Water Quality Monitoring

Indian Creek Soil Health Partnership

Summer 2022

Marty St. Clair
Bode Carter
Clayten Edwards
Liana Sweezer
Jackson Tupper

Coe Water Quality Lab

Introduction

Indian Creek is a 60,229 acre HUC 10 watershed located entirely within Linn County, Iowa. The Indian Creek Watershed Management Authority (ICWMA) was formed in 2011 to coordinate efforts to reduce flooding and improve water quality with in the watershed. With funding obtained from the Iowa Economic Development Authority, the ICWMA carried out a comprehensive assessment of the watershed and completed a watershed management plan in 2015.[1]

In 2018, a $306,500 grant from the USDA's NRCS, along with local funds from the ICWMA and Linn County Conservation, enabled the Linn County Soil Conservation department to create the Indian Creek Soil Health Partnership, which provides technical assistance to local farmers and landowners who wish to adopt soil health practices in the watershed. In support of those efforts, personnel from Coe's Water Quality Lab have been collecting and analyzing samples from sites in the watershed where wetlands, saturated buffers, bioreactors, and other practices have been installed.

Methods

<u>Sampling</u> Surface water samples were collected by direct grab sampling using a sample container attached to an extension pole. (Containers were rinsed three times with stream water prior to collecting the final sample.) Samples from tile boxes were collected either by grab sampling (with an extension pole) or by using a Global Water SP100 portable pump. If necessary, stoplogs were raised to get water flowing, and then returned to their original positions. The pump was emptied of sample water between sites. Samples to be analyzed for nitrate, chloride, and sulfate were collected in polyethylene bottles. (Polyethylene sample bottles were washed in a laboratory dishwasher with distilled water rinse.) Samples to be analyzed for dissolved reactive phosphorus (DRP) were filtered in the field through a 0.45 μm nylon syringe tip filter into a 60 mL acid-washed brown glass bottle. All samples were immediately stored in a cooler at 4°C until they could be transported back to the laboratory and refrigerated. Samples were typically analyzed within 24 hours of sampling.

[1] Available at http://www.indiancreekwma.org/the-plan.html

Table 2. Sampling locations[2]

Site Name	Practice	Latitude	Longitude
RSML	Saturated buffer	42º 04' 45.6"	91º 32' 58.3"
Landfill	Wetland (not installed)	42º 05' 16.1"	91º 33' 43.6"
Tuma	Biofilter	42º 06' 00.8"	91º 38' 20.0"
Bogert	Saturated buffer	42º 05' 54.8"	91º 35' 50.7"
Platner old	Biofilter	42º 07' 13.7"	91º 34' 33.7"
Platner new	Biofilter	42º 07' 32.2"	91º 34' 34.3"
Wanatee 13/100 wetland in	Wetland	42º 01' 05.2"	91º 33' 07.1"
middle		42º 01' 06.2"	91º 33' 11.8"
out		42º 01' 07.8"	91º 33' 17.5"
Wanatee fishing pond in	Pond	42º 00' 01.5"	91º 33' 05.1"
middle		42º 00' 02.3"	91º 33' 08.2"
out		42º 00' 05.2"	91º 33' 14.5"
Wanatee 100 wetland in	Wetland	42º 01' 08.0"	91º 34' 20.9"
out		42º 01' 00.4"	91º 34' 17.4"
Wanatee big wetland in	Wetland	42º 00' 55.4"	91º 34' 22.5"
out		42º 00' 47.3"	91º 34' 02.2"

Laboratory analysis Nitrate, sulfate, and chloride were measured using a Metrohm EcoIC ion chromatograph equipped with a Metrosep A Supp 5 ion exchange column and 3.2 mM Na_2CO_3/1.0 mM $NaHCO_3$ eluant.[3] A Metrohm 858 Professional Sample Processor with in-line filtration was used for sampling. Nitrate was reported as mg/L of NO_3^--N, sulfate as mg of SO_4^{-2}/L, and chloride as mg of Cl^-/L. Dissolved reactive orthophosphate (DRP) was analyzed using a Lachat QuikChem 8500 Series 2 flow injection analyzer running Lachat method 10-115-01-1-P.[4] All glassware used in sampling and analysis of DRP was acid washed in 1 M hydrochloric acid. Phosphate values were reported as mg PO_4^{3-}/L. Instrument blanks and reagent blanks were run daily, and did not indicate significant levels of contamination. Three to five standards were run daily for each analysis. If data is reported as NA, the sample was not analyzed; if reported as BDL, no analyte was detected above detection limits.

Results

As precipitation has a significant impact on the values observed, it is worth noting that summer 2022 was a relatively dry year with respect to rainfall. Values for May to August at the Cedar Rapids airport are shown in the table below.

Table 1. MJJA rainfall totals (inches) at Cedar Rapids[5]

Year	2018	2019	2020	2021	2022
Inches precipitation	21.35	19.61	13.47	8.24	13.51

[2] Estimated using Google Earth Pro

[3] American Public Health Association (APHA). 2005. Standard Methods of Water and Wastewater. 20th ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C. Method 4110B (ion chromatography)

[4] Equivalent to Method 4500-P G. in American Public Health Association (APHA). 2005. Standard Methods of Water and Wastewater. 20th ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.

[5] See https://mesonet.agron.iastate.edu/ASOS/reports/

Edge of field treatment sites

Selected results – focusing on nitrate concentrations – will be highlighted in this section. (Complete results are given at the end of this document.)

Saturated buffers

Two sites featured saturated buffers which were installed in previous years. Each had a tile control box which controlled whether tile drainage went through the saturated buffer or to a bypass tile line. Incoming untreated tile drainage was sampled at this point. In addition, water from adjacent streams was also sampled. Samples were also taken from observation wells closest to the stream to assess the effectiveness of denitrification in the saturated soil.

Figure 1. Nitrate concentrations at Bogert saturated buffer

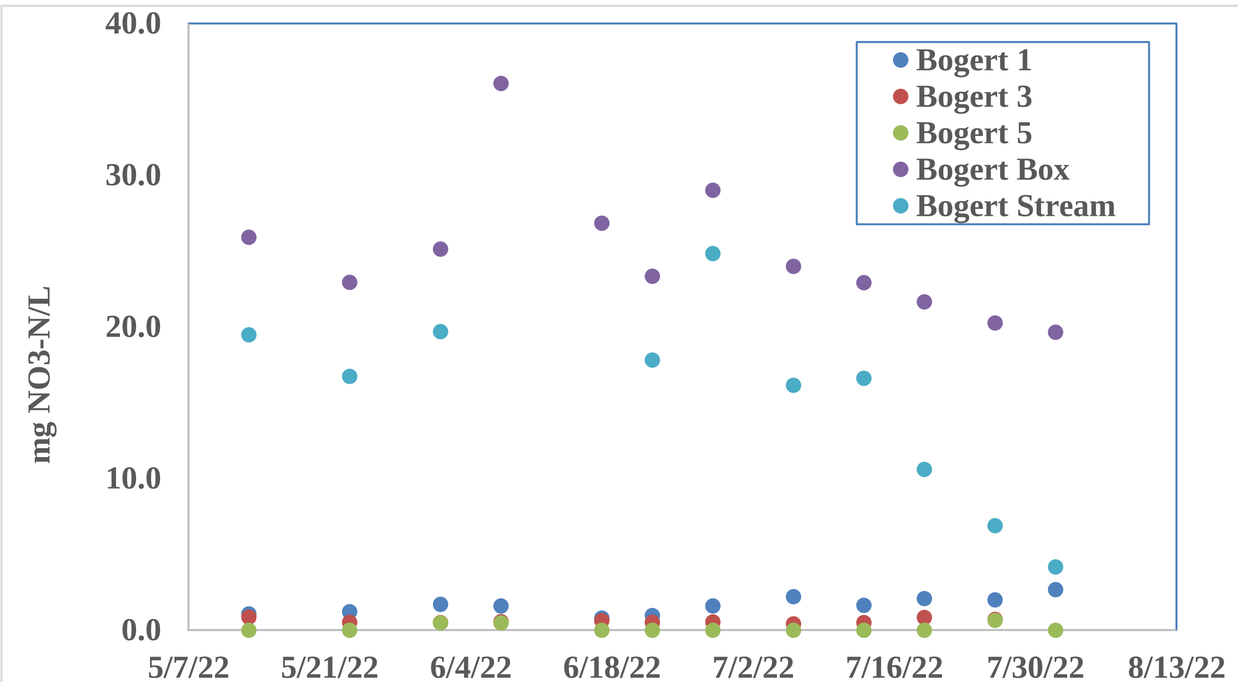
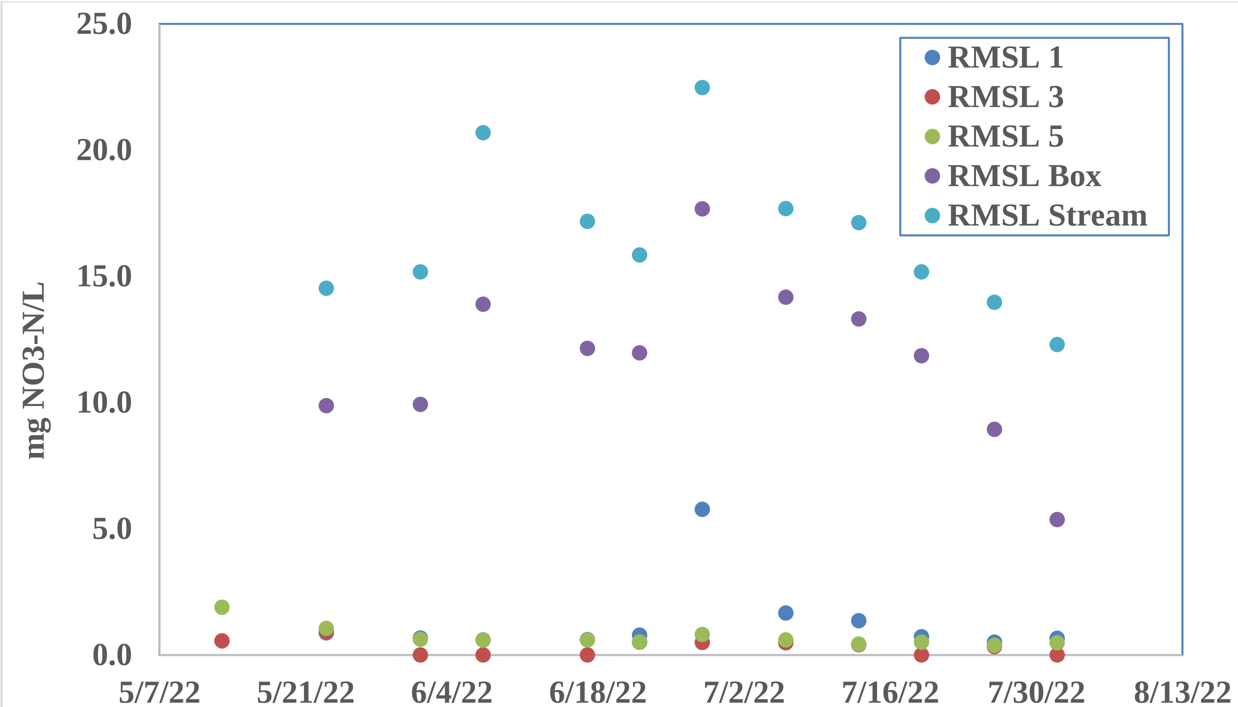


Figure 2. Nitrate concentrations at RSML saturated buffer

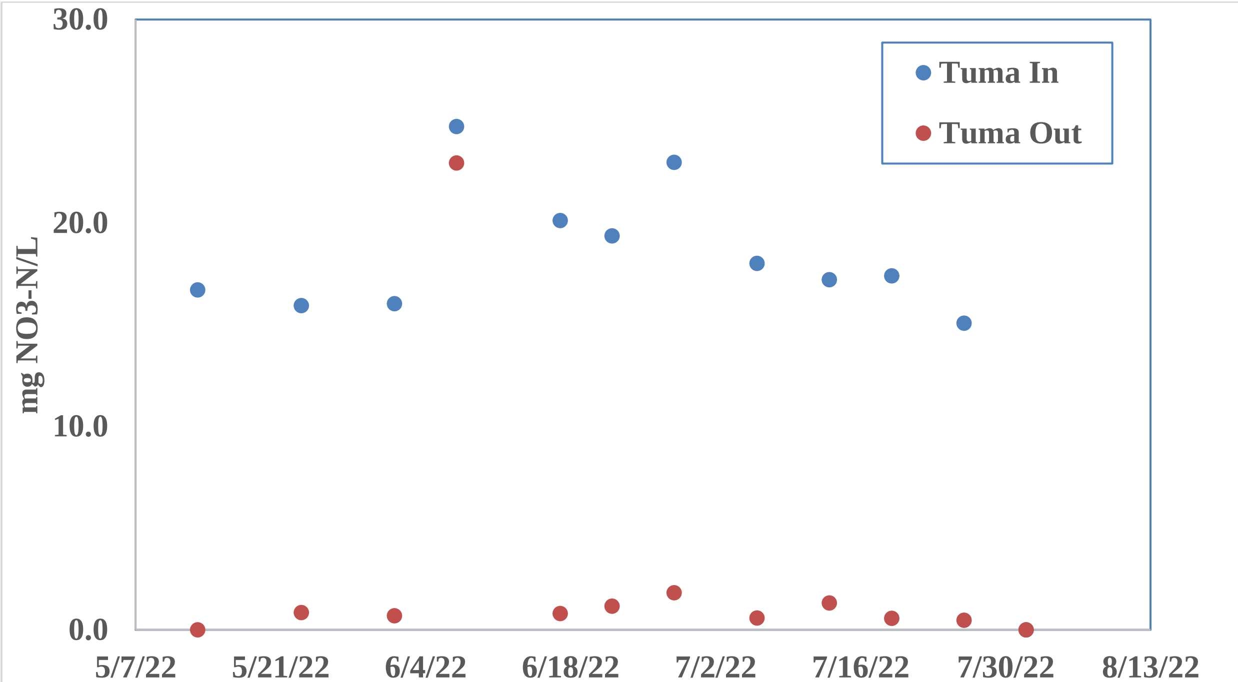


As can be seen in Figure 1 and 2, the saturated buffers are very effective at reducing the concentration of nitrate in the water entering them. Using the average of the wells sampled as the output and the concentration in the tile boxes as the input, nitrate concentrations were reduced by 97% in the Bogert saturated buffer and 94% in the RSML buffer. The streams next to the buffers, however, were at 15-20 mg NO_3^--N/L for much of the summer – reflecting the fact that much of the watershed remains untreated by edge of field practices.

<u>Bioreactors</u>

There are three bioreactors which have been constructed as part of the project. The last (Platner 2) was installed in the fall of 2021; thus this was the first full season of operation. The Tuma bioreactor showed good nitrate removal, with the comparison of the inflow box to the outflow box showing an 88% reduction in nitrate concentration.

Figure 3. Nitrate concentrations in the Tuma bioreactor



The bioreactors at the Platner sites show less effective nitrate removal (Platner 1: 30%; Platner 2: 12%. It should be noted that Platner 1 had excellent nitrate removal last summer at 85.3%.) Early in the season, the flow rate through Platner 2 seemed to be very high, as evidenced by audible flow at the input tile box as well as visual observations. This may have been the case with Platner 1 as well. Since residence time in the bioreactor has an impact on nitrate reduction[6], slowing the flow during the 2023 season would be important.

[6] See, for example, E.A. Martin, M.P. Davis, T.B. Moorman, T.M. Isenhart, M.L. Soupir, "Impact of hydraulic residence time on nitrate removal in pilot-scale woodchip bioreactors", *J. Envmntl. Mgmnt.*, 237, **2019**, pp. 424-432.

Figure 4. Nitrate concentrations in the Platner 1 bioreactor

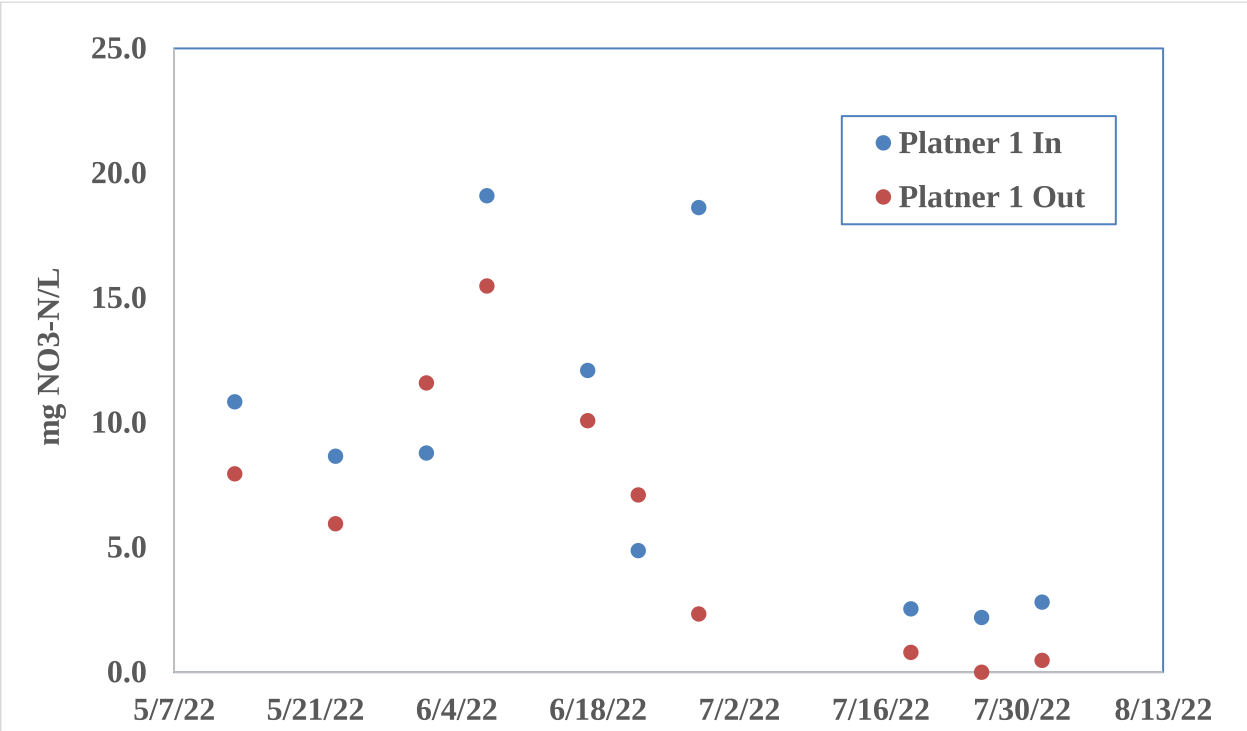
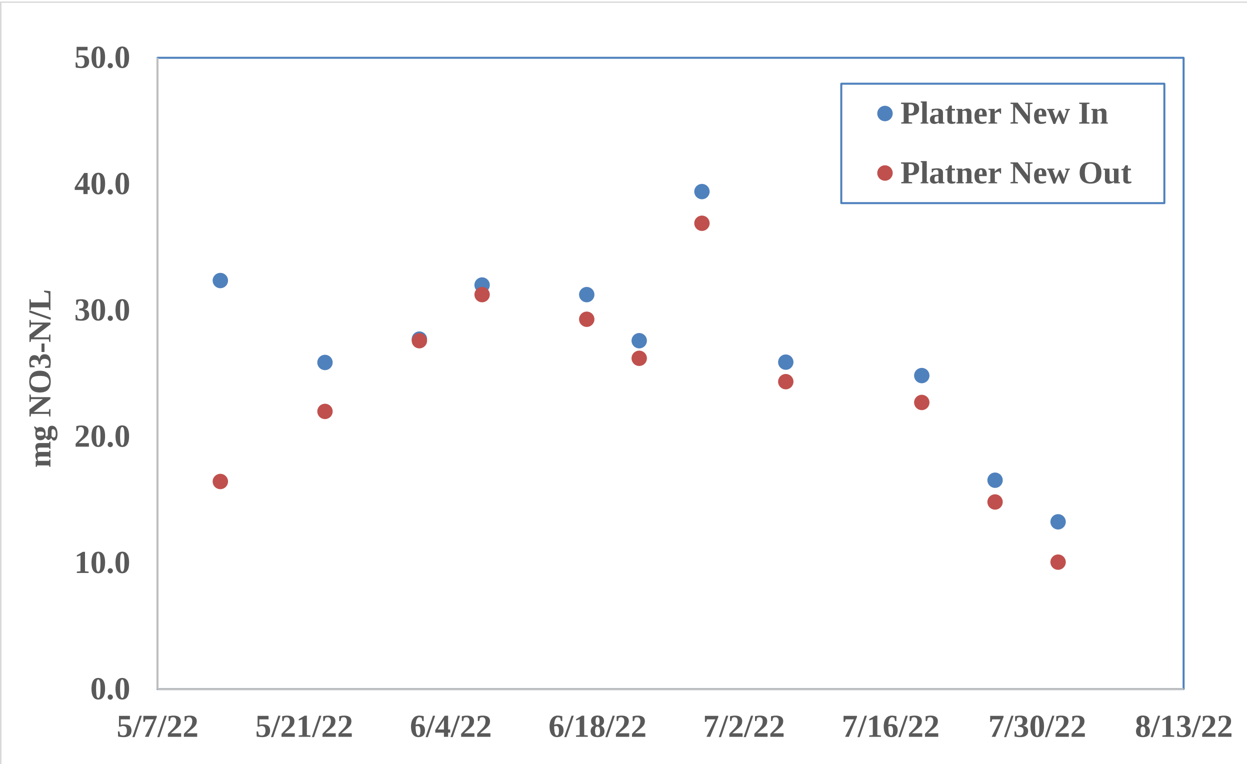
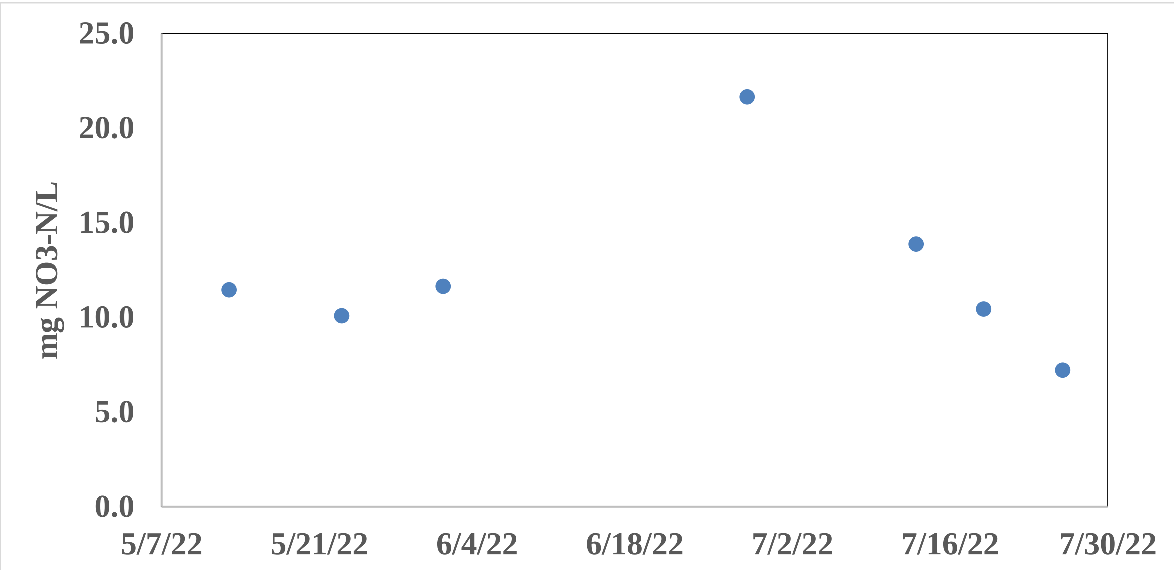


Figure 5. Nitrate concentrations in the Platner 2 bioreactor



Wetlands
We have monitored the tile entering Indian Creek on the western side of Indian Creek where construction of a wetland is planned since 2020. As shown below, nitrate concentrations are typical for Iowa row-cropped farmland.

Figure 6. Nitrate concentrations in tile drainage on Cedar Rapids-Linn County Solid Waste Agency farmland.



We have also carried out sampling and analyses of wetlands constructed in Wanatee Park by Linn County Conservation. These wetlands process tile drainage coming from agricultural land outside the park, while also providing recreational opportunities and wildlife habitat.

While not strictly a wetland, a new fishing pond in Wanatee Park has many of the same characteristics. Tile drainage enters a forebay, and then makes its way into the main pond area. Overflow from the pond then eventually enters Wanatee Creek. As shown in Figure 7, outflow from the pond shows a 96% reduction in nitrate concentration. The pond is not yet full; a higher flow through the pond would likely reduce the nitrate reduction capabilities. Nevertheless, it is effective in reducing nitrate levels. Interestingly, samples taken in the middle and at the outflow of pond (but not at the input) are elevated in chloride concentrations.

Figure 7. Nitrate concentrations in fishing pond at Wanatee Park

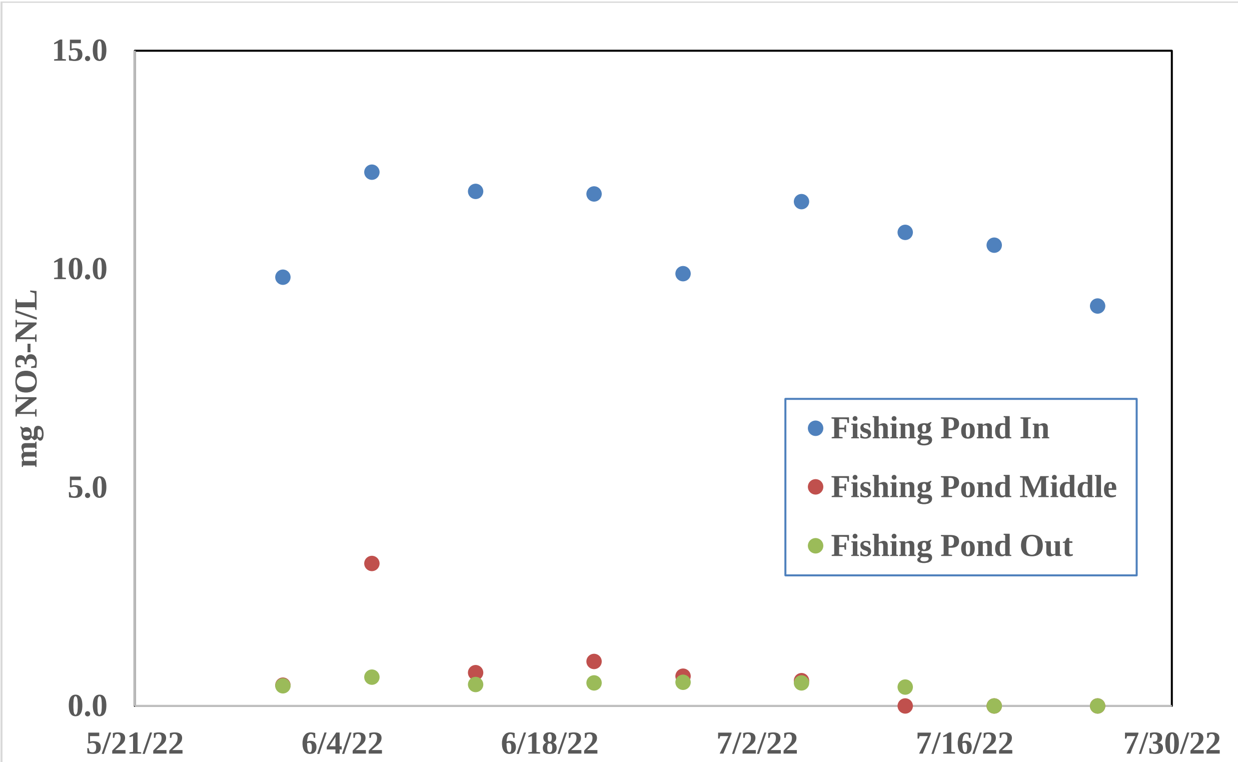
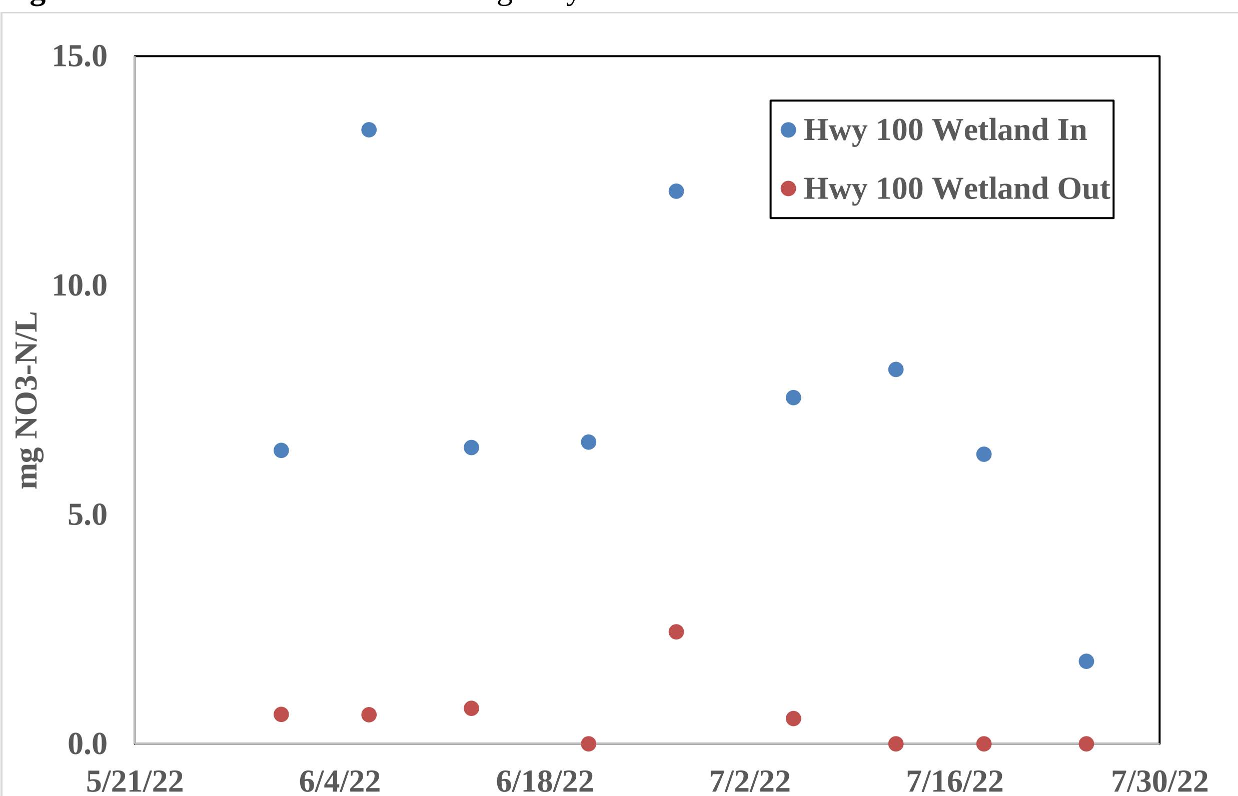


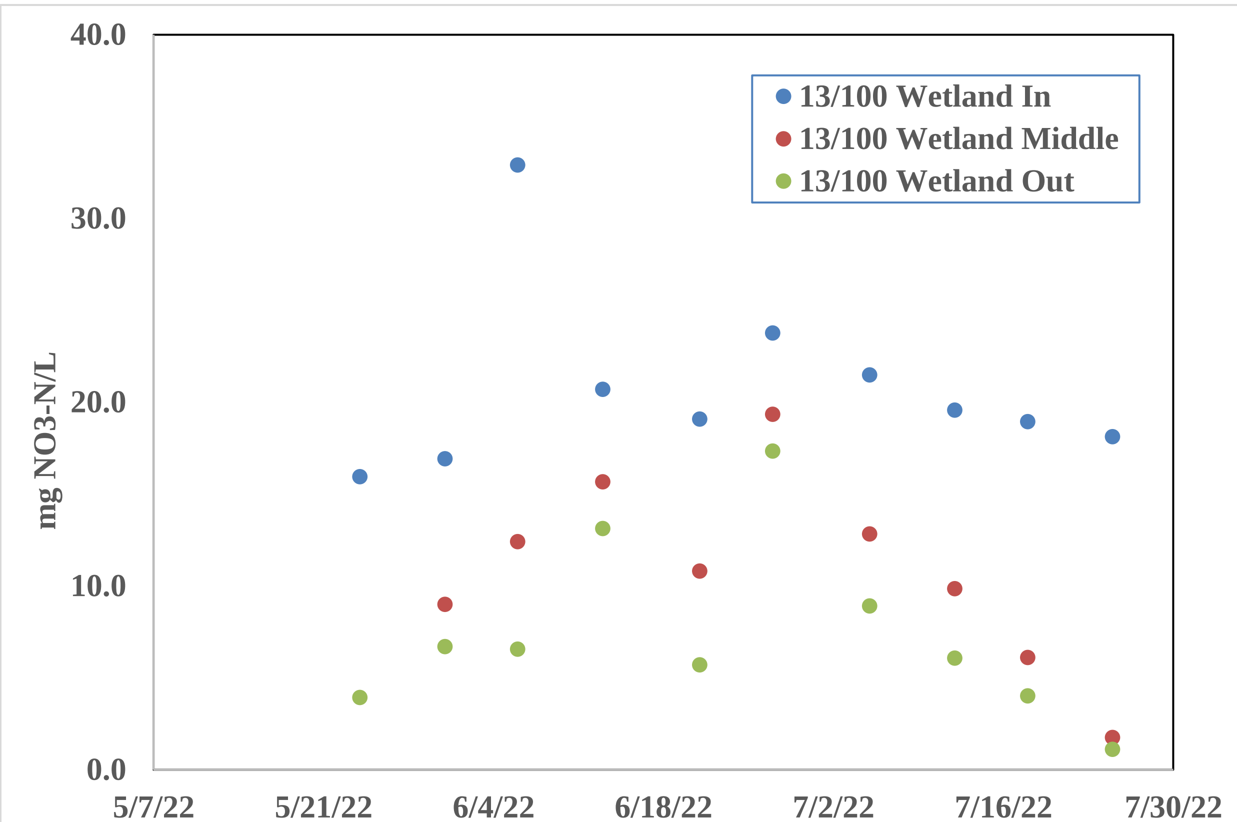
Figure 8. Nitrate concentrations in Highway 100 wetland



The Highway 100 wetland takes tile drainage from a culvert supplied from tile drainage on the north side of Highway 100. The wetland is within the park, and has a control structure which sends the outflow to another wetland before it enters Wanatee Creek. Again, it was very effective (94%) at reducing the concentration of nitrate in the water flowing through it.

The wetland at the corner of Highways 13 and 100 was re-engineered since last summer into a two component system. It receives tile drainage from the east side of Highway 13. Figure 9 shows that, while % reduction overall is not as high as the other wetlands (65%), it still reduces the nitrate load substantially.

Figure 9. Nitrate concentrations in the wetland at the corner of Highways 100 and 13



The large wetland within Wanatee Park was also monitored at one of the inlets and at the outlet; even though the water coming in was at a low nitrate concentration, the nitrate removal was still impressive (86%) as the effluent often had nitrate concentrations below detection limits.

Dissolved reactive phosphorus (sometimes referred to as orthophosphate) values were generally low, but did occasionally spike to higher levels. If waters were somewhat stagnant (as with low flow periods), values of DRP might increase. Chloride levels were higher in a number of the practices; in some cases possibly due to proximity to busy highways, while other situations may have been caused by construction materials.

Conclusions

The practices implemented as a part of the Indian Creek Soil Health program clearly reduce the concentration of nitrate reaching the surface waters of Indian Creek. In the case of the wetlands, the practices also provide wildlife habitat and recreational value. However, as illustrated in the samples taken in streams next to the saturated buffers, or in other monitoring of Indian Creek, these initial installations do not yet treat enough of the watershed to have observable impact on the concentration in the creek itself. Continued investments and additional installations, in addition to other practices, will be necessary to actually reduce the nutrients sent to the Cedar River.

Acknowledgments

We appreciate the cooperation of landowners in allowing access to the sampling sites. Financial support from the USDA Natural Resources Conservation Service – Iowa Partners for Conservation Program is gratefully acknowledged, as is a grant from the Greater Cedar Rapids Community Foundation for the purchase of the ion chromatograph.

Site	Date	DRP	Cl	NO3-N	SO4
Platner 2 In	5/13/2022	0.11	58.9	32.4	10.9
Platner 2 In	5/23/2022	0.06	51.0	25.9	14.0
Platner 2 In	6/1/2022	0.05	51.8	27.7	11.6
Platner 2 In	6/7/2022	0.04	53.5	32.0	19.5
Platner 2 In	6/17/2022	0.09	49.8	31.3	11.9
Platner 2 In	6/22/2022	0.11	47.7	27.6	12.5
Platner 2 In	6/28/2022	0.07	47.7	39.4	12.0
Platner 2 In	7/19/2022	0.04	41.3	25.9	12.9
Platner 2 In	7/26/2022	0.04	72.9	24.8	16.8
Platner 2 In	8/1/2022	0.05	35.1	16.5	14.9
Platner 2 Out	5/13/2022	0.20	49.5	16.4	12.5
Platner 2 Out	5/23/2022	0.14	51.0	22.0	14.0
Platner 2 Out	6/1/2022	0.04	51.5	27.6	12.0
Platner 2 Out	6/7/2022	0.03	53.1	31.3	19.6
Platner 2 Out	6/17/2022	0.09	49.7	29.3	11.9
Platner 2 Out	6/22/2022	0.10	50.0	26.2	12.5
Platner 2 Out	6/28/2022	0.08	46.7	36.9	12.2
Platner 2 Out	7/19/2022	0.03	41.0	24.4	12.9
Platner 2 Out	7/26/2022	0.03	38.8	22.7	13.0
Platner 2 Out	8/1/2022	0.03	34.9	14.8	15.0
Platner 1 In	5/13/2022	0.06	26.8	10.8	10.4
Platner 1 In	5/23/2022	0.13	27.1	8.7	13.8
Platner 1 In	6/1/2022	0.04	28.7	8.8	11.0
Platner 1 In	6/7/2022	0.08	28.9	19.1	9.1
Platner 1 In	6/17/2022	0.13	27.4	12.1	12.0
Platner 1 In	6/22/2022	0.14	29.3	4.9	23.9
Platner 1 In	6/28/2022	0.08	27.4	18.6	9.0
Platner 1 In	7/19/2022	0.06	24.7	2.5	14.4
Platner 1 In	7/26/2022	0.07	27.2	2.2	18.0
Platner 1 In	8/1/2022	0.08	26.6	2.8	18.2
Platner 1 Out	5/13/2022	0.03	27.6	8.0	10.0
Platner 1 Out	5/23/2022	0.05	28.6	6.0	15.1
Platner 1 Out	6/1/2022	0.09	27.3	11.6	11.3
Platner 1 Out	6/7/2022	0.03	29.6	15.5	9.3
Platner 1 Out	6/17/2022	0.09	28.7	10.1	12.1
Platner 1 Out	6/22/2022	0.13	34.9	7.1	12.7
Platner 1 Out	6/28/2022	0.06	27.2	2.3	14.3
Platner 1 Out	7/19/2022	0.14	27.6	0.8	9.5
Platner 1 Out	7/26/2022	0.16	28.9	BDL	5.0
Platner 1 Out	8/1/2022	0.23	35.9	0.5	10.4

Site	Date	DRP	Cl	NO3-N	SO4
Tuma In	5/13/2022	0.06	38.8	16.7	11.2
Tuma In	5/23/2022	0.08	37.8	15.9	13.4
Tuma In	6/1/2022	0.09	35.6	16.0	12.3
Tuma In	6/7/2022	0.07	34.9	24.8	20.0
Tuma In	6/17/2022	0.08	34.1	20.1	11.8
Tuma In	6/22/2022	0.12	34.7	19.4	12.2
Tuma In	6/28/2022	0.09	30.4	23.0	11.6
Tuma In	7/6/2022	0.05	27.9	18.0	12.6
Tuma In	7/13/2022	0.05	27.5	17.2	13.0
Tuma In	7/19/2022	0.04	25.8	17.4	16.5
Tuma In	7/26/2022	5.94	26.6	15.1	18.5
Tuma In	8/1/2022	0.33	27.0	BDL	16.2
Tuma Out	5/13/2022	0.04	32.1	BDL	3.5
Tuma Out	5/23/2022	0.04	40.1	0.9	3.8
Tuma Out	6/1/2022	0.07	38.7	0.7	2.5
Tuma Out	6/7/2022	0.04	34.3	23.0	19.8
Tuma Out	6/17/2022	0.11	32.3	0.8	3.3
Tuma Out	6/22/2022	0.11	33.5	1.2	2.8
Tuma Out	6/28/2022	0.05	28.4	1.8	11.0
Tuma Out	7/6/2022	0.06	5.3	0.6	2.1
Tuma Out	7/13/2022	0.02	27.8	1.3	9.6
Tuma Out	7/19/2022	0.04	27.2	0.6	2.5
Tuma Out	7/26/2022	0.06	28.1	0.5	4.4
Tuma Out	8/1/2022	0.04	27.4	BDL	3.1

Site	Date	DRP	Cl	NO3-N	SO4
Bogert 1	5/13/2022	0.72	3.3	1.1	3.8
Bogert 1	5/23/2022	0.61	6.6	1.2	6.6
Bogert 1	6/1/2022	0.62	5.7	1.7	5.0
Bogert 1	6/7/2022	0.62	7.0	1.6	4.2
Bogert 1	6/17/2022	0.30	4.8	0.8	5.8
Bogert 1	6/22/2022	0.22	8.8	1.0	9.1
Bogert 1	6/28/2022	0.44	6.5	1.6	5.7
Bogert 1	7/6/2022	0.26	9.8	2.2	9.0
Bogert 1	7/13/2022	0.22	8.1	1.6	6.4
Bogert 1	7/19/2022	0.20	14.0	2.1	11.6
Bogert 1	7/26/2022	0.22	11.8	2.0	10.3
Bogert 1	8/1/2022	0.17	16.0	2.7	16.5
Bogert 3	5/13/2022	0.06	3.5	0.6	17.2
Bogert 3	5/23/2022	0.04	6.6	0.9	20.7
Bogert 3	6/1/2022	0.04	5.7	0.5	18.3
Bogert 3	6/7/2022	0.05	6.3	0.5	18.8
Bogert 3	6/17/2022	0.09	6.2	0.6	18.4
Bogert 3	6/22/2022	0.10	7.5	0.6	17.2
Bogert 3	6/28/2022	0.11	5.6	0.5	11.9
Bogert 3	7/6/2022	0.02	6.7	0.5	15.9
Bogert 3	7/13/2022	0.02	7.0	0.4	17.2
Bogert 3	7/19/2022	0.03	8.9	0.5	17.0
Bogert 3	7/26/2022	0.02	8.4	0.8	16.3
Bogert 3	8/1/2022	0.02	8.1	0.7	18.2
Bogert 5	5/13/2022	0.06	2.9	BDL	6.8
Bogert 5	5/23/2022	0.05	7.1	BDL	15.6
Bogert 5	6/1/2022	0.06	4.5	0.5	11.8
Bogert 5	6/7/2022	0.03	7.2	0.5	11.7
Bogert 5	6/17/2022	0.08	9.4	BDL	15.3
Bogert 5	6/22/2022	0.09	15.2	BDL	17.7
Bogert 5	6/28/2022	0.04	4.0	BDL	8.6
Bogert 5	7/6/2022	0.02	6.9	BDL	12.5
Bogert 5	7/13/2022	0.02	6.5	BDL	12.3
Bogert 5	7/19/2022	0.03	8.9	BDL	16.5
Bogert 5	7/26/2022	0.02	7.3	0.6	15.1
Bogert 5	8/1/2022	0.01	8.3	0.0	16.8
Bogert Box	5/13/2022	0.08	39.3	25.9	19.5
Bogert Box	5/23/2022	0.08	37.2	22.9	21.1
Bogert Box	6/1/2022	0.07	37.3	25.1	19.2
Bogert Box	6/7/2022	0.07	8.7	36.1	5.5
Bogert Box	6/17/2022	0.11	34.6	26.8	19.4

Site	Date	DRP	Cl	NO3-N	SO4
Bogert Box	6/22/2022	0.12	32.3	23.3	19.2
Bogert Box	6/28/2022	0.09	32.6	29.0	19.0
Bogert Box	7/6/2022	0.03	28.3	24.0	19.0
Bogert Box	7/13/2022	0.03	27.9	22.9	20.1
Bogert Box	7/19/2022	0.04	28.0	21.7	20.2
Bogert Box	7/26/2022	0.04	26.7	20.3	20.2
Bogert Box	8/1/2022	0.04	27.3	19.7	21.4
Bogert Stream	5/13/2022	0.07	28.4	19.5	17.3
Bogert Stream	5/23/2022	0.08	28.4	16.7	19.9
Bogert Stream	6/1/2022	0.09	28.0	19.7	16.7
Bogert Stream	6/22/2022	0.18	27.3	17.8	17.2
Bogert Stream	6/28/2022	0.15	27.6	24.8	16.0
Bogert Stream	7/6/2022	0.12	24.0	16.1	18.0
Bogert Stream	7/13/2022	0.12	24.4	16.6	17.3
Bogert Stream	7/19/2022	0.16	23.1	10.6	21.7
Bogert Stream	7/26/2022	0.20	24.1	6.9	28.0
Bogert Stream	8/1/2022	0.07	22.7	4.2	30.3

Site	Date	DRP	Cl	NO3-N	SO4
RMSL 1	5/23/2022	0.05	15.5	0.9	19.9
RMSL 1	6/1/2022	0.06	13.9	0.7	17.7
RMSL 1	6/7/2022	0.08	13.0	0.6	16.0
RMSL 1	6/17/2022	0.10	13.1	0.6	15.7
RMSL 1	6/22/2022	0.12	14.6	0.8	15.7
RMSL 1	6/28/2022	0.58	12.2	5.8	10.8
RMSL 1	7/6/2022	0.07	14.0	1.7	14.2
RMSL 1	7/13/2022	0.11	11.3	1.4	11.7
RMSL 1	7/19/2022	0.05	13.7	0.7	13.6
RMSL 1	7/26/2022	0.05	13.4	0.5	14.2
RMSL 1	8/1/2022	0.05	14.1	0.7	17.3
RMSL 3	5/13/2022	0.04	15.7	0.6	3.2
RMSL 3	5/23/2022	0.08	16.0	0.9	6.1
RMSL 3	6/1/2022	0.07	14.5	BDL	3.7
RMSL 3	6/7/2022	0.07	14.2	BDL	3.8
RMSL 3	6/17/2022	0.13	14.3	BDL	3.0
RMSL 3	6/22/2022	0.85	15.3	0.5	3.4
RMSL 3	6/28/2022	0.15	15.1	0.5	3.7
RMSL 3	7/6/2022	0.11	14.6	0.5	2.8
RMSL 3	7/13/2022	0.06	13.9	0.4	3.7
RMSL 3	7/19/2022	0.04	14.4	BDL	4.2
RSML 3	7/26/2022	0.07	15.0	0.3	2.9
RMSL 3	8/1/2022	0.03	15.1	BDL	2.7

Site	Date	DRP	Cl	NO3-N	SO4
RMSL 5	5/13/2022	0.23	15.0	1.9	24.2
RMSL 5	5/23/2022	0.21	16.7	1.1	23.9
RMSL 5	6/1/2022	0.20	16.4	0.6	21.6
RMSL 5	6/7/2022	0.25	17.0	0.6	21.2
RMSL 5	6/17/2022	0.29	18.2	0.6	20.3
RMSL 5	6/22/2022	0.31	17.0	0.5	11.1
RMSL 5	6/28/2022	0.37	16.1	0.8	18.2
RMSL 5	7/6/2022	0.25	17.2	0.6	18.6
RMSL 5	7/13/2022	0.24	17.2	0.4	18.0
RMSL 5	7/19/2022	0.22	18.1	0.5	18.3
RMSL 5	7/26/2022	0.24	17.7	0.4	17.6
RMSL 5	8/1/2022	0.03	19.9	0.5	18.5
RMSL Box	5/23/2022	0.06	40.5	9.9	43.5
RMSL Box	6/1/2022	0.06	40.2	9.9	37.6
RMSL Box	6/7/2022	0.06	40.1	13.9	41.9
RMSL Box	6/17/2022	0.10	39.0	12.2	33.5
RMSL Box	6/22/2022	0.11	38.9	12.0	40.8
RMSL Box	6/28/2022	0.07	35.3	17.7	24.2
RMSL Box	7/6/2022	0.04	37.4	14.2	24.3
RMSL Box	7/13/2022	0.03	35.8	13.3	26.2
RMSL Box	7/19/2022	0.04	36.9	11.9	17.8
RMSL Box	7/26/2022	0.05	45.4	8.9	61.3
RMSL Box	8/1/2022	0.04	59.1	5.4	57.6
RMSL Stream	5/23/2022	0.08	38.4	14.5	13.1
RMSL Stream	6/1/2022	0.06	37.5	15.2	11.3
RMSL Stream	6/7/2022	0.07	38.0	20.7	11.3
RMSL Stream	6/17/2022	0.11	36.1	17.2	10.7
RMSL Stream	6/22/2022	0.12	36.6	15.9	10.0
RMSL Stream	6/28/2022	0.08	31.3	22.5	9.9
RMSL Stream	7/6/2022	0.05	31.3	17.7	9.7
RMSL Stream	7/13/2022	0.05	29.7	17.1	9.5
RMSL Stream	7/19/2022	0.07	31.0	15.2	10.4
RMSL Stream	7/26/2022	0.07	31.1	14.0	11.1
RMSL Stream	8/1/2022	0.06	30.7	12.3	12.1

Site	Date	DRP	Cl	NO3-N	SO4
13/100 Wetland In	5/24/2022	0.06	38.8	16.0	11.9
13/100 Wetland In	5/31/2022	0.06	39.9	16.9	11.8
13/100 Wetland In	6/6/2022	0.88	34.1	32.9	13.0
13/100 Wetland In	6/13/2022	0.12	38.5	20.7	11.9
13/100 Wetland In	6/21/2022	0.15	35.5	19.1	12.3
13/100 Wetland In	6/27/2022	0.17	36.2	23.8	11.6
13/100 Wetland In	7/5/2022	0.07	42.2	21.5	13.0
13/100 Wetland In	7/12/2022	0.08	46.6	19.6	13.3
13/100 Wetland In	7/18/2022	0.09	41.6	18.9	13.6
13/100 Wetland In	7/25/2022	0.11	56.5	18.1	15.4
13/100 Wetland Middle	5/31/2022	0.07	60.0	9.0	12.2
13/100 Wetland Middle	6/6/2022	0.31	47.5	12.4	11.1
13/100 Wetland Middle	6/13/2022	0.10	47.1	15.7	11.7
13/100 Wetland Middle	6/21/2022	0.12	47.4	10.8	11.3
13/100 Wetland Middle	6/27/2022	0.67	40.8	19.3	12.5
13/100 Wetland Middle	7/5/2022	0.03	44.6	12.8	11.3
13/100 Wetland Middle	7/12/2022	0.04	53.6	9.9	11.2
13/100 Wetland Middle	7/18/2022	0.13	65.0	6.1	10.6
13/100 Wetland Middle	7/25/2022	0.19	81.5	1.8	12.4
13/100 Wetland Out	5/24/2022	0.05	80.3	3.9	11.8
13/100 Wetland Out	5/31/2022	0.06	70.5	6.7	12.4
13/100 Wetland Out	6/6/2022	0.08	56.7	6.6	11.0
13/100 Wetland Out	6/13/2022	0.17	54.1	13.1	11.8
13/100 Wetland Out	6/21/2022	0.08	58.6	5.7	12.0
13/100 Wetland Out	6/27/2022	0.94	36.2	17.3	12.5
13/100 Wetland Out	7/5/2022	0.01	52.9	8.9	12.5
13/100 Wetland Out	7/12/2022	0.02	59.7	6.1	11.3
13/100 Wetland Out	7/18/2022	0.03	68.5	4.0	11.4
13/100 Wetland Out	7/25/2022	0.03	78.0	1.1	12.9

Site	Date	DRP	Cl	NO3-N	SO4
Fishing Pond In	5/31/2022	0.17	30.6	9.8	12.9
Fishing Pond In	6/6/2022	0.72	42.5	12.2	11.4
Fishing Pond In	6/13/2022	0.21	31.1	11.8	12.7
Fishing Pond In	6/21/2022	0.21	27.9	11.7	12.2
Fishing Pond In	6/27/2022	0.32	35.3	9.9	11.9
Fishing Pond In	7/5/2022	0.16	31.0	11.6	12.6
Fishing Pond In	7/12/2022	0.16	33.0	10.8	13.2
Fishing Pond In	7/18/2022	0.14	28.3	10.6	13.3
Fishing Pond In	7/25/2022	0.13	29.2	9.2	16.8
Fishing Pond Middle	5/31/2022	0.03	114.5	0.5	13.1
Fishing Pond Middle	6/6/2022	0.63	71.0	3.3	12.4
Fishing Pond Middle	6/13/2022	0.08	103.5	0.8	12.5
Fishing Pond Middle	6/21/2022	0.10	102.1	1.0	12.2
Fishing Pond Middle	6/27/2022	0.13	96.8	0.7	11.1
Fishing Pond Middle	7/5/2022	0.02	93.4	0.6	10.6
Fishing Pond Middle	7/12/2022	0.01	93.1	BDL	10.0
Fishing Pond Middle	7/18/2022	0.02	91.6	BDL	9.3
Fishing Pond Middle	7/25/2022	0.01	95.9	BDL	9.6
Fishing Pond Out	5/31/2022	0.06	110.8	0.5	12.2
Fishing Pond Out	6/6/2022	0.08	103.4	0.7	12.7
Fishing Pond Out	6/13/2022	0.11	106.3	0.5	11.7
Fishing Pond Out	6/21/2022	0.12	107.3	0.5	10.1
Fishing Pond Out	6/27/2022	0.13	100.7	0.5	10.0
Fishing Pond Out	7/5/2022	0.07	98.5	0.5	8.8
Fishing Pond Out	7/12/2022	0.06	95.6	0.4	7.1
Fishing Pond Out	7/18/2022	0.07	93.5	BDL	5.8
Fishing Pond Out	7/25/2022	0.07	96.2	BDL	6.1

Site	Date	DRP	Cl	NO3-N	SO4
Hwy 100 Wetland In	5/31/2022	0.16	23.9	6.4	18.4
Hwy 100 Wetland In	6/6/2022	0.32	28.2	13.4	18.0
Hwy 100 Wetland In	6/13/2022	0.20	27.0	6.5	16.7
Hwy 100 Wetland In	6/21/2022	0.22	20.6	6.6	17.7
Hwy 100 Wetland In	6/27/2022	0.21	26.9	12.1	18.6
Hwy 100 Wetland In	7/5/2022	0.15	22.1	7.6	16.9
Hwy 100 Wetland In	7/12/2022	0.14	22.7	8.2	17.2
Hwy 100 Wetland In	7/18/2022	0.14	21.8	6.3	16.9
Hwy 100 Wetland In	7/25/2022	0.20	23.6	1.8	16.4
Hwy 100 Wetland Out	5/31/2022	0.05	71.0	0.6	18.4
Hwy 100 Wetland Out	6/6/2022	0.19	60.9	0.6	10.9
Hwy 100 Wetland Out	6/13/2022	0.07	68.5	0.8	16.8
Hwy 100 Wetland Out	6/21/2022	0.32	94.7	BDL	12.9
Hwy 100 Wetland Out	6/27/2022	0.59	43.8	2.4	16.3
Hwy 100 Wetland Out	7/5/2022	0.28	64.8	0.6	15.1
Hwy 100 Wetland Out	7/12/2022	0.32	59.9	BDL	12.3
Hwy 100 Wetland Out	7/18/2022	0.19	70.7	BDL	11.7
Hwy 100 Wetland Out	7/25/2022	0.23	85.5	BDL	11.8

Site	Date	DRP	Cl	NO3-N	SO4
Big Wetland In	5/24/2022	0.06	102.0	1.0	25.9
Big Wetland In	5/31/2022	0.12	94.9	1.3	20.5
Big Wetland In	6/6/2022	0.15	46.5	1.4	11.5
Big Wetland In	6/13/2022	0.10	65.6	BDL	10.4
Big Wetland In	6/22/2022	0.13	92.3	0.8	22.2
Big Wetland In	6/27/2022	0.20	56.7	1.4	20.2
Big Wetland In	7/5/2022	0.10	61.0	0.8	17.3
Big Wetland In	7/12/2022	0.15	57.8	1.0	15.3
Big Wetland In	7/18/2022	0.11	70.4	0.6	19.4
Big Wetland In	7/25/2022	0.09	65.2	BDL	18.0
Big Wetland Out	5/24/2022	0.02	94.5	BDL	15.6
Big Wetland Out	5/31/2022	0.02	89.1	0.4	14.7
Big Wetland Out	6/6/2022	0.04	88.4	BDL	12.1
Big Wetland Out	6/13/2022	0.16	77.5	1.1	17.1
Big Wetland Out	6/21/2022	0.10	72.9	BDL	9.0
Big Wetland Out	6/27/2022	0.30	28.4	1.0	9.0
Big Wetland Out	7/5/2022	0.06	40.1	BDL	9.5
Big Wetland Out	7/12/2022	0.10	35.5	BDL	7.9
Big Wetland Out	7/18/2022	0.04	45.2	BDL	8.0
Big Wetland Out	7/25/2022	0.01	51.4	BDL	8.5

Site	Date	DRP	Cl	NO3-N	SO4
Landfill	5/13/2022	0.04	35.7	11.5	10.1
Landfill	5/23/2022	0.05	35.3	10.1	14.2
Landfill	6/1/2022	0.05	35.8	11.6	10.5
Landfill	6/28/2022	0.09	31.2	21.6	8.6
Landfill	7/13/2022	0.05	29.1	13.9	15.0
Landfill	7/19/2022	0.04	28.3	10.4	19.8
Landfill	7/26/2022	0.04	27.3	7.2	29.0

BDL – below detection limits