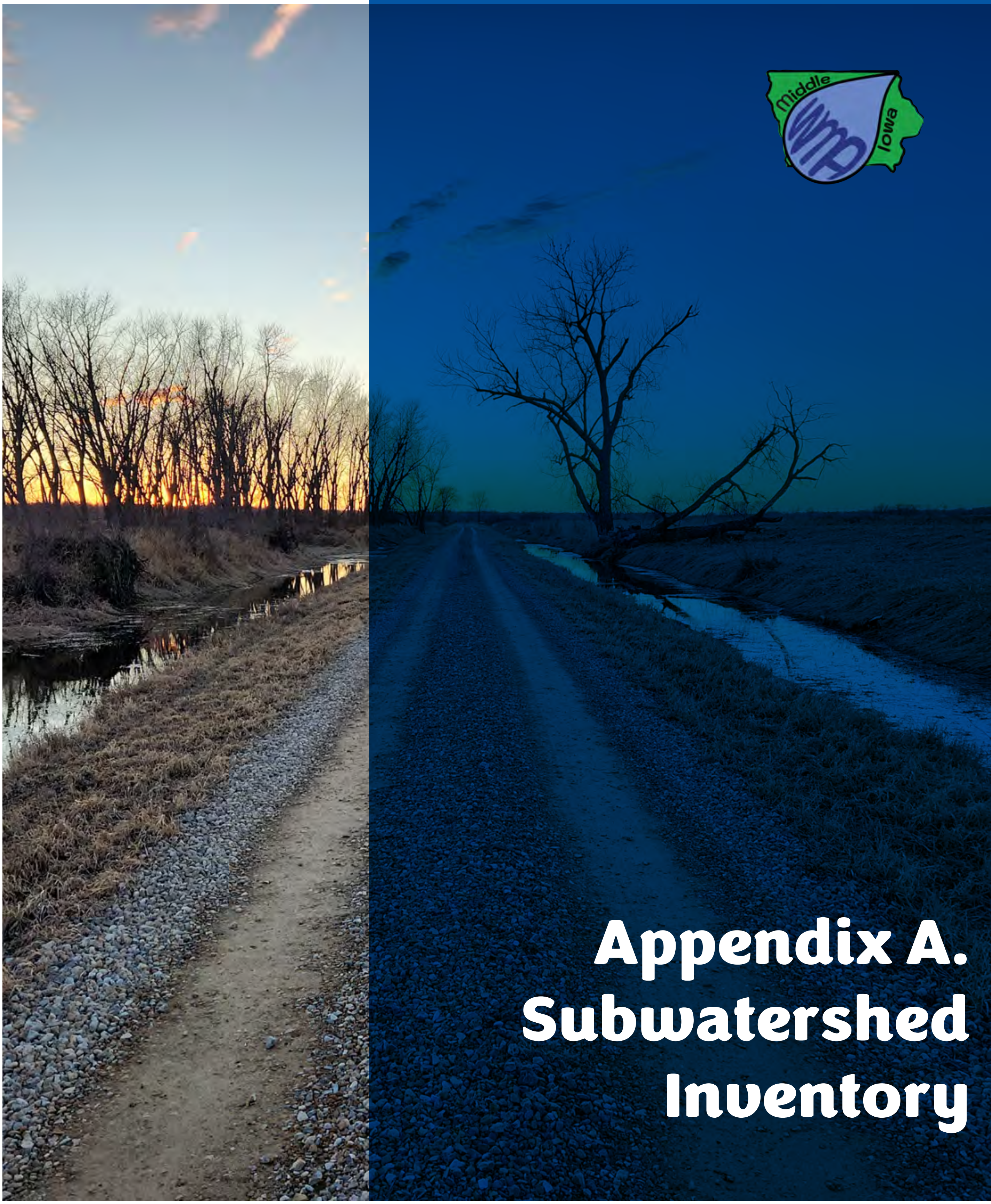


Appendix A. Subwatershed Inventory

Appendix A. Subwatershed Inventory

Table A-1. HUC-10 subwatersheds

Name	Number
Linn Creek	0708020801
Timber Creek	0708020802
Deer Creek	0708020803
Asher Creek-Iowa River	0708020804
Salt Creek	0708020805
Walnut Creek	0708020806
Otter Creek-Iowa River	0708020807
Big Bear Creek	0708020808
Honey Creek-Iowa River	0708020809
Coralville Reservoir-Iowa River	0708020810

Table A-2. HUC-12 subwatersheds

Name	Number
Asher Creek	070802080401
Bennett Creek-Iowa River	070802080407
Big Bear Creek	070802080806
Brush Creek	070802080202
Buckeye Creek	070802080901
Burnett Creek	070802080402
Coon Creek-Iowa River	070802080904
Coralville Lake-Iowa River	070802081009
Davisons Creek-Iowa River	070802080405
Deer Creek	070802080302
Dry Branch-Iowa River	070802080403
East Branch Salt Creek	070802080505
Hawkeye State Wildlife Area Coralville Lake-Iowa River	070802081006
Headwaters Big Bear Creek	070802080801
Headwaters Deer Creek	070802080301
Headwaters Linn Creek	070802080101
Headwaters North Timber Creek	070802080204
Headwaters Salt Creek	070802080502
Headwaters Walnut Creek	070802080602
Hilton Creek	070802081001
Honey Creek	070802080902
Hoosier Creek	070802081007
Knapp Creek	070802081004

Name	Number
Lake MacBride-Mill Creek	070802081008
Linn Creek	070802080102
Little Bear Creek	070802080805
Lutes Creek	070802080201
Matson Pond-Iowa River	070802081005
Mill Race-Iowa River	070802081003
North Timber Creek	070802080205
North Walnut Creek	070802080601
Otter Creek	070802080702
Plague Creek-Iowa River	070802080703
Price Creek	070802081002
Raven Creek	070802080406
Richland Creek	070802080701
Rock Creek	070802080804
Salt Creek	070802080507
South Branch Salt Creek	070802080501
South Timber Creek	070802080203
Stein Creek	070802080504
Stoney Creek-Big Bear Creek	070802080803
Sugar Creek	070802080404
Timber Creek	070802080206
Toogood Cemetery-Stein Creek	070802080503
Troublesome Creek-Salt Creek	070802080506
Village of Belle Plaine-Iowa River	070802080903
Village of Brooklyn-Little Bear Creek	070802080802
Walnut Creek	070802080603

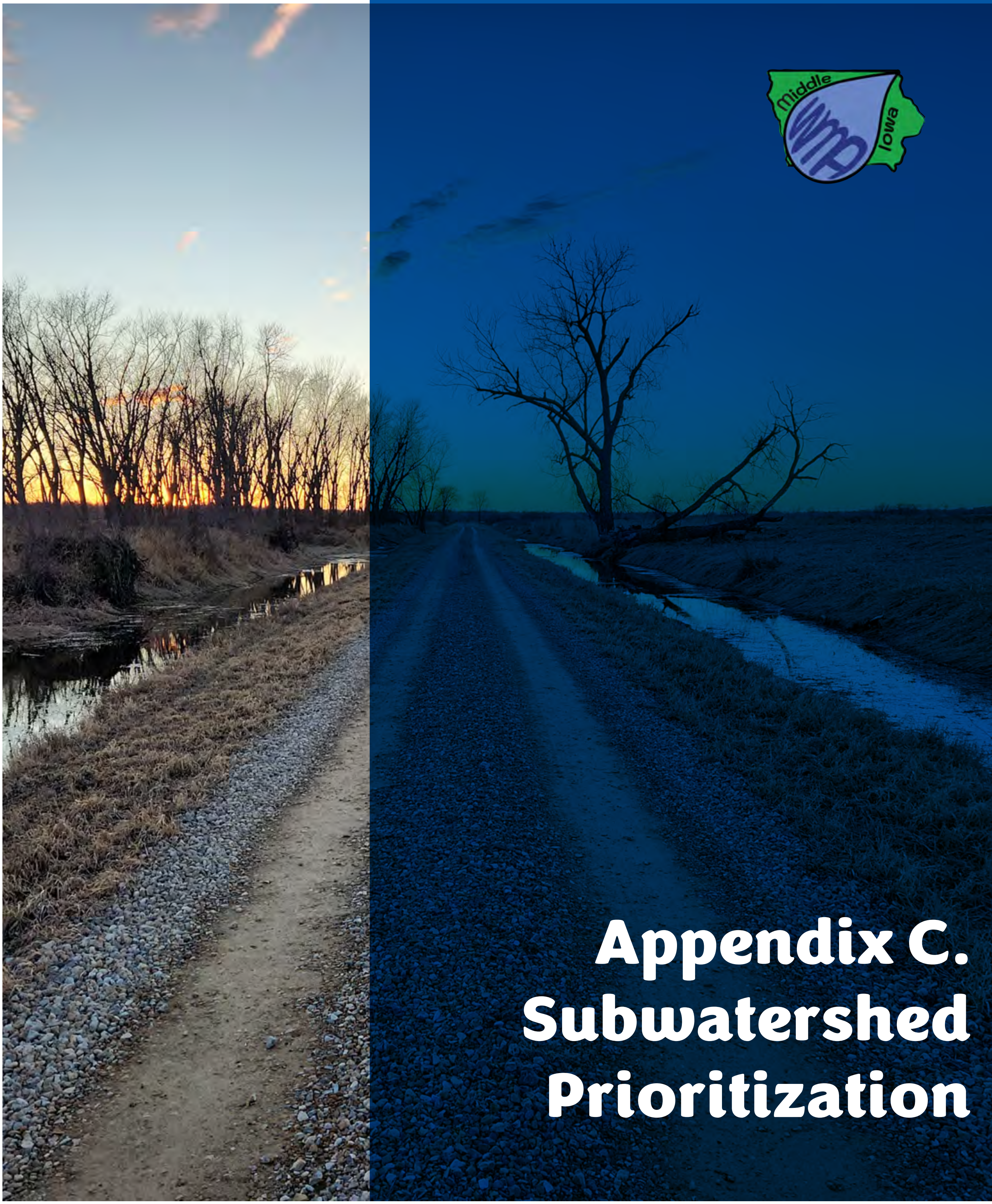
Appendix B. Wastewater Facility Inventory

Appendix B. NPDES Wastewater Facility Inventory

Table B-1. Active wastewater facility information (DNR, 2023b)

Name	EPA ID	City, if listed	Type
Albion City Of Stp	0034321	Albion	Municipal
Amana Farms - Feedlot	0077500		Agricultural
Amana Sanitary District	0059161	Amana	Municipal
Belle Plaine City Of Stp	0065404	Belle Plaine	Municipal
Bituminous Materials & Supply	0078158	Tama	Stormwater
Brooklyn City Of Stp	0020958	Brooklyn	Municipal
Bruin Manufacturing Co., Inc.	0081434	Marshalltown	Industrial
Buckeye Terminals, Llc - Cedar Rapids / N Liberty	0072273	North Liberty	Industrial
Camp Iodiseca	0067083	Solon	Semi-Public
Clutier City Of Stp	0056812	Clutier	Municipal
Cottage Reserve Corporation	0068331	Solon	Semi-Public
Dysart City Of Stp	0020745	Dysart	Municipal
Elberon City Of Stp	0061964	Elberon	Municipal
Ely City Of Stp	0047988	Ely	Municipal
Ely, City Of Ms4	0084476	Ely	Stormwater
Fisher Controls International Llc	0000221	Marshalltown	Industrial
Fisher Controls International, Inc.	0000230	Marshalltown	Industrial
Garwin City Of Stp	0025925	Garwin	Municipal
Gilman City Of Stp	0029033	Gilman	Municipal
Green Mountain - Iowa Regional Utilities Assoc.	0048236	Garwin	Municipal
Homestead Sanitary District	0023591	Homestead	Municipal
Koch Fertilizer, Llc - Marshalltown Terminal	0075591	Marshalltown	Industrial
Kwik Star #303	0067458	Brooklyn	Semi-Public
Ladora City Of Stp	0058521	Ladora	Municipal
Legrand City Of Stp	0027235	Le Grand	Municipal
Longview Estates Hoa	0080730	North Liberty	Semi-Public
Macbride Sanitary Sewer District	0073580	Solon	Municipal
Malcom City Of Stp	0048011	Malcom	Municipal
Marengo City Of Stp	0047937	Marengo	Municipal
Marshall County Law Center	0075973	Marshalltown	Semi-Public
Marshalltown Generating Station (mgs)	0000108	Marshalltown	Industrial
Marshalltown Water Treatment Plant	0075345	Marshalltown	Municipal-Wt
Montour City Of Stp	0058700	Montour	Municipal
Oxford Water Treatment Plant	0082252	Oxford	Municipal-Wt
Pilgrim Heights Camp	0074977	Montour	Semi-Public
Pilot Travel Center #495	0078361	Brooklyn	Semi-Public
Pioneer Hi-bred International, Inc	0083003	Dysart	Operation Permit
Pleasant Stay Inn & Suites	0078018	Brooklyn	Semi-Public
Scales Pointe Campground & Marina	0052791	North Liberty	Semi-Public
Swisher City Of Stp	0033774	Swisher	Municipal

Name	EPA ID	City, if listed	Type
Tama City Of Stp	0043681	Tama	Municipal
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Paperboard, Llc Dba Greif	0000841	Tama	Industrial
Tama Water Treatment Plant (Poweshiek Water Association)	0052527	Tama	Municipal-Wt
Timberlake Homeowners Association	0070076	Swisher	Semi-Public
Toledo City Of Stp	0033103	Toledo	Municipal
Victor City Of Stp	0058190	Victor	Municipal
Walford City Of Stp	0062545	Walford	Municipal
Water Pollution Control Plant - Marshalltown	0038610	Marshalltown	Municipal
Water Pollution Control Plant - Marshalltown	0080039	Marshalltown	Stormwater
Whirlpool Corporation - Amana Division	0000744		Industrial



Appendix C. Subwatershed Prioritization

Appendix C. Priority Subwatersheds

The Middle Iowa planning effort selected four priority subwatersheds to target implementation efforts: Asher Creek, Hilton Creek, South Branch Salt Creek, and Stoney Creek-Big Bear Creek.

Restoration and Protection Screening Tool

The 49 Hydrologic Unit Code (HUC) 12 subwatersheds within the Middle Iowa River Watershed were intensively analyzed based on output data from the Restoration and Protection Screening (RPS; formerly called the Recovery Potential Screening) tool, additional relevant data for the watershed, and local knowledge.

The RPS tool helps to prioritize HUC-12 subwatersheds by analyzing three composite "index" scores to determine the likelihood of successful protection or restoration of watersheds. These indices include an ecological index, which measures the ability to maintain or restore environmental stability, a stressor index which measures the anthropogenic sources that impact water quality, and a social index that measures societal and economic factors. Each index is composed of one or more "indicators" that relate directly to a specific measurable parameter (Figure C-1).

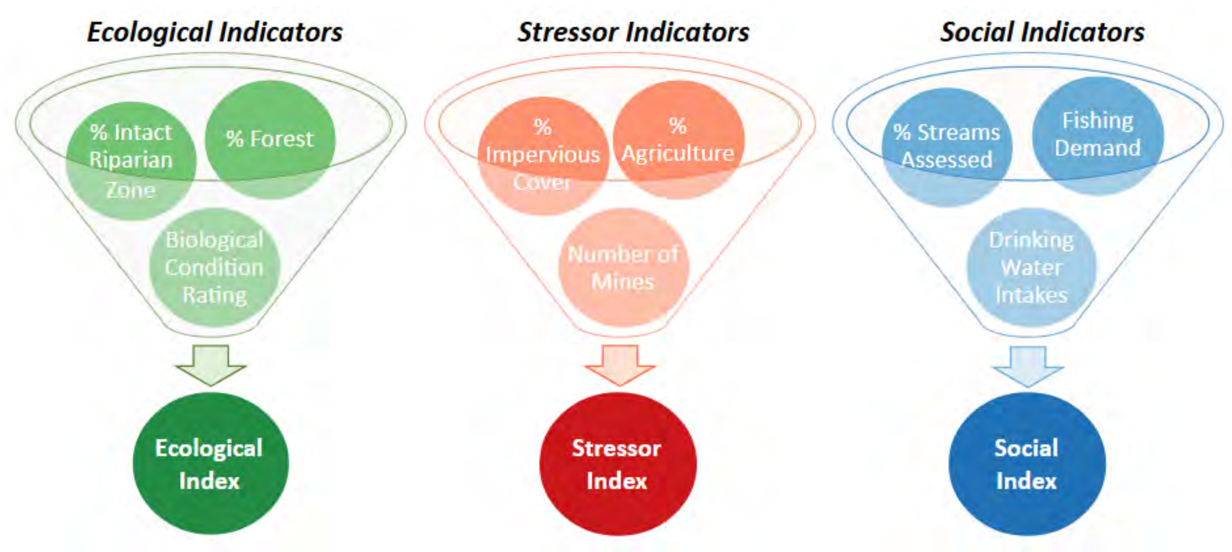


Figure C-1 Visual representation of RPS tool parameters (indicators) and indices.

The RPS tool has a default set of parameters that can be incorporated into each of the indices. However, because there are over 300 possible parameters to select from, overparameterization can become an issue. To avoid having a large number of parameters within an index obscure important trends, the list of total parameters was narrowed to a few select parameters (typically no more than five) that were most relevant to the Middle Iowa River Watershed. Choosing a small subset of the available parameters ensured that the HUC-12 prioritization process for the Middle Iowa River Watershed would be the most relevant to the area.

The following pages present several tables and figures with the indicators used for prioritizing each index, maps of the ranked HUC-12s based on results from the RPS tool for each index, and tables with the highest and lowest ranked HUC-12s for each index.

Ecological Prioritization

Ecological indicators processed by the RPS tool are presented in Table C-1 with the prioritized HUC-12s shown in Figure C-2 and Table C-2.

Table C-1. Ecological indicators selected for analysis within the RPS tool.

Ecological Indicator	Description
% Wetlands in Hydro-Connected Zone in HUC-12	% of watershed with wetlands contiguous to surface water AND has high runoff potential
% N-Index2 in Hydro-Active Zone in HUC-12	% of watershed in riparian zone AND Hydro-Connected Zone
Habitat Condition Index in Local Buffer in HUC-12	Measure of habitat condition within riparian buffer
PHWA Hydrology Sub-Index, State	EPA index of ability to support natural flow regime; considers impoundments, land cover, and crossings
PHWA Water Quality Sub-Index, State	EPA index of impaired waters
PHWA Habitat Sub-Index, State	EPA index of ability to support high quality stream habitat; considers obstructions, land cover, and potential for harmful and/or toxicity issues

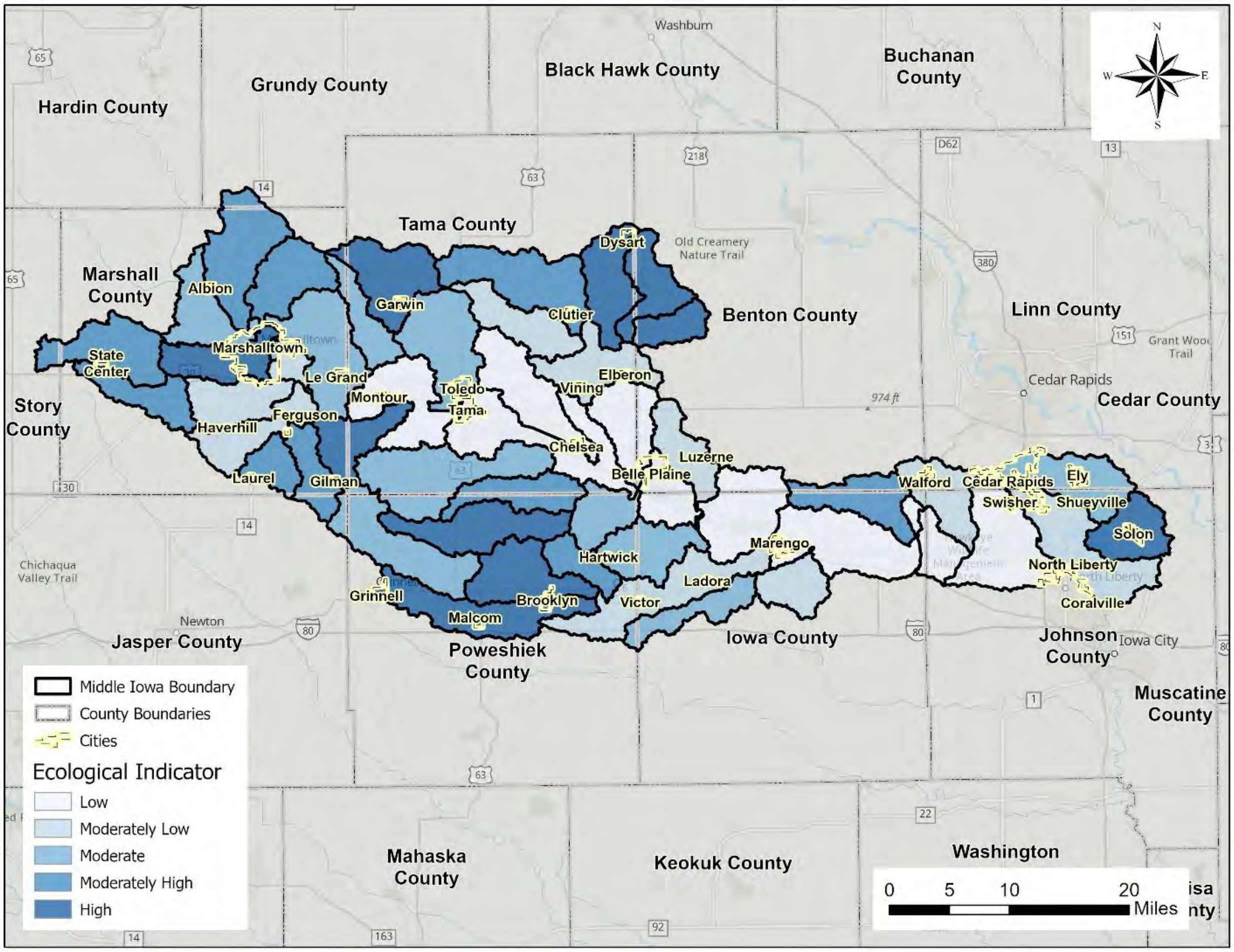


Figure C-2. HUC-12 subwatersheds ranked for likelihood of ecological restoration/protection.

Table C-2 lists subwatersheds with the highest and lowest ecological protection/restoration potential. Work focused in the highest ranking subwatersheds (left in Table C-2) will make the largest impact, while work done in subwatersheds with the lowest ranking (right) is less likely to improve ecological conditions.

Table C-2. Subwatersheds with the greatest potential for ecological restoration (left) and least potential for ecological restoration (right) based on RPS tool.

Subwatersheds with the highest ecological indictor ranking	Subwatersheds with the lowest ecological indictor ranking
Headwaters Deer Creek (070802080301)	Matson Pond-Iowa River (070802081005)
Village of Brooklyn-Little Bear Ck (070802080802)	Mill Race-Iowa River (070802081003)

Raven Creek (070802080406)	Plague Creek-Iowa River (070802080703)
Headwaters Walnut Creek (070802080602)	Village of Belle Plaine-Iowa River (070802080903)
Stoney Creek-Big Bear Creek (070802080803)	Coon Creek-Iowa River (070802080904)
Lake MacBride-Mill Creek (070802081008)	Otter Creek (070802080702)

Socioeconomic Prioritization

Socioeconomic indicators processed by the RPS tool are presented in Table C-3 with the prioritized HUC-12s shown in Figure C-3 and Table C-4.

Table C-3. Social indicators selected for analysis within the RPS tool.

Stressor Indicator	Description
% Low-Income Population in HUC-12	Percent of the total population in the HUC-12 that resides in household with income level that is less than or equal to twice the federal poverty level.
% Minority Population in HUC-12	Percent of the total population in the HUC-12 that is in a minority group.
% Less Than High School Educated Population in HUC-12	Percent of the age 25 and over population in the HUC-12 with less than a high school degree
% Vulnerable Age Group Population in HUC-12	Percent of the total population in the HUC-12 that is in a vulnerable age group, defined as under age 5 or over 64 years old.
Low Life Expectancy in HUC-12	Inverse of the average life expectancy of people residing in the HUC-12 (in years).

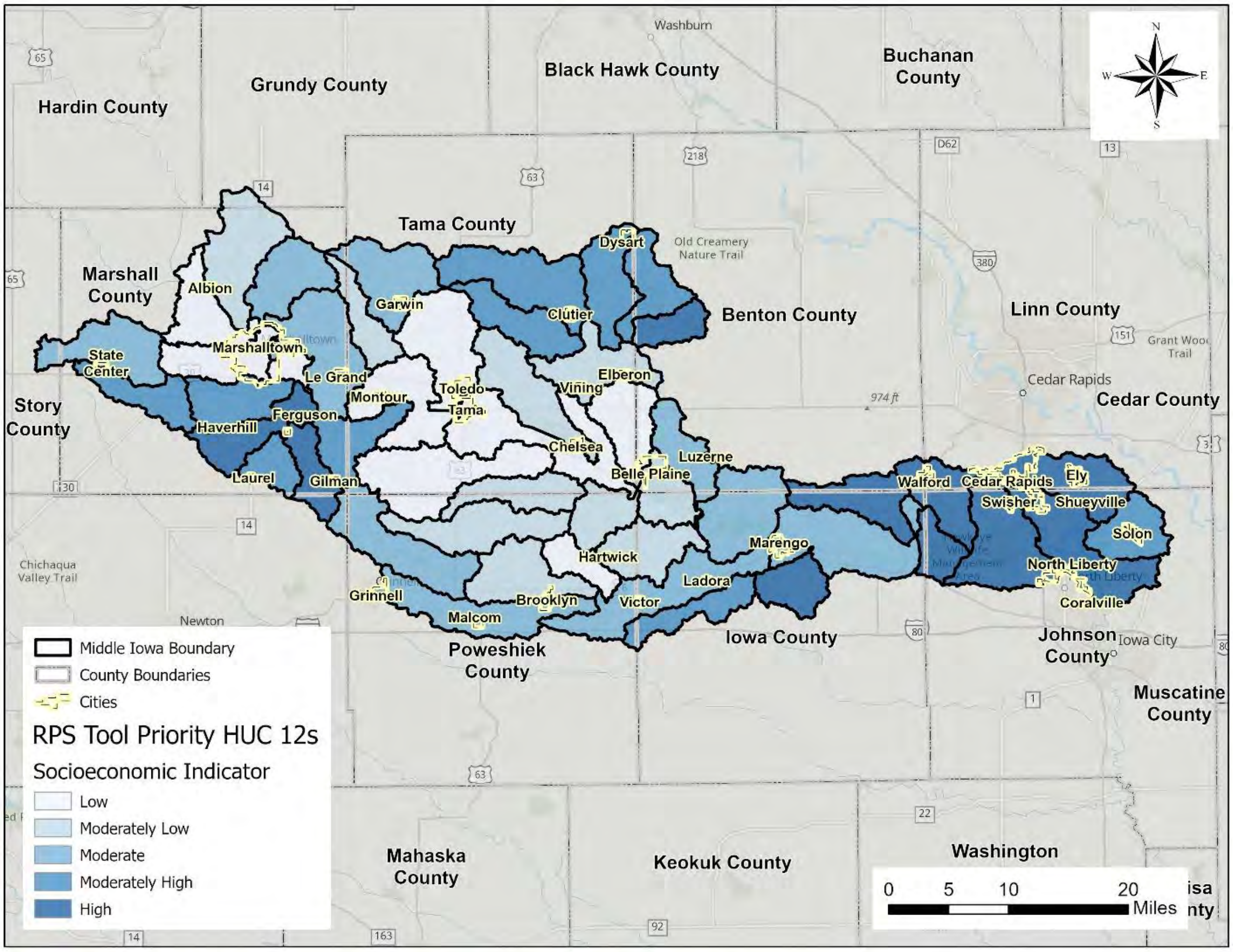


Figure C-3. HUC-12 subwatersheds ranked for likelihood of socioeconomic restoration/protection.

Table C-4 lists subwatersheds with the highest and lowest socioeconomic protection/restoration potential. Work focused in the highest ranking subwatersheds (left in Table C-4) will make the largest impact, while work done in subwatersheds with the lowest ranking (right) is less likely to improve socioeconomic conditions.

Table C-4. Subwatersheds with the greatest potential for socioeconomic restoration (left) and least potential for socioeconomic restoration (right) based on RPS tool.

Subwatersheds with the highest socioeconomic indictor ranking	Subwatersheds with the lowest socioeconomic indictor ranking
Hawkeye State Wildlife-Iowa River (070802081006)	Linn Creek (070802080102)
Knapp Creek (070802081004)	Dry Branch-Iowa River (070802080403)

Coralville Lake-Iowa River (070802081009)	Plague Creek-Iowa River (070802080703)
Hoosier Creek (070802081007)	Deer Creek (070802080302)
Matson Pond-Iowa River (070802081005)	Bennett Creek-Iowa River (070802080407)
Toogood Cemetery-Stein Creek (070802080503)	Timber Creek (070802080206)

Nitrogen Prioritization

The stressor index was evaluated separately for each of the most common water quality pollutants: sediment, phosphorus, and nitrogen. Indicators were chosen for each of the individual pollutants and analyzed separately.

Stressor indicators for nitrogen that were processed by the RPS tool are presented in Table C-5 with the prioritized HUC-12s shown in Figure C-4 and Table C-6.

Table C-5. Nitrogen stressor indicators selected for analysis within the RPS tool

Stressor Indicator	Description
% Agriculture on Hydric Soil in HUC-12	% of watershed with agricultural activity on hydric soils
% Nonbuffered Agriculture in HUC-12	% of watershed with agricultural land with drainage paths flowing to streams w/ no forest or grassland in between
Synthetic Fertilizer Nitrogen Application in HUC-12	Average annual N applications using county-wide estimates
% Tile Drained Area in HUC-12	% of watershed with subsurface tile drainage
Nitrogen Yield in HUC-12	USGS estimate of annual N yield

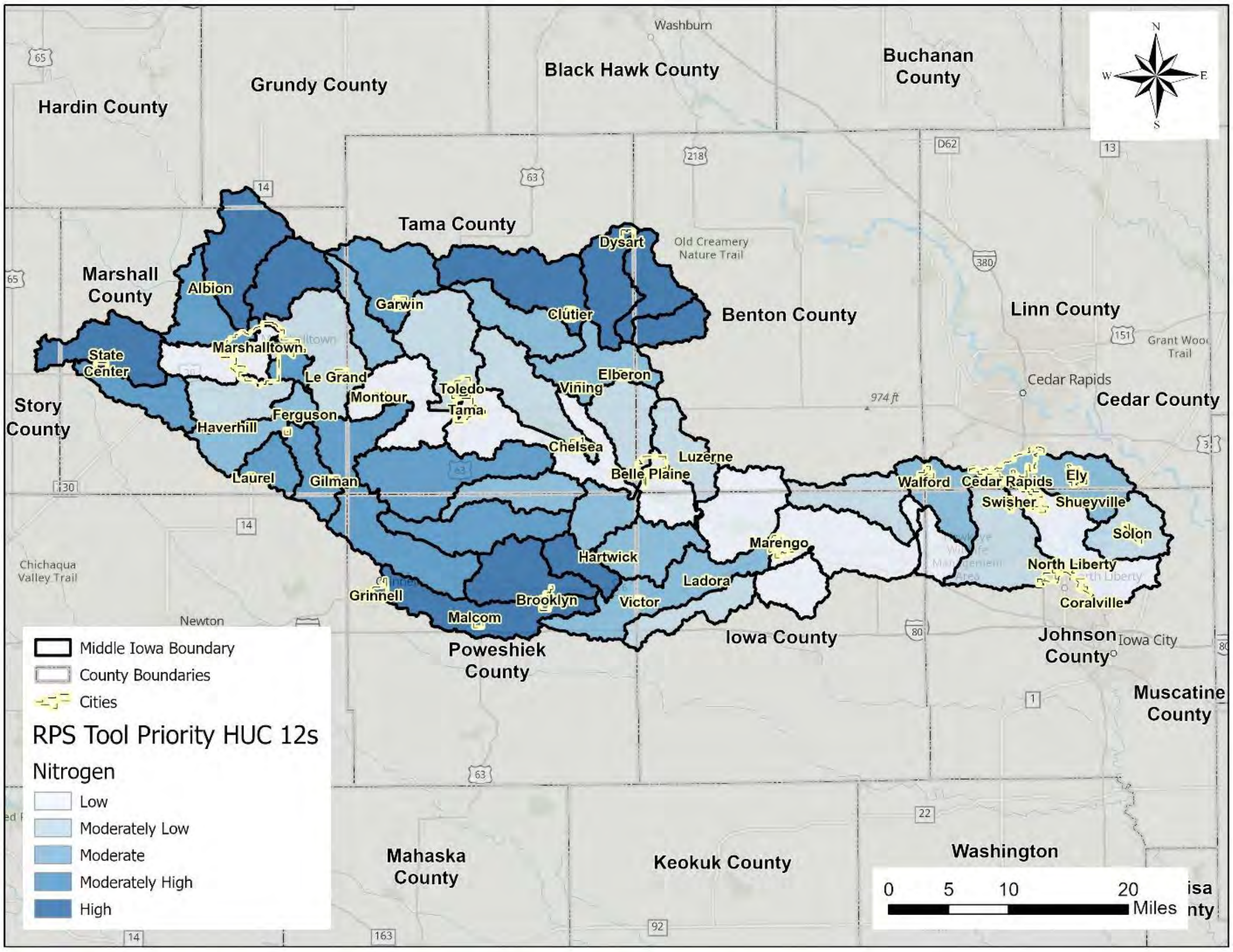


Figure C-4. HUC-12 subwatersheds ranked for likelihood of nitrogen stressor restoration/protection.

Table C-6 lists subwatersheds with the highest and lowest nitrogen stressor protection/restoration potential. Work focused in the highest ranking subwatersheds (left in Table C-6) will make the largest impact, while work done in subwatersheds with the lowest ranking (right) is less likely to address nitrogen as a stressor.

Table C-6. Subwatersheds with the greatest potential for nitrogen stressor protection or restoration (left) and least potential for nitrogen stressor protection or restoration (right) based on RPS tool.

Subwatersheds with the highest nitrogen stressor indictor ranking	Subwatersheds with the lowest nitrogen stressor indictor ranking
Asher Creek (070802080401)	Coralville Lake-Iowa River (070802081009)
Headwaters Linn Creek (070802080101)	Plague Creek-Iowa River (070802080703)

East Branch Salt Creek (070802080505)	Mill Race-Iowa River (070802081003)
Stein Creek (070802080504)	Matson Pond-Iowa River (070802081005)
Village of Brooklyn-Little Bear Ck (070802080802)	Coon Creek-Iowa River (070802080904)
Burnett Creek (070802080402)	Village of Belle Plaine-Iowa River (070802080903)

Phosphorus Prioritization

Stressor indicators for phosphorus that were processed by the RPS tool are presented in Table C-7 with the prioritized HUC-12s shown in Figure C-5 and Table C-8.

Table C-7. Phosphorus stressor indicators selected for analysis within the RPS tool.

Stressor Indicator	Description
% Agriculture on > 10% Slope in HUC-12	% of watershed with agricultural activity on steep slopes
Synthetic Fertilizer Phosphorus Application in HUC-12	Average annual P applications using county-wide estimates
Livestock Density in HUC-12	Density of animal units per acre
Phosphorus Yield in HUC-12	USGS estimate of annual P yield
Soil Erodibility, Mean in Hydro-Connected Zone in HUC-12	Average soil erodibility (K) factor of areas contiguous to surface water with high runoff potential

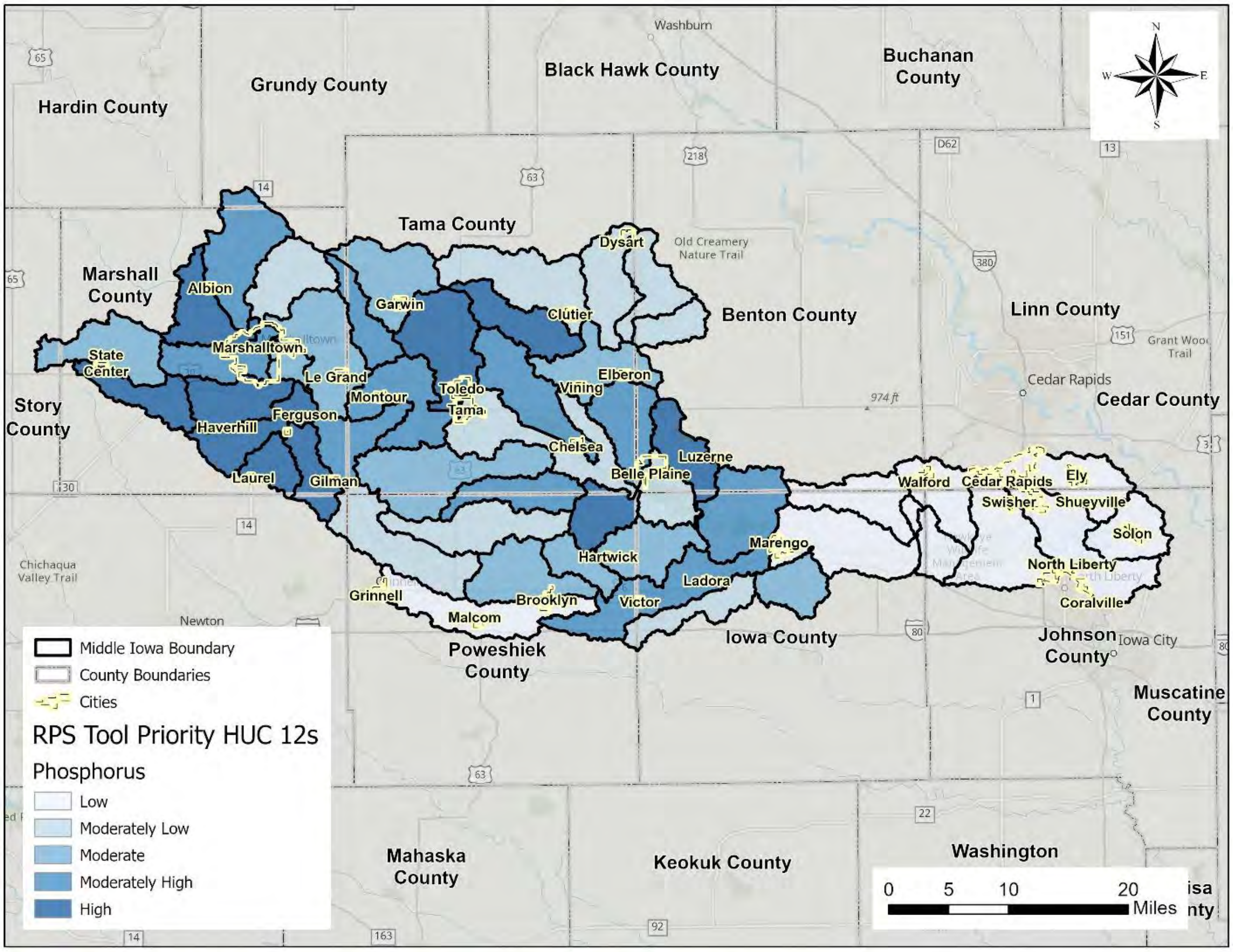


Figure C-5. HUC-12 subwatersheds ranked for likelihood of phosphorus stressor restoration/protection.

Table C-8 lists subwatersheds with the highest and lowest phosphorus stressor protection/restoration potential. Work focused in the highest ranking subwatersheds (left in Table C-8) will make the largest impact, while work done in subwatersheds with the lowest ranking (right) is less likely to address phosphorus as a stressor.

Table C-8. Subwatersheds with the greatest potential for phosphorus stressor protection or restoration (left) and least potential for phosphorus stressor protection or restoration (right) based on RPS tool.

Subwatersheds with the highest phosphorus stressor indictor ranking	Subwatersheds with the lowest phosphorus stressor indictor ranking
Buckeye Creek (070802080901)	Matson Pond-Iowa River (070802081005)
Dry Branch-Iowa River (070802080403)	Hawkeye State Wildlife-Iowa River (070802081006)
South Branch Salt Creek (070802080501)	Mill Race-Iowa River (070802081003)
South Timber Creek (070802080203)	Coralville Lake-Iowa River (070802081009)
Lutes Creek (070802080201)	Lake MacBride-Mill Creek (070802081008)
North Timber Creek (070802080205)	Village of Brooklyn-Little Bear Ck (070802080802)

Sediment Prioritization

The Iowa DNR conducted a sediment analysis within the Middle Iowa River watershed that prioritized HUC-12 subwatersheds based on surface sediment erosion and sediment delivery to the watershed outlet. HUC-12s were prioritized based on a combination of high local sediment erosion and high sediment delivery to the watershed outlet. Figure C-6 shows the outcome of that prioritization effort. Results from the sediment loss and delivery analysis were incorporated into the overall prioritization for this plan as an additional input into the RPS tool. As the DNR sediment analysis had already prioritized the HUC-12s in the watershed, no further parameters were used within the RPS tool for prioritizing the sediment stressor.

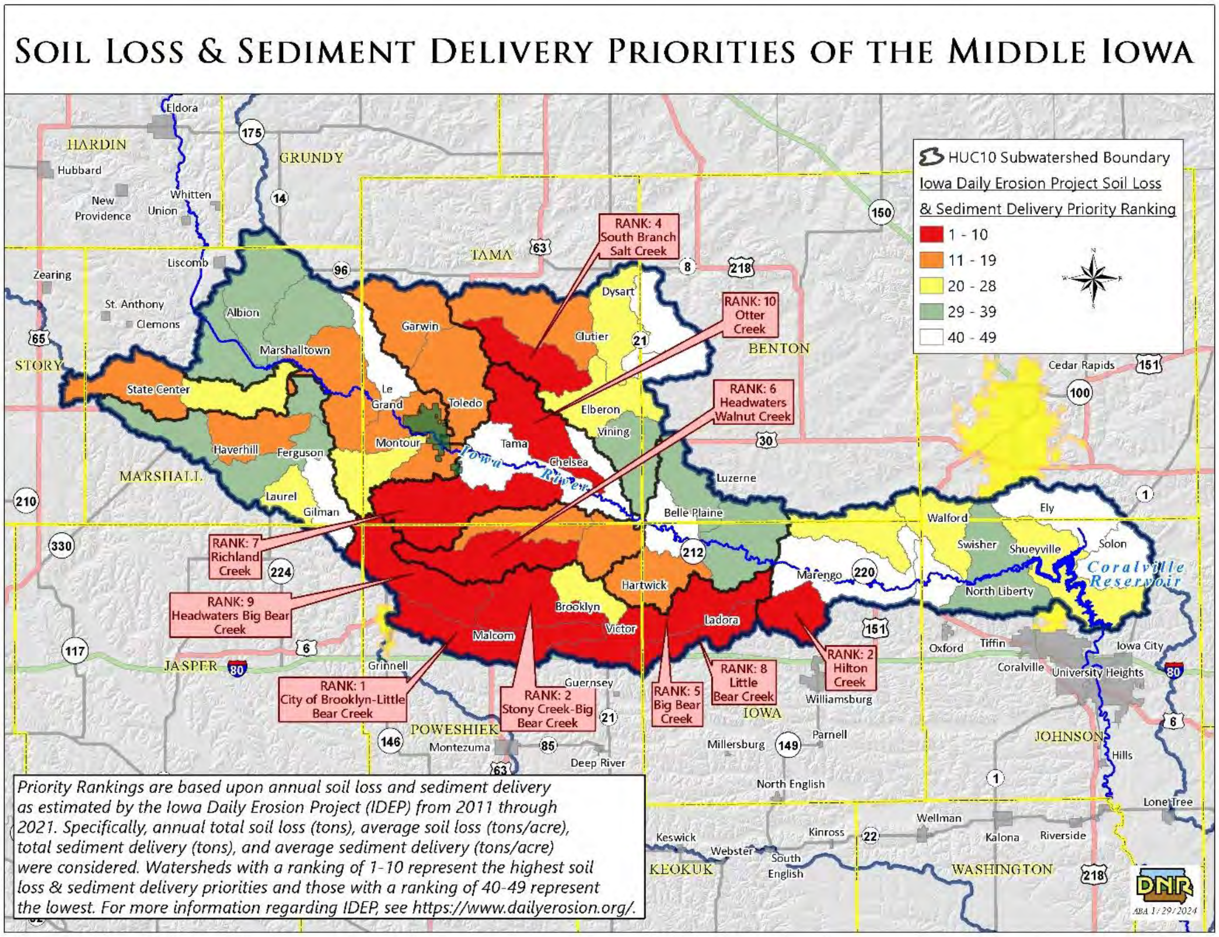


Figure C-6. Iowa DNR sediment delivery priority HUC-12 watersheds.

The Iowa DNR data for the sediment stressor indicator that was processed by the RPS tool is presented in Table C-9 with the prioritized HUC-12s shown in Figure C-7 and Table C-10.

Table C-9. Sediment stressor indicators selected for analysis within the RPS tool.

Stressor Indicator	Description
DNR and IDALS Sediment Delivery Estimation	RUSLE2 to estimate Soil Loss (Sheet & Rill Erosion) & Sediment Delivery (Transported to Surface Water). Analysis based on land cover, soil erodibility, and slope.

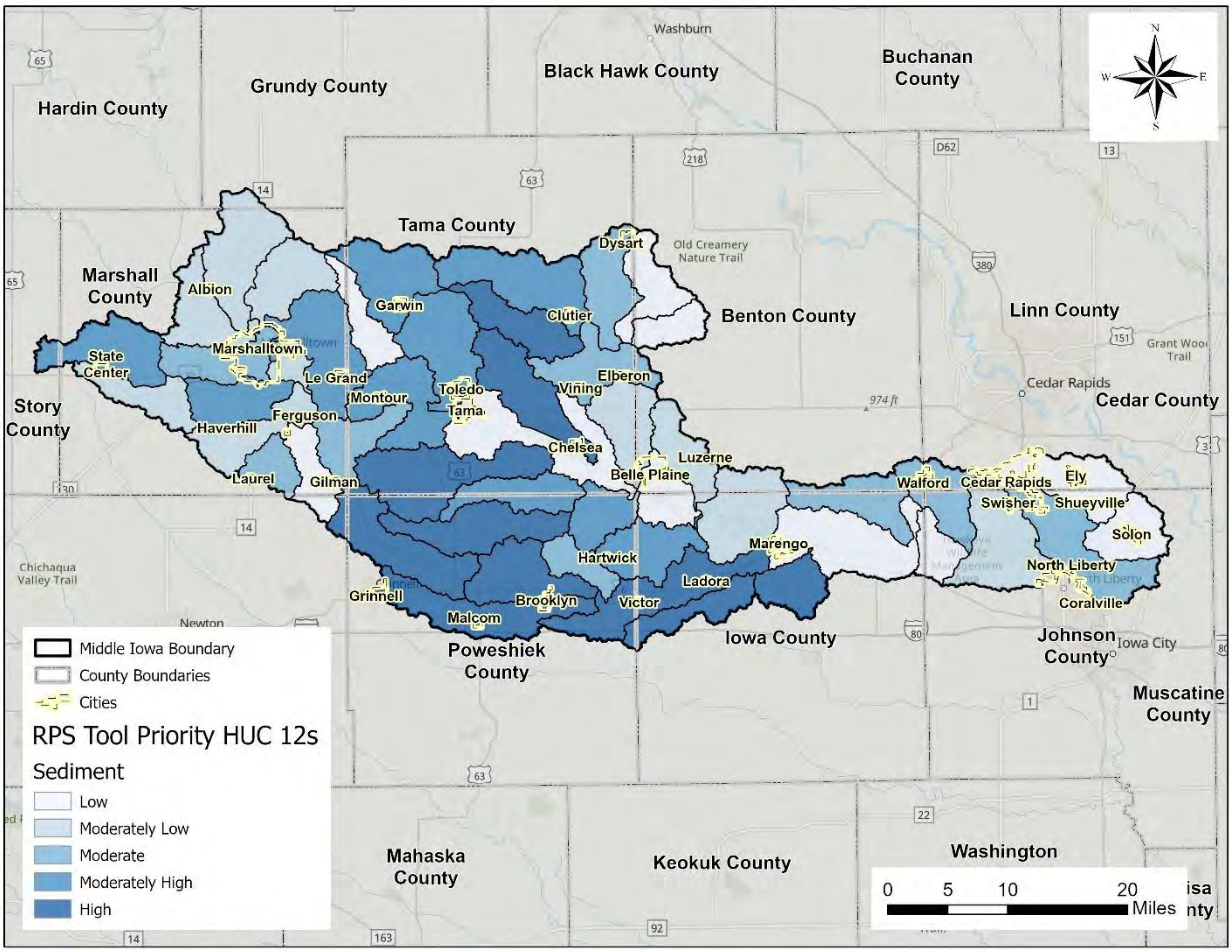


Figure C-7. HUC-12 subwatersheds ranked for likelihood of sediment stressor restoration/protection.

Table C-10 lists subwatersheds with the highest and lowest sediment stressor protection/restoration potential. Work focused in the highest ranking subwatersheds (left in Table C-10) will make the largest impact, while work done in subwatersheds with the lowest ranking (right) is less likely to address sediment as a stressor.

Table C-10. Subwatersheds with the greatest potential for sediment stressor protection or restoration (left) and least potential for sediment stressor protection or restoration (right) based on RPS tool.

Subwatersheds with the highest sediment stressor indictor ranking	Subwatersheds with the lowest sediment stressor indictor ranking
Village of Brooklyn-Little Bear Ck (070802080802)	Matson Pond-Iowa River (070802081005)
Hilton Creek (070802081001)	Lake MacBride-Mill Creek (070802081008)
Stoney Creek-Big Bear Creek (070802080803)	Toogood Cemetery-Stein Creek (070802080503)
South Branch Salt Creek (070802080501)	Sugar Creek (070802080404)
Big Bear Creek (070802080806)	Village of Belle Plaine-Iowa River (070802080903)
Headwaters Walnut Creek (070802080602)	Brush Creek (070802080202)

Results from all RPS tool analyses were reviewed and used by the Technical Advisory Committee to narrow down the list of possible HUC-12s for prioritization of protection and restoration efforts. Subwatersheds in Table C-11 represent the HUC-12s that have the highest rating for each factor that was considered.

Table C-11. HUC-12 subwatersheds ranked as the highest priority for restoration efforts based on the separate stressor indices from the RPS tool.

RANK	COMPOSITE SCORE*	PHOSPHORUS STRESS	NITROGEN STRESS	SEDIMENT STRESS
1	Bennett Creek-Iowa River	Buckeye Creek	**Asher Creek**	**Village of Brooklyn-Little Bear Creek**
2	Plague Creek-Iowa River	Dry Branch-Iowa River	**Headwaters Linn Creek**	**Hilton Creek**
3	**Otter Creek**	**South Branch Salt Creek**	**East Branch Salt Creek**	**Stoney Creek-Big Bear Creek**
4	**Hilton Creek**	South Timber Creek	Stein Creek	**South Branch Salt Creek**
5	Mill Race-Iowa River	**Lutes Creek**	**Village of Brooklyn-Little Bear Creek**	**Big Bear Creek**
6	Deer Creek	North Timber Creek	Burnett Creek	Headwaters Walnut Creek
7	Richland Creek	Deer Creek	**Stoney Creek-Big Bear Creek**	Richland Creek
8	Coralville Lake-Iowa River	Headwaters North Timber Creek	Rock Creek	**Little Bear Creek**
9	Linn Creek	Brush Creek	Toogood Cemetery-Stein Creek	**Headwaters Big Bear Creek**
10	Little Bear Creek	Walnut Creek	Headwaters Salt Creek	**Otter Creek**

*Combination of Ecological, Social, and Stressor indicators

Upon review of the output from the RPS tool using default data and sediment erosion priority data from the Iowa DNR, the Technical Advisory Committee selected a subset of priority HUC-12s shown in Figure C-8. More focus was placed on HUC-12s with the highest pollutant stressors. Socioeconomic indicators were used as a tie-breaker for HUC-12s that had the same stressor ranking. Subwatersheds that had high ecological protection value and high pollutant stress were given additional weight as they may offer a favorable return on restoration efforts while simultaneously protecting and improving ecological factors (e.g. Hilton Creek). Finally, subwatersheds were reviewed in regard to upstream and downstream subwatersheds within the same stream networks to possibly account for compounding or scaling benefits of restoration/protection in hydrologically connected subwatersheds (e.g. Salt Creek and Bear Creek).

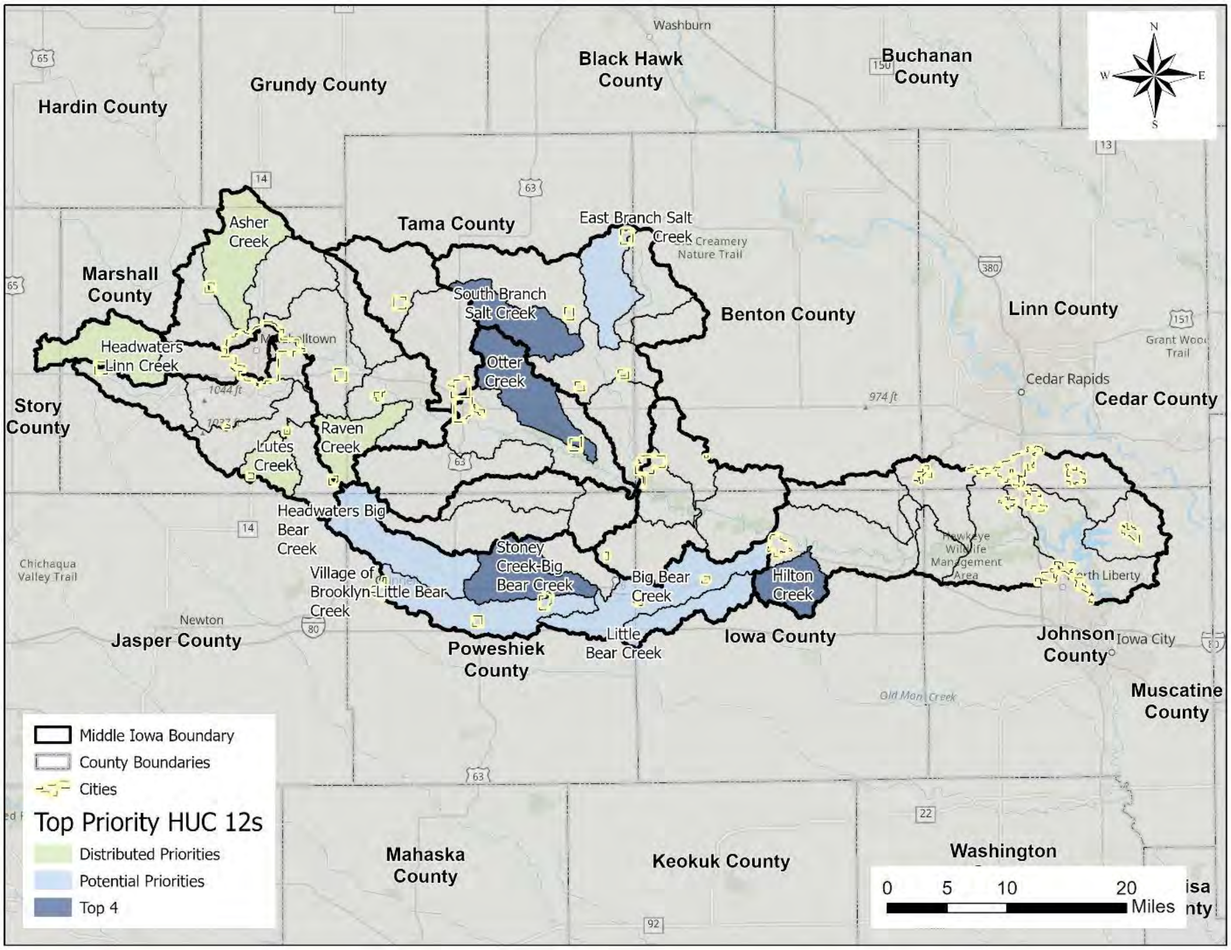


Figure C-8. Potential priority HUC-12 subwatersheds.

The goal was to select four HUC-12 subwatersheds to focus restoration and/or protection efforts, using the results of the prioritization analysis of all 13 HUC-12 subwatersheds. The initial prioritization resulted in all four top priority HUC-12s being located near the central portion of the Middle Iowa River Watershed (Figure C-8). To increase the spatial distribution of priority HUC-12s across the watershed, work in a subwatershed with little prior conservation efforts, and address the high nitrogen stressor, the Asher Creek HUC-12 (070802080401) was chosen in place of the Otter Creek subwatershed (070802080702), which has had multiple watershed plans and conservation efforts already implemented. The final selected priority HUC-12s are illustrated in Figure C-9.

The final four subwatersheds that were selected for intense analysis were Asher Creek (070802080401), South Branch Salt Creek (070802080501), Stoney Creek-Big Bear Creek (070802080803), and Hilton Creek (070802081001).

Asher Creek (Marshall County) ranked highest in nitrogen stress, moderately high in phosphorus stress, and fell near the median for sediment stress among all HUC-12s. South

Branch Salt Creek (Tama County) showed high sediment and phosphorus stress, contains several potential source water contaminant sources, and also includes the Kunch Wildlife Management Area. Stoney Creek-Big Bear Creek (Poweshiek County) has high sediment and nitrogen stress, over 20 potential source water contaminant sources, and Bear Creek is periodically impaired for fish and macroinvertebrates. Hilton Creek (Iowa County) ranks moderately high for sediment and nutrient stress, has 50 potential source water contaminant sources, and also has valuable ecological resources.

A closer look at the characteristics, resource conditions, and plan implementation within each of the subwatersheds is presented in Appendices D-G.

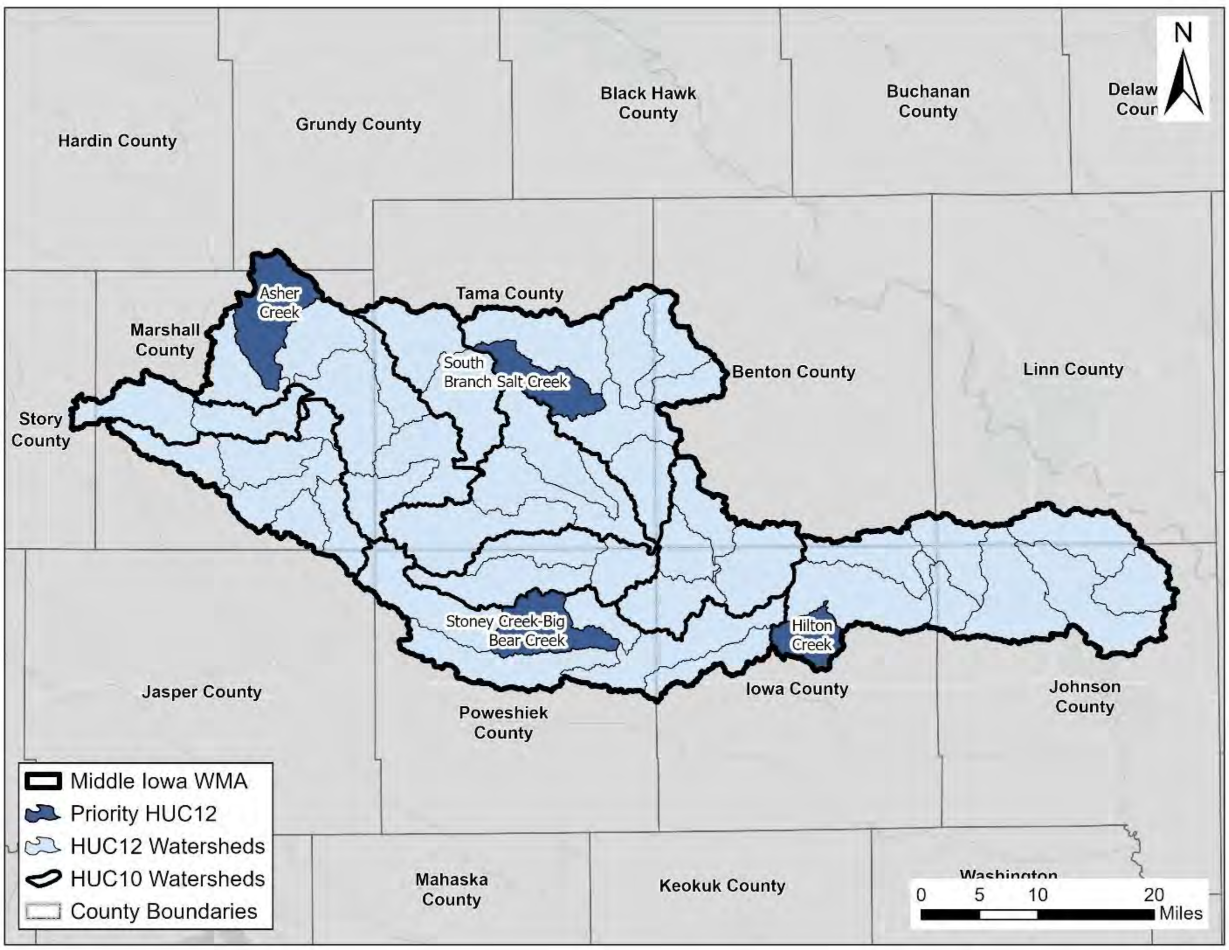
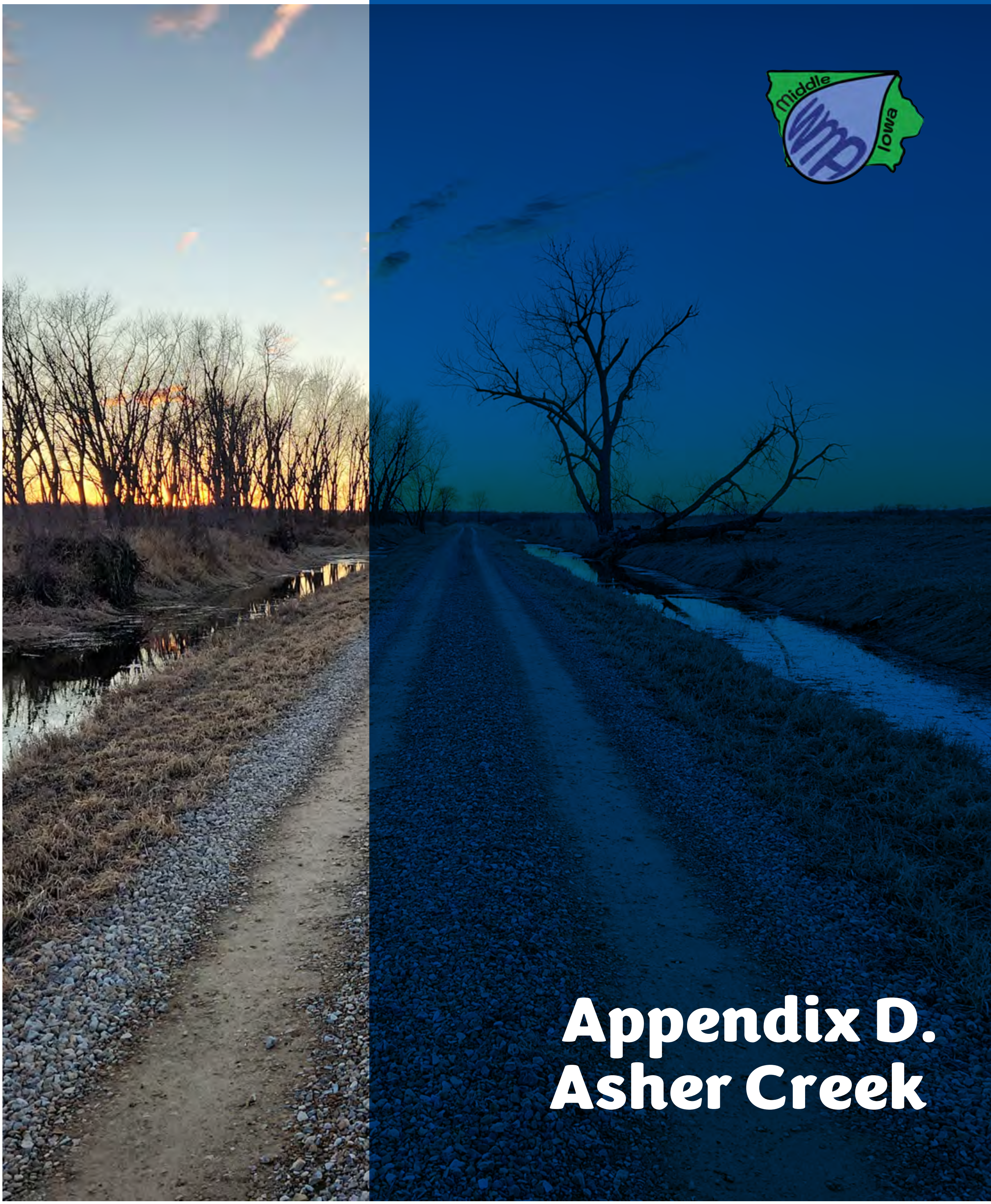


Figure C-9. Priority subwatersheds



Appendix D.
Asher Creek

Asher Creek Subwatershed

Introduction

The Asher Creek subwatershed (HUC-12 070802080401), Figure D-1, was selected as a priority subwatershed due to high nitrogen stress. The subwatershed contains the 29,700 acre drainage area around Asher Creek, to which Little Asher Creek and Chicken Creek are tributaries. Asher Creek is located along the northwestern boundary of the Middle Iowa Watershed and contains part of the city of Albion. Most of the subwatershed is in Marshall County, but the northern extent reaches into Grundy County.

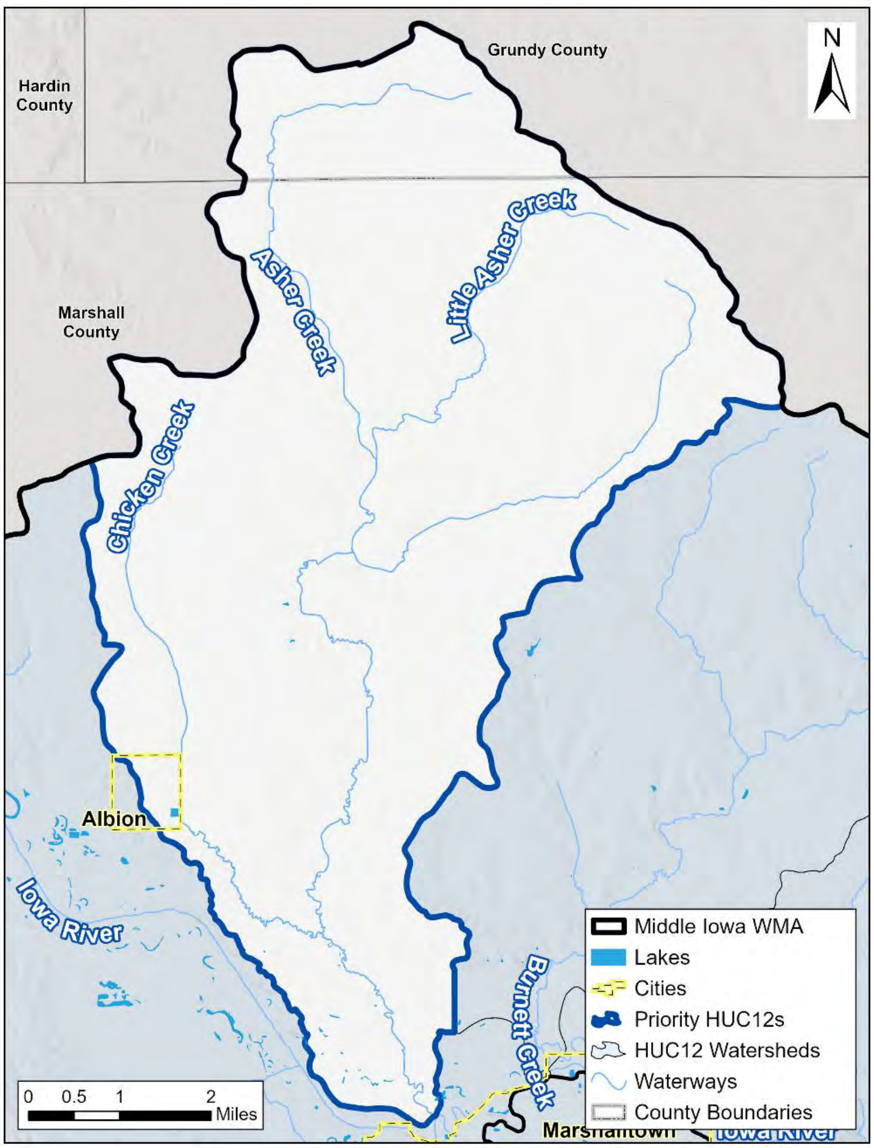


Figure D-1. Asher Creek priority subwatershed.

Watershed Characteristics

Population

Asher Creek subwatershed is largely cropland, with scattered farm homes. The total number of producers in Marshall County is 1,617 with an average farm size of 371 acres (USDA, 2022). As the subwatershed is 8% the size of Marshall County, an estimated 131 producers grow crops and/or have livestock in the watershed, assuming land ownership is distributed uniformly across the county. The only city is Albion, which has a population of around 450.

Land Use

Land cover in the Asher Creek subwatershed is cropland (88%), developed land (6%), pasture (4%), and wetlands (2%) (Figure D-2). In Marshall County, the average size of farms has increased by 4% and the number of farms has increased by 1% from 2017-2022 (USDA, 2022). About 70% of Marshall County farm sale revenues are crops, while the other 30% is livestock, poultry, and other products. Of these, 50% of publicly available livestock revenue is from hogs and pigs (USDA, 2022). In the Asher Creek subwatershed, there are two feedlots with about 1,400 animal units (DNR, 2024). The top crops grown are corn and soybeans (USDA, 2022). There are 335 acres of recreational land available for hunting or fishing within the subwatershed in the Iowa River Wildlife Management Area.

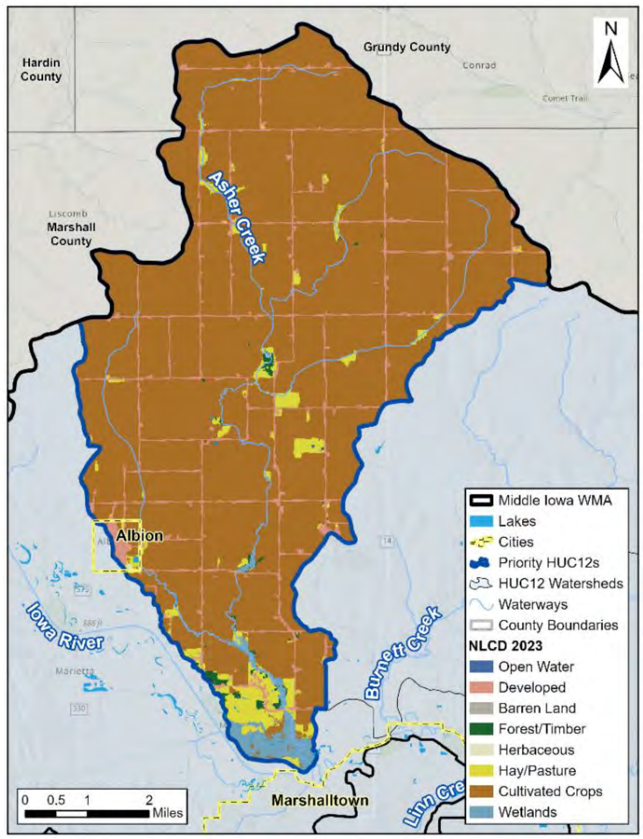


Figure D-2. Land cover in the Asher Creek subwatershed.

Table D-1. Land cover in Asher Creek subwatershed (USGS, 2023).

Land Use	Acres	Percent of Subwatershed
Cropland	26,136	88%
Developed	1,782	6%
Pasture	1,118	4%
Wetland	594	2%

Soils

Over 90% of the soil in the subwatershed is silty clay loam. Other soil types include silt loam, loam, fine sandy loam, loamy fine sand, and loamy sand. Infiltration of precipitation through soils recharges groundwater and reduces overland flow that carries pollutants to surface water, erodes soil, and can cause flooding. Given the clay composition of the soil, Asher Creek soils are hydrologic soil groups C or C/D, which have slow infiltration rates and high runoff potential. The Wind Erodibility Index in Asher Creek is reported as 49 tons/acre/year (Soil Survey Staff, 2025). It is important to note that this value reflects a theoretical potential soil loss under worst-case conditions—specifically, bare and smooth soil surfaces with no vegetation or surface roughness. Actual wind erosion rates under typical land management and cropping practices are expected to be significantly lower, with actual wind erosion rates of less than 5 tons/acre/year, compared to 1-10 tons/acre/year of rainfall-driven sheet and rill erosion.

Streams

A network of tributaries feed into the 19-mile Asher Creek. The two named tributaries include Little Asher Creek and Chicken Creek. Little Asher Creek flows about 5.5 miles before its confluence with Asher Creek. Further downstream, Chicken Creek flows about 8.5 miles before it meets Asher Creek (USGS, 2020).

Resource Conditions

Designations and Impairments

Asher Creek's designated uses are Class A1, Primary Contact Recreation, and BWW2 (Warm Water Aquatic Life (Iowa ADBNet, Waterbody IA 02-IOW-736). The Asher Creek subwatershed does not contain any impaired waters; however, there has not been sufficient data collected to fully document support or impairment of designated uses. Additionally, Asher Creek drains into the Iowa River which has an A1 and HH designated use and is impaired due to *E. coli* and mercury consumption through fish. Plan actions are not targeted towards mercury impairments but efforts to target sediment and nutrient losses will generally also reduce bacteria pollution.

Historical Conservation Success

To date, Asher Creek has not been the focus of any documented, targeted watershed grants (e.g., Section 319, Water Quality Initiative).

Iowa State University, with funding from Iowa Department of Natural Resources and other state resources, utilized satellite imagery and LiDAR resources to establish likely locations of

installed best management practices (BMPs) on the landscape in the Iowa BMP Mapping Project. The project focused on specific BMPs types, although the BMPs included in these results are not guaranteed to meet NRCS practice standards. The BMPs documented in the project are Terraces, Water and Sediment Control Basins, Grassed Waterways, Pond Dams, Contour Strip Cropping, and Contour Buffer Strips.

As of 2010, there were an estimated 745 BMPs within the drainage area of the Asher Creek HUC-12 watershed. A breakdown of BMPs is shown in Table D-2. Note that some BMPs are best expressed as size (acres or linear feet) rather than a count but size is not provided in the dataset.

Table D-2. Existing BMPs within Asher Creek, as of 2010 (ISU, 2017).

BMP Type	Number of BMPs
WASCOB (NRCS 638)	68
Terrance (NRCS 600)	45
Pond Dam (NRCS 378)	10
Grassed Waterways (NRCS 412)	617
Contour Buffer Strips (NRCS 332)	5

Pollutants of Concern

Monitoring of *E. coli* has led to the impairment listing of the Iowa River, and reducing bacteria loading in the Asher Creek subwatershed will help improve Iowa River water quality. *E. coli* is used as an indicator of the presence of fecal contamination, as *E. coli* is often present along with other pathogens that increase the risk of illness if people are exposed through swimming or recreation. *E. coli* can come from many nonpoint sources, including improper application of manure to fields, feedlot runoff, livestock grazing in riparian areas, leaking subsurface septic treatment systems, pet waste, and wildlife.

Erosion of topsoil through sheet and rill and ephemeral gully formation contribute to sediment transport to streams across Iowa, including through cropland in the Asher Creek watershed. Additionally, streambank and channel erosion also contribute to sediment loading and turbidity.

Nitrogen and phosphorus losses are high priorities as well, not only due to Gulf of Mexico / Gulf of America hypoxia issues addressed in Iowa's Nutrient Reduction Strategy, but also to protect and improve local water quality issues such as maintaining healthy drinking water sources and preventing nuisance growth of algae and other aquatic plants (to limit eutrophication).

Pollutant Source Assessment

General sources and quantities of water quality pollutants of concern were evaluated using the US Geological Survey (USGS) SPAtially-Referenced Regression On Watershed attributes (SPARROW) model. Predicted pollutant yields and load were summarized for runoff volume, sediment, total phosphorus, and total nitrogen.

The SPARROW model has separate multiple linear regression equations for estimating sediment, total phosphorus, and total nitrogen yield from the landscape and delivery to downstream locations. Each individual equation is composed of multiple variables that relate to source strength of the sediment, total phosphorus, or total nitrogen; the delivery of each component from the landscape to receiving waterbodies; and in-stream routing and loss due to natural physical, chemical, and/or biological factors.

The multiple linear regression model for sediment primarily derives its localized erosion estimates from landuse type(s) within each SPARROW catchment, whereas the models for total phsophorus and total nitrogen also include other factors such as fertilizer use, wastewater treatment plant effluent, atmospheric deposition, manure application on agricultural land, subsurface tile drainage density, etc. More information about the SPARROW model can be in the U.S. Geological Survey Scientific Investigations Report 2019–5114.

Figure D-3 presents the incremental yields of common water quality and quantity parameters. These represent the mass of each parameter lost from the landscape per hectare within each delineated SPARROW catchment.

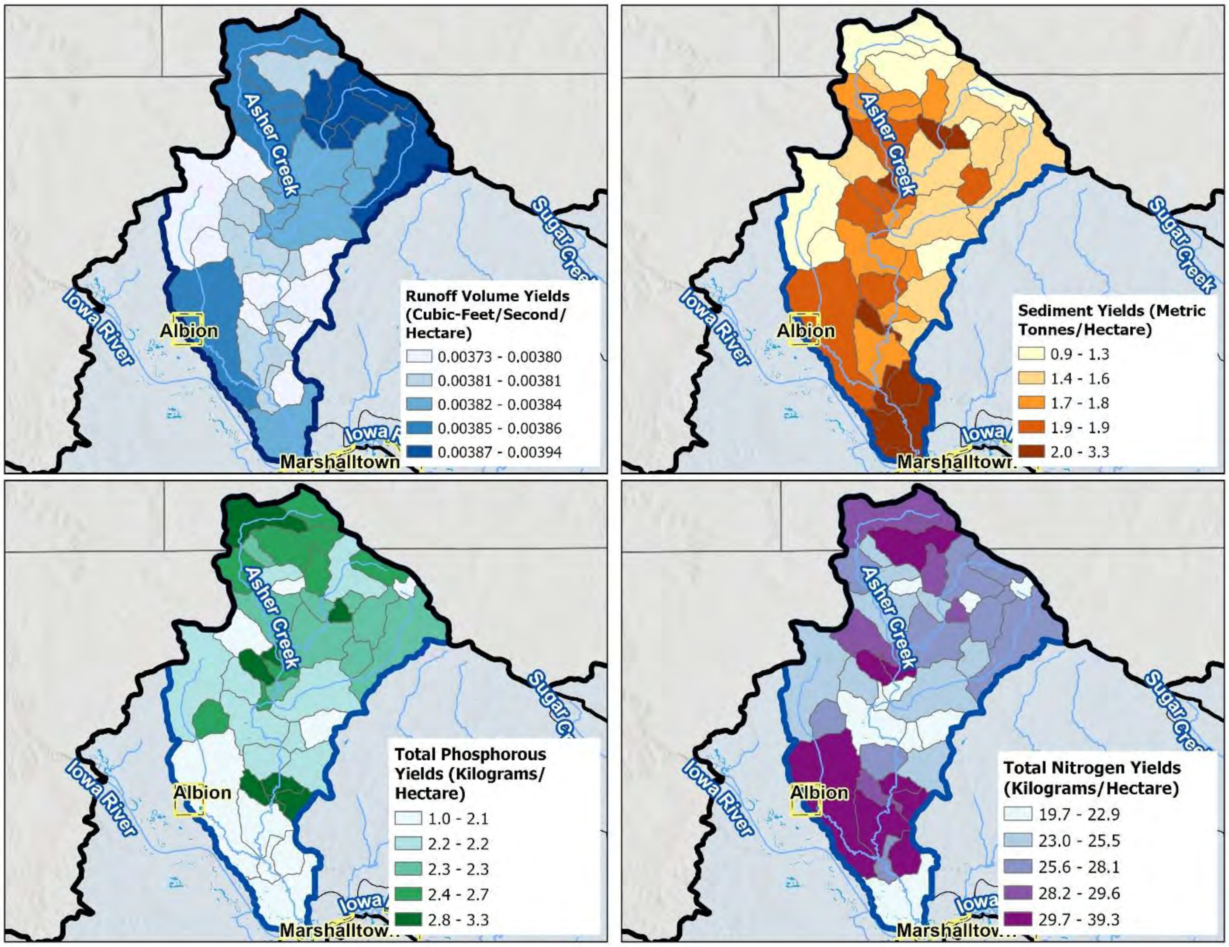


Figure D-3. Runoff, Sediment, Phosphorus, and Nitrogen yields for Asher Creek from the USGS SPAtially-Referenced Regression On Watershed attributes (SPARROW) model.

The SPARROW model includes a delivery fraction for each water quality parameter to mathematically route loads from each SPARROW catchment downstream, accounting for the fraction of the total mass generated within a SPARROW catchment that does not travel to the watershed outlet on an annual basis. With that information, the measurable total annual load of each water quality parameter was estimated at the outlet of the Asher Creek HUC-12 (Table D-3).

Table D-3. Total annual load of sediment, total phosphorus, and total nitrogen from the Asher Creek Subwatershed.

Water Quality Parameter	Existing load (Catchment Losses)	Existing Load (per acre)	Existing load (Delivered to HUC-12 outlet)	Delivery Ratio
Sediment (tons/yr)	21,098	0.71	13,629	0.65
Total Phosphorus (lbs/yr)	57,397	1.93	42,400	0.78
Total Nitrogen (lbs/yr)	723,616	24.36	590,507	0.82

Goals and Objectives

Within the Asher Creek subwatershed, existing loads of sediment, total phosphorus, and total nitrogen, as well as the Iowa Nutrient Reduction Strategy and recommendations from the Technical Advisory Committee, were used to establish load reduction goals.

Iowa Nutrient Reduction Strategy goals aim for a long-term reduction of phosphorus and nitrogen by 45%. The load reductions attributable to non-point source pollution are 41% for nitrogen and 29% for phosphorus. These are the established long-term goals for this watershed management plan. Short term goals (over the 10-year life of this plan) were established at a 10% reduction for both sediment, phosphorus, and nitrogen (Table D-4).

Table D-4. Plan (10-yr) and long-term water quality goals set for the Asher Creek HUC-12. Sediment and nutrient load reductions are measured at the outlet of the HUC-12 subwatershed.

Water Quality Parameter	Existing Loads (at HUC-12 outlet)	Asher Creek Load Reduction Goals
Sediment (tons/yr)	13,629	Short-term: 10% (1,363 tons)
Total Phosphorus (lbs/yr)	42,400	Short-term: 10% (4,240 lbs), Long-term: 29% (12,296 lbs)
Total Nitrogen (lbs/yr)	590,507	Short-term: 10% (59,051 lbs), Long-term: 41% (242,108 lbs)

Through the implementation of conservation practices (CP) and BMPs presented in the implementation scenario below, the desired water quality goals can be reached.

Implementation Plan: Asher Creek

Conservation and best management practices can be used, in tandem with other efforts throughout the subwatershed, to work toward achieving the water quality goals set forth in this plan.

The Agricultural Conservation and Planning Framework (ACPF) model was used to find locations on the landscape that are suitable for the implementation of CPs and BMPs. Costs for implementation of the BMPs were estimated using typical Iowa NRCS Environmental Quality Incentives Program (EQIP) payment rates. Those values were then doubled to more accurately represent the true cost of implementing each practice, accounting for additional factors such as administrative time.

Load reduction estimates for each individual BMP were estimated using the underlying SPARROW data and assumed load reduction efficiencies of each BMP type (Table D-5). Load reduction efficiencies are primarily from the Iowa NRS, Minnesota Agricultural BMP Handbook, and other applicable references; prioritizing data and research from Iowa sources, then midwestern sources, and finally regional/national sources. Rates reported in the Iowa NRS are expressed as ranges and have many caveats, making it necessary to use other sources of data to develop average rates.

Table D-5. Conservation and Best Management Practice load reduction fractions.

BMP	Sediment Reduction Efficiency	Total Phosphorus Reduction Efficiency	Total Nitrogen Reduction Efficiency
Nutrient Reduction Wetland (NRW)	0.75	0.53	0.30
Grassed waterway (GWW)†	0.96	1.00	1.00
Drainage water management (DWM)	0.69	0.55	0.4
Cover Crops - Rye (CCR)	0.70	0.50	0.28
Contour buffer strips (CBS)	0.87	0.695	0.52
Bioreactor (BIO)	0.69	0.55	0.24
Saturated Buffer (STB)	0.84	0.5	0.45
Riparian buffer (RIB)	0.76	0.58	0.87
Ponds and/or Water and sediment control basin (WASCOB)	0.88	0.85	0.57

† *Reduction for armoring the soil in the location of the grassed waterway, not filtering incoming water*

Load reduction estimates for a given BMP were calculated as the treatable load at the location of the BMP multiplied by the load reduction efficiency of that BMP type. Cost-effectiveness

was then also calculated for each BMP as the dollars needed to reduce one ton of sediment or one pound of nitrogen or phosphorus.

To work toward water quality goals most efficiently and effectively, BMPs were prioritized according to recommendations from the Technical Advisory Committee. Within the Asher Creek Watershed, BMPs were prioritized based on their cost-effectiveness for reducing nitrogen loads, as measured at the HUC-12 subwatershed outlet. Nitrogen was selected as the optimizing pollutant due to the high nitrogen indicator revealed by the RPS Tool analysis, but reductions of sediment and phosphorus loads will also be achieved.

The project pollutant load reductions were obtained by "weighting" BMP types based on the (1) likelihood of a BMP being implemented, as measured by landowner/producer interest, and/or (2) the interest/desire of conservation professionals to promoted a particular BMP type within the subwatershed (Table D-6). This information was obtained from the Marshall County Soil and Water Conservation District (SWCD).

Table D-6. Implementation Plan BMPs, likelihood of implementation, and weighting within the implementation scenario.

BMP	Likelihood of BMP type use within the HUC-12. (e.g. high, medium, low, zero)		Weighting*
	Popularity & Buy-In	Interest of SWCD in Promoting	
Grassed waterway	Medium	High	22.4%
Saturated buffer	Low	Medium	11.5%
Riparian buffer	Low	Low	2.5%
Pond/WASCOB	Low	Medium	11.5%
Nutrient reduction wetland	Medium	High	22.3%
Contour buffer strips	Low	Low	2.5%
Cover crops - rye	High	High	22.3%
Drainage water management	Low	Low	2.5%
Denitrifying bioreactor	Low	Low	2.5%

**Fraction of the nitrogen load reduction goal the selected BMP will reduce within the implementation scenario.*

Using this BMP selection methodology, a scenario was created to show one path for achieving the water quality goals of this plan. Necessary load reductions for each BMP type, based on the weighting factor, will be met or exceeded for both phosphorus and nitrogen using this scenario. This plan is not prescriptive but shows one way of efficiently reducing loads of sediment and nutrients.

Figure D-4 showcases the BMPs that were selected to be part of this implementation scenario, with estimated load reductions presented in Table D-7. In order to meet the 10-year plan goals, 218 BMPs are planned in the Asher Creek subwatershed that are estimated to reduce sediment by 2,919 tons/yr, phosphorus by 7,175 lbs/yr, and nitrogen by 59,132 lbs/yr. BMPs are concentrated towards the outlet as BMPs were prioritized by those that best meet plan load reduction goals at the outlet.

The Action Table (Table D-7) lays out the suggested areas of implementation efforts along with the suggested entities responsible for aiding and overseeing the implementation of the necessary BMPs to meet the goals laid out in this plan.

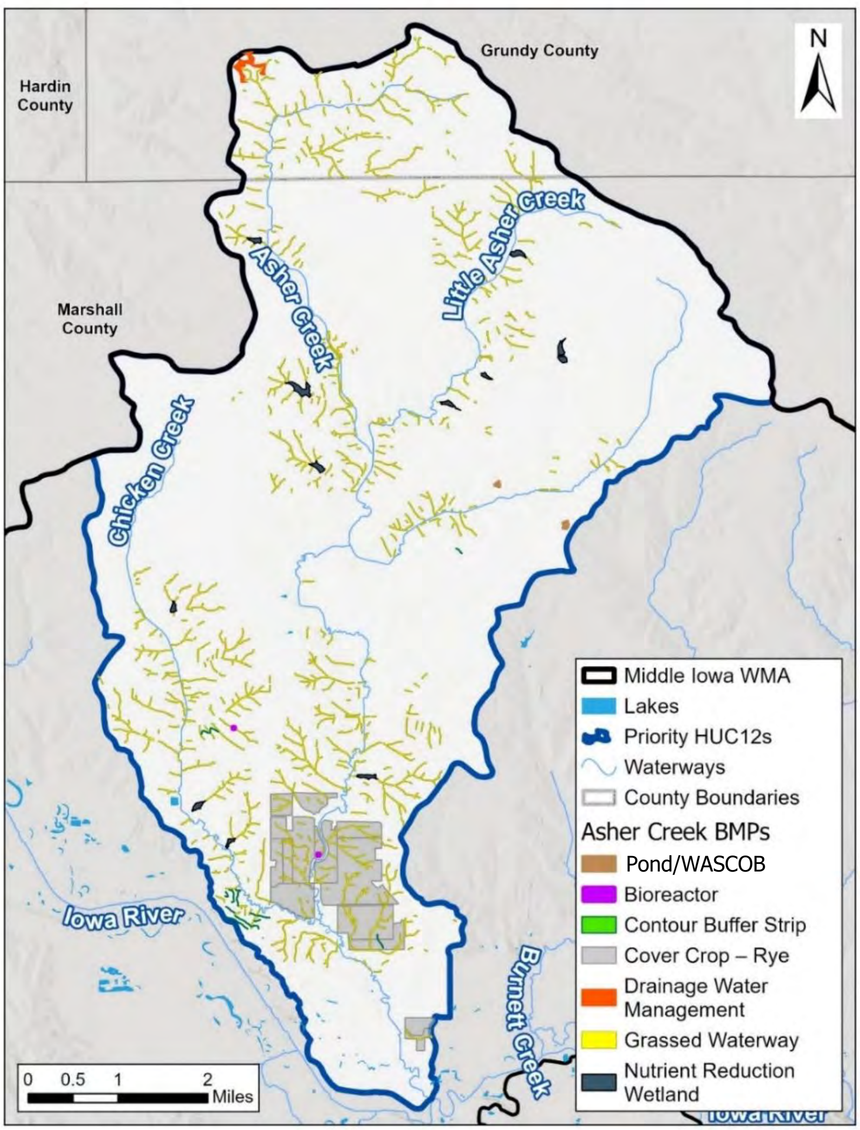


Figure D-4. Best management and conservation practices that are part of this implementation scenario.

Table D-7. Asher Creek Action Table.

BMP / Conservation Practice	Focus Areas	Output	Outcome	Responsible Entity	Timeline	10-Year Cost
Grassed Waterway	Nitrogen and Phosphorus Hot Spots	183 waterways	583 tons sed/yr 1306 lbs TP/yr 13,207 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$2,916,489
Saturated Buffer	N/A	0 buffers	0 tons sed/yr 0 lbs TP/yr 0 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$0
Riparian Buffer	N/A	0 buffers	0 tons sed/yr 0 lbs TP/yr 0 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$0
Ponds / WASCOB	Nitrogen and Phosphorus Hot Spots	2 WASCOBs	490 tons sed/yr 1,441 lbs TP/yr 11,057 lbs TN/yr 6 ac-ft	SWCDs, NRCS, IDALS	10 years	$9,000
Nutrient Reduction Wetland	Nitrogen and Phosphorus Hot Spots	11 nutrient reduction wetlands	1,186 tons sed/yr 2,885 lbs TP/yr 15,548 lbs TN/yr 230 ac-ft	SWCDs, NRCS, IDALS	10 years	$493,416
Contour Buffer Strips	Nitrogen and Phosphorus Hot Spots	4 buffer strips	42 tons sed/yr 95 lbs TP/yr 1,671 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$4,736
Cover Crops - Rye	Nitrogen and Phosphorus Hot Spots	14 rye cover crop fields	619 tons sed/yr 1,073 lbs TP/yr 13,815 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$68,580
Drainage Water Management	Nitrogen and Phosphorus Hot Spots	1 drainage water management practice	0 tons sed/yr 186 lbs TP/yr 1,863 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$86
Denitrifying Bioreactor	Nitrogen and Phosphorus Hot Spots	3 denitrifying bioreactors	0 tons sed/yr 189 lbs TP/yr 1,970 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$411,816
	Total	218 BMPs	2,919 tons sed/yr 7,175 lbs TP/yr 59,132 lbs TN/yr 236 ac-ft	N/A	N/A	$3,904,123

Monitoring and Evaluation

There is limited information on water quality within the priority subwatersheds. There is not enough information to determine impairment status of waterbodies and waterways within subwatersheds. Watershed monitoring should take place following defined procedures that are required to determine if a waterbody is impaired. Iowa DNR follows standards set forth under the Iowa Credible Data Law that align with federal requirements on proper water quality data collection and evaluation. Monitoring will be done in partnership with existing collaborators such as IDNR, Izaak Walton League, Iowa Institute for Hydraulic Research (IIHR), and local volunteer networks. Baseline water quality data will inform future management decisions on how best to implement practices and improvements that are defined within this subwatershed plan. Short-term funding priority should be given to the establishment of a monitoring framework to establish baseline water quality and track water quality improvement as a result of BMP implementation in the next 10 years.

Implementation documentation is an essential part of plan administration. Tracking how funds are spent, what outcomes were achieved, and any notes of successes or difficulties with implementation provide insight into how future implementation work within the subwatershed can be handled. Next steps should also include development of a database using GIS and/or spreadsheet tools so that there is a centralized and recognized place for the WMA to track funds, load reduction projections, and water quality improvements. Custom GIS and web-based applications can also be developed so that this information can be shared real-time with WMA members and agency partners in an online, dashboard format.

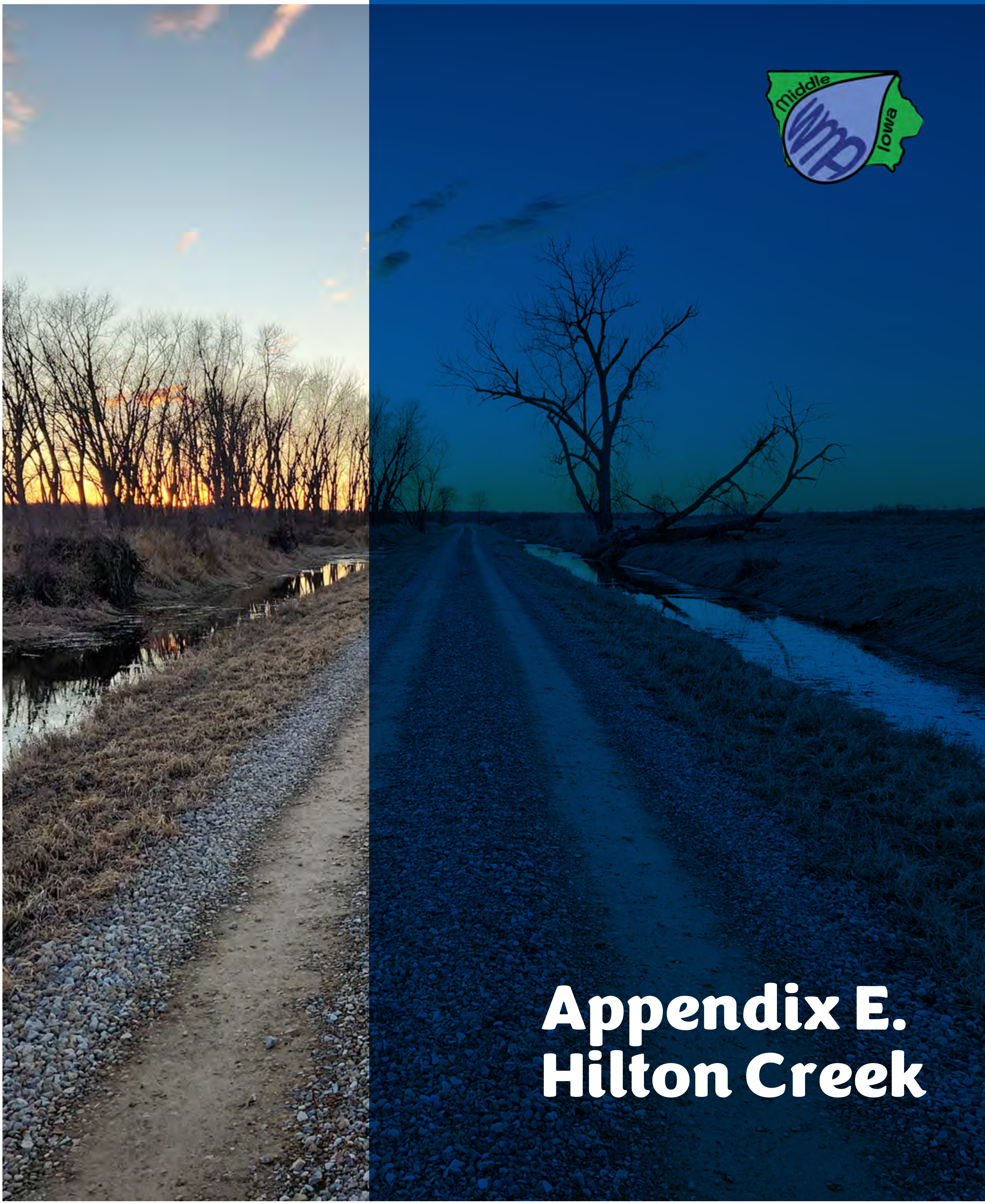
Plan Updates

Plan updates take place every five years. Updates provide information on what has changed since the plan was approved or since the last Plan Update. These plan updates also allow for a review of what successes or challenges have occurred since the last update.

Plan updates may include:

- Population and land use forecast and trends
- Water quality data review and 303(d) list review
- BMP tracking progress*
- Review of other models or monitoring programs that are taking place within the larger watershed that may be important to include in the updated subwatershed plan.

*Reporting and plan updates will be facilitated and enhanced if a framework is established early in the first steps of implementation following plan adoption.



Appendix E. Hilton Creek

Hilton Creek

Introduction

The Hilton Creek subwatershed (HUC-12 070802081001), Figure E-1, was selected as a priority subwatershed due to high sediment and phosphorus stress. The subwatershed contains the 13,935 acre drainage area around Hilton Creek. Hilton Creek is located along the southern boundary of the Middle Iowa Watershed and is south of the city of Marengo. Hilton Creek is located within Iowa County.

Watershed Characteristics

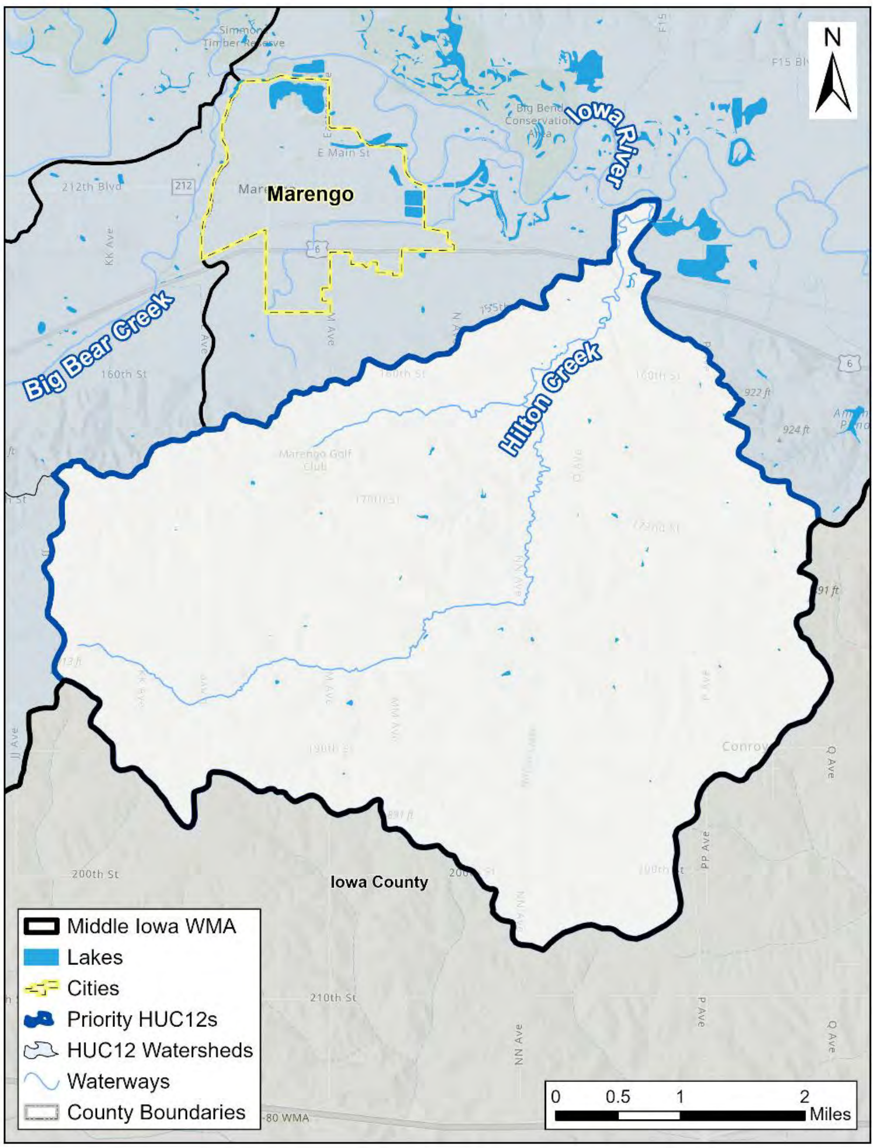


Figure E-1. Hilton Creek priority subwatershed

Population

Hilton Creek subwatershed is largely cropland, with scattered farm homes. The total number of producers in Iowa County is 1,667 with an average farm size of 354 acres (USDA, 2022). As the subwatershed is 4% the size of Iowa County, an estimated 71 producers grow crops and/or have livestock in the watershed, assuming land ownership is distributed uniformly across the county.

Land Use

Land cover in the Hilton Creek subwatershed is cropland (69%), developed land (5%), pasture (19%), wetland (1%) and forest (6%) (Figure E-2; Table E-1). In Iowa county from 2017-2022, the average size of farms decreased by 1% and the number of farms had no change. About 73% of Iowa County farm sale revenues are crops, while the other 27% is livestock, poultry, and other products. Of these, nearly 50% of livestock revenue is from hogs and pigs, and over 40% of revenue is from cattle (USDA, 2022). The top crops grown are corn and soybeans (USDA, 2022). In the Hilton Creek subwatershed, there are no feedlots and no wildlife management areas (DNR, 2024).

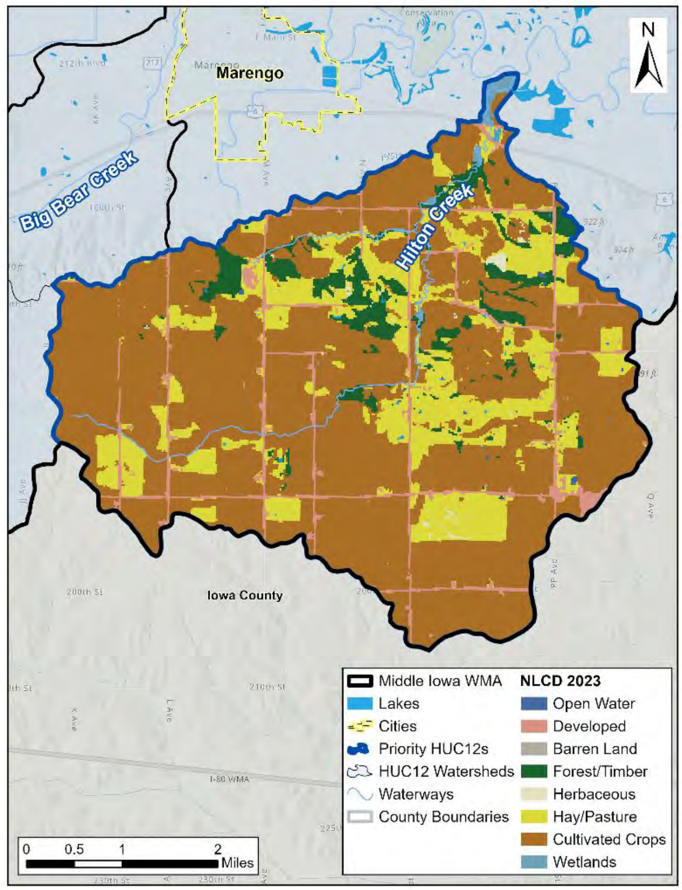


Figure E-2. Land cover in the Hilton Creek subwatershed

Table E-1. Land cover in the Hilton Creek subwatershed (USGS, 2023).

Land Use	Acres	Percent of Subwatershed
Cropland	9,615	69%
Pasture	2,648	19%
Forest	836	6%
Developed	697	5%
Wetland + Other	139	1%

Soils

The majority of the soil in the subwatershed is silty clay loam or silt loam. Infiltration of precipitation through soils recharges groundwater and reduces overland flow that carries pollutants to surface water, erodes soil, and can occur as flooding. Given the clay composition of the soil, Hilton Creek soils are hydrologic soil groups C or C/D, which have slow infiltration rates and high runoff potential. The Wind Erodibility Index in Hilton Creek is reported as 48 tons/acre/year (Soil Survey Staff, 2025). It is important to note that this value reflects a theoretical potential soil loss under worst-case conditions—specifically, bare and smooth soil surfaces with no vegetation or surface roughness. Actual wind erosion rates under typical land management and cropping practices are expected to be significantly lower, with actual wind erosion rates of less than 5 tons/acre/year, compared to 1-10 tons/acre/year of rainfall-driven sheet and rill erosion.

Streams

A network of tributaries feed into the 8-mile Hilton Creek. Hilton Creek flows into the Iowa River downstream of Marengo.

Resource Conditions

Designations and Impairments

As a minor creek, Hilton Creek does not have designated uses in ADBNet. The Hilton Creek subwatershed does not contain any impaired waters; however, there has not been sufficient data collected to fully document support or impairment of designated uses. Additionally, Hilton Creek drains into the Iowa River which has an A1 and HH designated use and is impaired due to *E. coli* and mercury consumption through fish. Plan actions are not targeted towards mercury impairments but efforts to target sediment and nutrient losses will also reduce bacteria pollution.

Historical Conservation Success

To date, Hilton Creek has not been the focus of any documented, targeted watershed grants (e.g., Section 319, Water Quality Initiative).

Iowa State University, with funding from Iowa Department of Natural Resources and other state resources, utilized satellite imagery and LiDAR resources to establish likely locations of installed best management practices (BMPs) on the landscape in the Iowa BMP Mapping Project. The project focused on specific BMPs types, although the BMPs included in these results are not guaranteed to meet NRCS practice standards. The BMPs documented in the project are Terraces, Water and Sediment Control Basins, Grassed Waterways, Pond Dams, and Contour Buffer Strips.

As of 2010, there were an estimated 1,283 BMPs within the drainage area of the Hilton Creek HUC-12 watershed. A breakdown of BMPs is shown in Table E-2. Note that some BMPs are best expressed as size (acres or linear feet) rather than a count but size is not provided in the dataset.

Table E-2. Existing BMPs within Hilton Creek, as of 2010 (ISU, 2017).

BMP Type	Number of BMPs
WASCOB (NRCS 638)	104
Terrance (NRCS 600)	165
Pond Dam (NRCS 378)	49
Grassed Waterways (NRCS 412)	914
Contour Buffer Strips (NRCS 332)	51

Pollutants of Concern

Monitoring of *E. coli* has led to the impairment listing of the Iowa River, and reducing bacteria loading in the Hilton Creek subwatershed will help improve Iowa River water quality. *E. coli* is used as an indicator of the presence of fecal contamination, as *E. coli* is often present along with other pathogens that pose an increased risk of illness if people are exposed through swimming or recreating. *E. coli* can come from many nonpoint sources, including improper application of manure to fields, feedlot runoff, livestock grazing in riparian areas, leaking subsurface septic treatment systems, pet waste, and wildlife.

Erosion of topsoil through sheet and rill and ephemeral gully formation contribute to sediment transport to streams across Iowa, including through cropland in the Hilton Creek watershed. Additionally, streambank and channel erosion also contribute to sediment loading and turbidity.

Nitrogen and phosphorus losses are high priorities as well, not only due to Gulf of America Hypoxia issues addressed in Iowa's Nutrient Reduction Strategy, but also to protect and improve local water quality issues such as maintaining healthy drinking water sources and preventing nuisance growth of algae and other aquatic plants (to limit eutrophication).

Pollutant Source Assessment

General sources and quantities of water quality pollutants of concern were evaluated using the US Geological Survey (USGS) SPAtially-Referenced Regression On Watershed attributes (SPARROW) model. Predicted pollutant yields and load were summarized for runoff volume, sediment, total phosphorus, and total nitrogen.

The SPARROW model has separate multiple linear regression equations for estimating sediment, total phosphorus, and total nitrogen yield from the landscape and delivery to downstream locations. Each individual equation is composed of multiple variables that relate to source strength of the sediment, total phosphorus, or total nitrogen; the delivery of each component from the landscape to receiving waterbodies; and in-stream routing and loss due to natural physical, chemical, and/or biological factors.

The multiple linear regression model for sediment primarily derives its localized erosion estimates from landuse type(s) within each SPARROW catchment, whereas the models for total phsophorus and total nitrogen also include other factors such as fertilizer use, wastewater treatment plant effluent, atmospheric deposition, manure application on agricultural land, subsurface tile drainage density, etc. More information about the SPARROW model can be in the U.S. Geological Survey Scientific Investigations Report 2019–5114.

Figure E-3 presents the incremental yields of common water quality and quantity parameters. These represent the mass of each parameter lost from the landscape per hectare within each delineated SPARROW catchment.

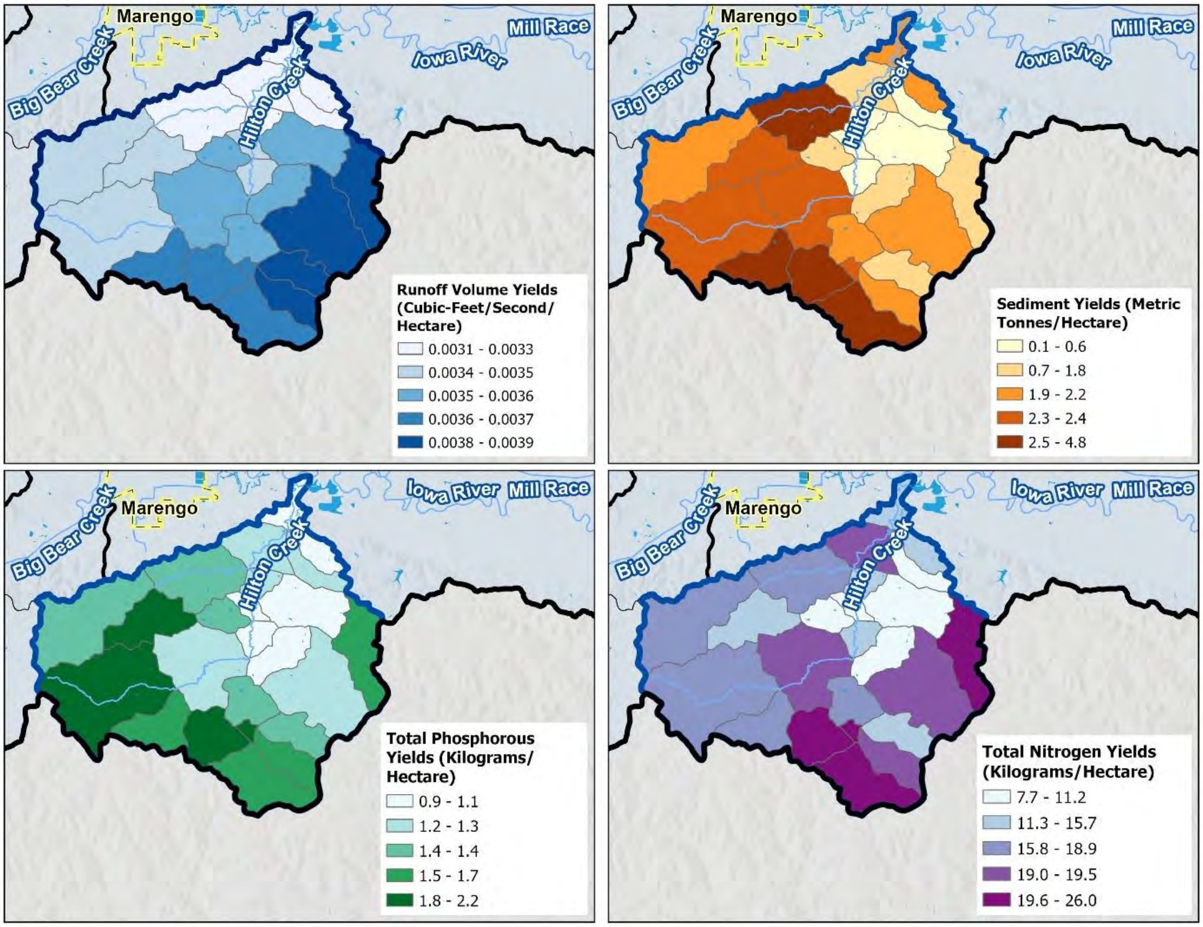


Figure E-3. Runoff, Sediment, Phosphorus, and Nitrogen yields for Hilton Creek from the USGS SPAtially-Referenced Regression On Watershed attributes (SPARROW) model.

The SPARROW model includes a delivery fraction for each water quality parameter to mathematically route loads from each SPARROW catchment downstream, accounting for the fraction of the total mass generated within a SPARROW catchment that does not travel to the watershed outlet on an annual basis. With that information, the measurable total annual load of each water quality parameter was estimated at the outlet of the Hilton Creek HUC-12 (Table E-3).

Table E-3. Total annual load of sediment, total phosphorus, and total nitrogen from the Hilton Creek Subwatershed

Water Quality Parameter	Existing load (Sum of Incremental)	Existing Load (per acre)	Existing load (accumulated at HUC-12 outlet)	Delivery Ratio
Sediment (tons/yr)	12,991	0.93	9,745	0.75
Total Phosphorus (lbs/yr)	17,997	1.44	15,195	0.84
Total Nitrogen (lbs/yr)	214,954	15.43	190,164	0.88

Goals and Objectives

Within the Hilton Creek subwatershed, existing loads of sediment, total phosphorus, and total nitrogen, as well as the Iowa Nutrient Reduction Strategy and recommendations from the Technical Advisory Committee, were used to establish load reduction goals.

Iowa Nutrient Reduction Strategy goals aim for a long-term reduction of phosphorus and nitrogen by 45%. The load reductions attributable to non-point source pollution are 41% for nitrogen and 29% for phosphorus. These are the established long-term goals for this watershed management plan. Short term goals (over the 10-year life of this plan) were established at a 10% reduction for both phosphorus, nitrogen, and sediment (Table E-4).

Table E-4. Plan (10-yr) and long-term water quality goals set for the Hilton Creek HUC-12. Sediment and nutrient load reductions are measured at the outlet of the HUC-12 subwatershed

Water Quality Parameter	Existing Loads (at HUC-12 outlet)	Hilton Creek Load Reduction Goals
Sediment (tons/yr)	9,745	Short-term: 10% (975 tons)
Total Phosphorus (lbs/yr)	15,195	Short-term: 10% (1,519 lbs), Long-term:29% (4,407 lbs)
Total Nitrogen (lbs/yr)	190,164	Short-term: 10% (19,016lbs), Long-term: 41% (77,967 lbs)

Through the implementation of conservation practices (CP) and BMPs presented in the implementation scenario below, the desired water quality goals can be reached.

Implementation Plan: Hilton Creek

Conservation and best management practices can be used, in tandem with other efforts throughout the subwatershed, to work toward achieving the water quality goals set forth in this plan.

The Agricultural Conservation and Planning Framework (ACPF) model was used to find locations on the landscape that are suitable for the implementation of CPs and BMPs. Costs for implementation of the BMPs were estimated using typical Iowa NRCS Environmental Quality Incentives Program (EQIP) payment rates. Those values were then doubled to more accurately represent the true cost of implementing each practice, accounting for additional factors such as administrative time.

Load reduction estimates for each individual BMP were estimated using the underlying SPARROW data and assumed load reduction efficiencies of each BMP type (Table E-5). Load reduction efficiencies are primarily from the Iowa NRS, Minnesota Agricultural BMP Handbook, and other applicable references; prioritizing data and research from Iowa sources, then midwestern sources, and finally regional/national sources. Rates reported in the Iowa NRS are expressed as ranges and have many caveats, making it necessary to use other sources of data to develop average rates.

Table E-5. Conservation and Best Management Practice load reduction fractions.

BMP	Sediment Reduction Efficiency	Total Phosphorus Reduction Efficiency	Total Nitrogen Reduction Efficiency
Nutrient reduction wetland (NRW)	0.75	0.53	0.30
Grassed waterway (GWW)†	0.96	1.00	1.00
Drainage water management (DWM)	0.69	0.55	0.4
Cover crops - rye (CCR)	0.70	0.50	0.28
Contour buffer strips (CBS)	0.87	0.695	0.52
Bioreactor (BIO)	0.69	0.55	0.24
Saturated buffer (STB)	0.84	0.5	0.45
Riparian buffer (RIB)	0.76	0.58	0.87
Ponds and/or Water and sediment control basin (WASCOB)	0.88	0.85	0.57

† *Reduction for armoring the soil in the location of the grassed waterway, not filtering incoming water*

Load reduction estimates for a given BMP were calculated as the treatable load at the location of the BMP multiplied by the load reduction efficiency of that BMP type. Cost-effectiveness

was then also calculated for each BMP as the dollars needed to reduce one ton of sediment or one pound of nitrogen or phosphorus.

To work toward water quality goals most efficiently and effectively, BMPs were prioritized according to recommendations from the Technical Advisory Committee. Based on the prioritization analysis using the RPS Tool, BMPs in the Hilton Creek watershed were prioritized based on their cost-effectiveness for reducing phosphorus loads, as measured at the HUC-12 subwatershed outlet.

The project pollutant load reductions were obtained by "weighting" BMP types based on the (1) likelihood of a BMP being implemented, as measured by landowner/producer interest, and/or (2) the interest/desire of conservation professionals to promoted a particular BMP type within the subwatershed (Table E-6). This information was obtained from conservation staff from Iowa County.

Table E-6. Implementation Plan BMPs, likelihood of implementation, and weighting within the implementation scenario.

BMP	Likelihood of BMP type use within the HUC-12. (e.g. high, medium, low, zero)		Weighting*
	Popularity & Buy-In	Interest of SWCD in Promoting	
Grassed waterway	Medium	Medium	8.3%
Saturated buffer	Low	Medium	8.3%
Riparian buffer	Very Low	High	8.3%
Pond/WASCOB	High	Medium	11.5%
Nutrient reduction wetland	Low	Medium	8.3%
Contour buffer strips	Low	High	8.3%
Cover crops - rye	High	High	22.5%
Drainage water management	Low	Low	5.0%
Denitrifying bioreactor	Medium	Low	8.3%

**Fraction of the phosphorus load reduction goal the selected BMP will reduce within the implementation scenario.*

Using this BMP selection methodology, a scenario was created to show one path for achieving the water quality goals of this plan. Necessary load reductions for each BMP type, based on the weighting factor, will be met or exceeded for both phosphorus and nitrogen using this scenario. This plan is not prescriptive but shows one way of efficiently reducing loads of sediment and nutrients. Figure E-4 showcases the BMPs that were selected to be part of this implementation scenario (Table E-7). In order to meet the 10-year plan goal, 352 BMPs are planned in the Hilton Creek subwatershed that are estimated to reduce sediment by 1,933 tons/yr, phosphorus by 2,233 lbs/yr, and nitrogen by 19,366 lbs/yr.

The Action Table (Table E-7) lays out a suggested areas of implementation efforts along with the suggested entities responsible for aiding and overseeing the implementation of the necessary BMPs to meet the goals laid out in this plan.

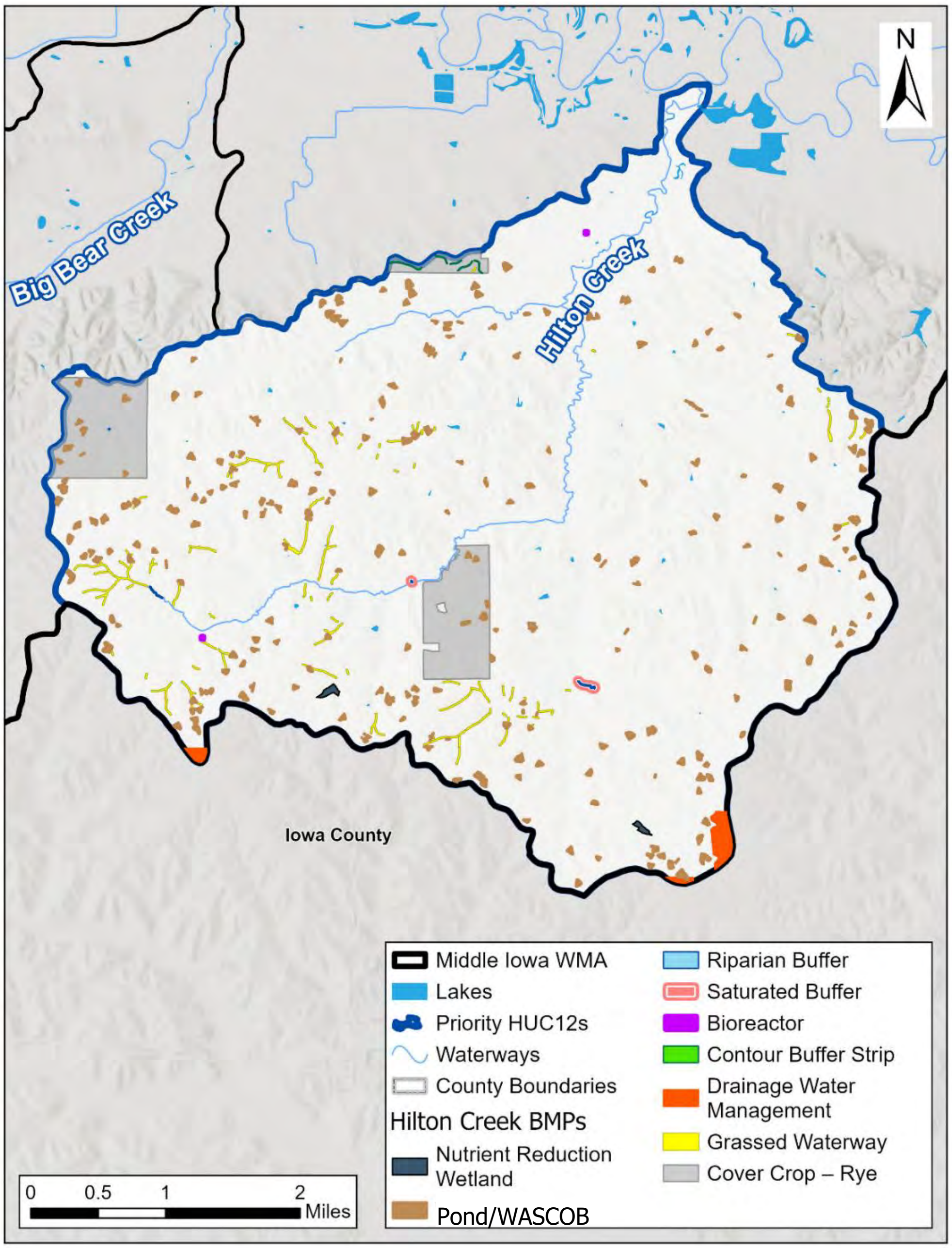


Figure E-4. Best management and conservation practices that are part of this implementation scenario.

Table E-7. Hilton Creek Action Table.

BMP / Conservation Practice	Focus Areas	Output	Outcome	Responsible Entity	Timeline	10-Year Cost
Grassed Waterway	Nitrogen and Phosphorus Hot Spots	47 waterways	112 tons sed/yr 135 lbs TP/yr 1,032 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$749,044
Saturated Buffer	N/A	4 buffers	126 tons sed/yr 130 lbs TP/yr 2,530 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$32,800
Riparian Buffer	N/A	4 buffers	604 tons sed/yr 538 lbs TP/yr 5,401 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$2,804
WASCOB	Nitrogen and Phosphorus Hot Spots	277 WASCOBs	113 tons sed/yr 142 lbs TP/yr 1,134 lbs TN/yr 308 ac-ft	SWCDs, NRCS, IDALS	10 years	$1,246,500
Nutrient Reduction Wetland	Nitrogen and Phosphorus Hot Spots	2 nutrient reduction wetlands	232 tons sed/yr 252 lbs TP/yr 1,258 lbs TN/yr 30 ac-ft	SWCDs, NRCS, IDALS	10 years	$89,712
Contour Buffer Strips	Nitrogen and Phosphorus Hot Spots	4 buffer strips	128 tons sed/yr 173 lbs TP/yr 1,182 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$4,736
Cover Crops - Rye	Nitrogen and Phosphorus Hot Spots	6 rye cover crop fields	616 tons sed/yr 612 lbs TP/yr 4,853 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$29,391
Drainage Water Management	Nitrogen and Phosphorus Hot Spots	3 drainage water management practices	0 tons sed/yr 111 lbs TP/yr 923 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$257
Denitrifying Bioreactor	Nitrogen and Phosphorus Hot Spots	5 denitrifying bioreactors	0 tons sed/yr 138 lbs TP/yr 1,052 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$686,360
	Total	352 BMPs	1,933 tons sed/yr 2,233 lbs TP/yr 19,366 lbs TN/yr 338 ac-ft	N/A	N/A	$2,841,604

Monitoring and Evaluation

There is limited information on water quality within the priority subwatersheds. There is not enough information to determine impairment status of waterbodies and waterways within subwatersheds. Watershed monitoring should take place following defined procedures that are required to determine if a waterbody is impaired. Iowa DNR follows standards set forth under the Iowa Credible Data Law that align with federal requirements on proper water quality data collection and evaluation. Monitoring will be done in partnership with existing collaborators such as IDNR, Izaak Walton League, Iowa Institute for Hydraulic Research (IIHR), and local volunteer networks. Baseline water quality data will inform future management decisions on how best to implement practices and improvements that are defined within this subwatershed plan. Short-term funding priority should be given to the establishment of a monitoring framework to establish baseline water quality and track water quality improvement as a result of BMP implementation in the next 10 years.

Implementation documentation is an essential part of plan administration. Tracking how funds are spent, what outcomes were achieved, and any notes of successes or difficulties with implementation provide insight into how future implementation work within the subwatershed can be handled. Next steps should also include development of a database using GIS and/or spreadsheet tools so that there is a centralized and recognized place for the WMA to track funds, load reduction projections, and water quality improvements. Custom GIS and web-based applications can also be developed so that this information can be shared real-time with WMA members and agency partners in an online, dashboard format.

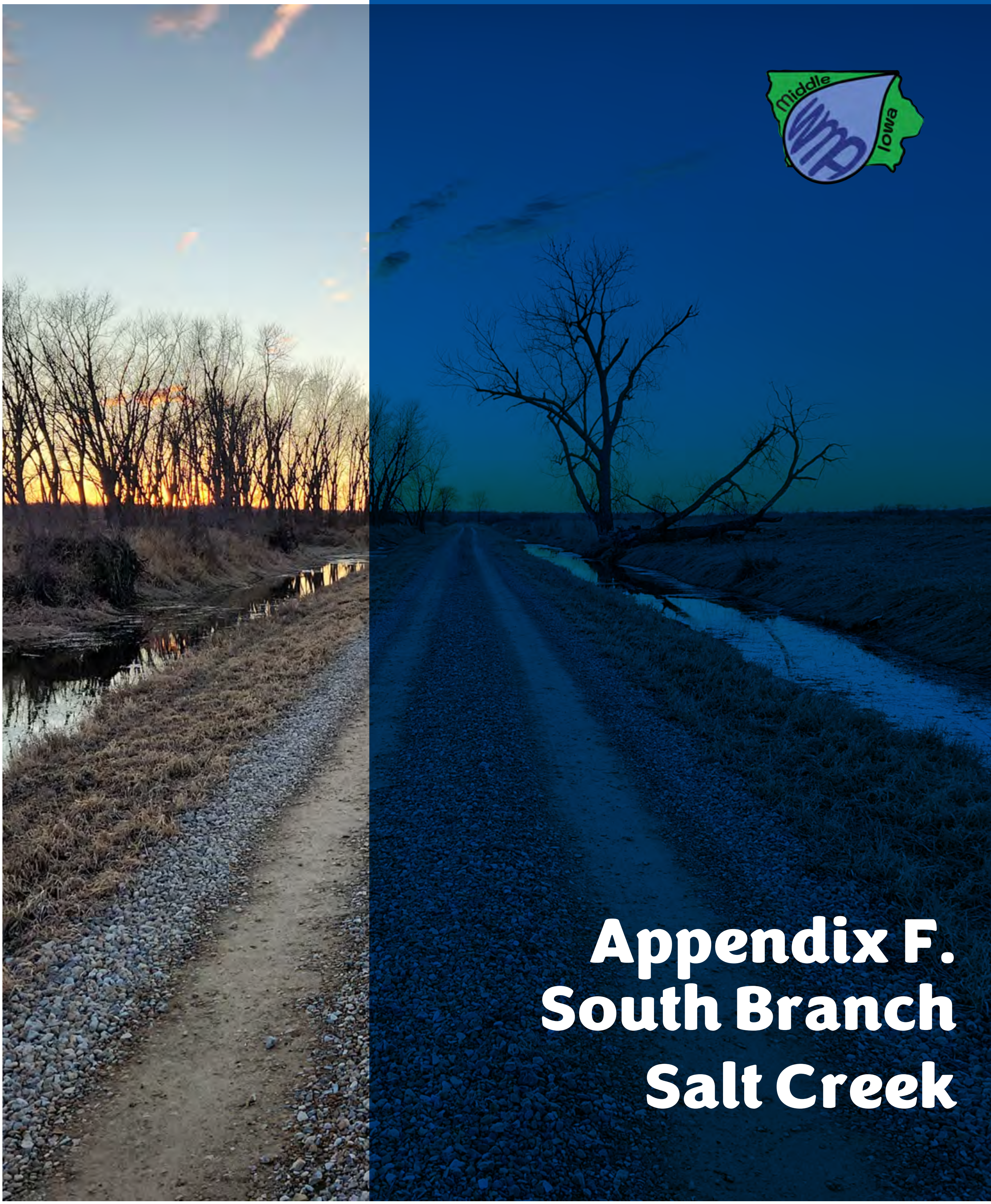
Plan Updates

Plan updates take place every five years. Updates provide information on what has changed since the plan was approved or since the last Plan Update. These plan updates also allow for a review of what successes or challenges have occurred since the last update.

Plan updates may include:

- Population and land use forecast and trends
- Water quality data review and 303(d) list review
- BMP tracking progress*
- Review of other models or monitoring programs that are taking place within the larger watershed that may be important to include in the updated subwatershed plan.

*Reporting and plan updates will be facilitated and enhanced if a framework is established early in the first steps of implementation following plan adoption.



Appendix F. South Branch Salt Creek

South Branch Salt Creek

Introduction

The South Branch Salt Creek subwatershed (HUC-12 070802080501), Figure F-1, was selected as a priority subwatershed due to high phosphorus and sediment stress. The subwatershed contains the 19,719 acre drainage area around South Branch Salt Creek. South Branch Salt Creek is located in Tama County, in the north of the Middle Iowa Watershed.

Watershed Characteristics

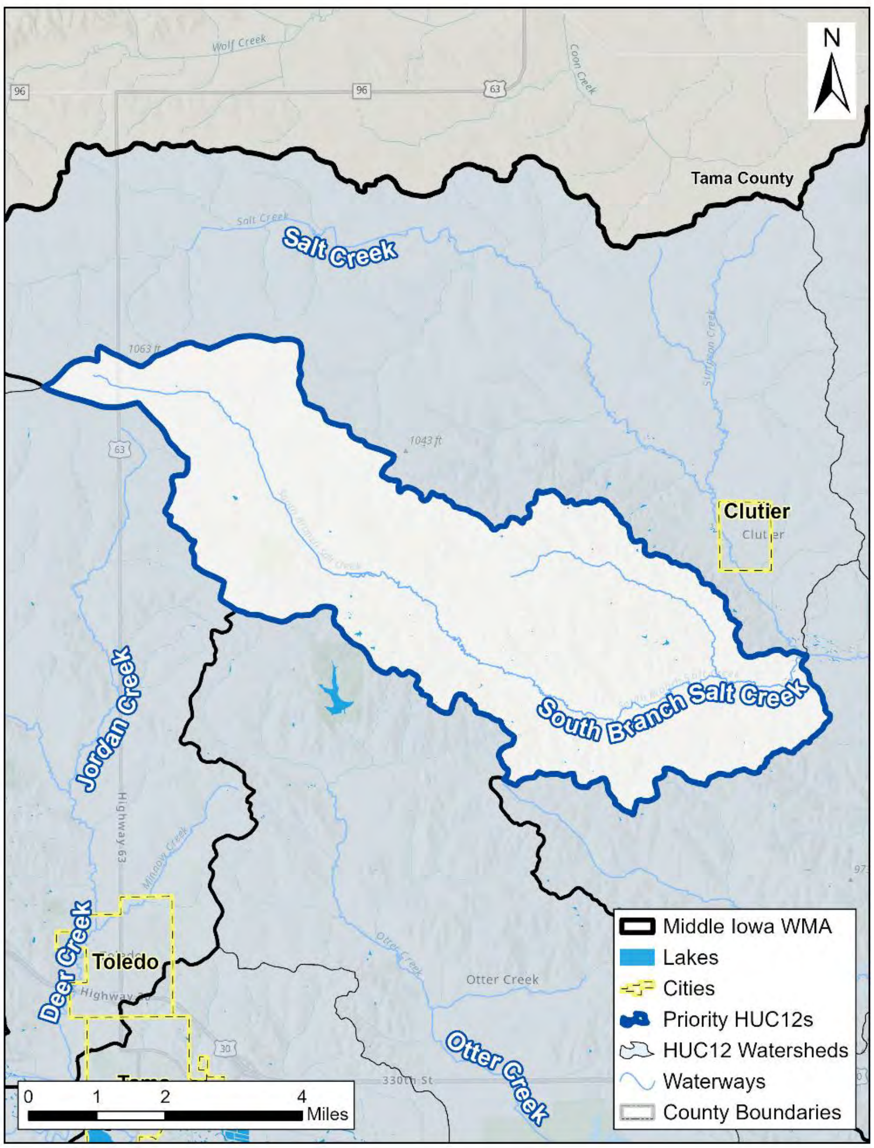


Figure F-1. South Branch Salt Creek priority subwatershed

Population

There are no cities within the watershed. South Branch Salt Creek subwatershed is largely cropland and pasture. The total number of producers in Tama County is 1,838 with an average farm size of 341 acres (USDA, 2022). As the subwatershed is 4% the size of Marshall County, an estimated 74 producers grow crops and/or have livestock in the watershed, assuming farm ownership is distributed uniformly across the county.

Land Use

Land cover in the South Branch Salt Creek subwatershed is cropland (69%), developed land (5%), pasture (22%), and forest (4%) (Figure F-2; Table F-1). In Tama County, the average size of farms has decreased by 10% and the number of farms has decreased by 1% from 2017-2022 (USDA, 2022). About 75% of Tama County farm sale revenues are crops, while the other 25% is livestock, poultry, and other products. Of these, 58% of publicly available livestock revenue is from hogs and pigs, and over 40% of revenue is from cattle (USDA, 2022). In the South Branch Salt Creek subwatershed, there are three feedlots with about 3,400 animal units (DNR, 2024). The top crops grown are corn and soybeans (USDA, 2022). There are 162 acres of recreational land available for hunting or fishing within the subwatershed in the Kunch Wildlife Management Area.

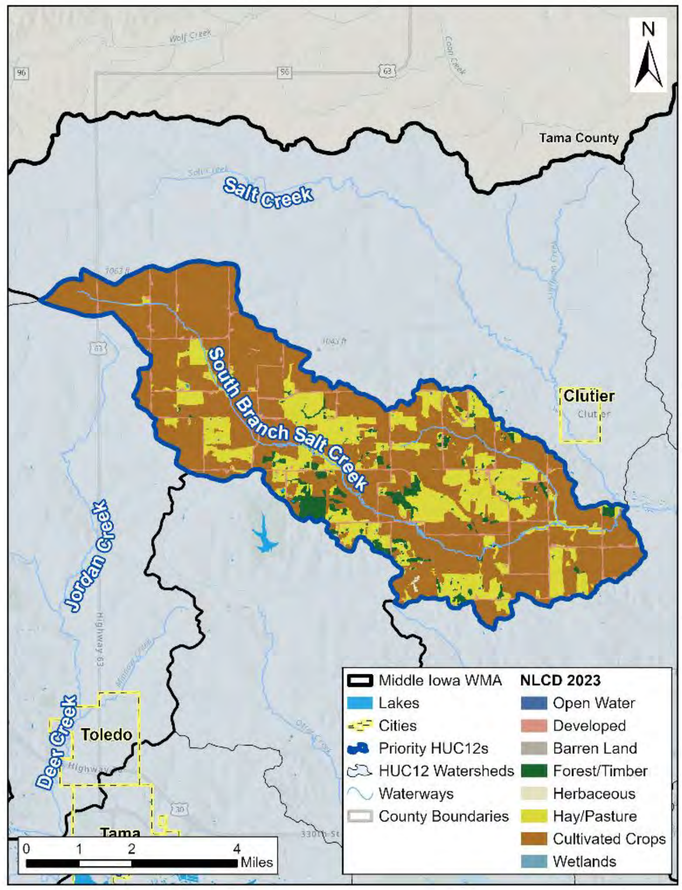


Figure F-2. Land cover in the South Branch Salt Creek subwatershed.

Table F-1. Land Cover in South Branch Salt Creek (USGS, 2023).

Land Use	Acres	Percent of Subwatershed
Cropland	13,606	69%
Pasture	4,338	22%
Forest	789	4%
Developed	986	5%

Soils

The majority of soil in the subwatershed is silt loam, with the next largest texture as silty clay loam. Given the clay composition of the soil, South Branch Salt Creek soils are hydrologic soil groups C or C/D, which have slow infiltration rates and high runoff potential. Infiltration of precipitation through soils recharges groundwater and reduces overland flow that carries pollutants to surface water, erodes soil, and can occur as flooding. The Wind Erodibility Index in South Branch Salt Creek is reported as 50 tons/acre/year (Soil Survey Staff, 2025). It is important to note that this value reflects a theoretical potential soil loss under worst-case conditions—specifically, bare and smooth soil surfaces with no vegetation or surface roughness. Actual wind erosion rates under typical land management and cropping practices are expected to be significantly lower, with actual wind erosion rates of less than 5 tons/acre/year, compared to 1-10 tons/acre/year of rainfall-driven sheet and rill erosion.

Streams

This subwatershed encompasses the 16-mile stretch of South Branch Salt Creek and its tributaries (USGS, 2020). The creek drains into Salt Creek at the subwatershed outlet.

Resource Conditions

Designations and Impairments

South Branch Salt Creek is waterbody IA 02-IOW-6476 on ADBNet. South Branch Salt Creek's designated uses are Class A1 (Primary Contact Recreation) and BWW1 (Warm Water Aquatic Life). The South Branch Salt Creek subwatershed does not contain any impaired waters; however, there has not been sufficient data collected to fully document support or impairment of designated uses. Additionally, South Branch Salt Creek drains into Salt Creek which drains into the Iowa River. The Iowa River has A1 and HH designated uses and is impaired due to *E. coli* and mercury consumption through fish. The Iowa River at the Salt Creek confluence is not impaired to due bacteria, but does become impaired due to bacteria again further downstream past Margengo. Plan actions are not targeted towards mercury impairments but efforts to target sediment and nutrient losses will also reduce bacteria pollution.

Historical Conservation Success

To date, South Branch Salt Creek has not been the focus of any documented, targeted watershed grants (e.g., Section 319, Water Quality Initiative).

Iowa State University, with funding from Iowa Department of Natural Resources and other state resources, utilized satellite imagery and LiDAR resources to establish likely locations of

installed best management practices (BMPs) on the landscape in the Iowa BMP Mapping Project. The project focused on specific BMPs types, although the BMPs included in these results are not guaranteed to meet NRCS practice standards. The BMPs documented in the project are Terraces, Water and Sediment Control Basins, Grassed Waterways, Pond Dams, Contour Strip Cropping, and Contour Buffer Strips.

As of 2010, there were an estimated 1,216 BMPs within the drainage area of the South Branch Salt Creek HUC-12 watershed. A breakdown of BMPs is shown in Table F-2Figure F-2. Note that some BMPs are best expressed as size (acres or linear feet) rather than a count but size is not provided in the dataset.

Table F-2. Existing BMPs within South Branch Salt Creek, as of 2010 (ISU, 2017).

BMP Type	Number of BMPs
WASCOB (NRCS 638)	106
Terrance (NRCS 600)	49
Pond Dam (NRCS 378)	70
Grassed Waterways (NRCS 412)	965
Contour Buffer Strips (NRCS 332)	21
Strip-cropping (NRCS 585)	5

Pollutants of Concern

Monitoring of *E. coli* has led to the impairment listing of the Iowa River, and reducing bacteria loading in the South Branch Salt Creek subwatershed will help improve Iowa River water quality. *E. coli* is used as an indicator of the presence of fecal contamination, as *E. coli* is often present along with other pathogens that pose an increased risk of illness if people are exposed through swimming or recreating. *E. coli* can come from many nonpoint sources, including improper application of manure to fields, feedlot runoff, livestock grazing in riparian areas, leaking subsurface septic treatment systems, pet waste, and wildlife.

Erosion of topsoil through sheet and rill and ephemeral gully formation contribute to sediment transport to streams across Iowa, including through cropland in the South Branch Salt Creek watershed. Additionally, streambank and channel erosion also contribute to sediment loading and turbidity.

Nitrogen and phosphorus losses are high priorities as well, not only due to Gulf of America Hypoxia issues addressed in Iowa's Nutrient Reduction Strategy, but also to protect and improve local water quality issues such as maintaining healthy drinking water sources and preventing nuisance growth of algae and other aquatic plants (to limit eutrophication).

Pollutant Source Assessment

General sources and quantities of water quality pollutants of concern were evaluated using the US Geological Survey (USGS) SPAtially-Referenced Regression On Watershed attributes (SPARROW) model. Predicted pollutant yields and load were summarized for runoff volume, sediment, total phosphorus, and total nitrogen.

The SPARROW model has separate multiple linear regression equations for estimating sediment, total phosphorus, and total nitrogen yield from the landscape and delivery to downstream locations. Each individual equation is composed of multiple variables that relate to source strength of the sediment, total phosphorus, or total nitrogen; the delivery of each component from the landscape to receiving waterbodies; and in-stream routing and loss due to natural physical, chemical, and/or biological factors.

The multiple linear regression model for sediment primarily derives its localized erosion estimates from landuse type(s) within each SPARROW catchment, whereas the models for total phsophorus and total nitrogen also include other factors such as fertilizer use, wastewater treatment plant effluent, atmospheric deposition, manure application on agricultural land, subsurface tile drainage density, etc. More information about the SPARROW model can be in the U.S. Geological Survey Scientific Investigations Report 2019–5114.

Figure F-3 presents the incremental yields of common water quality and quantity parameters. These represent the mass of each parameter lost from the landscape per hectare within each delineated SPARROW catchment.

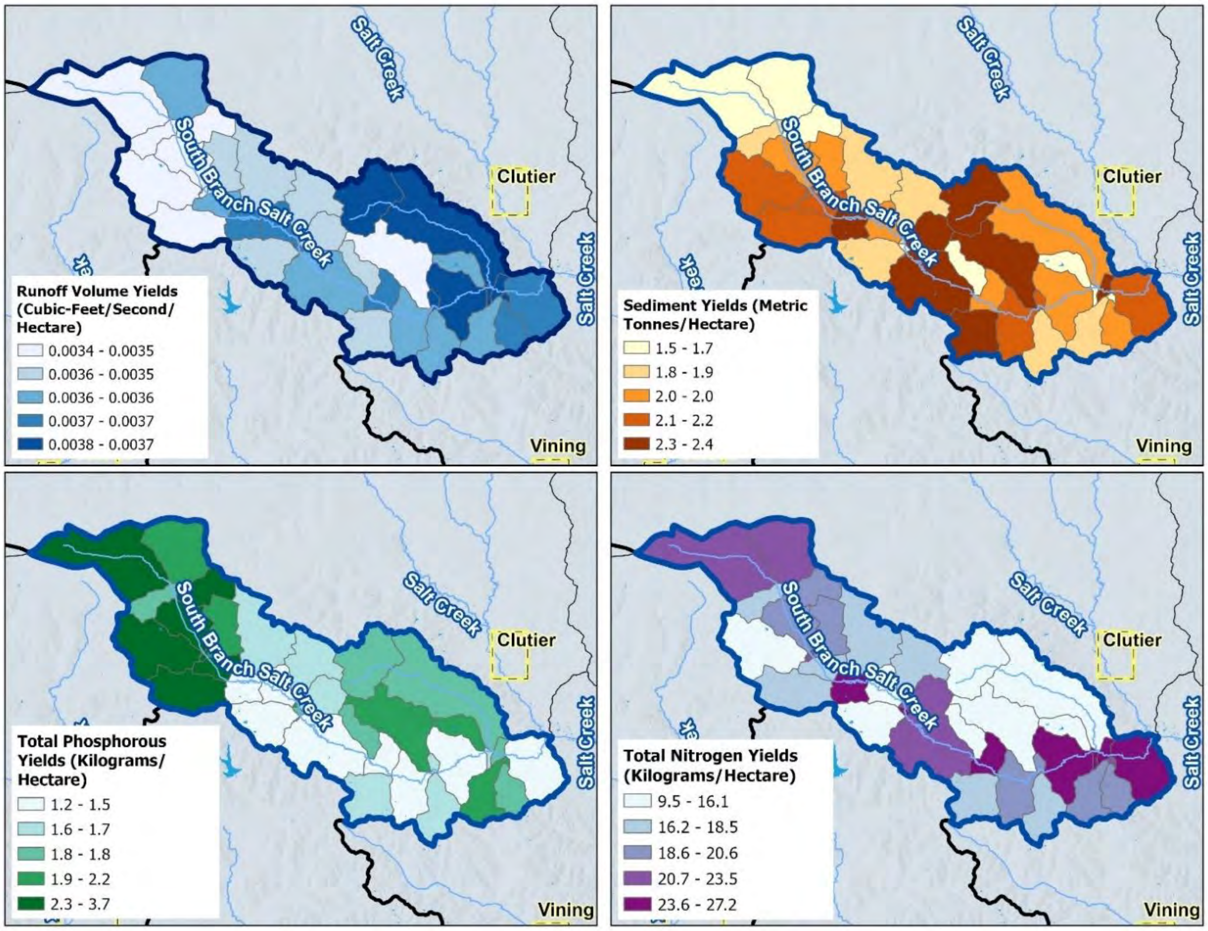


Figure F-3. Runoff, Sediment, Phosphorus, and Nitrogen yields for South Branch Salt Creek from the USGS SPAtially-Referenced Regression On Watershed attributes (SPARROW) model.

The SPARROW model includes a delivery fraction for each water quality parameter to mathematically route loads from each SPARROW catchment downstream, accounting for the fraction of the total mass generated within a SPARROW catchment that does not travel to the watershed outlet on an annual basis. With that information, the measurable total annual load of each water quality parameter was estimated at the outlet of the South Branch Salt Creek HUC-12 (Table F-3).

Table F-3. Total annual load of sediment, total phosphorus, and total nitrogen from the South Branch Salt Creek Subwatershed

Water Quality Parameter	Existing load (Sum of Incremental)	Existing Load (per acre)	Existing load (accumulated at HUC-12 outlet)	Delivery Ratio
Sediment (tons/yr)	17,223	0.87	12,431	0.72
Total Phosphorus	31,262	1.59	25,283	0.81

(lbs/yr)				
Total Nitrogen (lbs/yr)	324,077	16.43	280,043	0.86

Goals and Objectives

Within the South Branch Salt Creek subwatershed, existing loads of sediment, total phosphorus, and total nitrogen, as well as the Iowa Nutrient Reduction Strategy and recommendations from the Technical Advisory Committee, were used to establish load reduction goals.

Iowa Nutrient Reduction Strategy goals aim for a long-term reduction of phosphorus and nitrogen by 45%. The load reductions attributable to non-point source pollution are 41% for nitrogen and 29% for phosphorus. These are the established long-term goals for this watershed management plan. Short term goals (over the 10-year life of this plan) were established at a 10% reduction for both phosphorus, nitrogen, and sediment (Table F-4).

Table F-4. Plan (10-yr) and long-term water quality goals set for the South Branch Salt Creek HUC-12. Sediment and nutrient load reductions are measured at the outlet of the HUC-12 subwatershed.

Water Quality Parameter	Existing Loads (at HUC-12 outlet)	South Branch Salt Creek Load Reduction Goals
Sediment (tons/yr)	12,431	Short-term: 10% (1,243 tons)
Total Phosphorus (lbs/yr)	25,283	Short-term: 10% (2,528 lbs), Long-term:29% (7,332 lbs)
Total Nitrogen (lbs/yr)	280,043	Short-term: 10% (28,004), Long-term: 41% (114,817 lbs)

Through the implementation of conservation practices (CP) and BMPs presented in the implementation scenario below, the desired water quality goals can be reached.

Implementation Plan: South Branch Salt Creek

Conservation and best management practices can be used, in tandem with other efforts throughout the subwatershed, to work toward achieving the water quality goals set forth in this plan.

The Agricultural Conservation and Planning Framework (ACPF) model was used to find locations on the landscape that are suitable for the implementation of CPs and BMPs. Costs for implementation of the BMPs were estimated using typical Iowa NRCS Environmental

Quality Incentives Program (EQIP) payment rates. Those values were then doubled to more accurately represent the true cost of implementing each practice, accounting for additional factors such as administrative time.

Load reduction estimates for each individual BMP were estimated using the underlying SPARROW data and assumed load reduction efficiencies of each BMP type (Table F-5). Load reduction efficiencies are primarily from the Iowa NRS, Minnesota Agricultural BMP Handbook, and other applicable references; prioritizing data and research from Iowa sources, then midwestern sources, and finally regional/national sources. Rates reported in the Iowa NRS are expressed as ranges and have many caveats, making it necessary to use other sources of data to develop average rates.

Table F-5. Conservation and Best Management Practice load reduction fractions.

BMP	Sediment Reduction Efficiency	Total Phosphorus Reduction Efficiency	Total Nitrogen Reduction Efficiency
Nutrient reduction wetland (NRW)	0.75	0.53	0.30
Grassed waterway (GWW)†	0.96	1.00	1.00
Drainage water management (DWM)	0.69	0.55	0.4
Cover crops - rye (CCR)	0.70	0.50	0.28
Contour buffer strips (CBS)	0.87	0.695	0.52
Bioreactor (BIO)	0.69	0.55	0.24
Saturated buffer (STB)	0.84	0.5	0.45
Riparian buffer (RIB)	0.76	0.58	0.87
Ponds and/or Water and sediment control basin (WASCOB)	0.88	0.85	0.57

† *Reduction for armoring the soil in the location of the grassed waterway, not filtering incoming water*

Load reduction estimates for a given BMP were calculated as the treatable load at the location of the BMP multiplied by the load reduction efficiency of that BMP type. Cost-effectiveness was then also calculated for each BMP as the dollars needed to reduce one ton of sediment or one pound of nitrogen or phosphorus.

To work toward water quality goals most efficiently and effectively, BMPs were prioritized according to recommendations from the Technical Advisory Committee. Within the South Branch Salt Creek Watershed, BMPs were prioritized based on their cost-effectiveness for reducing nitrogen loads, as measured at the HUC-12 subwatershed outlet.

The project pollutant load reductions were obtained by "weighting" BMP types based on the (1) likelihood of a BMP being implemented, as measured by landowner/producer interest, and/or (2) the interest/desire of conservation professionals to promoted a particular BMP type within the subwatershed (Table F-6). This information was obtained from conservation professionals familiar with the subwatershed.

Table F-6. Implementation Plan BMPs, likelihood of implementation, and weighting within the implementation scenario.

BMP	Likelihood of BMP type use within the HUC-12. (e.g. high, medium, low, zero)		Weighting*
	Popularity & Buy-In	Interest of SWCD in Promoting	
Grassed waterway	Medium	High	19.2%
Saturated buffer	Low	Medium	4.6%
Riparian buffer	Low	Low	4.6%
Pond/WASCOB	Low	Medium	4.6%
Nutrient reduction wetland	Medium	High	4.6%
Contour buffer strips	Low	Low	19.3%
Cover crops - rye	High	High	19.2%
Drainage water management	Low	Low	19.3%
Denitrifying bioreactor	Low	Low	4.6%

**Fraction of the nitrogen load reduction goal the selected BMP will reduce within the implementation scenario.*

Using this BMP selection methodology, a scenario was created to show one path for achieving the water quality goals of this plan. Necessary load reductions for each BMP type, based on the weighting factor, will be met or exceeded for both phosphorus and nitrogen using this scenario. This plan is not prescriptive but shows one way of efficiently reducing loads of sediment and nutrients. Figure F-4 showcases the BMPs that were selected to be part of this implementation scenario. In order to meet the 10-year plan goal, 413 BMPs are planned in the South Branch Salt Creek subwatershed that are estimated to reduce sediment by 1,535 tons/yr, phosphorus by 3,199 lbs/yr, and nitrogen by 28,074 lbs/yr.

The Action Table (Table F-7) lays out a suggested areas of implementation efforts along with the suggested entities responsible for aiding and overseeing the implementation of the necessary BMPs to meet the goals laid out in this plan.

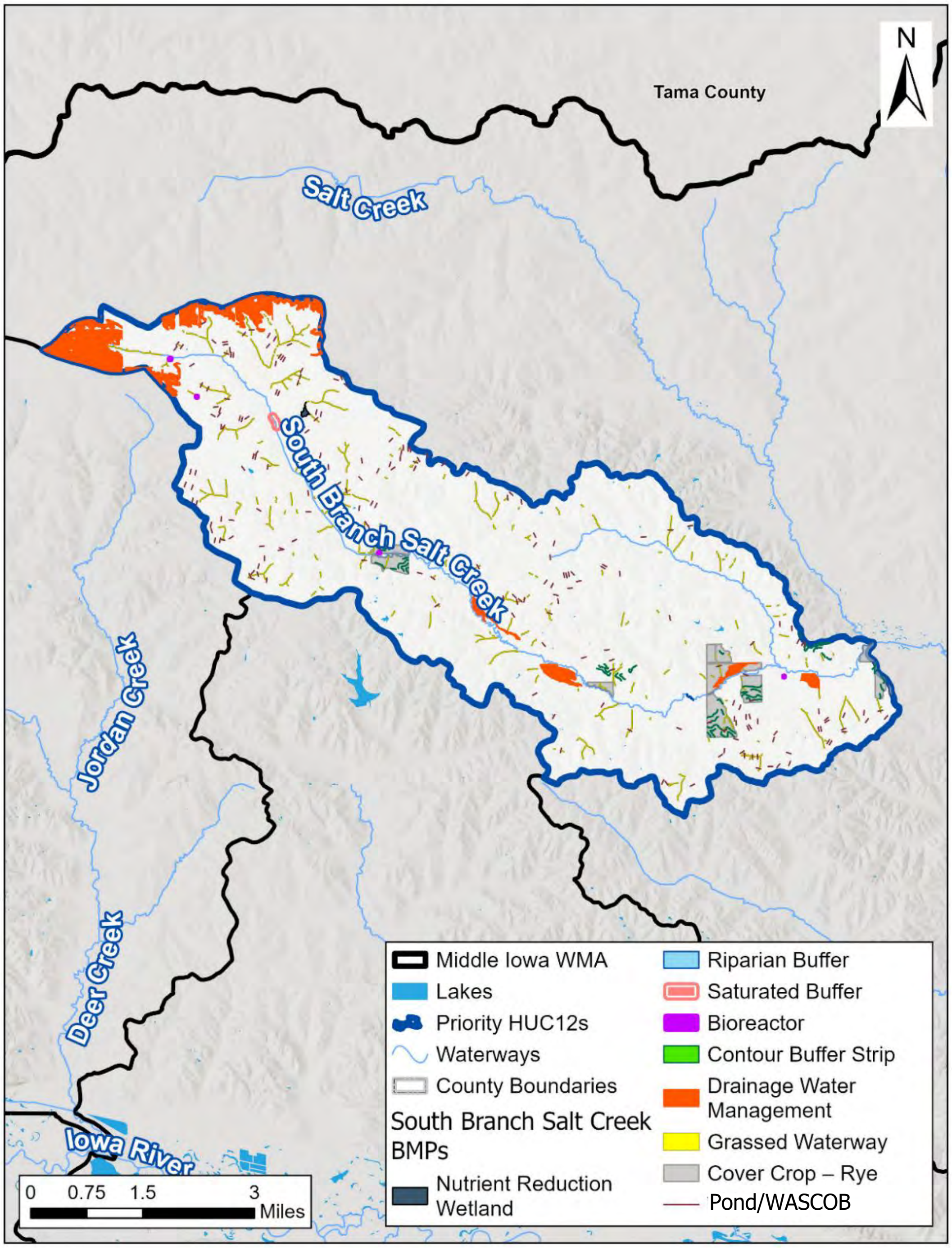


Figure F-4. Best management and conservation practices that are part of this implementation scenario.

Table F-7. South Branch Salt Creek Action Table.

BMP / Conservation Practice	Focus Areas	Output	Outcome	Responsible Entity	Timeline	10-Year Cost
Grassed Waterway	Nitrogen and Phosphorus Hot Spots	153 waterways	245 tons sed/yr 378 lbs TP/yr 2,898 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$2,438,376
Saturated Buffer	N/A	1 buffer	79 tons sed/yr 164 lbs TP/yr 2,184 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$8,200
Riparian Buffer	N/A	1 buffer	254 tons sed/yr 269 lbs TP/yr 2,857 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$701
WASCOB	Nitrogen and Phosphorus Hot Spots	213 WASCOBs	93 tons sed/yr 188 lbs TP/yr 1,219 lbs TN/yr 262 ac-ft	SWCDs, NRCS, IDALS	10 years	$958,500
Nutrient Reduction Wetland	Nitrogen and Phosphorus Hot Spots	1 nutrient reduction wetland	171 tons sed/yr 382 lbs TP/yr 1,470 lbs TN/yr 22 ac-ft	SWCDs, NRCS, IDALS	10 years	$44,856
Contour Buffer Strips	Nitrogen and Phosphorus Hot Spots	12 buffer strips	214 tons sed/yr 251 lbs TP/yr 4,771 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$14,208
Cover Crops - Rye	Nitrogen and Phosphorus Hot Spots	10 rye cover crop fields	480 tons sed/yr 416 lbs TP/yr 5,928 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$48,986
Drainage Water Management	Nitrogen and Phosphorus Hot Spots	17 drainage water management practices	0 tons sed/yr 938 lbs TP/yr 5,410 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$1,454
Denitrifying Bioreactor	Nitrogen and Phosphorus Hot Spots	5 denitrifying bioreactors	0 tons sed/yr 211 lbs TP/yr 1,337 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$686,360
	Total	413 BMPs	1,535 tons sed/yr 3,199 lbs TP/yr 28,074 lbs TN/yr 284 ac-ft	N/A	N/A	$4,201,641

Monitoring and Evaluation

There is limited information on water quality within the priority subwatersheds. There is not enough information to determine impairment status of waterbodies and waterways within subwatersheds. Watershed monitoring should take place following defined procedures that are required to determine if a waterbody is impaired. Iowa DNR follows standards set forth under the Iowa Credible Data Law that align with federal requirements on proper water quality data collection and evaluation. Monitoring will be done in partnership with existing collaborators such as IDNR, Izaak Walton League, Iowa Institute for Hydraulic Research (IIHR), and local volunteer networks. Baseline water quality data will inform future management decisions on how best to implement practices and improvements that are defined within this subwatershed plan. Short-term funding priority should be given to the establishment of a monitoring framework to establish baseline water quality and track water quality improvement as a result of BMP implementation in the next 10 years.

Implementation documentation is an essential part of plan administration. Tracking how funds are spent, what outcomes were achieved, and any notes of successes or difficulties with implementation provide insight into how future implementation work within the subwatershed can be handled. Next steps should also include development of a database using GIS and/or spreadsheet tools so that there is a centralized and recognized place for the WMA to track funds, load reduction projections, and water quality improvements. Custom GIS and web-based applications can also be developed so that this information can be shared real-time with WMA members and agency partners in an online, dashboard format.

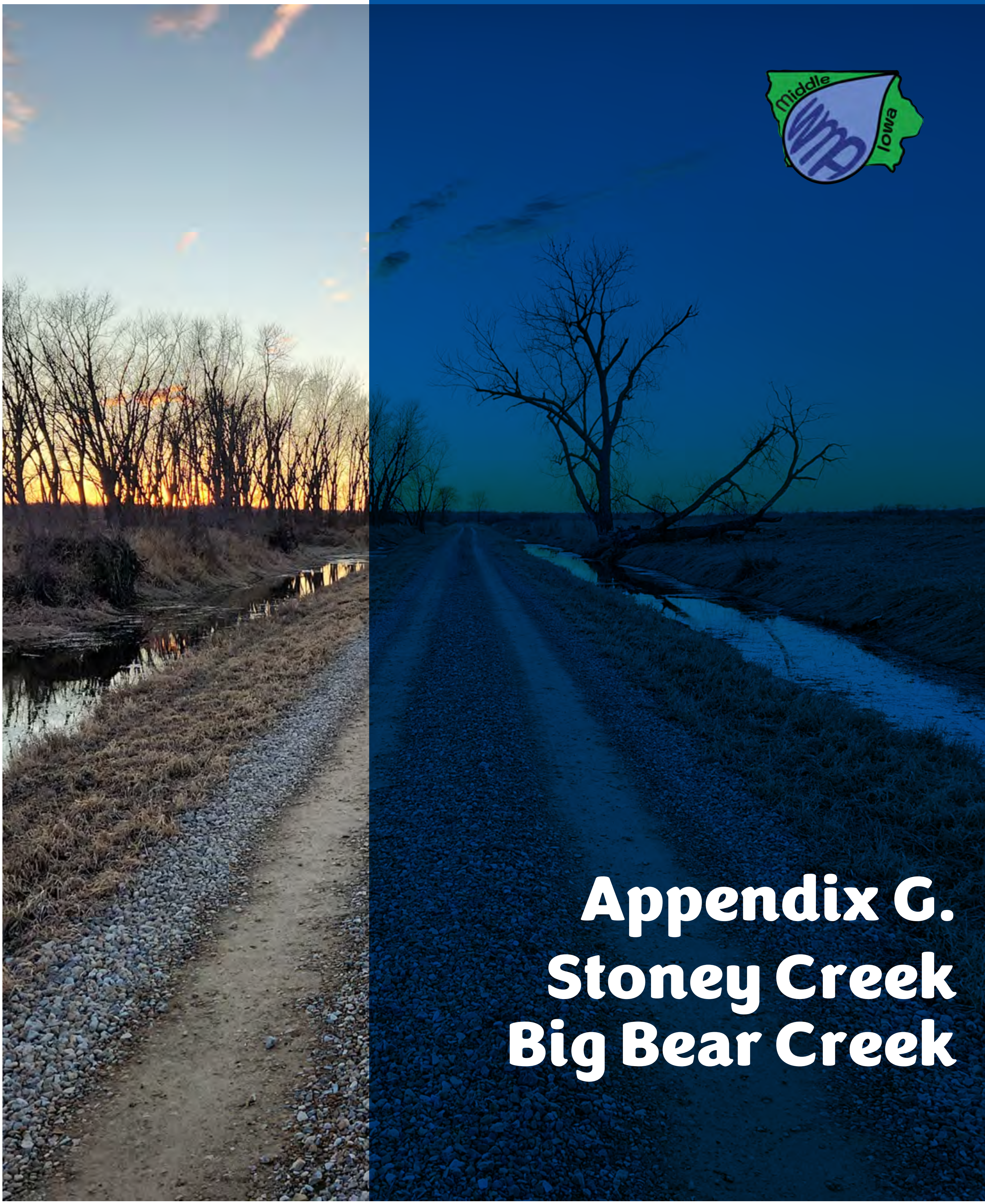
Plan Updates

Plan updates take place every five years. Updates provide information on what has changed since the plan was approved or since the last Plan Update. These plan updates also allow for a review of what successes or challenges have occurred since the last update.

Plan updates may include:

- Population and land use forecast and trends
- Water quality data review and 303(d) list review
- BMP tracking progress*
- Review of other models or monitoring programs that are taking place within the larger watershed that may be important to include in the updated subwatershed plan.

*Reporting and plan updates will be facilitated and enhanced if a framework is established early in the first steps of implementation following plan adoption.



Appendix G.
Stoney Creek
Big Bear Creek

Stoney Creek-Big Bear Creek

Introduction

The Stoney Creek-Big Bear Creek subwatershed (HUC-12 070802080803), Figure G-1, was selected as a priority subwatershed due to high sediment and nitrogen stress. The subwatershed contains the 23,390 acre drainage area around Stoney Creek-Big Bear Creek, in which Stoney Creek is a tributary to Big Bear Creek. Stoney Creek-Big Bear Creek is located in Poweshiek County, in south-central Middle Iowa Watershed. The northern portion of the city of Brooklyn is within this subwatershed.

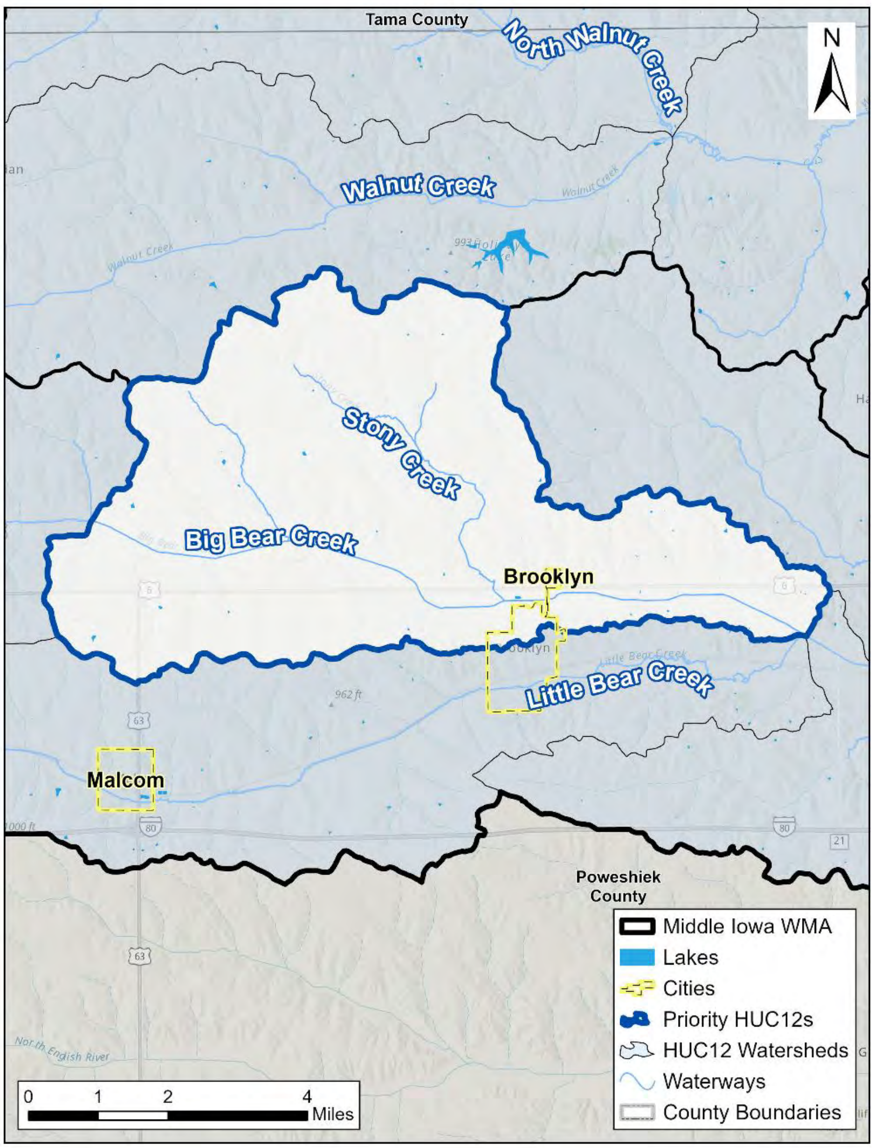


Figure G-1. Stoney Creek-Big Bear Creek priority subwatershed

Watershed Characteristics

Population

Stoney Creek-Big Bear Creek subwatershed is largely cropland, with scattered farm homes. The total number of producers in Poweshiek County is 1,370 with an average farm size of 364 acres (USDA, 2022). As the subwatershed is 6% the size of Poweshiek County, an estimated 82 producers grow crops and/or have livestock in the watershed, assuming land ownership is distributed uniformly across the county. The only city is Brooklyn (population 1,500).

Land Use

Land cover in the Stoney Creek-Big Bear Creek subwatershed is cropland (84%), pasture (8%), developed land (6%), wetland (1%), and forest (1%) (Figure G-2; Table G-1). In Poweshiek County, the average size of farms has decreased by 9%, land in farms has decreased by 15%, and the total number of farms has decreased by 7% from 2017-2022 (USDA, 2022). About 56% of Poweshiek County farm sale revenues are crops, while the other 44% is livestock, poultry, and other products. Of these, 25% of livestock revenue is from hogs and pigs and 11% of revenue is from cattle (USDA, 2022). The top crops grown are corn and soybeans (USDA, 2022). In the Stoney Creek-Big Bear Creek subwatershed, there are no feedlots and no wildlife management areas (DNR, 2024).

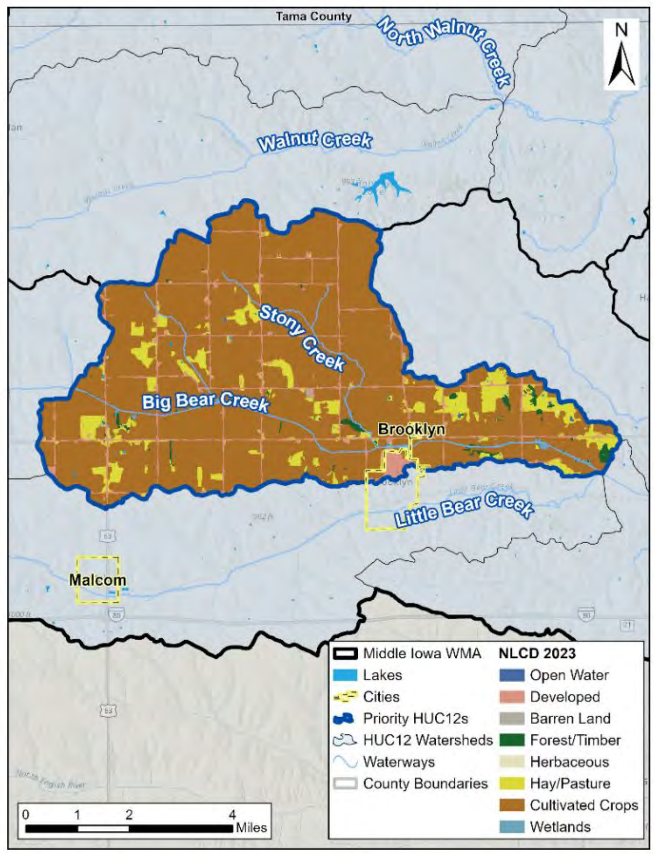


Figure G-2. Land cover in the Stoney Creek-Big Bear Creek subwatershed.

Table G-1. Land cover in Stoney Creek-Big Bear Creek subwatershed (USGS, 2023).

Land Use	Acres	Percent of Subwatershed
Cropland	19,648	84%
Pasture	1,871	8%
Developed	1,403	6%
Forest	234	1%
Wetland	234	1%

Soils

The majority of soil in the subwatershed is silty clay loam, with other common textures being stilt loam and loam. Infiltration of precipitation through soils recharges groundwater and reduces overland flow that carries pollutants to surface water, erodes soil, and can occur as flooding. Given the clay composition of the soil, Stoney Creek-Big Bear Creek soils are hydrologic soil groups C or C/D, which have slow infiltration rates and high runoff potential. The Wind Erodibility Index in Stoney Creek-Big Bear Creek is reported as 47 tons/acre/year (Soil Survey Staff, 2025). It is important to note that this value reflects a theoretical potential soil loss under worst-case conditions—specifically, bare and smooth soil surfaces with no vegetation or surface roughness. Actual wind erosion rates under typical land management and cropping practices are expected to be significantly lower, with actual wind erosion rates of less than 5 tons/acre/year, compared to 1-10 tons/acre/year of rainfall-driven sheet and rill erosion.

Streams

A network of tributaries feed into the 11-mile Big Bear Creek. The only named tributary is Stony Creek. Stony Creek flows about 7 miles before its confluence with Big Bear Creek north of Brooklyn.

Resource Conditions

Designations and Impairments

Big Bear Creek's designated uses are Class A1, Primary Contact Recreation, and BWW2 (Warm Water Aquatic Life (Iowa ADBNet, Waterbody IA 02-IOW-702 and 02-IOW-703). It is noted that ADBNet names this stream Bear Creek, while the NDH names it Big Bear Creek. Big Bear Creek was listed in 2006 for a biological impairment for low fish and invertebrate index of biological integrity, with an unknown cause. Additionally, Big Bear Creek drains into the Iowa River which has an A1 and HH designated use and is impaired due to *E. coli* and mercury consumption through fish. Plan actions are not targeted towards mercury impairments but efforts to target sediment and nutrient losses will also reduce bacteria pollution.

Historical Conservation Success

To date, Stoney Creek-Big Bear Creek has not been the focus of any documented, targeted watershed grants (e.g., Section 319, Water Quality Initiative).

Iowa State University, with funding from Iowa Department of Natural Resources and other state resources, utilized satellite imagery and LiDAR resources to establish likely locations of

installed best management practices (BMPs) on the landscape through the Iowa BMP Mapping Project. The project focused on specific BMPs types, although the BMPs included in these results are not guaranteed to meet NRCS practice standards. The BMPs documented in the project are Terraces, Water and Sediment Control Basins, Grassed Waterways, Pond Dams, Contour Strip Cropping, and Contour Buffer Strips.

As of 2010, there were an estimated 2,385 BMPs within the drainage area of the Stoney Creek-Big Bear Creek HUC-12 watershed. A breakdown of BMPs is shown in Table G-2. Note that some BMPs are best expressed as size (acres or linear feet) rather than a count but size is not provided in the dataset.

Table G-2. Existing BMPs within Stoney Creek-Big Bear Creek, as of 2010 (ISU, 2017).

BMP Type	Number of BMPs
WASCOB (NRCS 638)	384
Terrance (NRCS 600)	165
Pond Dam (NRCS 378)	53
Grassed Waterways (NRCS 412)	1,758
Contour Buffer Strips (NRCS 332)	25

Pollutants of Concern

Monitoring of *E. coli* has led to the impairment listing of the Iowa River, and reducing bacteria loading in the Stoney Creek-Big Bear Creek subwatershed will help improve Iowa River water quality. *E. coli* is used as an indicator of the presence of fecal contamination, as *E. coli* is often present along with other pathogens that pose an increased risk of illness if people are exposed through swimming or recreating. *E. coli* can come from many nonpoint sources, including improper application of manure to fields, feedlot runoff, livestock grazing in riparian areas, leaking subsurface septic treatment systems, pet waste, and wildlife.

Erosion of topsoil through sheet and rill and ephemeral gully formation contribute to sediment transport to streams across Iowa, including through cropland in the Stoney Creek-Big Bear Creek watershed. Additionally, streambank and channel erosion also contribute to sediment loading and turbidity.

Nitrogen and phosphorus losses are high priorities as well, not only due to Gulf of America Hypoxia issues addressed in Iowa's Nutrient Reduction Strategy, but also to protect and improve local water quality issues such as maintaining healthy drinking water sources and preventing nuisance growth of algae and other aquatic plants (to limit eutrophication).

Pollutant Source Assessment

General sources and quantities of water quality pollutants of concern were evaluated using the US Geological Survey (USGS) SPAtially-Referenced Regression On Watershed attributes (SPARROW) model. Predicted pollutant yields and load were summarized for runoff volume, sediment, total phosphorus, and total nitrogen.

The SPARROW model has separate multiple linear regression equations for estimating sediment, total phosphorus, and total nitrogen yield from the landscape and delivery to downstream locations. Each individual equation is composed of multiple variables that relate to source strength of the sediment, total phosphorus, or total nitrogen; the delivery of each component from the landscape to receiving waterbodies; and in-stream routing and loss due to natural physical, chemical, and/or biological factors.

The multiple linear regression model for sediment primarily derives its localized erosion estimates from landuse type(s) within each SPARROW catchment, whereas the models for total phsophorus and total nitrogen also include other factors such as fertilizer use, wastewater treatment plant effluent, atmospheric deposition, manure application on agricultural land, subsurface tile drainage density, etc. More information about the SPARROW model can be in the U.S. Geological Survey Scientific Investigations Report 2019–5114.

Figure G-3 presents the incremental yields of common water quality and quantity parameters. These represent the mass of each parameter lost from the landscape per hectare within each delineated SPARROW catchment.

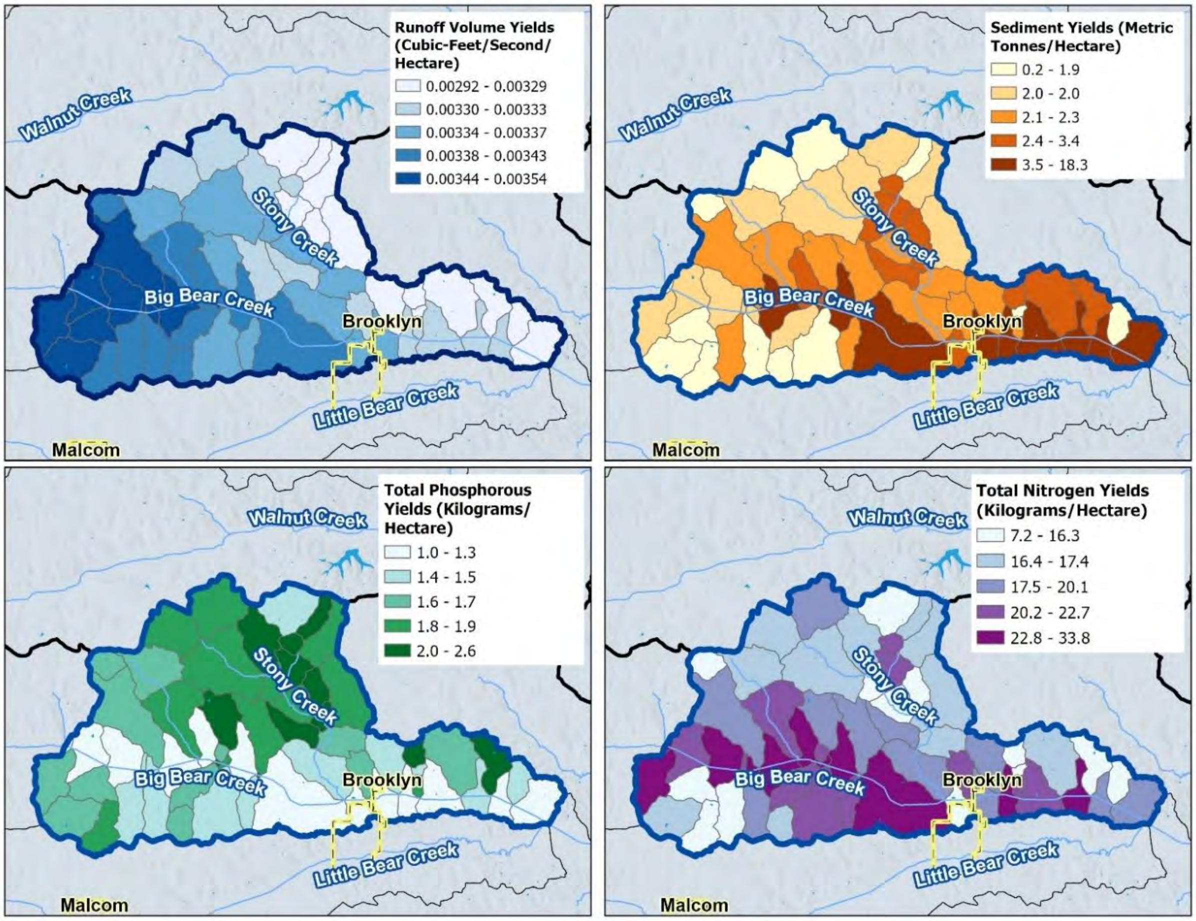


Figure G-3. Runoff, Sediment, Phosphorus, and Nitrogen yields for Stoney Creek - Big Bear Creek from the USGS SPAtially-Referenced Regression On Watershed attributes (SPARROW) model.

The SPARROW model includes a delivery fraction for each water quality parameter to mathematically route loads from each SPARROW catchment downstream, accounting for the fraction of the total mass generated within a SPARROW catchment that does not travel to the watershed outlet on an annual basis. With that information, the measurable total annual load of each water quality parameter was estimated at the outlet of the Stoney Creek-Big Bear Creek HUC-12 (Table G-3).

Table G-3. Total annual load of sediment, total phosphorus, and total nitrogen from the Stoney Creek-Big Bear Creek Subwatershed.

Water Quality Parameter	Existing load (Sum of Incremental)	Existing Load (per acre)	Existing load (accumulated at HUC-12 outlet)	Delivery Ratio
Sediment (tons/yr)	24,800	1.06	21,119	0.85
Total Phosphorus (lbs/yr)	33,432	1.43	29,439	0.88
Total Nitrogen (lbs/yr)	396,748	16.96	362,001	0.91

Goals and Objectives

Within the Stoney Creek-Big Bear Creek subwatershed, existing loads of sediment, total phosphorus, and total nitrogen, as well as the Iowa Nutrient Reduction Strategy and recommendations from the Technical Advisory Committee, were used to establish load reduction goals.

Iowa Nutrient Reduction Strategy goals aim for a long-term reduction of phosphorus and nitrogen by 45%. The load reductions attributable to non-point source pollution are 41% for nitrogen and 29% for phosphorus. These are the established long-term goals for this watershed management plan. Short term goals (over the 10-year life of this plan) were established at a 10% reduction for both phosphorus, nitrogen, and sediment (Table G-4).

Table G-4. Plan (10-yr) and long-term water quality goals set for the Stoney Creek-Big Bear Creek HUC-12. Sediment and nutrient load reductions are measured at the outlet of the HUC-12 subwatershed

Water Quality Parameter	Existing Loads (at HUC-12 outlet)	Stoney Creek-Big Bear Creek Load Reduction Goals
Sediment (tons/yr)	21,119	Short-term: 10% (2,120 tons)
Total Phosphorus (lbs/yr)	29,439	Short-term: 10% (2,944 lbs), Long-term:29% (8,537 lbs)
Total Nitrogen (lbs/yr)	362,001	Short-term: 10% (36,200), Long-term: 41% (148,420 lbs)

Through the implementation of conservation practices (CP) and BMPs presented in the implementation scenario below, the desired water quality goals can be reached.

Implementation Plan: Stoney Creek-Big Bear Creek

Conservation and best management practices can be used, in tandem with other efforts throughout the subwatershed, to work toward achieving the water quality goals set forth in this plan.

The Agricultural Conservation and Planning Framework (ACPF) model was used to find locations on the landscape that are suitable for the implementation of CPs and BMPs. Costs for implementation of the BMPs were estimated using typical Iowa NRCS Environmental Quality Incentives Program (EQIP) payment rates. Those values were then doubled to more accurately represent the true cost of implementing each practice, accounting for additional factors such as administrative time.

Load reduction estimates for each individual BMP were estimated using the underlying SPARROW data and assumed load reduction efficiencies of each BMP type (Table G-5). Load reduction efficiencies are primarily from the Iowa NRS, Minnesota Agricultural BMP Handbook, and other applicable references; prioritizing data and research from Iowa sources, then midwestern sources, and finally regional/national sources. Rates reported in the Iowa NRS are expressed as ranges and have many caveats, making it necessary to use other sources of data to develop average rates.

Table G-5. Conservation and Best Management Practice load reduction fractions.

BMP	Sediment Reduction Efficiency	Total Phosphorus Reduction Efficiency	Total Nitrogen Reduction Efficiency
Nutrient Reduction Wetland (NRW)	0.75	0.53	0.30
Grassed waterway (GWW)[†]	0.96	1.00	1.00
Drainage water management (DWM)	0.69	0.55	0.4
Cover Crops - Rye (CCR)	0.70	0.50	0.28
Contour buffer strips (CBS)	0.87	0.695	0.52
Bioreactor (BIO)	0.69	0.55	0.24
Saturated Buffer (STB)	0.84	0.5	0.45
Riparian buffer (RIB)	0.76	0.58	0.87
Ponds and/or Water and sediment control basin (WASCOB)	0.88	0.85	0.57

[†] *Reduction for armoring the soil in the location of the grassed waterway, not filtering incoming water*

Load reduction estimates for a given BMP were calculated as the treatable load at the location of the BMP multiplied by the load reduction efficiency of that BMP type. Cost-effectiveness

was then also calculated for each BMP as the dollars needed to reduce one ton of sediment or one pound of nitrogen or phosphorus.

To work toward water quality goals most efficiently and effectively, BMPs were prioritized according to recommendations from the Technical Advisory Committee. Within the Stoney Creek-Big Bear Creek Watershed, BMPs were prioritized based on their cost-effectiveness for reducing phosphorus loads, as measured at the HUC-12 subwatershed outlet.

The project pollutant load reductions were obtained by "weighting" BMP types based on the (1) likelihood of a BMP being implemented, as measured by landowner/producer interest, and/or (2) the interest/desire of conservation professionals to promoted a particular BMP type within the subwatershed (Table G-6). This information was obtained from conservation professionals familiar with the subwatershed.

Table G-6. Implementation Plan BMPs, likelihood of implementation, and weighting within the implementation scenario.

BMP	Likelihood of BMP type use within the HUC-12. (e.g. high, medium, low, zero)		Weighting*
	Popularity & Buy-In	Interest of SWCD in Promoting	
Grassed waterway	Medium	High	28.3%
Saturated buffer	Low	Low	2.5%
Riparian buffer	Low	Medium	2.5%
Pond/WASCOB	High	High	28.3%
Nutrient reduction wetland	Low	Low	2.5%
Contour buffer strips	Low	Low	2.5%
Cover crops - rye	High	High	28.4%
Drainage water management	Low	Low	2.5%
Denitrifying bioreactor	Low	Low	2.5%

**Fraction of the phosphorus load reduction goal the selected BMP will reduce within the implementation scenario.*

Using this BMP selection methodology, a scenario was created to show one path for achieving the water quality goals of this plan. Necessary load reductions for each BMP type, based on the weighting factor, will be met or exceeded for both phosphorus and nitrogen using this scenario. This plan is not prescriptive but shows one way of efficiently reducing loads of sediment and nutrients. Figure G-4 showcases the BMPs that were selected to be part of this implementation scenario. In order to meet the 10-year plan goal, 758 BMPs are planned in the Stoney Creek-Big Bear Creek subwatershed that are estimated to reduce sediment by 3,157 tons/yr, phosphorus by 3,968 lbs/yr, and nitrogen by 36,224 lbs/yr.

The Action Table (Table G-7) lays out a suggested areas of implementation efforts along with the suggested entities responsible for aiding and overseeing the implementation of the necessary BMPs to meet the goals laid out in this plan.

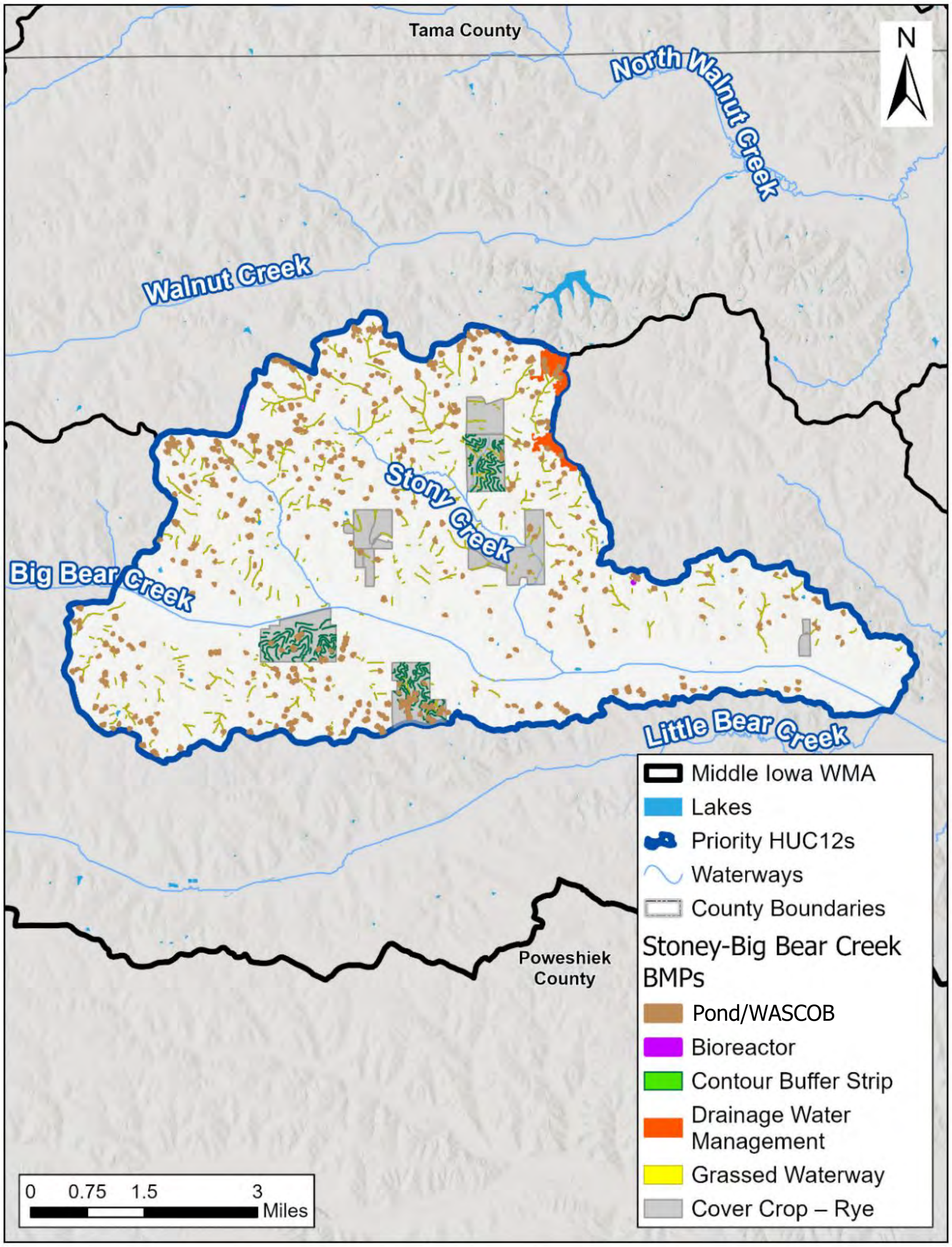


Figure G-4. Best management and conservation practices that are part of this implementation scenario.

Table G-7. Stoney Creek-Big Bear Creek Action Table.

BMP / Conservation Practice	Focus Areas	Output	Outcome	Responsible Entity	Timeline	10-Year Cost
Grassed Waterway	Nitrogen and Phosphorus Hot Spots	249 waterways	719 tons sed/yr 835 lbs TP/yr 7,252 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$3,968,338
Saturated Buffer	N/A	2 buffers	127 tons sed/yr 170 lbs TP/yr 3,064 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$16,400
Riparian Buffer	N/A	2 buffers	292 tons sed/yr 208 lbs TP/yr 1,857 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$1,402
WASCOB	Nitrogen and Phosphorus Hot Spots	484 WASCOBs	227 tons sed/yr 350 lbs TP/yr 2,627 lbs TN/yr 617 ac-ft	SWCDs, NRCS, IDALS	10 years	$2,178,000
Nutrient Reduction Wetland	Nitrogen and Phosphorus Hot Spots	0 nutrient reduction wetlands	0 tons sed/yr 0 lbs TP/yr 0 lbs TN/yr 0 ac-ft	SWCDs, NRCS, IDALS	10 years	$0
Contour Buffer Strips	Nitrogen and Phosphorus Hot Spots	3 buffer strips	474 tons sed/yr 630 lbs TP/yr 8,139 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$3,552
Cover Crops - Rye	Nitrogen and Phosphorus Hot Spots	14 rye cover crop fields	1,317 tons sed/yr 1,574 lbs TP/yr 12,254 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$68,580
Drainage Water Management	Nitrogen and Phosphorus Hot Spots	2 drainage water management practices	0 tons sed/yr 160 lbs TP/yr 784 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$171
Denitrifying Bioreactor	Nitrogen and Phosphorus Hot Spots	2 denitrifying bioreactors	0 tons sed/yr 41 lbs TP/yr 247 lbs TN/yr	SWCDs, NRCS, IDALS	10 years	$274,544
	Total	758 BMPs	3,157 tons sed/yr 3,968 lbs TP/yr 36,224 lbs TN/yr 617 ac-ft	N/A	N/A	$6,510,987

Monitoring and Evaluation

There is limited information on water quality within the priority subwatersheds. There is not enough information to determine impairment status of waterbodies and waterways within subwatersheds. Watershed monitoring should take place following defined procedures that are required to determine if a waterbody is impaired. Iowa DNR follows standards set forth under the Iowa Credible Data Law that align with federal requirements on proper water quality data collection and evaluation. Monitoring will be done in partnership with existing collaborators such as IDNR, Izaak Walton League, Iowa Institute for Hydraulic Research (IIHR), and local volunteer networks. Baseline water quality data will inform future management decisions on how best to implement practices and improvements that are defined within this subwatershed plan. Short-term funding priority should be given to the establishment of a monitoring framework to establish baseline water quality and track water quality improvement as a result of BMP implementation in the next 10 years.

Implementation documentation is an essential part of plan administration. Tracking how funds are spent, what outcomes were achieved, and any notes of successes or difficulties with implementation provide insight into how future implementation work within the subwatershed can be handled. Next steps should also include development of a database using GIS and/or spreadsheet tools so that there is a centralized and recognized place for the WMA to track funds, load reduction projections, and water quality improvements. Custom GIS and web-based applications can also be developed so that this information can be shared real-time with WMA members and agency partners in an online, dashboard format.

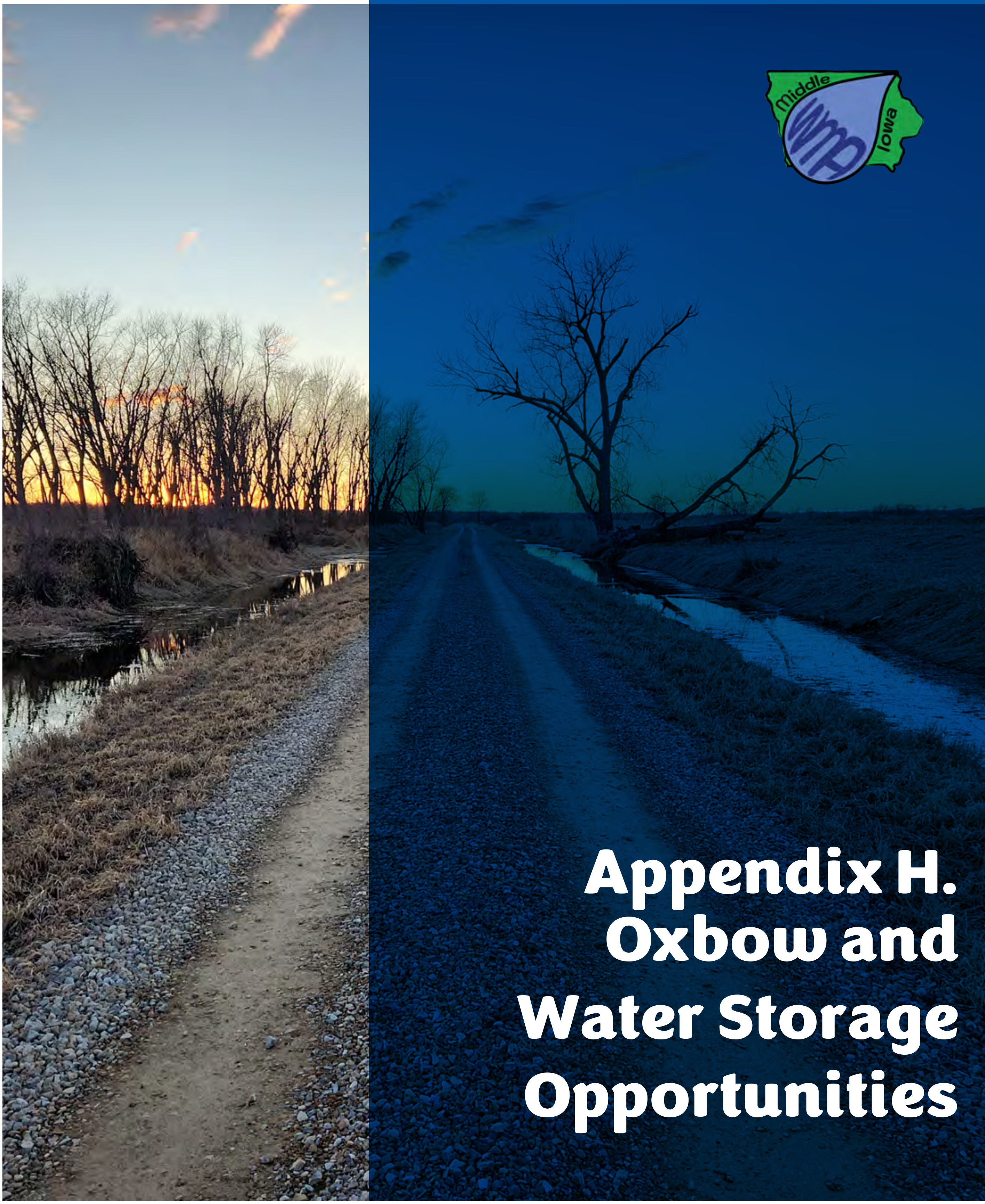
Plan Updates

Plan updates take place every five years. Updates provide information on what has changed since the plan was approved or since the last Plan Update. These plan updates also allow for a review of what successes or challenges have occurred since the last update.

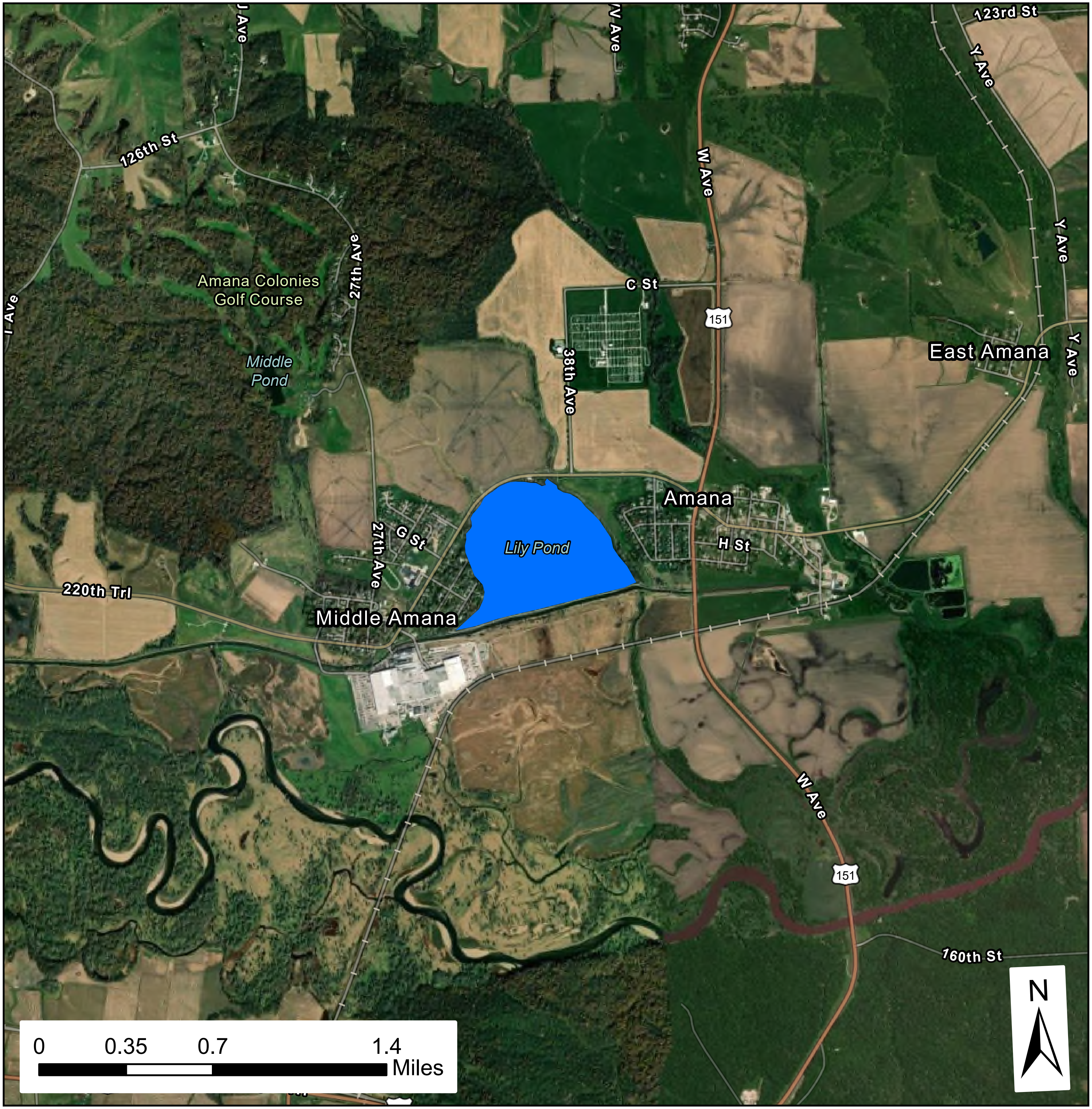
Plan updates may include:

- Population and land use forecast and trends
- Water quality data review and 303(d) list review
- BMP tracking progress*
- Review of other models or monitoring programs that are taking place within the larger watershed that may be important to include in the updated subwatershed plan.

*Reporting and plan updates will be facilitated and enhanced if a framework is established early in the first steps of implementation following plan adoption.



Appendix H. Oxbow and Water Storage Opportunities



Potential Oxbow 1 of 26

Amana Society

Site name: Lily Lake

Objective 2.2 water storage: 1,011 ac-ft

Infiltration Water Savings (Millions of Gallons per Year): 17,054

Number of days water will be held per year: 365

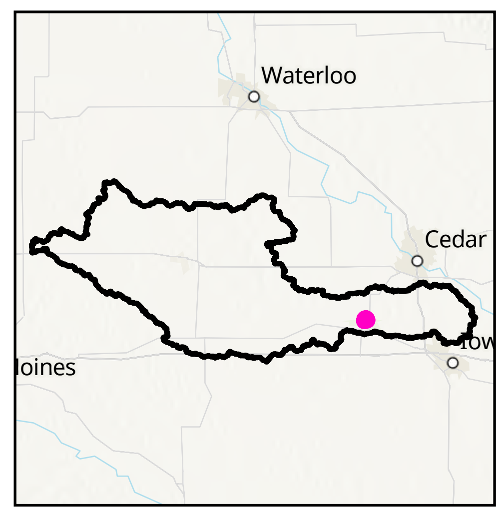
Useful lifespan: 25 years

Riparian Focus Area

Watershed Boundary

Potential Water Storage Sites

General Location of Storage Site



Potential Oxbow
2 of 26

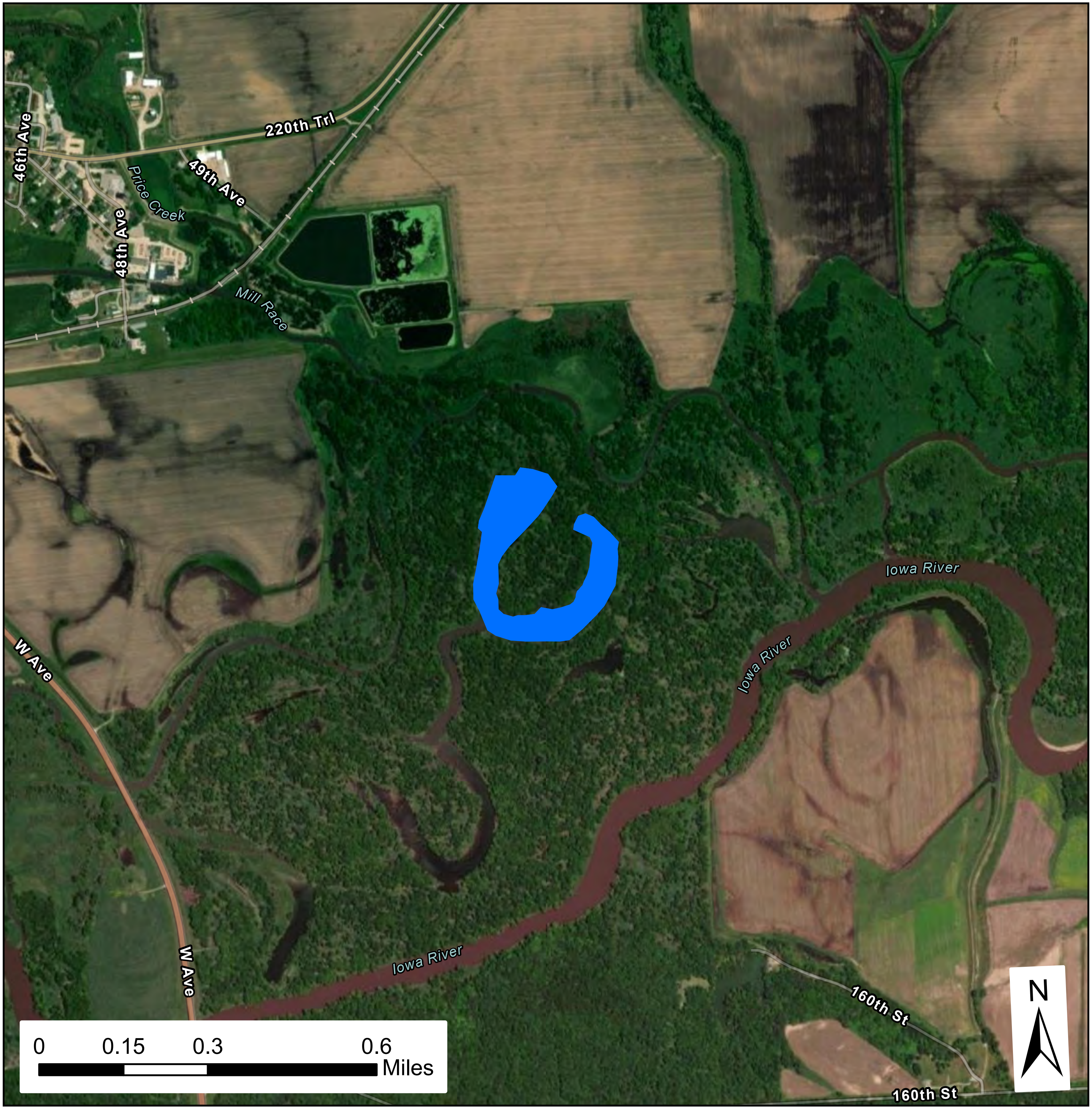
Amana Society

Site name:
Oxbow_3

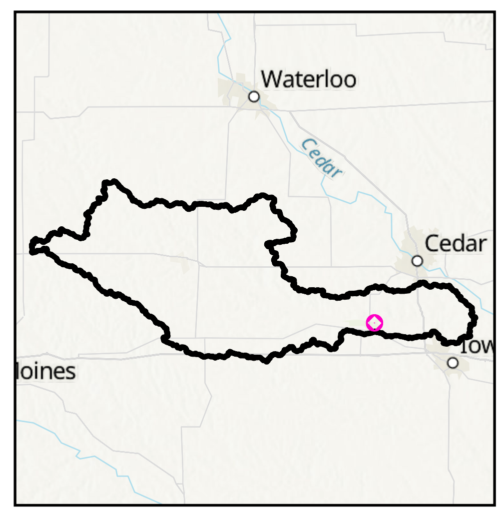
Infiltration Water Savings (Millions of Gallons per Year) 2,303

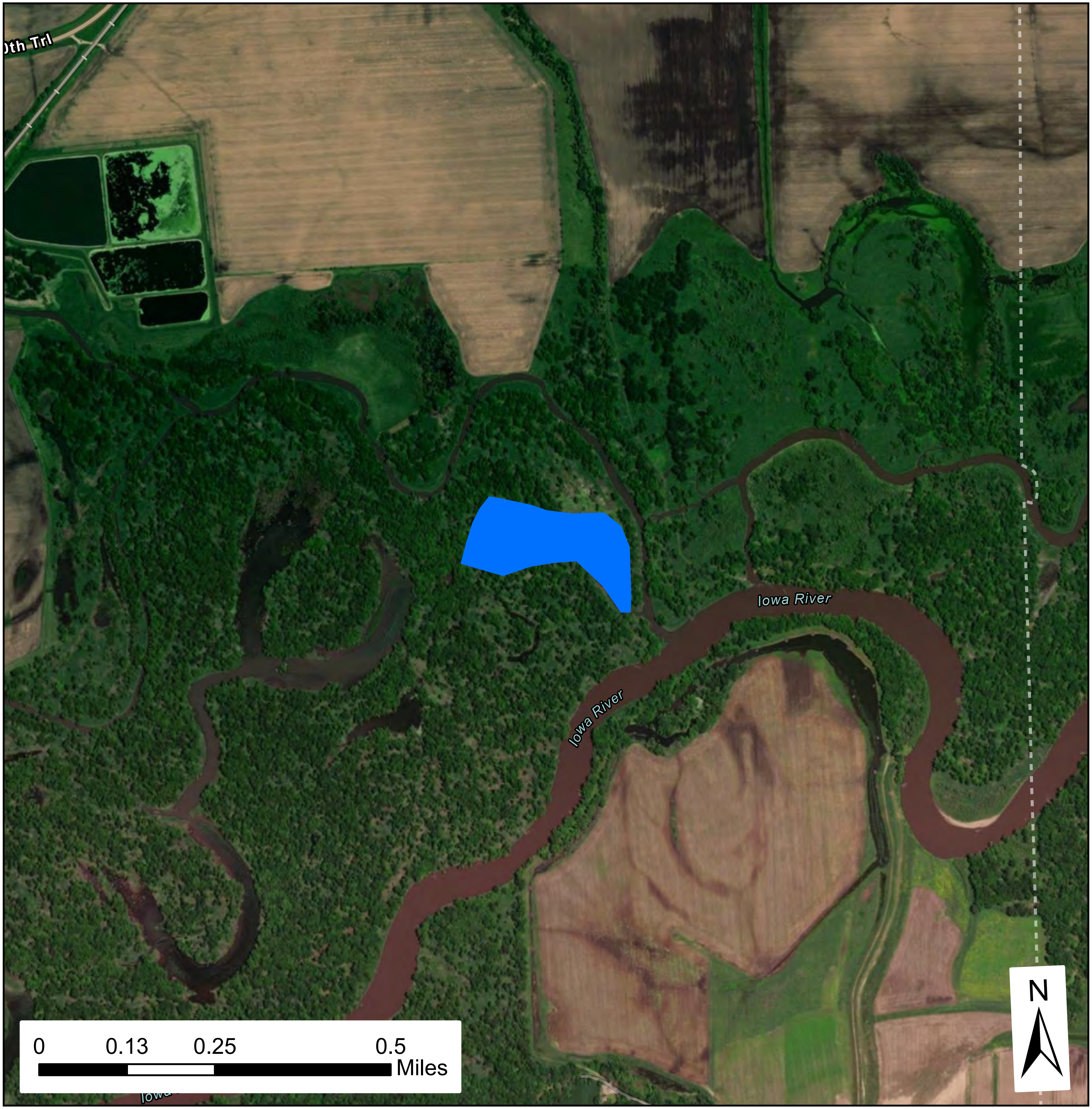
Number of days water will be held per year
365

Useful lifespan (years)
25



Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 3 of 26

Amana Society

Site name: Oxbow_4

Infiltration Water Savings (Millions of Gallons per Year): 1,380

Number of days water will be held per year 365

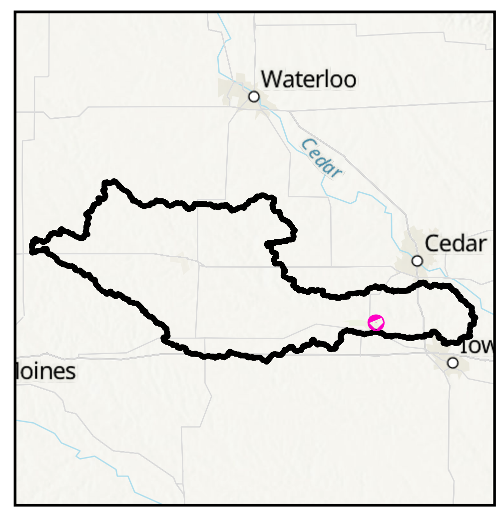
Useful lifespan (years) 25

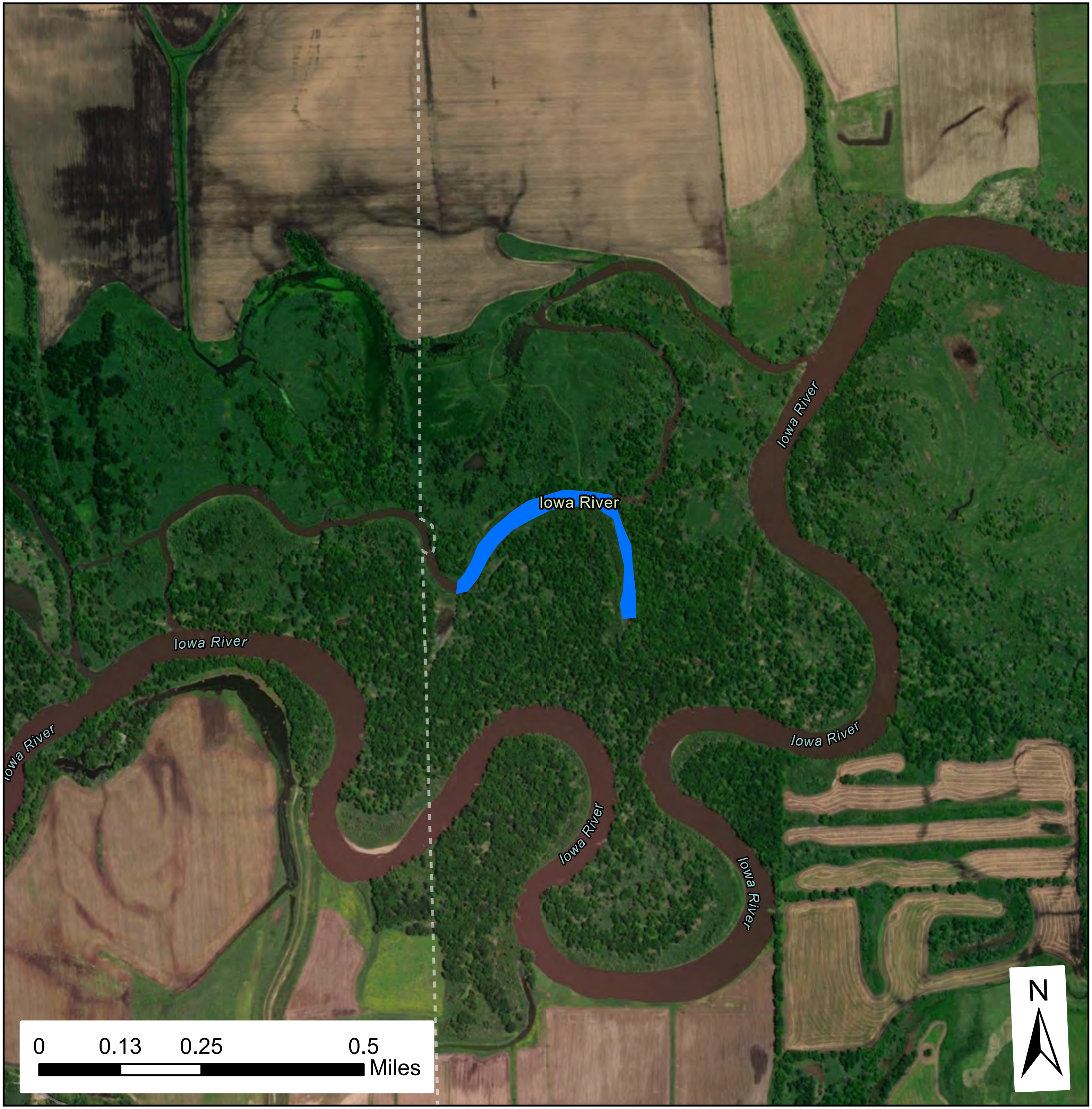
Riparian Focus Area

Watershed Boundary

Potential Water Storage Sites

General Location of Storage Site





Potential Oxbow
4 of 26

Amana Society

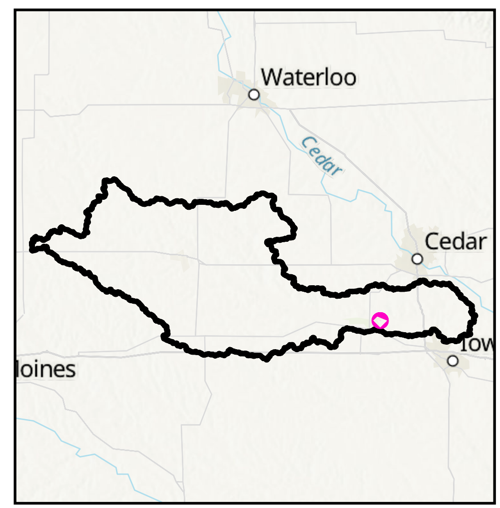
Site name:
Oxbow_5

Infiltration Water Savings (Millions of Gallons per Year): 669

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow 5 of 26

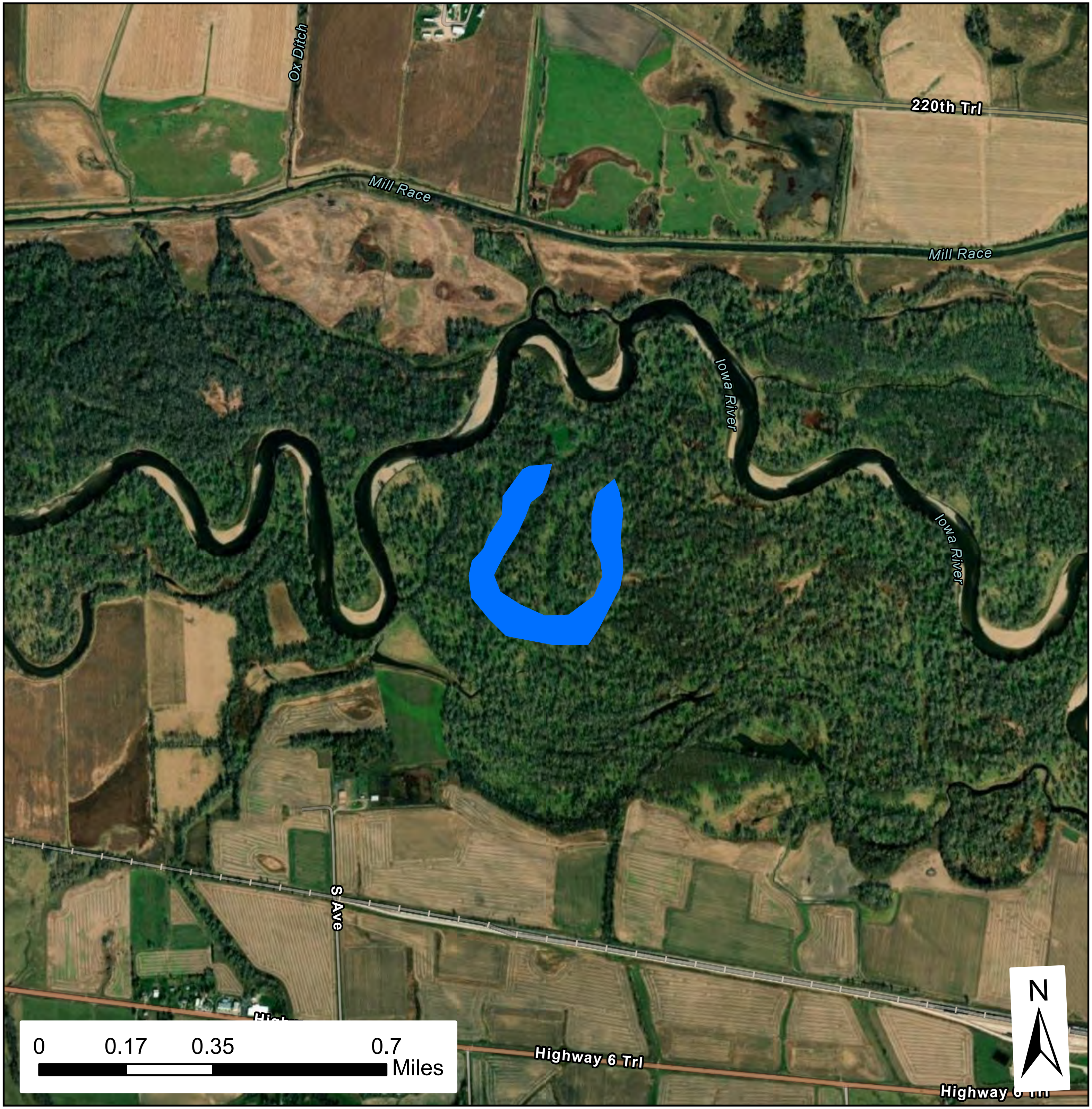
Amana Society

Site name: Oxbow_2

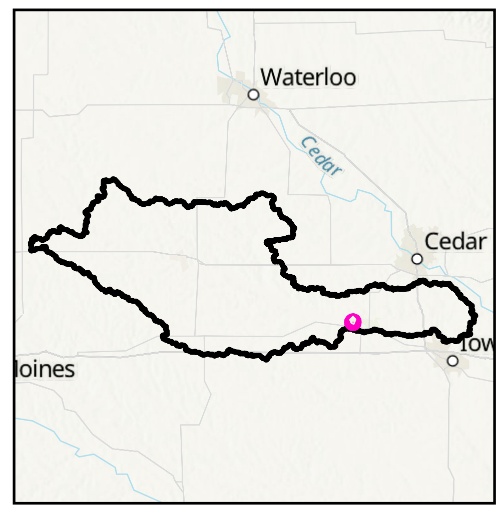
Infiltration Water Savings (Millions of Gallons per Year) 2,839

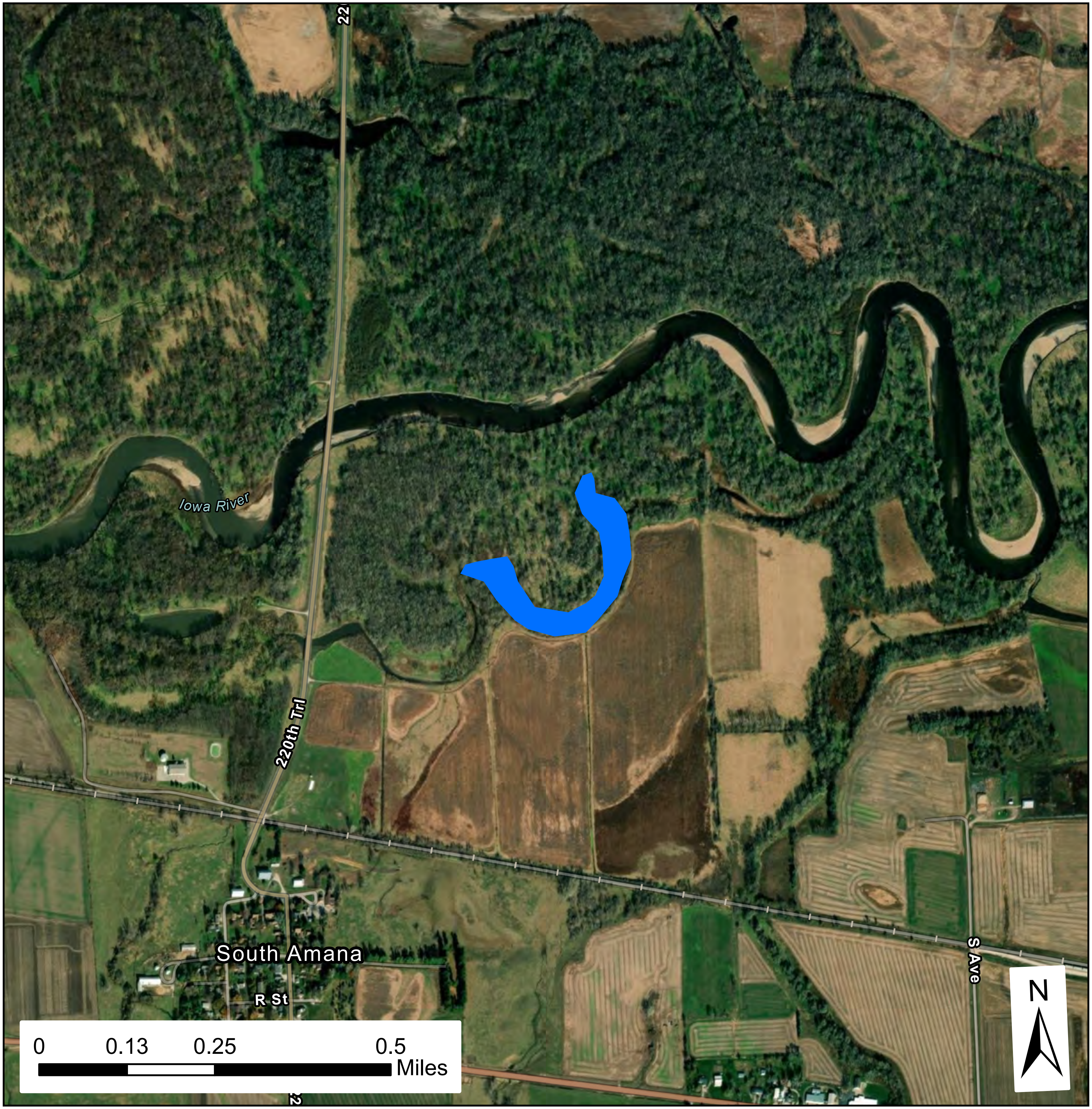
Number of days water will be held per year 365

Useful lifespan (years) 25



Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 6 of 26

Amana Society

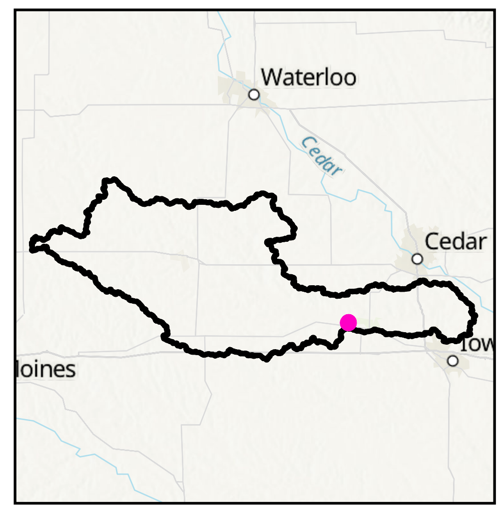
Site name: Oxbow_1

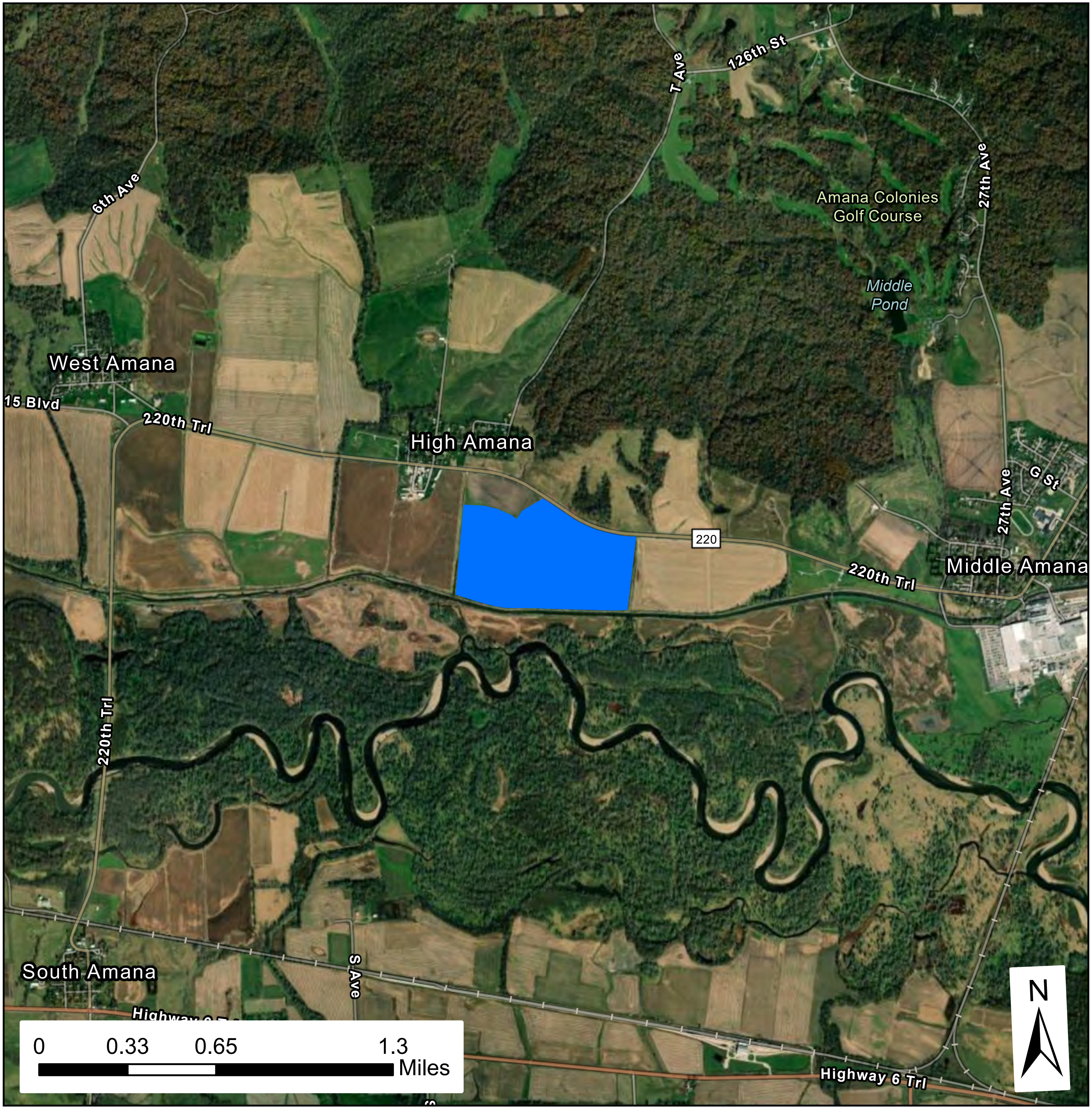
Infiltration Water Savings (Millions of Gallons per Year): 999

Number of days water will be held per year 365

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 7 of 26

Amana Society

Site name: Amana Wetland

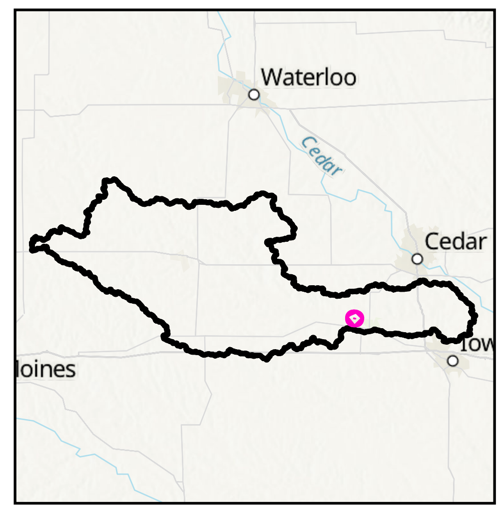
Objective 2.2 Water Storage: 823 ac-ft

Infiltration Water Savings (Millions of Gallons per Year): 41,633

Number of days water will be held per year: 365

Useful lifespan: 25 years

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
8 of 26

Belle Plaine

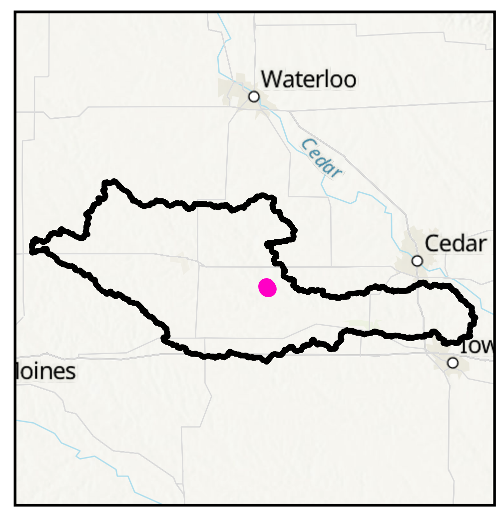
Site name:
Belle Plaine Wetland

Infiltration Water Savings (Millions of Gallons per Year):
3,506

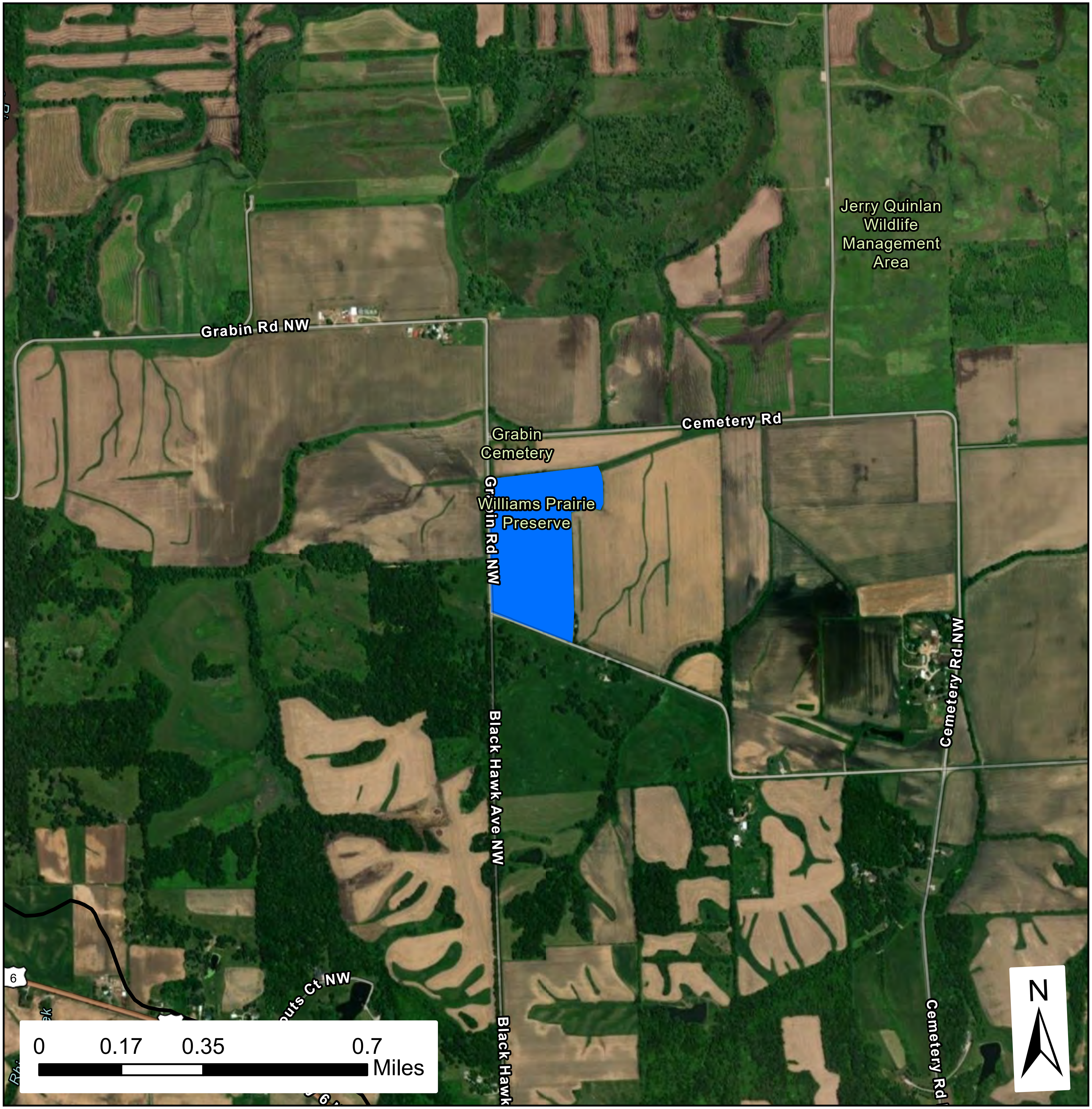
Number of days water will be held per year
183

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
9 of 26



JCCB

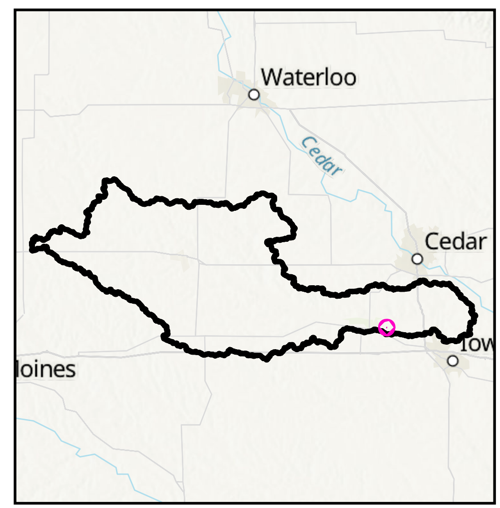
Site name: Williams Prairie Preserve

Infiltration Water Savings (Millions of Gallons per Year):
126,121

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
10 of 26

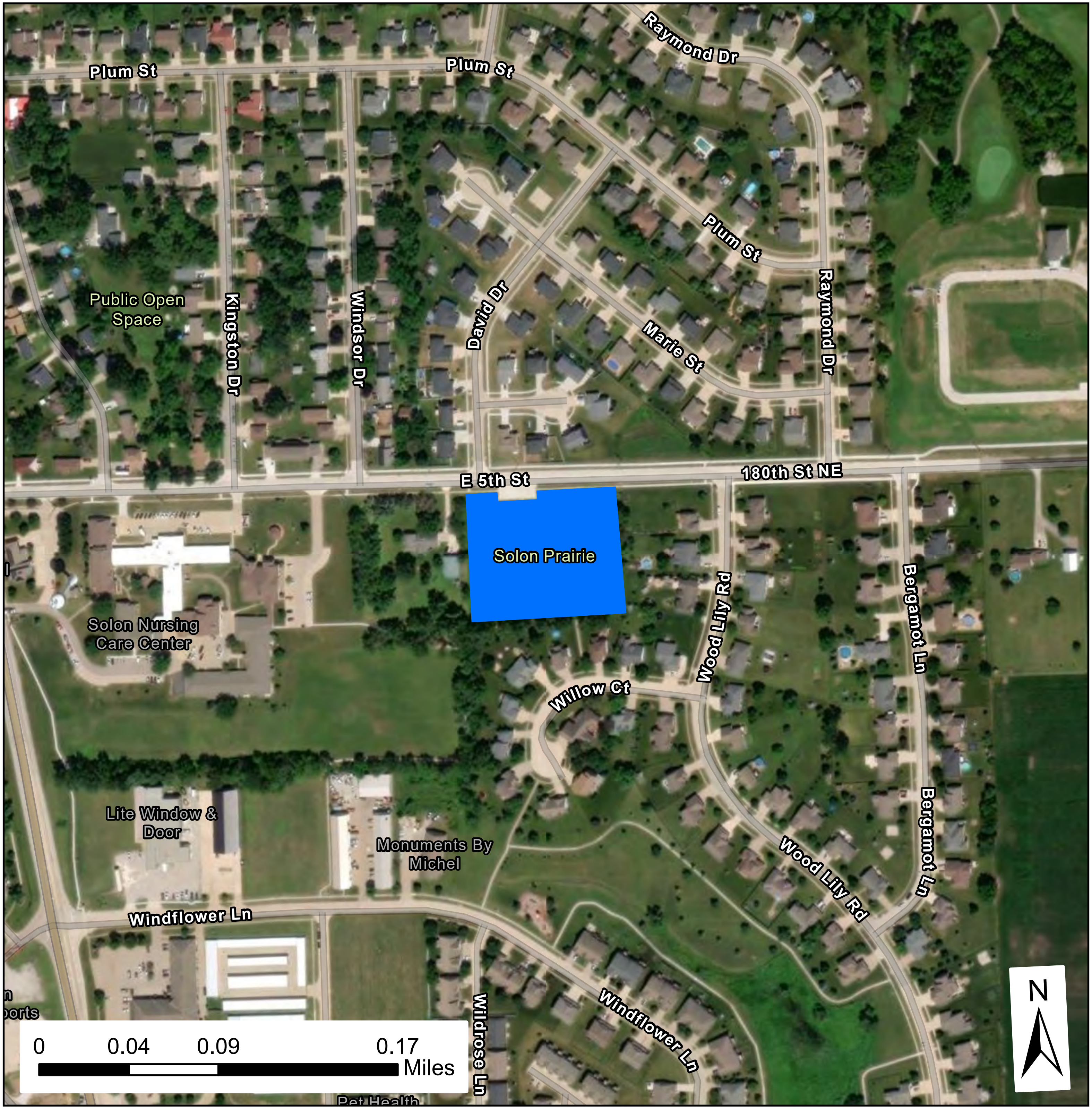
JCCB

Site name:
Solon Prairie

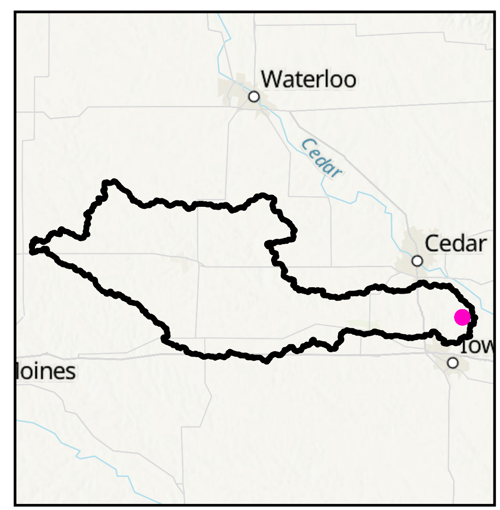
Infiltration Water Savings (Millions of Gallons per Year): 112

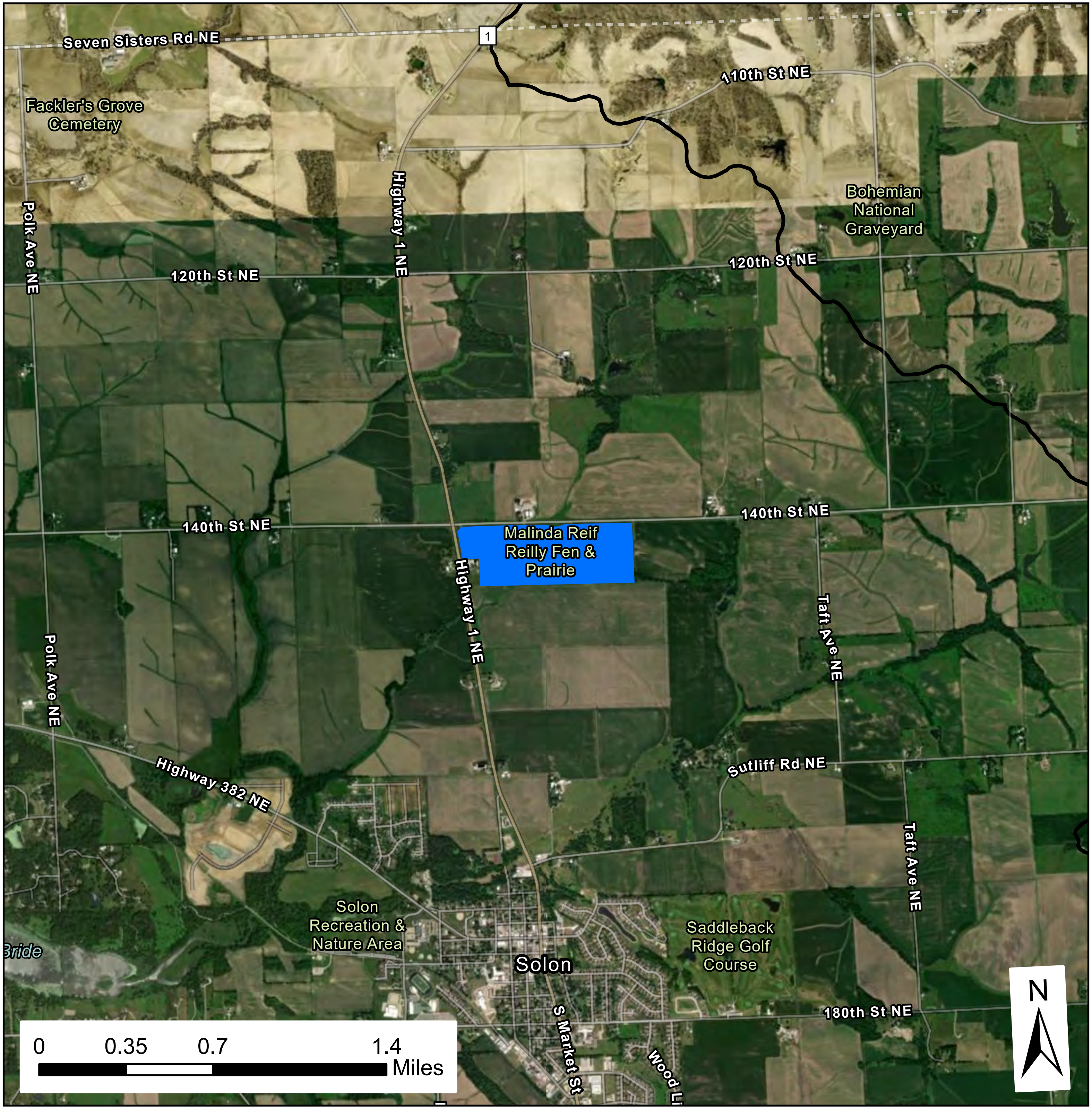
Number of days water will be held per year
183

Useful lifespan (years)
25



Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 11 of 26

JCCB

Site name: Melinda Reilly Prairie Border

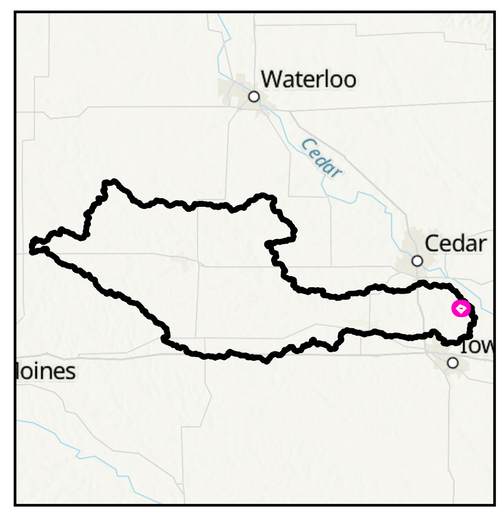
Objective 2.2 Water Storage: 614 ac-ft

Infiltration Water Savings (Millions of Gallons per Year): 317,460

Number of days water will be held each year: 365

Useful lifespan: 25 years

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
12 of 26

Marshall Co

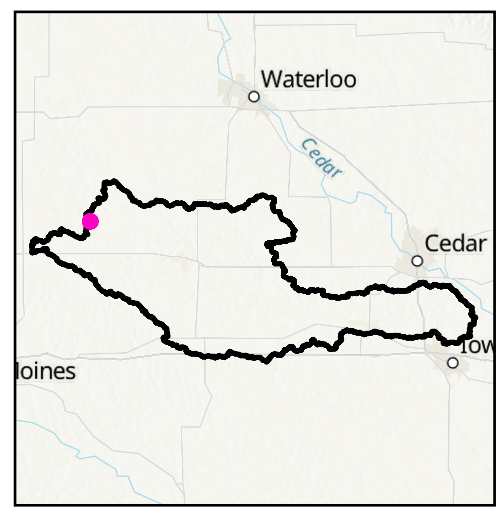
Site name:
Stanley Mill Oxbow_1

Infiltration Water Savings (Millions of Gallons per Year):
1,758

Number of days water will be held per year
37

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
13 of 26

Marshall Co

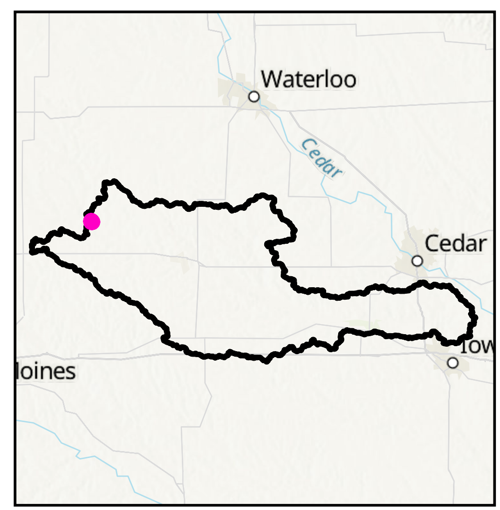
Site name:
Stanley Mill Oxbow_2

Infiltration Water Savings (Millions of Gallons per Year): 390

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow 14 of 26

Marshall Co

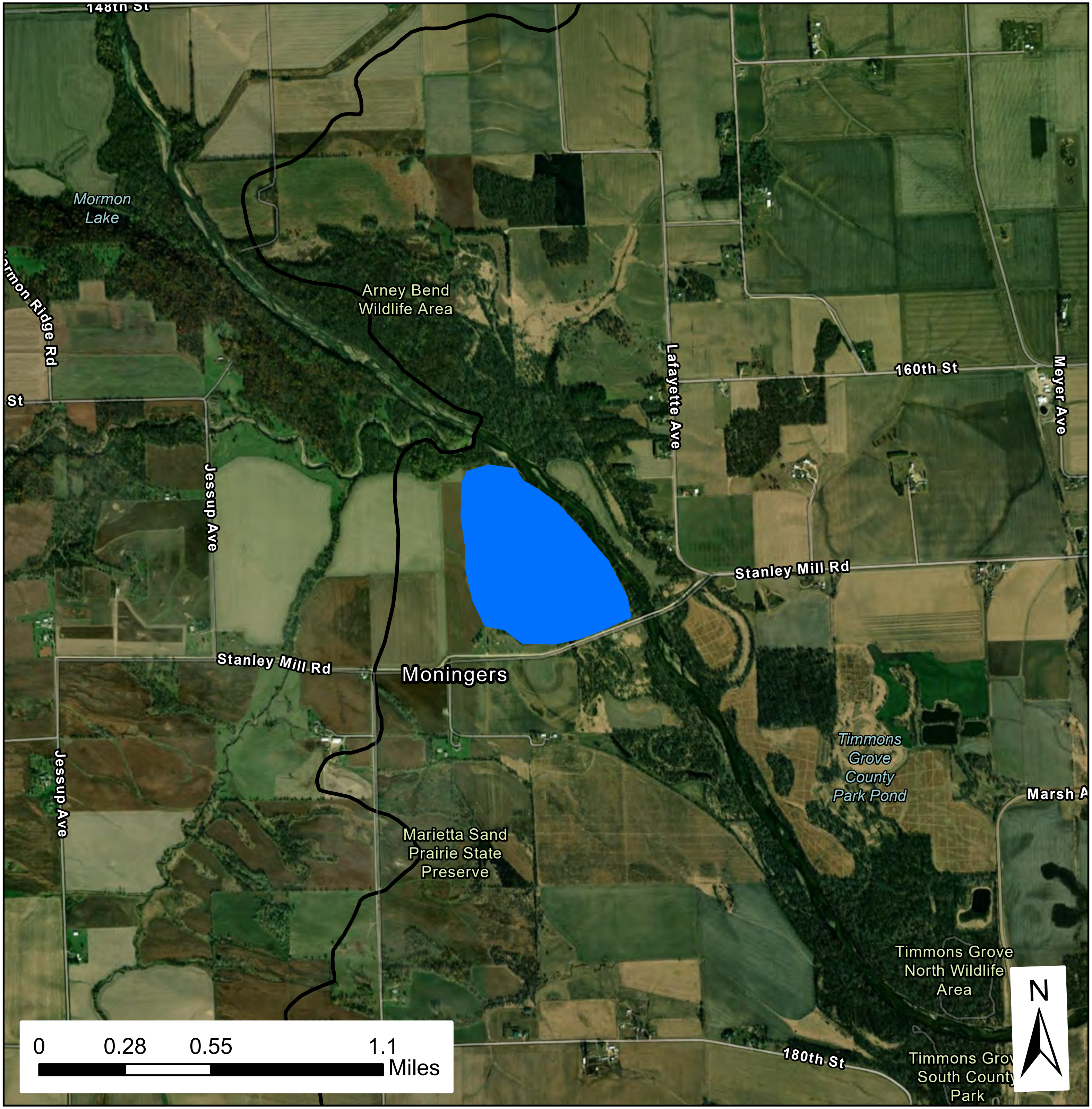
Site name: Stanley Mill Wetland

Objective 2.2 Water Storage: 817 ac-ft

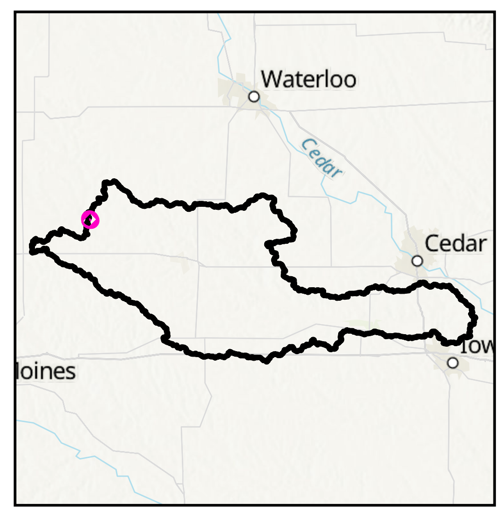
Infiltration Water Savings (Millions of Gallons per Year): 13,778

Number of days water can be held per year: 365

Useful lifespan: 25 years



Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow 15 of 26

Marshall Co

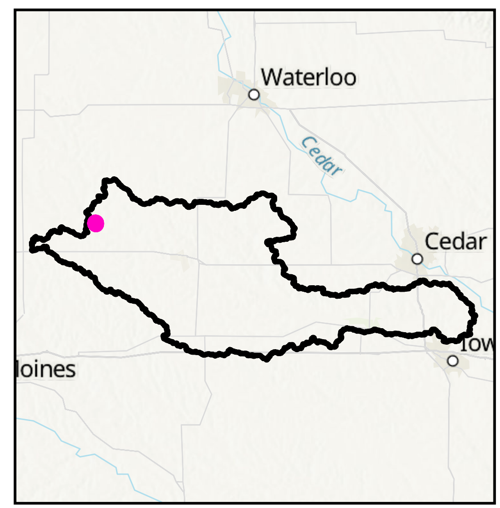
Site name: Timmons Oxbow_1

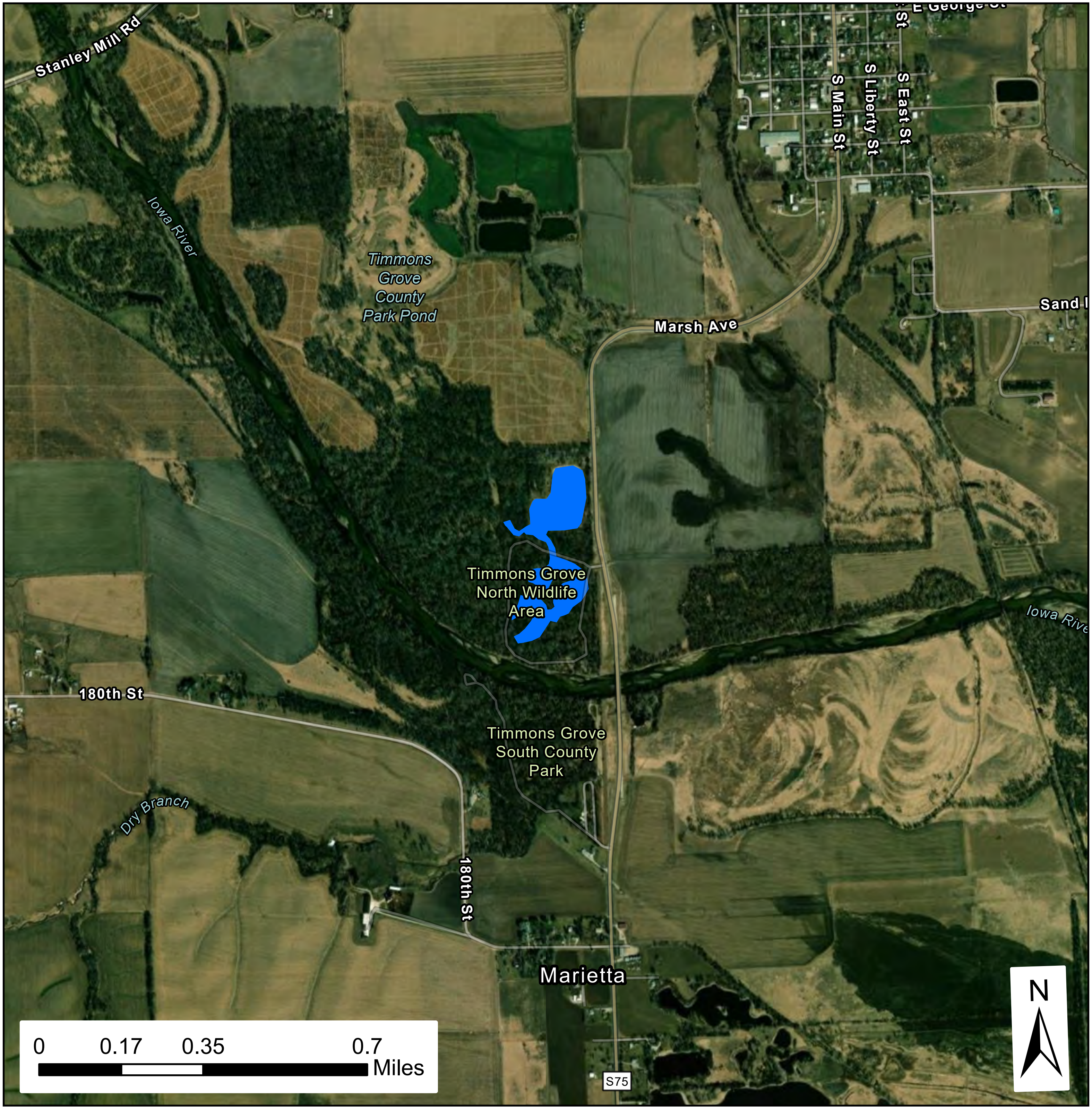
Infiltration Water Savings (Millions of Gallons per Year): 915

Number of days water will be held per year 365

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 16 of 26

Marshall Co

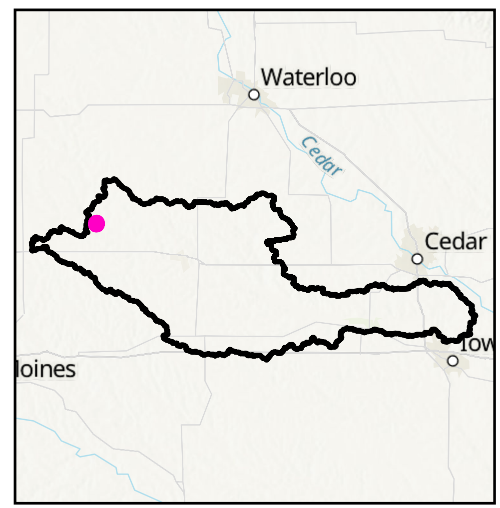
Site name: Timmons Oxbow_2

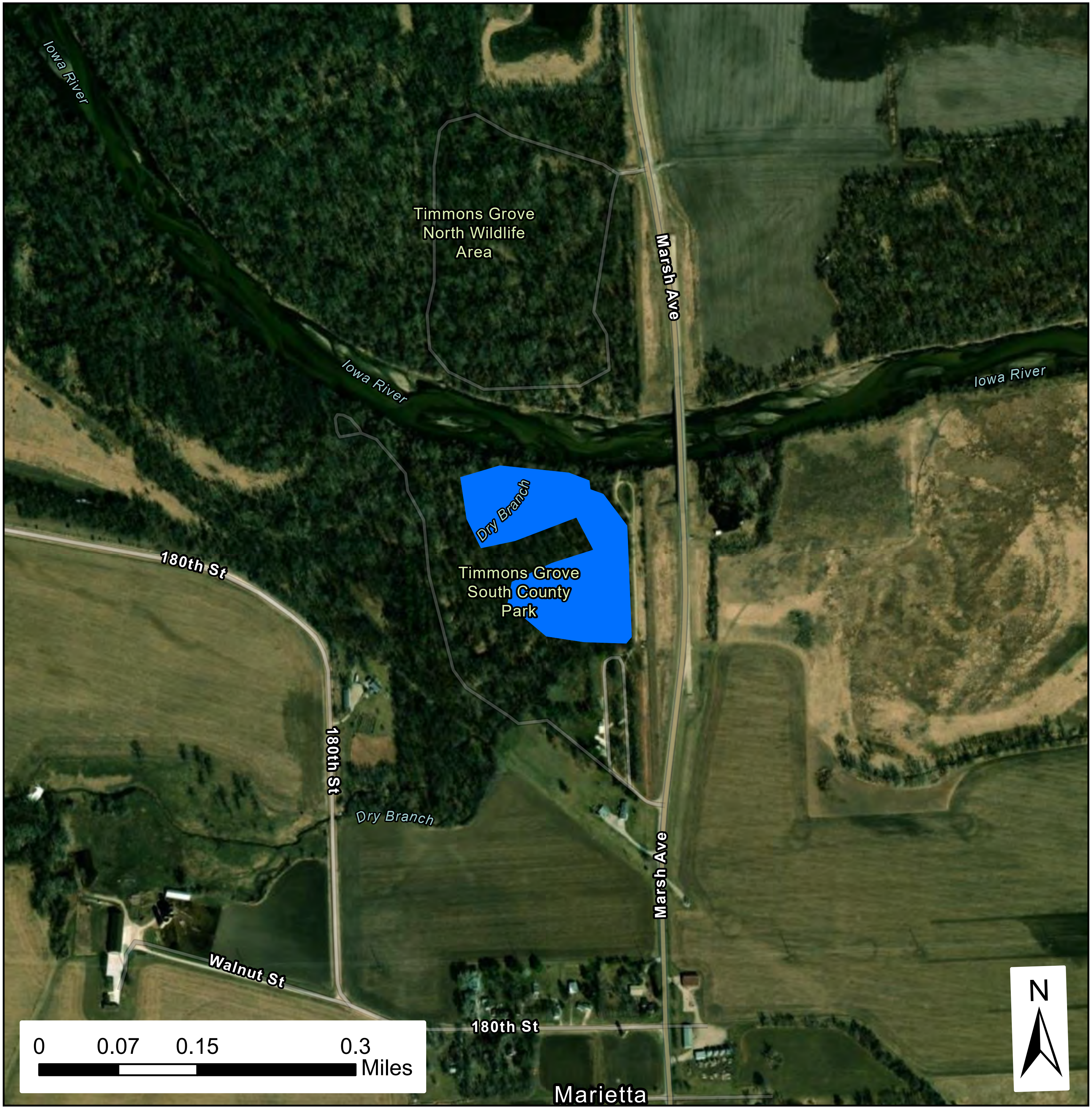
Infiltration Water Savings (Millions of Gallons per Year):
1,796

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow
17 of 26

Marshall Co

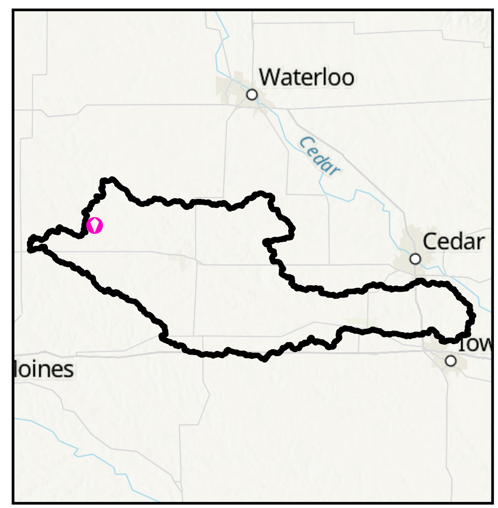
Site name: Timmons Oxbow_3

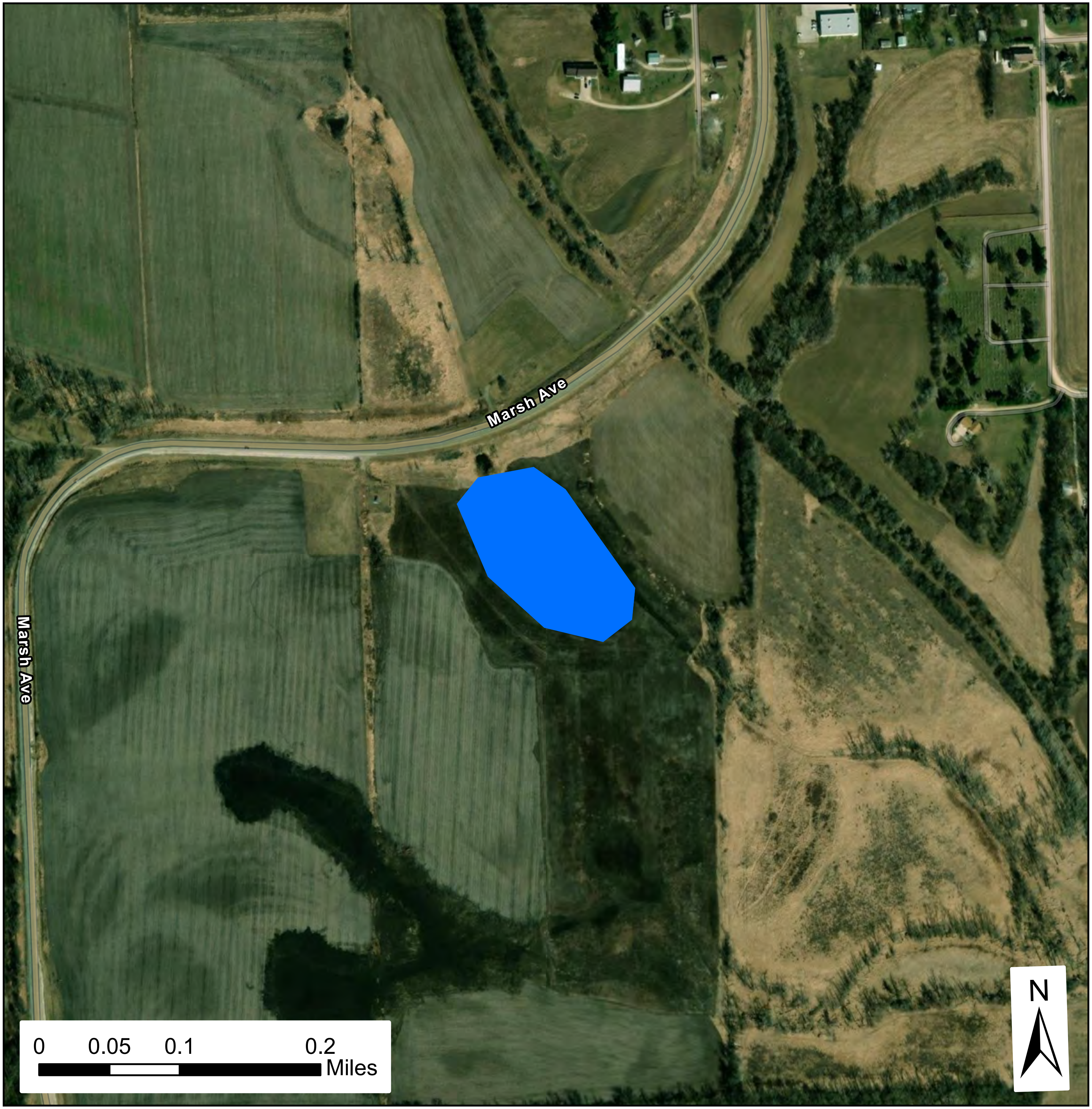
Infiltration Water Savings (Millions of Gallons per Year): 804

Number of days water will be held per year 183

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow

Marshall Co

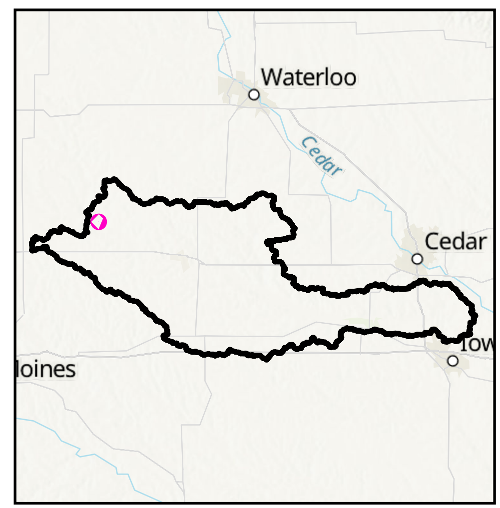
Site name:
Mann Wetlands Pond

Infiltration Water Savings (Millions of Gallons per Year): 261

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow 19 of 26

Marshall Co

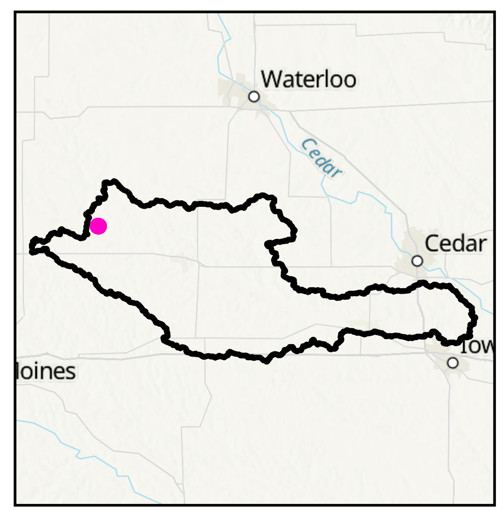
Site name: Mann Wetlands Oxbow_1

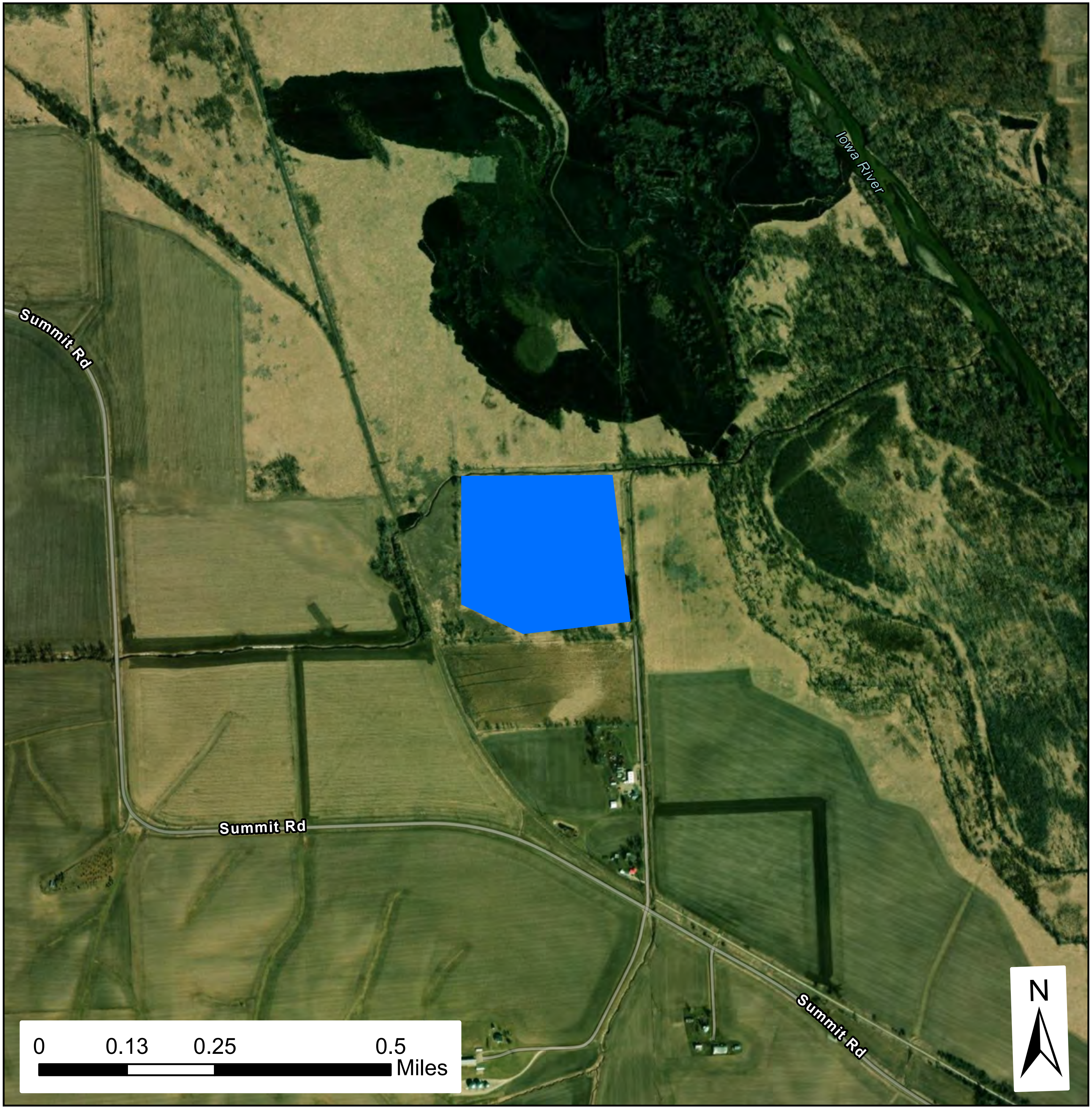
Infiltration Water Savings (Millions of Gallons per Year): 830

Number of days water will be held per year 365

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 20 of 26

Marshall Co

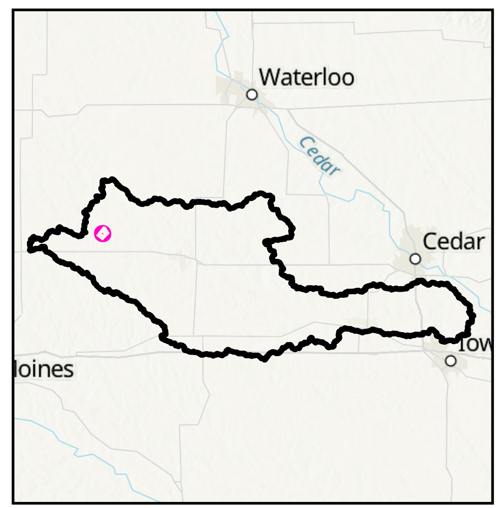
Site name: Winter Bottom Wetland

Infiltration Water Savings (Millions of Gallons per Year): 1,331

Number of days water will be held per year 365

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
21 of 26

Marshall Co

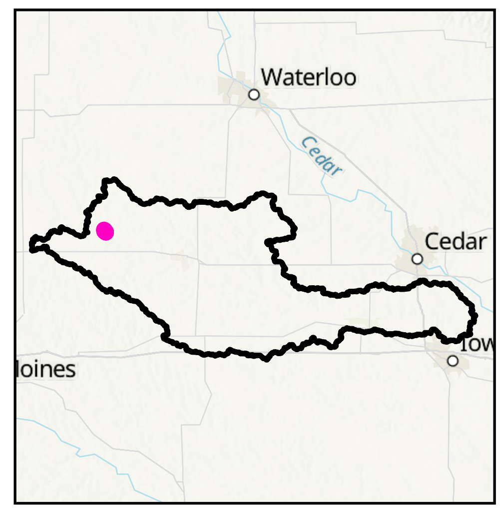
Site name: Winter Bottom Oxbow_1

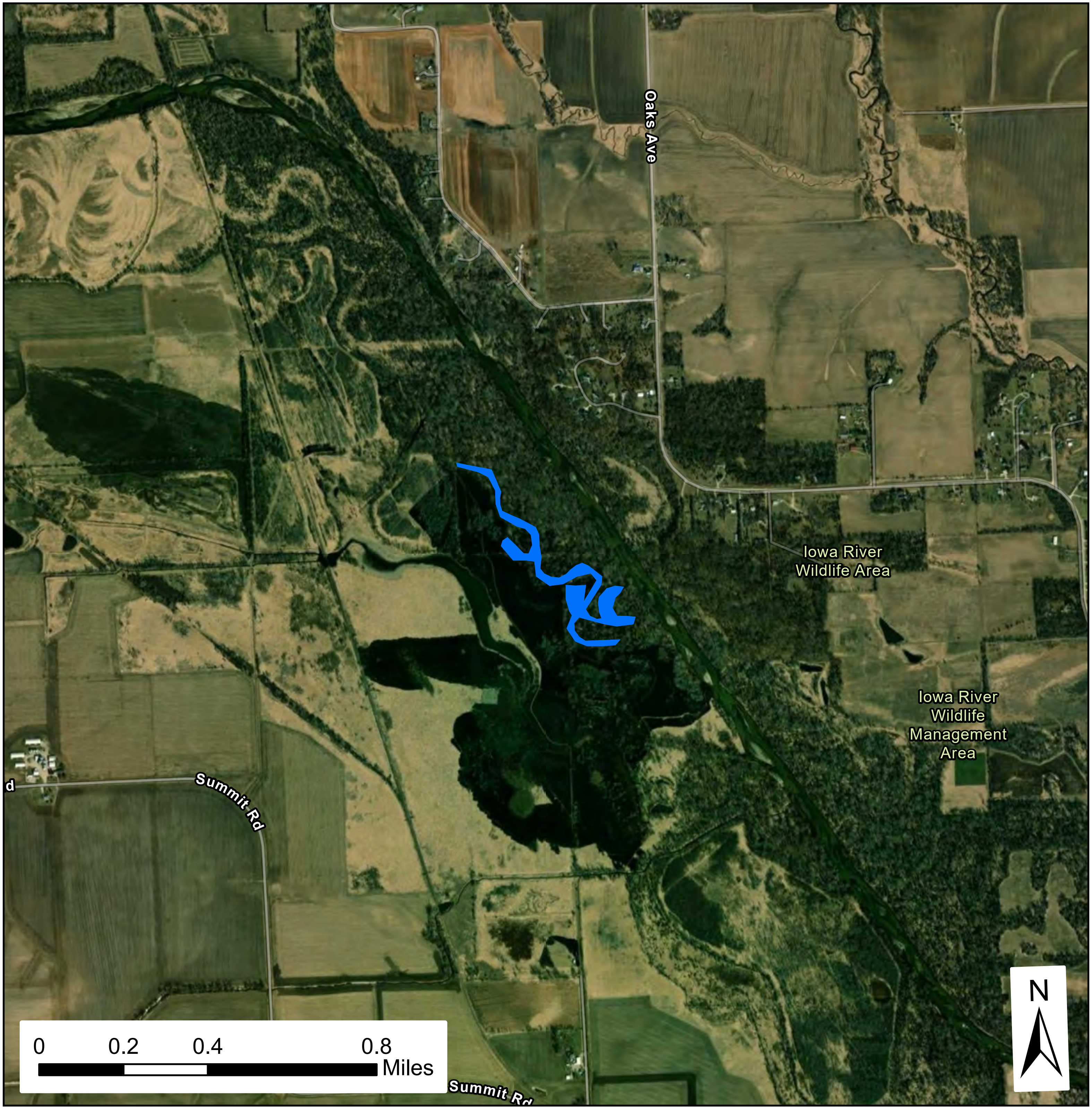
Infiltration Water Savings (Millions of Gallons per Year):
131,619

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 22 of 26

Marshall Co

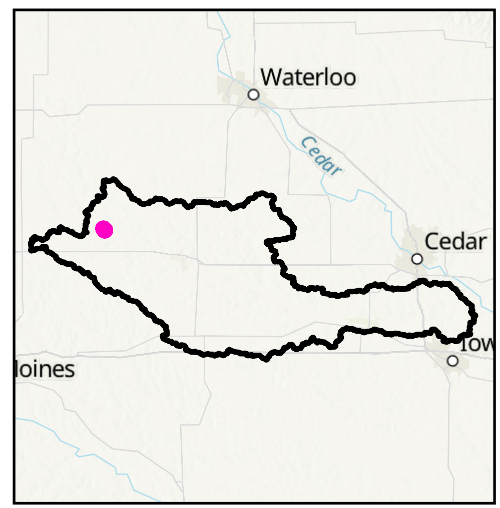
Site name: Winter Bottom Oxbow_2

Infiltration Water Savings (Millions of Gallons per Year): 1,458

Number of days water will be held per year 365

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
23 of 26

Marshall Co

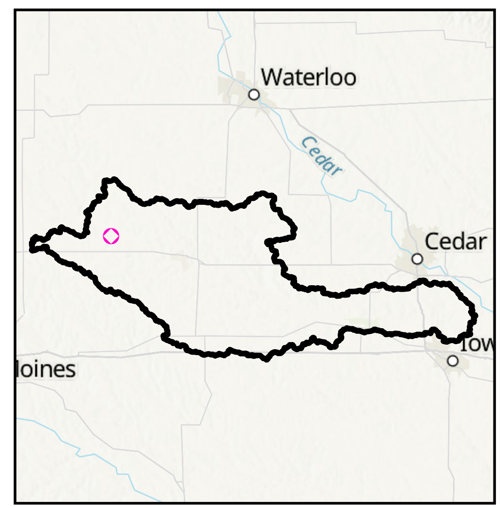
Site name:
Stewart WMA Wetland

Infiltration Water Savings (Millions of Gallons per Year): 172

Number of days water will be held per year
365

Useful lifespan (years)
25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site



Potential Oxbow
24 of 26

Marshall Co

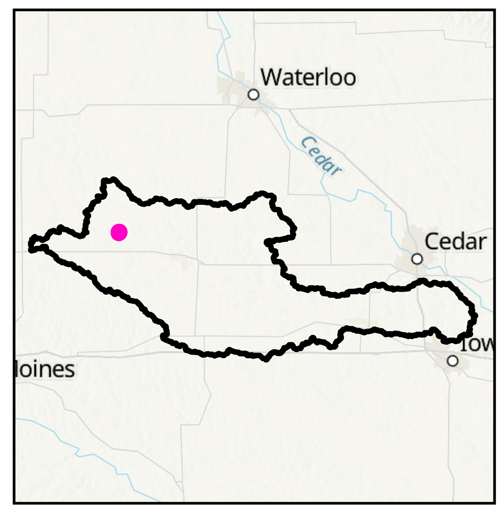
Site name: Bill Ernst Wetland

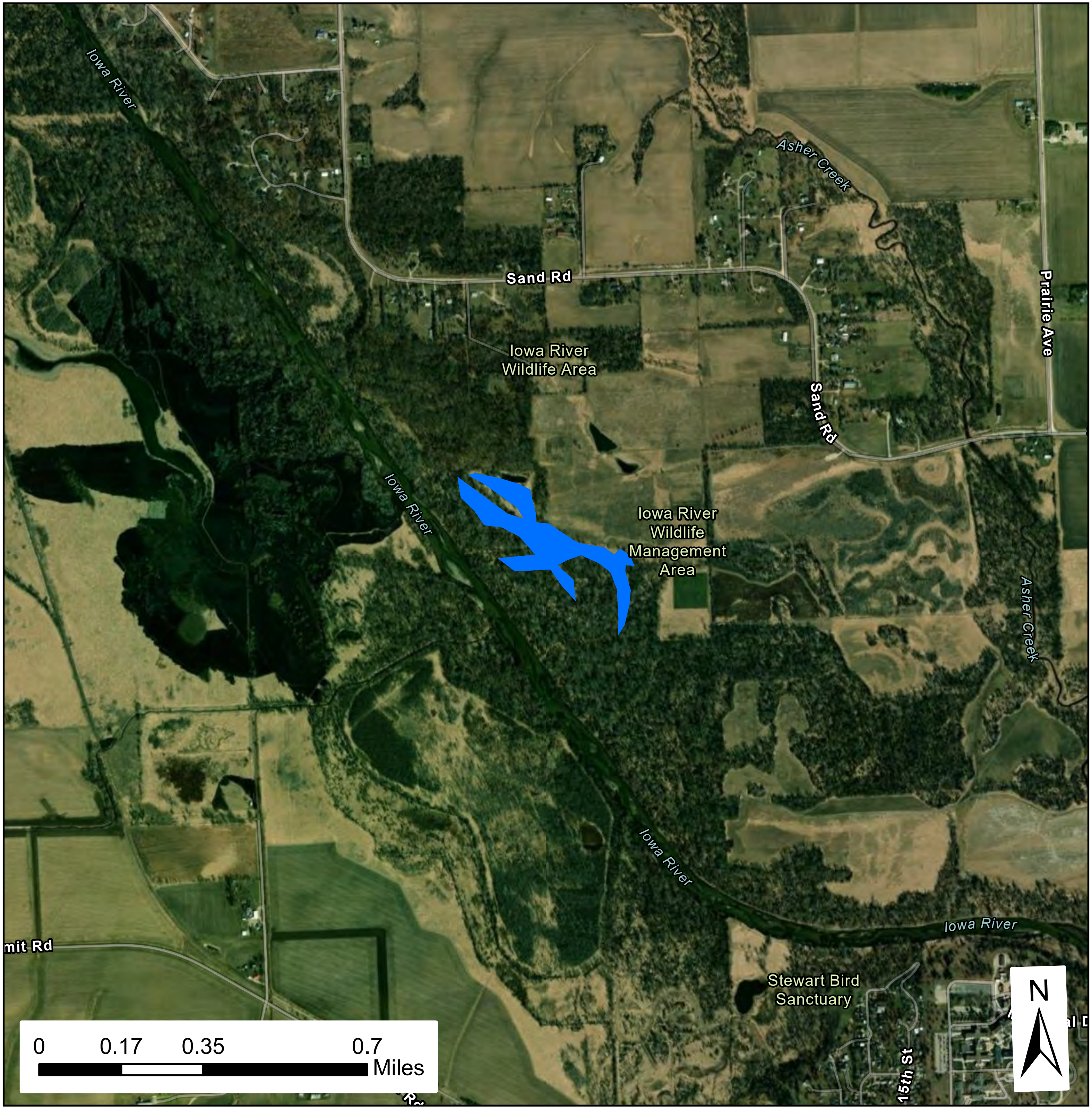
Infiltration Water Savings (Millions of Gallons per Year): 907

Number of days water will be held per year 183

Useful lifespan (years) 25

Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Potential Oxbow 25 of 26

Marshall Co

Site name: Iowa River WMA Oxbow 1

Infiltration Water Savings (Millions of Gallons per Year): 1,982

Number of days water will be held per year 365

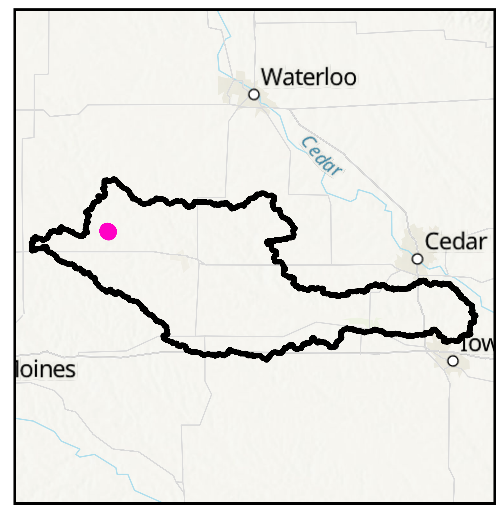
Useful lifespan (years) 25

Riparian Focus Area

Watershed Boundary

Potential Water Storage Sites

General Location of Storage Site



Potential Oxbow
26 of 26

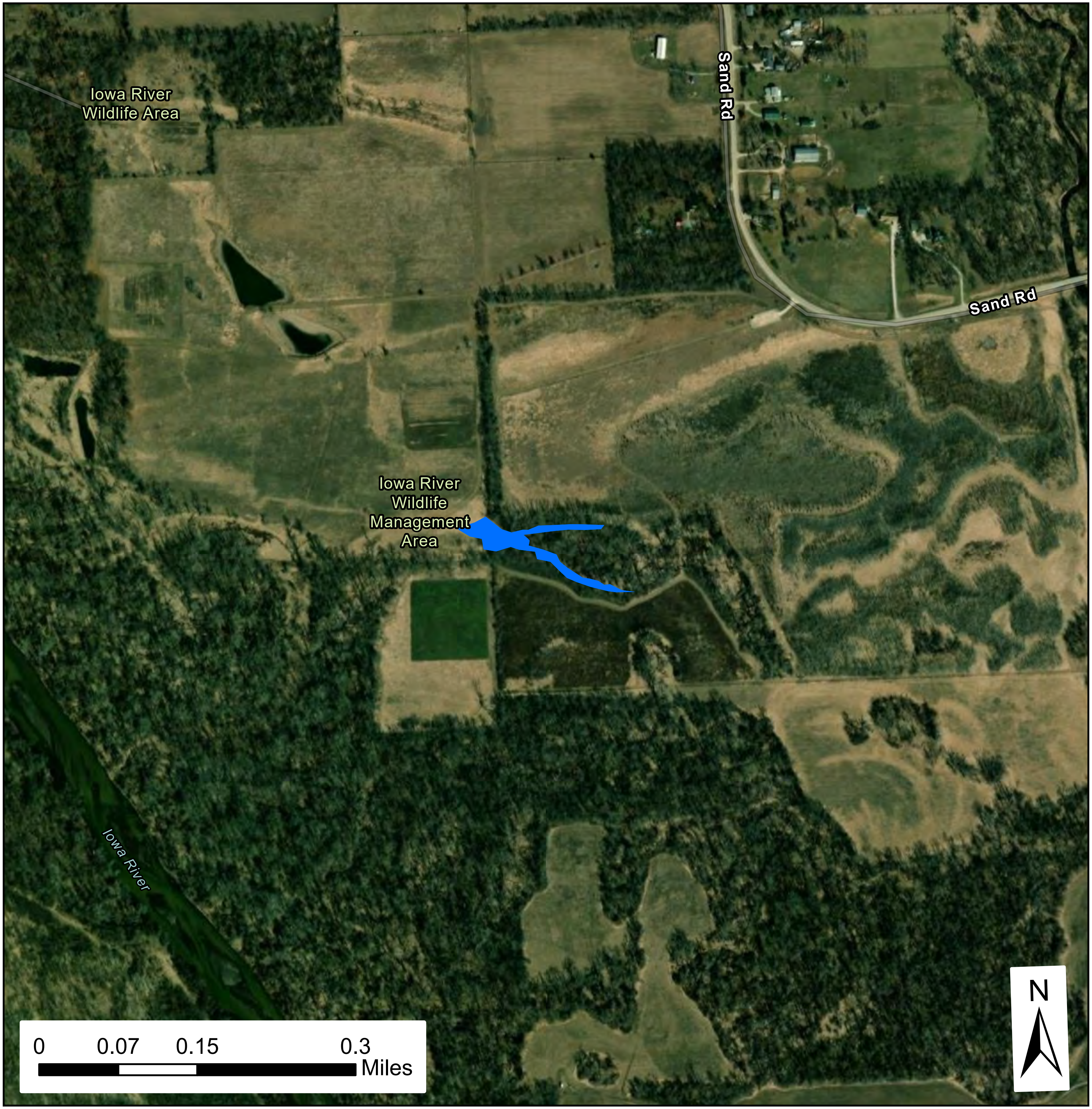
Marshall Co

Site name: Iowa River WMA Oxbow 2

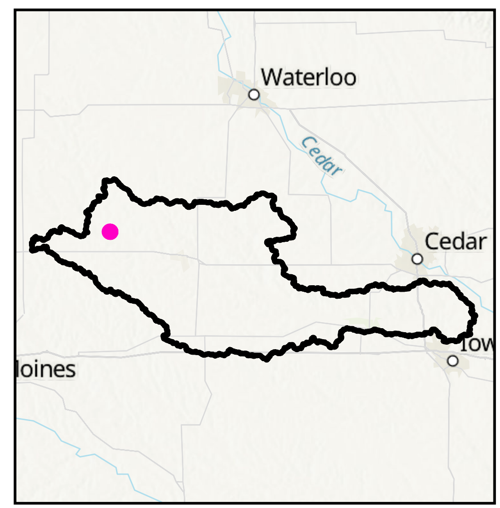
Infiltration Water Savings (Millions of Gallons per Year): 62

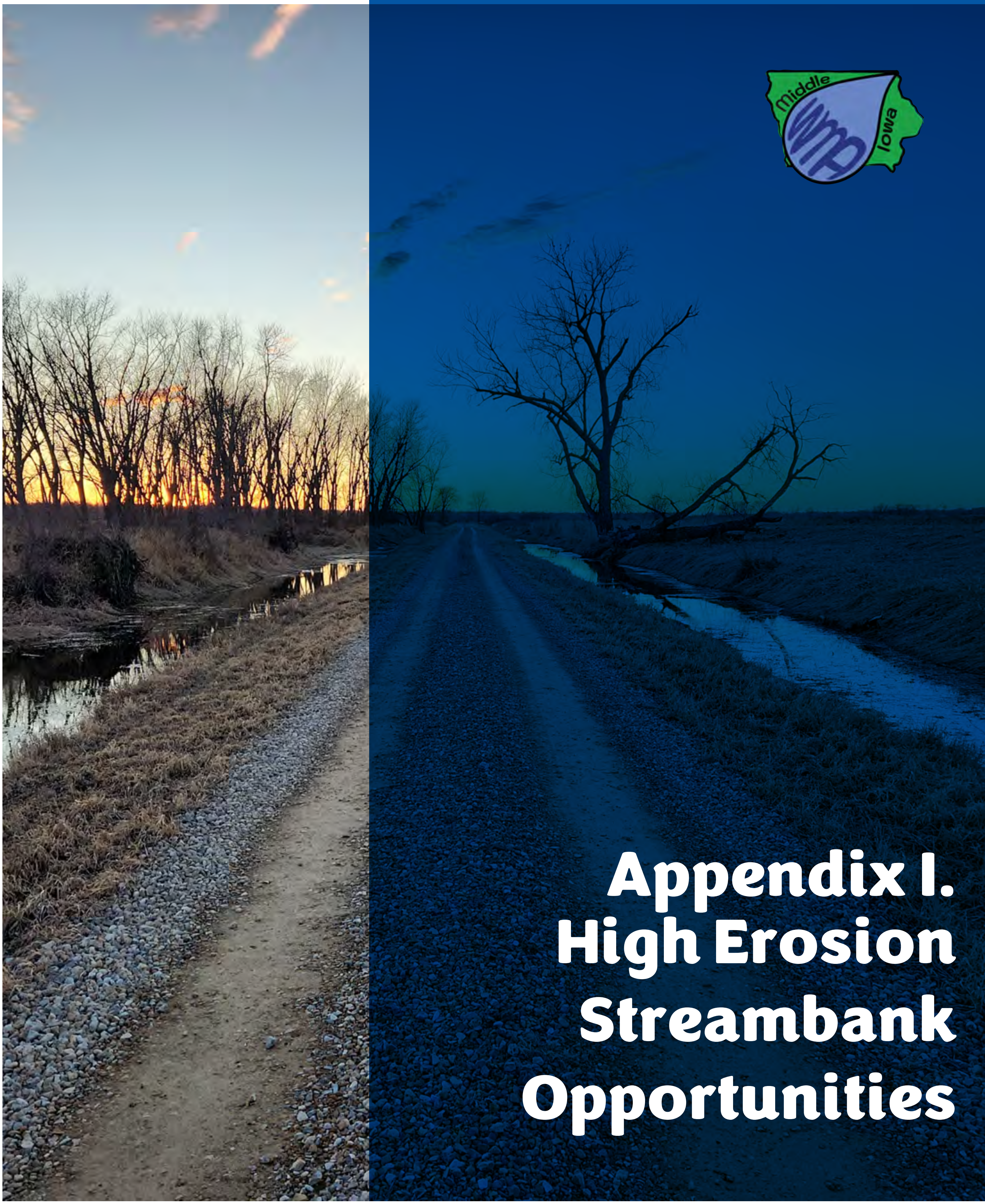
Number of days water will be held per year 365

Useful lifespan (years) 25



Riparian Focus Area
Watershed Boundary
Potential Water Storage Sites
General Location of Storage Site





Appendix I. High Erosion Streambank Opportunities

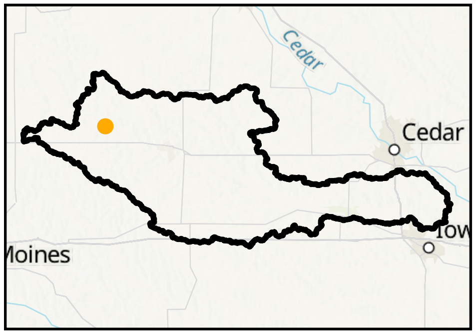
High Erosion Location 1 of 11

Location GIS ID: 5399

Watershed Boundary

Excessive Erosion Areas

N



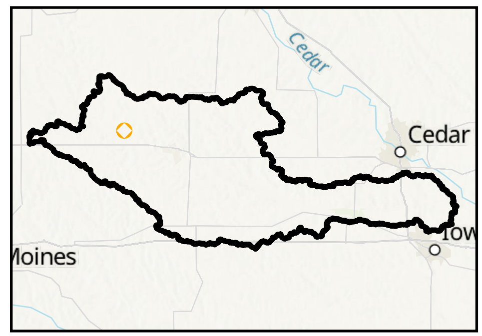
High Erosion Location 2 of 11

Location GIS ID: 6540

Watershed Boundary

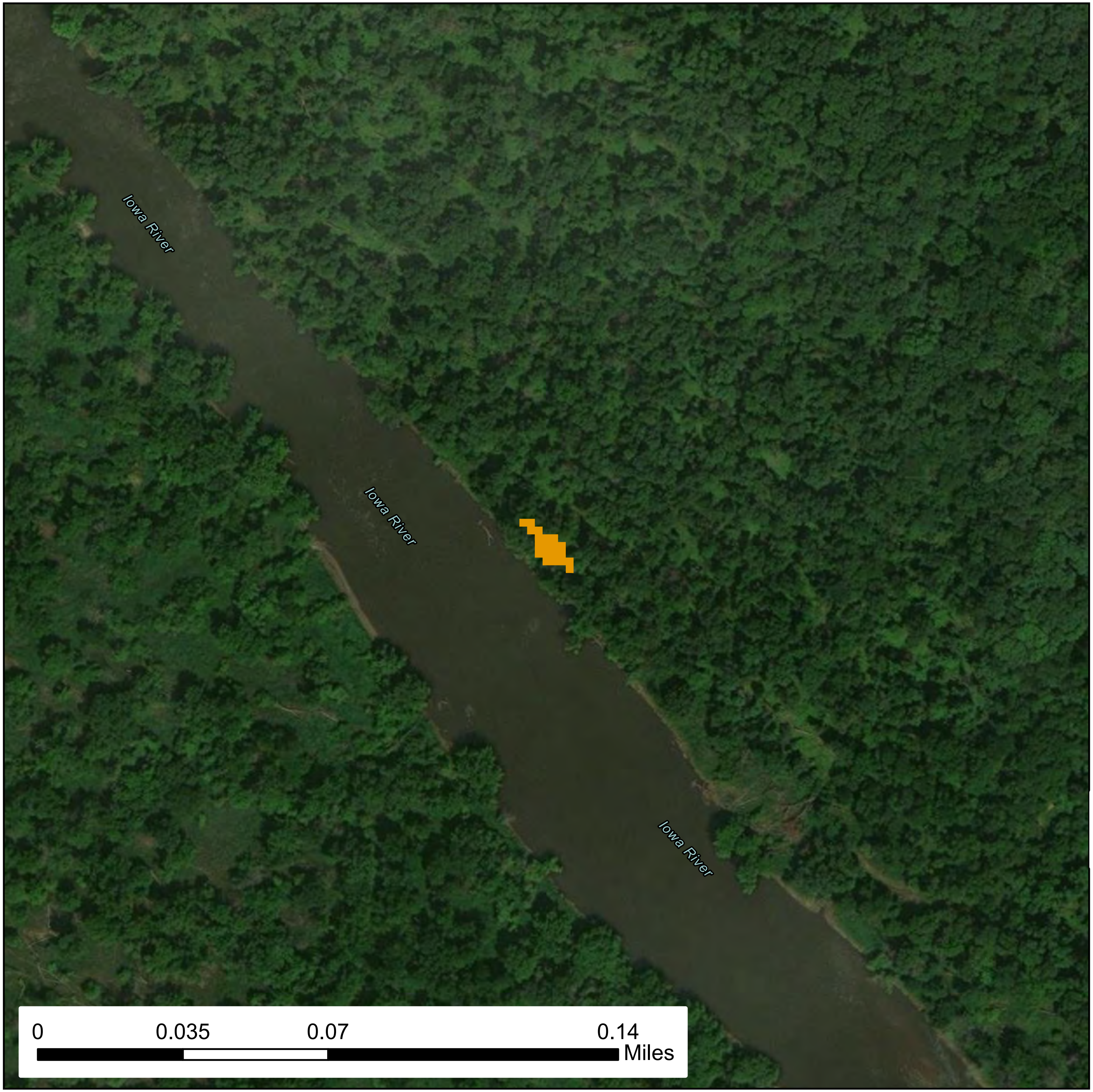
Excessive Erosion Areas

N



High Erosion Location 3 of 11

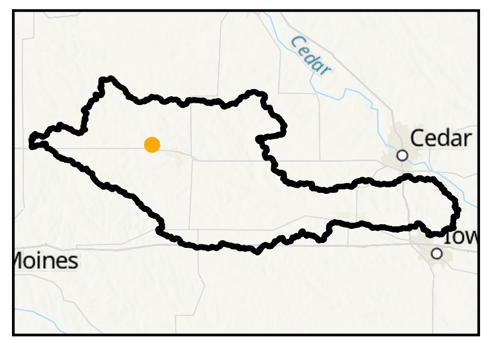
Location GIS ID: 23014



Watershed Boundary

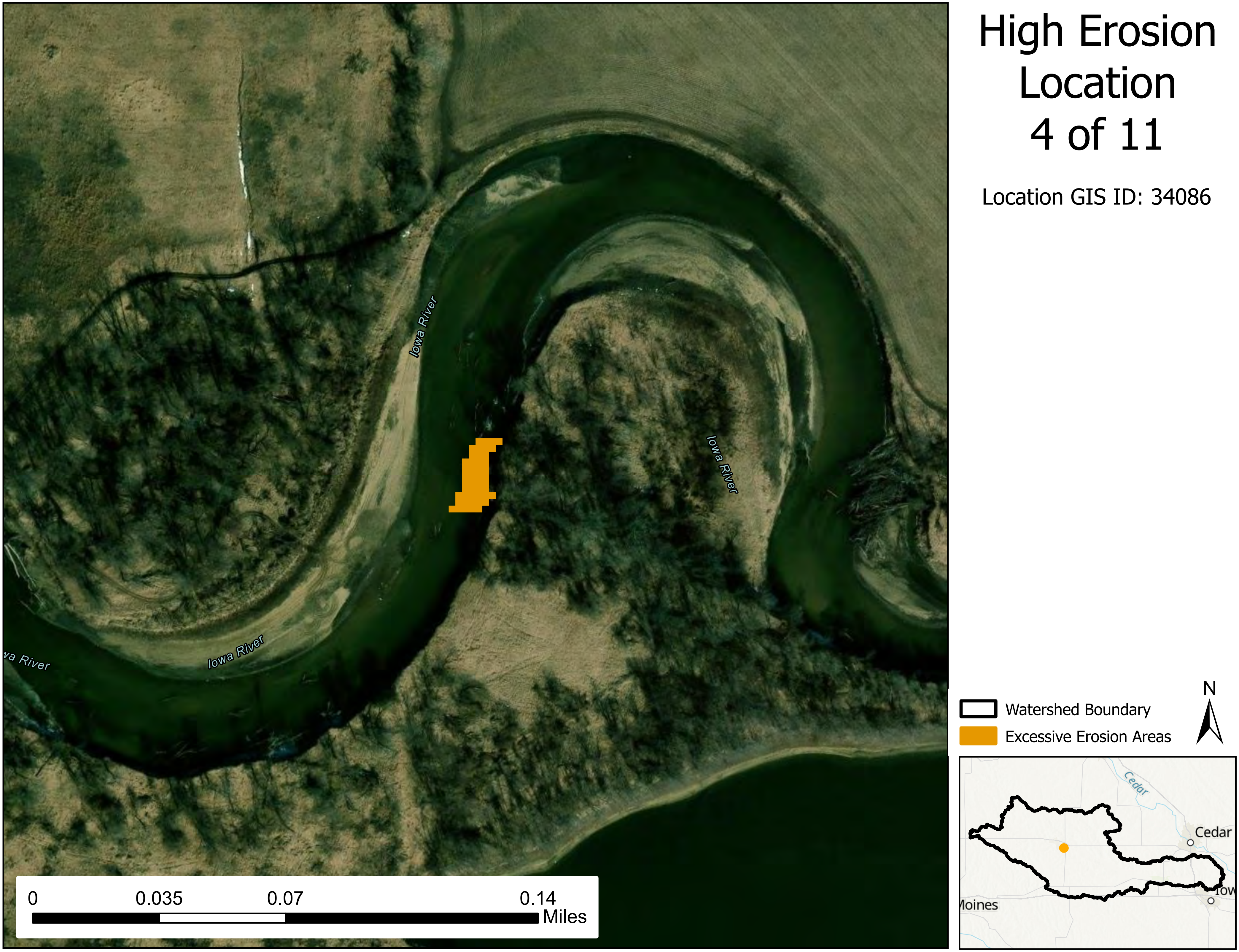
Excessive Erosion Areas

N



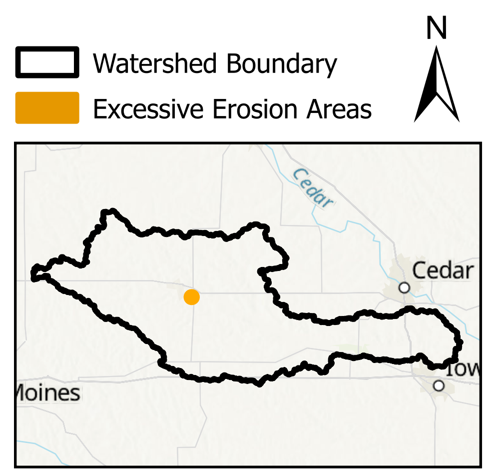
High Erosion Location 4 of 11

Location GIS ID: 34086



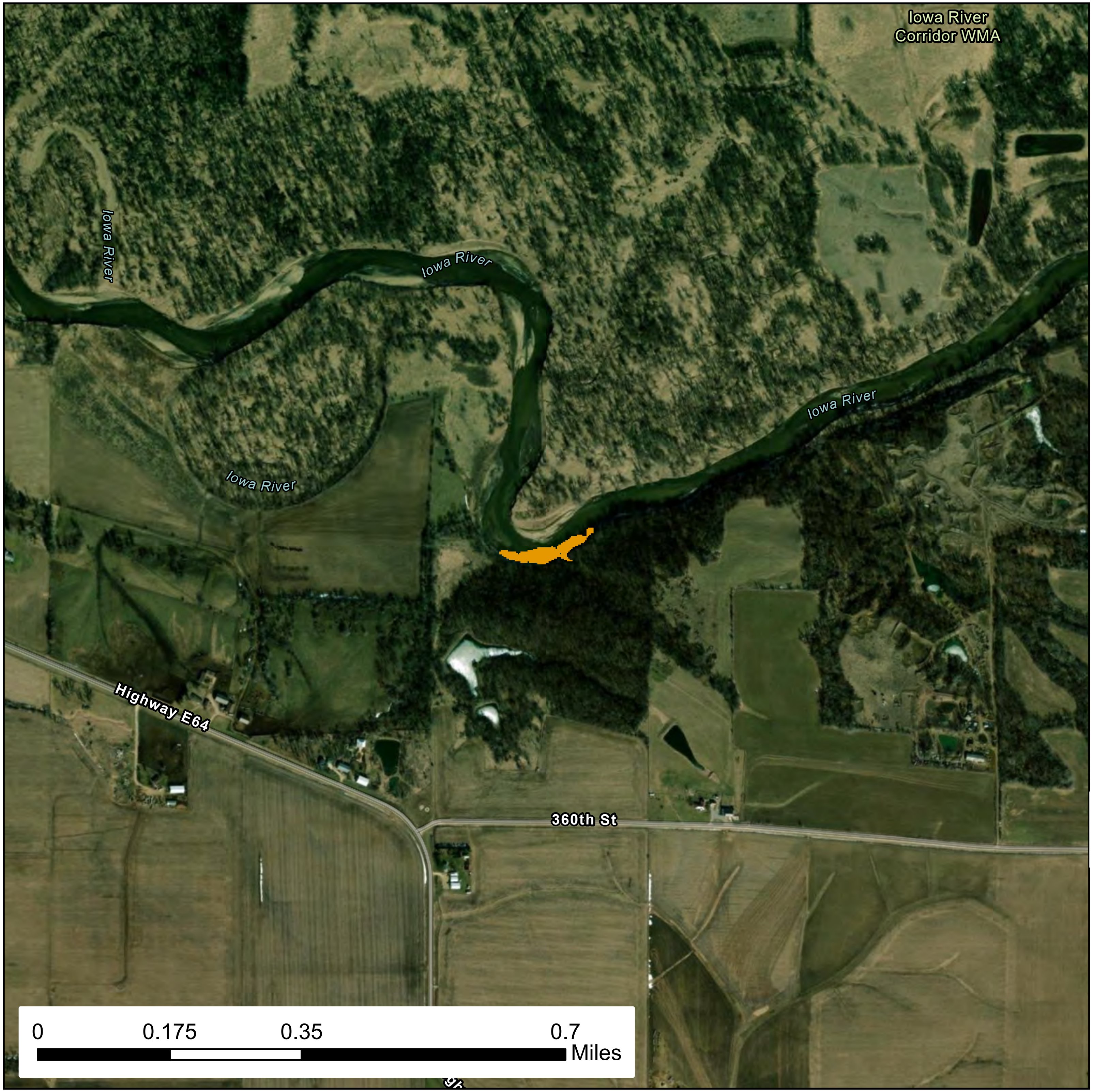
High Erosion Location 5 of 11

Location GIS ID: 34186



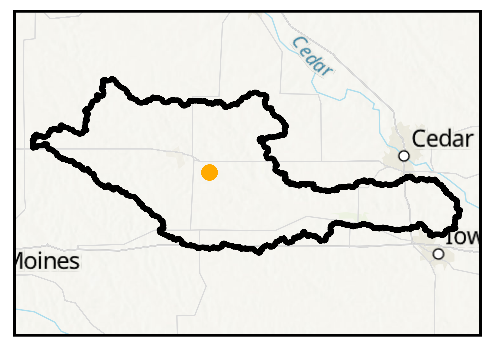
High Erosion Location
6 of 11

Location GIS ID: 38137



Watershed Boundary
Excessive Erosion Areas

N



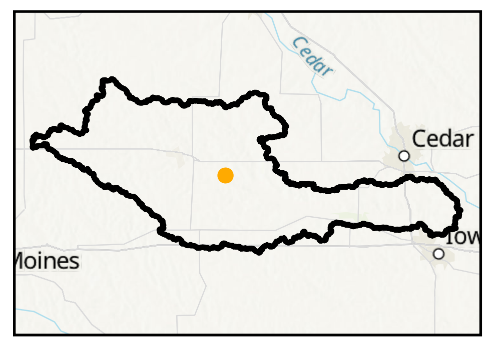
High Erosion Location 7 of 11

Location GIS ID: 38816

Watershed Boundary

Excessive Erosion Areas

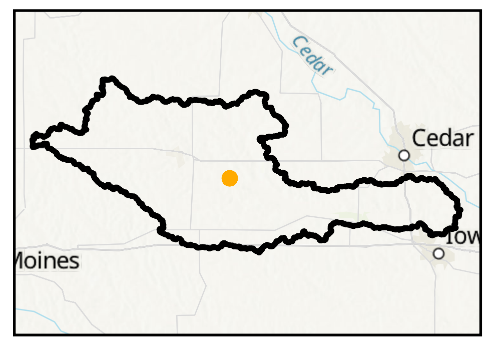
N



High Erosion Location 8 of 11

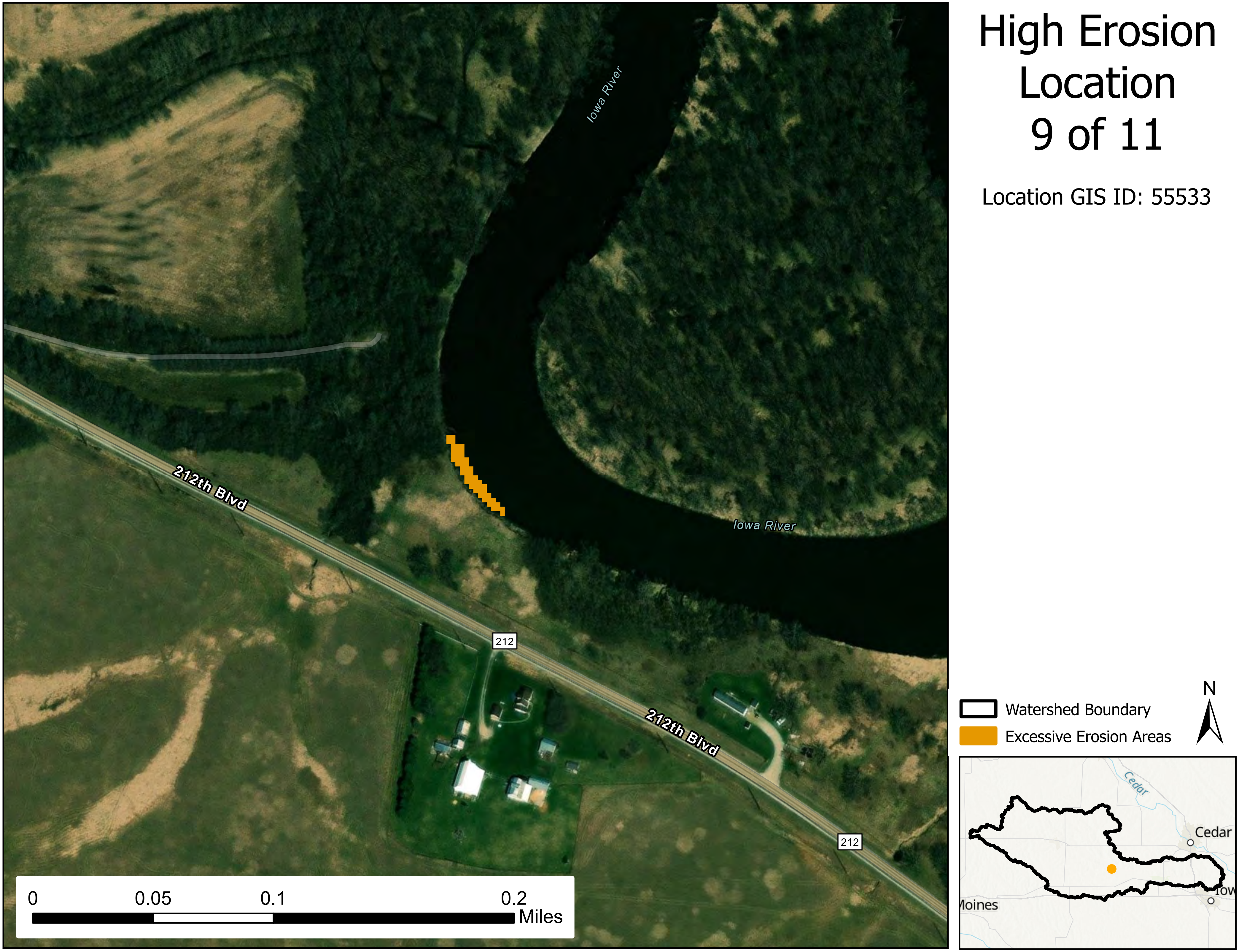
Location GIS ID: 39641

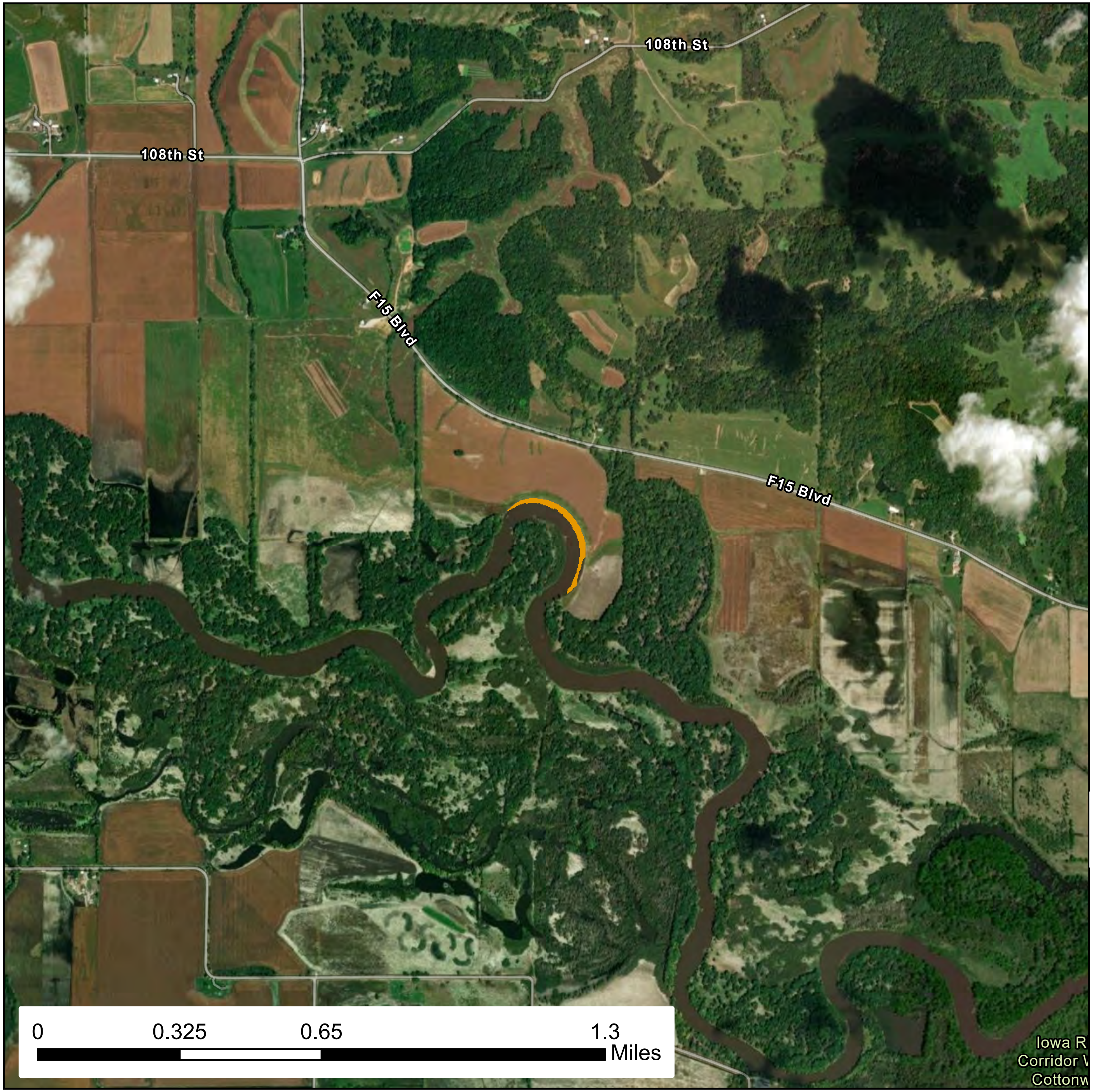
Watershed Boundary
Excessive Erosion Areas



High Erosion Location 9 of 11

Location GIS ID: 55533





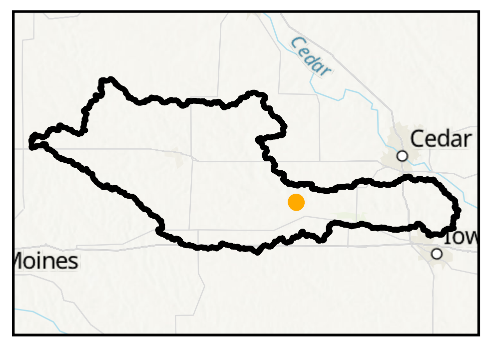
High Erosion Location 10 of 11

Location GIS ID: 59822

Watershed Boundary

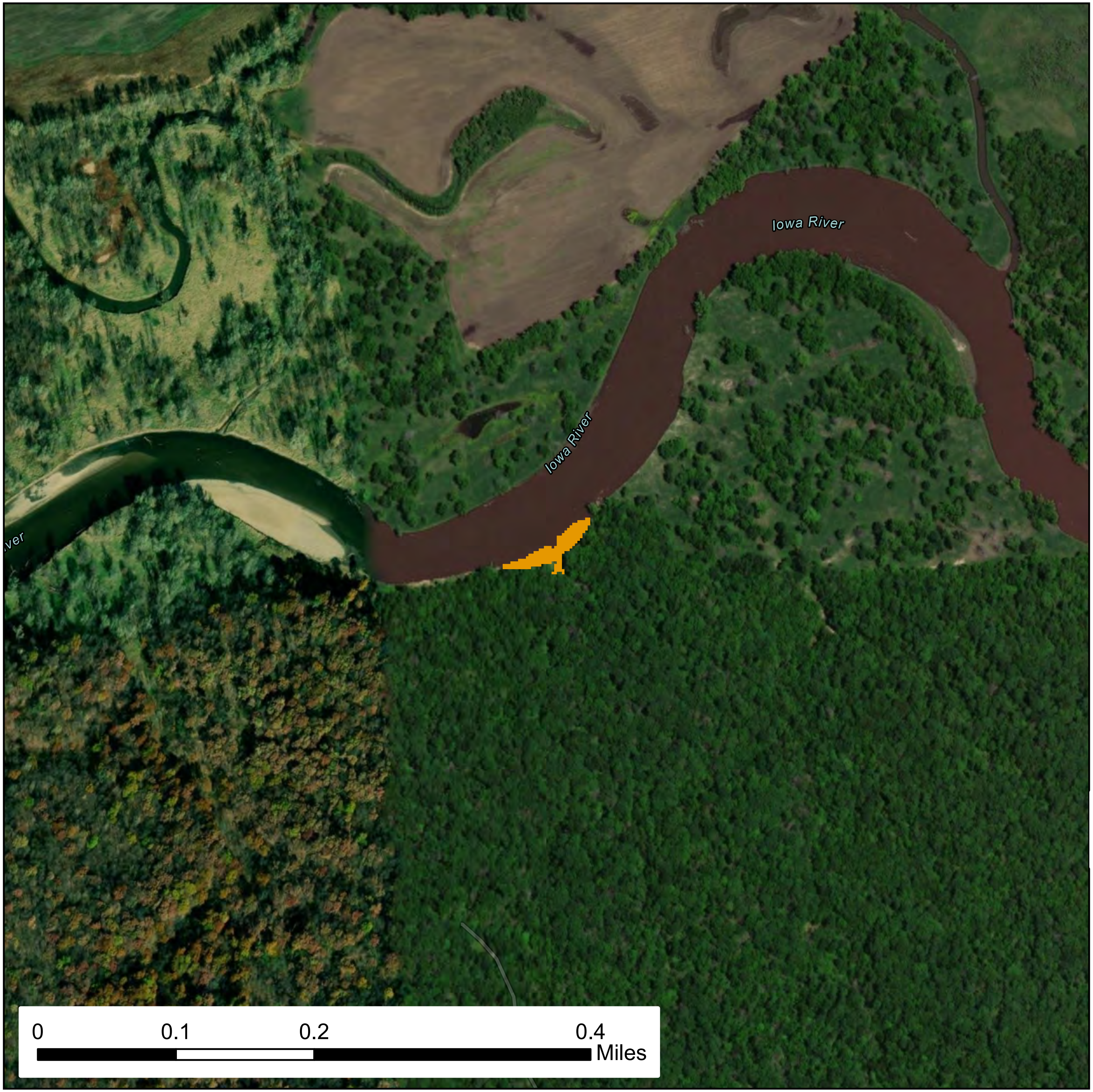
Excessive Erosion Areas

N

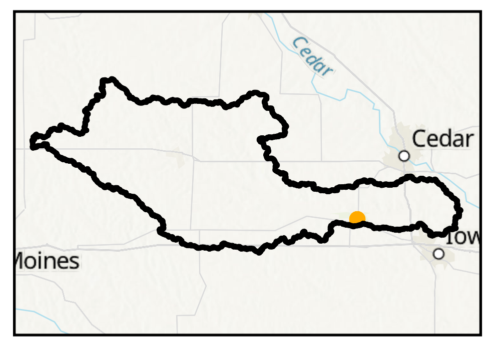


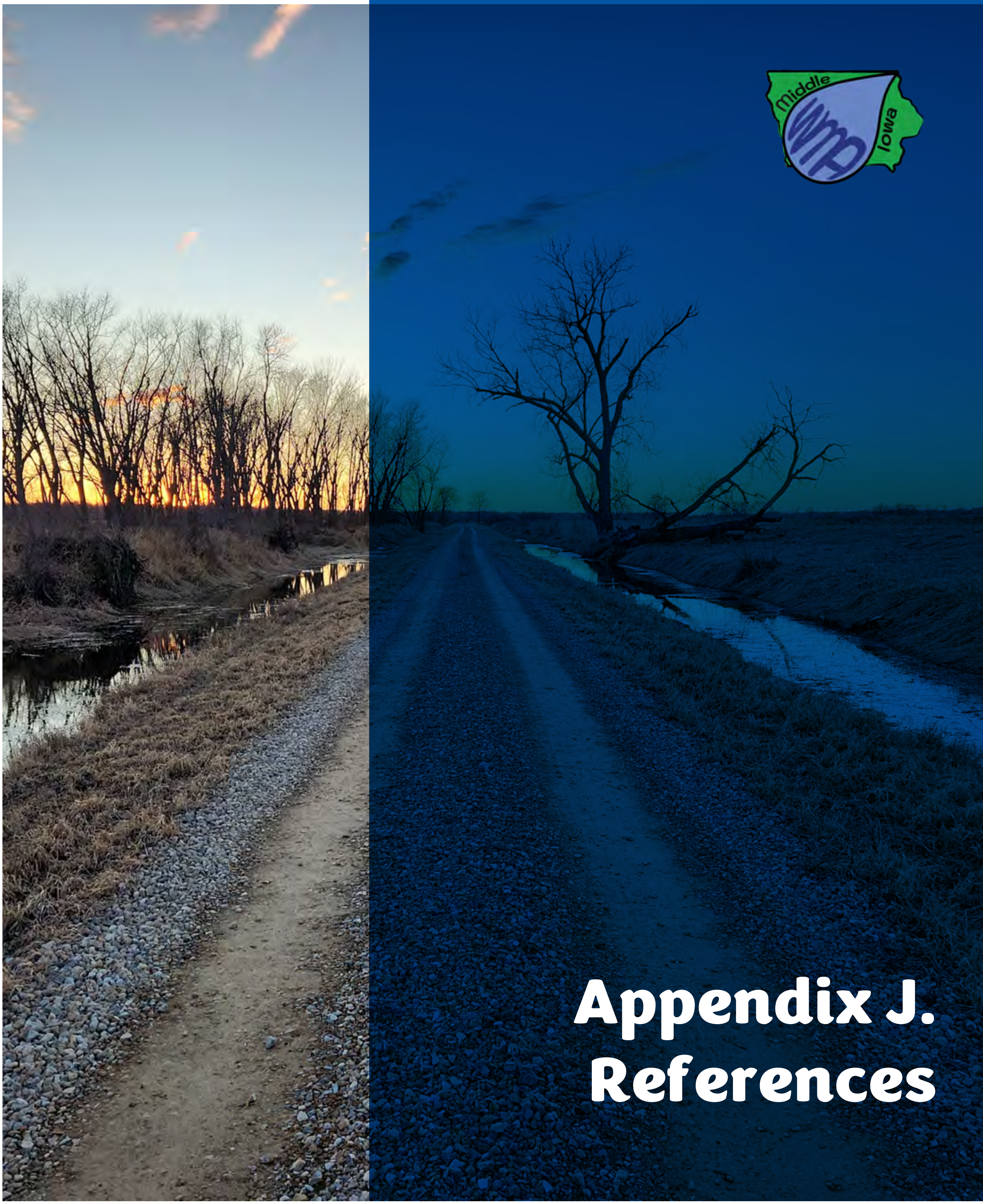
High Erosion Location 11 of 11

Location GIS ID: 80141



Watershed Boundary
Excessive Erosion Areas
N





Appendix J. References

References

Anderson, C. and Kean, A., 2004. Red river basin flood damage reduction framework.

Center for Biological Diversity. n.d. Threatened and Endangered Species by County. Available at: https://www.biologicaldiversity.org/programs/population_and_sustainability/T_and_E_map/

Prior, Kara. 2015. In-stream nitrogen processing and dilution in an agricultural stream network. Iowa Research Online.

Prior, Jean. n.d. Iowa Geological Survey, Landforms of Iowa. Available at: https://iowageologicalsurvey.uiowa.edu/iowa-geology/landforms-iowa

Garrett, J.D., and Kalkhoff, S.J., 2021, Nutrient concentrations, loads, and yields in the Middle Iowa River Basin, Iowa: U.S. Geological Survey Scientific Investigations Report 2020–5148, 22 p.

DNR, 2023a. Geospatial data accessed from Iowa Geospatial Data Clearinghouse. Source Water Protection.

DNR, 2023b. Geospatial data accessed from Iowa Geospatial Data Clearinghouse. Wastewater Industrial Facilities.

DNR. 2024. Geospatial data accessed from Iowa Geospatial Data Clearinghouse. Animal Feeding Operations.

DNR. 2025a. State Of Iowa Public Drinking Water Program 2024 Annual Compliance Report.

DNR. 2025b. Iowa Well Information System.

DNR. 2025c. Geospatial data of potential contaminant sources. Delivered to HEI via email communication 8 January 2025.

Iowa State University (ISU). 2017. Iowa BMP Mapping Project. Available at: https://www.gis.iastate.edu/current-projects/bmps/

Iowa State University (ISU). 2025. Wetlands webpage. Available at: https://naturalresources.extension.iastate.edu/wetlands

National Oceanic and Atmospheric Administration (NOAA). 2024.National Centers for Environmental Information: Climate Data Online. Downloaded Global Summary for GHCND:USC00130600

NRCS. 2025. Soil Health webpage. Available at: https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soil/soil-health

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: http://websoilsurvey.sc.egov.usda.gov/. Accessed 06/09/2025.

State Data Center. 2023. Annual population estimates.

TNC. 2025. The Nature Conservancy. Freshwater Resilient and Connected Network.

United States Department of Agriculture - National Agricultural Statistics Service (USDA-NASS). 2022. Census of Agriculture. Iowa Volume 1, Chapter 2. County Level Data.

United States Department of Agriculture (USDA). 2022. County Profiles.

United States Geological Survey (USGS). 2020. National Hydrography Dataset.

United States Geological Survey (USGS). 2023. National Land Cover Dataset.

United States Geological Survey (USGS). 2024. Gauge data for 05453100.

Links

EPA Environmental Justice Screening and Mapping Tool: https://ejscreen.epa.gov/mapper/

The Nature Conservancy data: https://www.nature.org/en-us/what-we-do/our-insights/data-and-tools/

Iowa Code Chapter 28E: https://www.legis.iowa.gov/docs/code/2021/28E.pdf

List of Iowa WMAs: https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Management-Authorities/Current-Iowa-WMAs

Middle Iowa River WMA 28E: https://www.iowadnr.gov/Portals/DNR/uploads/water/watershed/files/WMA_Files/M516114%20Middle%20Iowa%2028e.pdf?ver=_d5HmVNGDgu5n9xove2mOw%3d%3d

Lake Macbride State Park: https://www.iowadnr.gov/Places-to-Go/State-Parks/Iowa-State-Parks/Lake-Macbride-State-Park

TMDLs are available here: https://programs.iowadnr.gov/adbnet/Docs/TMDL

Watershed Management Plans:

Otter Creek Lake Watershed Plan:
https://www.iowadnr.gov/Portals/DNR/uploads/water/watershed/files/OtterCreekLakeWMP.pdf

Price Creek Watershed Management Plan:
https://www.iowadnr.gov/Portals/DNR/uploads/water/watershed/files/pricecreek.pdf

Union Grove Watershed Management Plan:
https://www.iowadnr.gov/Portals/DNR/uploads/water/watershed/files/uniongrovewmp.pdf

Hazard Mitigation Plans:

Tama:
https://tamacounty.iowa.gov/files/emergency_management/hazard_mitigation_plan_19801.pdf

Benton:
https://www.bentoncountyia.gov/files/emergency_management/benton_county_hazard_plan_2020_70180.pdf

Marshall: https://www.region6resources.org/wp-content/uploads/2016/07/Marshall_County_Hazard_Mitigation_Plan.pdf

Powesheik: https://www.region6resources.org/wp-content/uploads/2016/07/Poweshiek_Hazard_Mitigation_Plan.pdf

Linn: https://www.linncountyiowa.gov/DocumentCenter/View/26309/Linn-Co-HazMit-Plan-2025-FINAL?bidId=