Floyd County CREP Wetland Monitoring

William Crumpton—university professor, environmental programs, Department of Ecology, Evolution, and Organismal Biology

Greg Stenback—research scientist, Department of Ecology, Evolution, and Organismal Biology

Steve Fisher—research scientist, Department of Ecology, Evolution, and Organismal Biology

Jana Stenback—research scientist, Department of Ecology, Evolution, and Organismal Biology

The Iowa State University Wetland Research Group, with help from the Iowa State's Northeast Research and Demonstration Farm, monitored several CREP wetlands in Floyd County. The Iowa Conservation Reserve Enhancement Program (CREP) is a joint effort of the Iowa Department of Agriculture and Land Stewardship (IDALS) and USDA's Farm Service Agency. This program provides incentives to landowners to voluntarily restore shallow, semi-permanent wetlands in the heavily tile-drained regions of Iowa to improve water quality while providing valuable wildlife habitat.

Materials and Methods

Selected wetlands are instrumented for continuous flow measurement and automated sampling at inflows and outflows. Mass balance analyses are used to calculate mass removal rates of nitrate. The wetlands selected for monitoring span a broad range of factors affecting wetland performance, including hydraulic loading rate, residence time, nutrient concentration, and nutrient loading rate.

The two wetlands presented in this report were not instrumented with continuous flow measurement and automated sampling equipment, but were sampled weekly at the designated inflow and outflow locations designated on the aerial maps below. The Wilken wetland site is approximately three miles southwest of Nashua, Iowa, and the Tjaden wetland site is approximately three miles northeast of Charles City, Iowa.

Results and Discussion

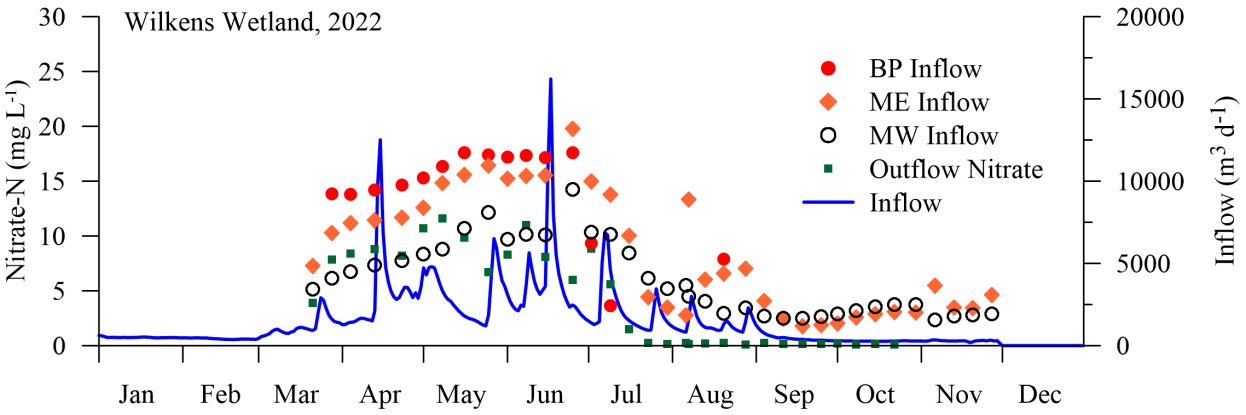
Nitrate removal depends primarily on hydraulic and nitrate loading rates, which depend on location, size and weather patterns. On average, wetlands occupying 0.5-2% of a catchment can reduce long-term nitrate loads by 30-70%. Nitrogen reduction is achieved primarily through the denitrifying bacteria that occur naturally in shallow wetlands. Through denitrification, the bacteria remove nitrate from the water and release it into the air as nitrogen gas (N2), of which the atmosphere is composed of about 78% nitrogen.

Precipitation in the growing season started out with near normal rainfall for April through June, producing consistent tile drainage flow. By the end of July, tile drainage decreased considerably due to crop water use requirements and below normal July, September and October rainfall.

Table 1. Precipitation during the growing season, inches

	Apr	May	June	July	Aug	Sept	Oct	Nov	Total
2022	3.62	4.10	5.22	2.55	6.74	1.03	0.75	2.02	26.03
1976-2021 Avg	3.61	4.50	5.38	4.53	4.80	3.51	2.71	1.75	30.79

Summary of Wilkens Wetland Nitrate Measurements. The estimated nitrate removal concentration measurements is about 35% (Figure 1). However, this estimate is highly uncertain because of the multiple inflow tiles having a wide range of nitrate concentrations and unmonitored discharge. The total discharge was estimated by scaling discharge from a nearby monitored gage station to the Wilken catchment area. On the basis of the wetland to watershed area ratio and typical water yields for Floyd County, it is estimated this wetland would have an average nitrate removal efficiency of about 35 to 40%.



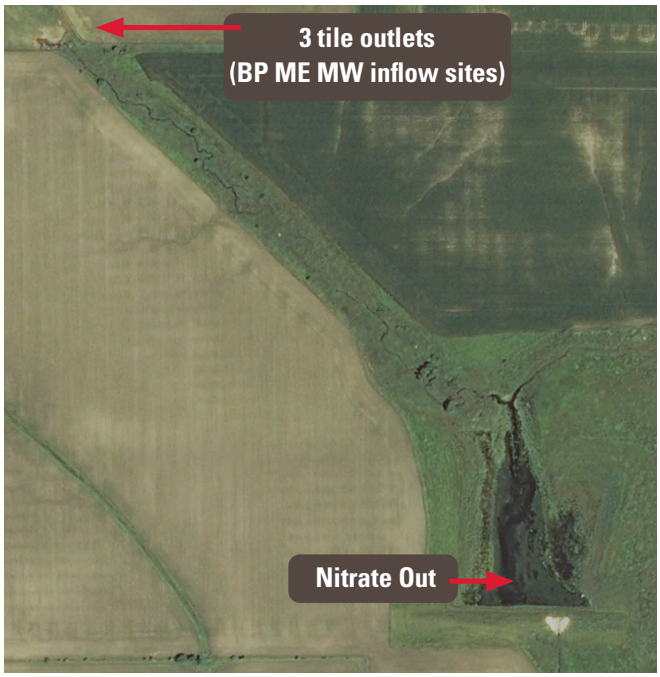
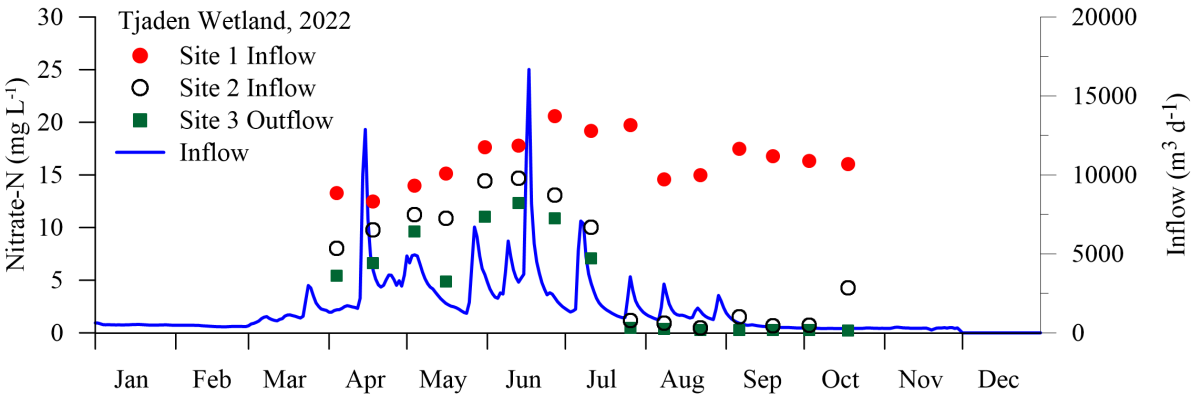


Figure 1. Plot of measured nitrate concentrations and estimated discharge.

Measured nitrate concentrations.

sample date	Nitrate BL (mg/L)	Nitrate ME (mg/L)	Nitrate MW (mg/L)	Nitrate Out (mg/L)
3/21/2022		7.27	5.14	3.87
3/28/2022	13.85	10.28	6..15	7.85
4/4/2022	13.81	11.19	6.74	8.4
4/13/2022	14.2	11.45	7.35	8.79
4/23/2022	14.64	11.72	7.72	8.18
5/1/2022	15.32	12.61	8.32	10.7
5/8/2022	16.36	14.83	8.79	11.59
5/16/2022	17.61	15.59	10.71	9.83
5/25/2022	17.41	16.46	12.16	6.71
6/1/2022	17.21	15.25	9.69	8.28
6/8/2022	17.34	15.48	10.12	10.98
6/15/2022	17.14	15.55	10.11	8.09
6/25/2022	17.6	19.81	14.23	6.01
7/2/2022	9.36	14.99	10.32	8.85
7/9/2022	3.64	13.82	10.16	5.6
7/16/2022	no tile flow	10.06	8.44	1.47
7/23/2022	no tile flow	4.43	6.12	0.23
7/30/2022	no tile flow	3.49	5.21	0.13
8/6/2022	no tile flow	2.8	5.5	0.23
8/7/2022	2.87 in. rain	13.35	4.49	0.15
8/13/2022	no tile flow	6.04	4.07	0.18
8/20/2022	7.87	6.59	2.95	0.23
8/28/2022	no tile flow	7.03	3.42	0.11
9/4/2022	no tile flow	4.11	2.67	0.22
9/11/2022	no tile flow	2.51	2.49	0.14
9/18/2022	no tile flow	1.77	2.48	0.13
9/25/2022	no tile flow	1.88	2.66	0.12
10/1/2022	no tile flow	2.06	2.86	0.21
10/8/2022	no tile flow	2.59	3.2	0.11
10/15/2022	no tile flow	2.88	3.55	0.15
10/22/2022	no tile flow	3.07	3.75	0.1
10/30/2022	no tile flow	3.03	3.72	0.17
11/6/2022	no tile flow	5.5	2.36	0.6
11/13/2022	no tile flow	3.47	2.7	0.94
11/20/2022	no tile flow	3.45	2.78	1
11/27/2022	no tile flow	4.62	2.86	0.86
Average	14.22	8.36	6	3.64

Summary of Tjaden Wetland Nitrate Measurements 2022. The estimated nitrate removal for the 2022 period having concentration measurements is 50%. 2022 has been a somewhat dry year resulting in higher than normal percent losses due to low hydraulic loading and high wetland residence times. The discharge shown in the below plot here was estimated by scaling discharge from a nearby monitored gage station to the Tjaden catchment area. The colored dots show measured nitrate concentrations at sample sites 1, 2, and 3. The mass load to this wetland can only be crudely estimated because the discharge at the two inflow sites is unknown.



Measured nitrate concentrations.

sample date	Site 1 Nitrate-N (mg/L)	Site 2 Nitrate-N MW (mg/L)	Nitrate Out (mg/L)
4/4/2022	13.28	8.03	5.42
4/18/2022	12.49	9.79	6.65
5/4/2022	14.00	11.24	9.62
5/16/2022	15.13	10.86	4.84
5/31/2022	17.66	14.45	11.03
6/13/2022	17.76	14.69	12.31
6/27/2022	20.60	13.08	10.89
7/11/2022	19.17	10.00	7.10
7/26/2022	19.73	1.19	0.45
8/8/2022	14.56	0.92	0.35
8/22/2022	15.00	0.46	0.26
9/6/2022	17.47	1.50	0.26
9/19/2022	16.77	0.64	0.27
10/3/2022	16.35	0.73	0.25
10/18/2022	16.03	4.27	0.22

Figure 2. Plot of measured nitrate concentrations and estimated discharge.