Iowa Conservation Reserve Enhancement Program (CREP)
2017 Annual Performance Report

Preface

The Iowa Conservation Reserve Enhancement Program (CREP) is a performance-based water quality program focusing on the reduction of nitrate loads to surface waters through the restoration of strategically designed and located wetlands that intercept tile drains from cropped lands.

The following narrative and illustrated report details annual and cumulative performance accomplishments including a brief background, executive summary, accomplishments, and monitoring data. Table 1 and Table 2 summarize financial and active site data. Table 3 is a cumulative program summary.

Background:

Approved on August 17, 2001, the Iowa CREP is available in thirty-seven counties in the tile-drained region of North-Central Iowa (Figure 1). Wetland restoration is one of the most effective strategies for reducing nitrate (N) transport to water resources from row-cropped lands; and research conducted at Iowa State University has demonstrated that strategically located and properly sized wetlands remove 40-90% of the nitrate from cropland tile drainage. The effect of wetlands on watershed scale nitrate reduction is largely determined by the watershed's total nitrate load that the wetlands intercept.

Practices eligible are wetland restoration (CP-23) and erosion control structures (CP-7), when needed as part of the wetland establishment.

Federal incentives include:

- 15 annual rental payments of 150% of the weighted average soil rental rate
- 50% cost-share for eligible costs of establishing conservation practices
- Practice Incentive Payment (PIP) up to 40% of the total eligible cost of practice installation.

State incentives include:

- Market based incentive payment for a 30-year or permanent easement (one-time payment)
- 10% cost-share for restoration costs
- Survey, engineering, design, permitting, oversight, public bidding, title services

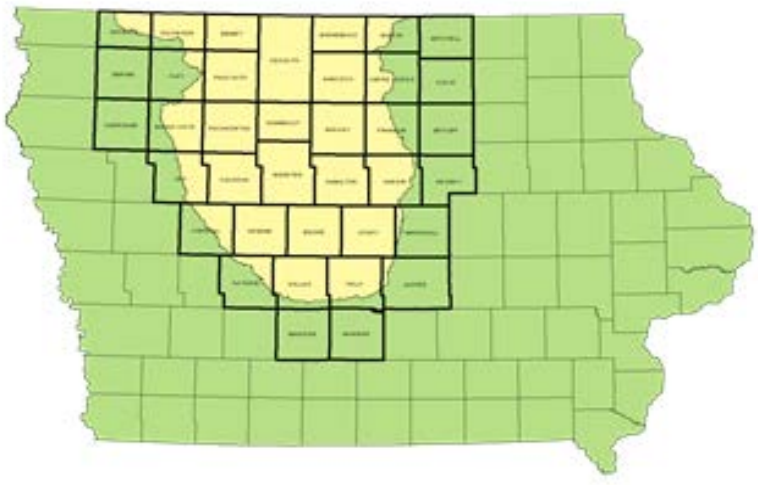

Figure 1. Counties Eligible for Iowa CREP

2017 Executive Summary

Landowner interest in the Iowa Conservation Reserve and Enhancement Program remains strong. However, the 4:1 Federal to State ratio of costs for the Iowa CREP remain unachieved. This is due to continued high land values, the CRP landowner $50,000 payment limitation cap applied to annual CREP payments under the program, and the increased cost out sourced engineering consultants and other technical services.

Farmland Values Survey for 2017 show that land values remain high. This is the first time land values have increase since reaching a peak in 2013. The average value of Iowa farmland in 2017 was reported as 2.0% higher than when land values were one year ago. However, the 2017 values are still 2.8 times higher than the value in 2001 at the inception of the CREP program.

Construction was completed on seven (7) wetlands during 2017 bringing the total wetlands restored to 86. These wetlands have a combined total of 784 acres of wetland pool and 2,610 acres of buffer plantings that protect 106,284 acres of drainage area by removing an estimated 88,189 tons of N over their lifetimes at an average cost of $3.06 per acre of protected drainage area. The average total cost of drainage area protection over their lifetime in CREP has increased from $2.61/ac in 2001 to $4.38/ac in 2017.

It is anticipated that two (2) wetlands will be let for bid in January of 2018. Two (2) more wetland have final designs and are waiting for CRP-contracts. There are eight (8) more wetlands in various stages of development. These ten (10) wetlands have an estimated combined total of 151 acres of wetland pool, 361 acres of buffer plantings protecting an estimated 15,937 acres of drainage area by removing an estimated 16,903 tons of N over their lifetimes.

Of the seven (7) completed wetland projects, six (6) were completed through partnership agreements with State water quality programs, private investors, and conservation organizations. These partners include Water Quality Initiative Program- Boone River Water Quality Project, Ducks Unlimited, The Nature Conservancy, Lake Panorama Association., and the National Fish and Wildlife Foundation – Monarch Butterfly Conservation Fund 2015 grant with a total contribution of $329,663.26.

Over the past 16 years of CREP, progress in successful designs and program implementations have been made through continued collaboration with the engineering consultants that design CREP wetlands and scientists at Iowa State University that monitor and evaluate water quality. Ongoing design adjustments have increased flood storage capacity, improved wetland longevity, and reduced costs while improving performance and maximizing nutrient removal. There has been varying success for wetland vegetation establishment. Although vegetation has a minimal effect on nutrient reduction, its success greatly enhances the habitat value and aesthetics of the wetlands.

The current field support staff level is at three (3) part time positions through an existing service contract with the Iowa Drainage District Association. The field personnel are and remain a proven essential component to carry out the processes involved with CREP.

Program Cost Justification

The current method of valuing State easement payments continues to be an effective means of providing fair value compensation to landowners enrolling in CREP. Without the approach of basing easement payments on the ISU Farmland Values Survey, CREP enrollment would be notably lower. The costs of the State easements remain high due to its reflection of the current land values in Iowa. This has a negative effect on the targeted 4:1 federal to state ratio of total project costs for the Iowa CREP. The targeted ration has yet to be achieved due to high easement payments combined with the increased cost of out-sourced engineering and the State coverage of CRP payment limitations cap overages.

FSA soil rental rates were adjusted in 2016 which has helped to alleviate some of the gap. The current soil rental rates were adopted in July 2016. According to the 2017 Farmland Value Survey conducted by Iowa State University, the state average for all grades of land was estimated to be $7,326 per acre, an increase of 2.0% from 2016. This represents the first time that land values have increased in three years since the 2013 peak. To many this indicates a turnaround on the farmland market and the majority of survey respondents expect another increase a year from now. The increase is said to be primarily due to the limited amount of farmland available for sale and the slight decrease in production costs. However, a caution comes with the report of higher values in that the fundamentals of the U.S. farm economy haven't improved significantly.

For medium to high grade land typical in the Des Moines Lobe, the farmland value increase range is broad from 0.3% in the SW portion to 3.3% in the Central portion. The average dollar value range is $4,172 to $9,388 per acre. Since inception of the CREP in 2001, the statewide average land value has risen from $1,926/acre to $7,326/acre, representing an increase of 3.8 times the value in 2001. In the CREP counties, the average land value has risen from $3,263 in 2006 to $7,367 in 2017, which represents an increase of 2.26 times the value in 2006. (*Wendong Zhang, 2017*.)

Interest in Iowa CREP remains strong with a continued majority of landowners pursuing permanent easements. To date, all of the State funds that have been appropriated for CREP State FY2018 are currently obligated. Of the 37 eligible Iowa counties, CREP wetlands are present in 29 to date.

The majority of Iowa's CREP current list of project applicants has recently been accepted with a few left from the project application in 2013/2014. In 2013 there was an expected five year wait for State funds to become available. We are now anticipating a three year wait for new applicants for State funds. The goal for CREP is to maintain a wait time of no longer than 2 years. We have found that landowners become inpatient and frustrated with the longer wait time and have a higher likelihood of withdrawing their application.

The shorter wait time for project completion has been achieved partly by pushing the process from application to construction at a faster pace in tasks that CREP has control. However the commitment of partnerships with other programs and conservation groups is primary to stretch our budget and increase the number of wetlands installed per year. Highlighted in local, state and national media, public awareness of CREP's role in water quality improvement has increased, prompting more frequent inquiry for participation.

The current field support staff level is at three part time positions through an existing service contract with the Iowa Drainage District Association. The field personnel remain instrumental in helping to carry out the processes involved with CREP. They are the first contact with landowners and continue as liaisons between the landowner, CREP agencies, engineering consultants, and contractors throughout the entire process.

Story County CREP Wetland Field Day

Accomplishments

2017 Wetland Restorations

Iowa CREP completed construction on seven (7) new sites during calendar year 2017. These sites have a combined total of 71.21 acres of wetland pool and 168.04 acres of buffer plantings and will protect 7,817 acres of drainage area by removing an estimated 8,011 tons of N over their lifetimes.

This brings the total wetlands restored up to 8**6** wetlands**.** The estimated annual N removal capacity of all wetlands**,** completed and in construction or development, is over 1,400,000 pounds per year with N removal costs remaining at an averag**e** $0.26/lb. without the CREP wetland, landowners in north central Iowa would need to permanently retire an estimated 50,000 to 87,000+ acres of cropland.

Additionally, there are 12 wetlands under development. Collectively these 12 projects represent and estimated 150 acres of wetland surrounded by an estimated 360 acres of buffer which will protect over 15,900 watershed acres by removing an estimated 16,900 tons of N over their lifetimes.

Of the twelve wetlands under development , one (1) wetland project has a CRP contract starting in 2017 (2018 FFY) and is planned to bid in January 2018 for construction completion in calendar year 2018. One (1) other wetland project has worked through the process to request a CRP contract start date of January 2018 (FFY2018) and is planned to bid in January 2018 (FFY2018). These two (2) wetland projects have an estimated combined total of 16.4 acres of wetland pool with an estimated 54.0 acres of buffer plantings that will protect 2,158 acres of drainage area by removing an estimated 1,845 Tons of N over their lifetimes.

Of the seven newly completed wetland projects, five have moved forward through partnership efforts with other State water quality programs, private investors, and not for profit organizations with a total contribution of $329,663.26.

The Water Quality Initiative Program (WQI) through the Boone River Watershed Project partnered with the CREP Program on two Kossuth County projects. This brings the total of CREP/WQI partnership projects to three. We look to further partnership with WQI in their priority watersheds within the CREP eligible counties.

The Nature Conservancy obtained grants from Coca Cola and the Greater Cedar Rapids Community Foundation to partner with CREP projects within the Middle Cedar River Basin area. They received funds for two projects, one in Grundy County and one in Floyd County. Plans are for them to apply for additional grants for projects in the near and extended future.

The Lake Panorama Association-Rural Improvement Zone (LPA-RIZ) has completed construction on a second CREP wetland project on the east shoreline of the Lake Panorama in Guthrie County. The LPA-RIZ plans to continue working in partnership with CREP to complete similar projects in the future.

The National Fish and Wildlife Foundation – Monarch Butterfly Conservation Fund 2015 partnered with a grant received by collaboration of IDALS and Pathfinders RC&D, Inc, that included seeding on six (6) CREP sites during the 2016 and 2017 calendar years. The purpose of the grant was to include milkweed species required for Monarch butterfly habitat. On the six sites, 162.8 acres included Asclepius sp. in the seed mix and other habitat plant species. The grant commitment also included a public field day held at a CREP site.

Wetland Seeding and Enhanced Design Plans

Over the first ten year period of CREP we had seen varied success rates for wetland vegetation establishment by passive means. Programmatic limitations that do not authorize wetland seeding as a restoration expense under the FSA CP-23 wetland restoration practice was the driving factor for utilizing this approach. Since the success had varying results, IDALS initiated an effort during 2012 to actively seed selected wetlands that had not yet successfully developed emergent wetland vegetation. This was expected to have limited effect on water quality performance but greatly enhance habitat value. It also help address the misperceptions of some groups that the Iowa CREP is building "ponds", which was derived from sites that had not yet established emergent wetland vegetation throughout their shallow water areas and were mostly open water with submergent vegetation. Several dozen CREP wetlands were seeded and vegetation survey work by Iowa State University was conducted in 2014 and 2015 to assess the success of these seedings and make recommendations on future efforts. Results of the survey work concluded that the seeded sites had no significant effect on total vegetation coverage; therefore IDALS decided to discontinue this wetland seeding effort as the cost was not justified by the results.

The State has also moved forward with new design concepts that help to provide temporary flood storage benefits while maintaining the high level of water quality performance already in place. IDALS has engaged in a collaborative process with the engineering consultants that design CREP sites and scientists at Iowa State University to further enhance the water quality performance of CREP sites by identifying and incorporating design features that improve hydraulic efficiency, maximize wetland area, and increase the overall habitat value. Results from these minor structural modifications to the designs indicate that significant improved nutrient removal performance is being achieved.

Program Evaluation

Tables 1 through 3 highlight CREP site data, costs, and projected nitrate reductions. Cost per pound for N removed remains below the current cost per pound of fertilizer application to cropland, and considerably below reported cost per pound of N removal by municipal treatment plants. Data from ISU monitoring indicate Iowa CREP wetlands are a highly cost effective method for removing nitrate from tile-drained landscapes thus improving water quality in local streams, drinking water supplies, and the Gulf of Mexico.

References

Zhang, Wendong. *2017 Iowa Farmland Value Survey: Overview*. CARD, Iowa State University Extension and Outreach, Department of Economics, College of Agriculture and Life Sciences. https://www.card.iastate.edu/land-value/2017/

Before and After
Floyd County CREP 2017

Presentation/Publications/Outreach

Iowa CREP remains in the public attention with requests for tours, presentations, and interviews from groups and organization that including ISU Iowa Learning Farm, farm managers and landowners, Iowa local and national leaders, watershed management groups and projects, Iowa and national publication, local, county and state agency cooperation, and the general public. Some of the presentations/publications/activities are listed below:

- Iowa Drainage Conference (January 27, 2017). Presented CREP accomplishments, monitoring results, and design/technology updates. About 53 in attendance.
- Upper Cedar River Watershed Coalition (March 31, 2017). Presented CREP accomplishment in the Cedar River basin with site specific details. About 50 present
- Iowa Learning Farms: wetland training with Wisconsin FSA (June 6, 2017). Presented CREP information to class covering program and site details. About 25 present
- Monarch NFWF Grant Field Day held with Iowa Learning Farms (June 14, 2017). Presented CREP program information and site detail and accomplishments in correlation with Monarch butterfly habitat. Site tour. About 25 present
- Coordination of researchers at CREP site in Floyd County (June and July, 2017).
- Governor's Tour with state and county agencies (August 8-9, 2017) Presented CREP program information and site specific details.
- National Geographic interview (July 21, 2017). CREP site tour and program information with site details, and Q&A.
- ISU drainage research team with Iowa Learning Farms site tour (August 30, 2017). Featured Iowa CREP program information with staff present for Q&A. Attended by local landowners and producers in Palo Alto County.
- Charles City Press: Returning to wetlands-Floyd County leads state in number of CREP sites (August 10, 2017). Presented CREP program information and site specific details.
- IDALS, ISU, Iowa Corn Growers joint tour (September 6, 2017). Presented CREP program information with site specific details and Q&A.
- CREP Field Specialists Annual Meeting (December 1, 2017). Meeting and training covering CREP program updates and materials for field specialists.

Monitoring and Evaluation

Submitted by William Crumpton, Professor and Greg Stenback, Associate Scientist
January 1, 2017 – November 30, 2017
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Preliminary 2017 Annual Report on Performance of Iowa CREP Wetlands: Wetland Performance

A unique aspect of the Iowa CREP is that nitrate reduction is not simply assumed based on wetland acres enrolled, but is calculated based on the measured performance of CREP wetlands. As an integral part of the Iowa CREP, a representative subset of wetlands is monitored and mass balance analyses performed to document nitrate reduction. By design, the wetlands selected for monitoring span the 0.5% to 2.0% wetland/watershed area ratio range approved for Iowa CREP wetlands. The wetlands also span a threefold range in average nitrate concentration. The wetlands thus provide a broad spectrum of those factors most affecting wetland performance: hydraulic loading rate, residence time, nitrate concentration, and nitrate loading rate. In addition to documenting wetland performance, ongoing monitoring and research programs will allow continued refinement of modeling and analytical tools used in site selection, design, and management of CREP wetlands.

Summary of 2017 Monitoring

Fourteen wetlands were monitored in 2017 (Figure 1), including 13 Iowa CREP wetlands and one mitigation wetland (DD15 north).

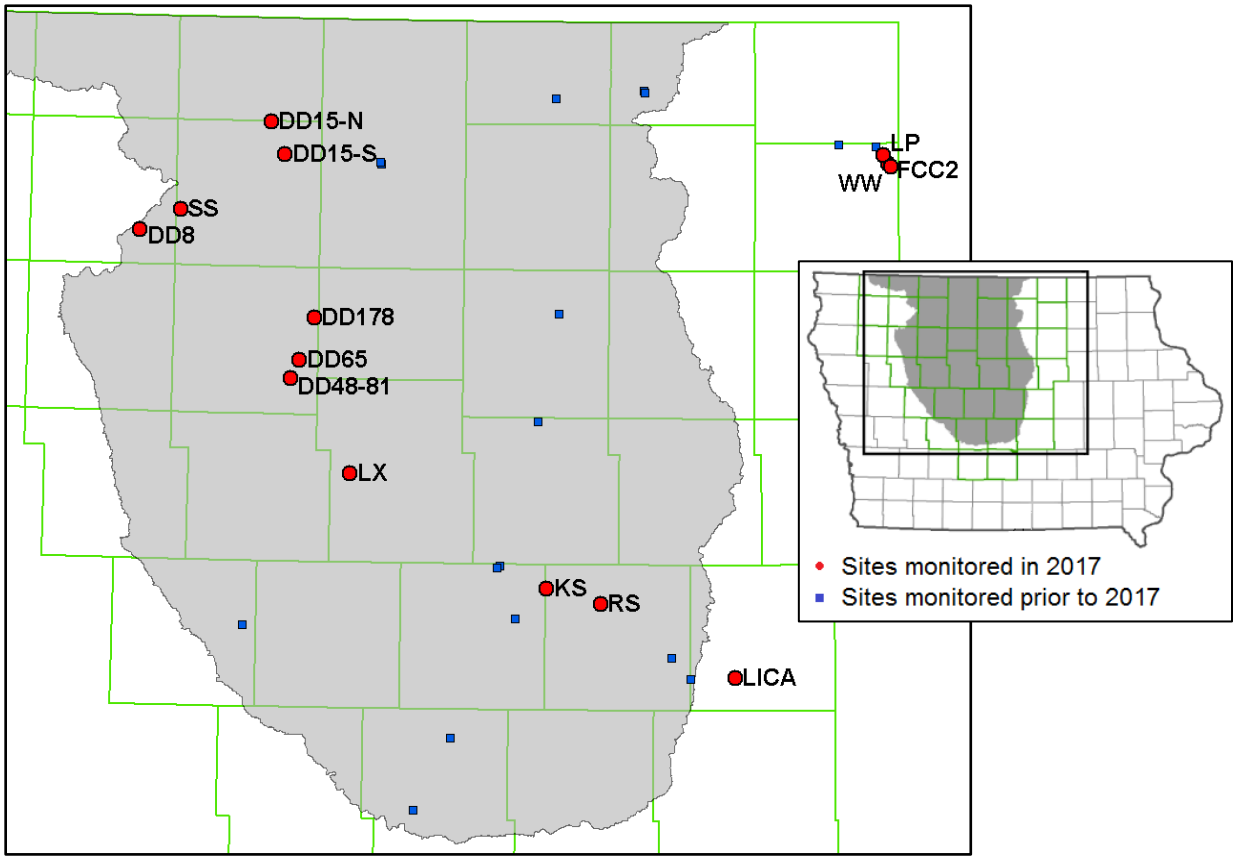

Figure 1. Wetlands monitored in 2017 (red circles, labeled) and additional wetlands monitored in prior years (blue squares). The shaded area represents the Des Moines Lobe in Iowa.

The information summarized below represents preliminary analyses of results through mid-October and will be updated following additional data collection and analyses. Wetland monitoring included measurements of wetland inflows, outflows, pool elevations and water temperature, and collection of weekly to biweekly water quality grab samples and daily automated samples. Daily samples were collected using automated samplers programmed to collect a daily sample at wetland inflows and outflows when temperatures were sufficiently above freezing to allow the equipment to function properly. Due to occasional equipment failure, some daily values are missing. Wetland inflow during winter months may be estimated from nearby USGS river monitoring stations scaled to the wetland watershed area.

Wetland inflow and/or outflow channels were instrumented with submerged area velocity (SAV) Doppler flow meters and stage recorders for continuous measurement of flow velocity and stream depth, respectively. The SAV measurements were combined with cross-sectional channel profiles and stream depth to calculate discharge as the product of water velocity and wetted cross-sectional area. Water depth upstream of V-notch weirs is monitored, but water velocity is generally not, and discharge is calculated using a weir equation. Wetland water levels were monitored continuously using stage recorders in order to calculate pool volume, wetland area, and discharge at outflow structures. The discharge equations and SAV based discharge measurements are calibrated using manual velocity-area based discharge measurements collected during prior monitoring years. Manual velocity-area discharge measurements were determined using the mid-section method whereby the stream depth is determined at 10 cm intervals across the stream and the water velocity is measured at the midpoint of each interval. Velocity was measured with a hand held Sontek Doppler water velocity probe using the 0.6 depth method where the velocity at 60% of the depth from the surface is taken as the mean velocity for the interval. The product of velocity and area summed over intervals gives the total discharge.

Monitoring at the LX wetland in Webster County was initiated on May 25 and the wetland did not receive significant flow after that. Accordingly, a valid measure of nitrate reduction during 2017 at the LX wetland is not possible. However, the monitoring infrastructure is in place to allow better measurements at the LX wetland during 2018. There was a beaver dam on the LX wetland outflow structure and in the channel below during much of the monitoring period causing elevated water depth in the wetland.

The LICA personnel pulled the stoplogs on August 5 nearly draining the LICA wetland before they replaced the stoplogs a few days later. The LICA wetland remained below full pool until October 22.

The valve in the stoplog structure at DD65 was opened during the second week of March to allow the wetland pool to drain so that the open submerged culvert within the wetland could be plugged. An endcap was placed on the culvert on March 29 and the stoplogs were replaced and the valve was closed the following week. A beaver constructed a dam in the outflow channel downstream of the road culvert containing our flow monitoring equipment below the DD65 outflow spillway in early June. This caused the water depth in the culvert to increase. The beaver dam is still there but has not seriously affected our flow measurements as the water velocity remained high enough to for the velocity probe to give a reliable reading.

Patterns in Nitrate Concentrations and Loads

Despite significant variation with respect to nitrate concentration and loading rates, the wetlands display similar seasonal patterns and general relationships to discharge (Figure 2). Historically, inflow nitrate concentrations are variable during the winter. However, because winter flows are typically low, the winter nitrate loading is also low during most years. Snow-melt often results in increased flow during late February or March but nitrate concentrations in the melt water and associated runoff are typically low.

Spring flow is usually high and shows the highest nitrate concentrations. Nitrate concentration generally declines through July and August during dry years, but may remain high as long as there is sufficient flow. Nitrate concentration during large summer flow events often declines abruptly with peak flows and is thought to be associated with surface runoff having low nitrate concentration; however, nitrate concentrations often rebound within a few days of these high flow events. These nitrate concentration and flow patterns are consistent with those of CREP wetlands monitored in prior years and represent the likely patterns for future wetlands restored as part of the Iowa CREP.

Wetland Performance (Nitrate mass loss and removal efficiency)

Wetland performance is a function of hydraulic loading rate, hydraulic efficiency, nitrate concentration, temperature, and wetland condition. Of these, hydraulic loading rate (HLR) and nitrate concentration are especially important for CREP wetlands. The range in HLR expected for CREP wetlands is significantly greater than would be expected based on just the four fold range in wetland/watershed area ratio approved for the Iowa CREP. In addition to spatial variation in precipitation (average precipitation declines from southeast to northwest across Iowa), there is large annual variation in both precipitation and water yield. The combined effect of these factors results in annual loading rates to CREP wetlands that vary by more than an order of magnitude, and will to a large extent determine nitrate loss rates for individual wetlands.

Mass balance analysis and modeling were used to calculate observed and predicted nitrate removal, respectively, for each monitored wetland (except LX as previously noted). Wetland bathymetry data were used to characterize wetland volume and area as functions of wetland depth. Wetland bathymetry has been determined by ISU on the basis of wetland construction plans and/or bathymetric surveys. These bathymetric relationships were used in numeric modeling of water budgets and nitrate mass balances to calculate nitrate loss, hydraulic loading, and hydraulic residence time. Wetland water depth and temperatures were recorded at five minute intervals for numerical modeling of nitrate loss.

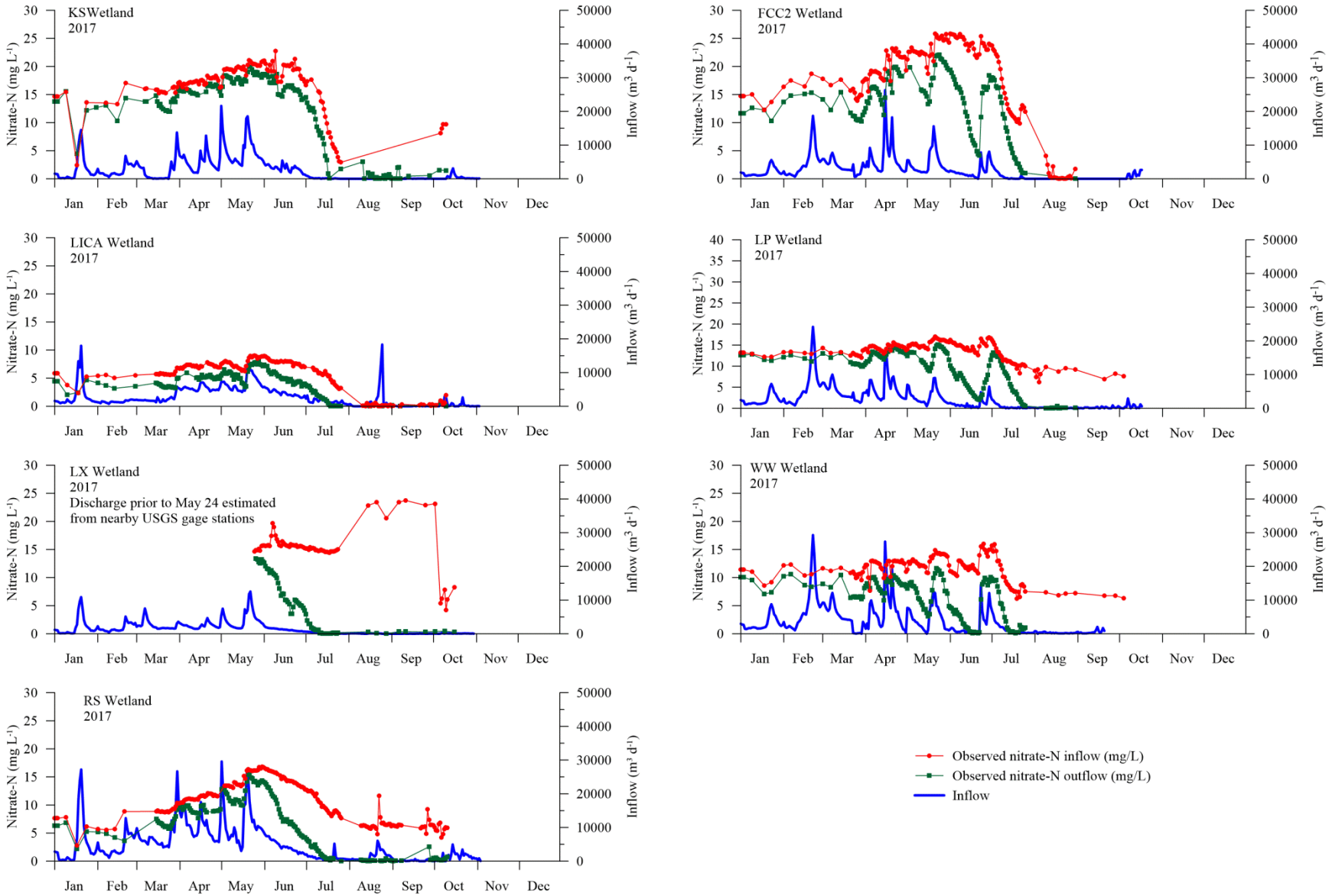

Figure 2. Measured and modeled nitrate concentrations and flows for northwest Iowa wetlands monitored during 2017.

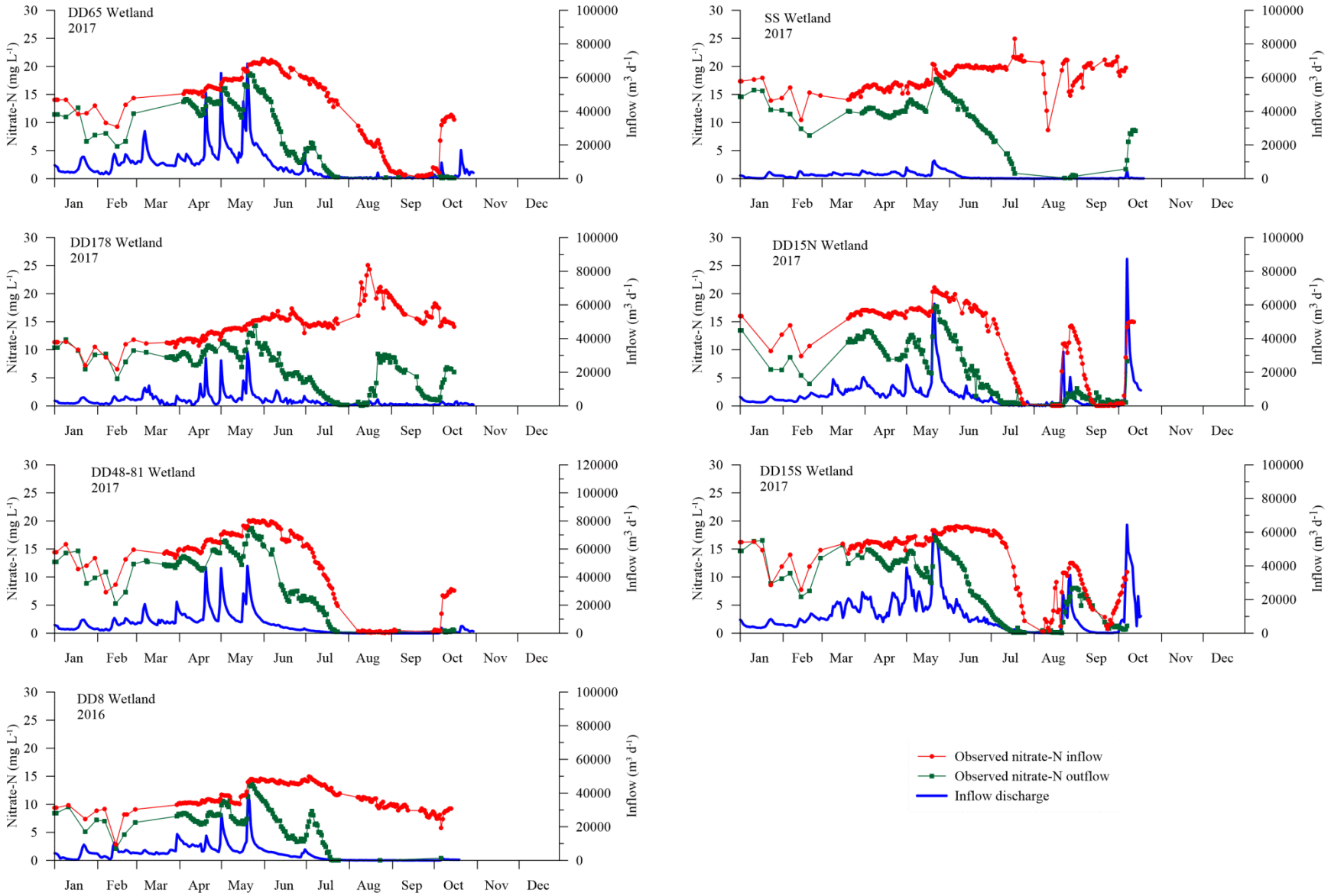

Figure 2. (Continued) Measured and modeled nitrate concentrations and flows for central and northeast Iowa wetlands monitored during 2017.

The monitored wetlands generally performed as expected with respect to nitrate removal efficiency (percent removal) and mass nitrate removal (expressed as kg N ha^{-1} $year^{-1}$). Variability in wetland performance is in part due to differences in wetland characteristics and condition and partly due to differences in loading rates and patterns. At a given HLR, differences in wetland condition and in timing of loading can result in significant differences in performance (Figure 3). Mass balance analysis and modeling was also used to examine the long term variability in performance of CREP wetlands including the effects of spatial and temporal variability in temperature and loading patterns. In addition to calculating the percent mass removal observed for wetlands monitored from 2004 through 2017, the percent nitrate removal expected for CREP wetlands was estimated based on hindcast modeling over the period from 1980 through 2005. The results illustrate reasonably good correspondence between observed and modeled performance and demonstrate that HLR is clearly a major determinant of wetland nitrate removal performance (Figure 3).

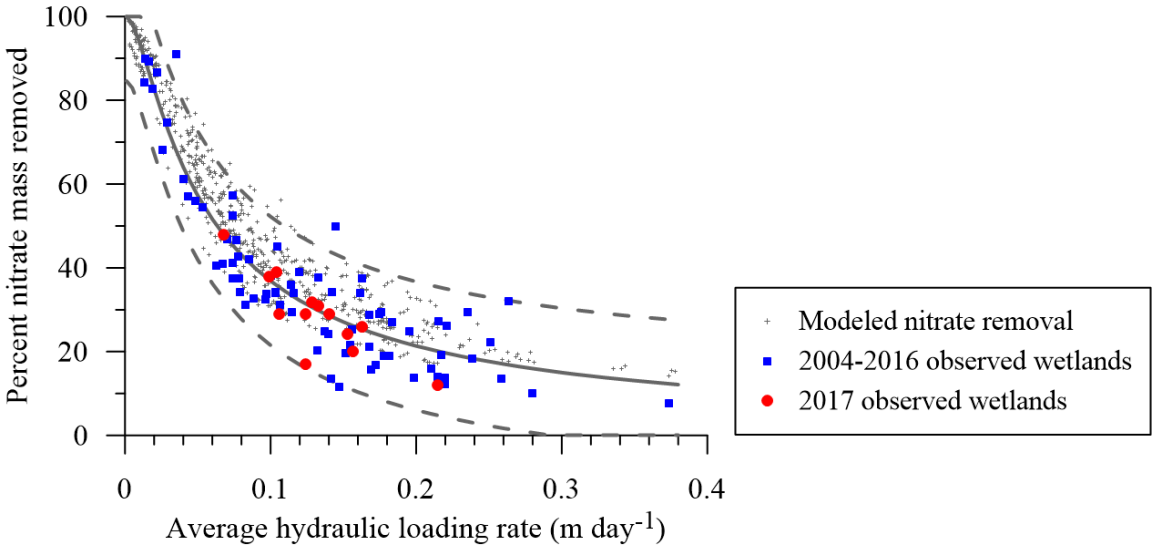

Figure 3. Percent nitrate removal performance for 2017 (January to mid-October, red circles) and wetlands monitored during prior years (2004-2016, blue squares). The dashed lines indicate the range expected to contain 95% of similar wetlands in Iowa on the basis of the 2004 to 2015 wetlands monitored.