Summary of Nitrogen and Phosphorus Load Estimates from Iowa Point and Nonpoint Sources during the 1980-96 Period
December 6, 2018

The Iowa Nutrient Reduction Strategy (NRS) is a research and technology-based approach to assess and reduce nutrients delivered to Iowa waterways and the Gulf of Mexico. The strategy outlines opportunities for efforts to reduce nutrients in surface water from both point and nonpoint sources, in a scientific and cost-effective manner with a goal of a 45 percent reduction in riverine total nitrogen and phosphorus load. Its development was prompted by the 2008 Gulf Hypoxia Action Plan that calls for Iowa and other states within the Mississippi/Atchafalaya River Basin to complete and implement comprehensive nitrogen and phosphorus reduction strategies.

The Iowa Department of Agriculture and Land Stewardship (IDALS), the College of Agriculture and Life Sciences at Iowa State University (ISU), and the Iowa Department of Natural Resources (DNR) partnered in 2011 to develop the NRS. ISU and IDALS collaborated to conduct the NRS Nonpoint Source Science Assessment (NSSA), which estimated nutrient loads from agriculture and land use over the 2006-2010 time period, reviewed scientific literature to assess potential practice performance, estimated potential load reductions of implementing various nutrient reduction practice scenarios, and estimated implementation costs. The DNR conducted the Point Source Technology Assessment to evaluate the potential for point source facilities—publically owned treatment works (POTWs) and industrial facilities—to increase nutrient removal capacities.

The initial NSSA estimated annual nitrate-nitrogen (Nitrate-N) and phosphorus loads using information from the 2006-2010 time period. This period was used due to the availability of land use and conservation practice data at the time that the NSSA was conducted. Recently, the Iowa legislature passed new laws relating to water quality funding, part of which requires the Water Resources Coordinating Council to evaluate progress consistent with the Gulf of Mexico Action Plan that reductions should be "measured against the average load over the 1980-1996 time period".

Section 466B.3, subsection 3, paragraph c:

c. Whether the funds, programs, and regulatory efforts coordinated by the council eventually result in a long-term improvement to the quality of surface water in Iowa. To evaluate the progress achieved over time toward the goals of the Iowa nutrient reduction strategy, as defined in section 455B.171, and the United States Environmental Protection Agency Gulf of Mexico Hypoxia Action Plan, the baseline condition shall be calculated for the time period from 1980 to 1996.

This document provides estimates of nitrogen and phosphorus loads from Iowa over this period by summarizing the methods and results detailed in two studies: "Assessment of the Estimated Non-Point Source Nitrogen and Phosphorus Loading from Agricultural Sources from Iowa During the 1980-96 Hypoxia Task Force Baseline Period", and "Nitrogen and Phosphorus Load Estimates from Iowa Point Sources During the 1980-96 Hypoxia Task Force Baseline Period". Both studies are available at www.nutrientstrategy.iastate.edu/documents. This document also describes the difference in 1980 - 1996 load estimates from the original NRS and highlights reasons for the changes. A conceptual timeline of the 1980-96 baseline, the 2006-10 benchmark, and selected subsequent events in the history of the Iowa Nutrient Reduction Strategy is shown in Figure 1.

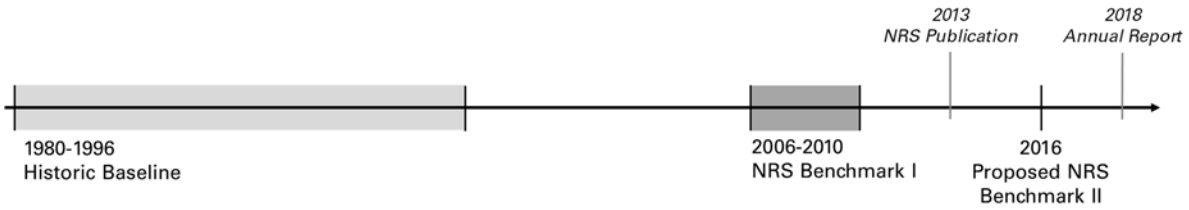

Figure 1 Conceptual timeline of the 1980-96 baseline, the 2006-10 benchmark, and selected subsequent events in the history of the Iowa Nutrient Reduction Strategy.

Annual loads from nonpoint sources from 1980 to 1996

The initial NSSA estimated nitrate-N and phosphorus loads from nonpoint sources using land use and agricultural management data from the 2006-2010 time period. In estimating the 1980-1996 baseline loads in the recent study, researchers used modeling methods consistent with those used for the NSSA. The 1980-1996 baseline estimates relied heavily on data from the Census of Agriculture in 1982, 1987, 1992, and 1997. For both the nitrate-N and phosphorus estimates, Census of Agriculture data were used to determine crop acres, pasture/hay acres, and corn and soybean yields.

In addition to land use and management data, the average nitrate-N load for nonpoint sources was calculated using data sources that included but were not limited to, nitrogen application data derived from statewide nitrogen fertilizer sales information and from Census of Agriculture data on commercial fertilizer and manure application. The average nitrate-N load for the 1980-1996 time period was estimated to be 278,852 tons (Table 1). Nitrate-N loads ranged from 273,909 tons in 1992 to 319,714 tons in 1997.

The average phosphorus load for the 1980-1996 baseline estimate was calculated using land use data outlined above, as well as data sources that included, but were not limited to, the following:

- Phosphorus application data, derived from statewide phosphorus fertilizer sales data and P_2O_5 application rate data.
- Acres of tillage practices conducted from 1989-1998, with additional years estimated using interpolation and static values based on a set of conservative assumptions.
- Soil test phosphorus values estimated from soil samples collected in 1987.

The average phosphorus load from nonpoint sources for the 1980-96 time period was estimated to be 21,436 tons (Table 1). At 24,797 tons, the annual phosphorus load were highest in 1982.

Table 1 Estimates of nitrate-N and phosphorus loads delivered to Iowa water bodies from nonpoint sources in the 1980-96 time period.

Nutrient	1980-96 Average Load (Tons)
Nitrate-N	278,852
Phosphorus	21,436

Limitations of these estimates include the inability to incorporate additional information on the impact of changes in precipitation on water yield and nutrient loads; structural conservation practices; stream bed and bank contribution to phosphorus loads; variable rate nutrient application; and changes in nitrogen

content in grain. Future evaluations may produce revised estimates of nonpoint source loads from 1980-96 as additional data on the historic use of structural conservation practices become available.

Annual nutrient loads from point sources in 1992

The Iowa DNR evaluated 1992 annual total nitrogen (TN) and total phosphorus (TP) load estimates for Iowa point sources available in a draft U.S. Geological Survey dataset, and then employed a modified approach to estimate baseline nutrient loads for Iowa point sources. Annual TN and TP loads in 1992 were estimated for Iowa's major POTWs, minor domestic wastewater dischargers (including POTWs and semipublic facilities), and industrial dischargers that provide biological treatment of process wastewater. These loads were then summed to provide a point source baseline of 13,170 tons of TN and 2,386 tons of TP in 1992 (Table 2).

Table 2 Estimates of annual point source loads delivered to Iowa water bodies of total nitrogen and total phosphorus in 1992.

Discharge Type	Total Nitrogen (tons)	Total Phosphorus (tons)
Major publically owned treatment works	10,311	1,380
Minor domestic wastewater dischargers	1,597	324
Industrial (major and minor with biological treatment of process wastewater)	1,262	683
Total	13,170	2,386

Combined point and nonpoint source nutrient loads

The combined statewide annual nutrient loads for both point and nonpoint sources during the baseline (1980-1996) and benchmark (2006-2010) time periods are shown in Table 3. Differences in the nonpoint source estimates are mostly a result of changes in land use for nitrogen and reduced tillage and decreases in soil test P for phosphorus. Differences in point source estimates were mostly a result of increased estimates in flow and better estimates of effluent concentrations. The average annual nitrogen load increased by 5.3 percent from the baseline to benchmark period, while the average annual phosphorus load decreased by 18.5 percent.

Table 3 Baseline (1980-96) and benchmark (2006-10) average annual loads from nonpoint sources (NPS) and point sources (PS). The baseline contribution is calculated as the percent of nitrogen and phosphorus loads that each source contributes to the total loads. The revised estimates represent the percent reductions contributed by each source, based on each source's baseline contribution.

		1980-96 Baseline Load (tons)	2006-10 Benchmark Load (tons)	Change, 1980-96 to 2006-10		Major cause of change
Nitrogen	NPS	278,852*	293,395	5.2%	Increase	Land use change
	PS	13,170	14,054	6.7%	Increase	Flow increase
	Total	**292,022**	**307,449**	**5.3%**	**Increase**	
Phosphorus	NPS	21,436	16,800	21.6%	Decrease	Reduced tillage and soil test P
	PS	2,386	2,623	9.9%	Increase	Flow increase
	Total	**23,822**	**19,423**	**18.5%**	**Decrease**	

*The method used to derive the total nitrogen estimate of 292,022 tons indirectly reflected the point source contributions.

Future adjustments to the 1980-1996 baseline

Several limitations to the 1980-1996 baseline estimates were identified above. As additional data become available from several ongoing projects, it is anticipated that the baseline will be revised to incorporate this information. Future estimates may also include estimates of the contribution of stream bed and bank contribution to phosphorus loads. This may result in partitioning phosphorus into point, nonpoint, and stream network sources.

Two ongoing projects, the Best Management Practices (BMP) Mapping project and the Iowa Nutrient Research and Education Council in-field practice assessment will further refine the availability and quality of conservation practice and management data. The BMP mapping project is a collaborative effort between ISU, DNR, the Iowa Nutrient Research and Education Council, and IDALS that aims to identify and inventory the aggregate amount of certain structural BMPs in the state using LiDAR elevation data and aerial photos. Practices include terraces, water and sediment control basins (WASCOBs), grassed waterways, pond dams, contour buffer strips, and contour strip cropping. The initial assessment of practices in place in 2010 is complete and quality assurance and quality control reviews are estimated to be complete in mid-2019. In addition, 25 percent of HUC 12 watersheds will be assessed and practices for the 1980-96 and 2016-17 time periods will be digitized. This sample will allow for progress tracking over time, improve understanding of practices installed and removed outside of state and federal cost share programs, and contribute to improved nutrient load estimates in the future.

In-field nutrient management, tillage and cover crop practices are often implemented without the use of state or federal cost share funds, leading to challenges in estimating total acres of each practice and their impact on nutrient load reductions. In partnership with the Iowa State University College of Agriculture and Life Sciences, the Iowa Nutrient Research and Education Council (INREC) is developing a pilot project to measure Iowa farmers' use of in field management practices to reduce nutrient loss. In the three-year project, INREC will conduct a statistically valid survey of farmers' fields using the objective data held by agricultural retailers who provide services to farmers. The aggregation of field-scale data will contribute to efforts to track conservation practice adoption in Iowa. By combining the information gathered into an anonymized dataset, a more accurate view of nutrient-reducing practices and product implementation will be formed.