=0.25).

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APPENDIX

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP	551	81	281	182	241	362	1698
NEMERTEA										
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae										
Musculium transversum	8	CF	BU							
Pisidium sp.	7	CF	BU							
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN							
Nais behningi	6	CG	CN							
Nais pardalis	8	CG	CN							
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes				150	60		60		80	350
Crustacea										
Copepoda										
Cyclopoida										
Ostracoda										
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW							
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Ephemeroptera										
Baetidae	4	CG	SP	250	160	200	210	640		1460
Baetis sp.	5	CG	SP							
Labiobaetis longipalpus				202	104	40	32	321	727	1426
Caenidae										
Americaenis ridens	7	CG	SP					160	80	240
Caenis sp.	7	CG	SP							
Heptageniidae				250	20			80	120	470
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN			100				100
Isonychiidae										
Isonychia sp.	2	CG	SW					1		1
Leptophlebiidae	2	CG								
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB							
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN							
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB				1			1
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP							
Hydropsychidae	5	CF	CN	3300	2420	1640	1921	6160	4922	20363
Cheumatopsyche sp.	5	CF	CN	50	40					90
Hydropsyche cf. bidens	5	CF	CN			40				40
Hydropsyche orris	8	CF	CN	1253	883	321	482	421	642	4002
Hydropsyche simulians	4	CF	CN	302	140	60	121	481	322	1426
Hydropsyche sp.	5	CF	CN			60				60
Potamyia flava	6	CF	CN	3902	983	1681	1023	2881	1842	12312
Hydroptilidae	4	SC	cn			20	30			50
Hydroptila sp.	6	SC	CN	250						250
Mayatrichia sp.	6	SC	CN				30	400		430
Leptoceridae	4	CG	CN							
Ceraclea sp.	4	CG	CB							
Mystacides sp.					80	40				120
Oecetis sp.	3	PR	SP							
Polycentropodidae										
Cyrnellus fraternus					22					22

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Neureclipsis sp.	6	FC	CN	52		21	2			75
Coleoptera										
Elmidae										
Stenelmis sp.	5	SC	CN	50						50
Diptera										
Ceratopogonidae								80		80
Chironomidae										
Conchapelopia sp.	6	PR	SP						2	2
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU							
Nanocladius distinctus	2	CG	SP							
Paratendipes albimanus	6	CG	SP							
Polypedilum flavum (convictum)	4	SH	SP	200	120	80	30	160	160	750
Polypedilum halterale gp.	7	SH	SP							
Rheotanytarsus exiguus gp.	6	FC	CN	1900	1282	2461	840	1680	1880	10043
Tanytarsus sp.	6	CF	CB	150	20	160		240	40	610
Empididae	8	CG	SP				1			1
Hemerodromia sp.	6	PR	CN	100		20	60		41	221
Simuliidae										
Simulium sp.	6	FC	CN					80		80
TOTAL NO. OF ORGANISMS				**12912**	**6415**	**7225**	**5025**	**14026**	**11220**	**56823**
TOTAL NO. OF TAXA				**17**	**15**	**17**	**16**	**16**	**14**	**31**
EPT TAXA										**19**
HBI										**5.69**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 125' Downstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP		52	481	81	81	101	796
NEMERTEA				1						1
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae										
Musculium transversum	8	CF	BU		1					1
Pisidium sp.	7	CF	BU	1						1
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN							
Nais behningi	6	CG	CN							
Nais pardalis	8	CG	CN							
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes				280		80		100	100	560
Crustacea										
Copepoda										
Cyclopoida										
Ostracoda								20		20
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW				80			80
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										
Ephemeroptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 125' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Baetidae	4	CG	SP	201	500	480	160	81	350	1772
Baetis sp.	5	CG	SP							
Labiobaetis longipalpus				122	200	481	82	62	513	1460
Caenidae										
Americaenis ridens	7	CG	SP		50				50	100
Caenis sp.	7	CG	SP							
Heptageniidae						80	80		103	263
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN			1		1		2
Isonychiidae										
Isonychia sp.	2	CG	SW							
Leptophlebiidae	2	CG								
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB		50					50
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN				1			1
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB							
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP							
Hydropsychidae	5	CF	CN	4562	3201	4880	3440	2985	4200	23268
Cheumatopsyche sp.	5	CF	CN		50			20		70
Hydropsyche cf. bidens	5	CF	CN			80		40		120
Hydropsyche orris	8	CF	CN	681	500	881	640	542	401	3645
Hydropsyche simulians	4	CF	CN	483	51	801	320	241	352	2248
Hydropsyche sp.	5	CF	CN				80			80
Potamyia flava	6	CF	CN	1521	2604	2400	2641	540	2850	12556
Hydroptilidae	4	SC	cn			80				80
Hydroptila sp.	6	SC	CN							
Mayatrichia sp.	6	SC	CN	200	150					350
Leptoceridae	4	CG	CN				80	140	100	320
Ceraclea sp.	4	CG	CB							
Mystacides sp.										
Oecetis sp.	3	PR	SP						50	50
Polycentropodidae							80			80
Cyrnellus fraternus				40						40
Neureclipsis sp.	6	FC	CN	1		1	1	2	1	6
Coleoptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence 125' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Elmidae										
Stenelmis sp.	5	SC	CN						1	1
Diptera										
Ceratopogonidae										
Chironomidae										
Conchapelopia sp.	6	PR	SP		350	1			50	401
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU							
Nanocladius distinctus	2	CG	SP							
Paratendipes albimanus	6	CG	SP							
Polypedilum flavum (convictum)	4	SH	SP	40	200	320	240	41	400	1241
Polypedilum halterale gp.	7	SH	SP							
Rheotanytarsus exiguus gp.	6	FC	CN	1720	2750	3200	3600		1150	12420
Tanytarsus sp.	6	CF	CB	40	300	80	80	680		1180
Empididae	8	CG	SP							
Hemerodromia sp.	6	PR	CN	41	100			20		161
Simuliidae										
Simulium sp.	6	FC	CN							
TOTAL NO. OF ORGANISMS				**9934**	**11109**	**14327**	**11686**	**5596**	**10772**	**63424**
TOTAL NO. OF TAXA				**16**	**17**	**17**	**17**	**17**	**17**	**34**
EPT TAXA										**20**
HBI										**5.57**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence Upstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	**8**	**CG**	**SP**	401	801	322	362	321	80	2287
NEMERTEA										
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae					81					81
Musculium transversum	**8**	**CF**	**BU**	53			2	161	1	217
Pisidium sp.	**7**	**CF**	**BU**							
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	**8**	**SC**	**CN**							
Physidae										
Physella sp.	**9**	**SC**	**SP**							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	**8**	**CG**	**CN**							
Nais behningi	**6**	**CG**	**CN**	50					80	130
Nais pardalis	**8**	**CG**	**CN**							
Nais sp.	**9**	**CG**	**BU**							
Pristina sp.	**4**	**CG**	**CN**							
ARTHROPODA										
Arachnoidea										
Acariformes										
Crustacea										
Copepoda										
Cyclopoida						40				40
Ostracoda										
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	**2**	**CG**	**SW**							
Decapoda										
Cambaridae										
Orconectes sp.	**8**	**SC**	**SP**							
Insecta										
Ephemeroptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence Upstream						
				B1	B2	B3	B4	B5	B6	Total
Baetidae	4	CG	SP	400		760	120		961	2241
Baetis sp.	5	CG	SP							
Labiobaetis longipalpus				353	1285	765	846	5281	1202	9732
Caenidae										
Americaenis ridens	7	CG	SP					321		321
Caenis sp.	7	CG	SP							
Heptageniidae					80		120	160		360
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN		80			160		240
Isonychiidae										
Isonychia sp.	2	CG	SW		161	2	66	321	161	711
Leptophlebiidae	2	CG								
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB							
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN							
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB							
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP		1					1
Hydropsychidae	5	CF	CN	5650	8480	5361	4981	8320	8641	41433
Cheumatopsyche sp.	5	CF	CN	50	160		120	160	160	650
Hydropsyche cf. bidens	5	CF	CN		80			320		400
Hydropsyche orris	8	CF	CN	1255	2000	1523	1441	2881	4321	13421
Hydropsyche simulians	4	CF	CN	50	241	202	60	481	562	1596
Hydropsyche sp.	5	CF	CN							
Potamyia flava	6	CF	CN	2704	5521	4241	2225	10721	5201	30613
Hydroptilidae	4	SC	cn		240			320		560
Hydroptila sp.	6	SC	CN							
Mayatrichia sp.	6	SC	CN		240	200	120	160	401	1121
Leptoceridae	4	CG	CN	100						100
Ceraclea sp.	4	CG	CB							
Mystacides sp.										
Oecetis sp.	3	PR	SP							
Polycentropodidae										
Cyrnellus fraternus										
Neureclipsis sp.	6	FC	CN							
Coleoptera										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Florence Upstream						
				B1	B2	B3	B4	B5	B6	Total
Elmidae										
Stenelmis sp.	5	SC	CN				60			60
Diptera										
Ceratopogonidae										
Chironomidae										
Conchapelopia sp.	6	PR	SP	50	240	80	240	480		1090
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU							
Nanocladius distinctus	2	CG	SP				60			60
Paratendipes albimanus	6	CG	SP		80					80
Polypedilum flavum (convictum)	4	SH	SP	200	400	480	360	160	160	1760
Polypedilum halterale gp.	7	SH	SP							
Rheotanytarsus exiguus gp.	6	FC	CN	2800	2160	2401	1140	3680	2800	14981
Tanytarsus sp.	6	CF	CB	100	80	41	300		80	601
Empididae	8	CG	SP							
Hemerodromia sp.	6	PR	CN	100		80		160	160	500
Simuliidae										
Simulium sp.	6	FC	CN			40				40
TOTAL NO. OF ORGANISMS				**14316**	**22411**	**16538**	**12623**	**34568**	**24971**	**125427**
TOTAL NO. OF TAXA				**16**	**20**	**16**	**18**	**19**	**16**	**30**
EPT TAXA										**16**
HBI										**5.77**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
PLATYHELMINTHES										
Turbellaria										
Tricladida										
Dugesiidae										
Girardia (Dugesia) tigrina	8	CG	SP	400	161	1	481	1		1044
NEMERTEA										
MOLLUSCA										
Bivalvia										
Veneroida										
Sphaeriidae										
Musculium transversum	8	CF	BU	1		82	241	61	1	386
Pisidium sp.	7	CF	BU							
Gastropoda										
Basommatophora										
Ancylidae										
Ferrissia rivularis	8	SC	CN							
Physidae										
Physella sp.	9	SC	SP							
ANNELIDA										
Oligochaeta										
Tubificida										
Naididae										
Nais barbata	8	CG	CN				80			80
Nais behningi	6	CG	CN			80			100	180
Nais pardalis	8	CG	CN				80			80
Nais sp.	9	CG	BU							
Pristina sp.	4	CG	CN							
ARTHROPODA										
Arachnoidea										
Acariformes				100		80		60		240
Crustacea										
Copepoda										
Cyclopoida										
Ostracoda										
Cladocera										
Sidaidae										
Sida crystillina										
Amphipoda										
Crangonyctidae										
Crangonyx sp.	2	CG	SW							
Decapoda										
Cambaridae										
Orconectes sp.	8	SC	SP							
Insecta										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Ephemeroptera										
Baetidae	4	CG	SP	200		400			400	1000
Baetis sp.	5	CG	SP	600			321			921
Labiobaetis longipalpus				1	363	805	321	609	505	2604
Caenidae										
Americaenis ridens	7	CG	SP	100	40	240	80	60	200	720
Caenis sp.	7	CG	SP		40					40
Heptageniidae						320	80			400
Heptagenia sp.	4	SC	CN							
Maccaffertium mexicanum	5	SC	CN							
Maccaffertium sp.	3	SC	CN		200	1		60		261
Isonychiidae										
Isonychia sp.	2	CG	SW	1	1	3	1	64	102	172
Leptophlebiidae	2	CG			80		80			160
Odonata										
Coenagrionidae	9	PR	CB							
Argia sp.	8	PR	CB							
Enallagma sp.	9	PR	CB							
Libellulidae	9	PR	SP							
Neurocordulia molesta	4	PR	SP							
Plecoptera										
Perlidae										
Acroneuria sp.	1	PR	CN							
Megaloptera										
Corydalidae	4	PR	CB							
Corydalus cornutus	4	PR	CB					1		1
Trichoptera										
Brachycentridae										
Brachycentrus sp.	3	CG	SP							
Hydropsychidae	5	CF	CN	4500	2800	6401	2160	3005	5502	24368
Cheumatopsyche sp.	5	CF	CN	100	40	80	1	1	100	322
Hydropsyche cf. bidens	5	CF	CN	100	200					300
Hydropsyche orris	8	CF	CN	1401	721	1361	160	603	2200	6446
Hydropsyche simulians	4	CF	CN	501	321	962		241	604	2629
Hydropsyche sp.	5	CF	CN							
Potamyia flava	6	CF	CN	4001	1401	4641	1681	1143	5001	17868
Hydroptilidae	4	SC	cn	400	80					480
Hydroptila sp.	6	SC	CN							
Mayatrichia sp.	6	SC	CN	200	240	720	80	180	600	2020
Leptoceridae	4	CG	CN				80			80
Ceraclea sp.	4	CG	CB		40					40
Mystacides sp.										
Oecetis sp.	3	PR	SP							
Polycentropodidae										
Cyrnellus fraternus										

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 600' Downstream						
				B1	B2	B3	B4	B5	B6	Total
Neureclipsis sp.	6	FC	CN		40	2	1			43
Coleoptera										
Elmidae										
Stenelmis sp.	5	SC	CN							
Diptera										
Ceratopogonidae										
Chironomidae										
Conchapelopia sp.	6	PR	SP	500	202	400	640	61	300	2103
Corynoneura sp.	3	CG	SP							
Cryptochironomus sp.	8	PR	SP							
Glyptotendipes sp.	10	CF	BU				400			400
Nanocladius distinctus	2	CG	SP			80				80
Paratendipes albimanus	6	CG	SP							
Polypedilum flavum (convictum)	4	SH	SP	900	241	800	160	120	700	2921
Polypedilum halterale gp.	7	SH	SP	100	40		80			220
Rheotanytarsus exiguus gp.	6	FC	CN	12000	7400	13200	11520	5705	16002	65827
Tanytarsus sp.	6	CF	CB	200	200		800	120	200	1520
Empididae	8	CG	SP							
Hemerodromia sp.	6	PR	CN	100	40	240	80		100	560
Simuliidae										
Simulium sp.	6	FC	CN							
TOTAL NO. OF ORGANISMS				**26406**	**14891**	**30899**	**19608**	**12095**	**32617**	**136516**
TOTAL NO. OF TAXA				**22**	**23**	**22**	**24**	**18**	**17**	**35**
EPT TAXA										**20**
HBI										**5.82**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 125' Downstream					
				B1	B2	B3	B5	B6	Total
PLATYHELMINTHES									
Turbellaria									
Tricladida									
Dugesiidae									
Girardia (Dugesia) tigrina	8	CG	SP	541	321	241	600	321	2024
NEMERTEA									
MOLLUSCA									
Bivalvia									
Veneroida									
Sphaeriidae									
Musculium transversum	8	CF	BU	62			102		164
Pisidium sp.	7	CF	BU						
Gastropoda									
Basommatophora									
Ancylidae									
Ferrissia rivularis	8	SC	CN			1			1
Physidae									
Physella sp.	9	SC	SP			80			80
ANNELIDA									
Oligochaeta									
Tubificida									
Naididae								160	160
Nais barbata	8	CG	CN						
Nais behningi	6	CG	CN	240		320	100	80	740
Nais pardalis	8	CG	CN						
Nais sp.	9	CG	BU	60					60
Pristina sp.	4	CG	CN						
ARTHROPODA									
Arachnoidea									
Acariformes				120	80	80	100	80	460
Crustacea									
Copepoda									
Cyclopoida									
Ostracoda									
Cladocera									
Sidaidae									
Sida crystillina						240			240
Amphipoda									
Crangonyctidae									
Crangonyx sp.	2	CG	SW						
Decapoda									
Cambaridae									
Orconectes sp.	8	SC	SP			1			1
Insecta									
Ephemeroptera									

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 125' Downstream					
				B1	B2	B3	B5	B6	Total
Baetidae	4	CG	SP				100	320	420
Baetis sp.	5	CG	SP						
Labiobaetis longipalpus				301	5		407	483	1196
Caenidae					80	400			480
Americaenis ridens	7	CG	SP	121				80	201
Caenis sp.	7	CG	SP			321			321
Heptageniidae				60			200	480	740
Heptagenia sp.	4	SC	CN					1	1
Maccaffertium mexicanum	5	SC	CN			1		2	3
Maccaffertium sp.	3	SC	CN		80	320	100	240	740
Isonychiidae									
Isonychia sp.	2	CG	SW	1	4	1	4	164	174
Leptophlebiidae	2	CG				80			80
Odonata									
Coenagrionidae	9	PR	CB						
Argia sp.	8	PR	CB						
Enallagma sp.	9	PR	CB						
Libellulidae	9	PR	SP						
Neurocordulia molesta	4	PR	SP			1			1
Plecoptera									
Perlidae									
Acroneuria sp.	1	PR	CN						
Megaloptera									
Corydalidae	4	PR	CB						
Corydalus cornutus	4	PR	CB				1		1
Trichoptera									
Brachycentridae									
Brachycentrus sp.	3	CG	SP						
Hydropsychidae	5	CF	CN	3420	2561	320	3300	4720	14321
Cheumatopsyche sp.	5	CF	CN		160			320	480
Hydropsyche cf. bidens	5	CF	CN						
Hydropsyche orris	8	CF	CN	721	721		601	802	2845
Hydropsyche simulians	4	CF	CN	781	2		5	401	1189
Hydropsyche sp.	5	CF	CN		160				160
Potamyia flava	6	CF	CN	2521	3840	321	3605	5202	15489
Hydroptilidae	4	SC	cn						
Hydroptila sp.	6	SC	CN						
Mayatrichia sp.	6	SC	CN	300		80	300	320	1000
Leptoceridae	4	CG	CN						
Ceraclea sp.	4	CG	CB						
Mystacides sp.									
Oecetis sp.	3	PR	SP						
Polycentropodidae									
Cyrnellus fraternus									
Neureclipsis sp.	6	FC	CN	1	2			1	4
Coleoptera									

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South 125' Downstream					
				B1	B2	B3	B5	B6	Total
Elmidae									
Stenelmis sp.	5	SC	CN						
Diptera									
Ceratopogonidae									
Chironomidae									
Conchapelopia sp.	6	PR	SP	120	81	160	300	560	1221
Corynoneura sp.	3	CG	SP					80	80
Cryptochironomus sp.	8	PR	SP				100		100
Glyptotendipes sp.	10	CF	BU						
Nanocladius distinctus	2	CG	SP	60		80		80	220
Paratendipes albimanus	6	CG	SP						
Polypedilum flavum (convictum)	4	SH	SP	180	561	80	501	480	1802
Polypedilum halterale gp.	7	SH	SP						
Rheotanytarsus exiguus gp.	6	FC	CN	8160	10962	10240	9805	14801	53968
Tanytarsus sp.	6	CF	CB	180	240	1120		320	1860
Empididae	8	CG	SP						
Hemerodromia sp.	6	PR	CN		80	81	100	480	741
Simuliidae									
Simulium sp.	6	FC	CN						
TOTAL NO. OF ORGANISMS				**17950**	**19940**	**14569**	**20331**	**30978**	**103768**
TOTAL NO. OF TAXA				**20**	**18**	**23**	**20**	**26**	**39**
EPT TAXA									**19**
HBI									**5.85**

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South Upstream			
				B2	B3	B4	Total
PLATYHELMINTHES							
Turbellaria							
Tricladida							
Dugesiidae							
Girardia (Dugesia) tigrina	**8**	**CG**	**SP**	21	1601	841	2463
NEMERTEA							
MOLLUSCA							
Bivalvia							
Veneroida							
Sphaeriidae							
Musculium transversum	**8**	**CF**	**BU**	20		1	21
Pisidium sp.	**7**	**CF**	**BU**				
Gastropoda							
Basommatophora							
Ancylidae							
Ferrissia rivularis	**8**	**SC**	**CN**				
Physidae							
Physella sp.	**9**	**SC**	**SP**				
ANNELIDA							
Oligochaeta							
Tubificida							
Naididae				40	160		200
Nais barbata	**8**	**CG**	**CN**				
Nais behningi	**6**	**CG**	**CN**	120	480	420	1020
Nais pardalis	**8**	**CG**	**CN**		80		80
Nais sp.	**9**	**CG**	**BU**				
Pristina sp.	**4**	**CG**	**CN**			60	60
ARTHROPODA							
Arachnoidea							
Acariformes						240	240
Crustacea							
Copepoda							
Cyclopoida							
Ostracoda							
Cladocera							
Sidaidae							
Sida crystillina							
Amphipoda							
Crangonyctidae							
Crangonyx sp.	**2**	**CG**	**SW**				
Decapoda							
Cambaridae							
Orconectes sp.	**8**	**SC**	**SP**				
Insecta							
Ephemeroptera							

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South Upstream B2	B3	B4	Total
Baetidae	4	CG	SP				
Baetis sp.	5	CG	SP				
Labiobaetis longipalpus					161		161
Caenidae						60	60
Americaenis ridens	7	CG	SP		80	60	140
Caenis sp.	7	CG	SP				
Heptageniidae				20		60	80
Heptagenia sp.	4	SC	CN				
Maccaffertium mexicanum	5	SC	CN		80		80
Maccaffertium sp.	3	SC	CN				
Isonychiidae							
Isonychia sp.	2	CG	SW		1		1
Leptophlebiidae	2	CG					
Odonata							
Coenagrionidae	9	PR	CB				
Argia sp.	8	PR	CB	21			21
Enallagma sp.	9	PR	CB				
Libellulidae	9	PR	SP				
Neurocordulia molesta	4	PR	SP				
Plecoptera							
Perlidae							
Acroneuria sp.	1	PR	CN				
Megaloptera							
Corydalidae	4	PR	CB				
Corydalus cornutus	4	PR	CB			1	1
Trichoptera							
Brachycentridae							
Brachycentrus sp.	3	CG	SP				
Hydropsychidae	5	CF	CN	320	1200	1380	2900
Cheumatopsyche sp.	5	CF	CN	20	161	241	422
Hydropsyche cf. bidens	5	CF	CN			61	61
Hydropsyche orris	8	CF	CN	20	561	60	641
Hydropsyche simulians	4	CF	CN	60	81	360	501
Hydropsyche sp.	5	CF	CN				
Potamyia flava	6	CF	CN	367	1201	1620	3188
Hydroptilidae	4	SC	cn	20			20
Hydroptila sp.	6	SC	CN				
Mayatrichia sp.	6	SC	CN	160	560	422	1142
Leptoceridae	4	CG	CN				
Ceraclea sp.	4	CG	CB				
Mystacides sp.							
Oecetis sp.	3	PR	SP				
Polycentropodidae							
Cyrnellus fraternus							
Neureclipsis sp.	6	FC	CN		1	1	2
Coleoptera							

Table 1A. Benthic Macroinvertebrate Data, Artificial Substrates, August 13 and 14, 2012.

SPECIES	T.V.	F.F.G.	Habit	Platte South Upstream			
				B2	B3	B4	Total
Elmidae							
Stenelmis sp.	**5**	**SC**	**CN**				
Diptera							
Ceratopogonidae							
Chironomidae							
Conchapelopia sp.	**6**	**PR**	**SP**	142	80	180	402
Corynoneura sp.	**3**	**CG**	**SP**				
Cryptochironomus sp.	**8**	**PR**	**SP**			60	60
Glyptotendipes sp.	**10**	**CF**	**BU**	20			20
Nanocladius distinctus	**2**	**CG**	**SP**	40	160	60	260
Paratendipes albimanus	**6**	**CG**	**SP**				
Polypedilum flavum (convictum)	**4**	**SH**	**SP**	61	480	240	781
Polypedilum halterale gp.	**7**	**SH**	**SP**				
Rheotanytarsus exiguus gp.	**6**	**FC**	**CN**	6523	12800	8520	27843
Tanytarsus sp.	**6**	**CF**	**CB**	680	2240	1080	4000
Empididae	**8**	**CG**	**SP**	2		60	62
Hemerodromia sp.	**6**	**PR**	**CN**	20	80		100
Simuliidae							
Simulium sp.	**6**	**FC**	**CN**				
TOTAL NO. OF ORGANISMS				**8697**	**22248**	**16088**	**47033**
TOTAL NO. OF TAXA				**21**	**21**	**24**	**33**
EPT TAXA							**15**
HBI							**5.99**

October 10, 2013

Metropolitan Utilities District of Omaha
Engineering Memorandum No. 10
NPDES Studies
EE&T Project No. 12501

Subject: **Assessment of the Economic Impact on Residential Customers of the Annual Costs Associated with Implementing Dewatering Alternatives at Platte South and/or Florence PWTP Using USEPA (2011) Methodology**

Introduction

The Metropolitan Utilities District of Omaha (M.U.D.) operates two split-treatment softening facilities that discharge residuals to the Missouri River: the Florence Potable Water Treatment Plan (PWTP) and the Platte South PWTP. These discharges are permitted under NPDES Permits No. NE0000914 and NE0000906, respectively, both of which went into effect on October 1, 2009. As part of the permit renewals, the Nebraska Department of Environmental Quality (NDEQ) directed M.U.D. to conduct an evaluation of selected technologies to reduce solids discharged to the Missouri River. These studies were completed by EE&T and are described in Engineering Memorandum (EM) 5 – Platte South Evaluation of Selected Technologies to Reduce Solids Discharged to the Missouri River (EE&T 2012a) and EM7 – Florence Evaluation of Selected Technologies to Reduce Solids Discharged to the Missouri River (EE&T 2012b). These memos described the residuals treatment processes required to remove various levels of solids from the Missouri River at each plant, along with the projected capital and annual costs for those systems.

In order to evaluate the impact of these costs on M.U.D.'s customers, an assessment of the economic impact was prepared using methodology described by USEPA (2011). This economic analysis includes not only the dewatering improvements described in EM5 and EM7, but also takes into account the fact that many of M.U.D.'s customers will be facing sewer system rate increases due to improvements that the City of Omaha Public Works Department (PWD) is required to implement to reduce combined sewer overflows (CSOs) to surface waters. The costs of those improvements, which are summarized in a report prepared for PWD by the University of

Cincinnati (2013). These latter improvements will be referred to collectively in this report as the “sewer improvements”, and were also considered when evaluating the economic impact of adding dewatering facilities to M.U.D.’s Florence PWTP and Platte South PWTP faciltiies.

This memorandum presents the results of the aforementioned economic analysis. This assessment includes the costs of adding dewatering both with and without the simultaneous costs for sewer improvements. The information used to make these assessments includes information assumed by EE&T for things like interest rate and payback period, assumptions recommended by the USEPA (2011) document, information provided by M.U.D. (treated water volume and things like that), and information from the above referenced dewatering (EE&T 2012 a&b) and sewer improvements (University of Cincinnati 2013) reports.

Information Used to Make Assessments

Household Income Levels from US Census Bureau

To do the analysis outlined in USEPA 2011, a determination of the distribution of household income levels in the communities served by M.U.D. was needed. This was completed using data from US Census Bureau (US Department of Commerce 2013). The zip codes used and the results of this determination are summarized in Appendix A. Using these results tabulated in Appendix A, Figure 1 summarizes the distribution of annual household incomes in areas served by M.U.D. as determined in this report. The median is about $55,000 and the other quartile values are approximately $29,000 and $92,000.

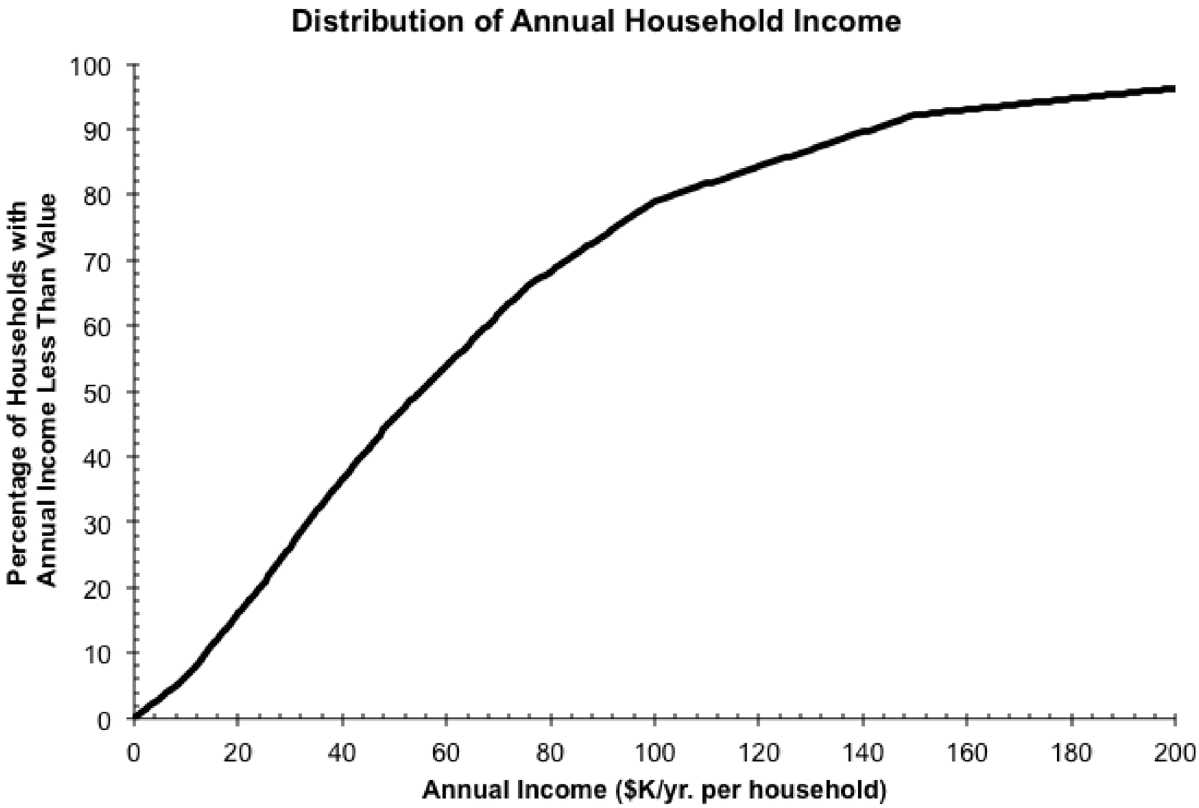

Figure 1 Cumulative distribution of annual household income in M.U.D. service area using US Census Bureau data as summarized in Appendix A

Estimated Cost of PWTP Dewatering Improvements

Capital and Annual Recurring Costs (O&M) from EM5 and EM7 (EE&T 2012a&b) are summarized in Table 1. Note that in EM5 and EM7 there were separate costs listed for centrifuges versus plate and frame filter presses. In Table 1, the lowest cost option of the two alternatives was used. Note that this table not only includes cost estimates from EM5 for Platte South and from EM7 for Florence, but also combined total for an option including dewatering added at both plants. In EM5 and EM7 there were separate estimates depending upon whether all of the residuals generated at the plant were treated (100 percent), or whether the residuals discharges were only partially treated (50, 65, 75, and 90 percent of flow treated). As expected, costs increased as flow increased. Also, costs at Florence were three or more times higher than at Platte South due to Florence's larger size and solids production.

Constants Used in Evaluations – Assumed or from M.U.D. records

The USEPA (2011) methodology includes some constant values that either needs to be assumed or else based on utility records. These are summarized in Table 2. Most of these are probably fairly familiar with most readers. One that probably requires further explanation and elaboration is the Achievability Threshold, also called Income Threshold. This is a key decision making setpoint in the analysis described below. In USEPA's example analyses (USEPA 2011), they assumed a value of 1.0 percent. The methodology calculates the annual household cost to residential customers for the proposed improvements (sewer or dewatering). Then a household is defined as "impacted" by the costs of the improvements if these annual improvement costs represent greater than the threshold percentage of the household annual income. For example, if the annual cost to residential customers is \$100/yr per household, then if the threshold percentage is assumed to be 1.0 percent as in this report, then households with incomes less than \$10,000/yr per household (\$100 divided by 0.01) area defined as "impacted" by the costs of the proposed improvements.

Table 1
Summary of Dewatering Cost Estimates from EM5 and EM7 (EE&T 2012 a&b)

Percent of Flow Treated	Lowest Cost Alternative	Costs to Implement Dewatering Alternative: Capital Outlay ($M)	Costs to Implement Dewatering Alternative: Annual Recurring Costs ($M/yr)
Platte South Only			
50	Centrifuge	19.94	0.99
65	Centrifuge	21.90	1.07
75	Centrifuge	22.27	1.10
90	Centrifuge	22.82	1.16
100	Plate and Frame	27.00	1.50
Florence Only			
50	Plate and Frame	56.46	2.45
65	Centrifuge	59.83	2.69
75	Plate and Frame	65.06	3.02
90	Centrifuge	86.47	4.54
100	Plate and Frame	127.67	7.33
Both Plants			
50	Plate and Frame	77.44	3.44
65	Centrifuge	81.73	3.76
75	Plate and Frame	88.59	4.16
90	Centrifuge	109.29	5.70
100	Plate and Frame	154.67	8.83

Table 2
Summary of assumptions and information about water system

Description of Variable	Abbreviation from USEPA 2011 discussion	Value Used/Assumed (Including units)
Assumptions by EE&T		
Payback period	N	20 years
Annual Interest Rate	r	0.05 % per year
Information Provided by M.U.D.		
Proportion Finished Water Production Used by Residential Customers		
By revenue	Rev Share $_{res}$	59.6%
By Volume	Water Share $_{res}$	53.5%
Treated Water Volume – All customers	Treated Volume	30,600 MG/yr
Annual Household Water Consumption	HH Water Cons $_{av}$	0.089 MG/yr-household
Assumptions Based on Recommendations in USEPA 2011		
Years for which annual charge is calculated	n +1	3
Achievability Threshold	Income Threshold	1.0%

Results and Discussion

Overview

Table 3 summarizes results from all evaluations. The first four columns of the table are identical to the columns in Table 1. The next three columns apply to dewatering without sewer improvements and summarize results for: a) average residential household cost for improvements, b) number of "impacted" households (i.e., number where costs for improvements exceeds 1 percent of annual household income), and c) percent of impacted households. The last three columns are similar except they include the cost of PWD's sewer improvements in addition to the cost of M.U.D.'s dewatering improvements. Note also that first row of data in Table 3 was added to list cost for sewer improvements alone, without any dewatering improvements, for comparison purposes. Therefore, the difference between sewer alone versus sewer plus dewatering is the incremental increase due to adding a given dewatering option. As you will note that number of impacted houses due to adding dewatering is greater when added on top of sewer improvements than when only dewatering costs are considered. This is described in more detail in a later discussion illustrating some example calculations.

Results for increase in household water costs from Table 3 are summarized In Figure 2 for dewatering only, and Figure 3 for dewatering plus sewer (and sewer alone). Similarly, percent of households impacted is summarized in Figure 4 for dewatering only, and Figure 5 for dewatering plus sewer (and sewer alone). An example is presented in the next paragraph in order to demonstrate how intermediate and final calculations were completed, and how to interpret results.

Table 3

Household water costs and number/percentage of impacted houses for dewatering or sewer, together or separate

Description		Costs to Implement Dewatering Alternative		Dewatering Only			Sewer plus Dewatering		
Percent of Flow Treated	Lowest Cost Alternative	Capital Outlay ($M)	Annual Recurring Costs ($M/yr)	Household Water Cost Increase ($/yr-house)	Number of impacted households	Percentage of houses impacted (%)	Household Water Cost Increase ($/yr-house)	Number of impacted households	Percentage of houses impacted (%)
No Dewatering									
						Not applicable	292.40	60,941	25.47%
Platte South Only									
50	Centrifuge	19.94	0.99	7.02	1,057	0.44%	299.42	62,767	26.23%
65	Centrifuge	21.90	1.07	7.68	1,157	0.48%	300.08	62,939	26.30%
75	Centrifuge	22.27	1.10	7.84	1,181	0.49%	300.24	62,980	26.32%
90	Centrifuge	22.82	1.16	8.12	1,223	0.51%	300.52	63,054	26.35%
100	Plate/Frame	27.00	1.50	9.97	1,501	0.63%	302.37	63,535	26.55%
Florence Only									
50	Plate/Frame	56.46	2.45	18.87	2,842	1.19%	311.27	65,851	27.52%
65	Centrifuge	59.83	2.69	20.27	3,053	1.28%	312.67	66,215	27.67%
75	Plate/Frame	65.06	3.02	22.32	3,361	1.40%	314.72	66,748	27.89%
90	Centrifuge	86.47	4.54	31.19	4,698	1.96%	323.59	69,057	28.86%
100	Plate/Frame	127.67	7.33	47.88	7,211	3.01%	340.28	73,399	30.67%
Both Plants									
50	Plate/Frame	77.44	3.44	26.11	3,932	1.64%	318.51	67,734	28.31%
65	Centrifuge	81.73	3.76	27.95	4,210	1.76%	320.35	68,213	28.51%
75	Plate/Frame	88.59	4.16	30.52	4,597	1.92%	322.92	68,883	28.79%
90	Centrifuge	109.29	5.70	39.32	5,921	2.47%	331.71	71,170	29.74%
100	Plate/Frame	154.67	8.83	57.85	8,713	3.64%	350.25	75,982	31.75%

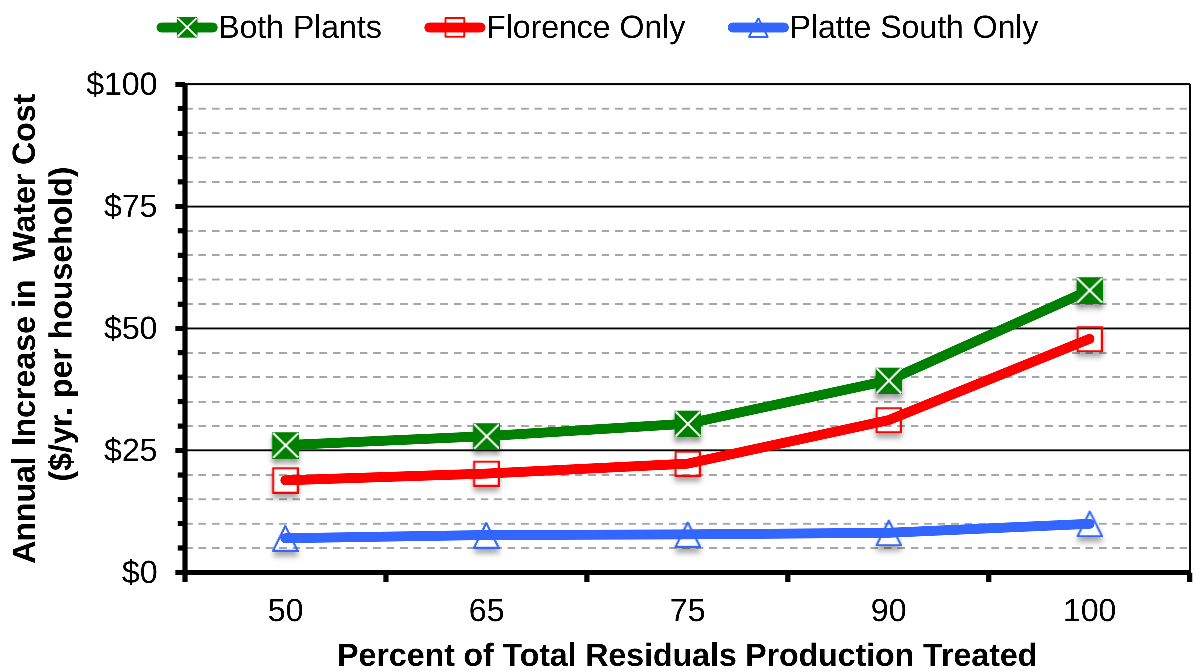

Figure 2 Annual increase in water cost per household for M.U.D. dewatering improvements only

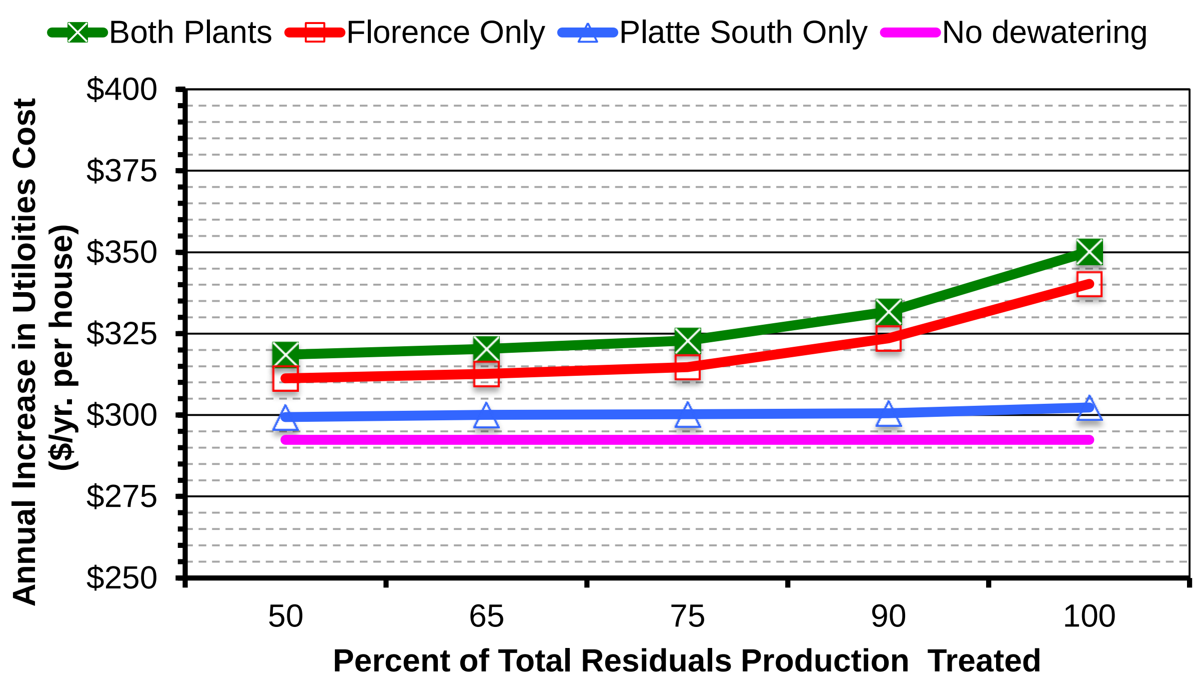

Figure 3 Annual increase in utilities cost per household for both M.U.D. dewatering improvements and PWD sewer improvements

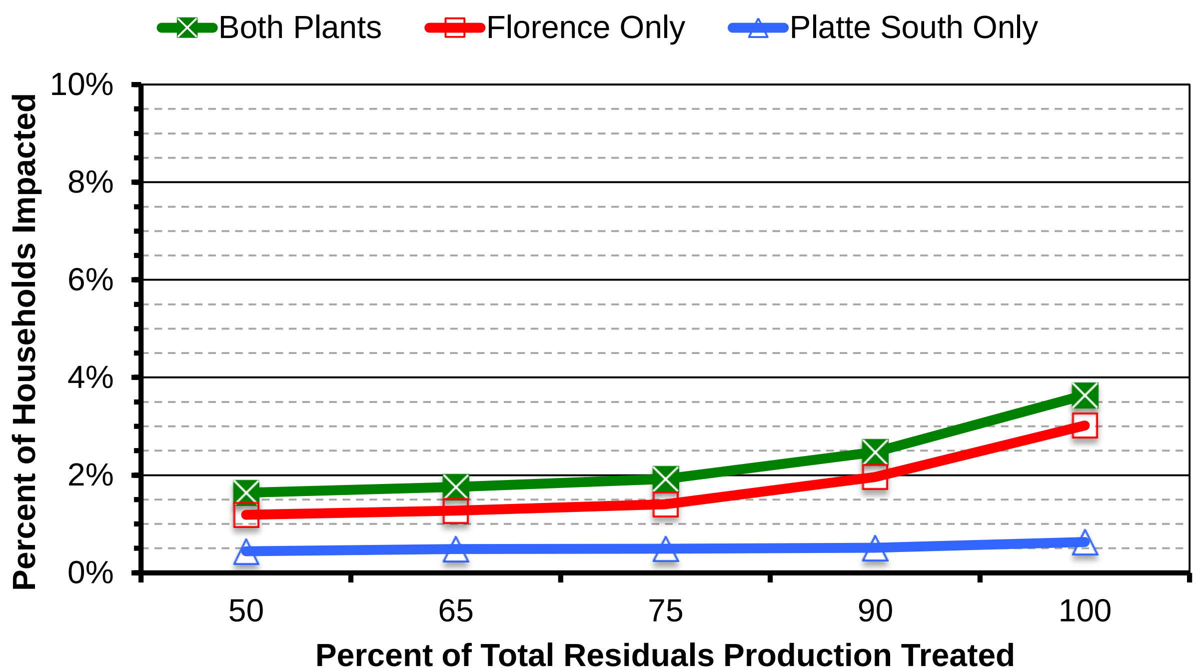

Figure 4 Percent of households impacted (cost of improvements exceeds 1% of household income) for dewatering improvements only

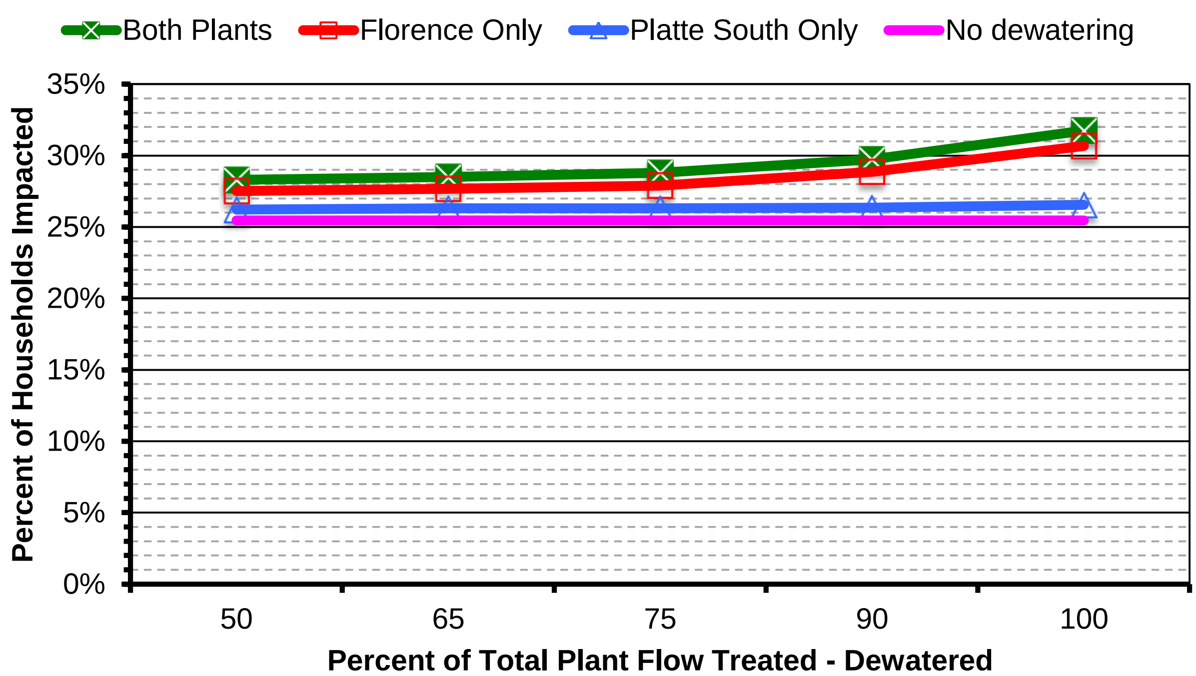

Figure 5 Percent of households impacted (cost of improvements exceeds 1% of household income) for both M.U.D. dewatering improvements and PWD sewer improvements

Example Calculations

The calculations involved in the methodology described in USEPA 2011 are not necessarily intuitive. This example, presented in Table 4 and Figure 6 and in the text, is intended to illustrate the calculations involved for the different dewatering and sewer economic analyses listed in Table 3 and Figures 2 thru 5.

The example described below assumes plate and frame dewatering added at both Platte South and Florence PWTP to treat 75 of flow/solids. From EM5 the capital cost for Platte South is $23.53 million and from EM7 $65.06 million at Florence. Annual O&M ("Annual Recurring Costs") from the same two memoranda were $1.14 and $3.02 million, respectively. The capital costs are amortized as described in equation 13-2 on page 13-7 (USEPA 2011), which is just the capital cost recovery factor (see equation 13-1, page 13-6 of USEPA 2011) often used in this type of economic analysis (for example to amortize capital costs in EM5 and EM7). Then after amortizing capital costs, these and the annual recurring costs are converted from "$/yr" to "$/MG) by dividing by the annual treated water production using equations 13-4 and 13-5 in USEPA 2011; the resulting values are then added together to get a total cost in $/MG of treated water. This value is divided by the residential consumption rate provided by M.U.D. (89,000 gal/yr per household) to get the cost to residential customers in units of "$/yr per household" (note there is a typo in Equation 13-9 of USEPA 2011). In this example, the result of all these calculations ends with a final value of $30.52/yr per household due to improvements proposed for both PWTPs.

The next step in the process is to figure out the number of households where this value of $30.52/yr per household represents more than 1 percent of annual household income. This is illustrated for the above example in Table 4 and Figure 6. Note this performed by first calculating the "threshold income" by dividing the $30.52/yr per household value by 0.01 (i.e., 1 percent), and coming up with a value of $3,052/yr per household as the threshold income level. The proposed costs for the dewatering improvements ($30.52/yr household) are >1 percent for households with income below this value. The census data includes number of households within a given household income range. So in order to estimate the number of households "impacted" the steps are:

1. Determine which range the threshold value falls in,
2. Add all households in income ranges below this range

3. Within this range, assume incomes are linearly distributed and estimate the number of impacted households by linear interpolation
4. Add results from steps 3 and 4

In Table 4 for the dewatering only option, the threshold income of $3,052 falls in the 1st income range, so the number of impacted households is estimated at 4,597 (3,052 * 15,061/9,999). Thus, when considered by itself, the increase in cost associated with implementing the dewatering improvements at both the Platte South and Florence PWTPs (75 percent treatment option) would impact (i.e. exceed the 1.0 percent of annual household income) only 1.9 percent of the 239,296 households served by M.U.D.

However, this number increases significantly when the coming sewer system cost increases are considered. The Financial Capability Assessment prepared by University of Cincinnati estimates that, by 2018, annual wastewater treatment costs for PWD customers will have increased by 273 percent from the current level of $59,592,150 to $162,940,550 (see Table 1 in University of Cincinnati 2013). Approximately 14 percent of this $103,348,400 increase will be associated with higher operations and maintenance (O&M) costs; the remainder is comprised of capital expenditures (cash-funded and debt service) that are largely associated with implementation of the Omaha Long Term Control Plan to Address Combined Sewer Overflows.

The University of Cincinnati report (2013) estimates that the total current and projected wastewater treatment costs for 2018 ($162,940,550) will correspond to an average annual cost of $461 per household. Since $59,592,150 of that total represents current wastewater treatment costs, the 2018 household costs were reduced by 36.6 percent ($59,592,150/$162,940,550) to account for those current costs. Therefore, total portion of the projected annual cost per household in 2018 that corresponds to the projected costs for the proposed new sewer improvements (including projected increases in future O&M costs) is about $292.40/yr per household. While there is not an exact overlap between the service areas for M.U.D. and PWD, the average M.U.D. customer is likely to experience an increase in annual sewer rates of $292.40 by 2018; any increase in water rates associated with the dewatering improvements at the Platte South and Florence PWTPs would be on top of this sewer rate increase, for most M.U.D. customers.

Consequently, adding this value to value for dewatering improvements in the example in Table 4, the resulting threshold income for sewer plus dewatering is $32,292/yr per household.

Therefore, as shown in Table 4 and Figure 6, all households in the first three income groups are all “impacted”, as well as part of the households in the $25,000 to $34,999/yr per household income range. Therefore, the number of impacted households is 68,833 (15,061 + 11,661 + 23,188 + [(32,292-25,000)/(34,999-25,000)]), or 28.2 percent of the 239,296 total residential households. By comparison, the number of households impacted by sewer alone would be 60,941 or 25.5 percent calculated in a similar manner.

In this example, adding dewatering impacts 4,597 (1.9 percent of total) households when no sewer improvements are added. However, the same dewatering improvements impact 7,942 households (3.3 percent of total) when accompanying sewer improvement costs. This increased number of impacted households is due to the distribution of annual household income in the community, as can be observed by noting the number of households in some income ranges vs. others in Table 4, or by the slope of the curve in Figure 6. For example, a hypothetical $5,000 increase in Threshold Income will impact half of 26,015 households (~13,000) and the same $5,000 increase within the lowest range will only impact half of 15,061 households (~7,500). Using data from the example in Figure 6, this graph illustrates that a ~$3,000 increase in Threshold Income from 0 to $3,000 impacts fewer households than a ~$3,000 increase from ~$30,000 to ~$33,000.

Table 4

Example Calculations for dewatering option at 75 percent of total flow for both plants (plate and frame)

(Dewatering improvements impact 4,597 more households w/o sewer improvements, but 7,942 more w/ sewer improvements)

Description		Dewatering Only		Dewatering plus Sewer Improvements		Sewer Improvements Only	
Annual Cost of Improvements		$31/yr per household		$323/yr per household		$292/yr per household	
Threshold Income ‡		$3,052/yr per household		$32,292/yr per household		$29,240/yr per household	
Income Range	Number of Households	Household Achievability †		Household Achievability †		Household Achievability †	
		Number	Percent	Number	Percent	Number	Percent
< $10,000	15,061	4,597	30.5%	15,061	100.0%	15,061	100.0%
$10,000 to $14,999	11,661	0	0.0%	11,661	100.0%	11,661	100.0%
$15,000 to $24,999	23,188	0	0.0%	23,188	100.0%	23,188	100.0%
$25,000 to $34,999	26,015	0	0.0%	18,973	72.9%	11,031	42.4%
$35,000 to $49,999	34,235	0	0.0%	0	0.0%	0	0.0%
$50,000 to $74,999	46,998	0	0.0%	0	0.0%	0	0.0%
$75,000 to $99,999	31,991	0	0.0%	0	0.0%	0	0.0%
$100,000 to $149,999	31,491	0	0.0%	0	0.0%	0	0.0%
$150,000 to $199,999	9,815	0	0.0%	0	0.0%	0	0.0%
≥ $200,000 to higher	8,841	0	0.0%	0	0.0%	0	0.0%
Total	239,296	4,597	1.9%	68,883	28.8%	60,941	25.5%
		Difference from Sewer Only		7,942	3.3%		

Note:

‡ = Annual household income level where greater than 1 percent of household income is needed to cover costs of improvements

† = Number of households where total annual costs for the improvements are greater than 1 percent of Annual Household Income

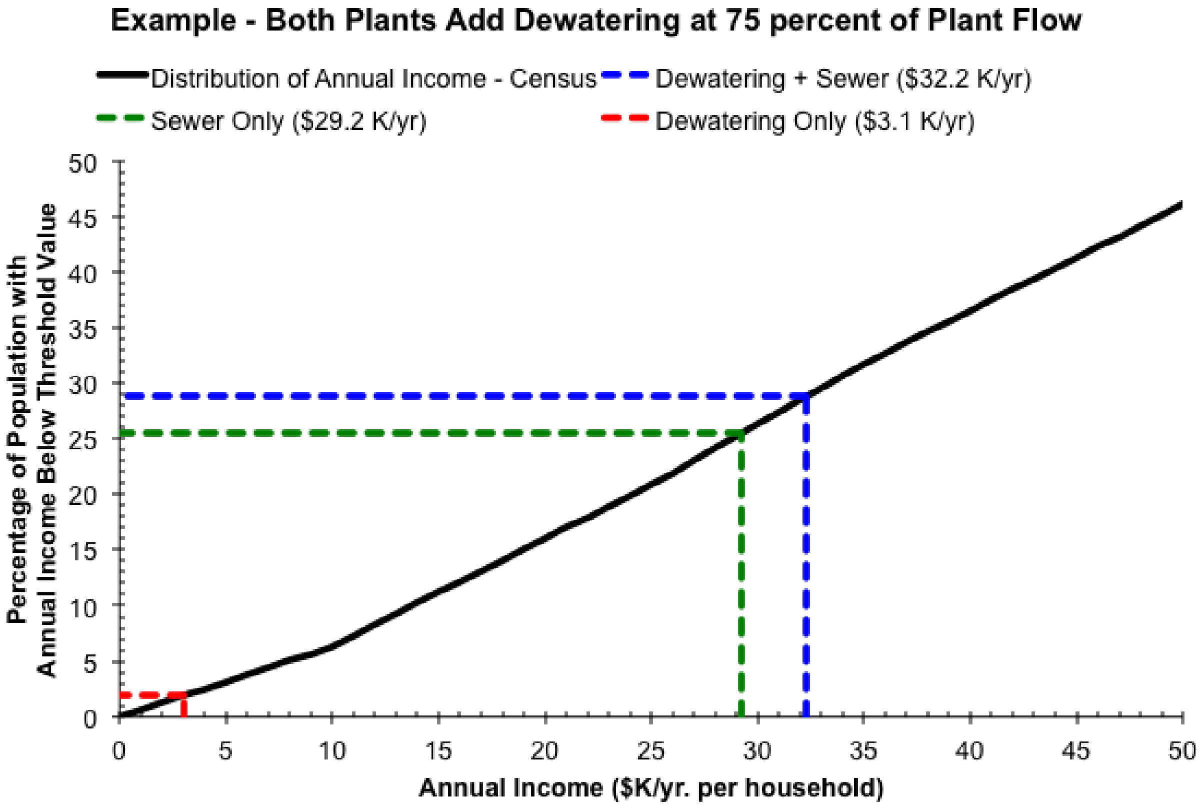

Figure 6 Distribution of household income versus results from example in Table 4 for M.U.D. dewatering improvements at 75 percent total flow at both water plants – with or without PWD sewer improvements

Summary and Conclusions

Using the methodology described in USEPA 2011, this memorandum evaluates the economic impacts of the dewatering improvements described in EM5 and EM7 on the 239,236 households estimated in the communities served by M.U.D.. The economic impact was evaluated for different sizes (percent flow) of dewatering improvements individually at each PWTP as well as for both PWTPs together, plus the impact of all these situations when costs for sewer improvements (University of Cincinnati 2013) were added. Observations from these data are summarized below:

- The definition of an "impacted" household in this analysis was assumed to be a household from the US Census database where the cost of a given improvement (dewatering alone or dewatering plus sewer) represented more than 1 percent of the household annual income.

- The cost of sewer improvements was determined to be $292/yr per household based on information in University of Cincinnati (2013) report.
- 1,000 to 1,500 households or about 0.5 percent of the households served by M.U.D. could be impacted by proposed dewatering improvements at Platte South PWTP, if the improvements for Florence PWTP are not considered. When these are added to sewer improvements, the number of impacted houses increases to between 62,700 and 63,500 (about 26.5 percent of households).
- A greater number of households are expected to be impacted by the dewatering system improvements at Florence PWTP (2,800 to 7,200 households or 1.2 to 3.0 percent of the households served by M.U.D.) or by combined impacts of those improvements together with the PWD sewer improvements (65,800 to 73,400 households or 27.5 to 30.7 percent), if the improvements for Platte South PWTP are not considered.
- When the dewatering improvements at both PWTPs are combined, the estimated number of impacted households increases by 4,000 to 8,700 or about 1.6 to 3.6 percent of the households served by M.U.D. This impact increases to 67,700 to 76,000 households (28.3 to 31.8 percent of households served by M.U.D.) when the PWD sewer improvements are considred in conjunction with the dewatering improvements.
- The economic analysis described above suggests that any of the PWTP dewatering improvements, by themselves, are not expected to impact households with income >$10,000/yr per household. However, sewer improvements, by themselves, impact households with incomes up to $29,240/yr per household, which includes more than 60,000 households (25.5 percent of households served by M.U.D.) Therefore, considering the cost of the PWD sewer improvmenets in conjunction with the PWTP dewatering improvements increases the impacted households to those with annual incomes $30,000 to $35,000/yr.
- Therefore, even though dewatering improvements alone may have a relatively minor impact on M.U.D.'s residential customers (up to 3.6 percent of households would

exceed the threshold income level), in a community that is currently facing with substantial costs for sewer improvements, the additional costs for dewatering improvements can increase the overall impact up to about one-third households in the community.

References

EE&T 2012a. *Engineering Memorandum No. 5: Platte South Evaluation of Selected Technologies to Reduce Solids Discharged to the Missouri River (June 27, 2012).*

EE&T 2012b. *Engineering Memorandum No. 7: Florence Evaluation of Selected Technologies to Reduce Solids Discharged to the Missouri River (September 11, 2012).*

University of Cincinnati 2013. *Financial Capability Assessment: Omaha Long Term Control Plan to Address Combined Sewer Overflows and Related Wastewater Projects (May 2013).*

US Department of Commerce. 2013. United States Census Bureau - American Fact Finder [Online]. Available: <http://factfinder2.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>.

USEPA. 2011. Chapter 13 – Economic Considerations for Permit Writers. Drinking Water Treatment Plant Residuals Management Technical Report - Summary of Residuals Generation, Treatment, and Disposal at Large Community Water Systems (December 2011, EPA 820-R-11-003). Washington, DC: USEPA.

Appendix A

Summary of Data From Census (US Department of Commerce 2013)

City	Zip Code	Households in 2011 Census Data (US Department of Commerce 2013)										
		Total	<$10,000	$10,000 to $14,999	$15,000 to $24,999	$25,000 to $34,999	$35,000 to $49,999	$50,000 to $74,999	$75,000 to $99,999	$100,000 to $149,999	$150,000 to $199,999	>=$200,000
Bellevue	68005	9,520	542	475	837	1,056	1,389	2,293	1,265	1,265	294	104
Bellevue	68123	9,520	133	209	638	809	1,352	2,133	1,657	1,856	495	238
Bellevue	68147	3,819	107	183	428	557	649	764	504	493	107	27
Bennington	68007	2,292	9	66	73	112	137	396	454	665	224	156
Carter Lk	51510	1,344	44	113	109	165	298	253	216	86	12	48
Ft Calhoun	68023	910	38	52	58	93	74	151	168	187	31	58
La Vista	68128	7,234	231	109	543	709	1,327	1,537	1,125	1,125	297	231
Omaha	68102	2,485	544	164	259	251	453	400	192	90	10	122
Omaha	68104	14,068	1,210	1,055	1,773	2,054	2,349	2,420	1,702	1,027	267	211
Omaha	68105	9,301	1,292	827	1,487	1,301	1,487	1,422	799	548	55	83
Omaha	68106	9,181	670	468	808	1,148	1,726	2,268	1,001	688	303	101
Omaha	68107	9,060	879	616	1,133	1,568	1,676	1,848	770	507	18	45
Omaha	68108	4,753	556	375	746	807	941	731	365	147	61	24
Omaha	68110	2,835	609	382	513	501	380	215	159	62	0	14
Omaha	68111	8,019	1,347	1,107	1,532	1,339	1,107	954	305	224	72	32
Omaha	68112	4,449	276	320	618	561	801	1,077	405	249	89	53
Omaha	68114	8,124	683	383	1,000	1,138	1,114	1,496	813	683	334	480
Omaha	68116	8,926	117	206	438	403	661	1,608	1,652	2,331	858	652
Omaha	68117	3,176	207	108	368	286	600	934	416	181	51	25
Omaha	68118	3,170	12	44	82	66	225	513	361	1,008	371	488
Omaha	68122	3,333	63	157	130	187	360	816	726	677	147	70
Omaha	68124	6,546	242	308	674	589	818	1,231	903	917	314	550
Omaha	68127	9,910	377	347	1,447	1,387	1,605	2,309	1,159	803	268	208
Omaha	68130	6,407	121	128	236	204	659	1,057	1,159	1,345	659	839
Omaha	68131	5,906	1,217	579	987	674	892	763	266	432	48	48
Omaha	68132	5,964	632	406	656	775	757	871	489	674	286	418
Omaha	68134	12,329	888	530	1,479	1,627	2,055	2,684	1,537	1,085	284	160
Omaha	68135	7,956	95	56	231	278	453	1,448	1,321	2,554	923	597
Omaha	68136	4,583	96	0	114	220	353	981	1,100	1,059	394	266
Omaha	68137	9,838	296	276	572	867	1,565	2,215	1,939	1,555	237	316
Omaha	68138	4,450	14	121	152	307	610	1,220	997	761	165	103
Omaha	68142	1,291	96	59	107	66	170	217	196	121	108	151
Omaha	68144	9,938	378	328	765	964	1,361	1,948	1,501	1,679	537	477
Omaha	68152	2,587	143	140	202	230	406	551	306	329	161	119
Omaha	68154	9,738	351	351	750	1,198	1,168	1,597	1,285	1,665	516	857
Omaha	68157	1,806	43	29	112	202	195	486	393	245	52	49
Omaha	68164	11,010	396	418	793	870	1,464	2,422	1,894	1,773	650	330
Omaha	68178	0	0	0	0	0	0	0	0	0	0	0
Waterloo	68069	917	34	33	109	95	130	139	119	129	80	49
Ralston	68127	2,601	73	133	229	351	468	630	372	266	37	42
		239,296	15,061	11,661	23,188	26,015	34,235	46,998	31,991	31,491	9,815	8,841