2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

GRITTER CREEK

HUC-12: 070802090301

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Gritter Creek subwatershed is located in the central region of the ERW. It overlaps 2 counties (Iowa and Keokuk) and a portion of the City of North English. Figure 1 is a location map of the subwatershed. The subwatershed encompasses 14,836 acres (23.2 square miles) of land, which is predominately row crops (corn and soybeans). Gritter Creek stretches approximately 31 miles through the subwatershed in west to east direction, eventually outletting into the Middle English River.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is phosphorus and sediment contamination. Additionally, the Gritter Creek subwatershed ranked low in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

Resource concerns in the Gritter Creek subwatershed aided in the ERW's decision to designate the subwatershed as one of five priority areas for implementation of best management practices (BMPs) through cost share partnerships with local landowners. Funding for this program is available through the Iowa Watershed Approach (IWA).

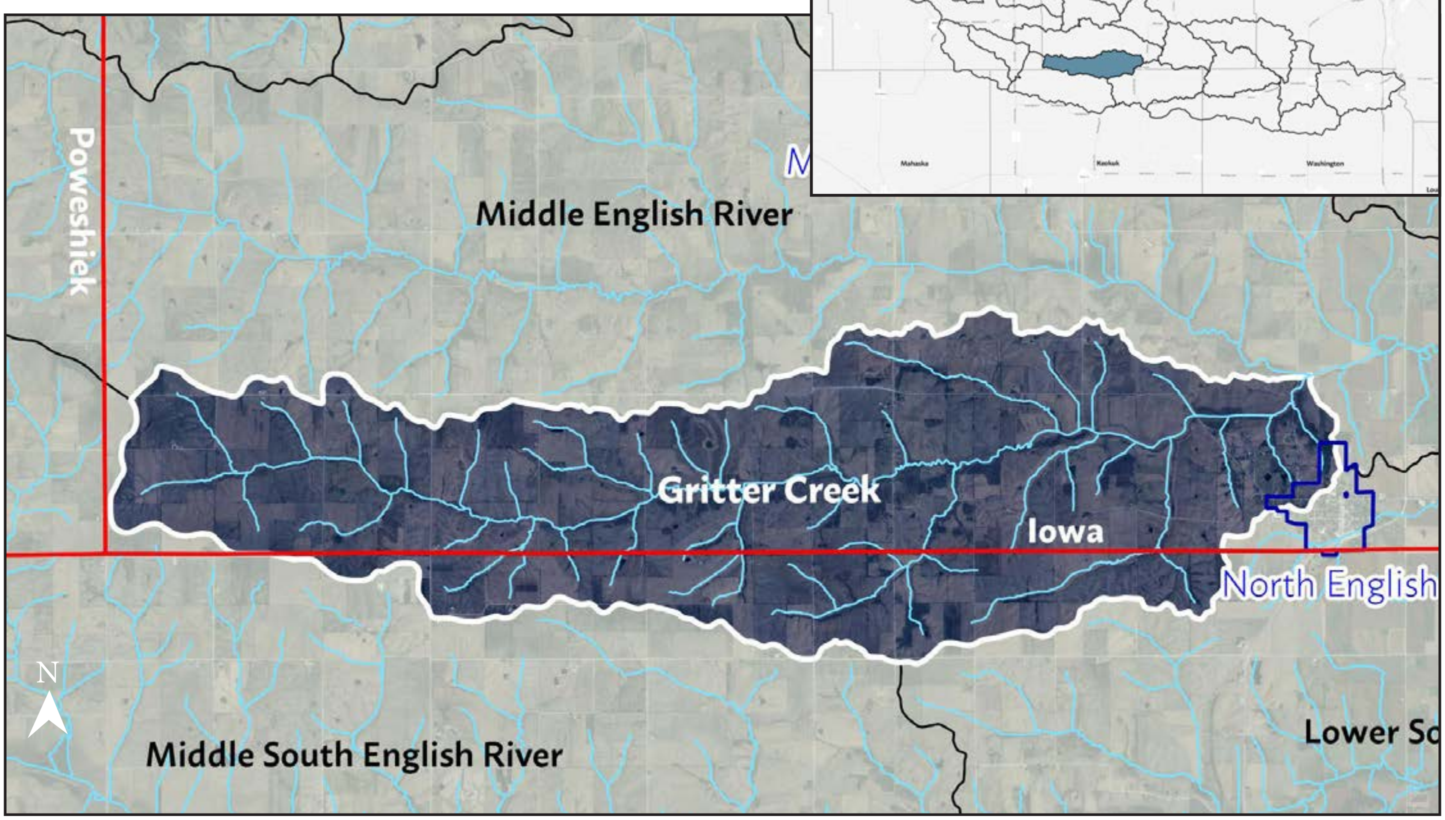

Figure 1. Gritter Creek Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

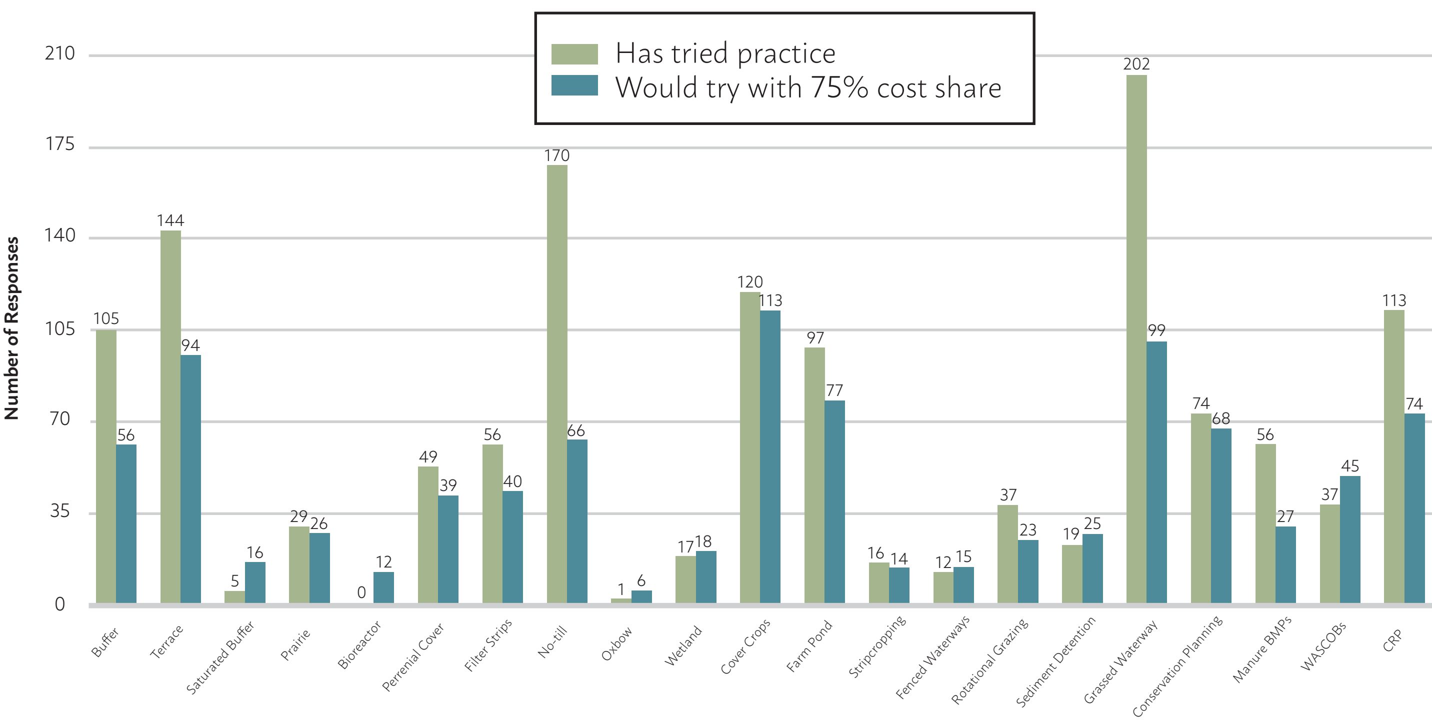

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

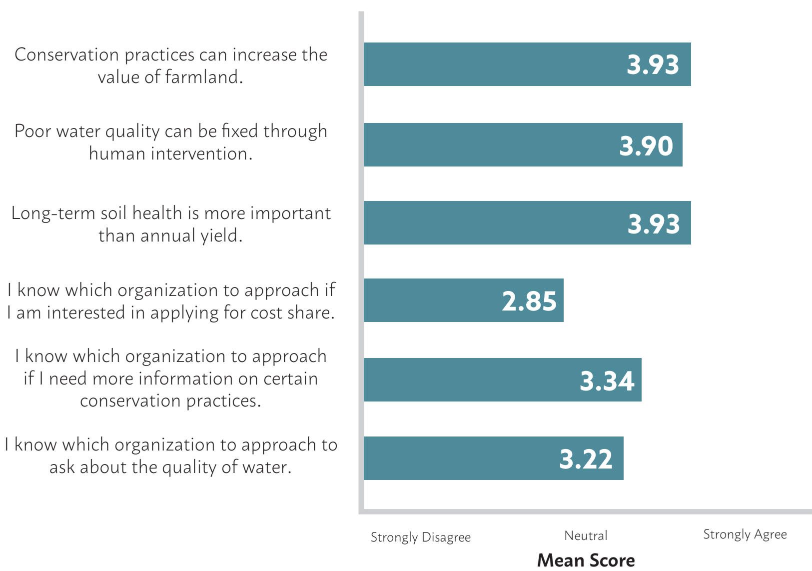

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 11 is at the L Avenue bridge over Gritter Creek, just north of North English, in Iowa County.Figure 4 shows a map of the sampling location.

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

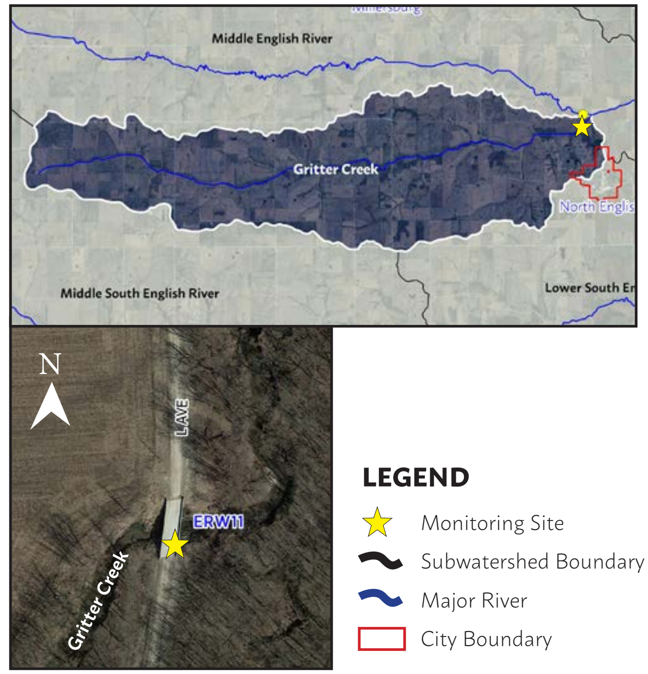

Figure 4. Water quality monitoring location for Gritter Creek subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Gritter Creek sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. More detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 13 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 11 was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 13 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 11 ranked 5th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 11 ranked 4th (Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL).

In 2017, Site 11 ranked 12th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 11 ranked 14th.

In 2017, Site 11 ranked 9th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 11 ranked 11th (Values in red exceed EPA standard of 0.075 mg/L for freshwater streams).

In 2017, Site 11 ranked 17th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 11 also ranked 17th (Values in red exceed EPA drinking water standard of 10 mg/L).

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 11 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	110	10,000	2,281
2018	31	20,000	3,619

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 11 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.06	0.03
2018	0.02	0.11	0.05

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 11 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.11	0.33	0.18
2018	0.06	0.70	0.20

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 11 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	12.0	1.9
2018	0.7	6.4	3.4

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

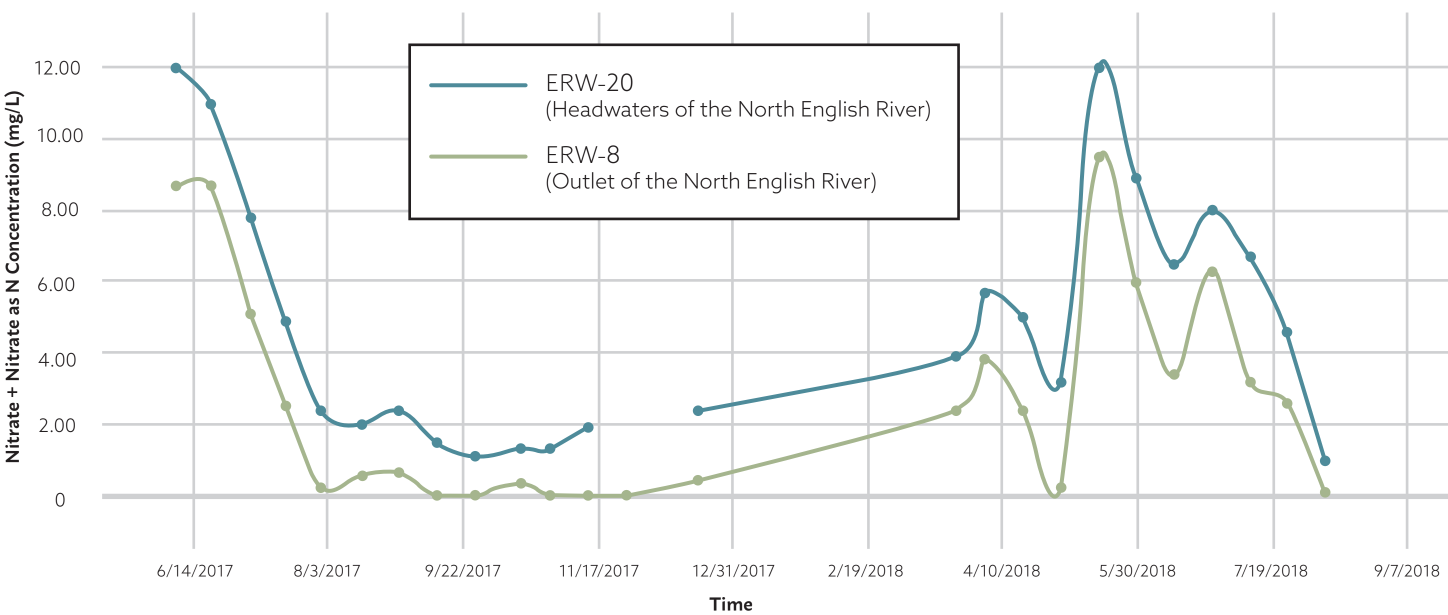

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Gritter Creek subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 12 times the total erosion (151.37 mm) than Gritter Creek's average monthly erosion of 12.59 mm (0.49 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Gritter Creek's HUC is "070802090301"; see 301 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	**301**	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	12.75	**12.59**	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	82.23	**83.68**	82.65	83.17	84.61	82.92	82.29

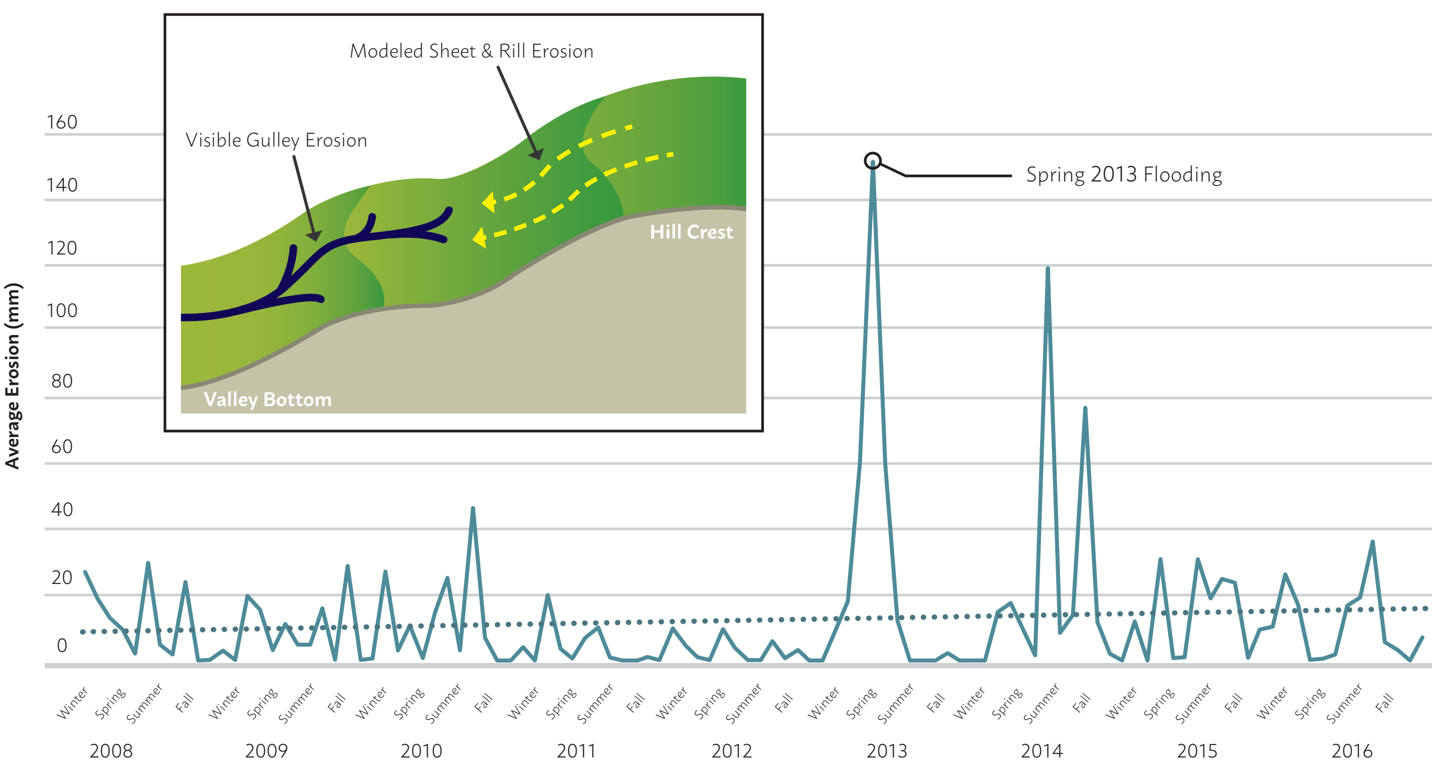

Figure 6. Soil Erosion in Gritter Creek (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. Gritter Creek experienced an average of 5.78 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 8 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Gritter Creek subwatershed ranks near the middle of all subwatersheds for soil delivery at 7.96 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Gritter Creek is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for Gritter Creek.

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

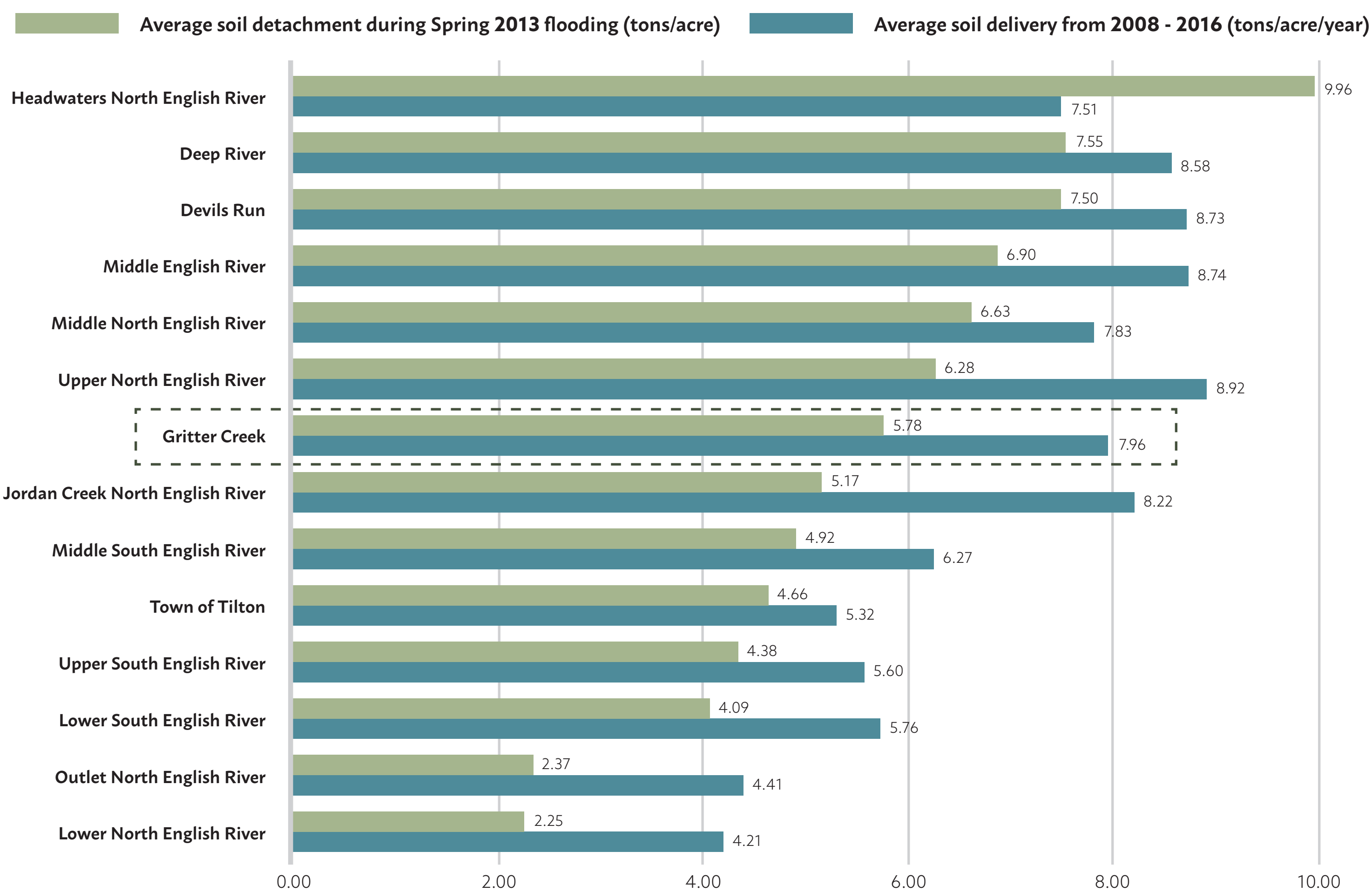

Figure 7. Soil Delivery and Detachment in Gritter Creek (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR GRITTER CREEK :
https://bit.ly/2Nfly7i

SHEET AND RILL EROSION & SEDIMENT DELIVERY POTENTIAL

Four priority subwatersheds (Gritter Creek, Middle English River, Headwaters North English, and the Middle North English River) were selected for implementation of BMPs through the IWA project through a cost-share program. As a result, these subwatersheds were subject to a greater level of research and planning including a detailed land use assessment completed in 2017 for use in the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) analysis, which estimated sheet and rill erosion (Figure 8) and sediment delivery (Figure 9). The Iowa Department of Natural Resources (IDNR) estimates sheet and rill erosion in the subwatershed is 96,119 tons per year. The IDNR also estimates that 19,279 tons of sediment is delivered to waterways per year.

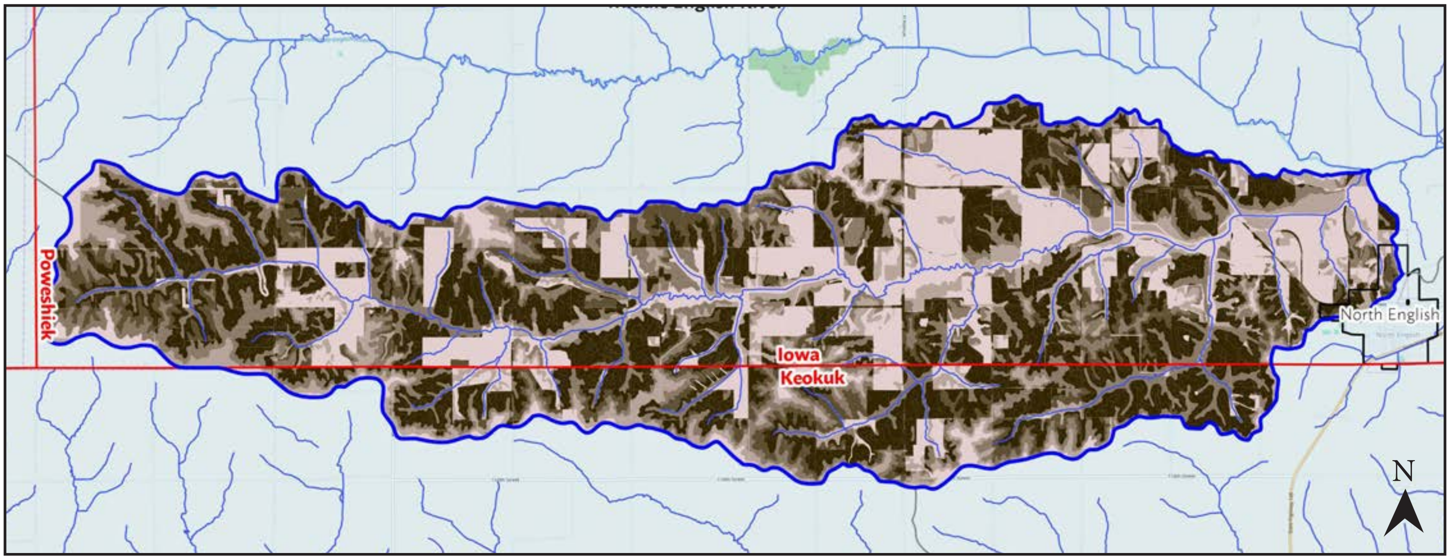

Figure 8. Estimated Sheet and Rill Erosion for the Gritter Creek Subwatershed, 2017. *Source: Iowa DNR*

0-1 tons/acre/year | 1-2 tons/acre/year | 2-5 tons/acre/year | 5-8 tons/acre/year | 8-43.5 tons/acre/year

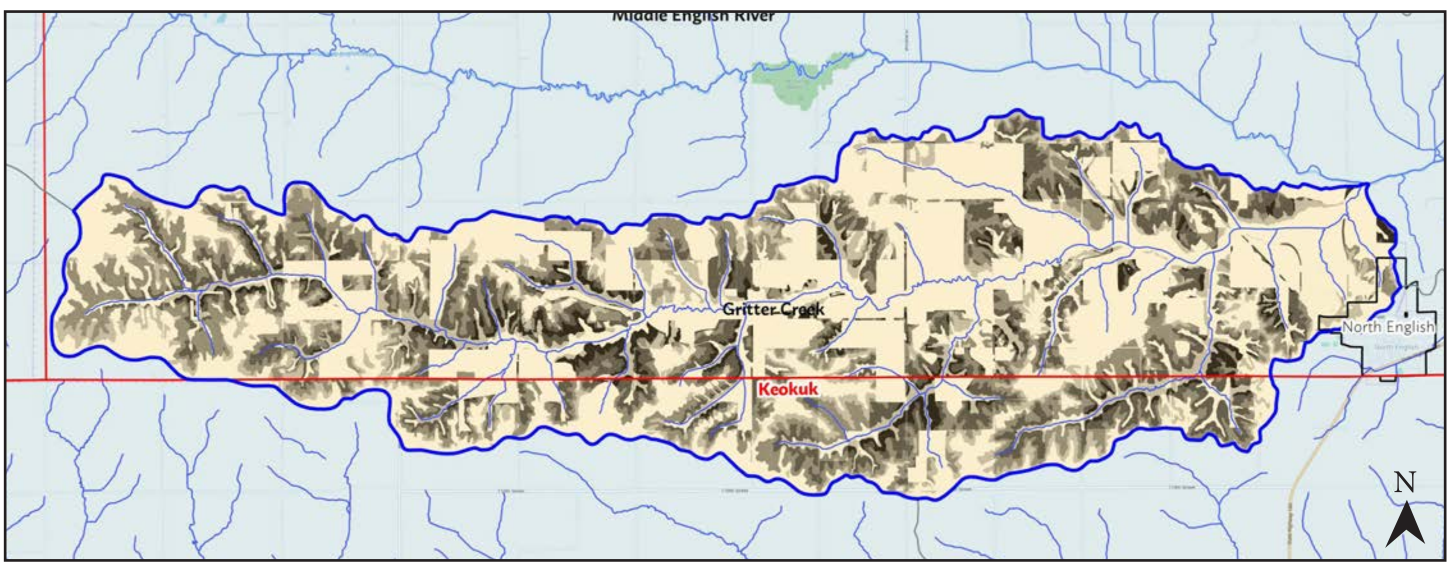

Figure 9. Estimated Sediment Delivery for the Gritter Creek Subwatershed, 2017. *Source: Iowa DNR*

0-0.5 tons/acre/year | 0.5-1 tons/acre/year | 1-2 tons/acre/year | 2-4 tons/acre/year | 4-6.21 tons/acre/year

VIEW SOIL EROSION WEBMAPS FOR GRITTER CREEK:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 389.52 miles of contour buffer strips, 23 bioreactors, 255 WASCOBs, 7 nutrient-removal wetlands, a total of 1,728 acres of drainage area for the wetlands, and 35.18 miles of grassed waterways in the Middle English River subwatershed (Table 11). If all 7 wetlands were installed in the subwatershed, roughly 11.7 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 10. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	**14,836**	**389.52**	**23**	**255**	**7**	**1,728.87**	**11.7 %**	**35.18**
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

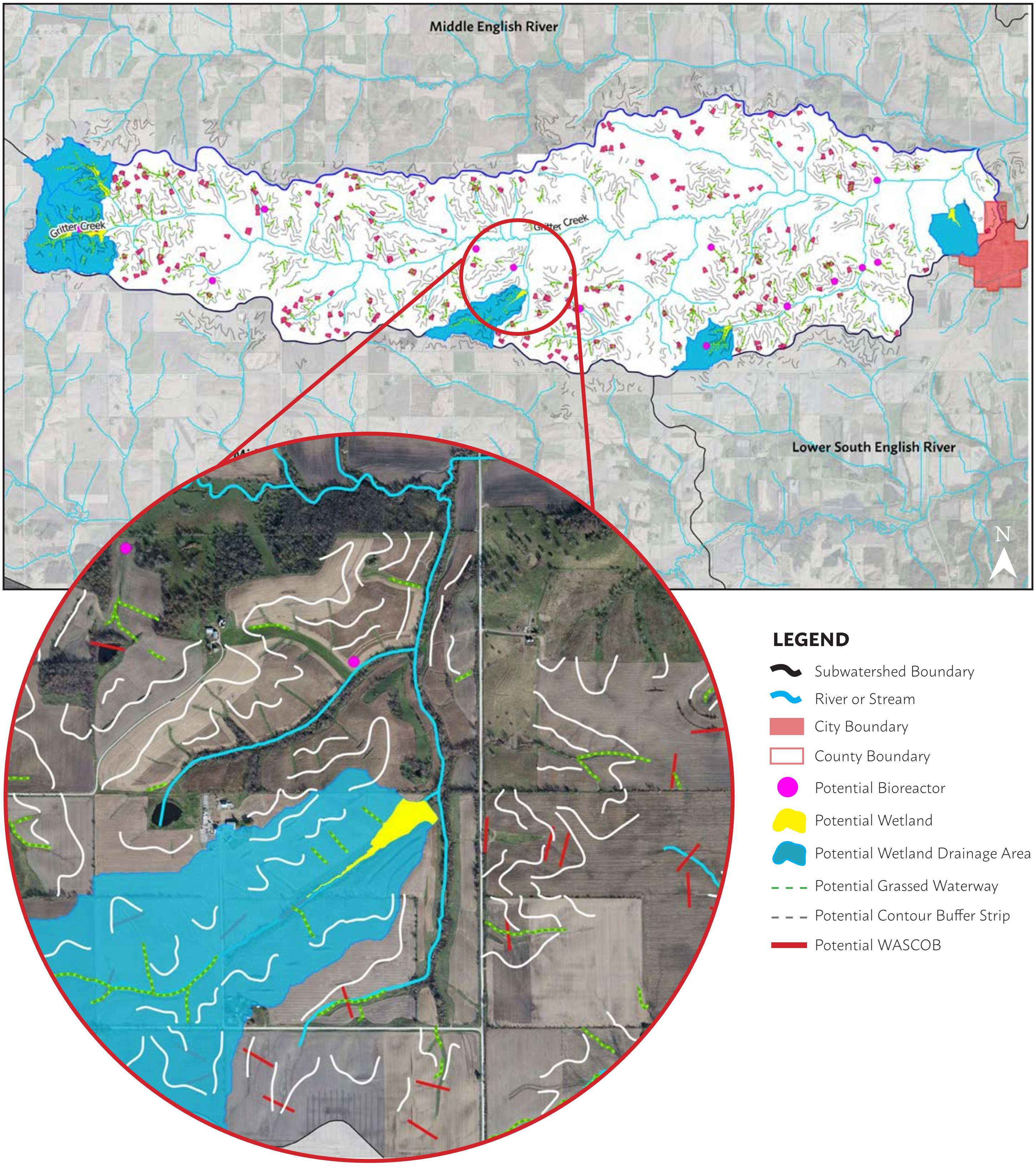

Figure 10. ACPF Model Results for Gritter Creek Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR GRITTER CREEK:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or “hot spots”. The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of North English is the only urbanized, incorporated area in the Gritter Creek subwatershed. English River Watershed boundaries encompass the entirety of North English. However, the Gritter Creek subwatershed only spans a portion of northwest North English, which is primarily residential land uses. The majority of urbanized area lies in the Lower South English River subwatershed.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Gritter Creek subwatershed. Figure 11 represents the stormwater runoff volume for each catchment area within the city limits of North English where orange and red portray higher runoff volumes. These “hot spots” would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

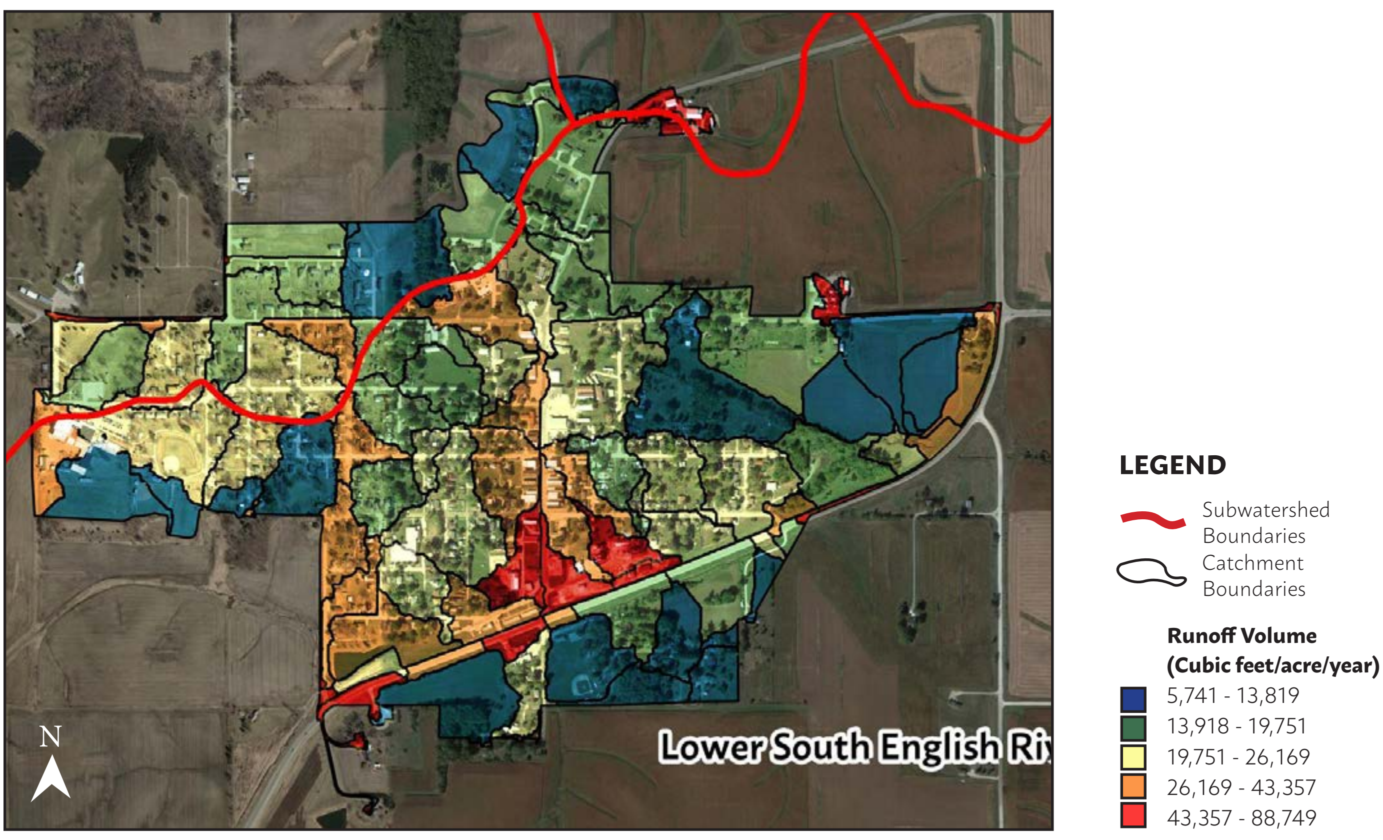

Figure 11. Modeled Runoff Volume in North English, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 12 displays total nitrate loads for each catchment area within the city limits of North English where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 13 and 14 display total phosphorus loads and total sediment loads for each catchment area within the city limits of North English where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

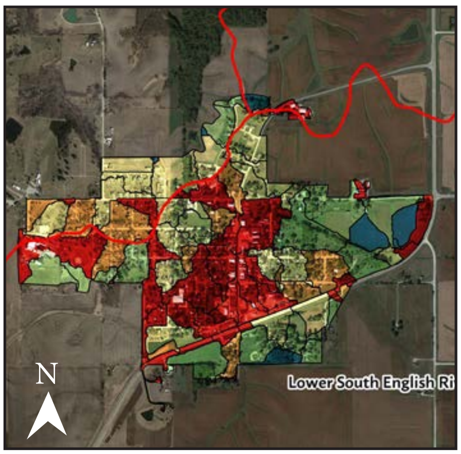

Figure 12. *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

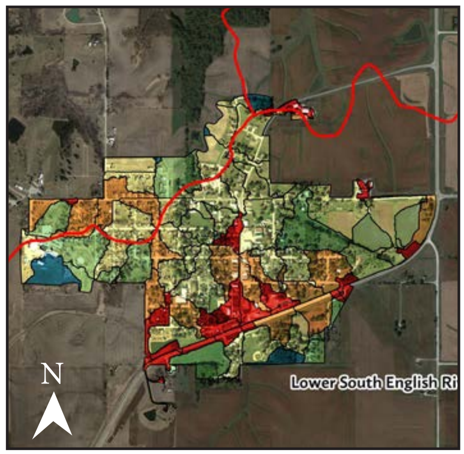

Figure 13. *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

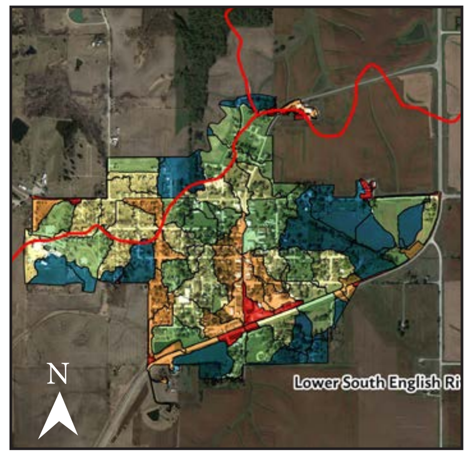

Figure 14. *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW NORTH ENGLISH INTERACTIVE WEBMAP:
https://arcg.is/1zur1j

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 15 shown below represents the flood hazards that exist in the Gritter Creek subwatershed. The flood hazard area accounts for roughly 6.3 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the city of North English, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 1.7 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

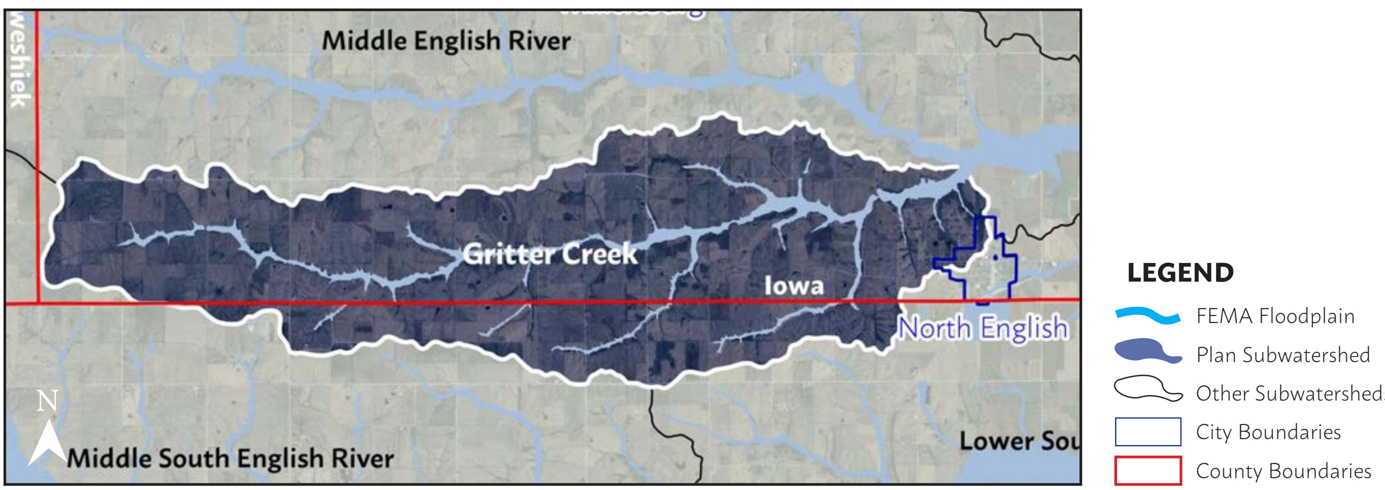

Figure 15. Flood hazard boundary areas for Gritter Creek Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from various flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 1 structure vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 16).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

Figure 16. Vulnerable structure(s) for flood hazards in the Gritter Creek Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW NORTH ENGLISH NFIP FLOOD MAP:
http://arcg.is/SLfjH

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	**Yes**
Iowa County	**Yes**
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	**No**

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/ high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	**Keokuk**	**Gibson, Keswick, Webster**	**0.404**	**7 % Unemployed**	**15 % Poverty**	**25 % Children**
9603	**Iowa**	**North English, Millersburg**	**0.401**	**27 % Children**	**11 % Poverty**	**0.5 % Black or African American**
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Gritter Creek subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

Gritter Creek ranks high for E.Coli bacteria contamination. Improve water quality in Gritter Creek and its tributaries through implementation of urban and rural BMPs that are designed to treat stormwater. Areas for targeted rural improvements can be found in Sections 4 and 5. Areas for targeted urban improvements can b found in Section 6. Gritter Creek presents a high potential for nutrient removal wetlands, which could treat over 11 percent the entire subwatershed if implemented. The City of North English, although ranking midrange on the Social Vulnerability Index (SVI), should consider participation in the NFIP program. The city also overlaps the Lower South English River subwatershed, which presents a higher SVI value and the most structures in the entire ERW vulnerable to losses from flood events.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Gritter Creek subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Gritter Creek in the City of North English	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Gritter Creek subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa/ Keokuk SWCD, NRCS	Iowa/Keokuk Counties, North English	Medium/ High
	1.3	Flood protection for population safety in Gritter Creek subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	IWA, PDM	City of North English, ERW	City of North English	Low
2	2.2	Acquire property at risk of flooding near Gritter Creek; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in North English	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Gritter Creek subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	IWA, WQI	Iowa/Keokuk SWCD, NRCS, ERW	City of North English	Medium/ High
	3.2	Improve water quality in rural areas in Gritter Creek subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319, IWA	Iowa/Keokuk SWCD, NRCS, ERW	Iowa/Keokuk Counties	High
4	4.1	Provide flood protection for roads and in Gritter Creek subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa/ Keokuk SWCD, NRCS	Iowa/Keokuk Counties, North English	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygienic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

MIDDLE ENGLISH RIVER

HUC-12: 070802090302

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Middle English River subwatershed is located in the central region of the ERW. It overlaps 2 counties (Iowa and Poweshiek) and a portion of the City of Millersburg.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is phosphorus and sediment contamination. Additionally, the Middle English River subwatershed ranked high for flooding risks and nitrogen pollution. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

Resource concerns in the Middle English River subwatershed aided in the ERW's decision to designate the subwatershed as one of five priority areas for implementation of best management practices (BMPs) through cost share partnerships with local landowners. Funding for this program is available through the Iowa Watershed Approach (IWA).

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 29,845 acres (46.6 square miles) of land, which is predominately row crops (corn and soybeans). Gritter Creek stretches approximately 25.5 miles through the subwatershed in west to east direction, eventually outletting into the North English River.

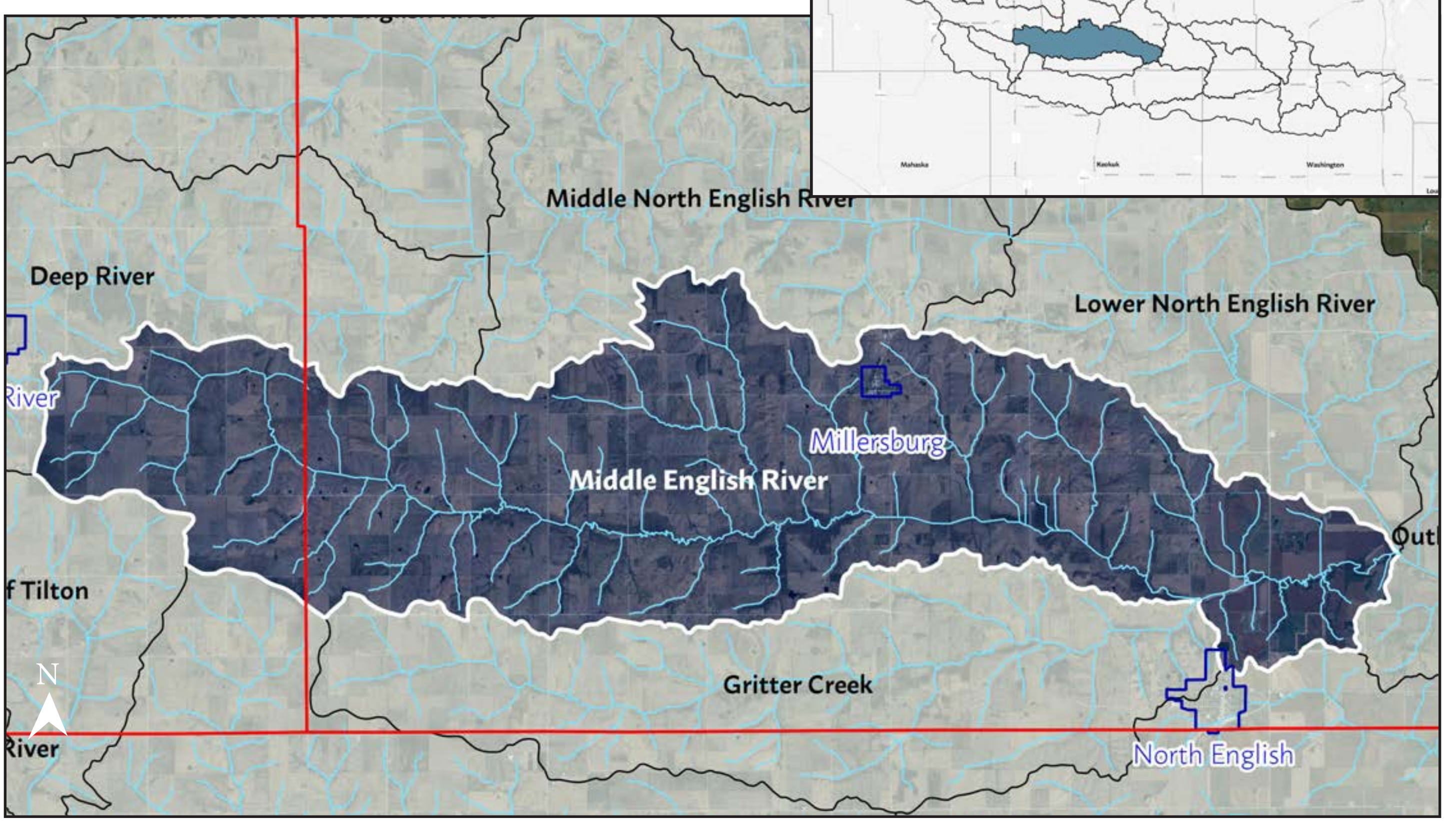

Figure 1. Middle English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

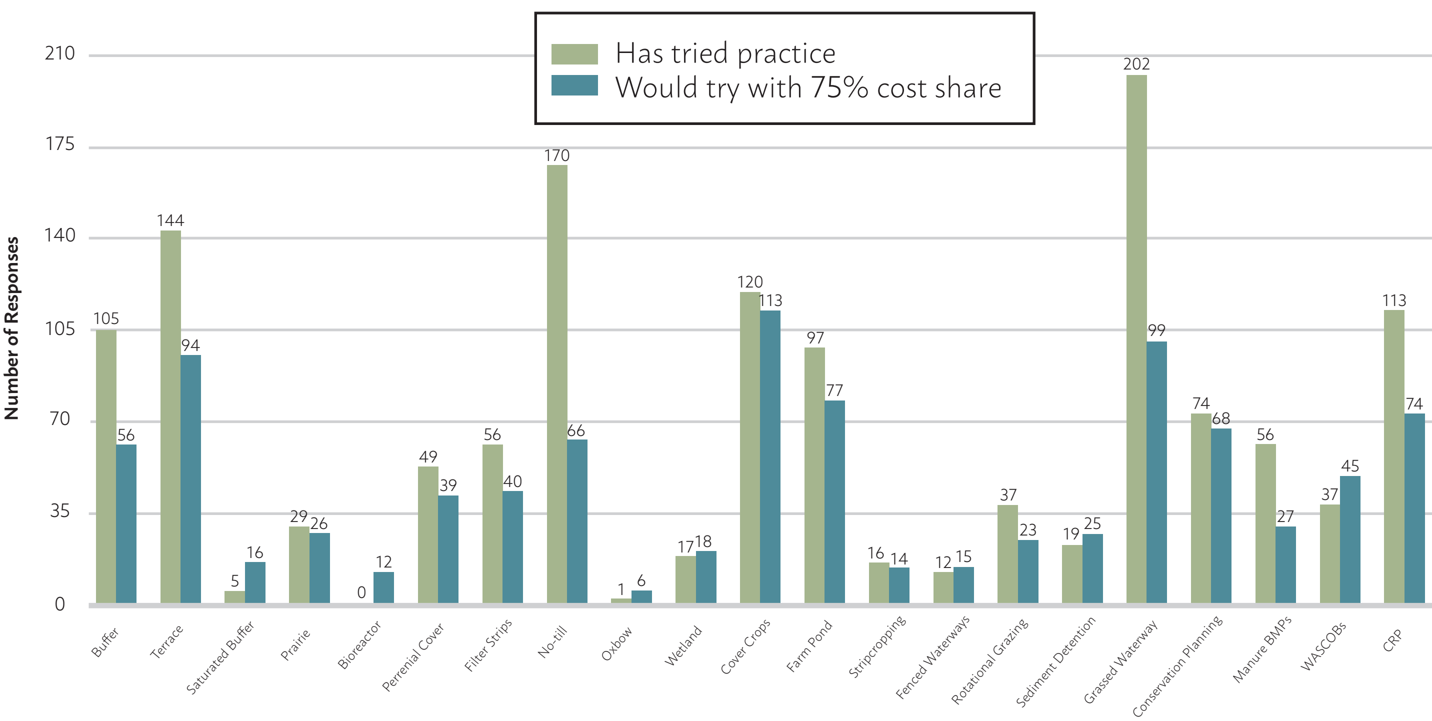

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

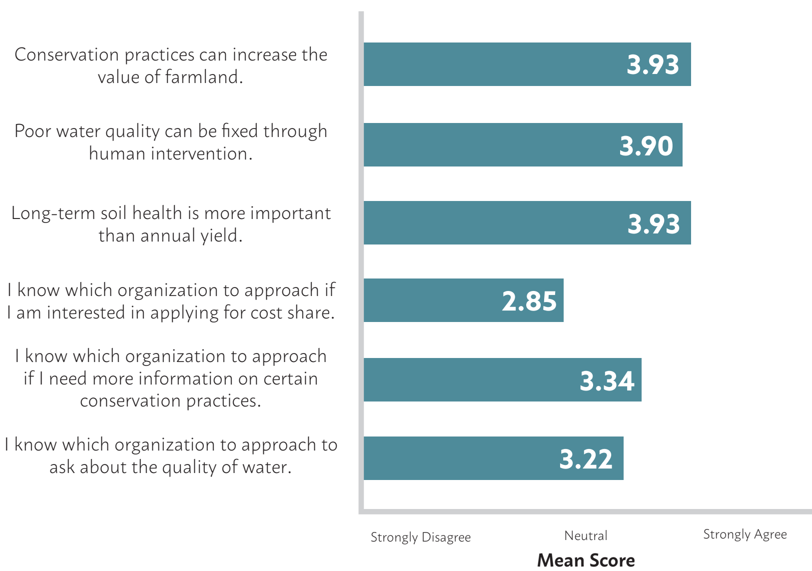

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 10 is at the L Avenue bridge over the Middle English River just north of North English, in Iowa County. Figure 4 shows a map of the sampling location.

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

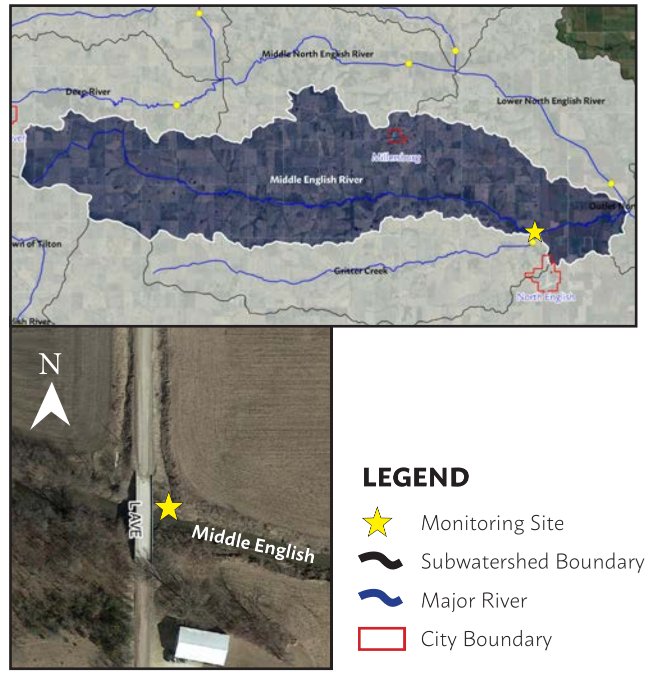

Figure 4. Water quality monitoring location for Middle English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Middle English River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). More detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 14 times for Nitrate+Nitrite as N, 14 times for E. coli Bacteria, 13 times for ortho-Phosphate as P, and 14 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 10 was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 13 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 10 ranked 2nd (nearly the highest) of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 10 ranked 7th. A value of 24,000+ means that the measurable value of E. Coli Bacteria exceeded the lab test's capacity of identifying up to 24,000 CFUs. Further dilution and testing would be required to determine an actual value higher than that. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 10 ranked 10th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 10 ranked 18th.

In 2017, Site 10 ranked 4th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 10 ranked 13th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 10 ranked 19th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 10 ranked 18th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	74	24,000+	2,920
2018	63	24,000+	2,976

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.08	0.03
2018	0.02	0.10	0.05

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.12	0.40	0.20
2018	0.06	0.51	0.18

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	10.0	1.8
2018	0.6	4.2	3.2

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

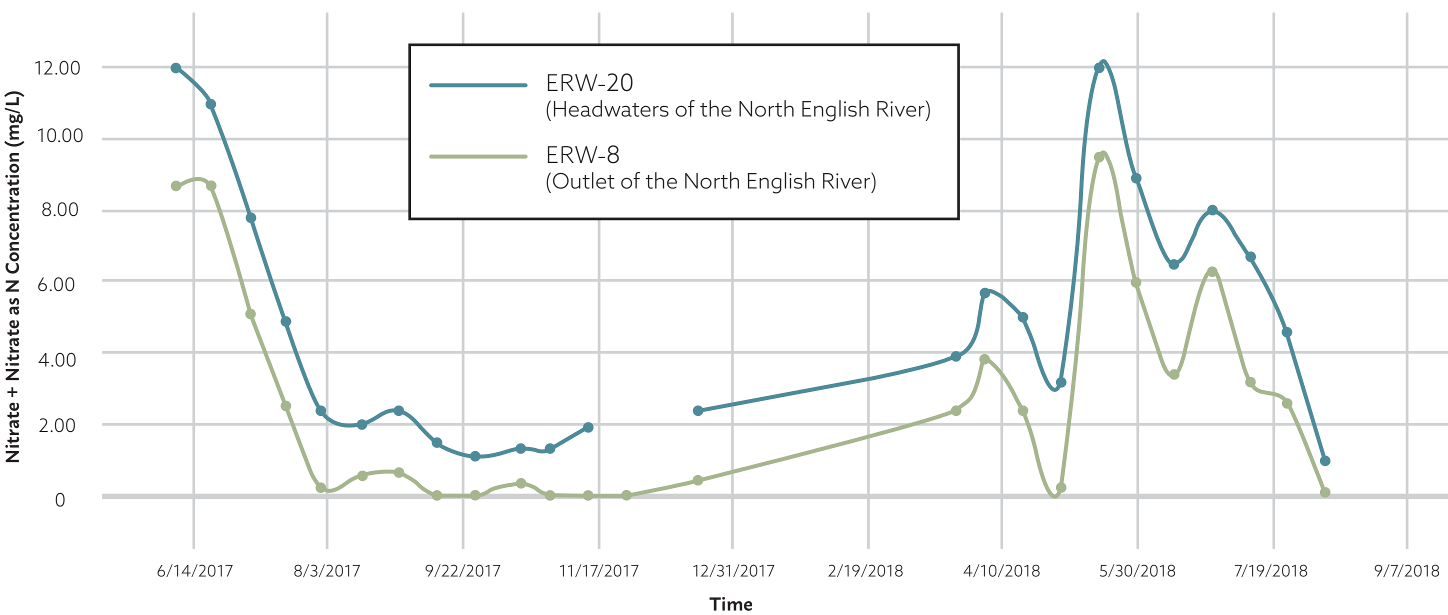

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Middle English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 11 times the total erosion (152.64 mm) than Middle English River's average monthly erosion of 13.05 mm (0.51 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Middle English River's HUC is "070802090302"; see 302 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	**302**	401	501	403	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	**13.05**	13.02	12.89	12.76	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	**83.21**	79.25	82.04	81.65	82.23	83.68	82.65	83.17	84.61	82.92	82.29

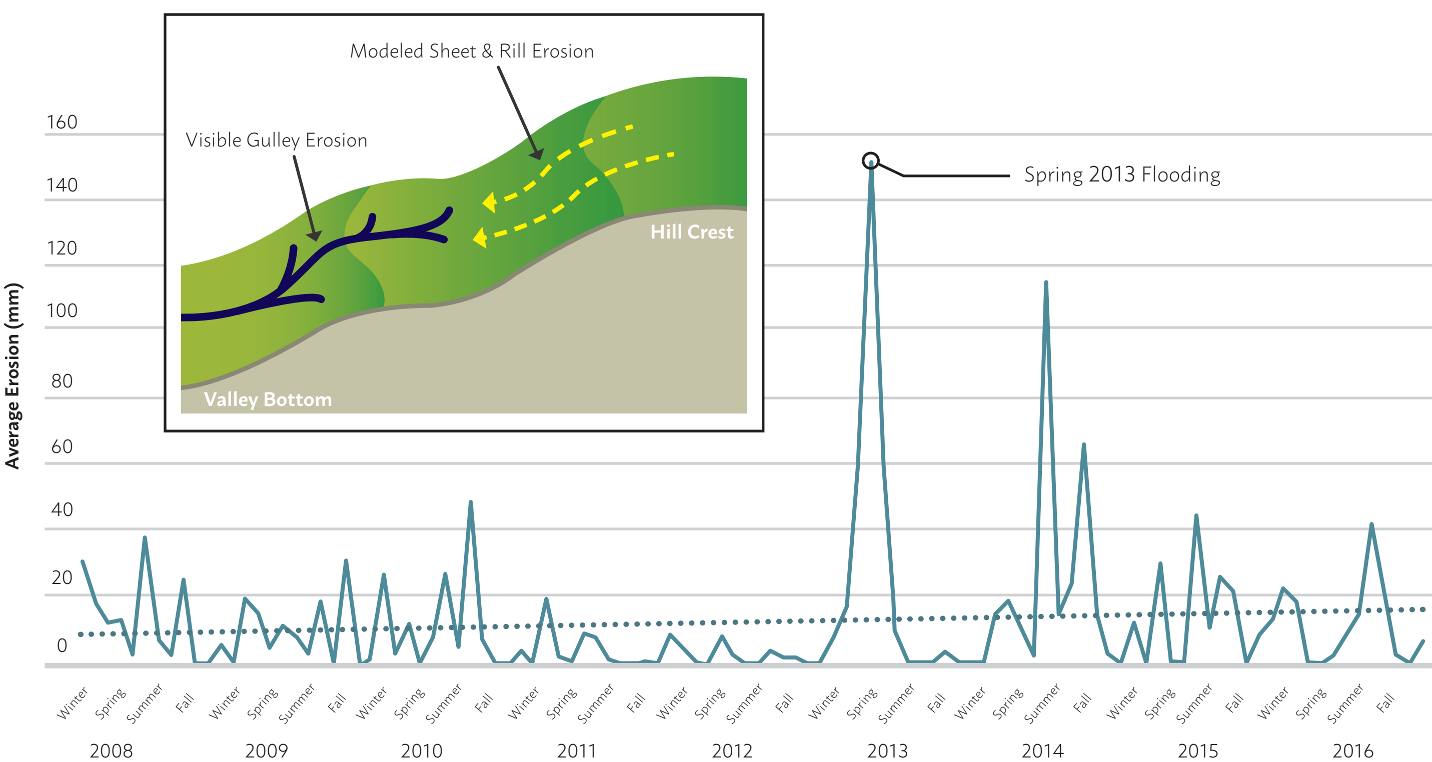

Figure 6. Soil Erosion in Middle English River (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Middle English River subwatershed experienced an average of 6.90 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 8 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Middle English River subwatershed ranks high among all subwatersheds for soil delivery at 8.74 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Gritter Creek is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Middle English River.

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

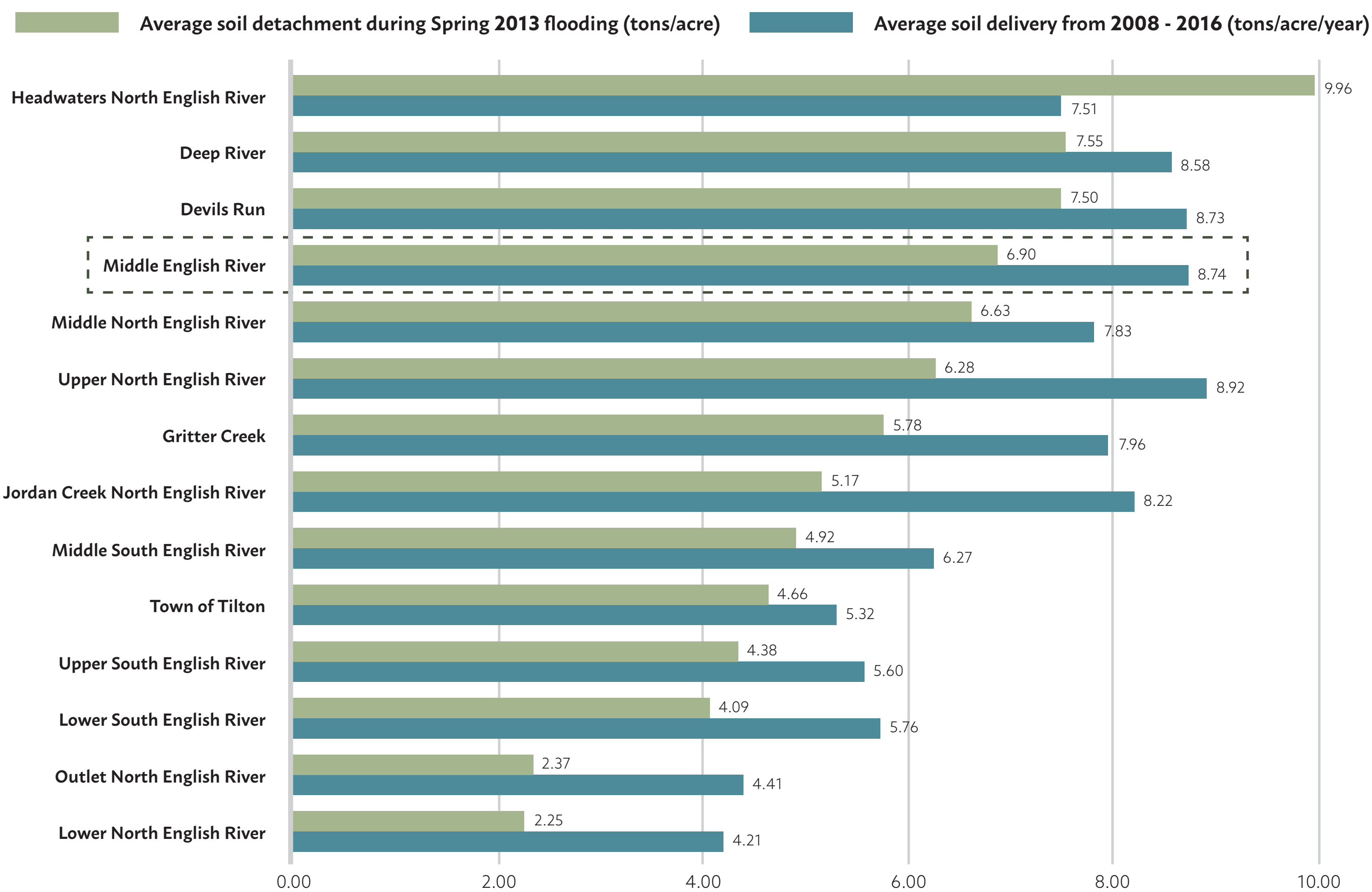

Figure 7. Soil Delivery and Detachment in Middle English River (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR MIDDLE ENGLISH RIVER:
https://bit.ly/2NZVLqc

SHEET AND RILL EROSION & SEDIMENT DELIVERY POTENTIAL

Four priority subwatersheds (Gritter Creek, Middle English River, Headwaters North English, and the Middle North English River) were selected for implementation of BMPs through the IWA project through a cost-share program. As a result, these subwatersheds were subject to a greater level of research and planning including a detailed land use assessment completed in 2017 for use in the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) analysis, which estimated sheet and rill erosion (Figure 8) and sediment delivery (Figure 9). The Iowa Department of Natural Resources (IDNR) estimates sheet and rill erosion in the subwatershed is 192,017 tons per year. The IDNR also estimates that 35,447 tons of sediment is delivered to waterways per year.

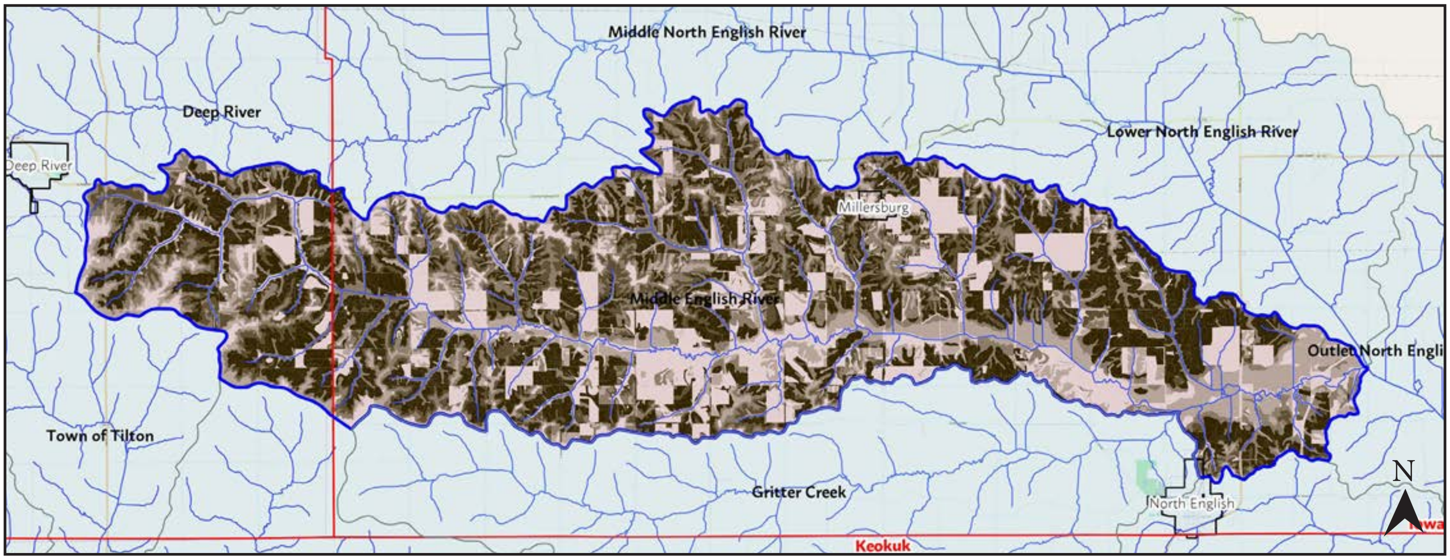

Figure 8. Estimated Sheet and Rill Erosion for the Middle English River Subwatershed, 2017. *Source: Iowa DNR*

0-1 tons/acre/year | 1-2 tons/acre/year | 2-5 tons/acre/year | 5-8 tons/acre/year | 8-43.5 tons/acre/year

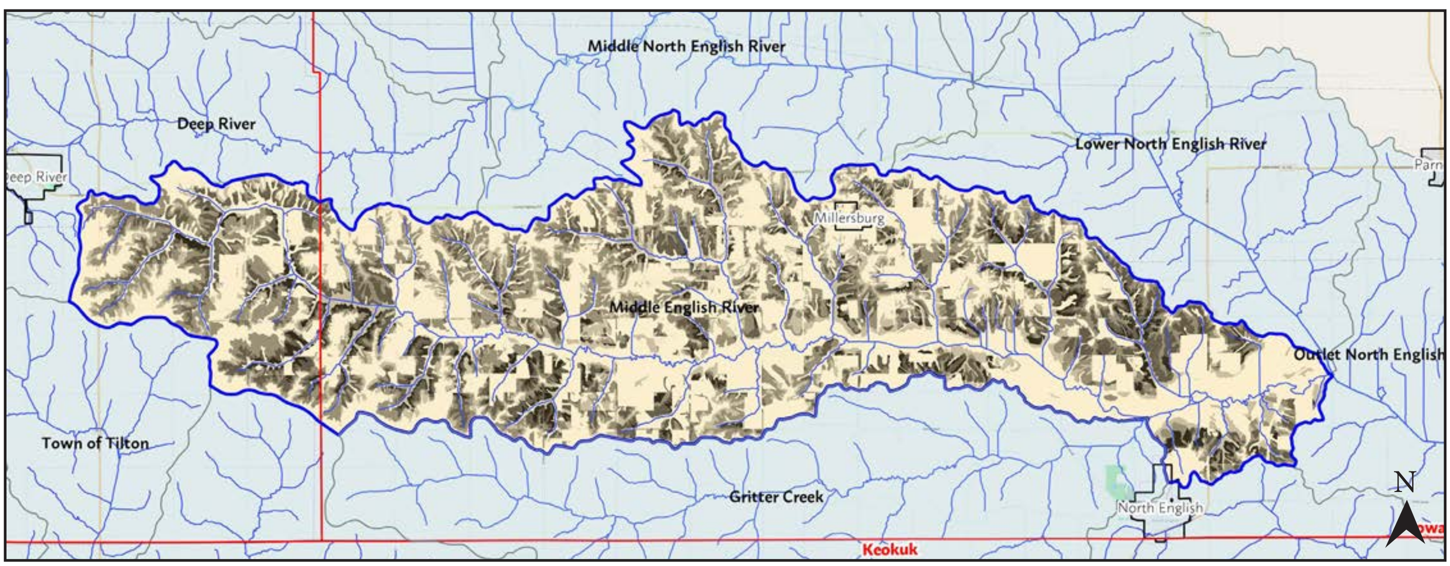

Figure 9. Estimated Sediment Delivery for the Middle English River Subwatershed, 2017. *Source: Iowa DNR*

0-0.5 tons/acre/year | 0.5-1 tons/acre/year | 1-2 tons/acre/year | 2-4 tons/acre/year | 4-6.21 tons/acre/year

VIEW SOIL EROSION WEBMAPS FOR MIDDLE ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 693.60 miles of contour buffer strips, 53 bioreactors, 464 WASCOBs, 14 nutrient-removal wetlands, a total of 2,520 acres of drainage area for the wetlands, and 104.88 miles of grassed waterways in the Middle English River subwatershed (Table 11). If all 14 wetlands were installed in the subwatershed, roughly 8.5 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 10. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	**29,845**	**693.60**	**53**	**464**	**14**	**2,520.01**	**8.5 %**	**104.88**
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

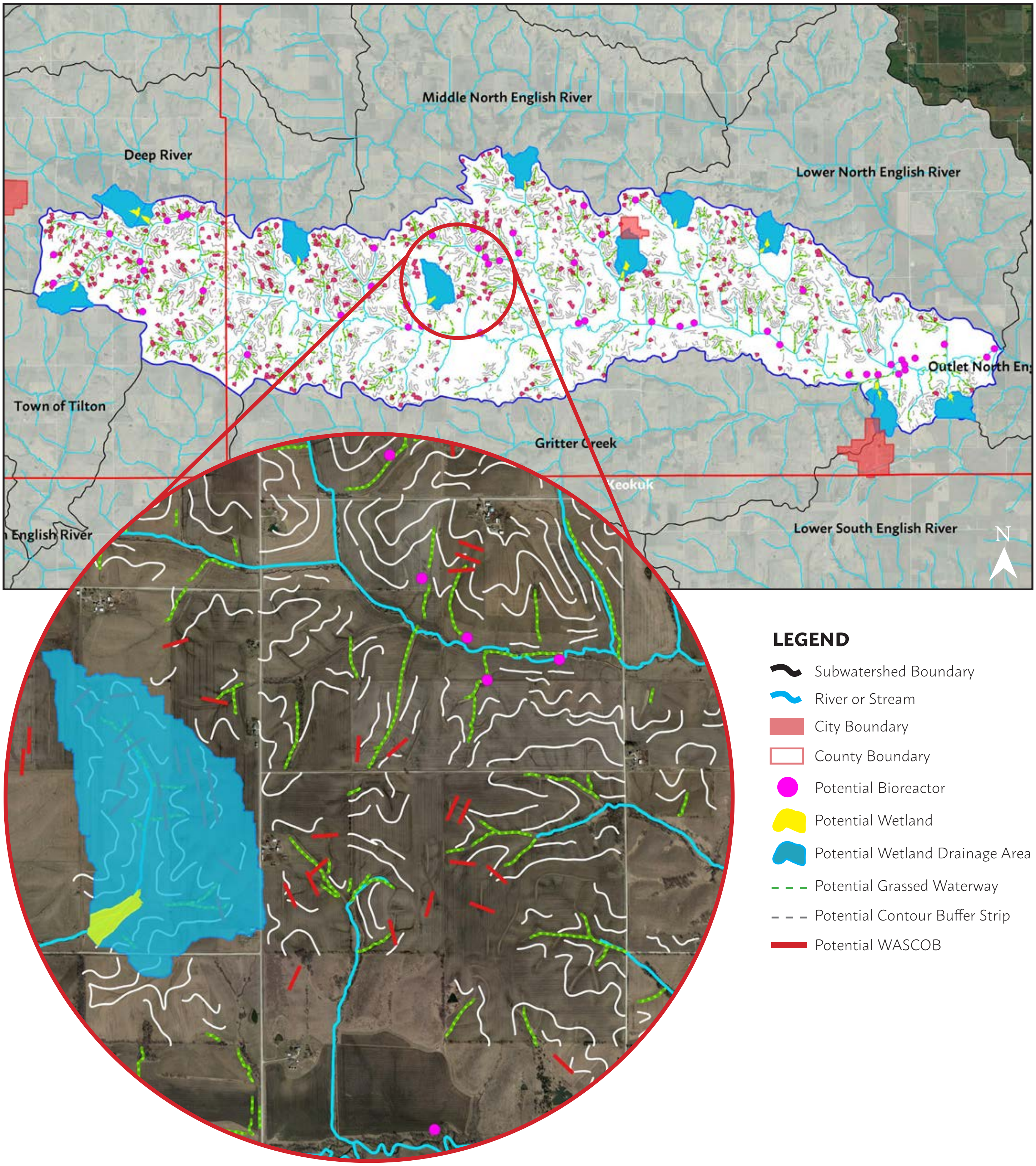

Figure 10. ACPF Model Results for Middle English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR MIDDLE ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Millersburg is the only urbanized, incorporated area in the Middle English River subwatershed. English River Watershed boundaries encompass the entirety of North English.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Middle English River subwatershed. Figure 11 represents the stormwater runoff volume for each catchment area within the city limits of Millersburg where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

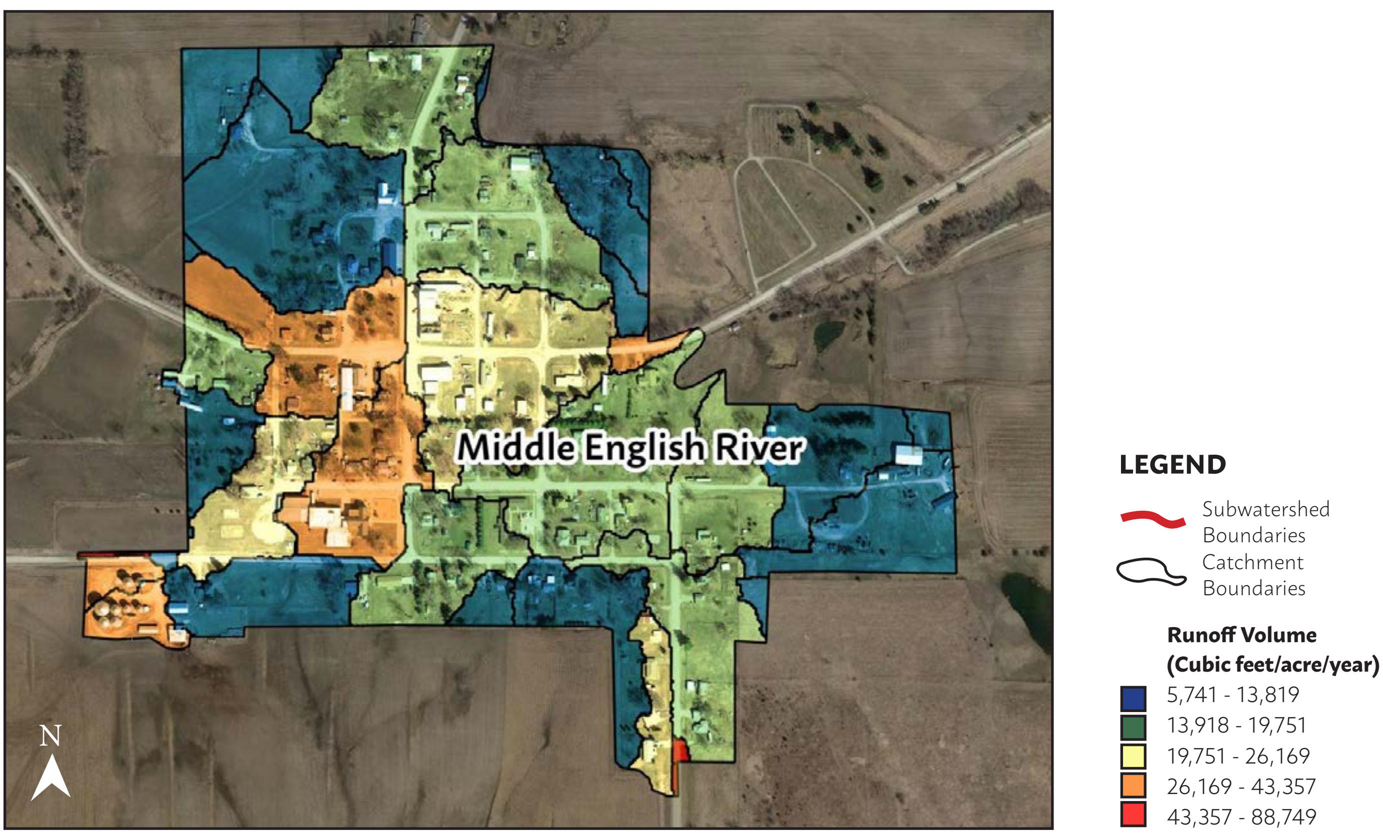

Figure 11. Modeled Runoff Volume in Millersburg, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 12 displays total nitrate loads for each catchment area within the city limits of Millersburg where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 13 and 14 display total phosphorus loads and total sediment loads for each catchment area within the city limits of Millersburg where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

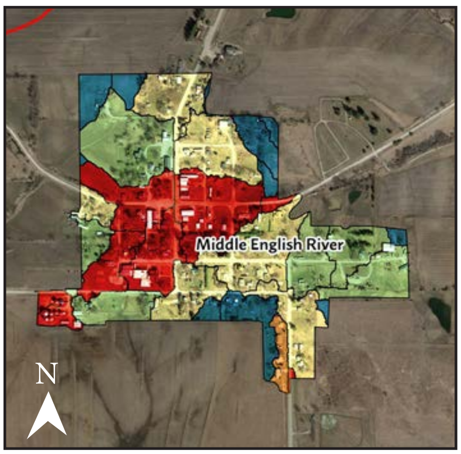

Figure 12. Modeled Nitrate Load in Millersburg, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

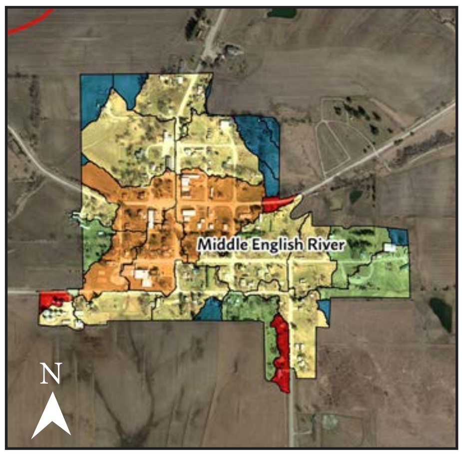

Figure 13. Modeled Phosphorus Load in Millersburg, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

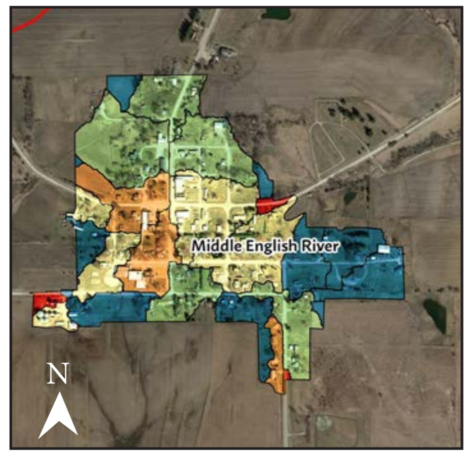

Figure 14. Modeled Sediment Load in Millersburg, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW MIDDLE ENGLISH RIVER INTERACTIVE WEBMAP:
https://arcg.is/0bf99i

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 15 shown below represents the flood hazards that exist in the Middle English River subwatershed. The flood hazard area accounts for roughly 7.9 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the city of Millersburg, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 8 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

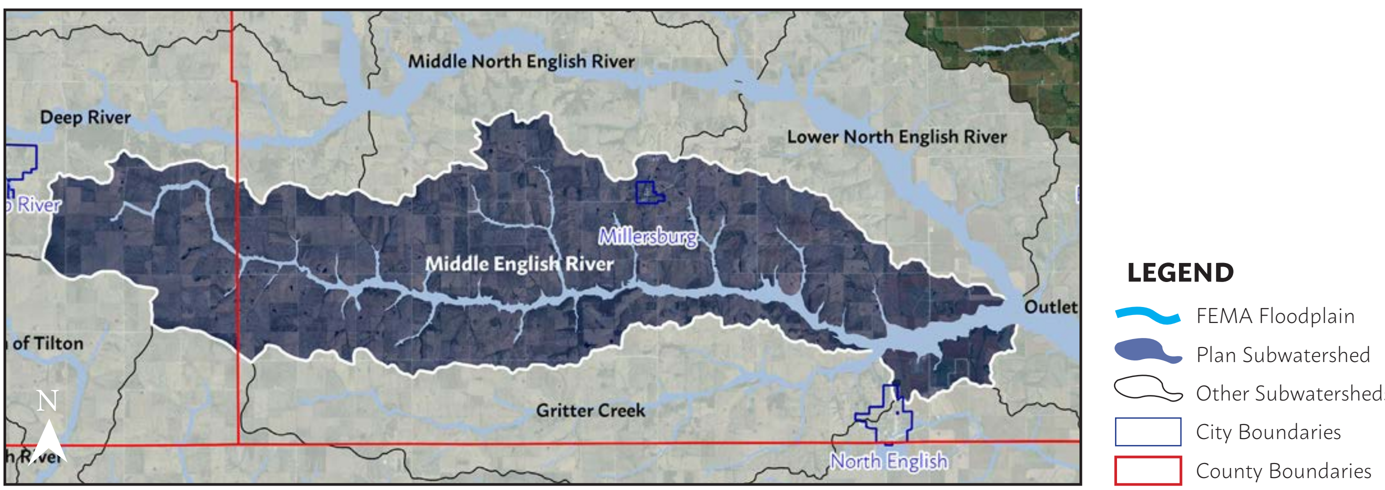

Figure 15. Flood hazard boundary areas for Gritter Creek Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from various flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 3 structure vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 16).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

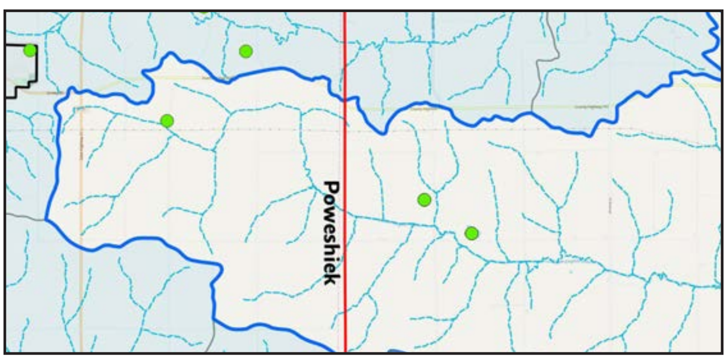

Figure 16. Vulnerable structure(s) for flood hazards in the Middle English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW MILLERSBURG NFIP FLOOD MAP:
http://arcg.is/0ieLGG

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	**Yes**
Poweshiek County	**Yes**
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	**No**
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	**Iowa**	**North English, Millersburg**	**0.401**	**27 % Children**	**11 % Poverty**	**0.5 % Black or African American**
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	**Iowa**	**Parnell**	**0.326**	**0.5 % Black or African American**	**10 % Poverty**	**19 % Age 65 or Older**

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 16) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Middle English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

Water quality contaminants in the Middle English River subwatershed generally rank in the middle among all subwatersheds. E.Coli bacteria and Total Phosphorus, however, still exceeded relevant water quality standards on average in our testing seasons. The subwatershed ranks high for soil erosion, detachment and delivery rates according to DEP estimates. Targeted areas for implementation can be found in Section 4, which includes a detailed RUSLE analysis based on actual ground conditions surveyed in 2017. BMPs that can aid in reducing soil erosion and have high potential for implementation in the subwatershed are contour buffer strips, WASCOBs, and nutrient-removal wetlands. Recommended locations for such BMPs can be found in Section 5. The subwatershed ranks low on the SVI scale, based on its overlapping census tracts. However, eleven of the thirteen overlapping census tracts in the ERW share a SVI ranking classified as "medium", including those in the Middle English River subwatershed.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Middle English River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Middle North English River	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Middle North English River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa SWCD, NRCS	Iowa County	Medium/ High
	1.3	Flood protection for population safety in Middle North English River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	IWA, PDM	ERW	N/A	Low
2	2.2	Acquire property at risk of flooding near Middle North English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk in incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Middle North English River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	IWA, WQI	Iowa SWCD, NRCS, ERW	N/A	Medium/ High
	3.2	Improve water quality in rural areas in Middle North English River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319, IWA	Iowa SWCD, NRCS, ERW	Iowa County	High
4	4.1	Provide flood protection for roads and in Middle North English River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa SWCD, NRCS	Iowa County	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework	**ISWMM**	Iowa Stormwater Management Manual
BMP	Best Management Practice	**IWA**	Iowa Watershed Approach
DEP	Daily Erosion Project	**NFIP**	National Flood Insurance Program
EPA	Environmental Protection Agency	**NRCS**	Natural Resource Conservation Service
ERW	English River Watershed	**NRS**	Nutrient Reduction Strategy
FEMA	Federal Emergency Management Agency	**SCS-CN**	Soil Conservation Service - Curve Number
HSEM	Homeland Security & Emergency Management	**SWCD**	Soil & Water Conservation District
HUC	Hydrologic Unit Code	**WMA**	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

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2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

HEADWATERS NORTH ENGLISH

HUC-12: 070802090401

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Headwaters subwatershed is located in the central region of the ERW. It overlaps 1 county (Poweshiek) and a portion of the City of Grinnell.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is phosphorus and sediment contamination. Additionally, the Headwaters subwatershed ranked high in comparison to all subwatersheds for nitrogen reduction. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

Resource concerns in the Middle English River subwatershed aided in the ERW's decision to designate the subwatershed as one of five priority areas for implementation of best management practices (BMPs) through cost share partnerships with local landowners. Funding for this program is available through the Iowa Watershed Approach (IWA).

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 36,075 acres (56.3 square miles) of land, which is predominately row crops (corn and soybeans). The North English River stretches approximately 17.8 miles through the subwatershed in west to east direction.

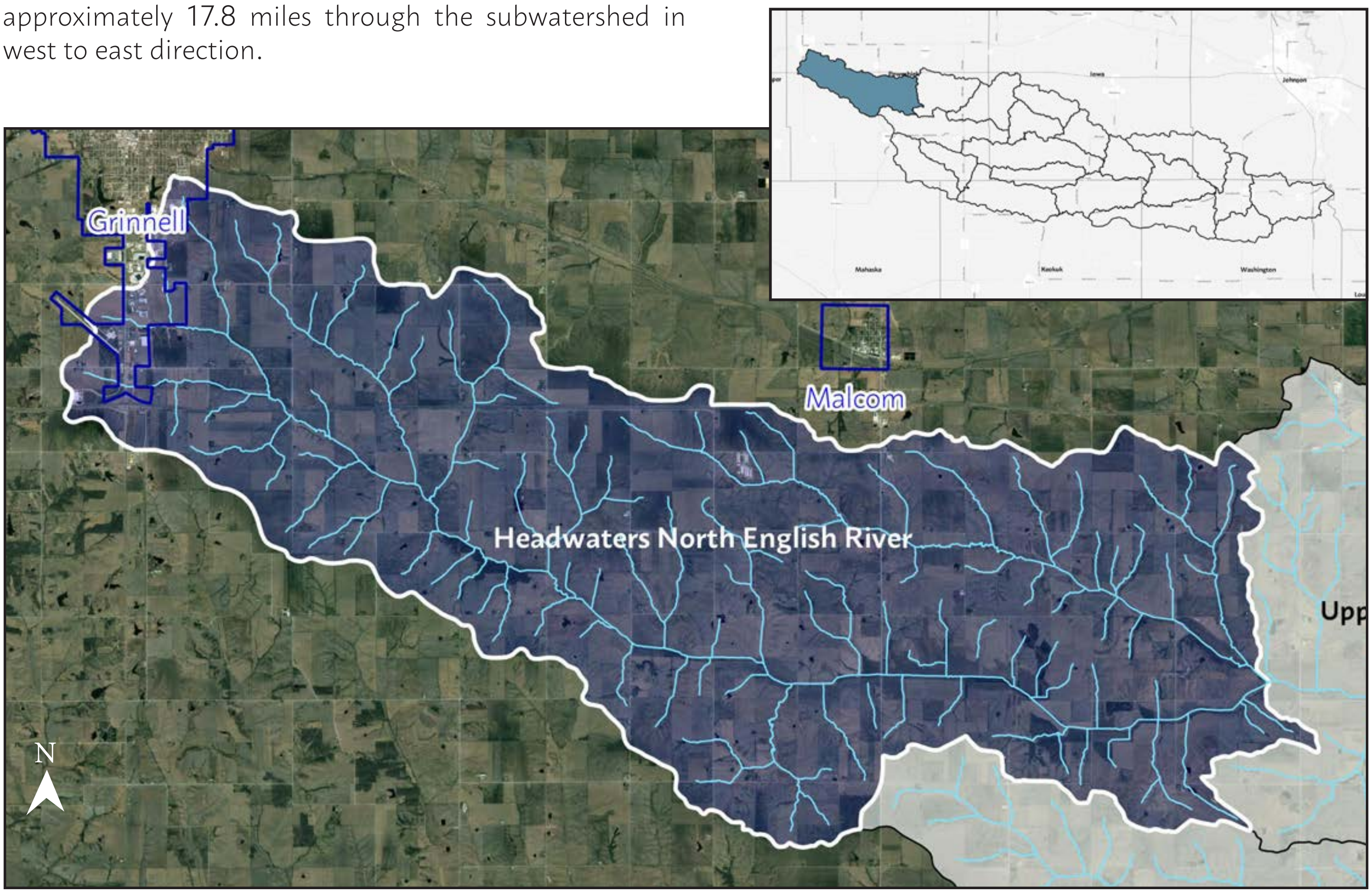

Figure 1. Headwaters Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

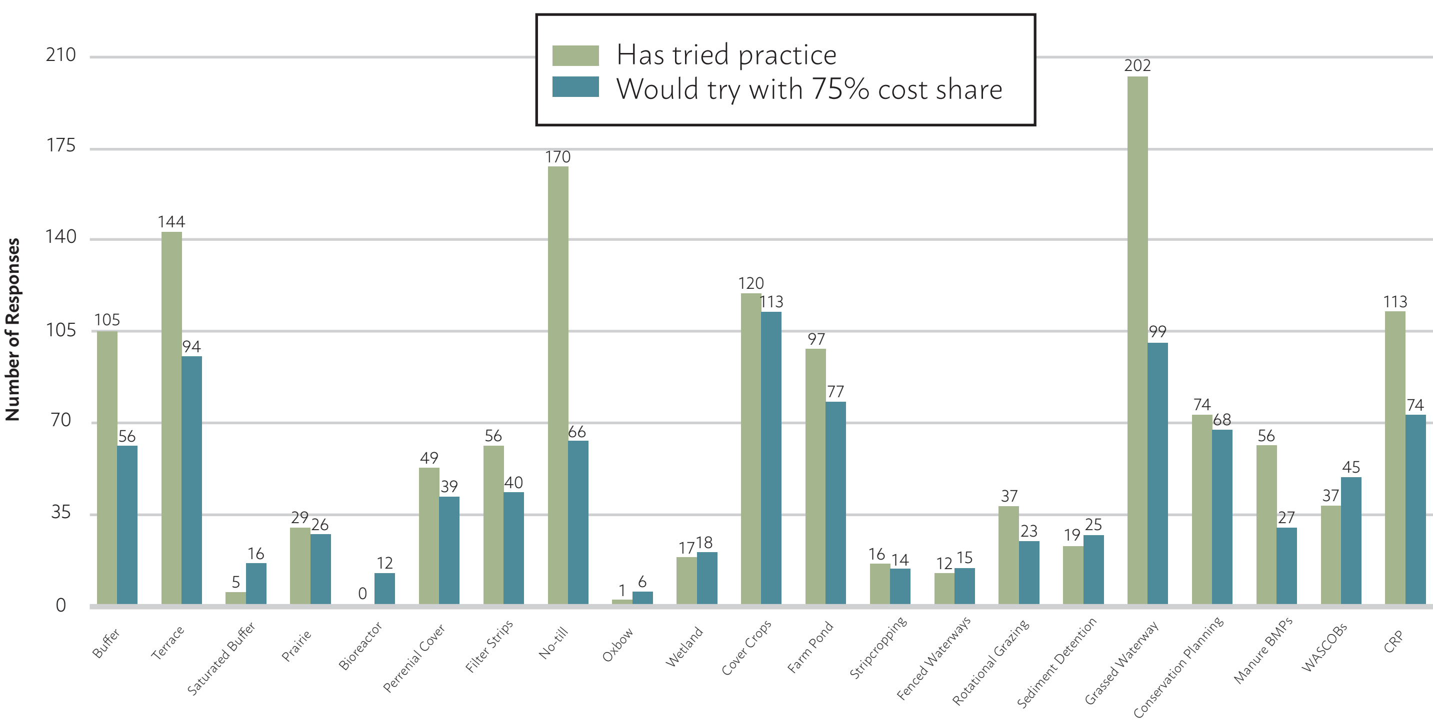

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

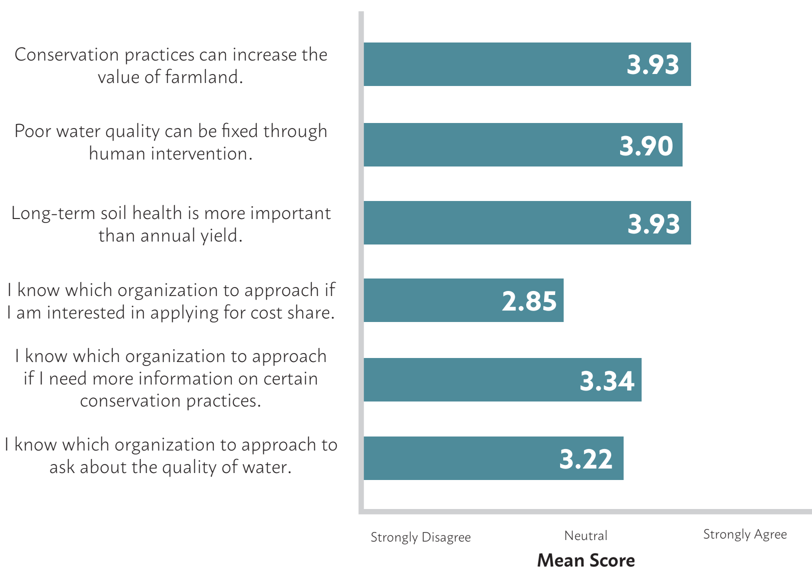

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 20 is near the outlet of the Headwaters of the North English River subwatershed. The sampling site is located on the V18 bridge over the North English River in Poweshiek County. Figure 4 shows a map of the sampling location.

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

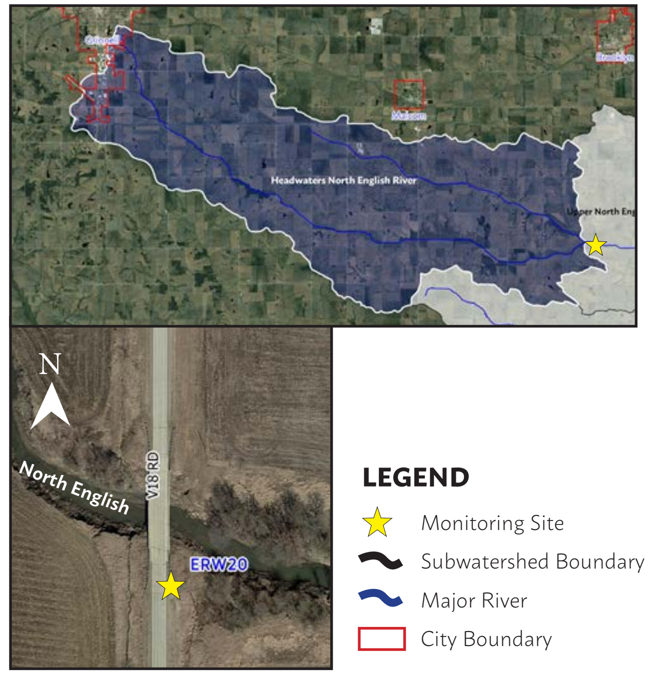

Figure 4. Water quality monitoring location for Headwaters subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Middle English River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). More detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 14 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 20 was sampled 12 times for Nitrate+Nitrite as N, 12 times for E. coli Bacteria, 11 times for ortho-Phosphate as P, and 12 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 20 ranked 1st (the highest) of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 20 ranked 10th. A value of 24,000+ means that the measurable value of E. Coli Bacteria exceeded the lab test's capacity of identifying up to 24,000 CFUs. Further dilution and testing would be required to determine an actual value higher than that. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 20 ranked 4th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 20 ranked 11th.

In 2017, Site 20 ranked 16th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 20 ranked 12th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 20 ranked 6th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 20 also ranked 6th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	230	24,000+	2,949
2018	150	6,500	1,837

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.13	0.05
2018	0.02	0.17	0.06

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.05	0.40	0.15
2018	0.06	0.71	0.19

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	1.1	12.0	4.0
2018	1.0	12.0	5.8

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

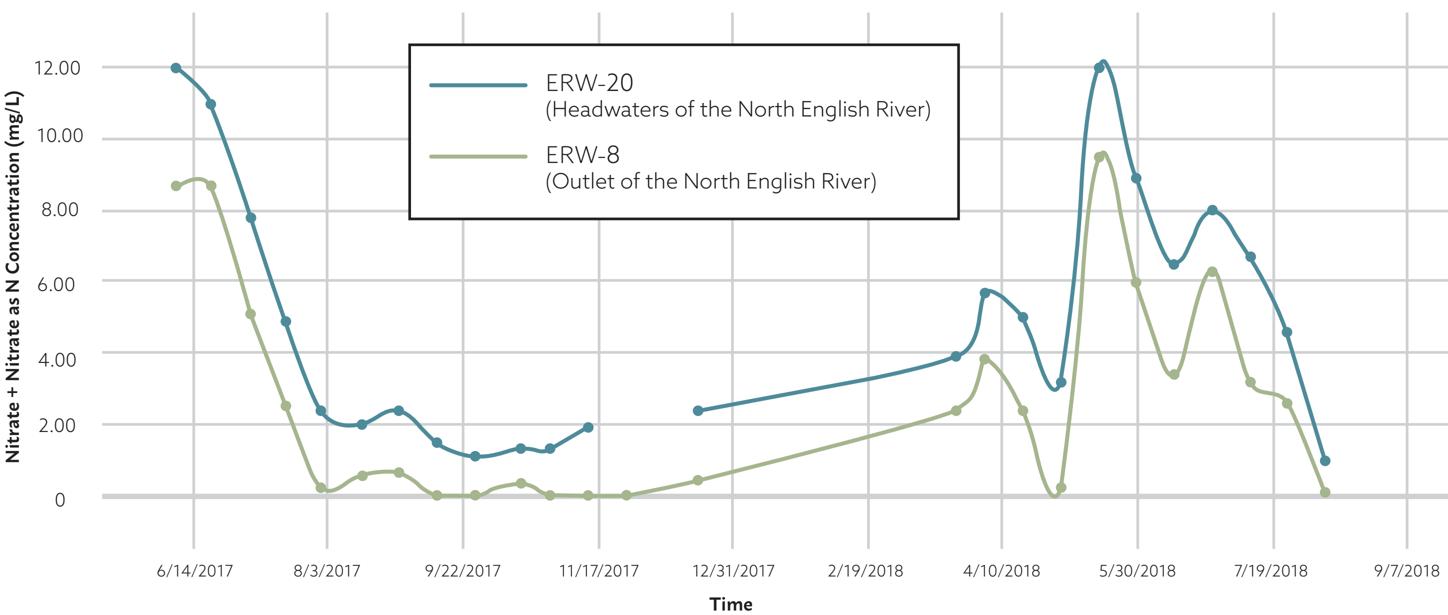

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Headwaters subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be slightly increasing. Flooding in April of 2013 generated over 10 times the total erosion (135.99 mm) than the Headwater's average monthly erosion of 13.02 mm (0.51 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Gritter Creek's HUC is "070802090401"; see 401 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	**401**	501	403	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	**13.02**	12.89	12.76	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	**79.25**	82.04	81.65	82.23	83.68	82.65	83.17	84.61	82.92	82.29

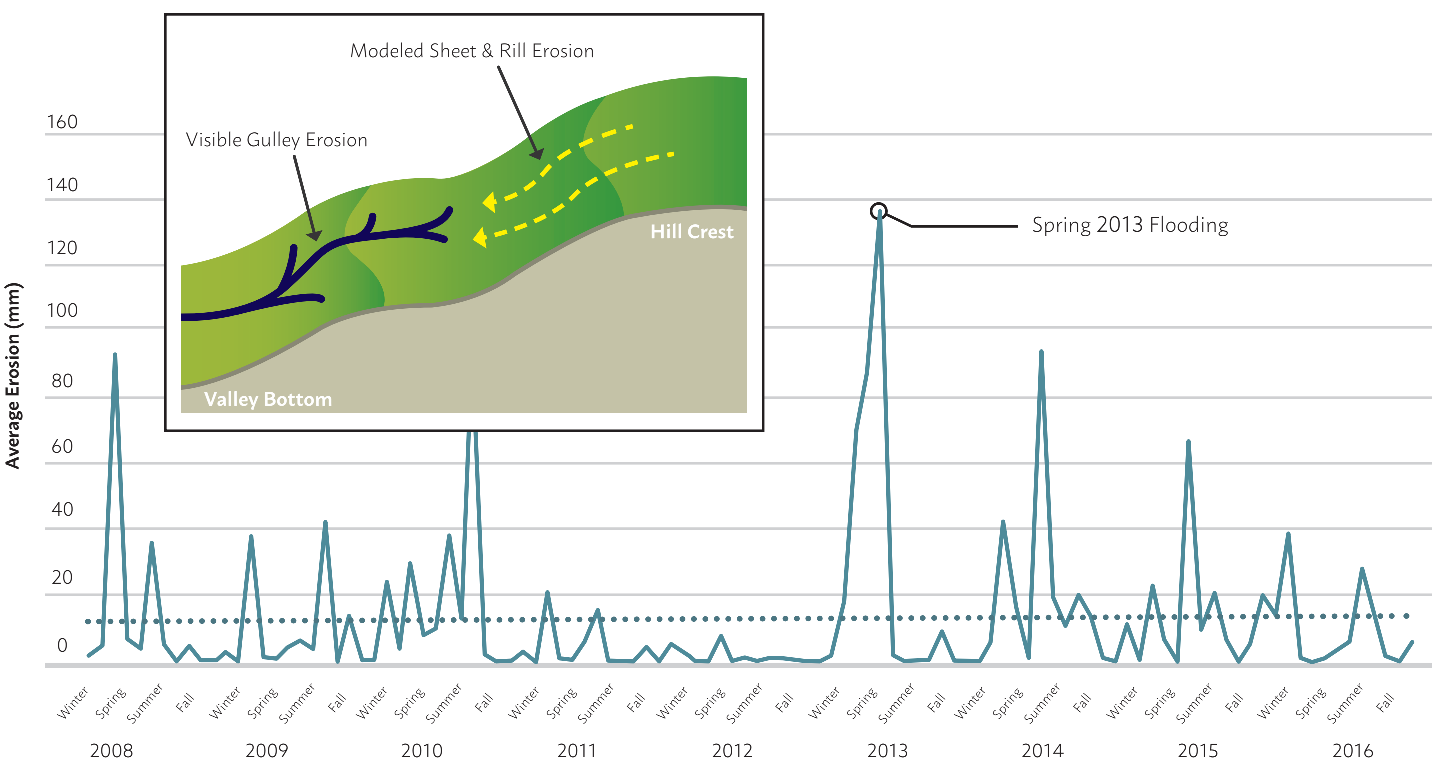

Figure 6. Soil Erosion in Headwaters Subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Headwaters subwatershed experienced an average of 9.96 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 8 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Headwaters subwatershed ranks near the middle of all subwatersheds for soil delivery at 7.51 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Headwaters is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Headwaters subwatershed.

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

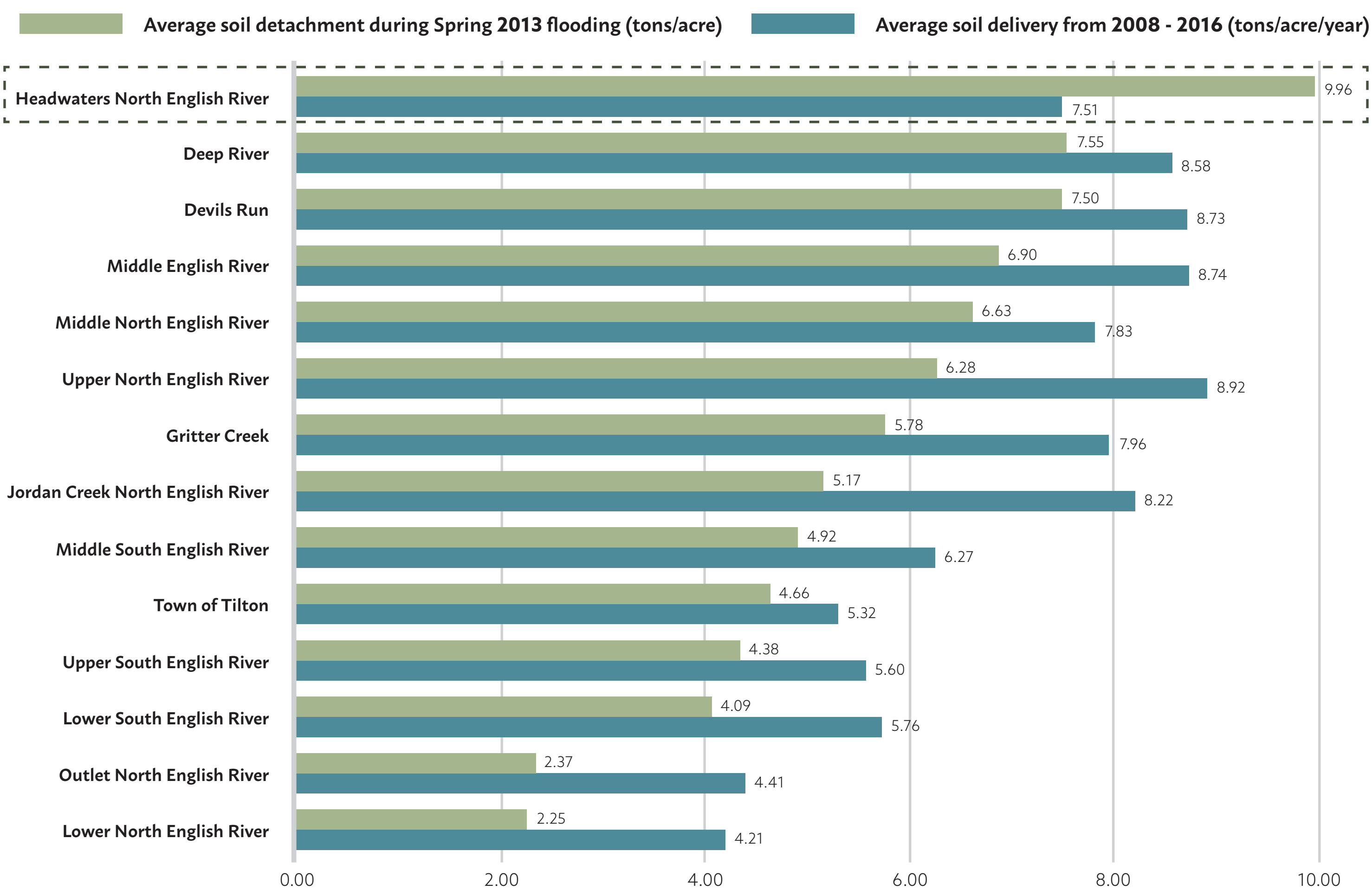

Figure 7. Soil Delivery and Detachment in Headwaters subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR HEADWATERS NORTH ENGLISH:
https://bit.ly/2zMykYv

SHEET AND RILL EROSION & SEDIMENT DELIVERY POTENTIAL

Four priority subwatersheds (Gritter Creek, Middle English River, Headwaters North English, and the Middle North English River) were selected for implementation of BMPs through the IWA project through a cost-share program. As a result, these subwatersheds were subject to a greater level of research and planning including a detailed land use assessment completed in 2017 for use in the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) analysis, which estimated sheet and rill erosion (Figure 8) and sediment delivery (Figure 9). The Iowa Department of Natural Resources (IDNR) estimates sheet and rill erosion in the subwatershed is 183,556 tons per year. The IDNR also estimates that 31,614 tons of sediment is delivered to waterways per year.

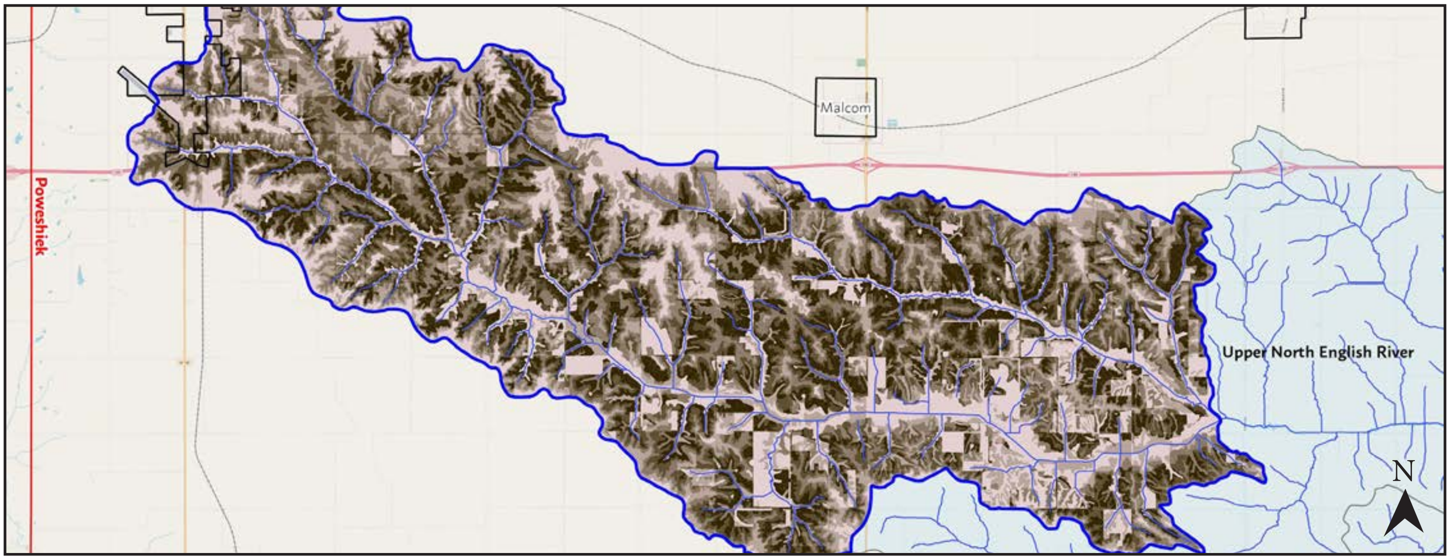

Figure 8. Estimated Sheet and Rill Erosion for the Headwaters North English River Subwatershed, 2017. *Source: Iowa DNR*

0-1 tons/acre/year | 1-2 tons/acre/year | 2-5 tons/acre/year | 5-8 tons/acre/year | 8-43.5 tons/acre/year

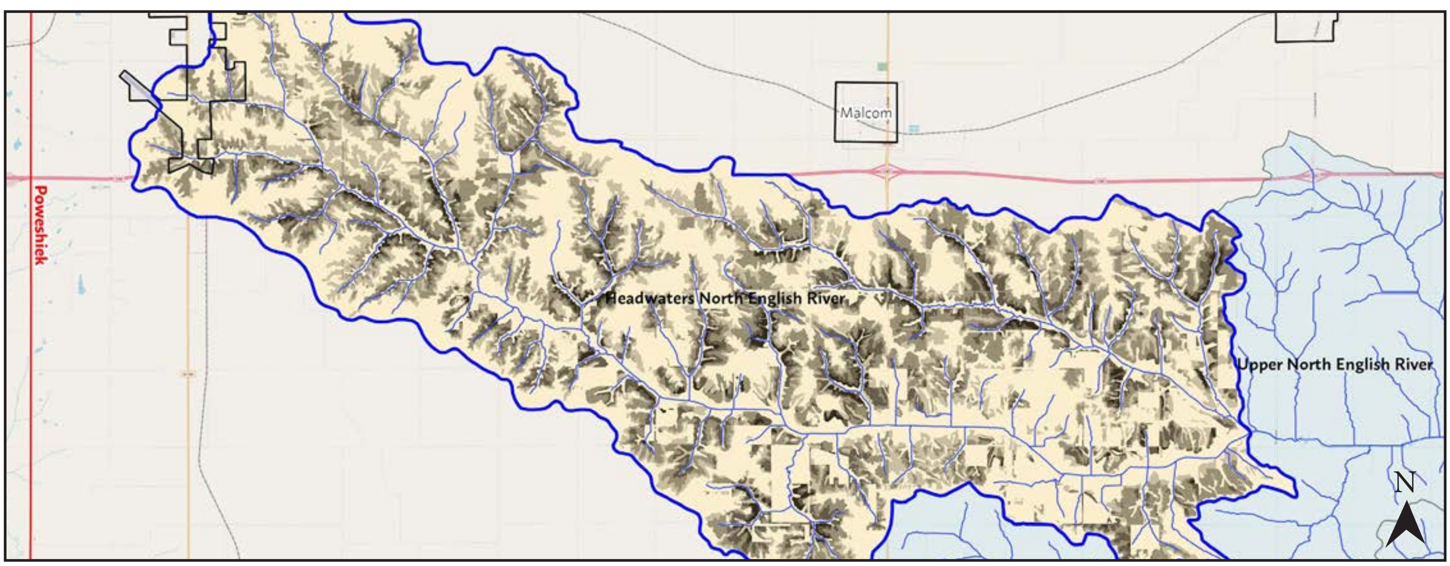

Figure 9. Estimated Sediment Delivery for the Headwaters North English River Subwatershed, 2017. *Source: Iowa DNR*

0-0.5 tons/acre/year | 0.5-1 tons/acre/year | 1-2 tons/acre/year | 2-4 tons/acre/year | 4-6.21 tons/acre/year

VIEW SOIL EROSION WEBMAPS FOR HEADWATERS NORTH ENLGISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 885.55 miles of contour buffer strips, 80 bioreactors, 826 WASCOBs, 14 nutrient-removal wetlands, a total of 2,520 acres of drainage area for the wetlands, and 313.86 miles of grassed waterways in the Headwaters North English River subwatershed (Table 11). If all 14 wetlands were installed in the subwatershed, roughly 23.8 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 10. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	**36,075**	**885.55**	**80**	**826**	**39**	**8,608.98**	**23.8 %**	**313.86**
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

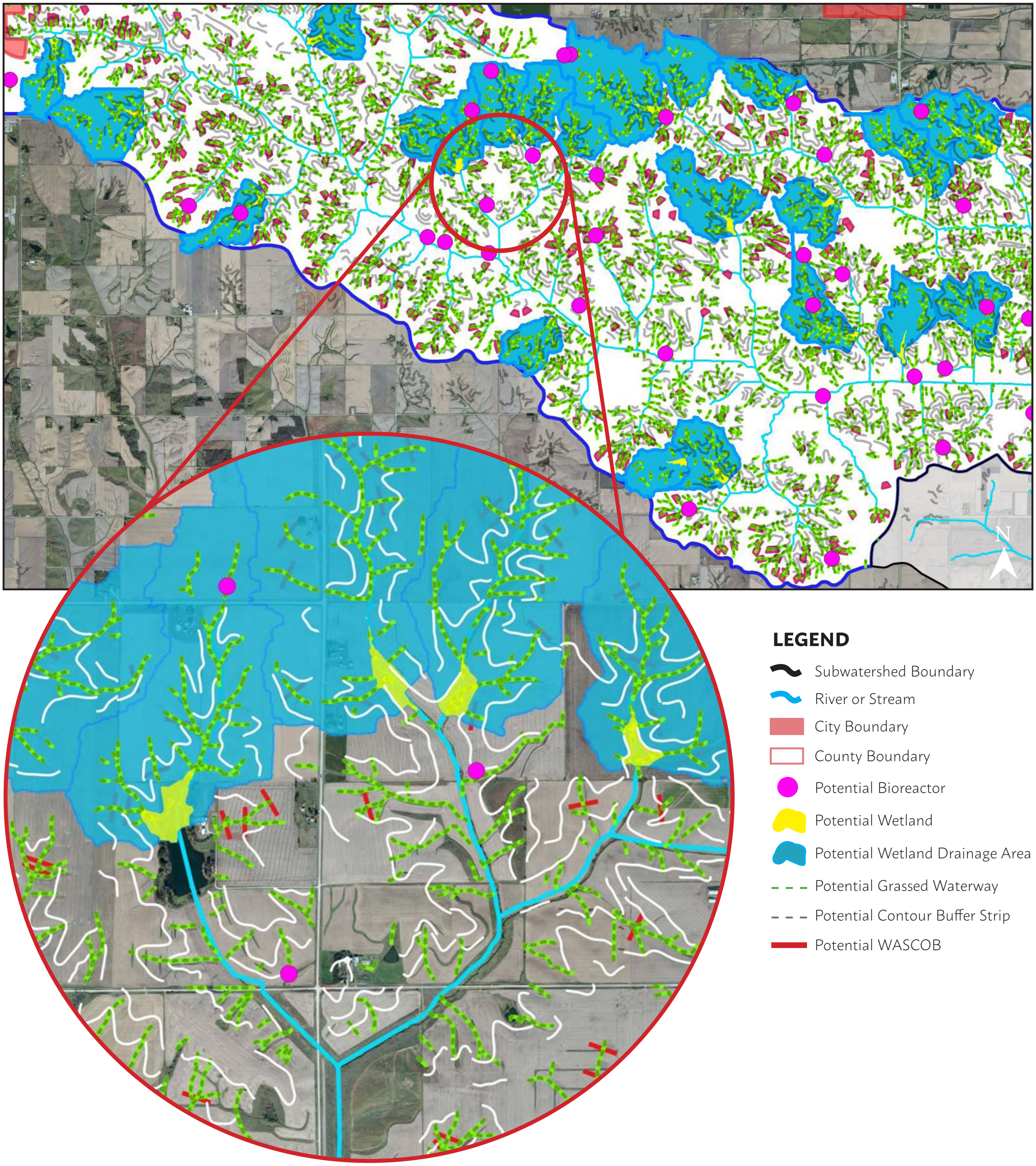

Figure 10. ACPF Model Results for Headwaters Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR HEADWATERS NORTH ENGLISH:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Grinnell is the only urbanized, incorporated area in the Headwaters subwatershed. English River Watershed boundaries encompass the a portion of North English. Likewise, the Headwaters subwatershed only spans a portion of southwest Grinnell, which is primarily commercial and industrial land uses.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Headwaters subwatershed. Figure 11 represents the stormwater runoff volume for each catchment area within the city limits of Grinnell where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

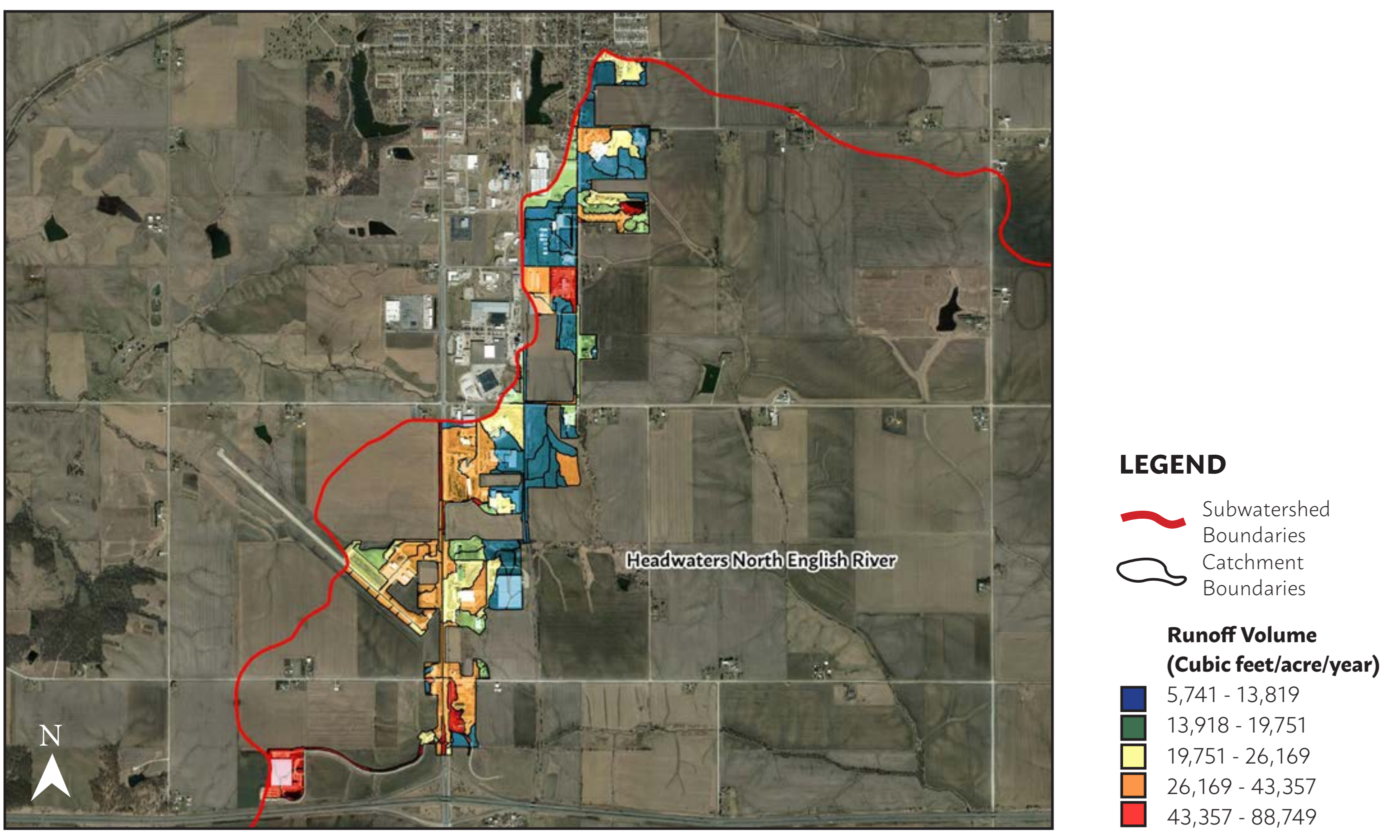

Figure 11. Modeled Runoff Volume in Grinnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 12 displays total nitrate loads for each catchment area within the city limits of Grinnell where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 13 and 14 display total phosphorus loads and total sediment loads for each catchment area within the city limits of Grinnell where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

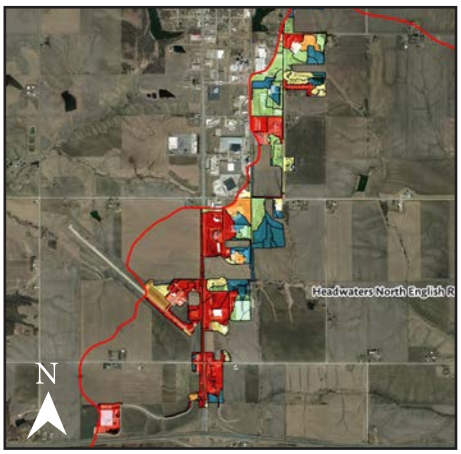

Figure 12. Modeled Nitrate Load in Grinnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

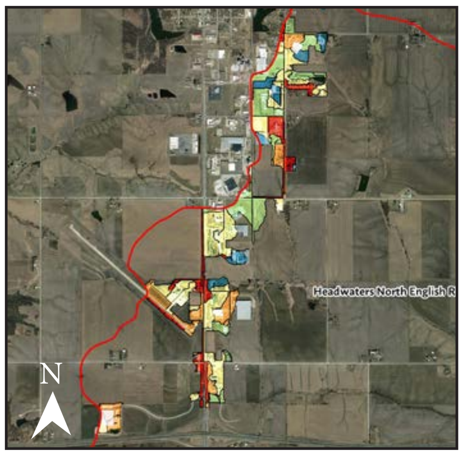

Figure 13. Modeled Phosphorus Load in Grinnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

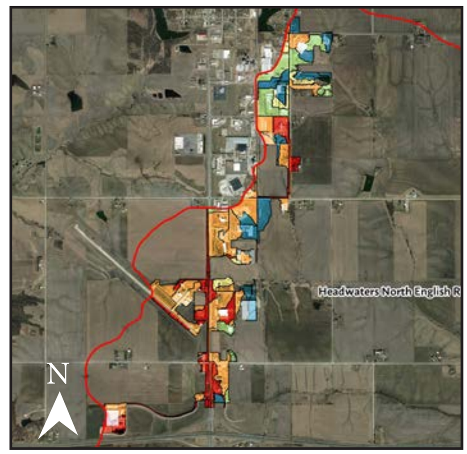

Figure 14. Modeled Sediment Load in Grinnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW GRINNELL INTERACTIVE WEBMAP:
https://arcg.is/14yfWT0

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Poweshiek County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2016 and expires in 2021.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 15 shown below represents the flood hazards that exist in the Headwaters North English River subwatershed. The flood hazard area accounts for roughly 8.4 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the city of Grinnell, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 9.6 percent of Poweshiek County's area. By contrast, the English River Watershed overlaps about 45 percent of Poweshiek County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

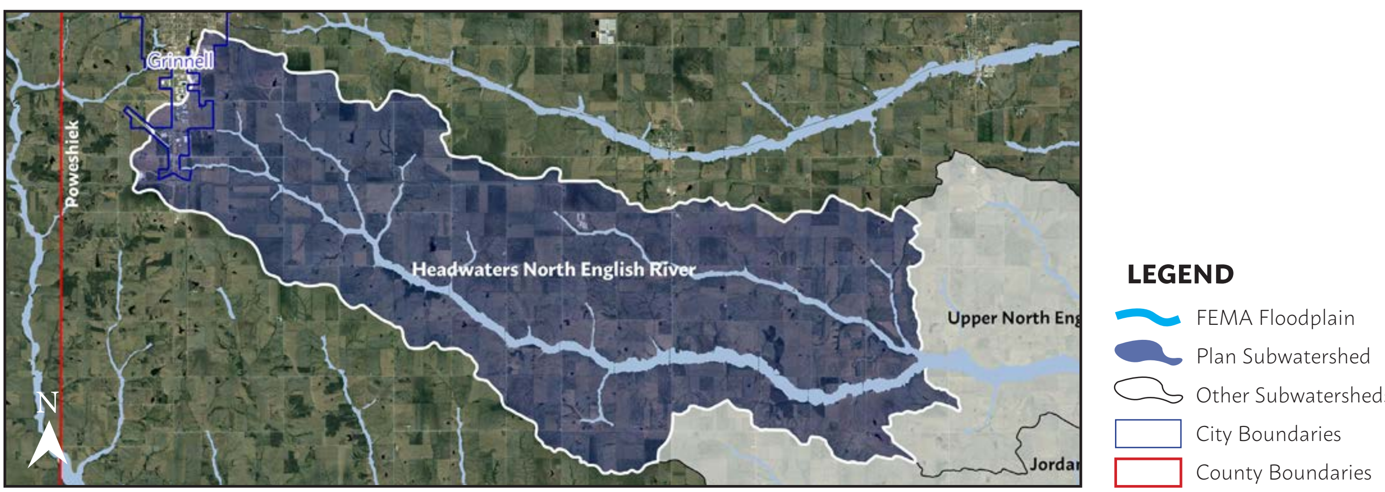

Figure 15. Flood Hazard Boundary Areas for Headwaters Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Poweshiek County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$623,826.13
Debris Removal	$133,878.41
Emergency Procedures	$40,166.52
Total	**$797,171.06**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Poweshiek County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at Deep River Monitoring Gauge
May 25 - August 13, 2008	$249,331.52	No historic data available
May 19 - June 1, 2013	$352,811.41	81.53' (6th Highest)
June 26 - July 8, 2014	$195,728.13	81.94' (7th Highest)
Total	**$797,171.06**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 1 structure vulnerable to losses from the 1 percent annual chance flood (red dots) and 16 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 16).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

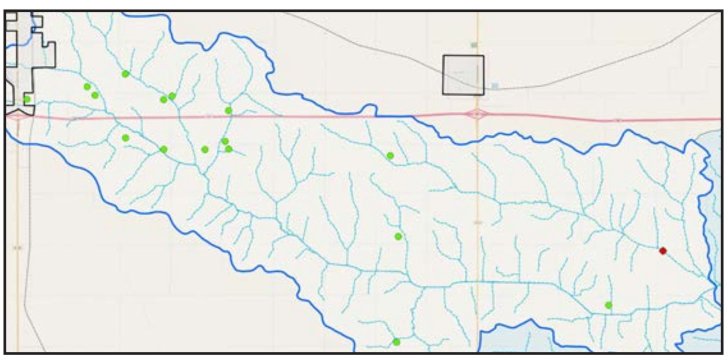

Figure 16. Vulnerable structures for flood hazards in the Headwaters North English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW GRINNELL NFIP FLOOD MAP:
http://arcg.is/0WGm0H0

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	**Yes**
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	Yes
Poweshiek County	**Yes**
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	**Poweshiek**	**Grinnell**	**0.725**	**2 % Black or African American**	**24 % Age 65 or Older**	**7 % Unemployed**
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	**Poweshiek**	**Grinnell**	**0.363**	**5 % Unemployed**	**20 % Age 65 or Older**	**3 % Hispanic or Latino**
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Poweshiek County's Hazard Mitigation Plan. The following recommendations for the Headwaters subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

The subwatershed ranks high among all subwatershed for nitrate and nitrite contamination in the 2018 testing season. Other contaminants (E.Coli bacteria, orthophosphate, and total phosphate) rank in the middle. In the soil erosion process, the Headwaters subwatershed experienced the highest average soil detachment during the 2013 flood period. There exists the highest potential in the Headwaters subwatershed for contour buffer strips, bioreactors, WASCOBs, nutrient-removal wetlands, and grassed waterways among any subwatershed in the ERW. Nearly one-quarter of the subwatershed area could be treated with complete implementation of nutrient-removal wetlands. The subwatershed also ranks the highest on the SVI scale in the ERW. Moreover, the subwatershed includes the second most structures that are vulnerable to physical damage during the 1 percent annual chance and 0.2 percent annual chance flood events. Together with a high SVI, BMPs should be designed to slow stormwater runoff.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Gritter Creek subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Upper North English River in the City of Grinnell	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Headwaters subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Poweshiek SWCD, NRCS	Poweshiek County, Grinnell	Medium/ High
	1.3	Flood protection for population safety in Headwaters subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	IWA, PDM	City of Grinnell, ERW	City of Grinnell	Low
2	2.2	Acquire property at risk of flooding near Upper North English; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in Grinnell	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Headwaters subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	IWA, WQI	Poweshiek SWCD, NRCS, ERW	City of Grinnell	Medium/ High
	3.2	Improve water quality in rural areas in Headwaters subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319, IWA	Poweshiek SWCD, NRCS, ERW	Poweshiek County	High
4	4.1	Provide flood protection for roads in Headwaters subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Poweshiek SWCD, NRCS	Poweshiek County, Guernsey	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

SUBWATERSHED TOOLKITS

UPPER NORTH ENGLISH RIVER

HUC-12: 070802090402

TABLE OF CONTENTS

Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Upper North English subwatershed is located in the headwaters region of the ERW. It overlaps one county (Poweshiek). The City of Guernsey (population 63) is the only incorporated area that overlaps the subwatershed. The Upper North English subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features shallow depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 54-56.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 19,076 acres (29.8 square miles) of land, which is predominately row crops (corn and soybeans). The North English River stretches approximately 7.76 miles through the subwatershed in west to east direction, eventually meets Deep River at the confluence about 4.5 miles east of the Deep River Timber Reserve.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is nitrate and nitrite contamination. Additionally, the Upper North English subwatershed ranked high in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

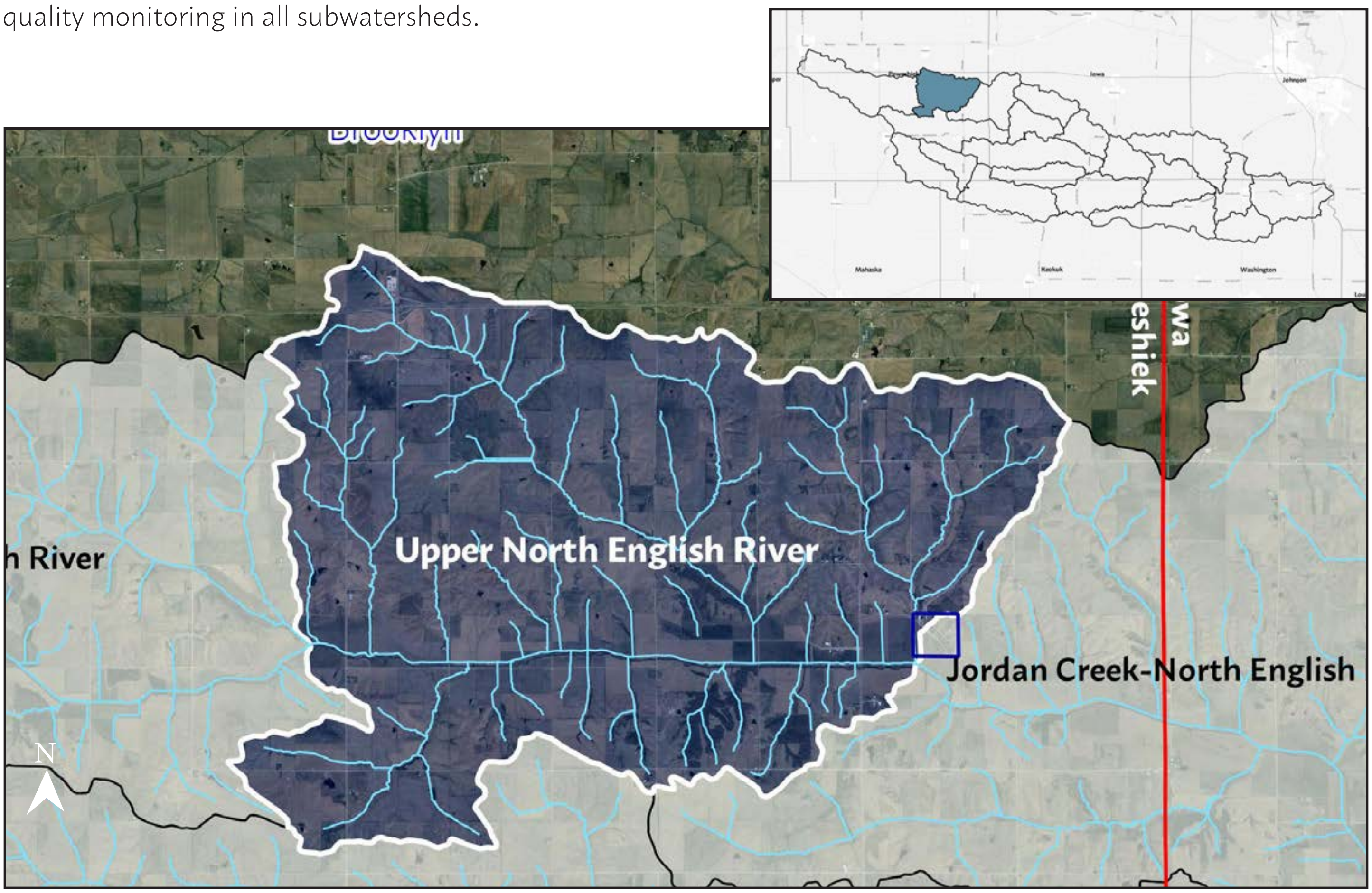

Figure 1. Upper North English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

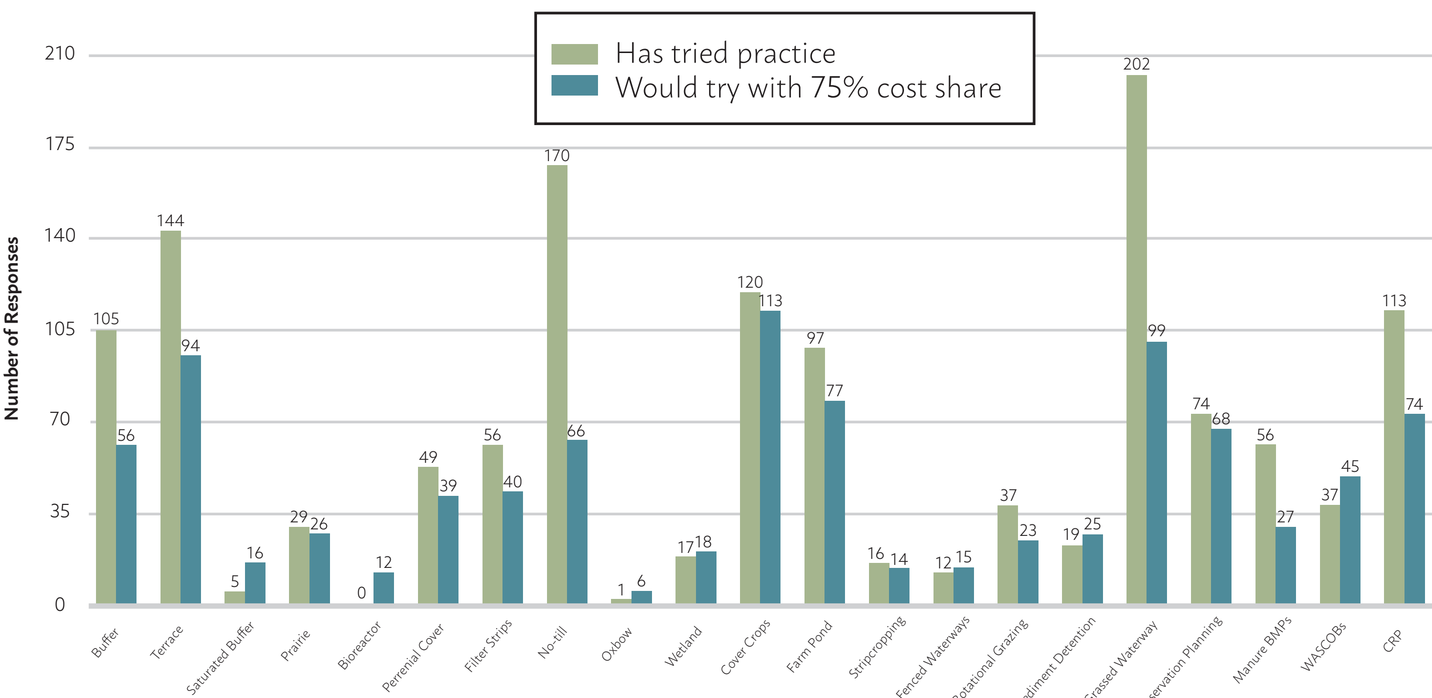

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

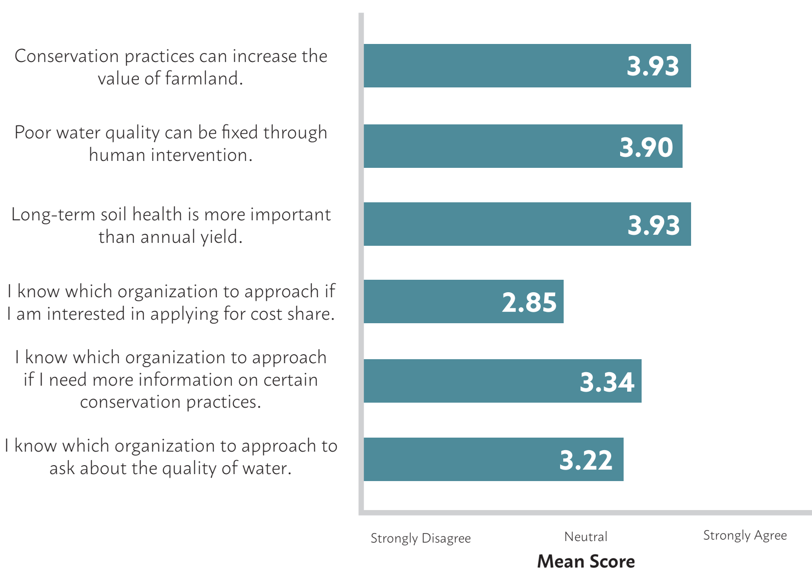

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 19 is near the outlet of the Upper North English River subwatershed. The sampling site is located on the 235th Street bridge over the North English River, in the SE quadrant of Poweshiek County, not far from the Poweshiek/Iowa County line (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

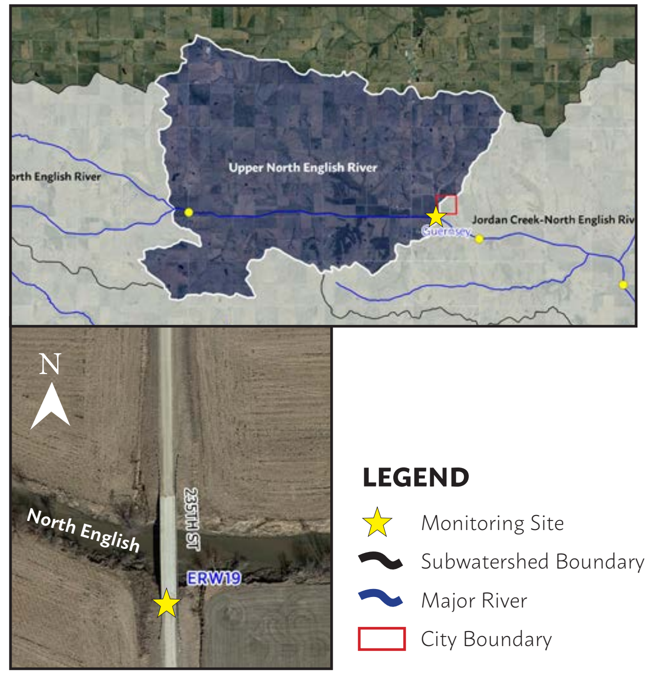

Figure 4. Water quality monitoring location for the Upper North English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Upper North English River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 19 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 19 ranked 18th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 19 ranked 15th. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 19 ranked 14th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 19 ranked 7th.

In 2017, Site 19 ranked 19th (nearly the lowest) of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 19 ranked 10th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 19 ranked 7th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 19 ranked 4th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 19 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	150	760	430
2018	31	1,300	770

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 19 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.07	0.03
2018	0.06	0.08	0.07

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 19 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.08	0.16	0.13
2018	0.11	0.40	0.22

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 19 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	1.0	11.0	3.9
2018	3.5	12.0	7.2

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

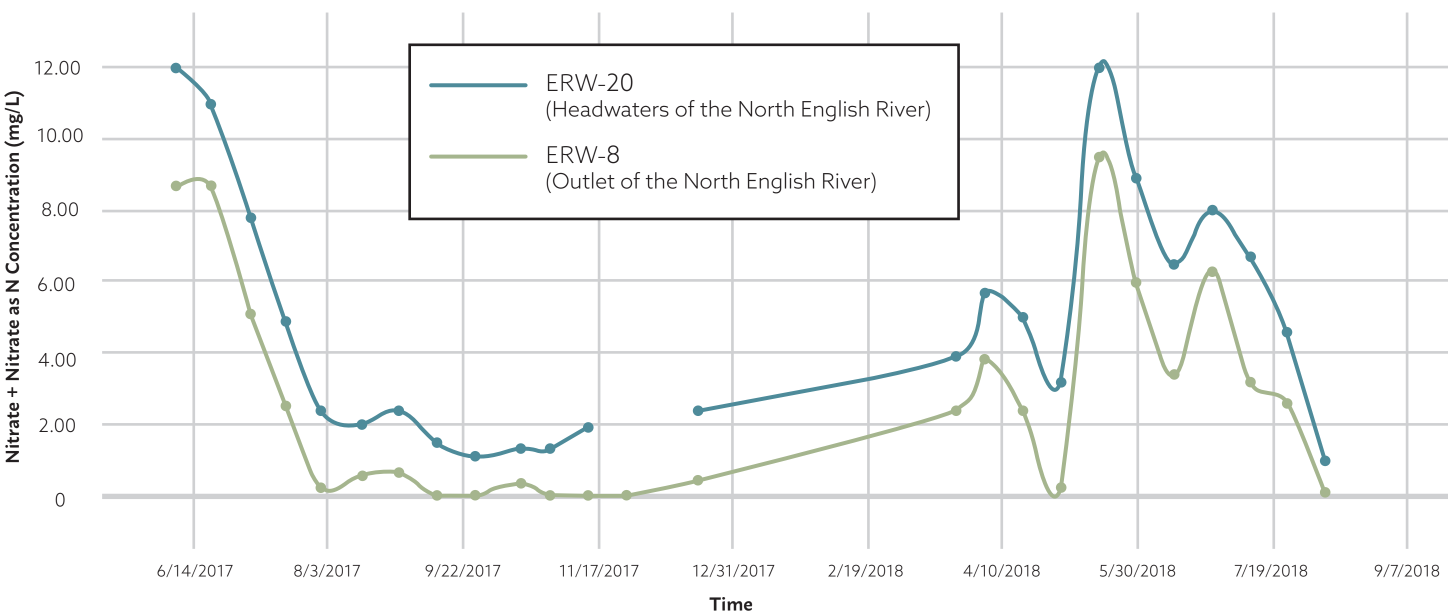

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Upper North English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be slightly increasing. Flooding in April of 2013 generated over 8 times the total erosion (113.94 mm) than Upper North English River's average monthly erosion of 13.28 mm (0.52 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Upper North English River's HUC is "070802090402"; see 402 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	**402**	302	401	501	403	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	**13.28**	13.05	13.02	12.89	12.76	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	**80.54**	83.21	79.25	82.04	81.65	82.23	83.68	82.65	83.17	84.61	82.92	82.29

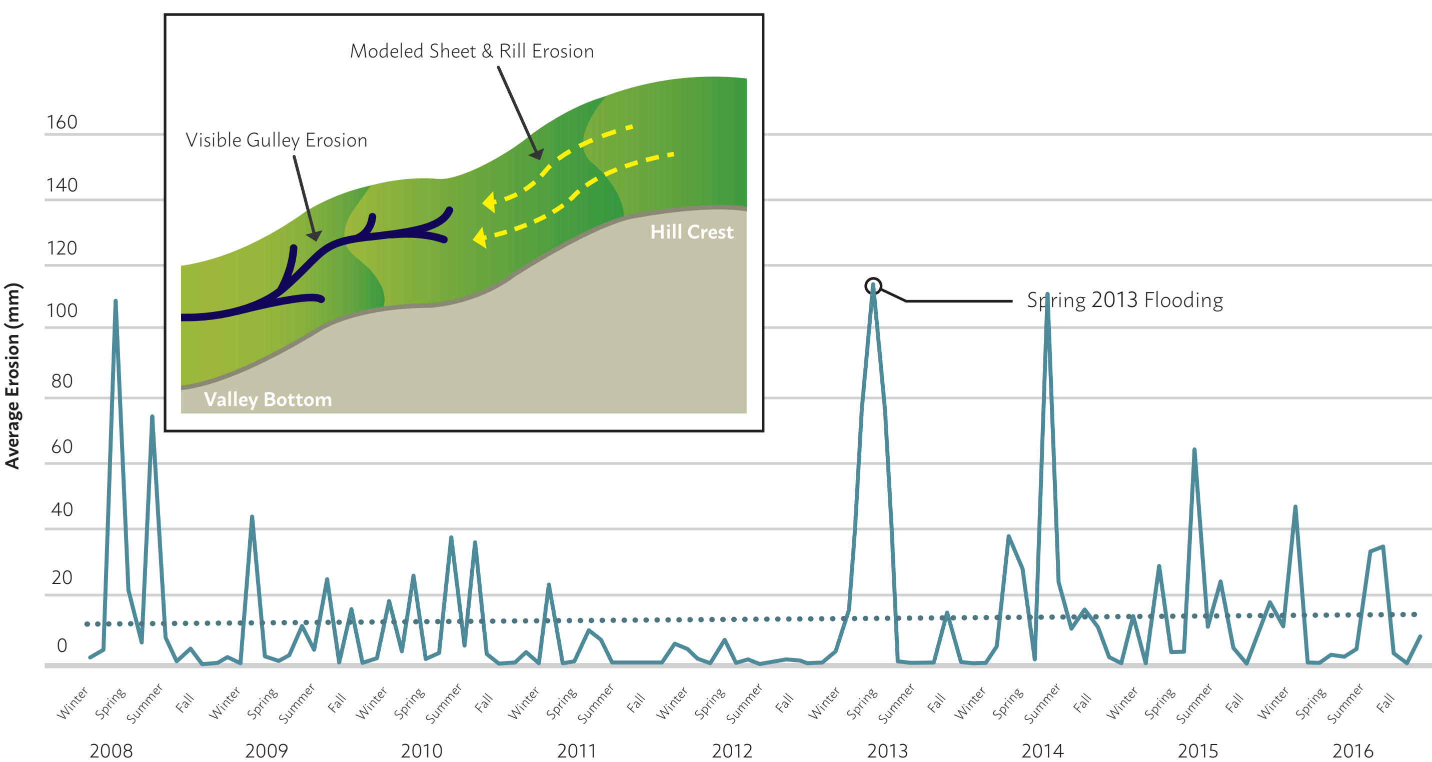

Figure 6. Soil Erosion in Upper North English River Subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Upper North English River experienced an average of 6.28 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Upper North English River subwatershed ranks the highest among all subwatersheds for soil delivery at 8.92 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Upper North English is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Upper North English River subwatershed.

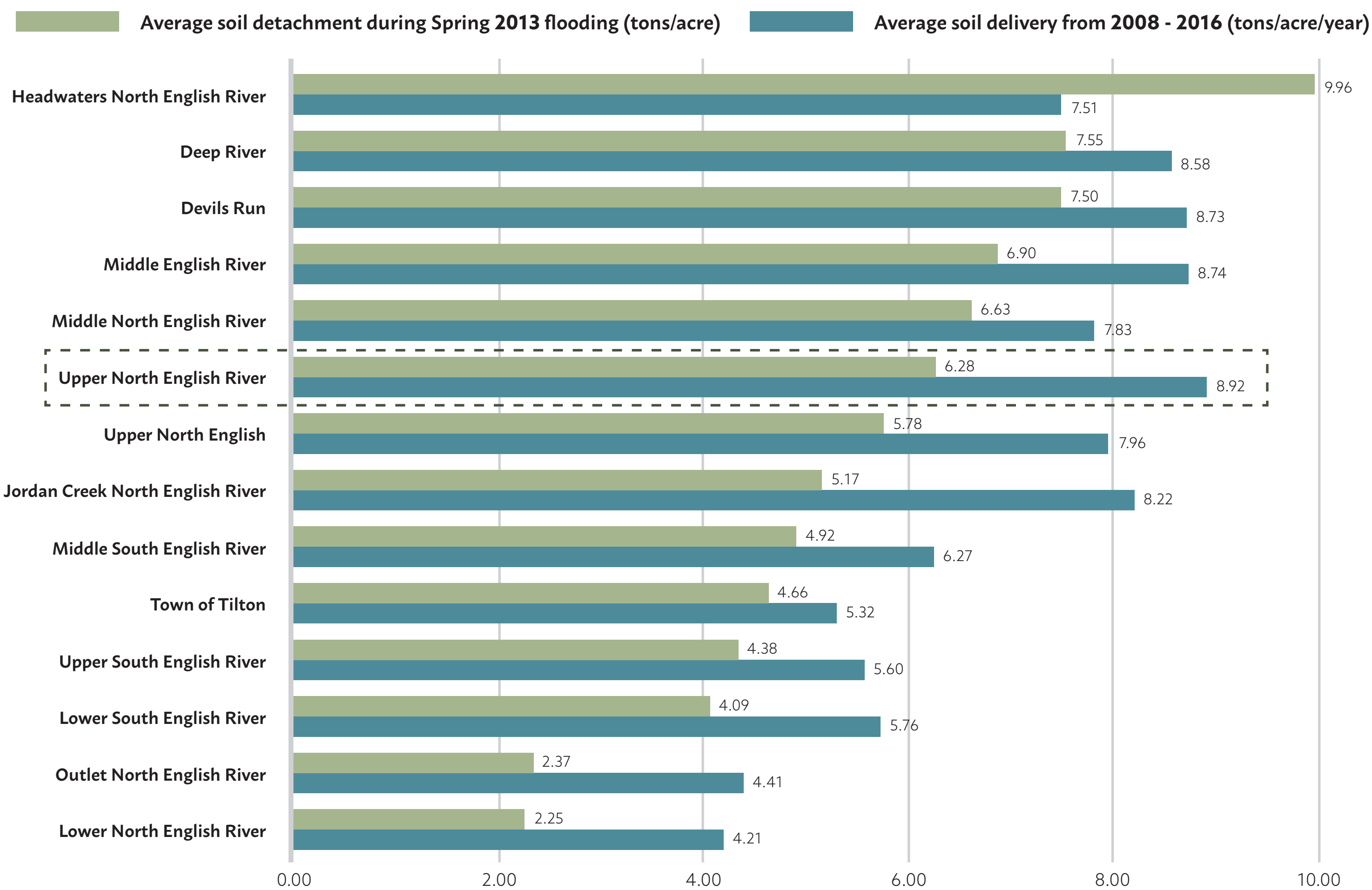

Figure 7. Soil Delivery and Detachment in the Upper North English River Subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR UPPER NORTH ENGLISH RIVER:
https://bit.ly/2P4mZID

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Upper North English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

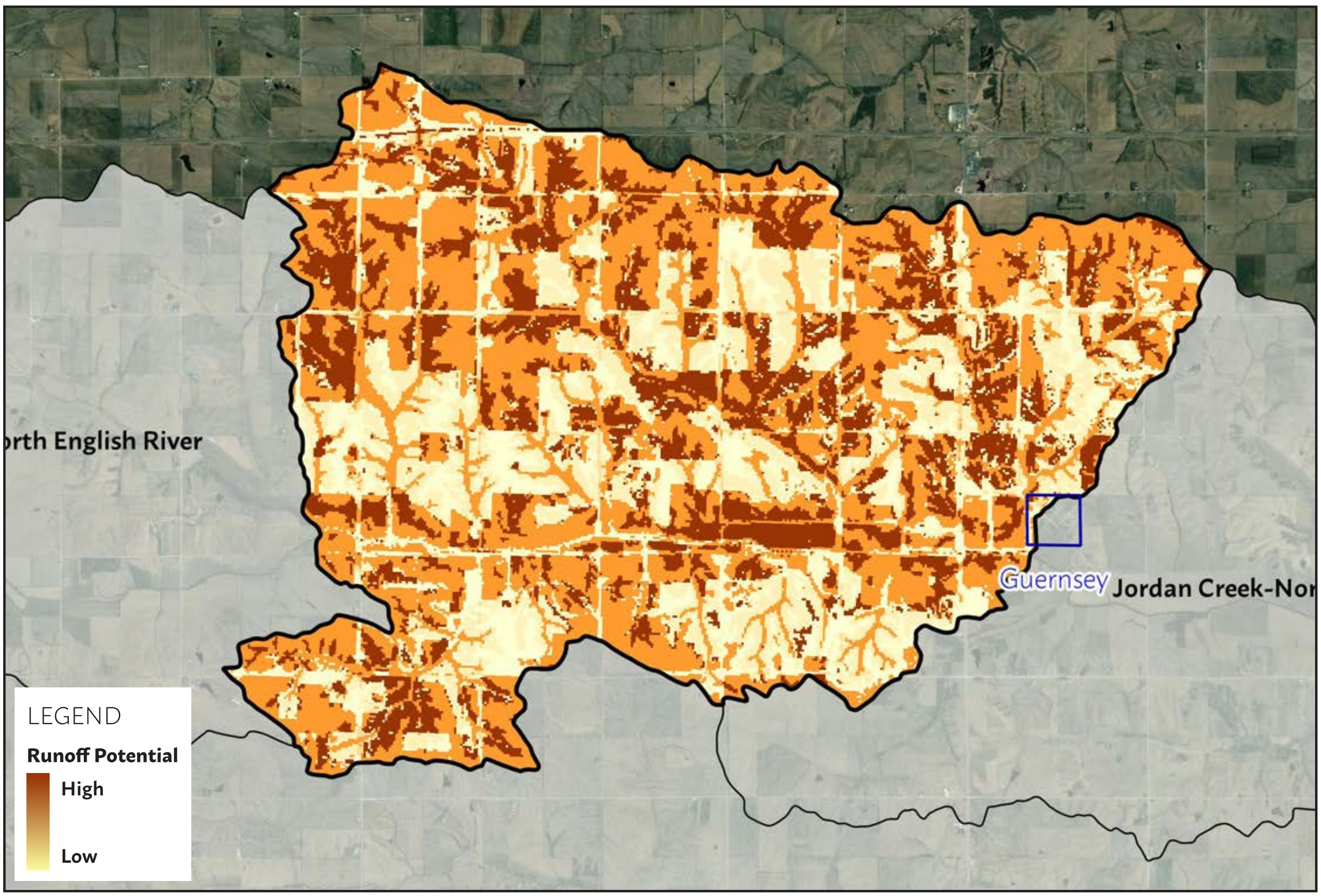

Figure 8. SCS-CN Runoff Potential Model for the Upper North English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR UPPER NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 381.94 miles of contour buffer strips, 49 bioreactors, 245 WASCOBs, 2 nutrient-removal wetlands, a total of 348.79 acres of drainage area for the wetlands, and 58.52 miles of grassed waterways in the Upper North English subwatershed (Table 11). If both wetlands were installed in the subwatershed, roughly 1.8 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	**19,076**	**381.94**	**49**	**245**	**2**	**348.79**	**1.8 %**	**58.52**
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

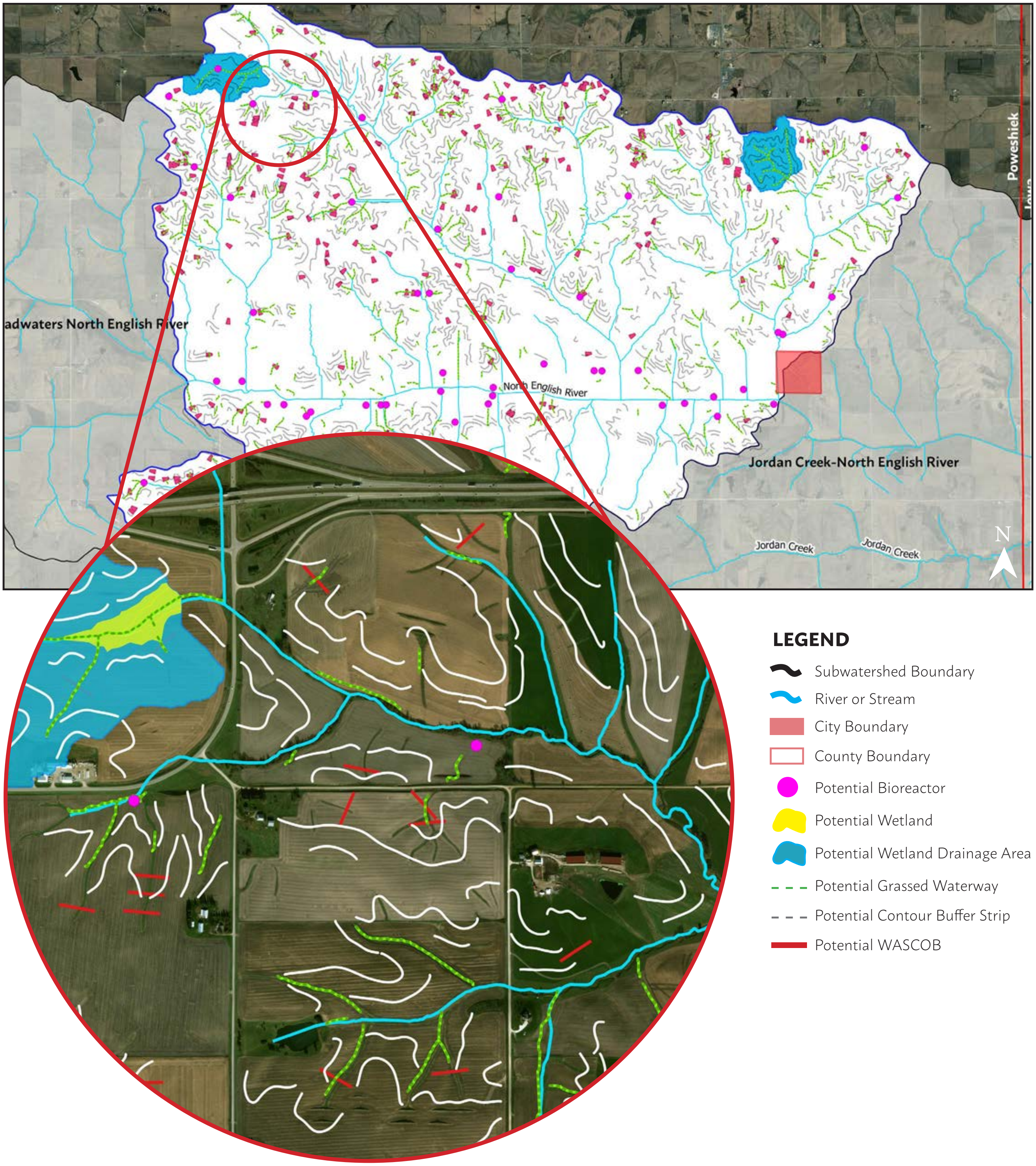

Figure 9. ACPF Model Results for the Upper North English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR UPPER NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Guernsey is the only urbanized, incorporated area in the Upper North English River subwatershed. English River Watershed boundaries encompass the entirety of Guernsey. However, the Upper North English River subwatershed only spans a portion of northwest Guernsey, which is primarily residential land uses. The majority of urbanized area lies in the Lower South English River subwatershed.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Upper North English River subwatershed. Figure 10 represents the stormwater runoff volume for each catchment area within the city limits of Guernsey where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

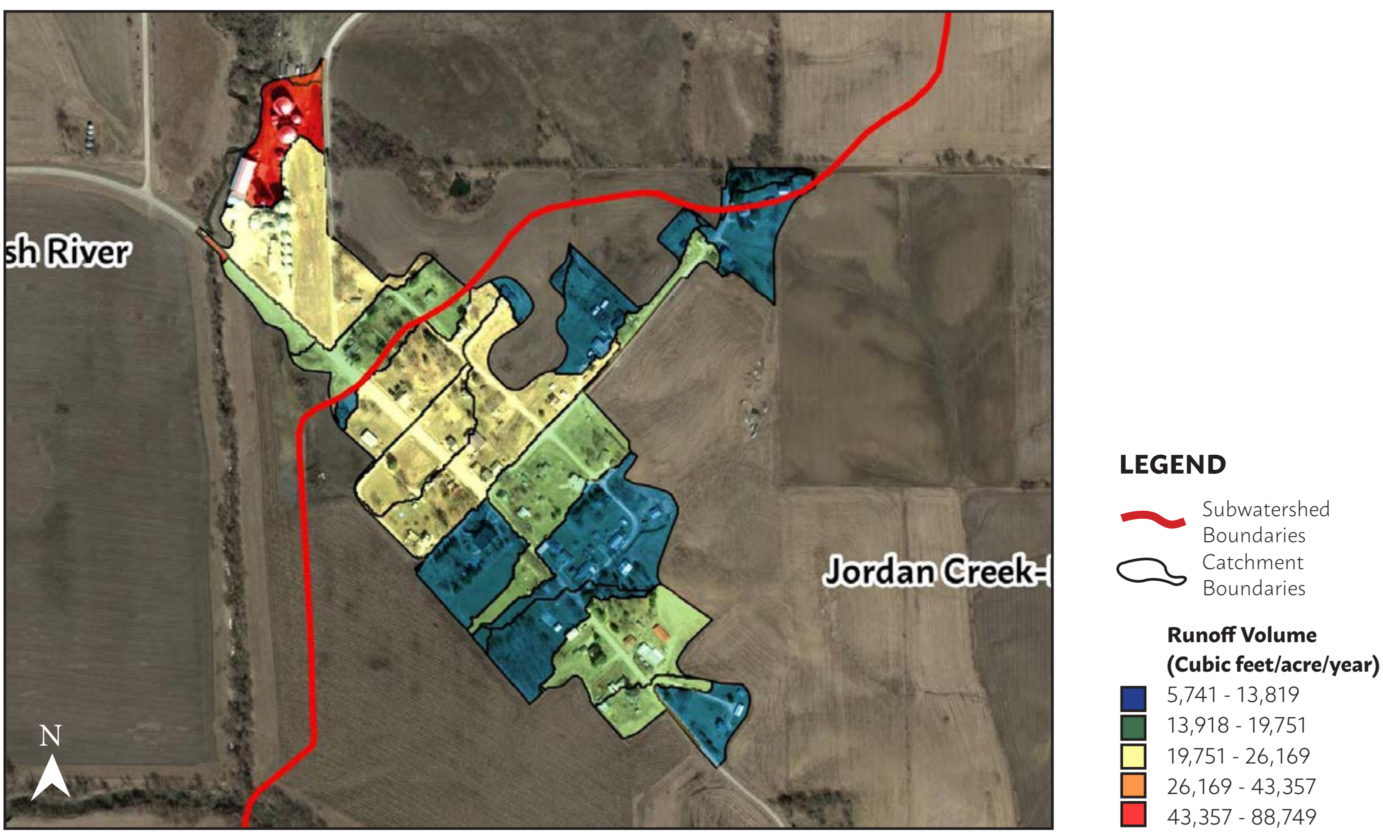

Figure 10. Modeled Runoff Volume in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 11 displays total nitrate loads for each catchment area within the city limits of Guernsey where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 12 and 13 display total phosphorus loads and total sediment loads for each catchment area within the city limits of Guernsey where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

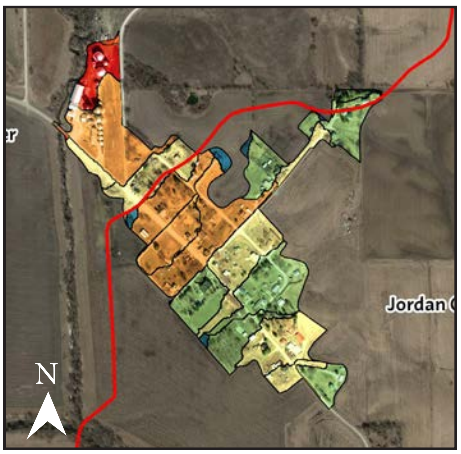

Figure 11. Modeled Nitrate Load in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

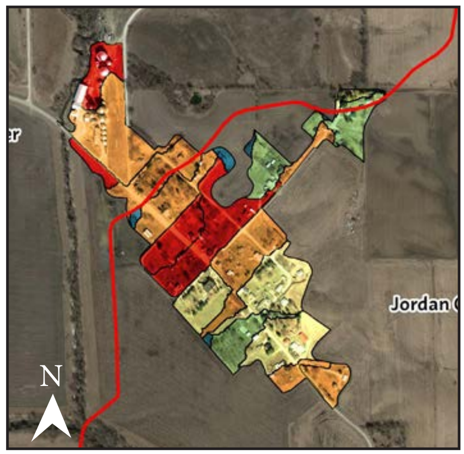

Figure 12. Modeled Phosphorus Load in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

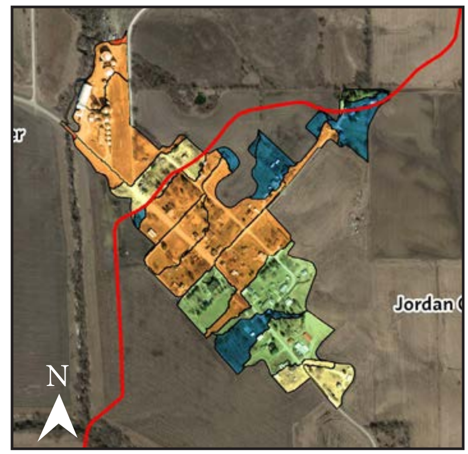

Figure 13. Modeled Sediment Load in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW GUERNSEY INTERACTIVE WEBMAP:
https://arcg.is/1ybrby0

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Poweshiek County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2016 and expires in 2021.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Upper North English River subwatershed. The flood hazard area accounts for roughly 12.0 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the city of Guernsey, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 5 percent of Poweshiek County's area. By contrast, the English River Watershed overlaps about 45 percent of Poweshiek County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

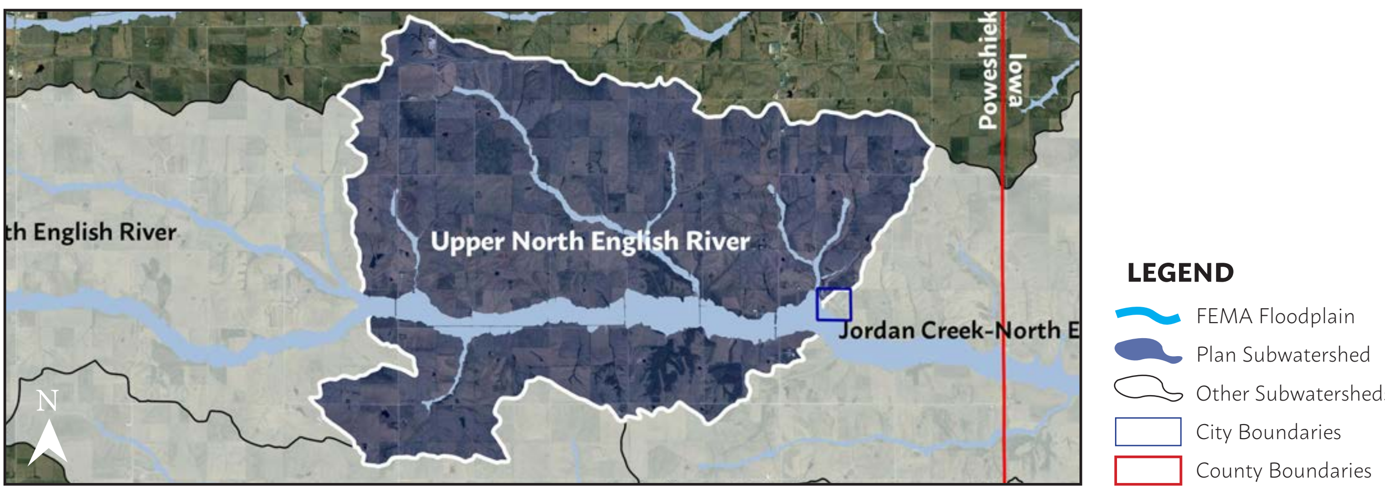

Figure 14. Flood hazard boundary areas for Upper North English Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Poweshiek County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$623,826.13
Debris Removal	$133,878.41
Emergency Procedures	$40,166.52
Total	**$797,171.06**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Poweshiek County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at Deep River Monitoring Gauge
May 25 - August 13, 2008	$249,331.52	No historic data available
May 19 - June 1, 2013	$352,811.41	81.53' (6th Highest)
June 26 - July 8, 2014	$195,728.13	81.94' (7th Highest)
Total	**$797,171.06**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 2 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 6 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

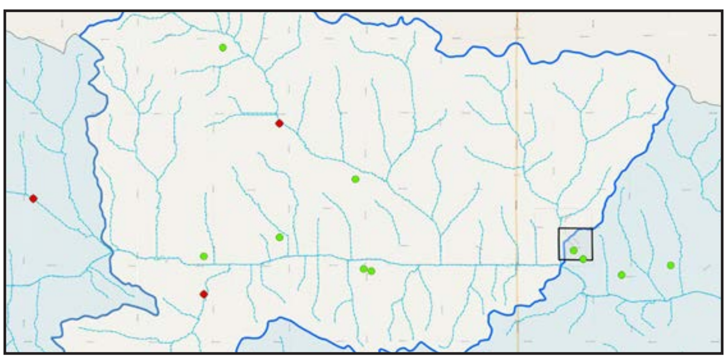

Figure 15. Vulnerable structures for flood hazards in the Headwaters North English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW GUERNSEY NFIP FLOOD MAP:
http://arcg.is/9GL0n

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	**Yes**
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	Yes
Poweshiek County	**Yes**
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	**Poweshiek**	**Montezuma, Guernsey, Deep River**	**0.44**	**1 % Black or African American**	**12 % Poverty**	**5 % Unemployed**
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Poweshiek County's Hazard Mitigation Plan. The following recommendations for the Upper North English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

The subwatershed ranks in the top 3 for nitrate and nitrite contamination during the 2018 testing season. Implementation of BMPs such as bioreactors can be installed to treat runoff prior to entering the North English River. 49 suitable locations for bioreactors are identified in Section 5 of this plan. The subwatershed presents the highest rate of soil delivery (average amount of soil transported to the bottom of hillslopes) among all subwatershed. Implementation of edge-of-field practices like contour buffer strips or grassed waterways can help prevent soil delivery. The North English River subwatershed, which includes portions of 3 small rural communities, presents the third highest SVI. High umployment and poverty rates in the subwatershed, as well as several structures vulnerable to annual flood damages, indicates a lower level of social resiliency to hazardous situations.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Upper North English subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Upper North English in the City of Guernsey	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Upper North English subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Poweshiek SWCD, NRCS	Poweshiek County, Guernsey	Medium/ High
	1.3	Flood protection for population safety in Upper North subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	City of Guernsey, ERW	City of Guernsey	Low
2	2.2	Acquire property at risk of flooding near Upper North English ; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in Guernsey	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Upper North English subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Poweshiek SWCD, NRCS, ERW	City of Guernsey	Medium/ High
	3.2	Improve water quality in rural areas in Upper North English subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319,	Poweshiek SWCD, NRCS, ERW	Poweshiek County	High
4	4.1	Provide flood protection for roads and in Upper North English subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Poweshiek SWCD, NRCS	Poweshiek County, Guernsey	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

DEEP RIVER

HUC-12: 070802090403

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Deep River subwatershed is located in the headwaters region of the ERW. It overlaps two counties (Poweshiek and Iowa). The City of Deep River (population 279) completely overlaps the subwatershed and the City of Montezuma (population 1,462) overlaps a small portion. The Deep River subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features moderately shallow depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 47-50.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 26,535 acres (41.4 square miles) of land, which is predominately row crops (corn and soybeans). Deep River stretches approximately 18.17 miles through the subwatershed in west to east direction, and eventually meets the North English River about 5 miles east of the City of Deep River.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is sediment and phosphorus contamination. Additionally, the Deep River subwatershed ranked high in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

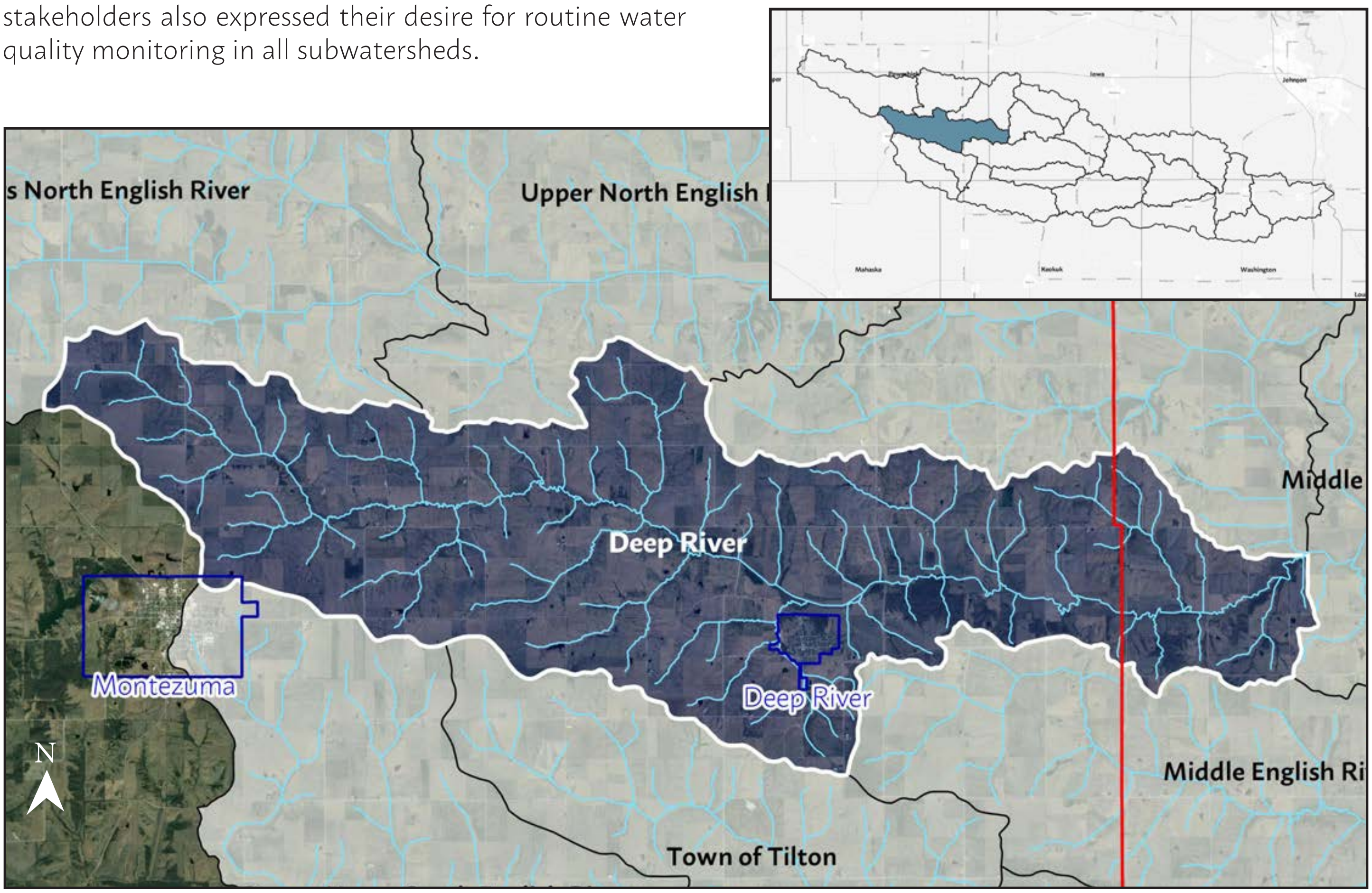

Figure 1. Deep River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

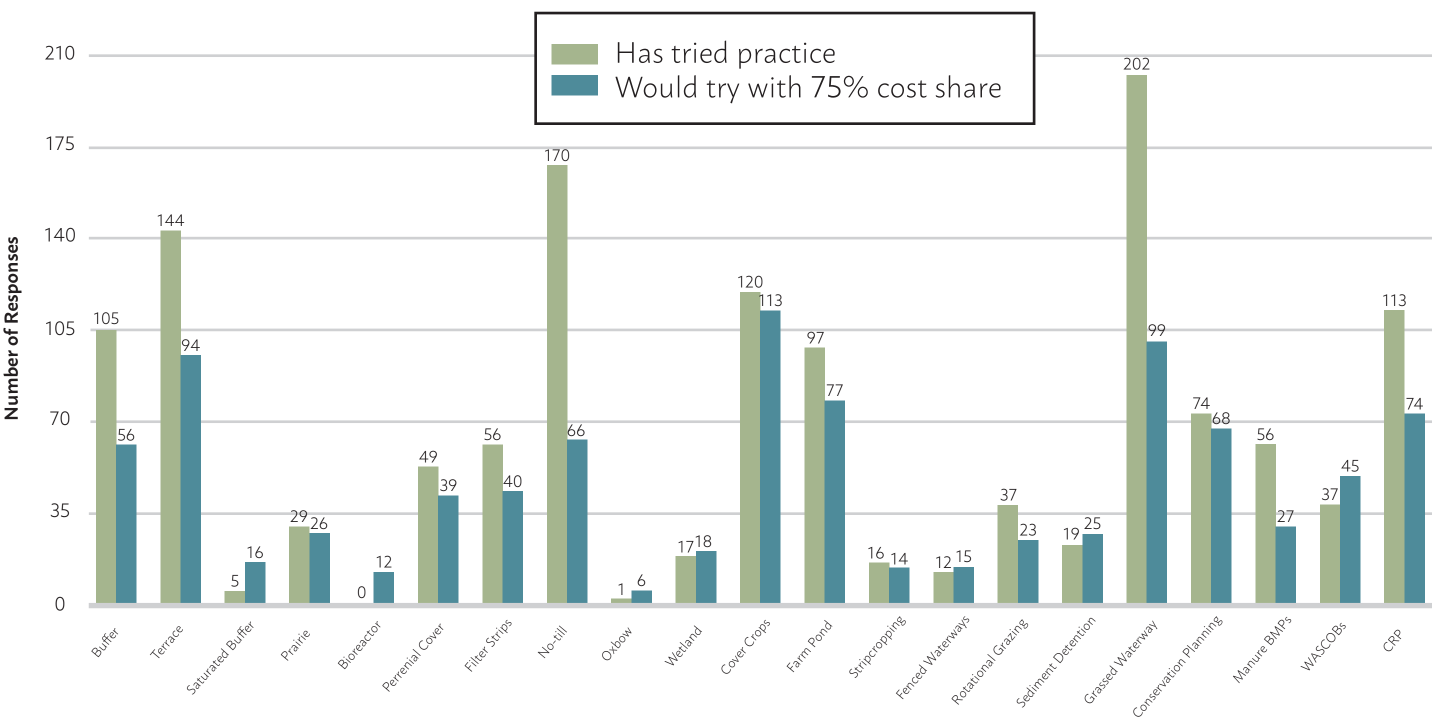

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

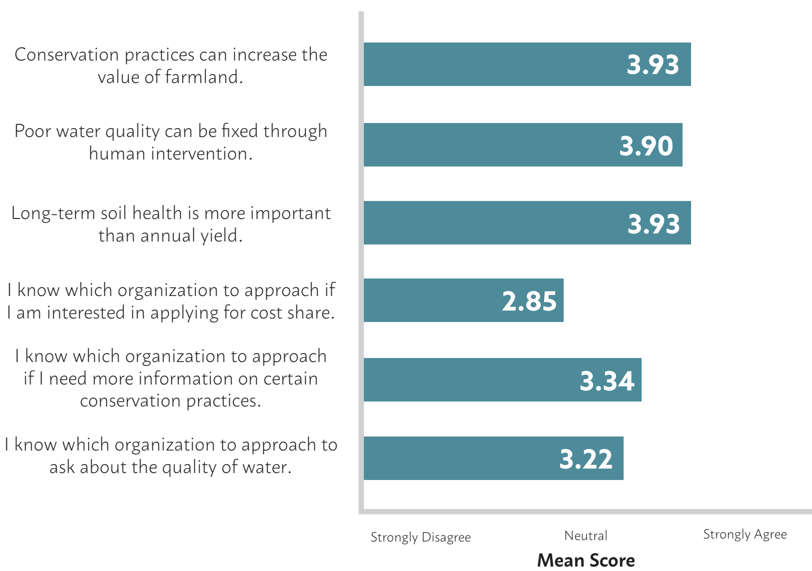

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 16 is near the outlet of the Deep River subwatershed. This subwatershed encompasses the entire length of Deep River. The site is located on the B Avenue bridge in Iowa County, about halfway between the cities of Millersburg and Deep River (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

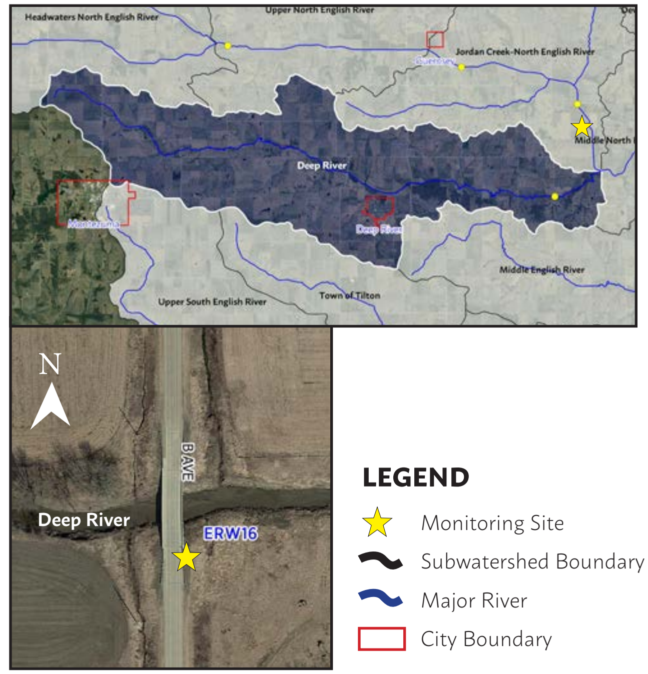

Figure 4. Water quality monitoring location for the Deep River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 16 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 16 ranked 13th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 16 ranked 19th (nearly the lowest). Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 16 ranked 20th (the lowest) of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 16 ranked 17th.

In 2017, Site 16 ranked 10th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 16 ranked 18th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 16 ranked 11th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 16 ranked 20th (the lowest). Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 16 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	250	860	665
2018	31	1,300	670

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 16 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.06	0.02
2018	0.05	0.05	0.05

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 16 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.13	0.28	0.17
2018	0.07	0.17	0.12

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 16 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.3	11.0	3.2
2018	0.9	2.4	1.8

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

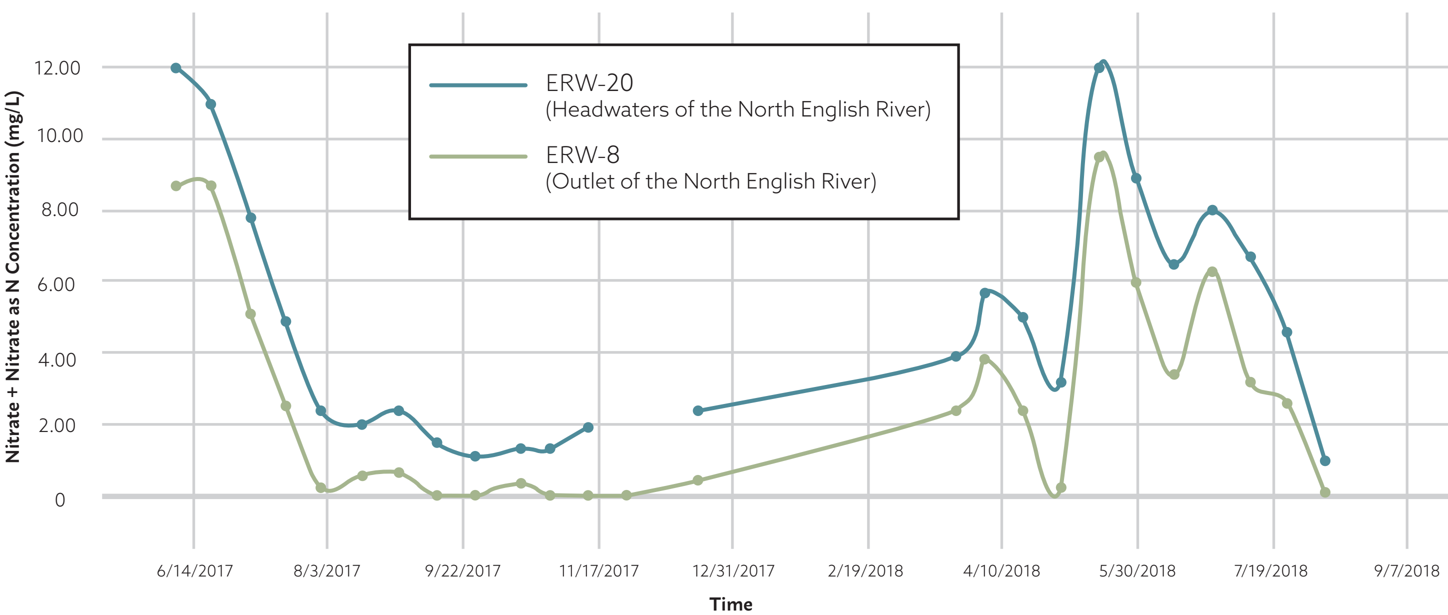

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Deep River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be slightly increasing. Flooding in April of 2013 generated over 8 times the total erosion (102.79 mm) than Deep River's average monthly erosion of 12.76mm (0.50 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Deep River's HUC is "070802090403"; see 403 in Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	**403**	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	**12.76**	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	**81.65**	82.23	83.68	82.65	83.17	84.61	82.92	82.29

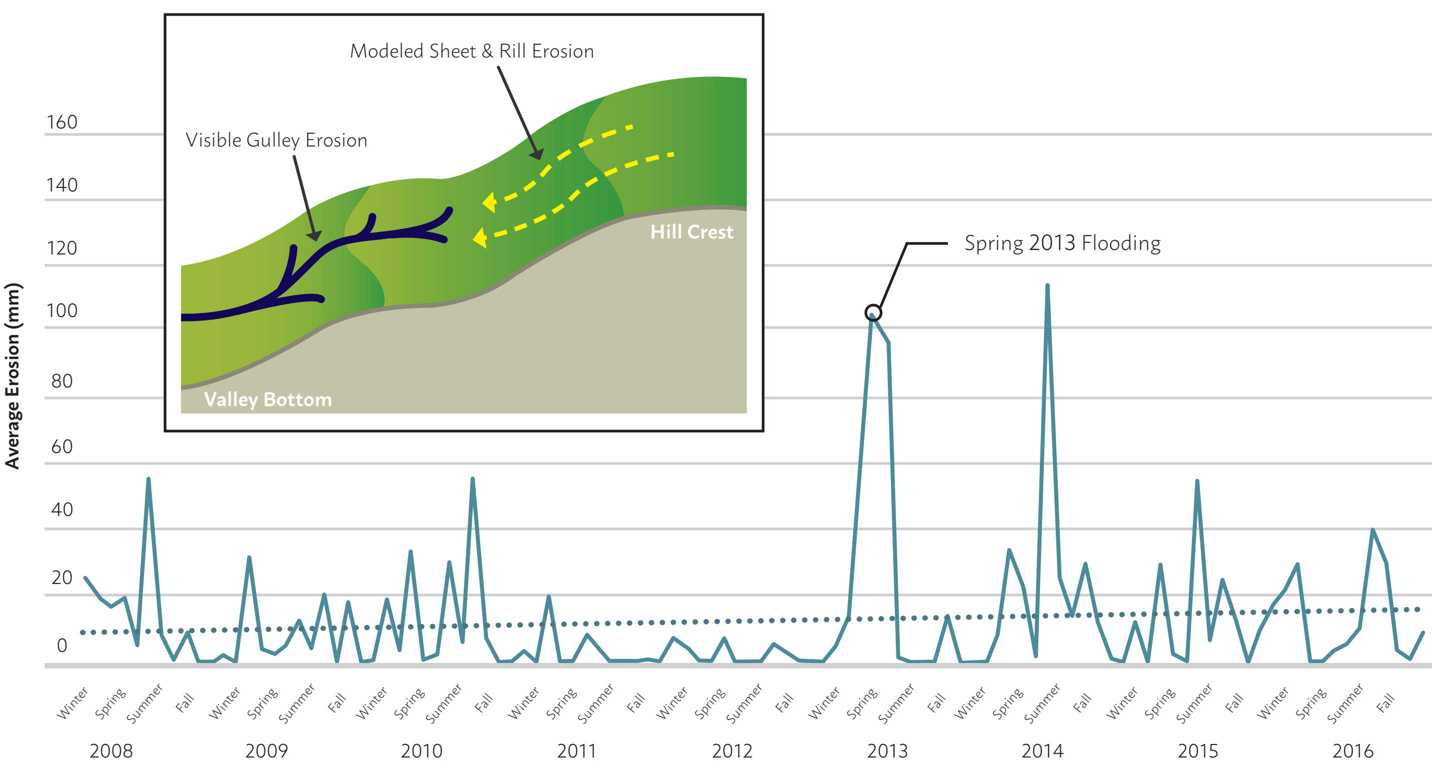

Figure 6. Soil Erosion in the Deep River Subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Deep River subwatershed experienced an average of 7.55 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Deep River subwatershed ranks among the highest of all subwatersheds for soil delivery at 8.58 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Deep River is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Deep River subwatershed.

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

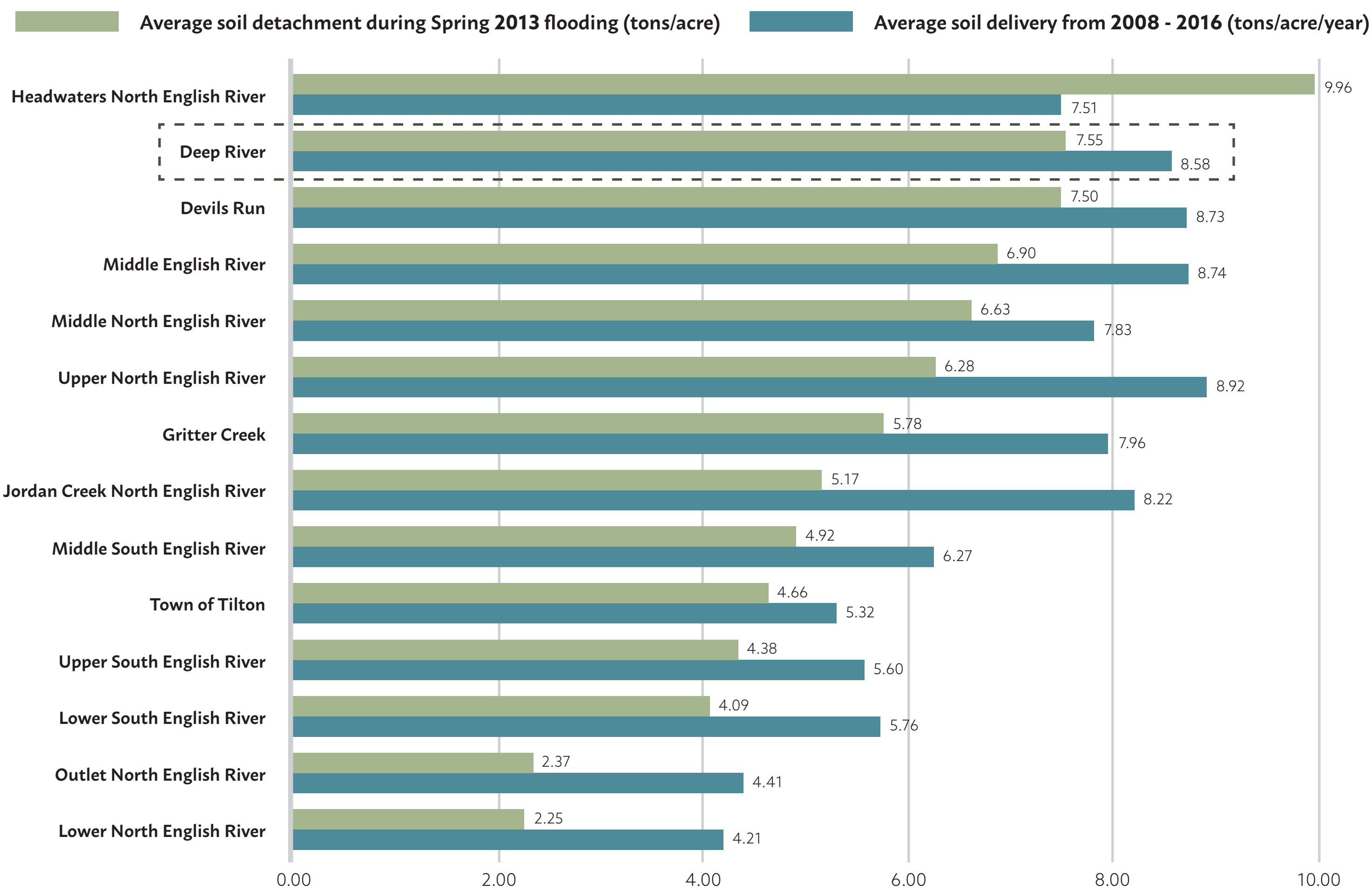

Figure 7. Soil Delivery and Detachment in the Deep River Subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR DEEP RIVER:
https://bit.ly/2NmxO7m

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Deep River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

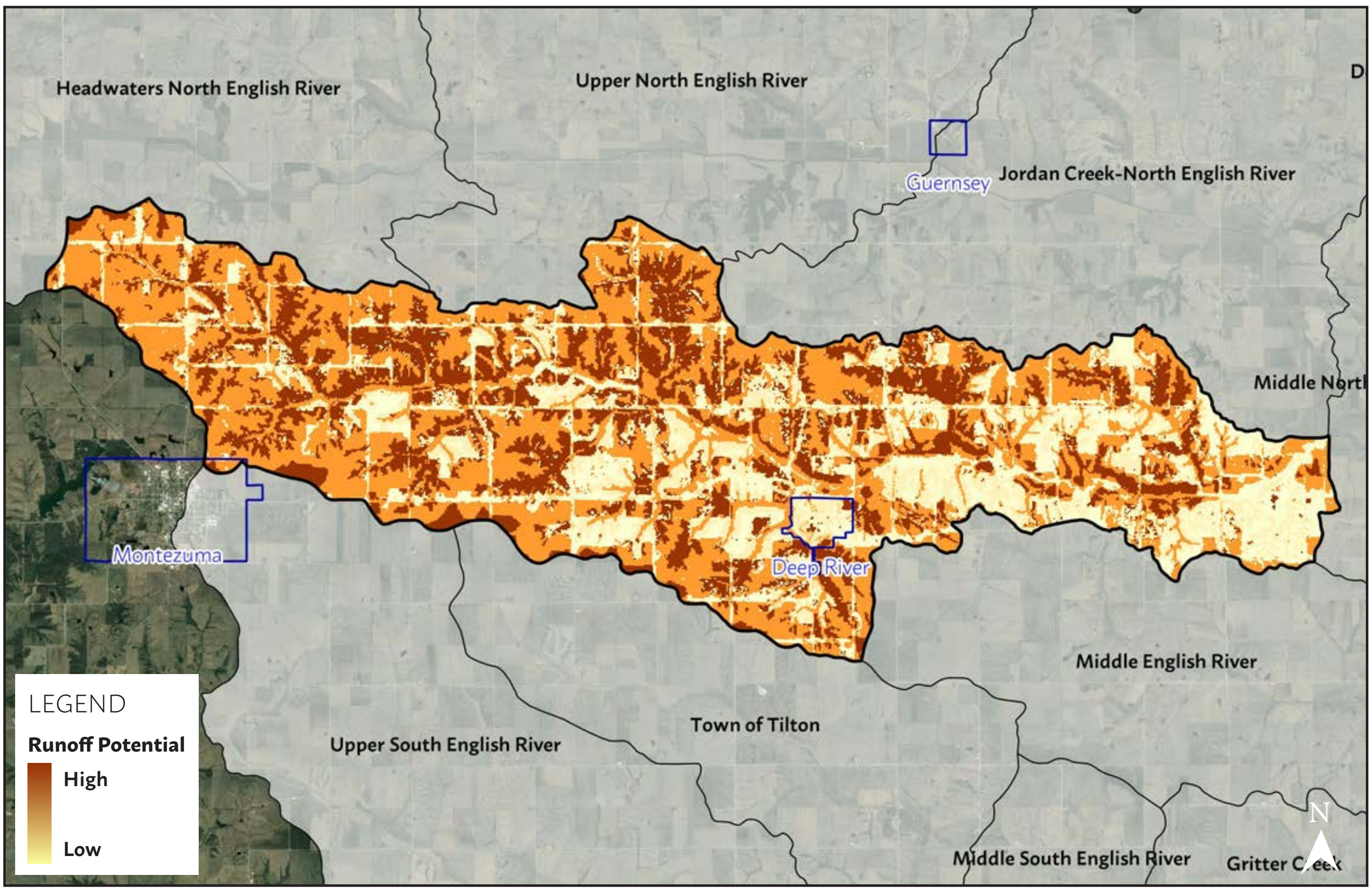

Figure 8. SCS-CN Runoff Potential Model for the Deep River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR DEEP RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 579.03 miles of contour buffer strips, 65 bioreactors, 393 WASCOBs, 5 nutrient-removal wetlands, a total of 1,156 acres of drainage area for the wetlands, and 91 miles of grassed waterways in the Deep River subwatershed (Table 11). If all 5 wetlands were installed in the subwatershed, roughly 4.4 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	**26,535**	**579.03**	**65**	**393**	**5**	**1,156.23**	**4.4 %**	**91.17**
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

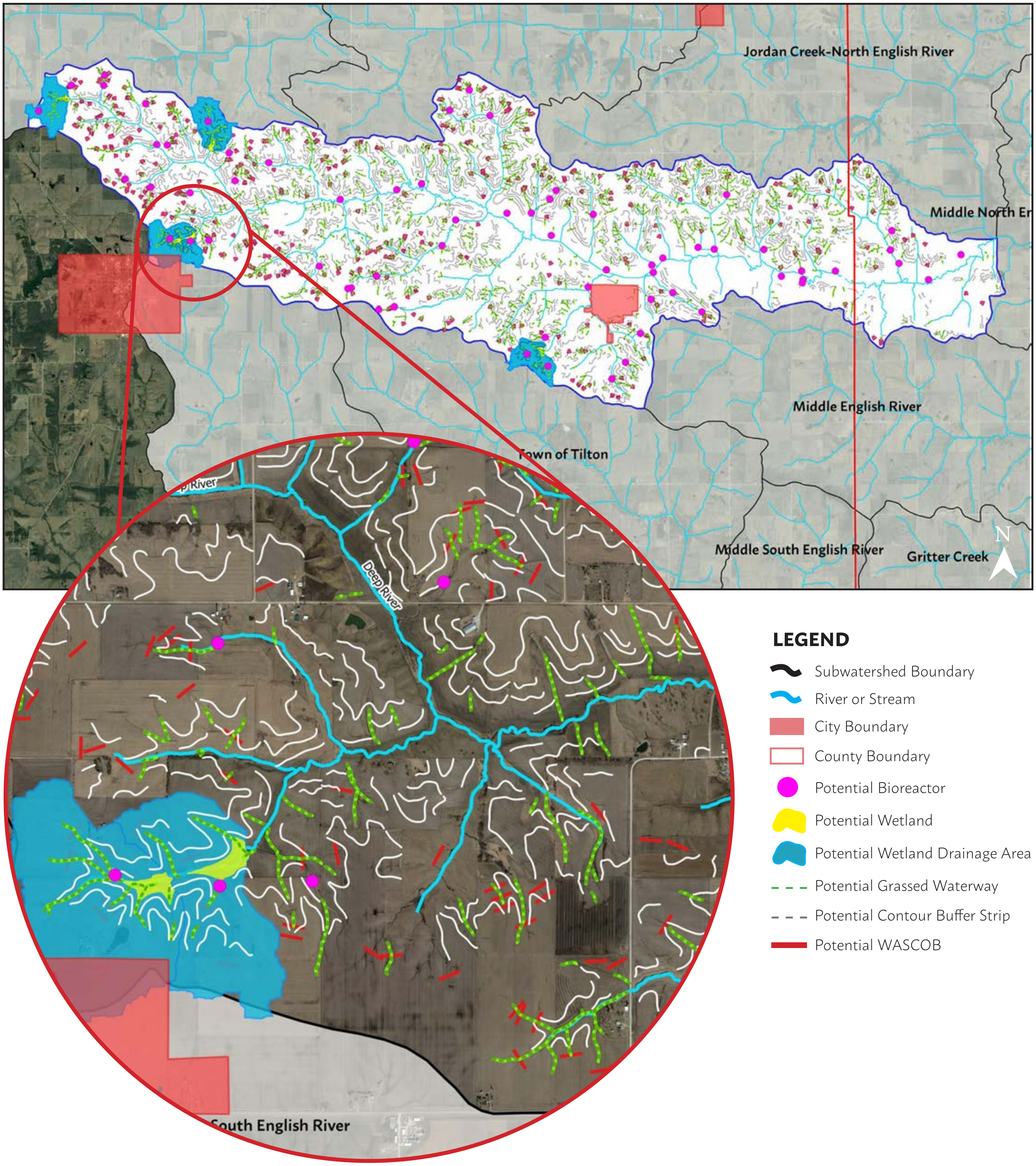

Figure 9. ACPF Model Results for the Deep River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR DEEP RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Deep River is the primary urbanized, incorporated area in the Gritter Creek subwatershed. Deep River subwatershed boundaries encompass the entirety of Guernsey. The subwatershed also covers a small area in the northeast corner of the City of Montezuma. See the Upper South English River subwatershed plan for an urban analysis of Montezuma.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Deep River subwatershed. Figure 10 represents the stormwater runoff volume for each catchment area within the city limits of Deep River where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

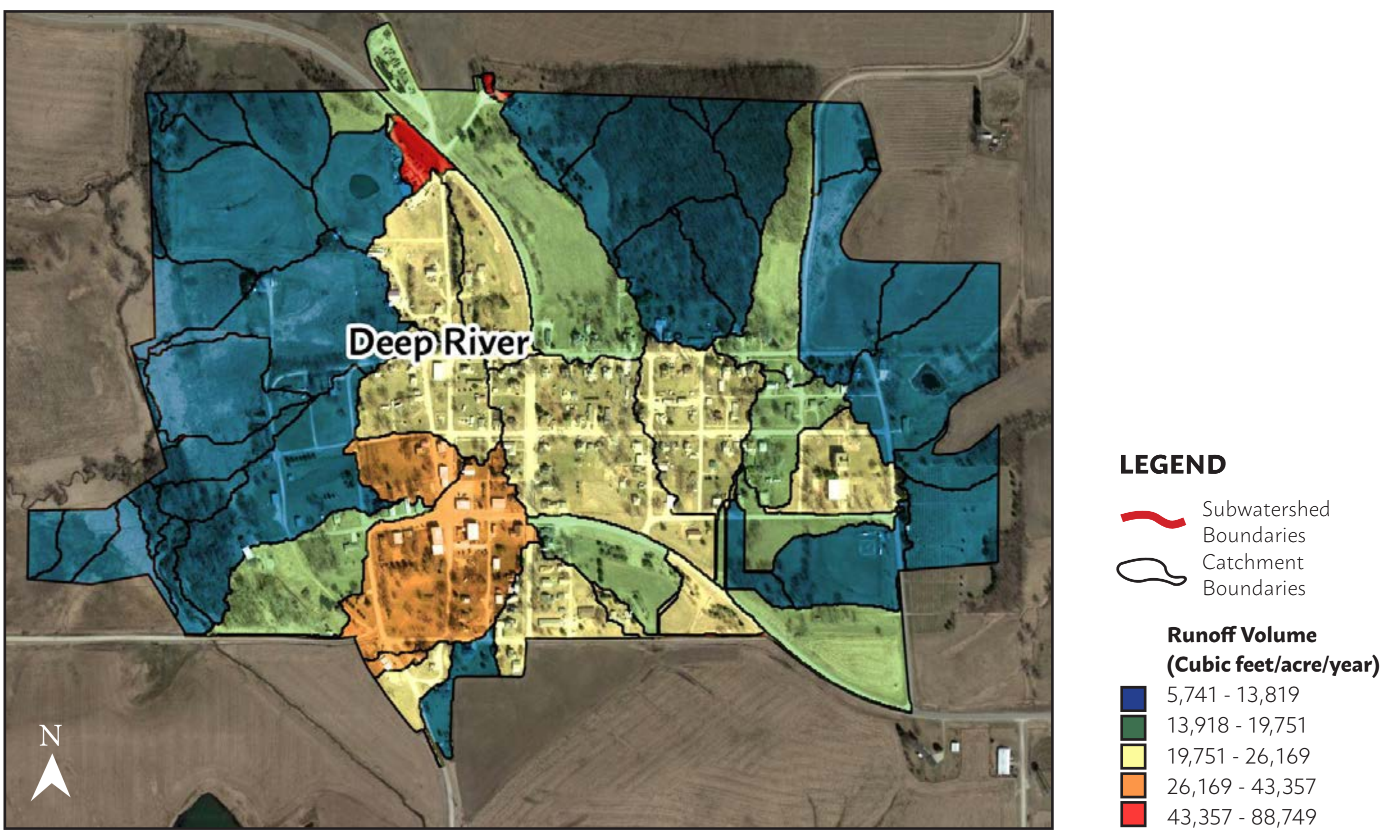

Figure 10. Modeled Runoff Volume in Deep River, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 11 displays total nitrate loads for each catchment area within the city limits of Deep River where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 12 and 13 display total phosphorus loads and total sediment loads for each catchment area within the city limits of North English where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

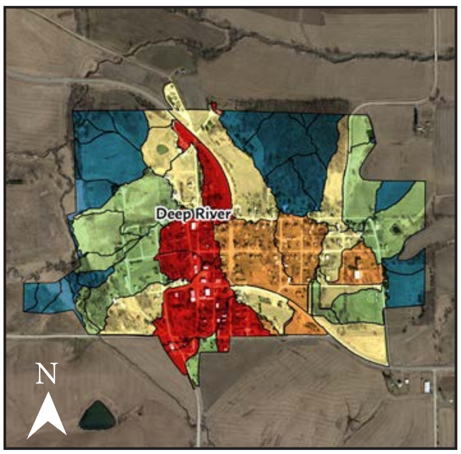

Figure 11. Modeled Nitrate Load in Deep River, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

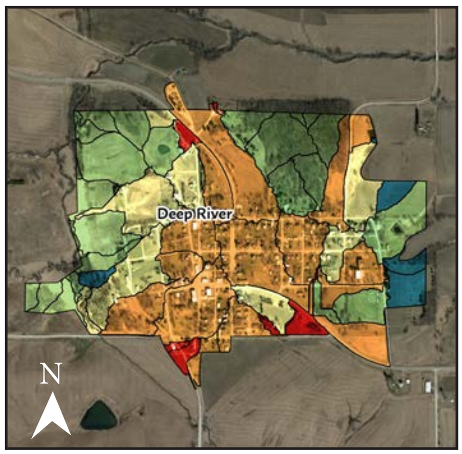

Figure 12. Modeled Phosphorus Load in Deep River, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

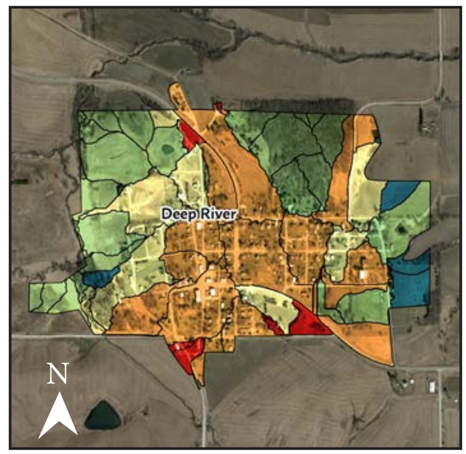

Figure 13. Modeled Sediment Load in Deep River, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW DEEP RIVER INTERACTIVE WEBMAP:
https://arcg.is/1v4D500

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Poweshiek County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2016 and expires in 2021.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Deep River subwatershed. The flood hazard area accounts for roughly 9.1 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the cities of Deep River and Montezuma, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 7 percent of Poweshiek County's area. By contrast, the English River Watershed overlaps about 45 percent of Poweshiek County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

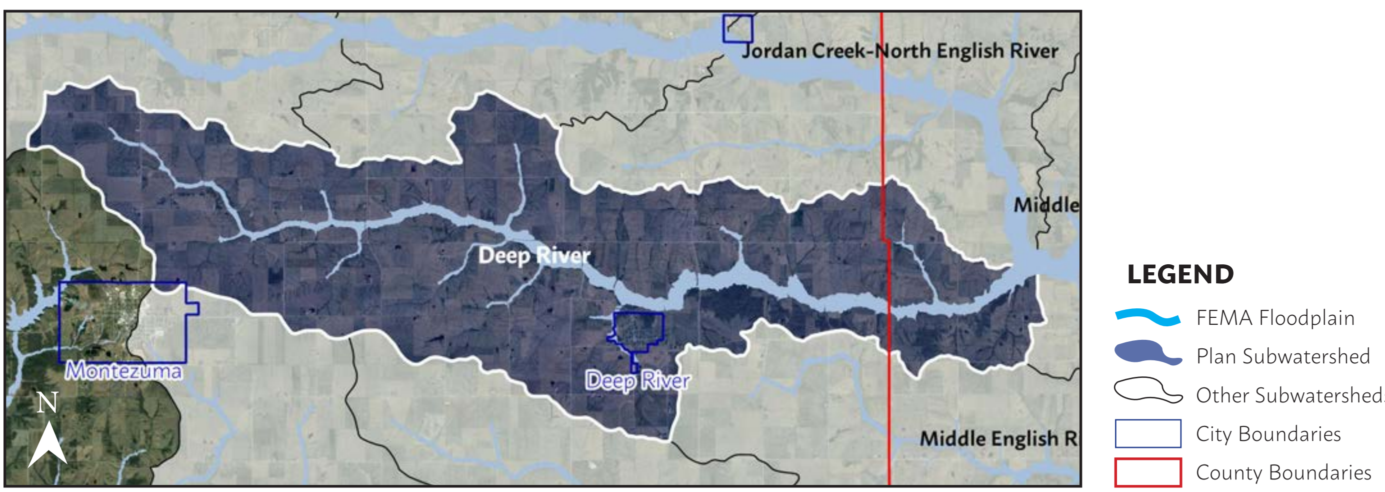

Figure 14. Flood hazard boundary areas for the Deep River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Poweshiek County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$623,826.13
Debris Removal	$133,878.41
Emergency Procedures	$40,166.52
Total	**$797,171.06**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Poweshiek County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at Deep River Monitoring Gauge
May 25 - August 13, 2008	$249,331.52	No historic data available
May 19 - June 1, 2013	$352,811.41	81.53' (6th Highest)
June 26 - July 8, 2014	$195,728.13	81.94' (7th Highest)
Total	**$797,171.06**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 13 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

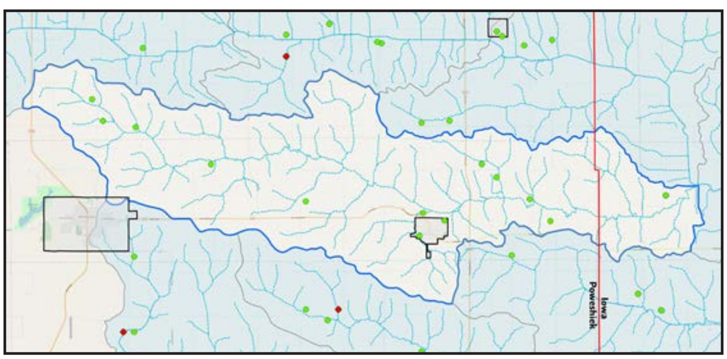

Figure 15. Vulnerable structures for flood hazards in the Deep River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW DEEP RIVER NFIP FLOOD MAP:
http://arcg.is/bDLq8

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	Yes
Poweshiek County	**Yes**
Barnes City	No
Deep River	**No**
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	**Poweshiek**	**Montezuma, Guernsey, Deep River**	**0.44**	**1 % Black or African American**	**12 % Poverty**	**5 % Unemployed**
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 18) supplement recommendations stated in Poweshiek County's Hazard Mitigation Plan. The following recommendations for the Deep River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

For all four water quality contaminants tested in 2017 and 2018, the subwatershed ranks low for each contaminant. However, on average, concentrations of E.Coli bacteria and total phosphorus still exceeded relevant water quality standards in both years. Soil detachment (amount of soil that is disturbed on the hillslopes) during the 2013 flood event period was the second highest in the Deep River subwatershed. Soil detachment and water quality issues can be improved through WASCOBs and contour buffer strips, both of which present high potential for implementation. There are also 13 structures in the subwatershed (third most among subwatersheds) vulnerable to financial losses from the 0.2 percent annual chance flood event. Several of these structures are within Deep River city limits, which should consider participation in the NFIP program. The subwatershed also ranks second highest for social vulnerability, which is a factor of unemployment and poverty rates.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Deep River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Deep River in the Deep River	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Deep River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Poweshiek/Iowa SWCD, NRCS	Poweshiek/ Iowa County, Deep River	Medium/ High
	1.3	Flood protection for population safety in Deep River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	City of Deep River, ERW	City of Deep River	Low
2	2.2	Acquire property at risk of flooding near Deep River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in Deep River	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Deep River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Poweshiek /Iowa SWCD, NRCS, ERW	City of Deep River	Medium/ High
	3.2	Improve water quality in rural areas in Deep River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319,	Poweshiek/Iowa SWCD, NRCS, ERW	Poweshiek / Iowa County	High
4	4.1	Provide flood protection for roads in Deep River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Poweshiek/Iowa SWCD, NRCS	Poweshiek / Iowa County, Deep River	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

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2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS
JORDAN CREEK

HUC-12: 070802090404

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Jordan Creek subwatershed is located in the north central region of the ERW. It overlaps two counties (Poweshiek and Iowa). The City of Guernsey (population 63) is the only incorporated area that overlaps the subwatershed. The Jordan Creek subwatershed primarily consists of Denovian and Mississippian soils and, in comparison to the entire ERW, features average depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 47-50.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 19,540 acres (30.5 square miles) of land, which is predominately row crops (corn and soybeans). The North English River stretches approximately 9.13 miles through the subwatershed in northwest to southeast direction, and eventually meets Deep River about 5 miles east of the City of Deep River.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is sediment and phosphorus contamination. Additionally, the Deep River subwatershed ranked high in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

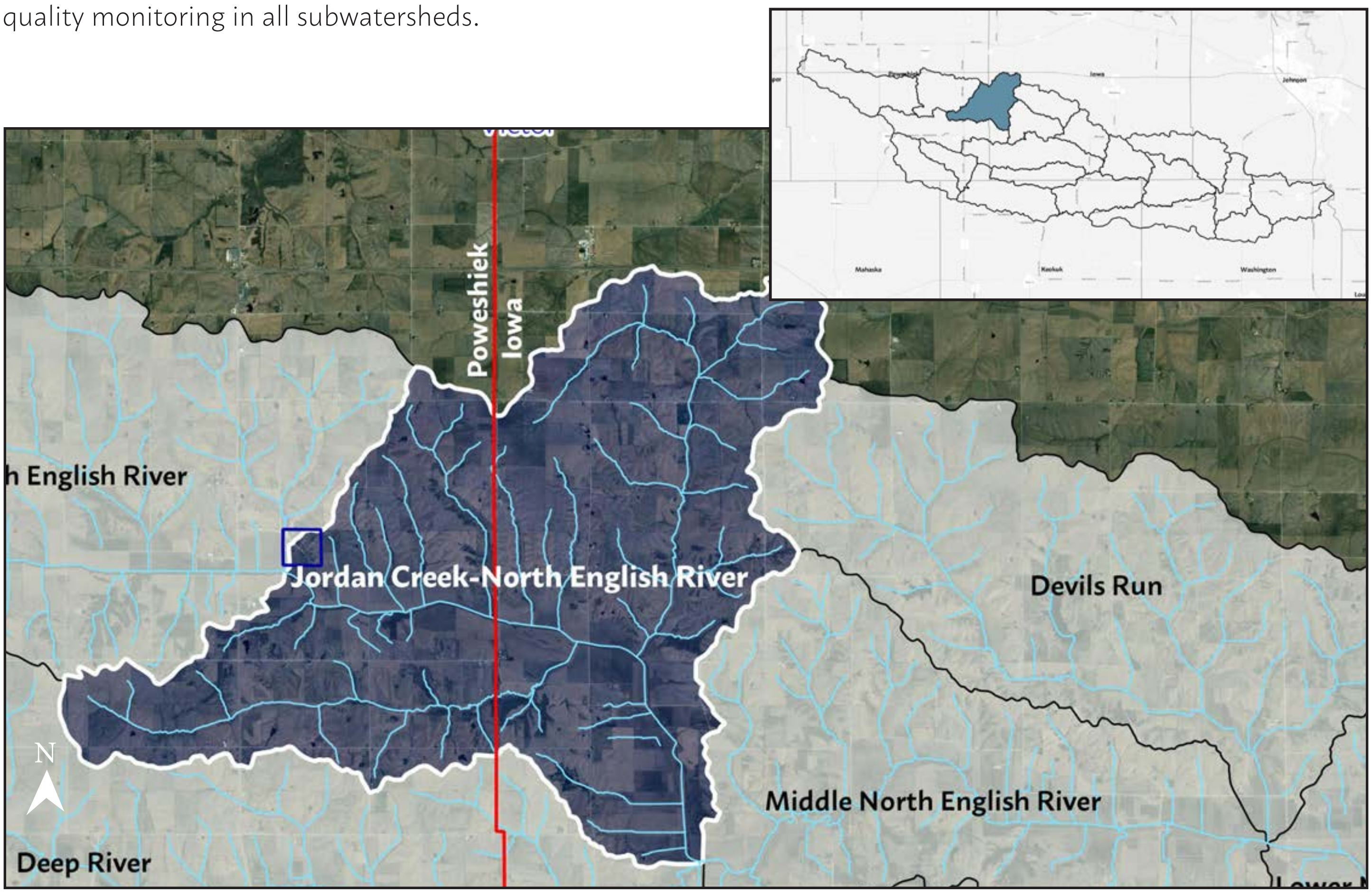

Figure 1. Jordan Creek Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

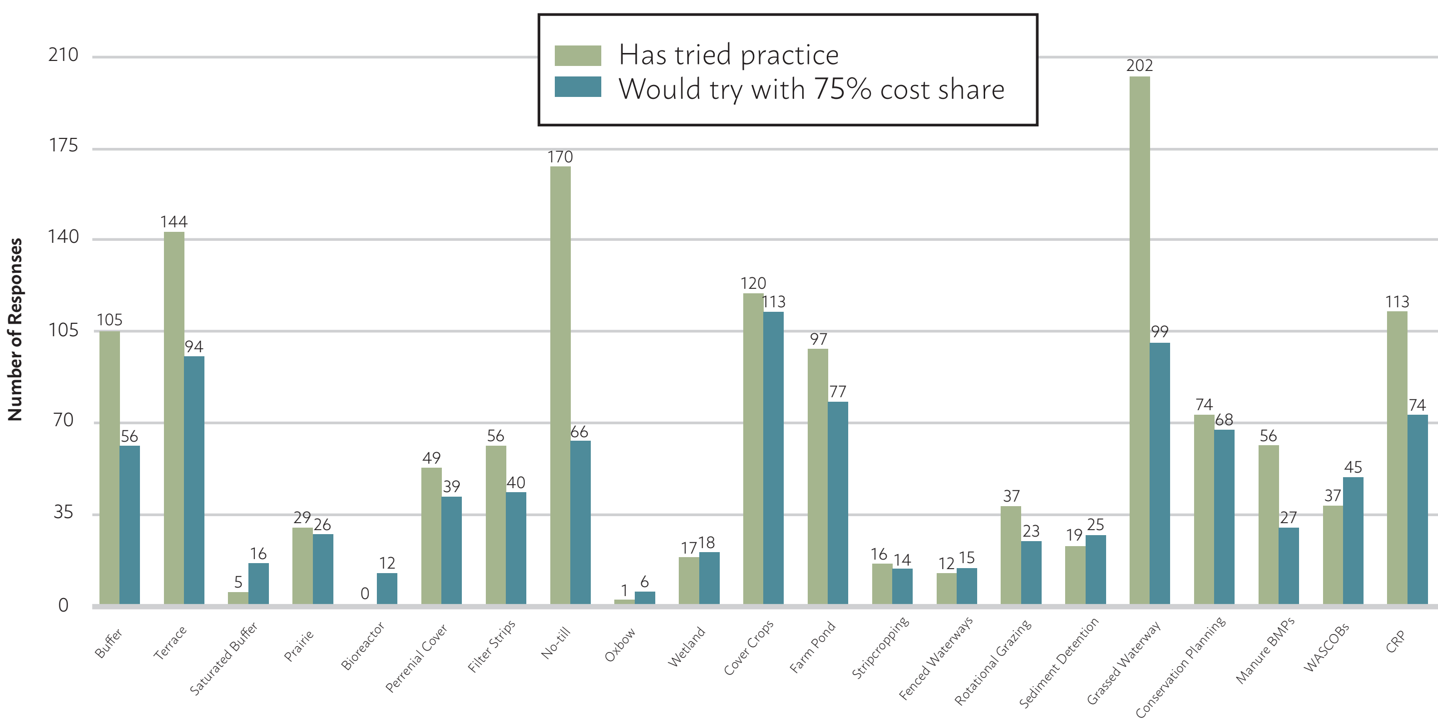

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

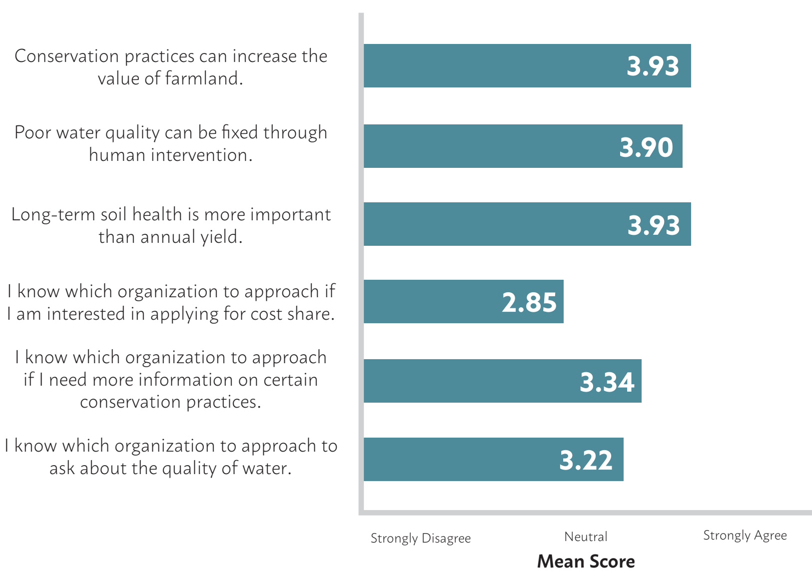

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 15 is near the outlet of the Jordan Creek subwatershed, and drains into the North English River. The site is located on the 265th Street bridge in Iowa County, about 8 miles SE of the city of Guernsey. (Figure 4)

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

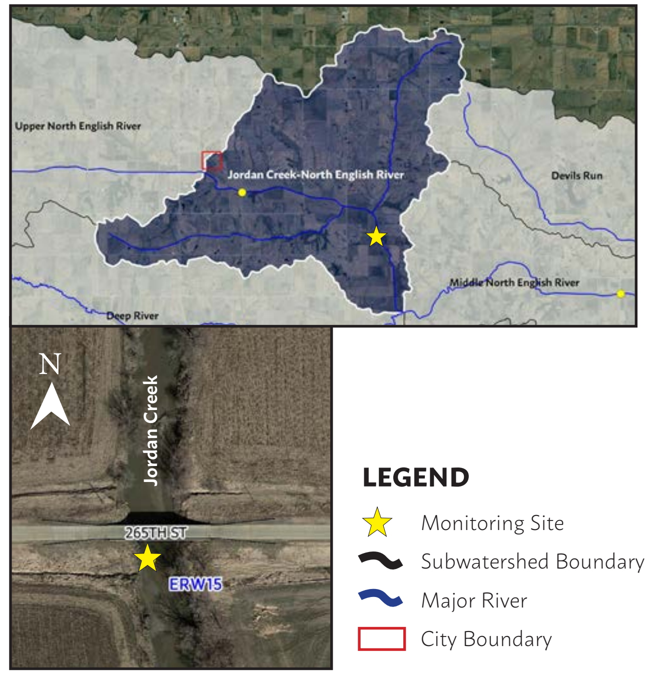

Figure 4. Water quality monitoring location for the Jordan Creek subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 15 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 15 ranked 14th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 15 ranked 17th. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 15 ranked 13th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 15 ranked 5th.

In 2017, Site 15 ranked 18th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 15 ranked 8th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 15 ranked 9th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 15 ranked 5th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 15 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	350	750	543
2018	20	1,200	687

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 15 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.07	0.03
2018	0.06	0.09	0.08

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 15 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.11	0.14	0.13
2018	0.09	0.44	0.24

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 15 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.8	9.9	3.4
2018	3.2	12.0	7.0

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

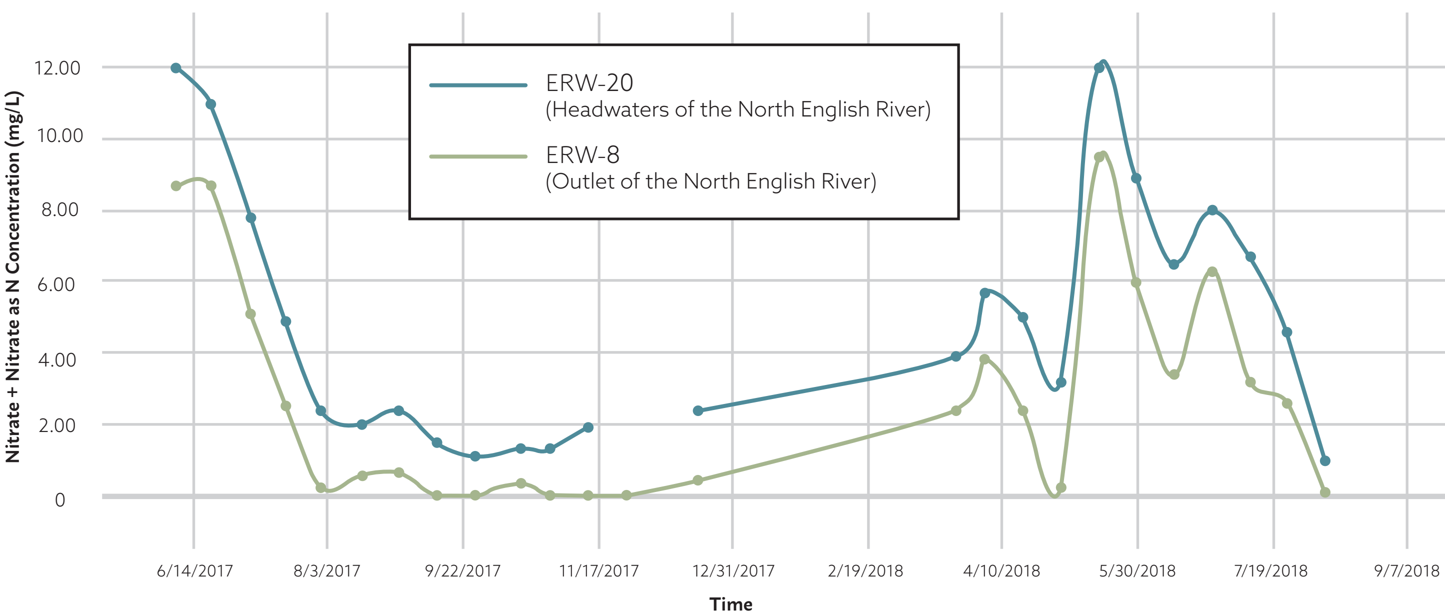

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Jordan Creek subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 8 times the total erosion (112.74 mm) than Jordan Creek's average monthly erosion of 13.42 mm (0.49 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Jordan Creek's HUC is "070802090404"; see 404 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	**404**	402	302	401	501	403	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	**13.42**	13.28	13.05	13.02	12.89	12.76	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	**81.97**	80.54	83.21	79.25	82.04	81.65	82.23	83.68	82.65	83.17	84.61	82.92	82.29

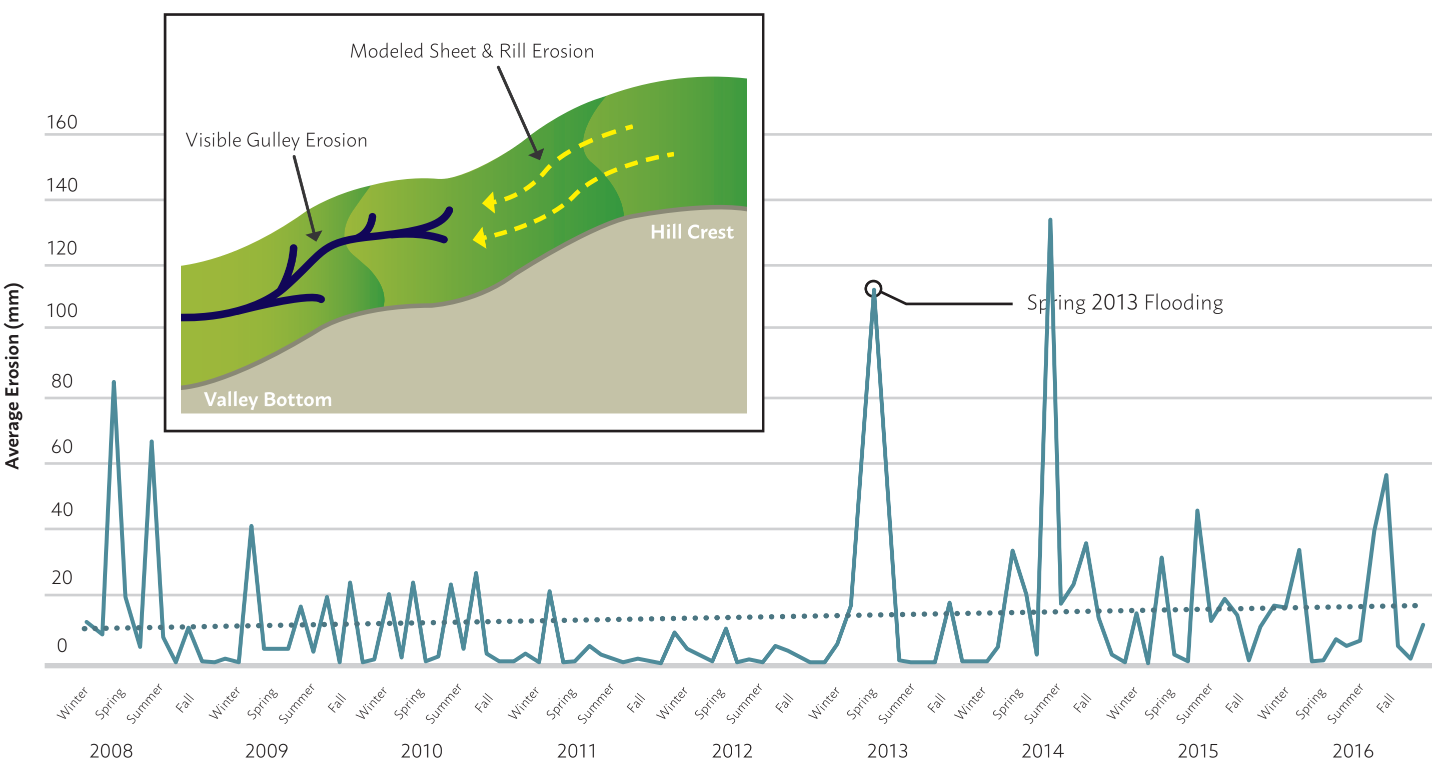

Figure 6. Soil Erosion in the Jordan Creek subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Jordan Creek subwatershed ranks among the highest of all subwatersheds for soil delivery at 8.22 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Jordan Creek subwatershed is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. Jordan Creek experienced an average of 5.17 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Jordan Creek subwatershed.

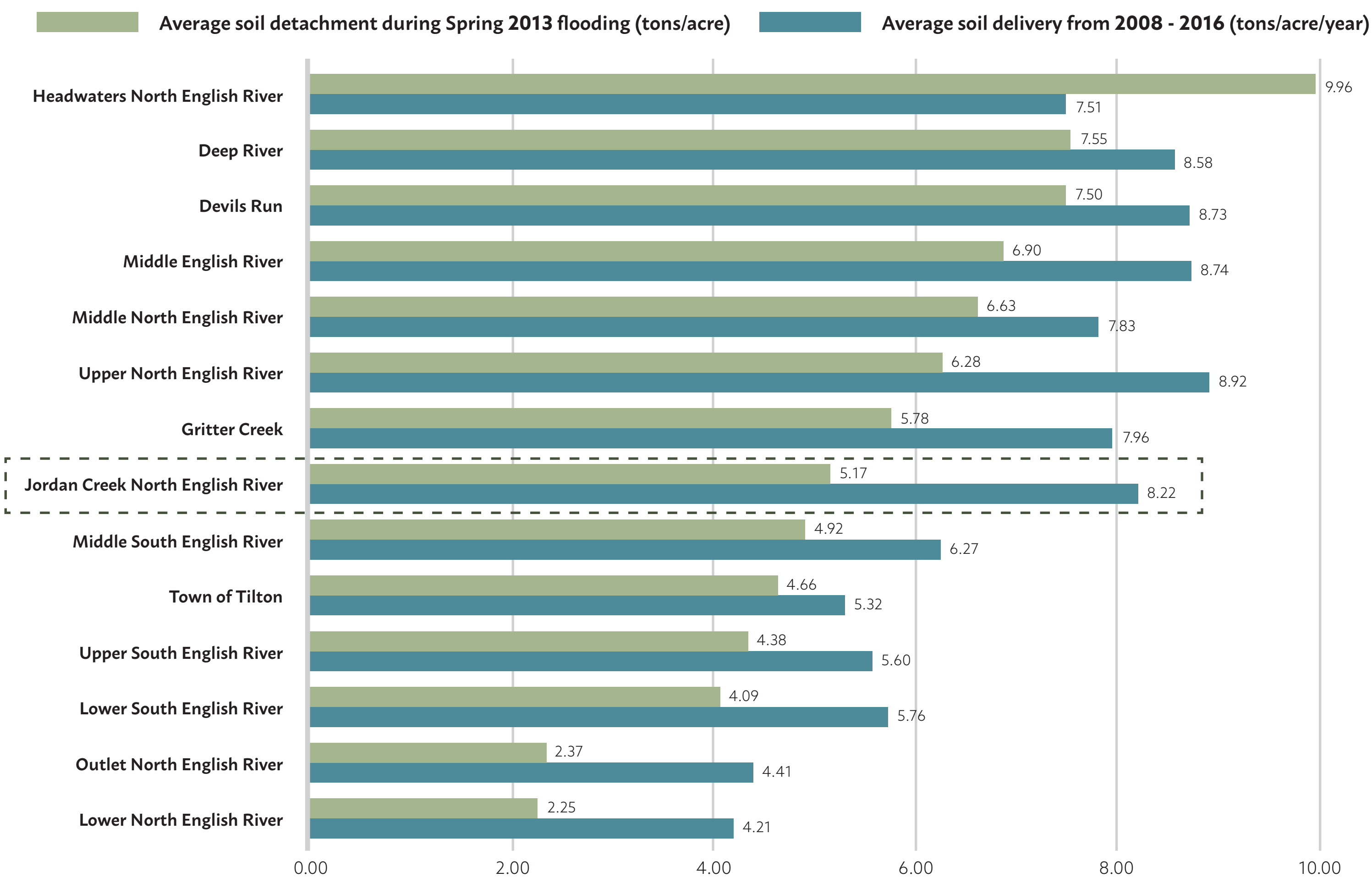

Figure 7. Soil Delivery and Detachment in the Jordan Creek subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR JORDAN CREEK:
https://bit.ly/2IyNVOa

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Jordan Creek subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

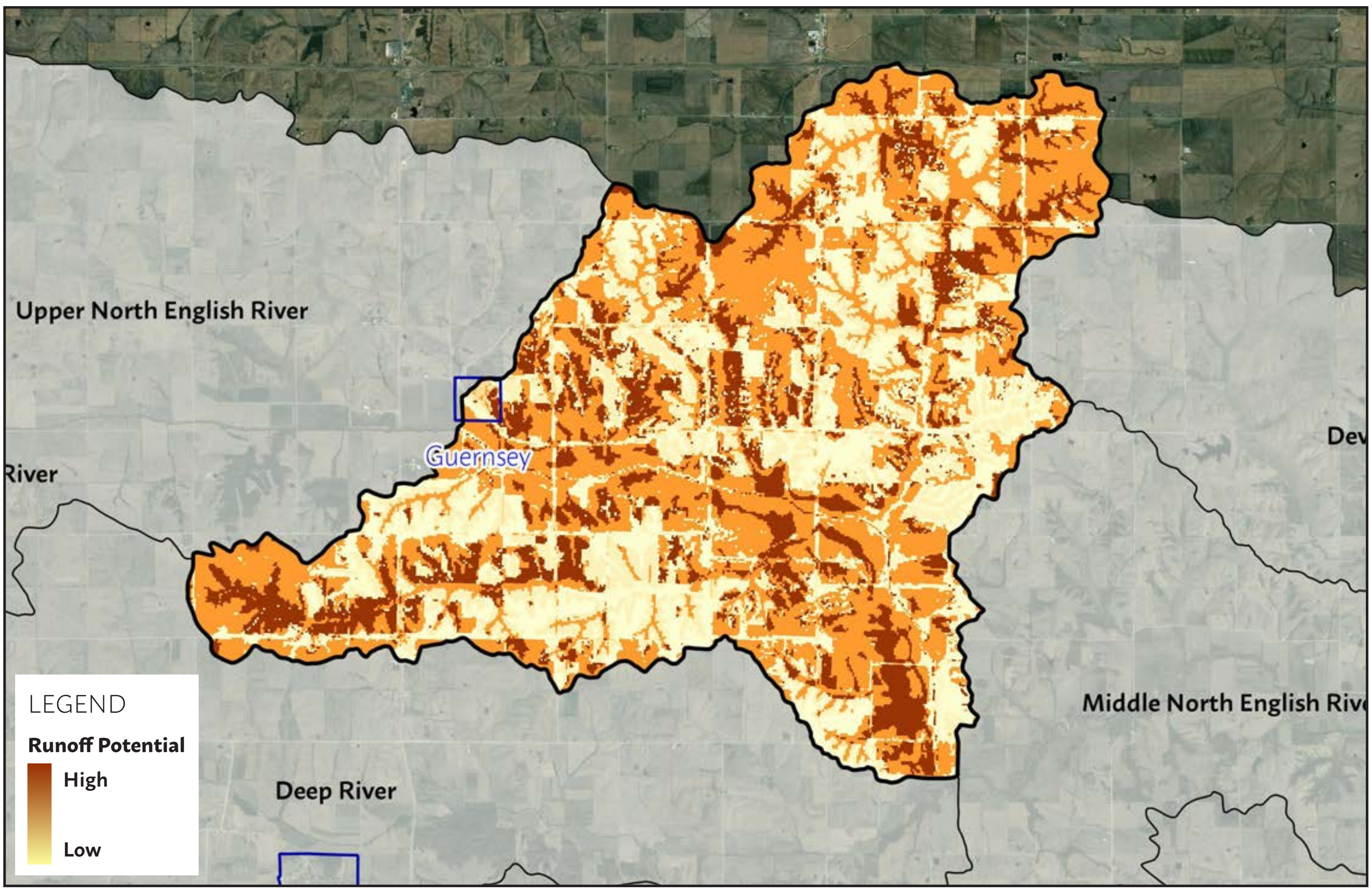

Figure 8. SCS-CN Runoff Potential Model for the Jordan Creek Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR JORDAN CREEK:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 328.89 miles of contour buffer strips, 36 bioreactors, 195 WASCOBs, 5 nutrient-removal wetlands, a total of 903.01 acres of drainage area for the wetlands, and 137.75 miles of grassed waterways in the Jordan Creek subwatershed (Table 11). If all 5 wetlands were installed in the subwatershed, roughly 4.6 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	**19,540**	**328.89**	**36**	**195**	**5**	**903.01**	**4.6 %**	**137.75**
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

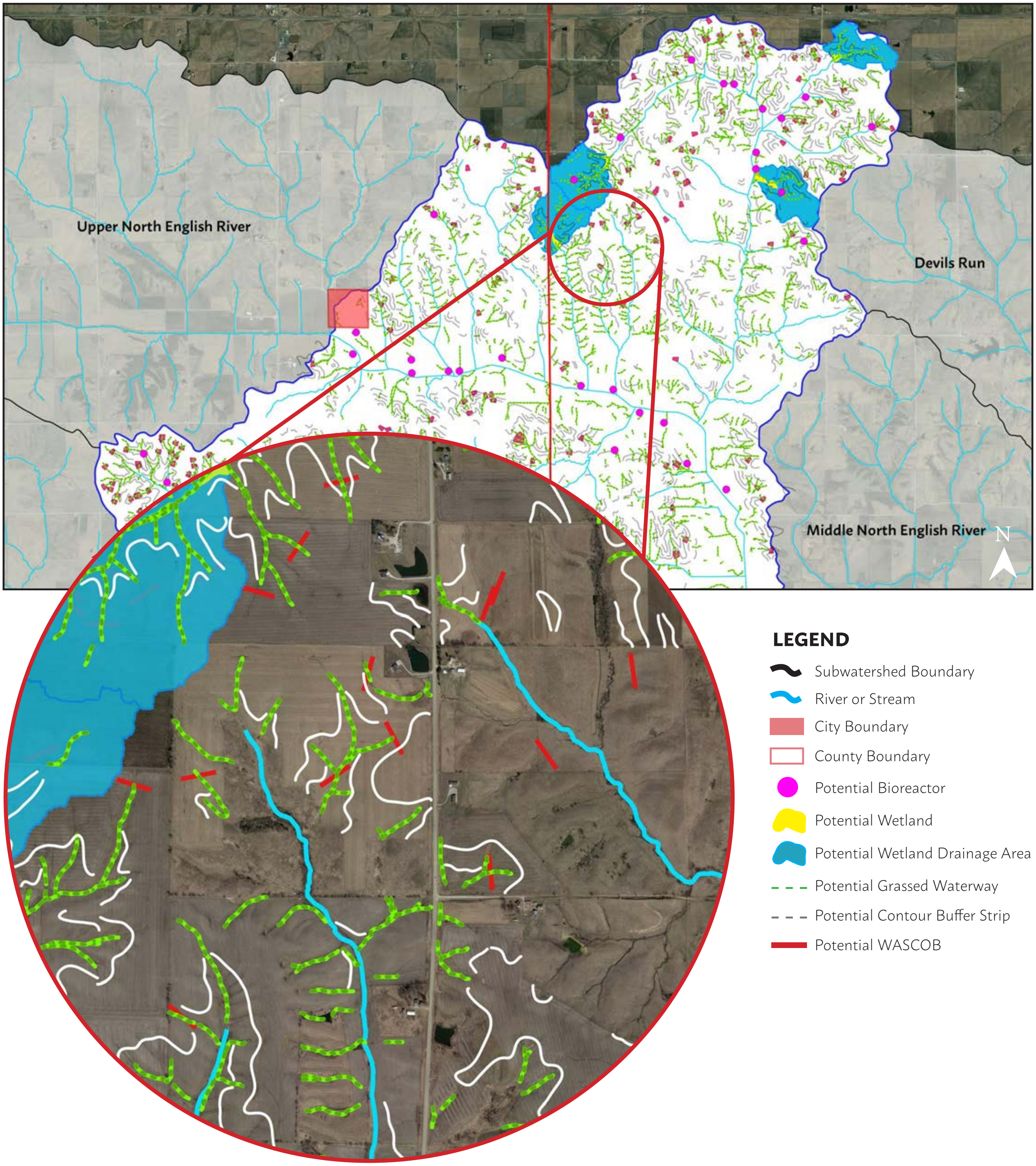

Figure 9. ACPF Model Results for the Jordan Creek Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR JORDAN CREEK:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Guernsey is the only urbanized, incorporated area in the Upper North English River subwatershed. English River Watershed boundaries encompass the entirety of Guernsey. However, the Upper North English River subwatershed only spans a portion of northwest Guernsey, which is primarily residential land uses. The majority of urbanized area lies in the Lower South English River subwatershed.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Upper North English River subwatershed. Figure 10 represents the stormwater runoff volume for each catchment area within the city limits of Guernsey where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

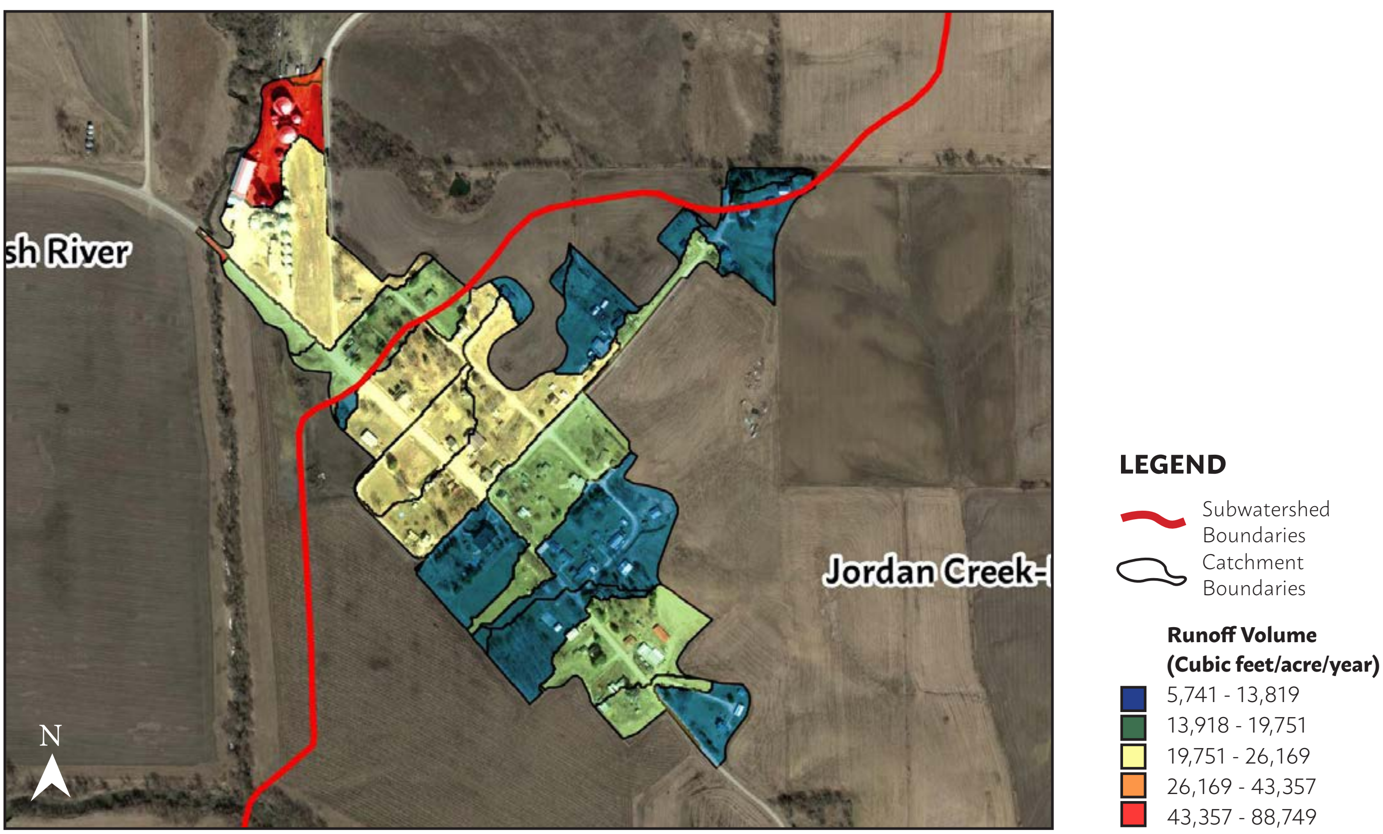

Figure 10. Modeled Runoff Volume in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 11 displays total nitrate loads for each catchment area within the city limits of Guernsey where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 12 and 13 display total phosphorus loads and total sediment loads for each catchment area within the city limits of Guernsey where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

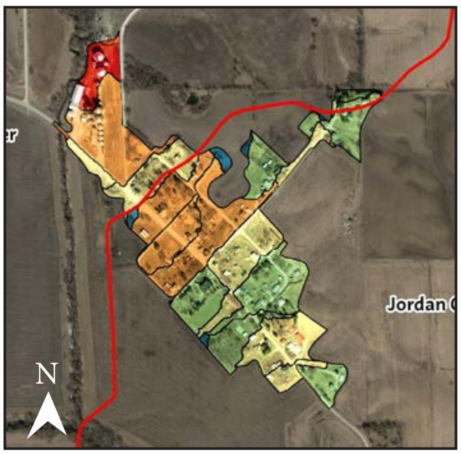

Figure 11. Modeled Nitrate Load in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

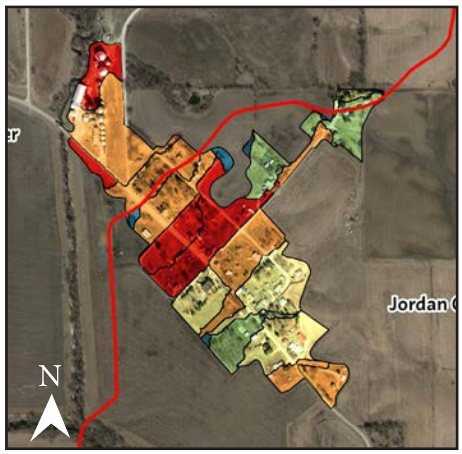

Figure 12. Modeled Phosphorus Load in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

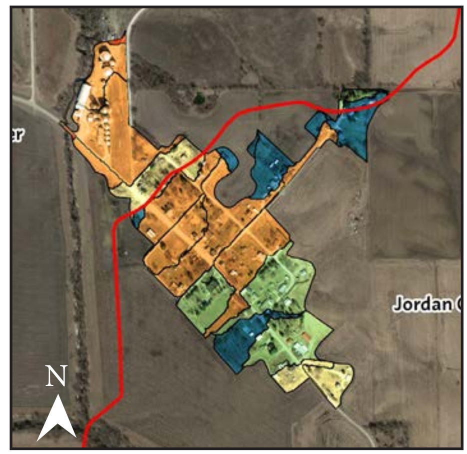

Figure 13. Modeled Sediment Load in Guernsey, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW GUERNSEY INTERACTIVE WEBMAP:
https://arcg.is/0rea45

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Jordan Creek subwatershed. The flood hazard area accounts for roughly 10.4 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the city of Guernsey, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 5.2 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

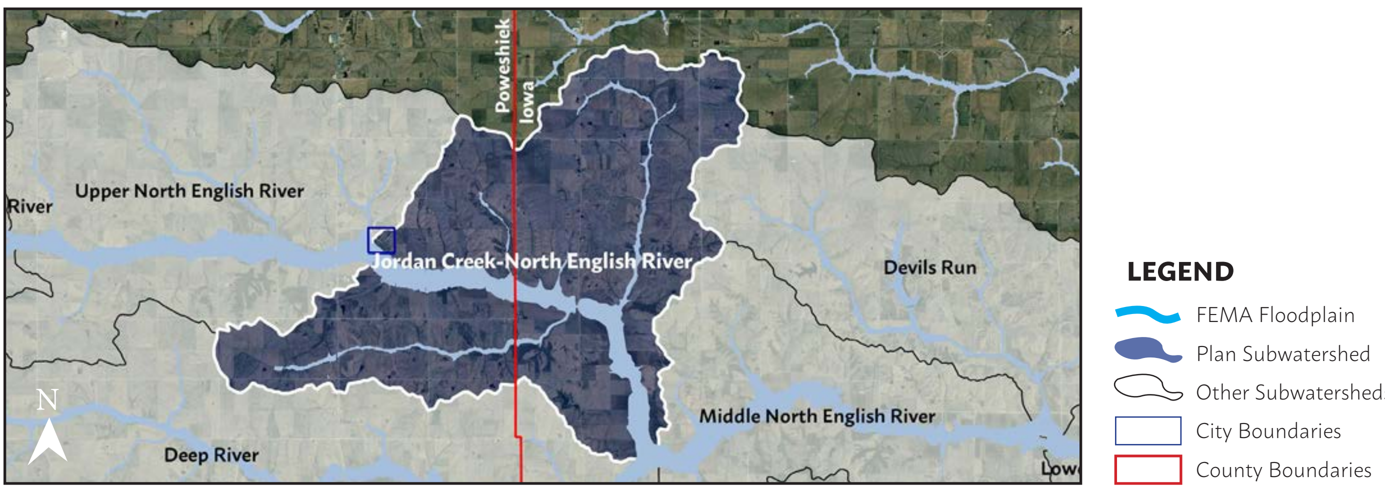

Figure 14. Flood hazard boundary areas for the Jordan Creek Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 7 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

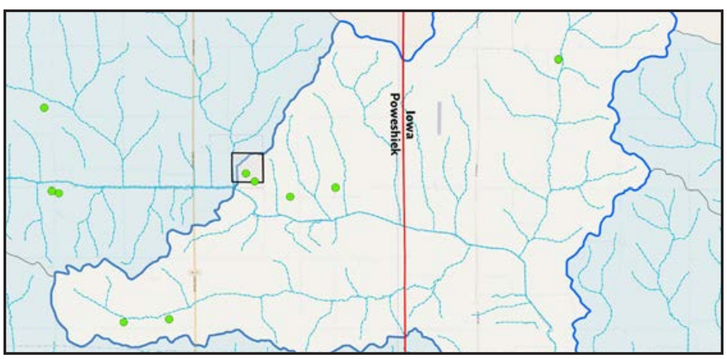

Figure 15. Vulnerable structures for flood hazards in the Jordan Creek Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW GUERNSEY NFIP FLOOD MAP:
http://arcg.is/0yjK0L

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	**Yes**
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	**Yes**
Poweshiek County	**Yes**
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	**Poweshiek**	**Montezuma, Guernsey, Deep River**	**0.44**	**1 % Black or African American**	**12 % Poverty**	**5 % Unemployed**
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	**Iowa**	**North English, Millersburg**	**0.401**	**27 % Children**	**11 % Poverty**	**0.5 % Black or African American**
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Jordan Creek subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

Nitrates and nitrites are the primary water quality concerns in the subwatershed, in comparison to other subwatersheds. The average rate of soil erosion in the Jordan Creek subwatershed is also ranked second of the fourteen areas. According to the ACPF analysis (Section 5), there exists a wide range of potential BMPs suitable for addressing high nitrate and soil erosion rates in rural areas. Several structures within the city limits of Guernsey or in rural areas nearby are prone to financial losses from flood events. Targeted areas for BMPs designed for flood mitigation can be found in Section 6. The City of Guernsey should continue its participation in the NFIP program and consider joining the Community Rating System (CRS), which is a program designed to further educate residents about flood risks. The program can also lower flood insurance rates dependent on the extent of CRS participation.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Jordan Creek subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Jordan Creek in the City of Guernsey	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Jordan Creek subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Iowa/ Poweshiek SWCD, NRCS	Iowa/ Poweshiek Counties, Guernsey	Medium/ High
	1.3	Flood protection for population safety in Jordan Creek subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	City of Guern-sey, ERW	City of Guernsey	Low
2	2.2	Acquire property at risk of flooding near Jodran Creek; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in Guernsey	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Jordan Creek subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Iowa/Poweshiek SWCD, NRCS, ERW	City of Guernsey	Medium/ High
	3.2	Improve water quality in rural areas in Jordan Creek subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319,	Iowa/Keokuk SWCD, NRCS, ERW	Iowa/ Poweshiek Counties	High
4	4.1	Provide flood protection for roads and in Jordan Creek subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Iowa/ Poweshiek SWCD, NRCS	Iowa/ Poweshiek Counties, Guernsey	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework	**ISWMM**	Iowa Stormwater Management Manual
BMP	Best Management Practice	**IWA**	Iowa Watershed Approach
DEP	Daily Erosion Project	**NFIP**	National Flood Insurance Program
EPA	Environmental Protection Agency	**NRCS**	Natural Resource Conservation Service
ERW	English River Watershed	**NRS**	Nutrient Reduction Strategy
FEMA	Federal Emergency Management Agency	**SCS-CN**	Soil Conservation Service - Curve Number
HSEM	Homeland Security & Emergency Management	**SWCD**	Soil & Water Conservation District
HUC	Hydrologic Unit Code	**WMA**	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

DEVIL'S RUN

HUC-12: 070802090405

TABLE OF CONTENTS

Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Devil's Run subwatershed is located in the north central region of the ERW. It overlaps one county (Iowa). There are no incorporated areas that overlap the subwatershed. The Devil's Run subwatershed primarily consists of Denovian soils and, in comparison to the entire ERW, features moderately deep depth to bedrock. The mean Corn Suitability Rating (CSR) for the subwatershed is between 37-40, which is the lowest CSR in the ERW.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 13,007 acres (20.3 square miles) of land, which is predominately row crops (corn and soybeans). The Devil's Run river stretches approximately 9.96 miles through the subwatershed in northwest to southeast direction, and eventually meets the North English River about 3.25 miles northeast of the city of Millersburg.

It was determined in Phase 1 planning that the Devil's Run subwatershed ranks low for sediment, phosphorus, and nitrate contamination. Additionally, the Devil's Run subwatershed ranked low in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

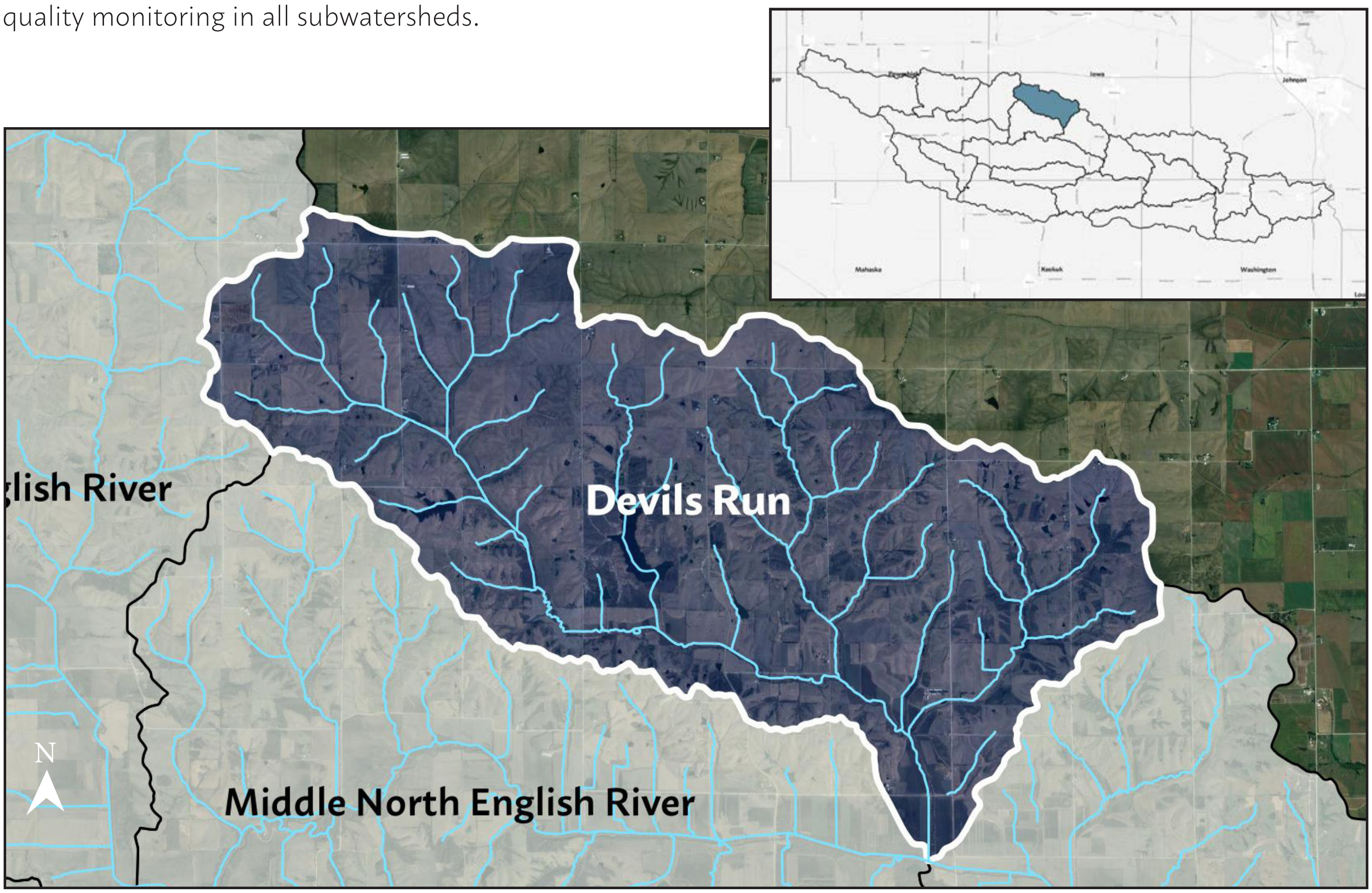

Figure 1. Devil's Run Creek Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

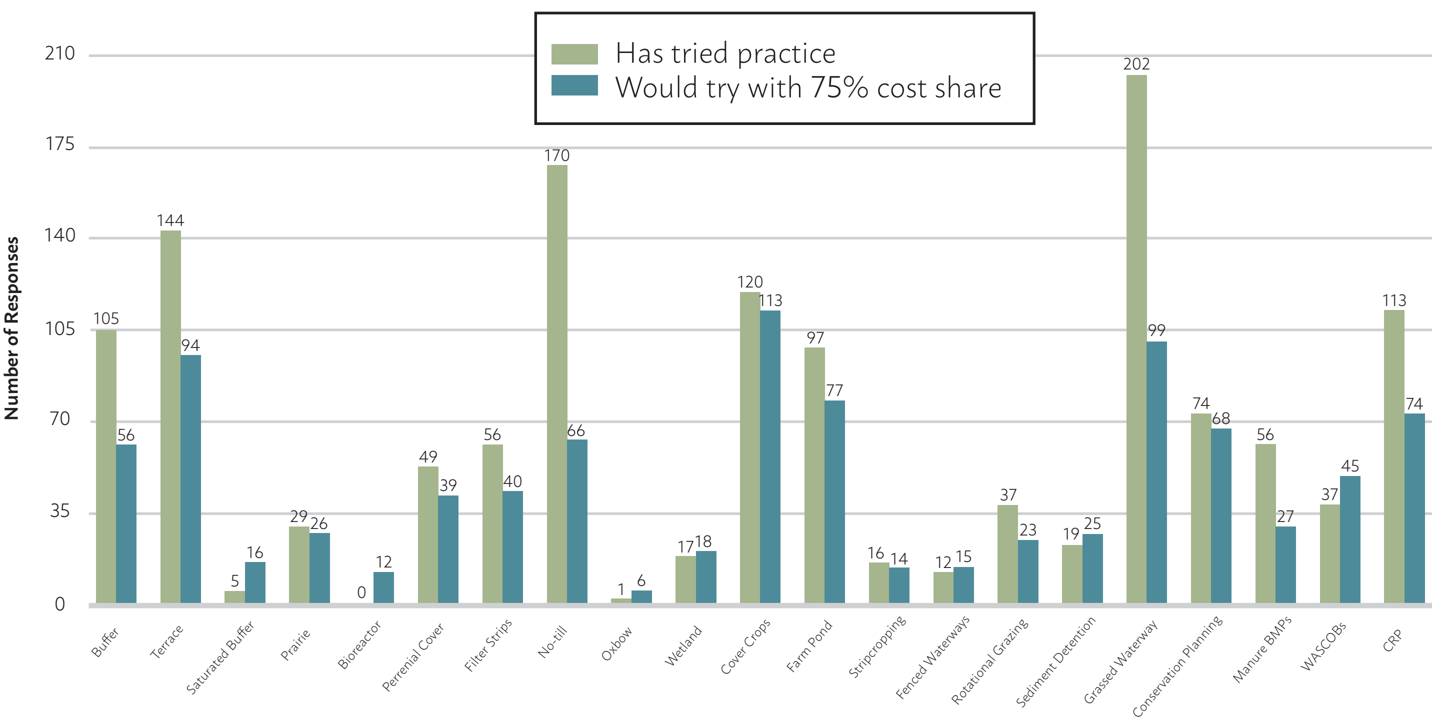

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

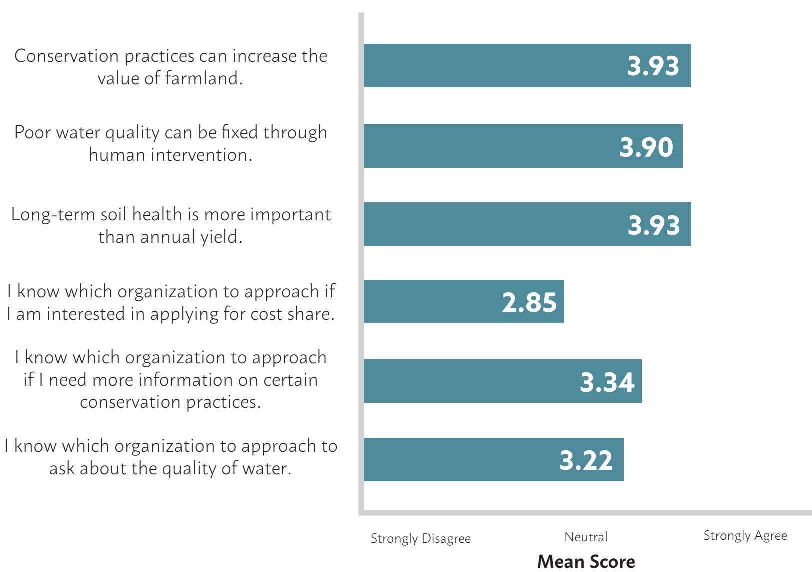

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 13 is the outlet of the Devil's Run subwatershed, located on 275th Street in Iowa County, a little NE of the City of Parnell (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

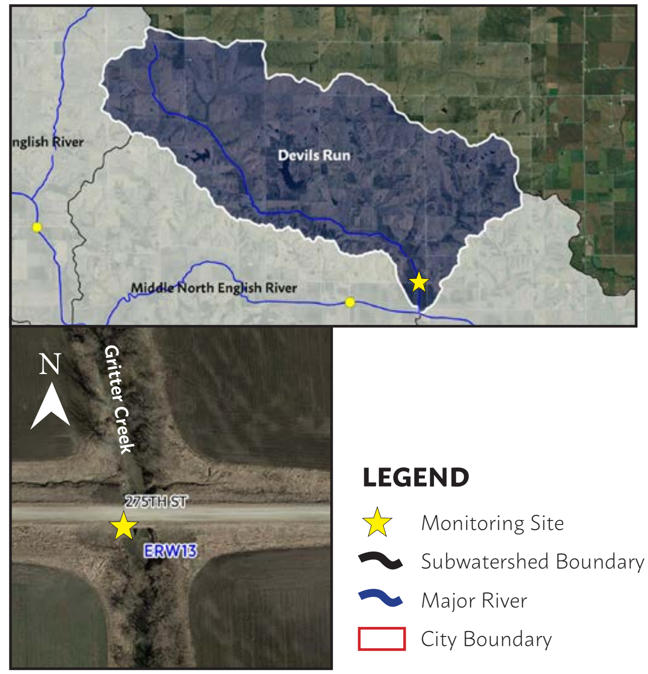

Figure 4. Water quality monitoring location for the Devil's Run subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 13 was sampled 2 times for Nitrate+Nitrite as N, 2 times for E. coli Bacteria, 1 time for ortho-Phosphate as P, and 2 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 13 ranked 16th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 13 ranked 18th. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 13 ranked 16th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 13 also ranked 16th.

In 2017, Site 13 ranked 20th (lowest) of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 13 ranked 16th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 13 ranked 20th (lowest) of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 13 ranked 19th (nearly the lowest). Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 13 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	380	630	473
2018	41	1,300	671

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 13 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.05	0.03
2018	0.05	0.05	0.05

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 13 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.06	0.16	0.11
2018	0.11	0.18	0.15

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 13 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.2	5.7	1.8
2018	0.7	5.2	2.9

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

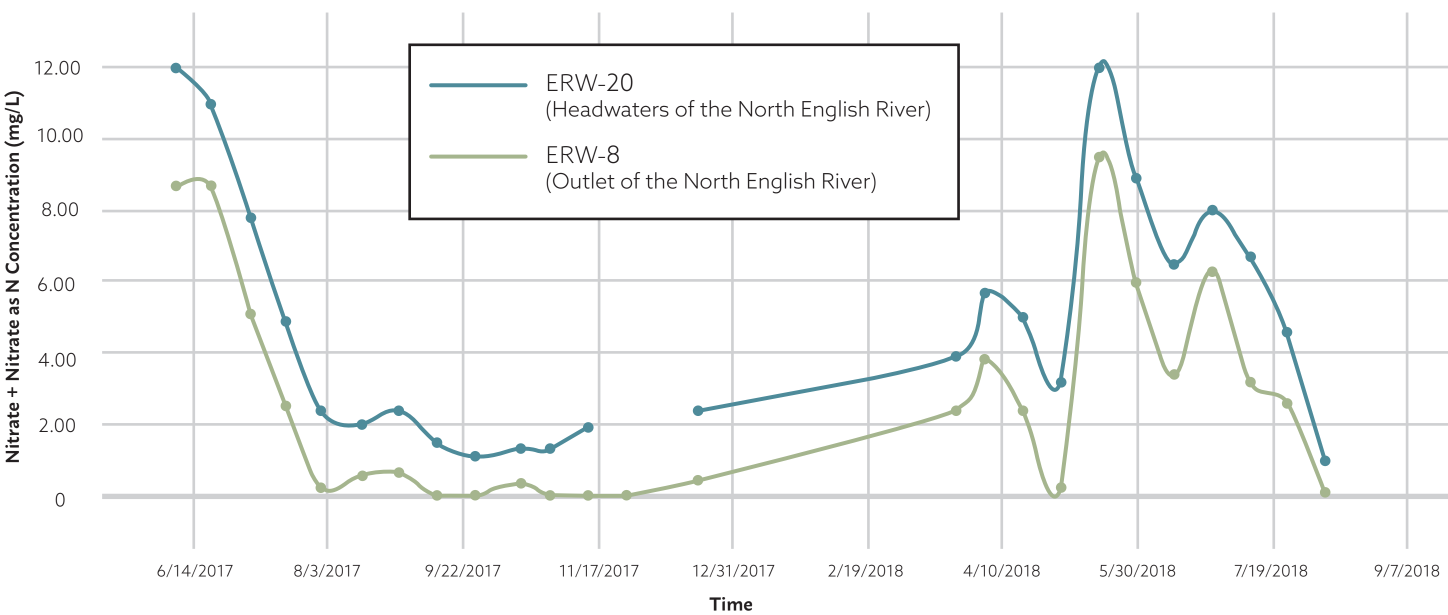

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Devil's Run subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 10 times the total erosion (136.8 mm) than Gritter Creek's average monthly erosion of 13.43mm (0.53 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Gritter Creek's HUC is "070802090405"; see 405 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	**13.43**	13.42	13.28	13.05	13.02	12.89	12.76	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	**82.68**	81.97	80.54	83.21	79.25	82.04	81.65	82.23	83.68	82.65	83.17	84.61	82.92	82.29

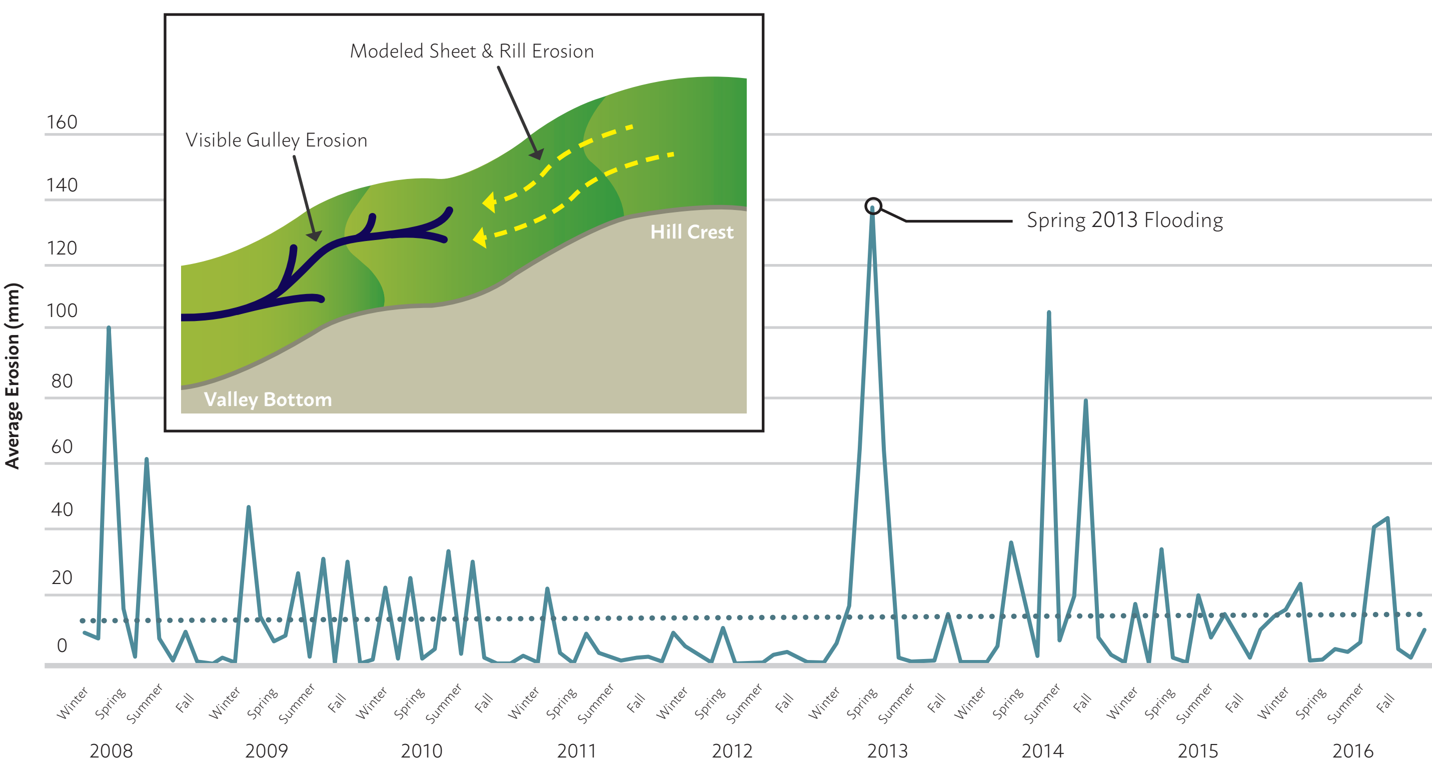

Figure 6. Soil Erosion in the Devil's Run Subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Devil's Run subwatershed experienced an average of 7.50 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 8 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Devil's Run subwatershed ranks among the highest of all subwatersheds for soil delivery at 8.73 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Devil's Run is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Devil's Run subwatershed.

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

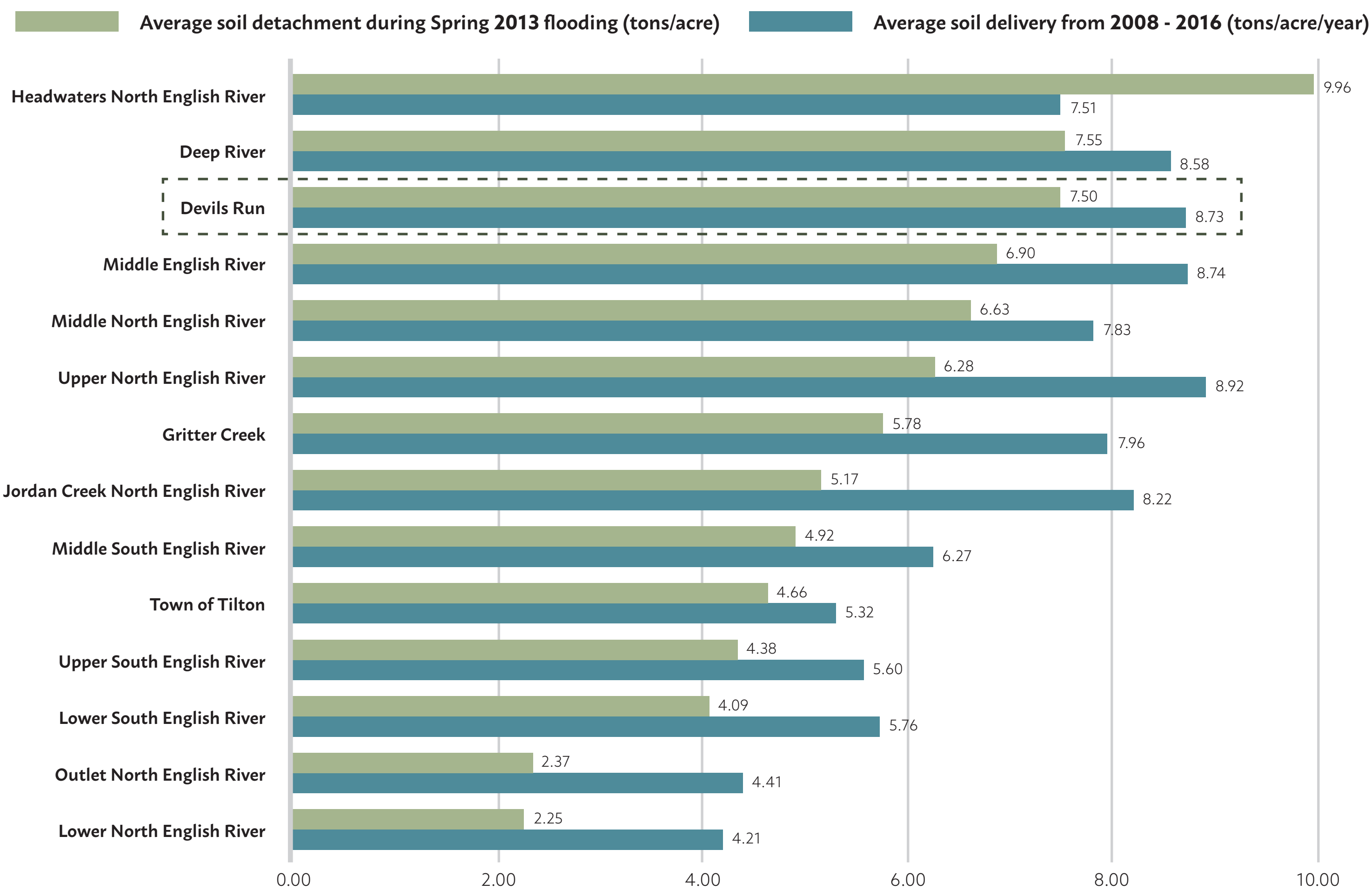

Figure 7. Soil Delivery and Detachment in the Devil's Run subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR DEVIL'S RUN:
https://bit.ly/2lxHGdv

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Devil's Run subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

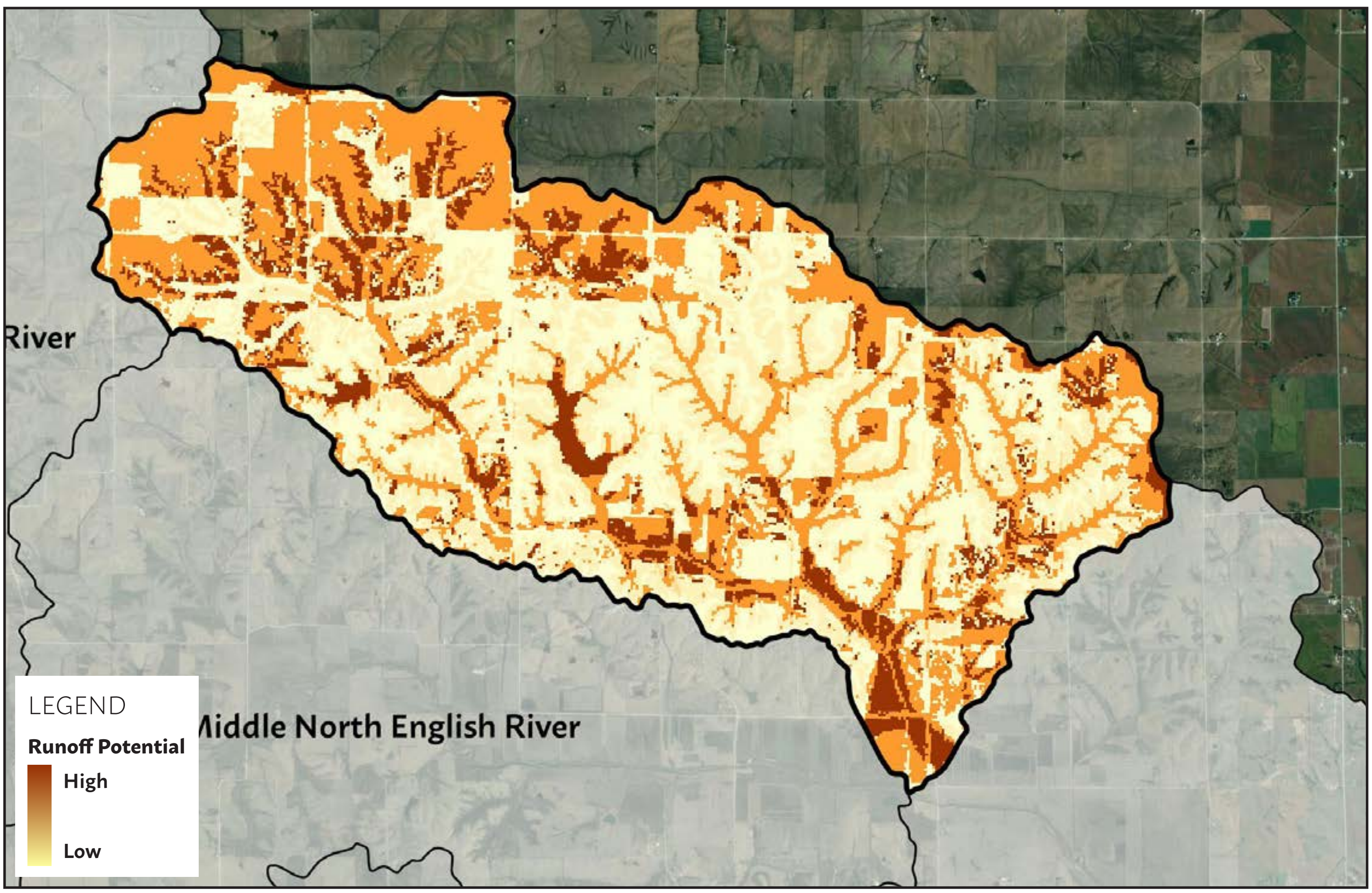

Figure 8. SCS-CN Runoff Potential Model for the Devil's Run Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR DEVIL'S RUN:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 155.69 miles of contour buffer strips, 8 bioreactors, 113 WASCOBs, 1 nutrient-removal wetlands, a total of 226.90 acres of drainage area for the wetlands, and 57.89 miles of grassed waterways in the Devil's Run subwatershed (Table 11). If the wetland was installed in the subwatershed, roughly 1.7 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	**13,007**	**155.69**	**8**	**113**	**1**	**226.90**	**1.7 %**	**57.89**
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

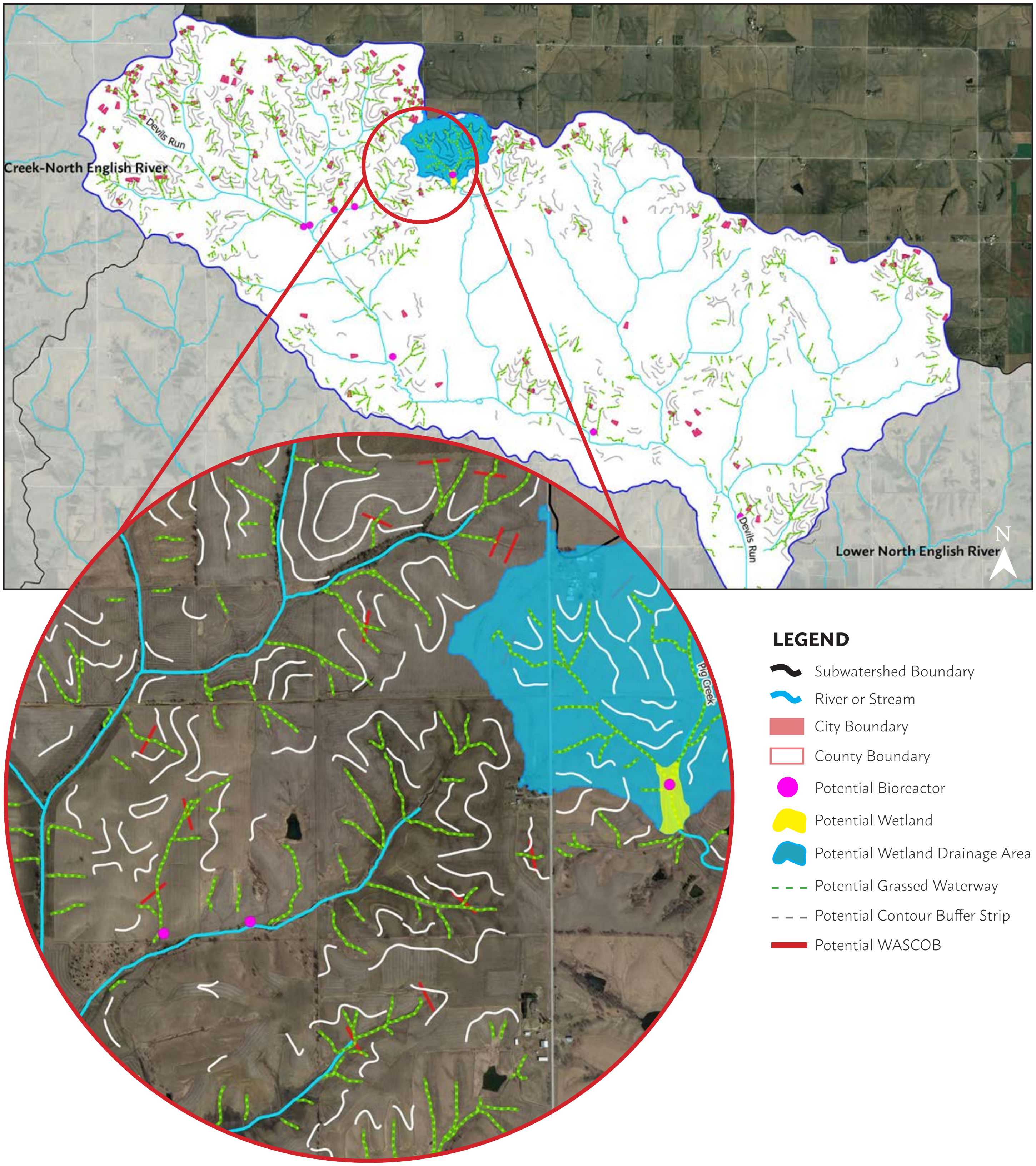

Figure 9. ACPF Model Results for the Devil's Run Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR THE DEVIL'S RUN:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Devil's Run subwatershed. The flood hazard area accounts for roughly 6.0 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, although none exist in the subwatershed, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 3.4 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

Figure 10. Flood hazard boundary areas for Devil's Run Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 0 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

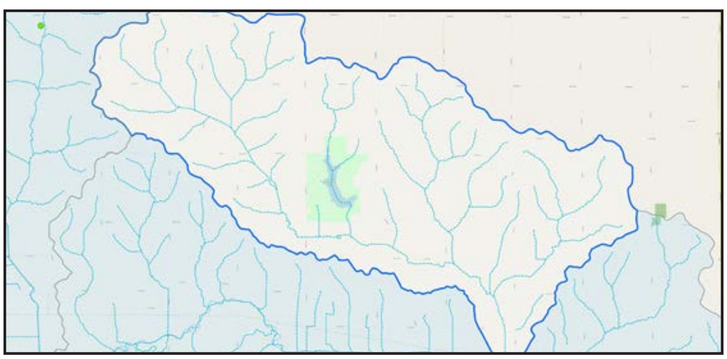

Figure 15. Vulnerable structures for flood hazards in the Devil's Run Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW IOWA COUNTY NFIP FLOOD MAP:
http://arcg.is/f84Wy

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	**Yes**
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	**Iowa**	**North English, Millersburg**	**0.401**	**27 % Children**	**11 % Poverty**	**0.5 % Black or African American**
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 7: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Devil's Run subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

The primary resource concern in the Devil's Run subwatershed is soil erosion. In comparison to all other subwatersheds, Devil's run ranks in the top 3 for average annual soil erosion, soil detachment during the 2013 spring flooding, and for soil delivery rates. Targeted areas for implementation of BMPs such as contour buffer strips, terraces, and grassed waterways should be focused in areas identified as high runoff potential (Section 4). Flood mitigation and large-scale efforts to improve water quality in the subwatershed can be focused on or upstream of the publicly-owned Lake Iowa recreation area. The subwatershed ranks low for all four water quality contaminants and low on the SVI scale, in comparison to all other subwatersheds. Similar to other subwatersheds, however, E.Coli Bacteria and total phosphorus averages for both the 2017 and 2018 sampling season still exceed relevant water quality standards in Iowa.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: \$100-\$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: \$100-\$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Gritter Creek subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Devil's Run	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Devil's Run subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Iowa SWCD, NRCS	Iowa/Keokuk Counties	Medium/ High
	1.3	Flood protection for population safety in Devil's Run subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	ERW	N/A	Low
2	2.2	Acquire property at risk of flooding near Devil's Run; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk in incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Devil's Run subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Iowa/Keokuk SWCD, NRCS, ERW	N/A	Medium/ High
	3.2	Improve water quality in rural areas in Devil's Run subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Iowa/Keokuk SWCD, NRCS, ERW	Iowa/Keokuk Counties	High
4	4.1	Provide flood protection for roads and in Devil's Run subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Iowa/ Keokuk SWCD, NRCS	Iowa/Keokuk Counties	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

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2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

MIDDLE NORTH ENGLISH RIVER

HUC-12: 070802090406

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/ rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Middle North English River subwatershed is located in the central region of the ERW. It overlaps Iowa County and does not overlap any incorporated cities in the ERW. Figure 1 is a location map of the subwatershed. The subwatershed encompasses 12,841 acres (20.1 square miles) of land, which is predominately row crops (corn and soybeans). The Middle North English River stretches approximately 9.03 miles through the subwatershed in west to east direction, eventually outletting into the English River.

It was determined in Phase 1 planning that nutrient concentrations in the subwatershed for nitrates and phosphorus were average in comparison the entire ERW. Furthermore, water quality testing in 2018 also uncovered very high concentrations of E.Coli bacteria. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

Resource concerns within and upstream of the the Middle North English River subwatershed aided in the ERW's decision to designate the subwatershed as one of five priority areas for implementation of best management practices (BMPs) through cost share partnerships with local landowners. Funding for this program is available through the Iowa Watershed Approach (IWA).

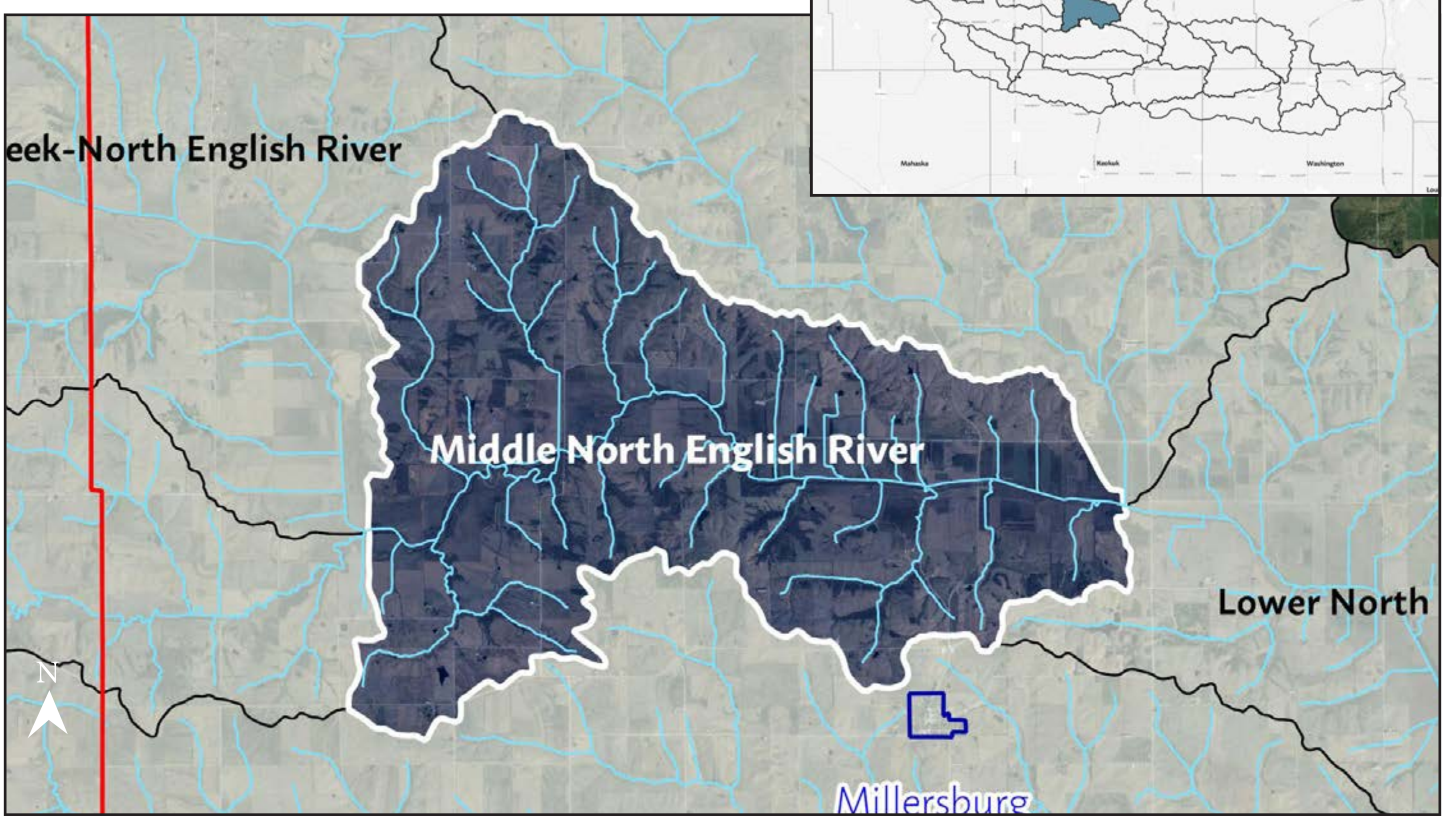


Figure 1. Middle North English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

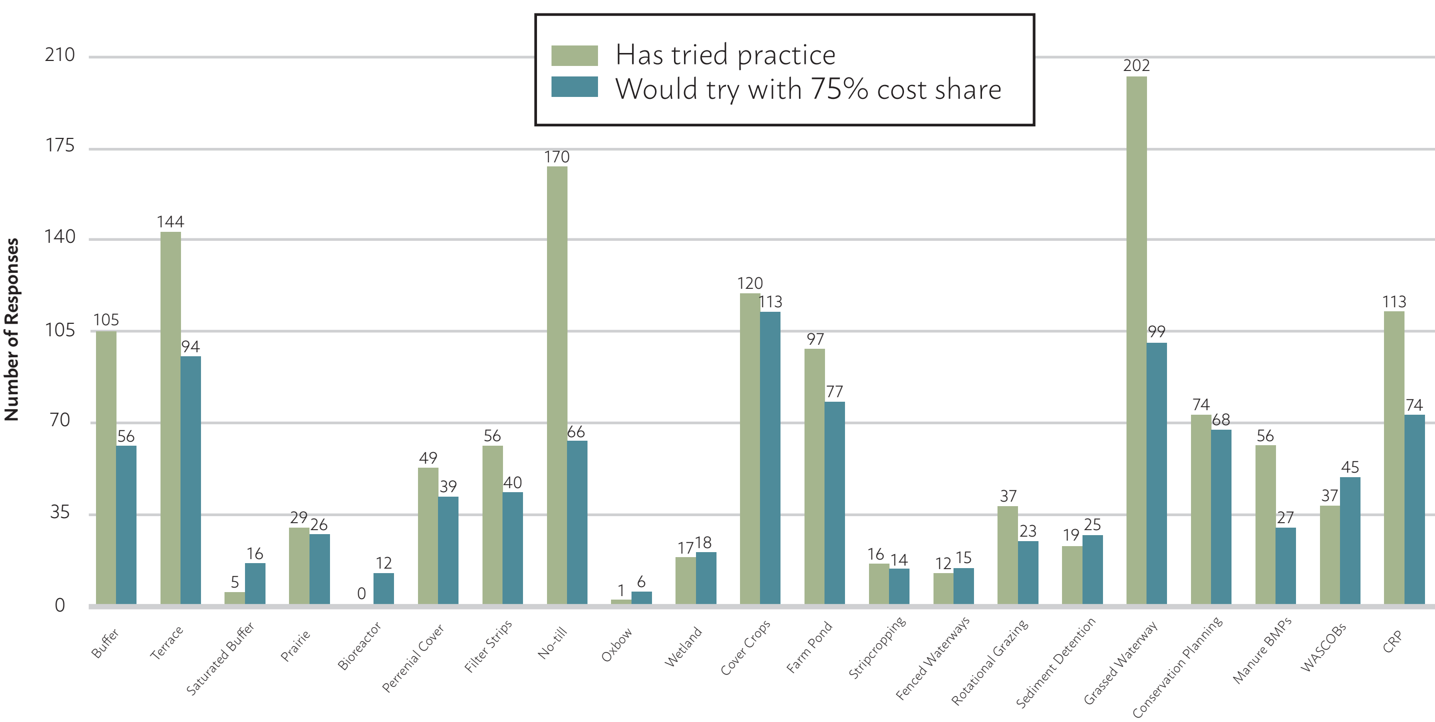


Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

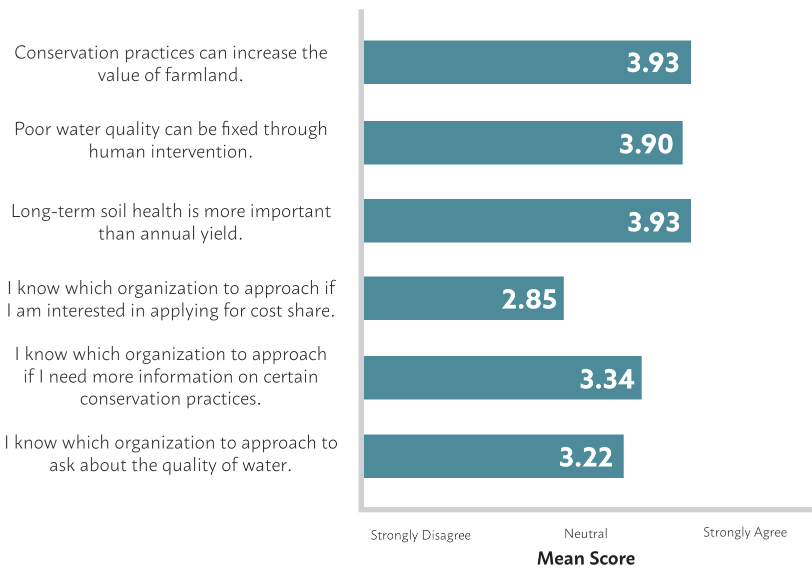


Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 14 is near the outlet of the Middle North English subwatershed. It is located on the H Avenue bridge, just north of the city of Millersburg, in Iowa County (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

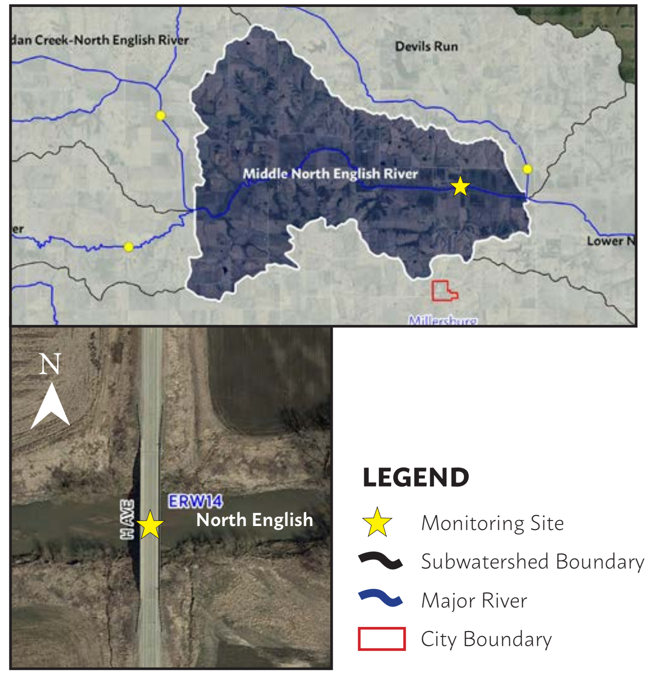


Figure 4. Water quality monitoring location for the Middle North English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 14 times for Nitrate+Nitrite as N, 14 times for E. coli Bacteria, 13 times for ortho-Phosphate as P, and 14 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 14 was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 13 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 14 ranked 3rd of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 14 also ranked 3rd. A value of 24,000+ means that the measurable value of E. Coli Bacteria exceeded the lab test's capacity of identifying up to 24,000 CFUs. Further dilution and testing would be required to determine an actual value higher than that. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 14 ranked 5th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 14 ranked 4th.

In 2017, Site 14 ranked 12th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 14 ranked 6th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 14 ranked 15th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 14 ranked 12th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 14 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	150	24,000+	2,685
2018	52	24,000+	4,568

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 14 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.10	0.05
2018	0.03	0.14	0.09

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 14 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.51	0.17
2018	0.11	1.60	0.32

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 14 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	9.4	2.3
2018	0.5	9.8	4.2

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

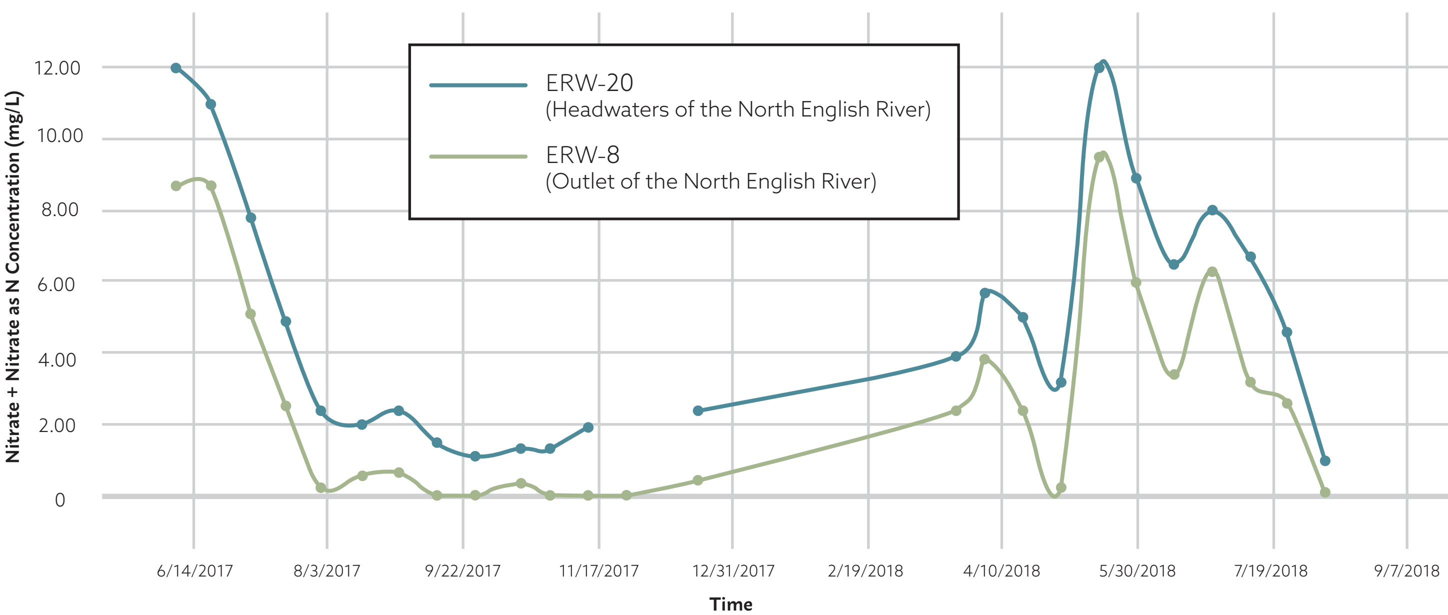


Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Middle North English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 12 times the total erosion (147.94 mm) than Middle River's average monthly erosion of 12.26 mm (0.48 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Middle North English River HUC is "070802090406"; see 406 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	301	**406**	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	12.75	12.59	**12.26**	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	82.23	83.68	**82.65**	83.17	84.61	82.92	82.29

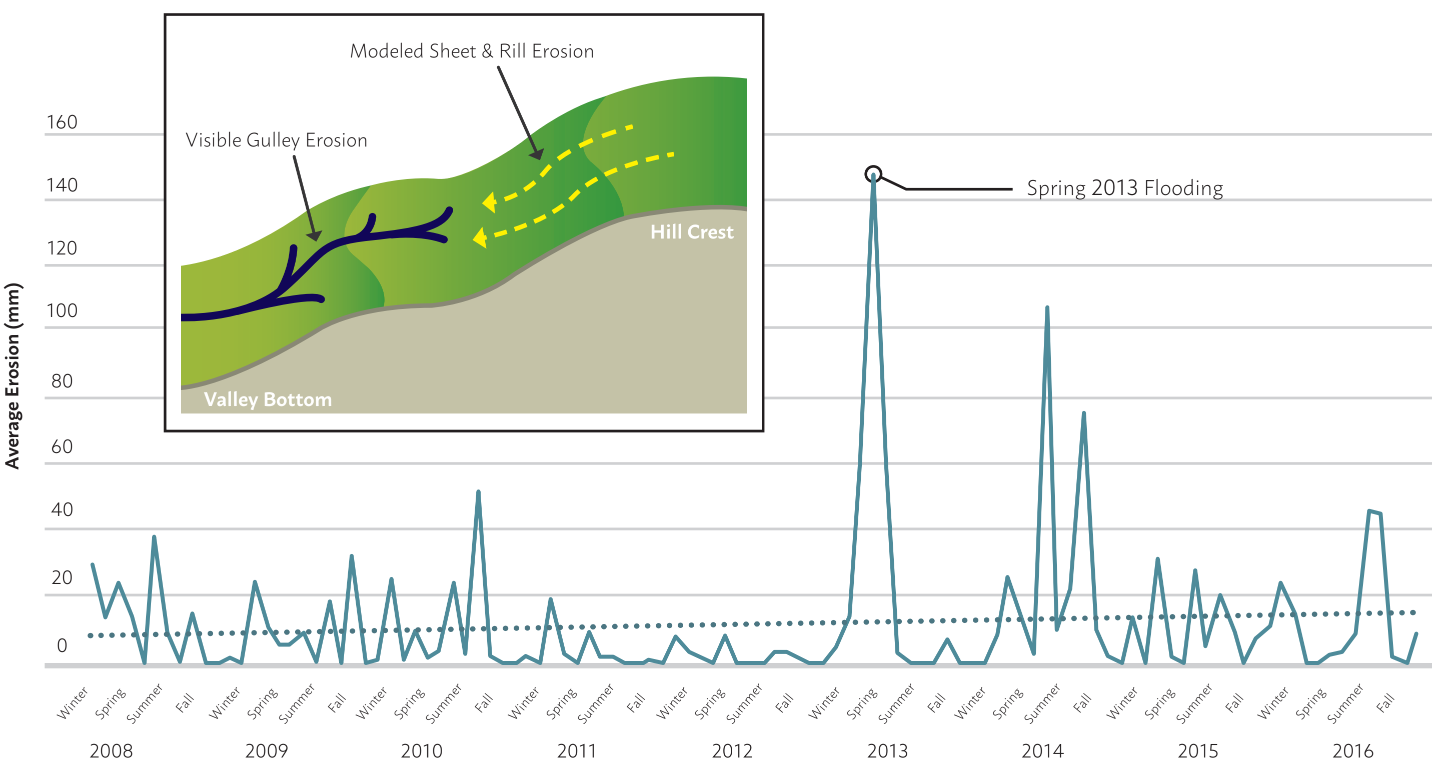


Figure 6. Soil Erosion in the Middle North English River Subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Middle North English River subwatershed experienced an average of 6.63 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Middle North English River subwatershed ranks near the middle of all subwatersheds for soil delivery at 7.83 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Middle North English River is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Middle North English River subwatershed.

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

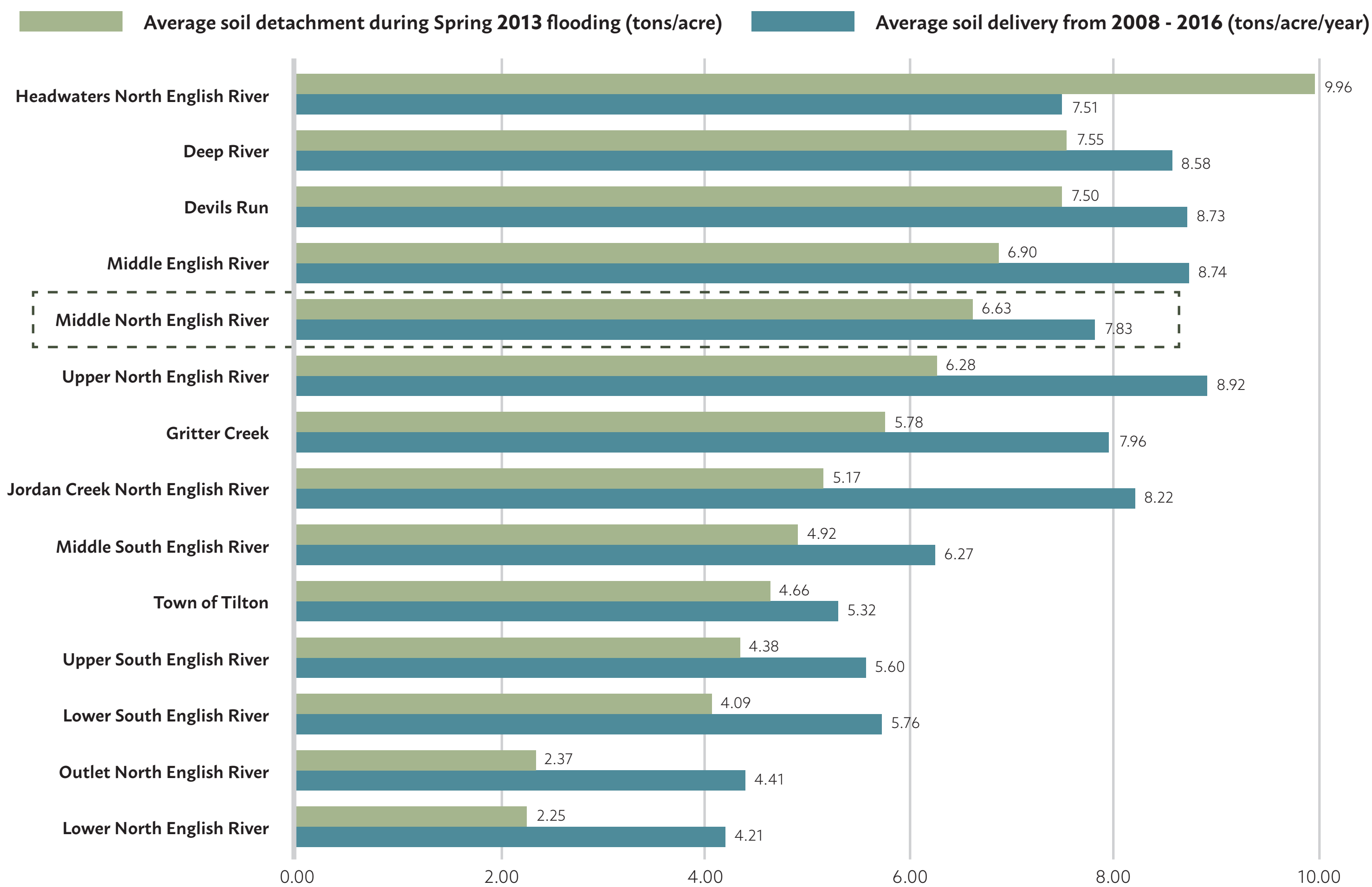


Figure 7. Soil Delivery and Detachment in the Middle North English River Subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR MIDDLE NORTH ENGLISH:
https://bit.ly/2Qslqoh

SHEET AND RILL EROSION & SEDIMENT DELIVERY POTENTIAL

Four priority subwatersheds (Gritter Creek, Middle English River, Headwaters North English, and the Middle North English River) were selected for implementation of BMPs through the IWA project through a cost-share program. As a result, these subwatersheds were subject to a greater level of research and planning including a detailed land use assessment completed in 2017 for use in the Revised Universal Soil Loss Equation, Version 2 (RUSLE2) analysis, which estimated sheet and rill erosion (Figure 8) and sediment delivery (Figure 9). The Iowa Department of Natural Resources (IDNR) estimates sheet and rill erosion in the subwatershed is 53,235 tons per year. The IDNR also estimates that 10,992 tons of sediment is delivered to waterways per year.

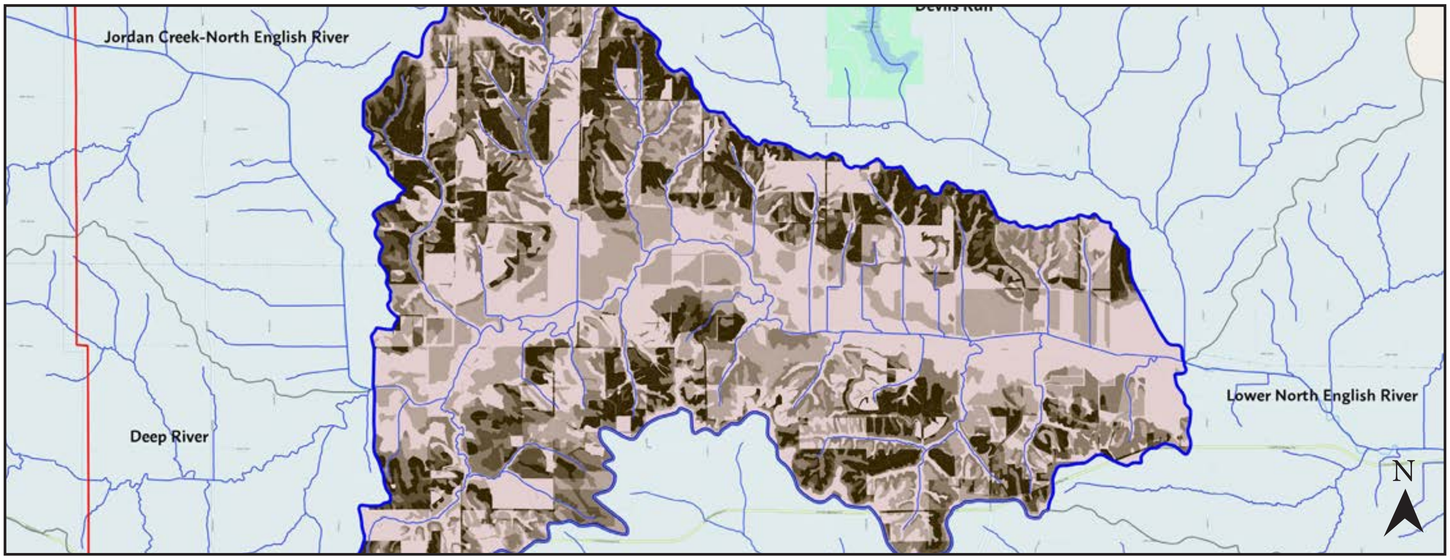


Figure 8. Estimated Sheet and Rill Erosion for the Middle North English River Subwatershed, 2017. *Source: Iowa DNR*

0-1 tons/acre/year   1-2 tons/acre/year   2-5 tons/acre/year   5-8 tons/acre/year   8-43.5 tons/acre/year

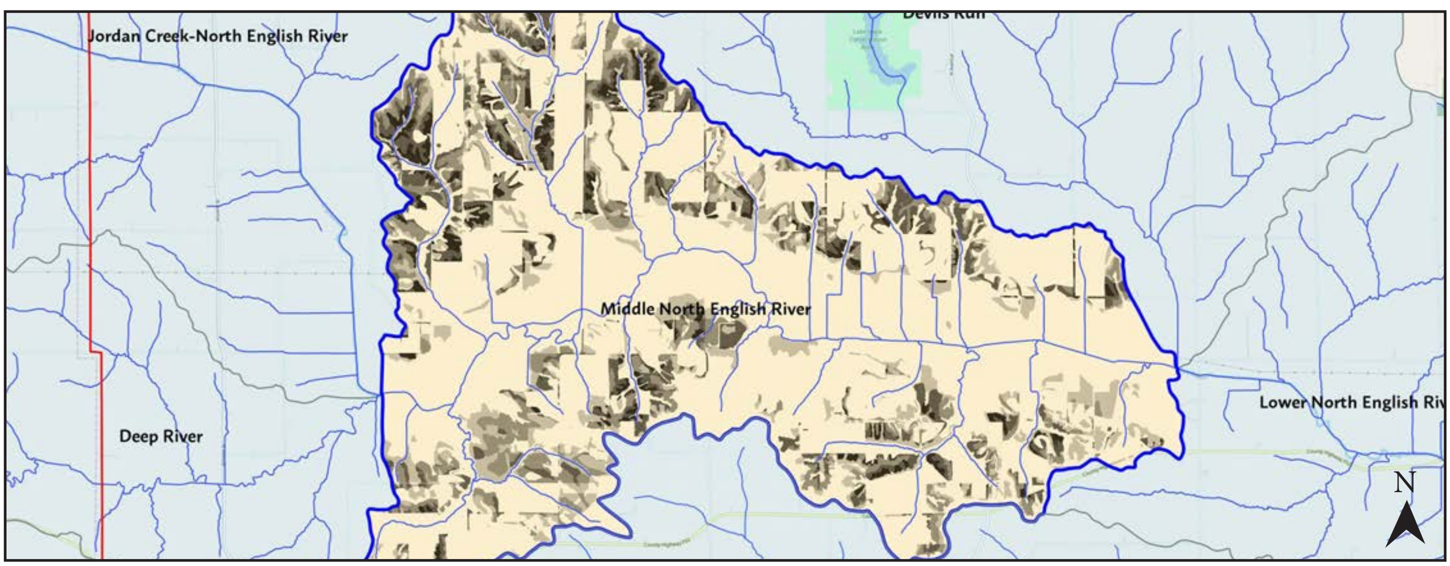


Figure 9. Estimated Sediment Delivery for the Middle North English River Subwatershed, 2017. *Source: Iowa DNR*

0-0.5 tons/acre/year   0.5-1 tons/acre/year   1-2 tons/acre/year   2-4 tons/acre/year   4-6.21 tons/acre/year

VIEW SOIL EROSION WEBMAPS FOR MIDDLE NORTH ENLGISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 79.46 miles of contour buffer strips, 27 bioreactors, 65 WASCOBs, 0 nutrient-removal wetlands, and 120.80 miles of grassed waterways in the Middle North English River subwatershed (Table 11). These practices are spatially depicted in Figure 10. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	**12,841**	**79.46**	**27**	**65**	**0**	**0**	**0.0 %**	**120.80**
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

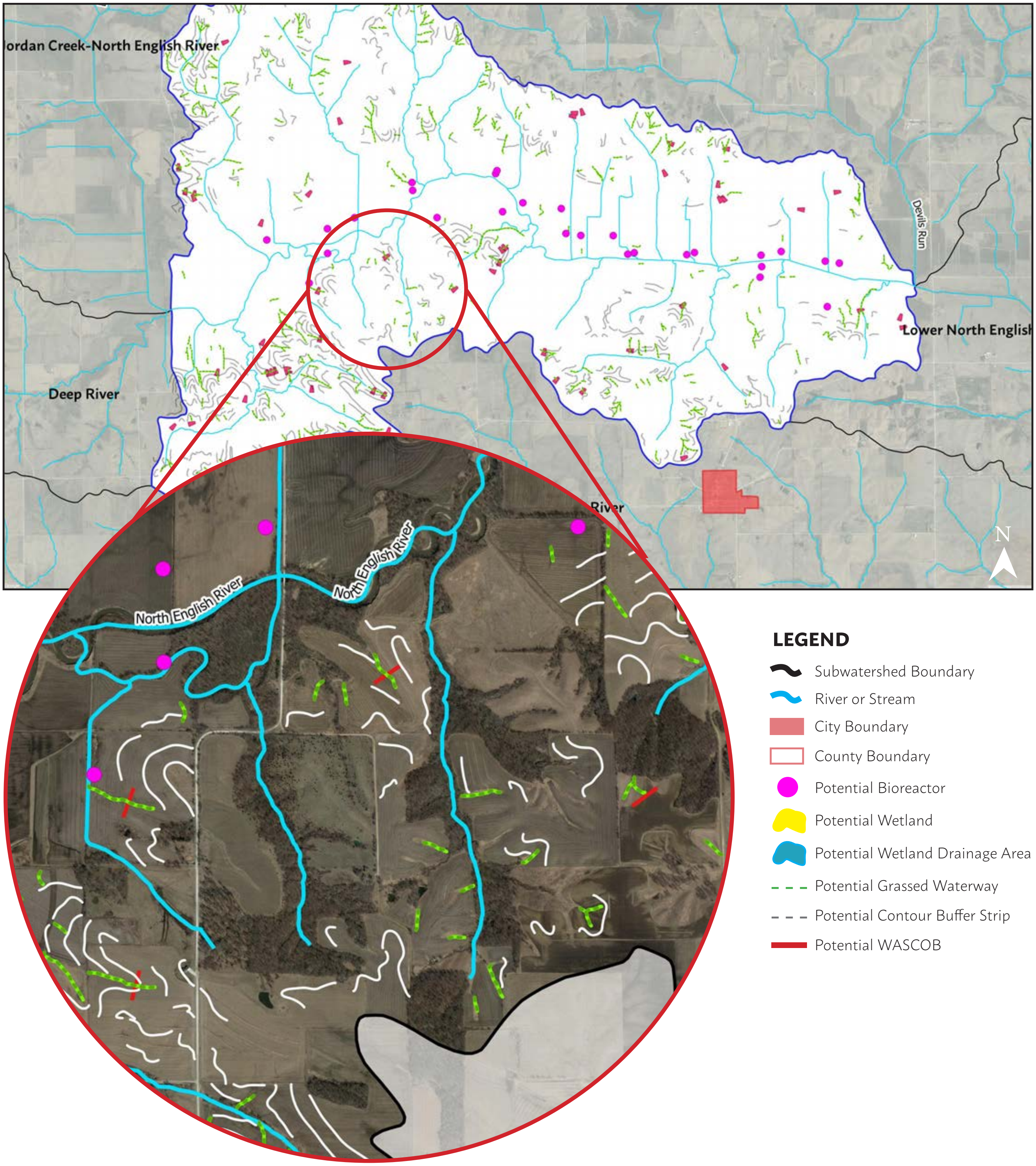


Figure 10. ACPF Model Results for the Middle North English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR THE MIDDLE NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 15 shown below represents the flood hazards that exist in the Devil's Run subwatershed. The flood hazard area accounts for roughly 12.6 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, although none exist in the subwatershed, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 3.4 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

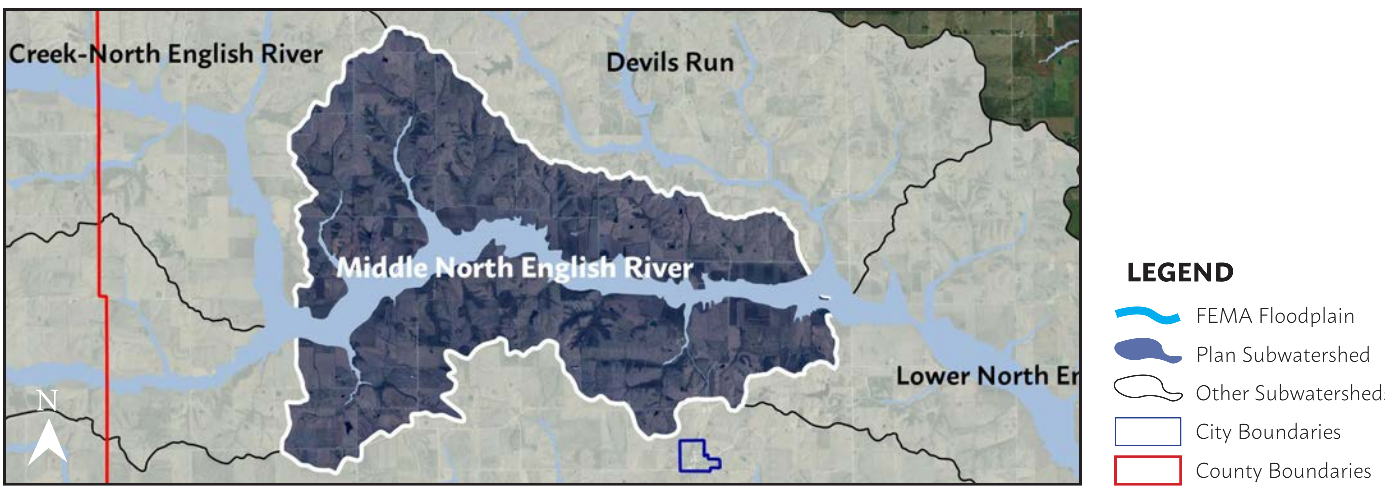


Figure 15. Flood hazard boundary areas for the Middle North English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 1 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 16).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

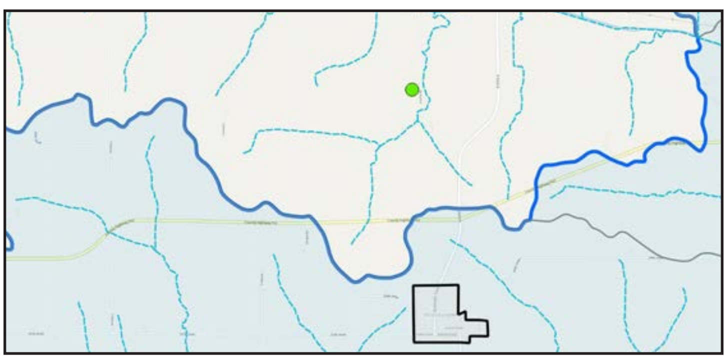


Figure 16. Vulnerable structures for flood hazards in the Middle North English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW IOWA COUNTY NFIP FLOOD MAP:
http://arcg.is/f84Wy

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	**Yes**
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	**Iowa**	**North English, Millersburg**	**0.401**	**27 % Children**	**11 % Poverty**	**0.5 % Black or African American**
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Middle North English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

In comparison to subwatersheds in the ERW, the Middle North English River subwatershed ranks high for E.Coli bacteria, total phosphorus, and orthosphates with respect to water quality contamination. Soil erosion rates are in the middle range among the fourteen subwatersheds. BMPs that can be installed through cost share via the Iowa Watershed Approach project should be focused on controlling the movement of sediment, which can negatively impact streams through excess levels of phosphorus and bacteria. Suitable locations for agricultural BMPs (grassed waterways, WASCOBs, contour buffer strips) can be found in Section 5. These locations should overlap with areas that are highly prone to soil erosion, according to the RUSLE analysis presented in Section 4. Locating practices according to the ACPF and RUSLE analyses results in more impactful practices and better utilizes limited funding.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: \$100-\$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: \$100-\$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Middle North English Subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Gritter Creek in the City of North English	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Gritter Creek subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa/ Keokuk SWCD, NRCS	Iowa/Keokuk Counties, North English	Medium/ High
	1.3	Flood protection for population safety in Gritter Creek subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	IWA, PDM	City of North English, ERW	City of North English	Low
2	2.2	Acquire property at risk of flooding near Gritter Creek; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in North English	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Gritter Creek subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	IWA, WQI	Iowa/Keokuk SWCD, NRCS, ERW	City of North English	Medium/ High
	3.2	Improve water quality in rural areas in Gritter Creek subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319, IWA	Iowa/Keokuk SWCD, NRCS, ERW	Iowa/Keokuk Counties	High
4	4.1	Provide flood protection for roads and in Gritter Creek subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa/ Keokuk SWCD, NRCS	Iowa/Keokuk Counties, North English	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

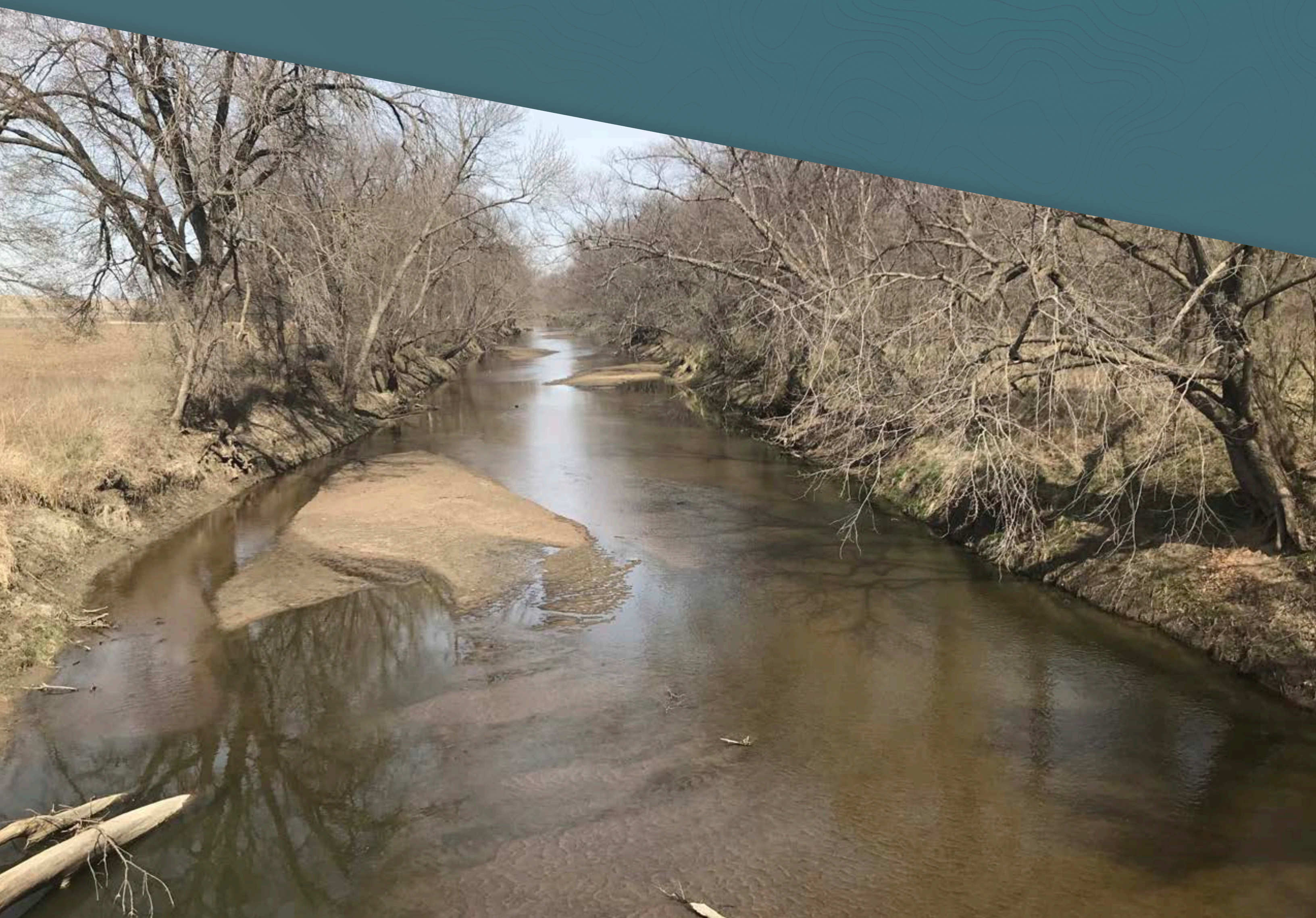
2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

LOWER NORTH ENGLISH RIVER

HUC-12: 070802090407



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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Lower North English River subwatershed is located in the central region of the ERW. It overlaps one county (Iowa). There are no incorporated areas that overlap the subwatershed. The Lower North English River subwatershed primarily consists of Denovian soils and, in comparison to the entire ERW, features deep depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 44-46.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 12,611 acres (19.7 square miles) of land, which is predominately row crops (corn and soybeans). The North English River stretches approximately 8.41 miles through the subwatershed in northwest to southeast direction, and eventually outlets into the English River about 8.5 miles east of the City of North English.

It was determined in Phase 1 planning that the nutrient contamination ranked low as a resource concern in the subwatershed. However, water quality testing in Phase 2 planning uncovered greater contamination of nitrates and phosphorus. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

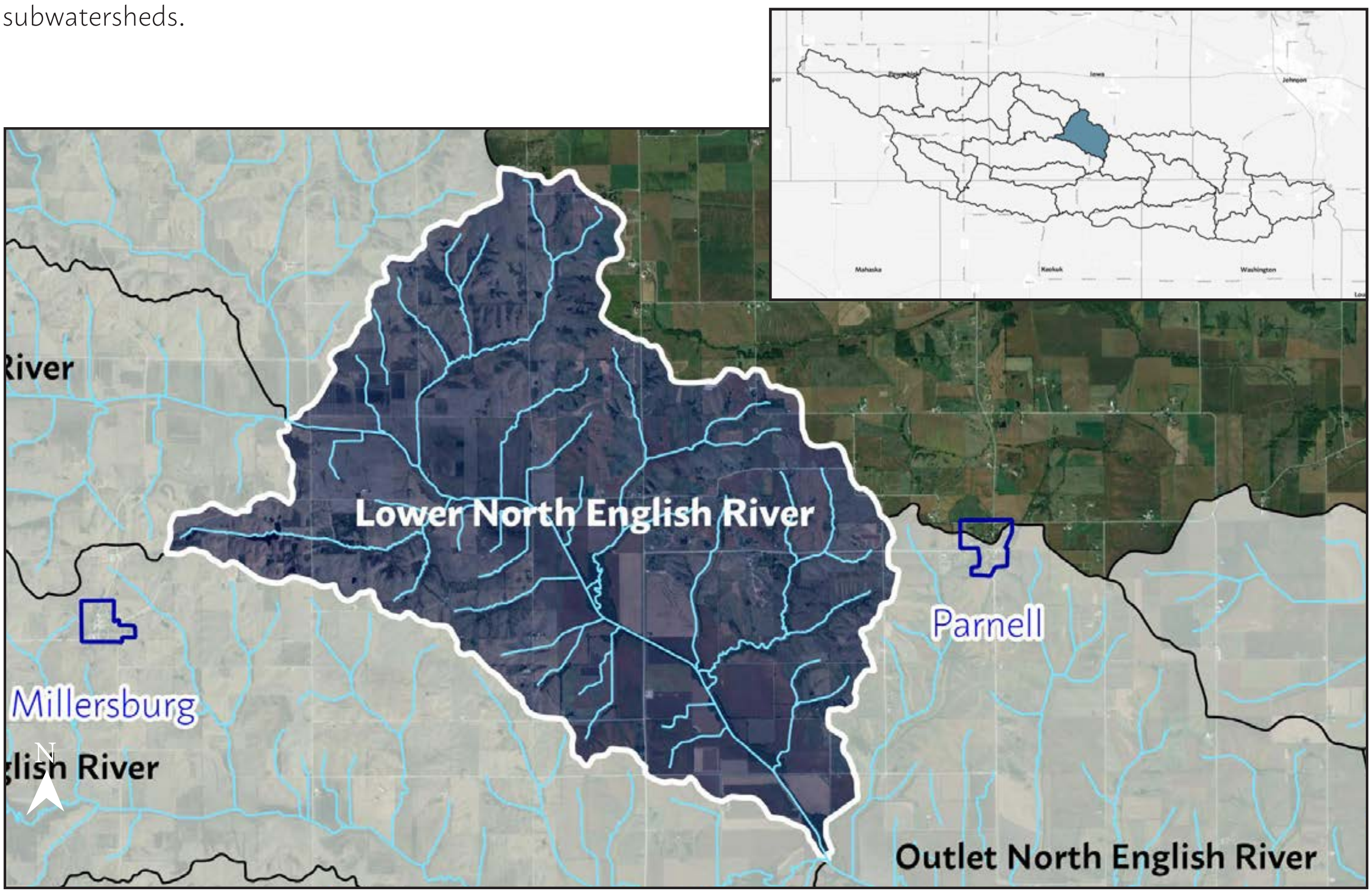


Figure 1. Lower North English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

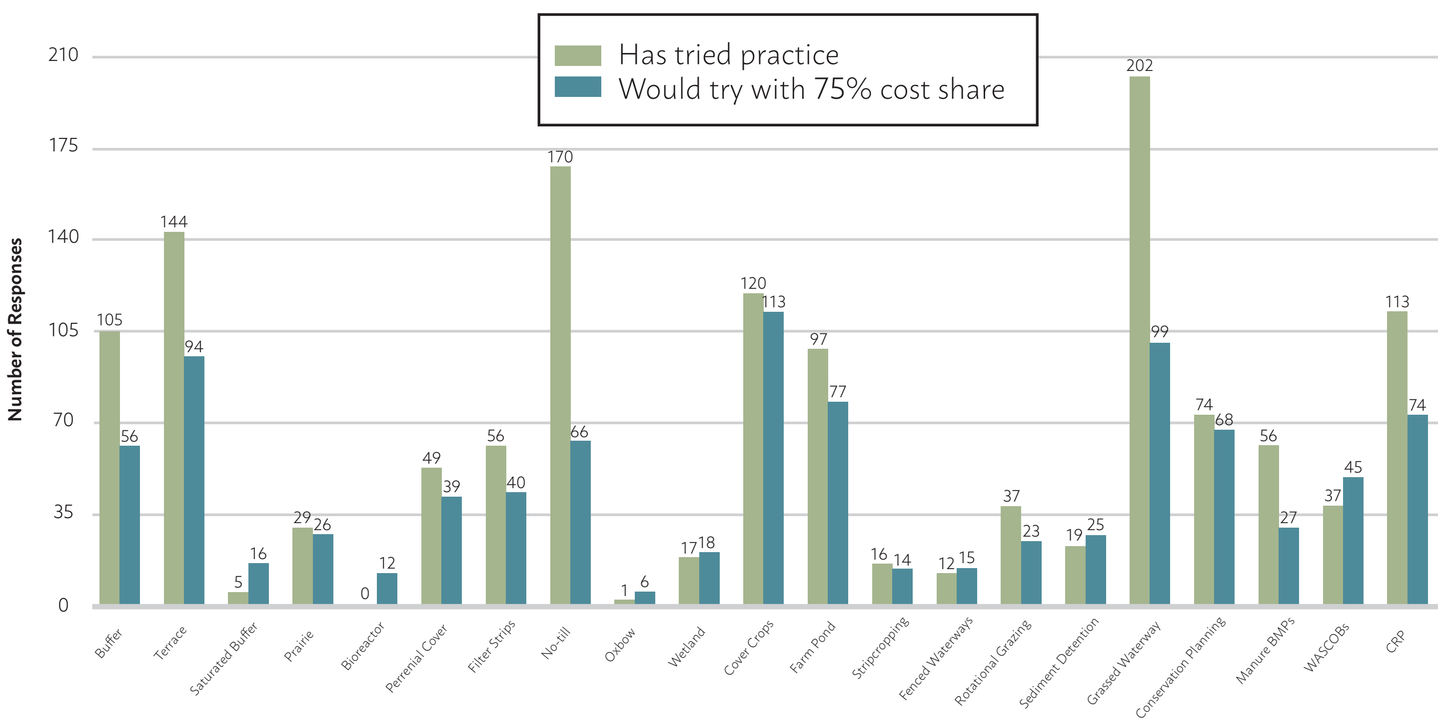


Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

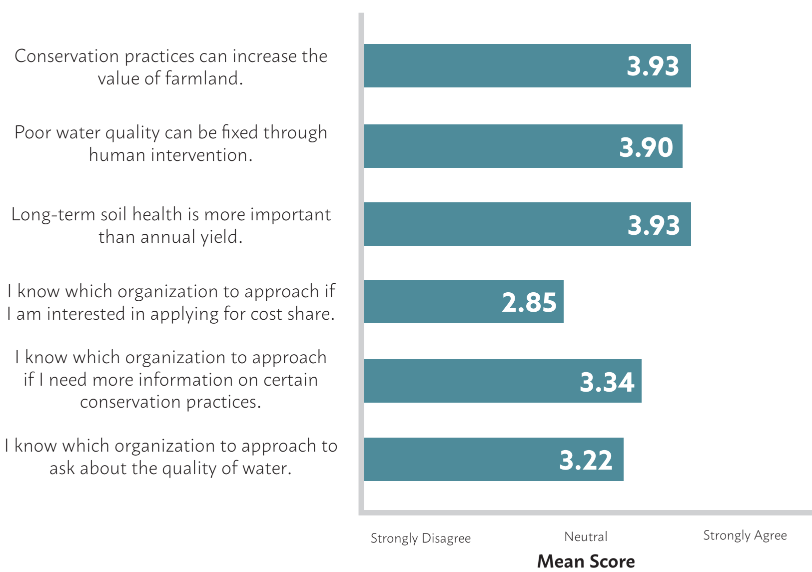


Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 9 is on Deer Creek at the 310th Street bridge (aka "Yankee Point") in Iowa County. The bridge is SW of the City of Parnell (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

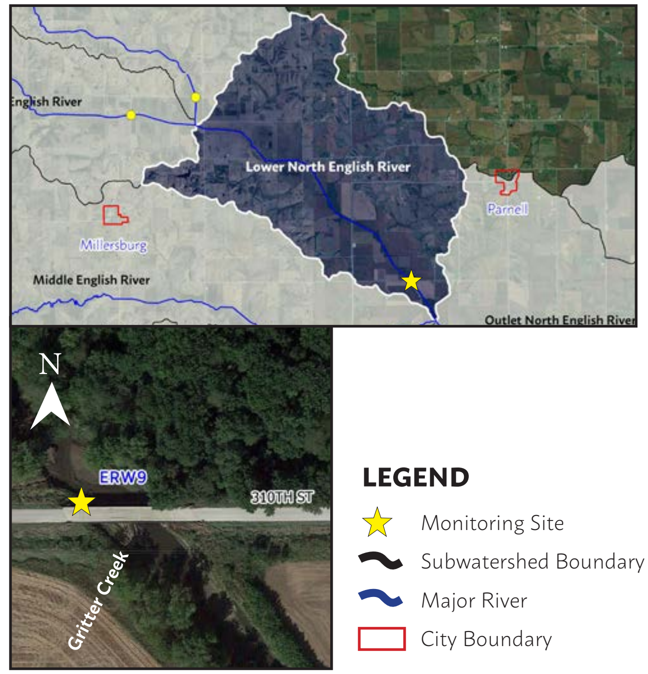


Figure 4. WaterQuality Monitoring Location for the Lower North English River Subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 14 times for Nitrate+Nitrite as N, 14 times for E. coli Bacteria, 13 times for ortho-Phosphate as P, and 14 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 9 was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 13 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 9 ranked 6th of the English River's 20 subwatersheds for its seasonal average E. Coli Bacteria values. In 2018, Site 9 ranked 1st (the highest). A value of 24,000+ means that the measurable value of E. Coli Bacteria exceeded the lab test's capacity of identifying up to 24,000 CFUs. Further testing would be required to determine an actual value higher than that. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 9 ranked 3rd of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 9 ranked 2nd (nearly the highest).

In 2017, Site 9 ranked 5th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 9 also ranked 5th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 9 ranked 16th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 9 ranked 15th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 9 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	280	17,000	2,151
2018	52	24,000+	5,385

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 9 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.11	0.06
2018	0.04	0.14	0.10

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 9 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.05	0.46	0.19
2018	0.11	1.40	0.35

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 9 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	8.8	2.1
2018	0.6	9.6	3.9

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

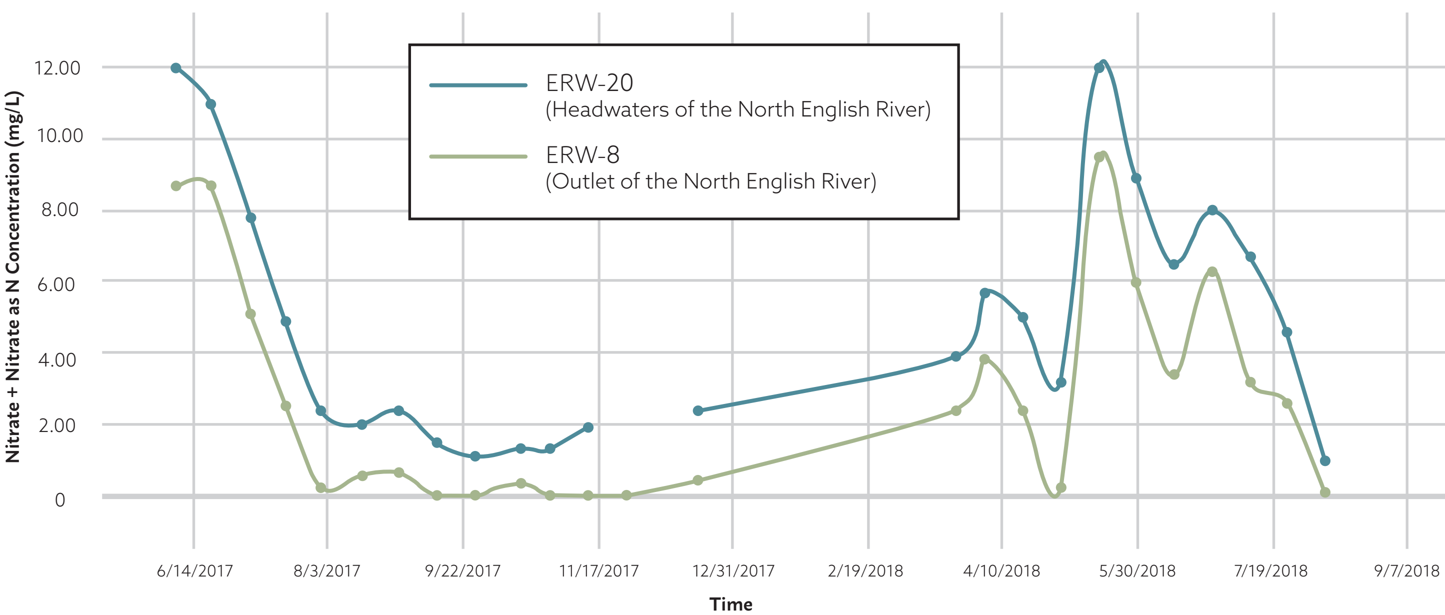


Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Lower North English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 13 times the total erosion (166.95 mm) than the Lower North English River's average monthly erosion of 12.23 mm (0.48 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, the Lower North English River's HUC is "070802090407"; see 407 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	301	406	408	**407**	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	12.75	12.59	12.26	12.24	**12.23**	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	82.23	83.68	82.65	83.17	**84.61**	82.92	82.29

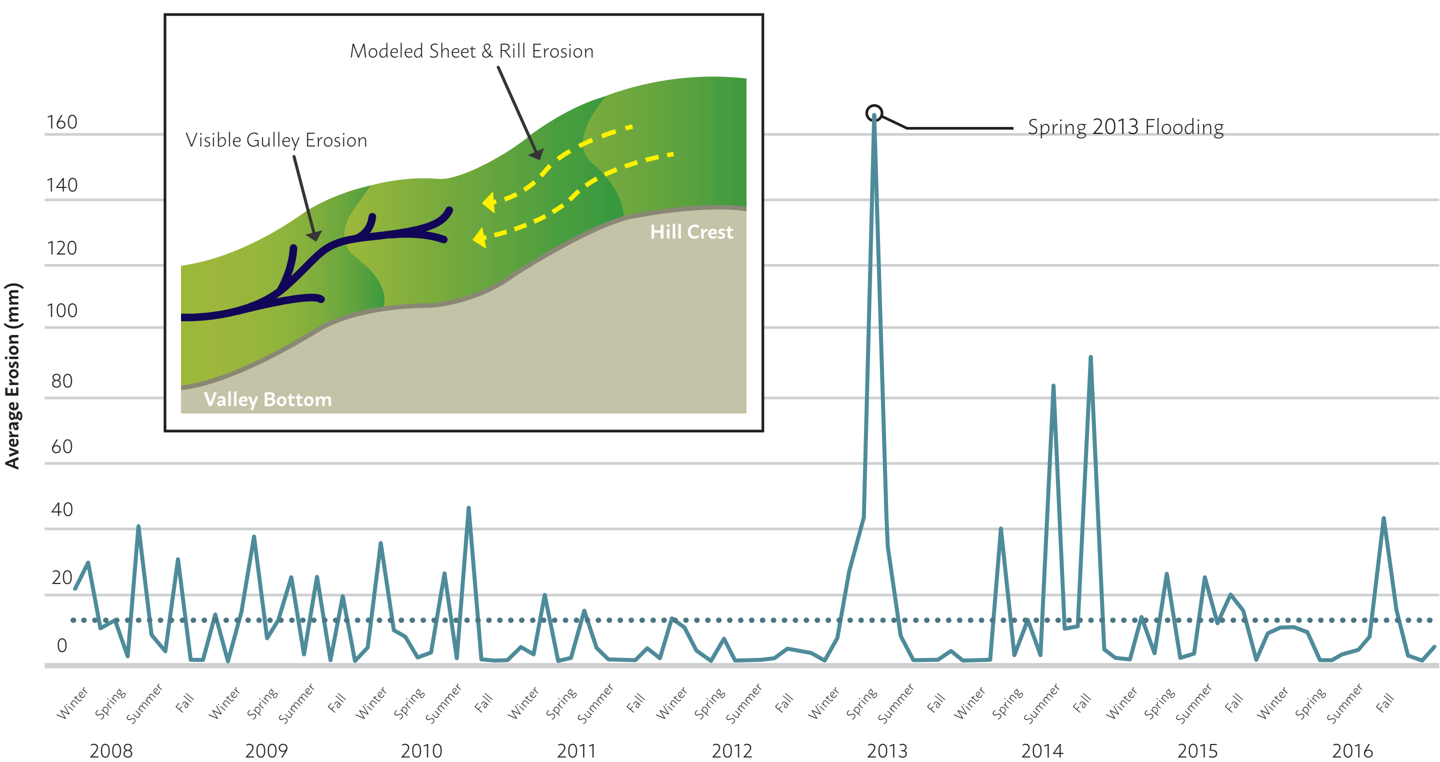


Figure 6. Soil Erosion in the Lower North English River Subwatershed (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Lower North English River subwatershed experienced an average of 4.21 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Lower North English River subwatershed ranks as the lowest of all subwatersheds for soil delivery at 4.21 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Lower North English River subwatershed is below the state average and below the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the North English River subwatershed.

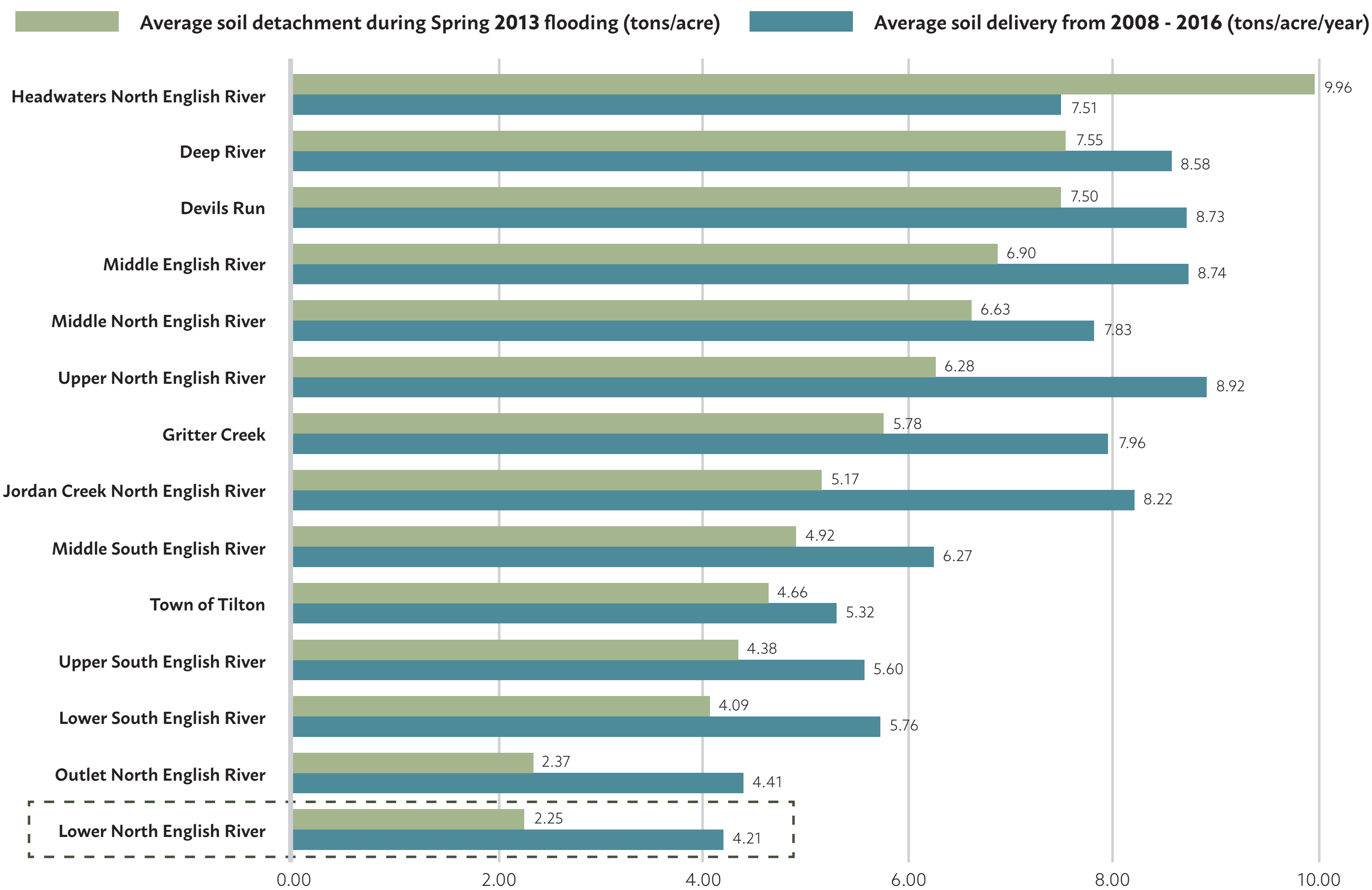


Figure 7. Soil Delivery and Detachment in the Lower North English River Subwatershed (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR LOWER NORTH ENGLISH RIVER:
https://bit.ly/2DRL5VG

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Lower North English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

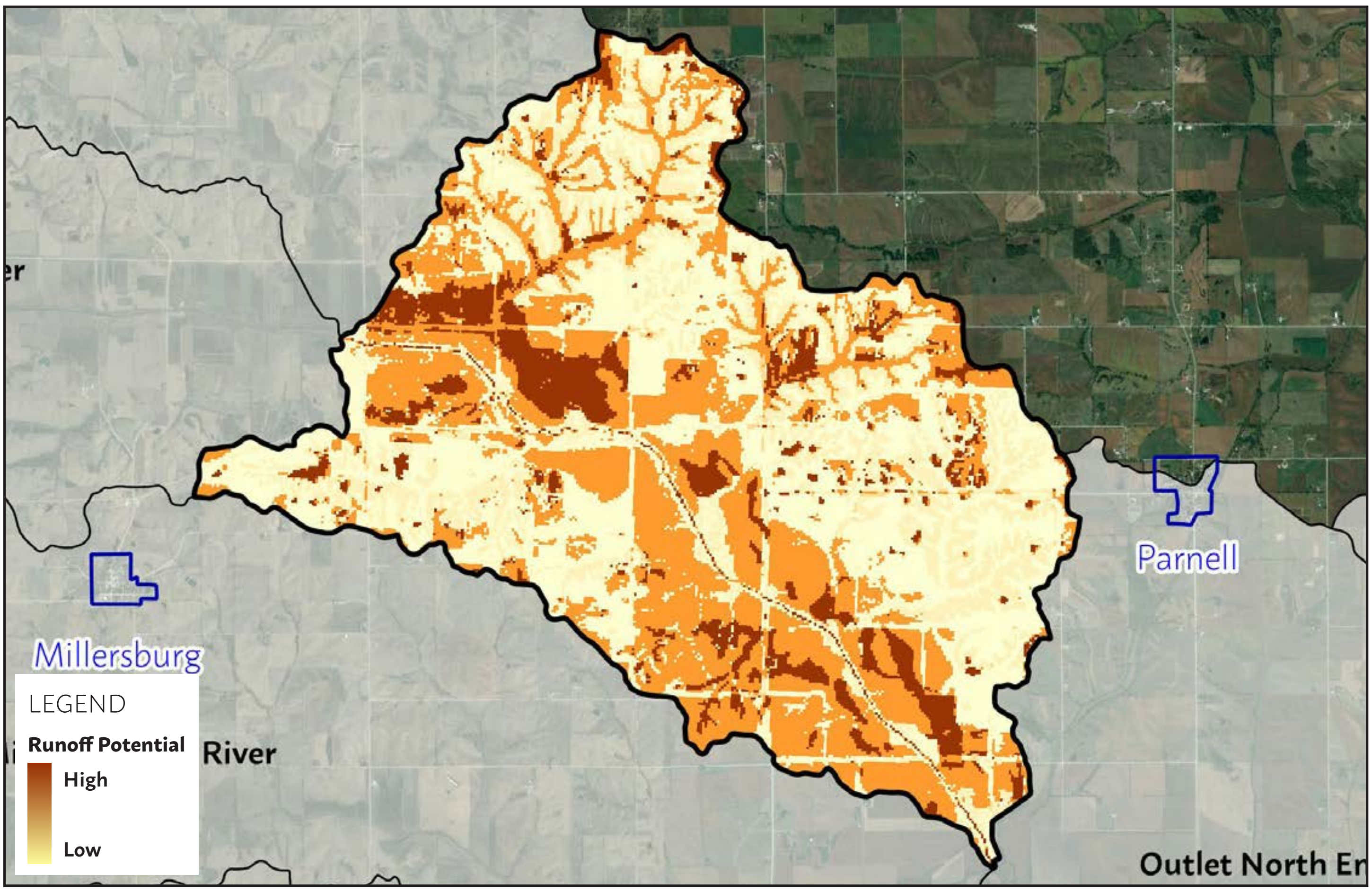


Figure 8. SCS-CN Runoff Potential Model for the Lower North English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR LOWER NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 107.77 miles of contour buffer strips, 20 bioreactors, 66 WASCOBs, 1 nutrient-removal wetlands, a total of 183.03 acres of drainage area for the wetlands, and 28.28 miles of grassed waterways in the Lower North English River subwatershed (Table 11). If the wetland was installed in the subwatershed, roughly 1.5 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	**12,611**	**107.77**	**20**	**66**	**1**	**183.03**	**1.5 %**	**28.28**
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

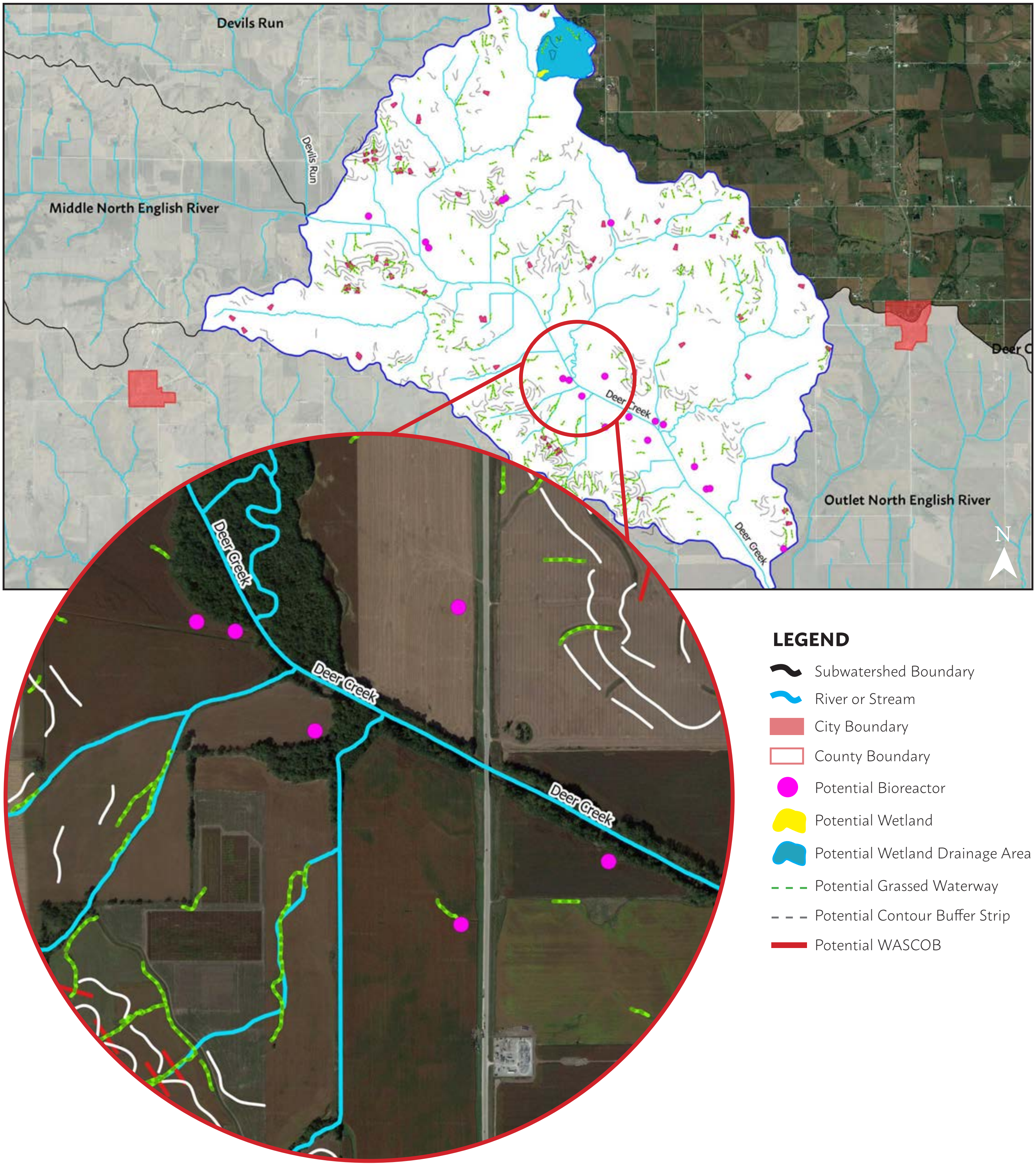


Figure 9. ACPF Model Results for the Lower North English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR LOWER NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Lower North English River subwatershed. The flood hazard area accounts for roughly 13.0 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, although none exist in the subwatershed, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 3.3 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

Figure 10. Flood hazard boundary areas for the Lower North English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 1 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

Figure 15. Vulnerable structures for flood hazards in the Lower North English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW IOWA COUNTY NFIP FLOOD MAP:
http://arcg.is/f84Wy

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	**Yes**
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.148	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	**Iowa**	**North English, Millersburg**	**0.401**	**27 % Children**	**11 % Poverty**	**0.5 % Black or African American**
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	**Iowa**	**Parnell**	**0.326**	**0.5 % Black or African American**	**10 % Poverty**	**19 % Age 65 or Older**

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 7: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Lower North English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

E.Coli bacteria and orthophosphate contamination levels in the subwatershed rank as the highest and second-highest, respectively, for the 2018 monitoring season. Due to topography and land use practices, the Lower North English River subwatershed is more limited in the quantity of suitable locations for agricultural BMPs. However, many opportunities for the installation of contour buffer strips, terraces, nutrient-removal wetlands still exist. A large floodplain area allow for floodplain restoration techniques, which can provide significant nutrient uptake. Floodplain techniques can slow stormwater velocities and protect downstream communities and structures from flood impacts. The subwatershed is classified as "medium vulnerability" on the SVI, with indicators of an aging population and higher rates of poverty. These factors limit the ability for individuals to recover from a flood event.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: \$100-\$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: \$100-\$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Lower North English subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Lower North English River	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Lower North English River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Iowa SWCD, NRCS	Iowa County	Medium/ High
	1.3	Flood protection for population safety in Lower North English River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	ERW	N/A	Low
2	2.2	Acquire property at risk of flooding near Lower North English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk in incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Lower North English River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Iowa SWCD, NRCS, ERW	N/A	Medium/ High
	3.2	Improve water quality in rural areas in Lower North English River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Iowa SWCD, NRCS, ERW	Iowa County	High
4	4.1	Provide flood protection for roads and in Lower North English River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM,	Secondary Roads, Iowa SWCD, NRCS	Iowa County	Low

ACRONYMS

ACPF Agriculture Conservation Planning Framework
BMP Best Management Practice
DEP Daily Erosion Project
EPA Environmental Protection Agency
ERW English River Watershed
FEMA Federal Emergency Management Agency
HSEM Homeland Security & Emergency Management
HUC Hydrologic Unit Code
ISWMM Iowa Stormwater Management Manual
IWA Iowa Watershed Approach
NFIP National Flood Insurance Program
NRCS Natural Resource Conservation Service
NRS Nutrient Reduction Strategy
SCS-CN Soil Conservation Service - Curve Number
SWCD Soil & Water Conservation District
WMA Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

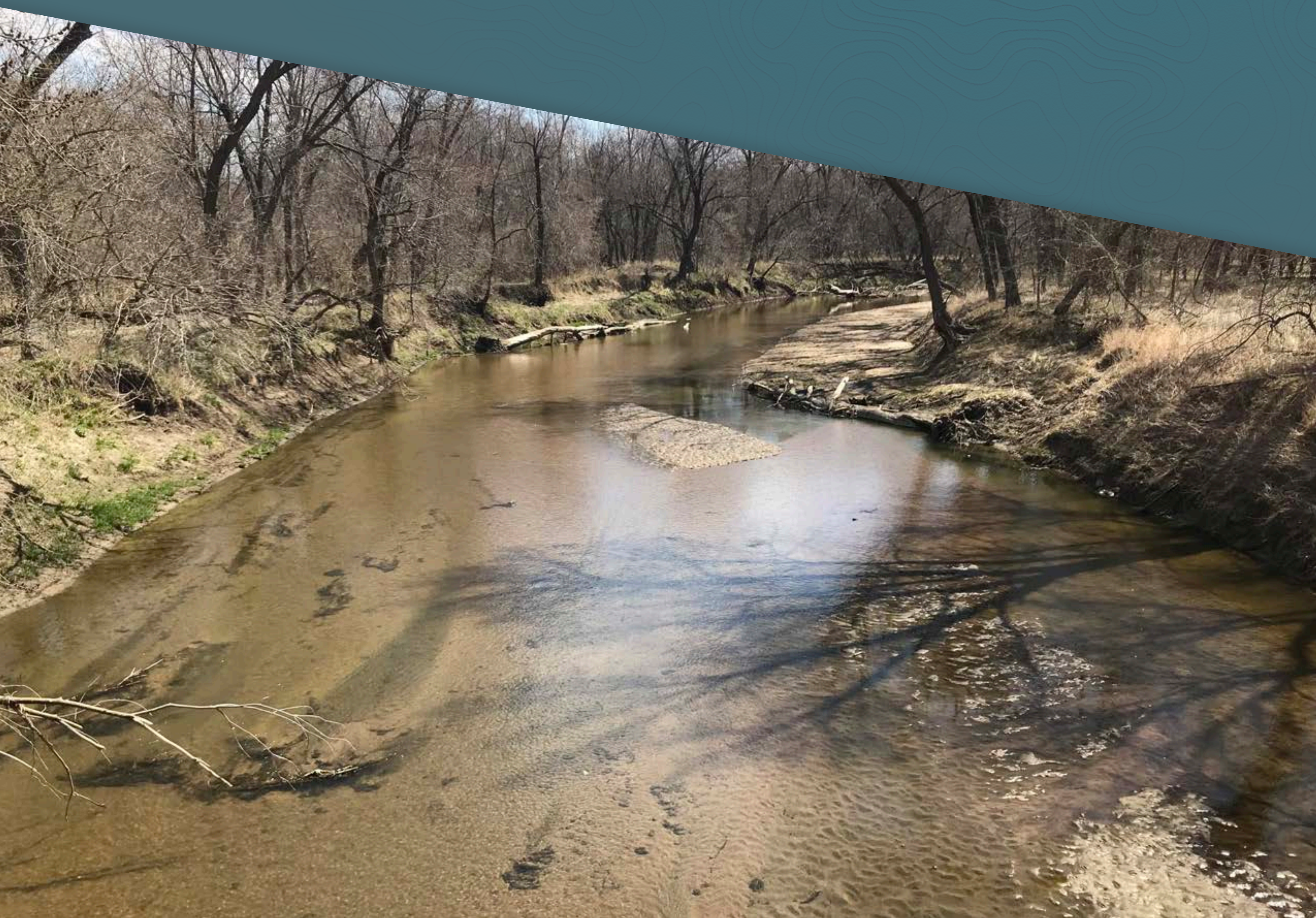
2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

OUTLET NORTH ENGLISH RIVER

HUC-12: 070802090408



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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/ rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Outlet North English River subwatershed is located in the central region of the ERW. It overlaps two counties (Iowa and a sliver of Washington). The City of Parnell (population 193) is the only incorporated area that overlaps the subwatershed. The Outlet North English River subwatershed primarily consists of Mississippian soils and, in comparison to entire ERW, features shallow depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 47-50.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 14,193 acres (22.2 square miles) of land, which is predominately row crops (corn and soybeans). The North English River stretches approximately 8.16 miles through the subwatershed in northwest to southeast direction, and eventually outlets into the English River about 8.5 miles east of the City of North English.

It was determined in Phase 1 planning that the primary resource concern in the subwatershed is riverine flooding risks. Phase 2 planning also revealed high concentrations of E.Coli bacteria and ortho-phosphates. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

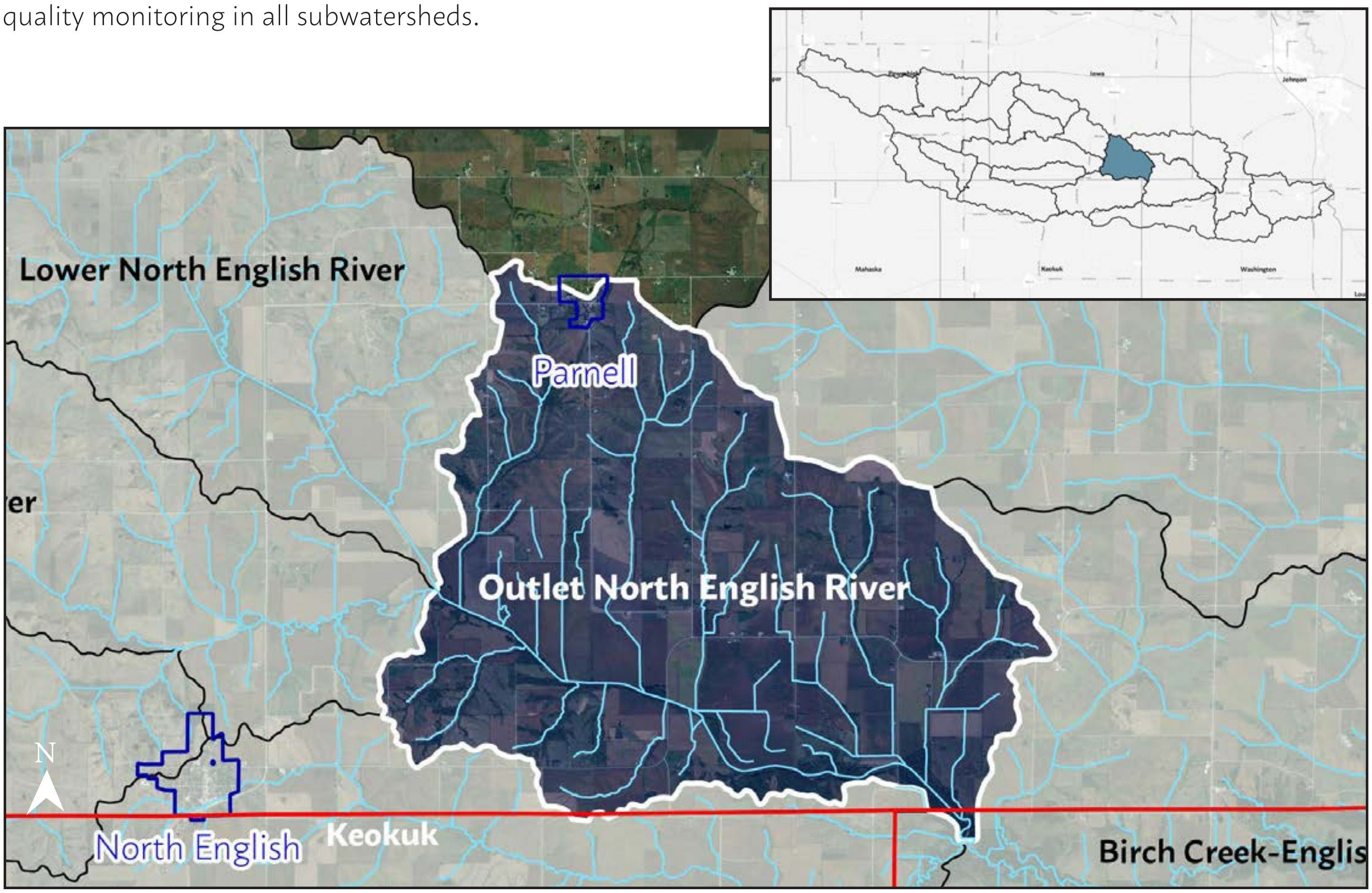

Figure 1. Outlet North English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

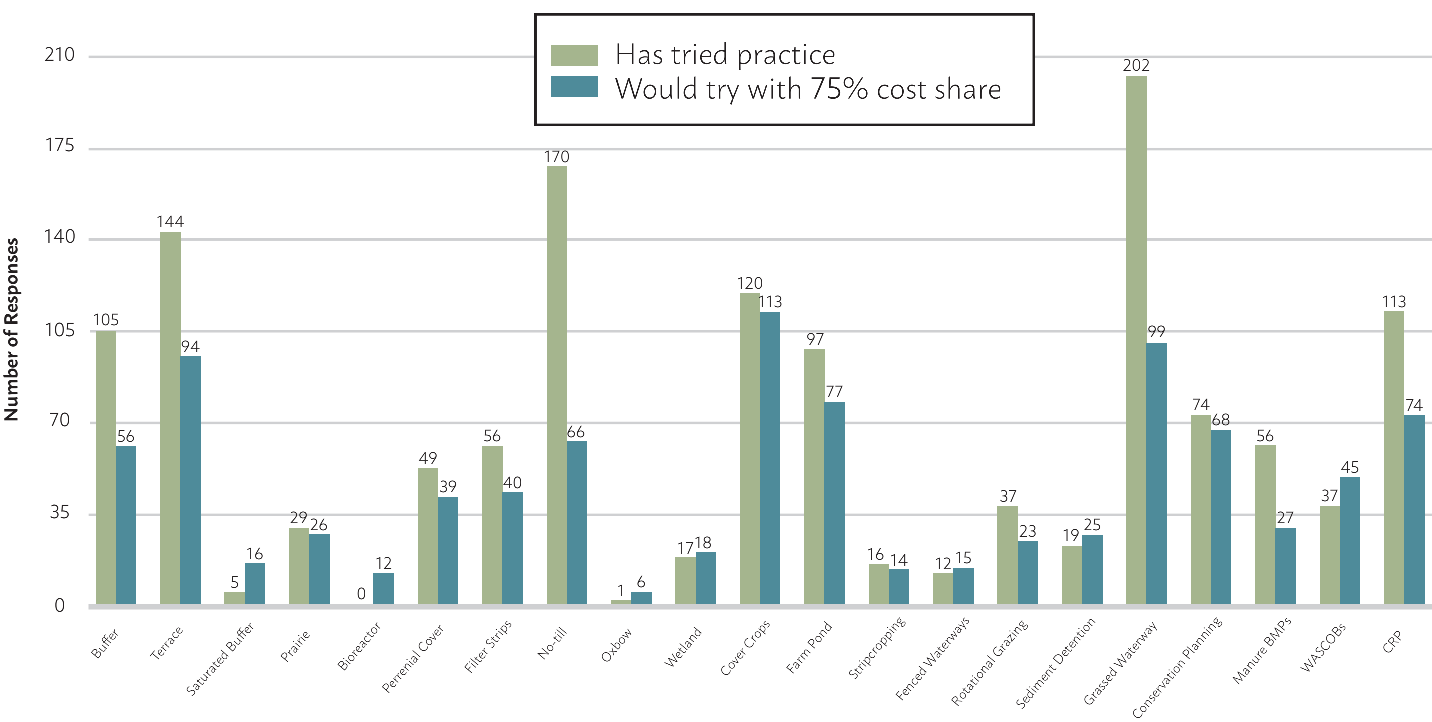

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

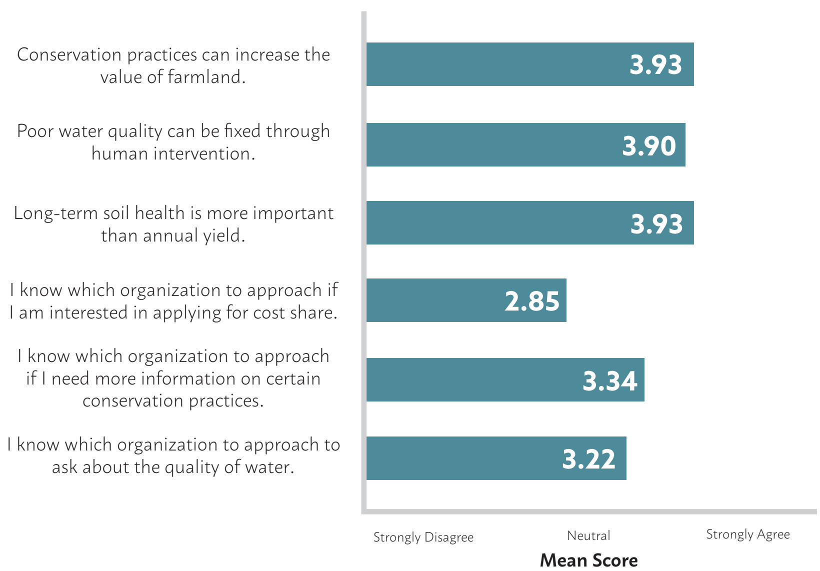

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 8 is on Deer Creek, which is the outlet of the North English River, at the S Avenue bridge (aka "Green Valley Bridge") near the Iowa/Washington County line (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

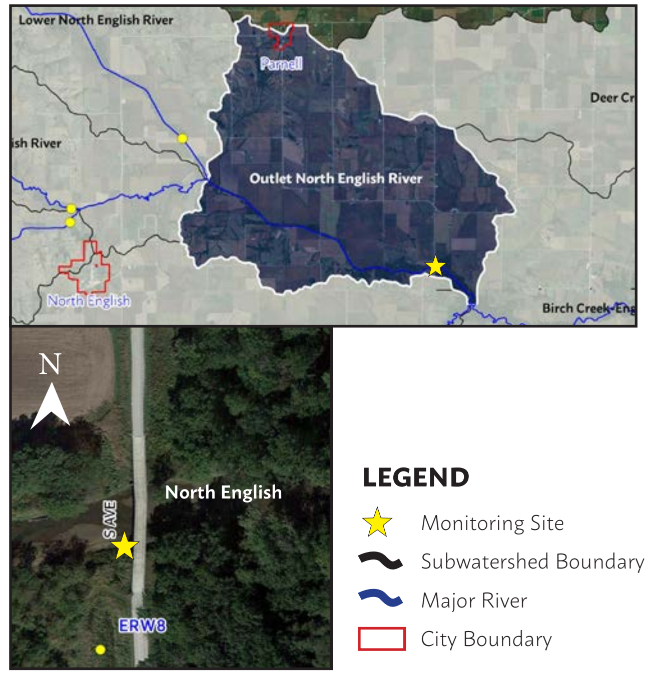

Figure 4. Water quality monitoring location for the Outlet North English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 14 times for Nitrate+Nitrite as N, 14 times for E. coli Bacteria, 13 times for ortho-Phosphate as P, and 14 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 8 was sampled 13 times for Nitrate+Nitrite as N, 13 times for E. coli Bacteria, 12 times for ortho-Phosphate as P, and 13 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 8 ranked 4th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 8 ranked 2nd (nearly the highest). A value of 24,000+ means that the measurable value of E. Coli Bacteria exceeded the lab test's capacity of identifying up to 24,000 CFUs. Further dilution would be required to determine an actual value higher than that. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 8 ranked 2nd (nearly the highest) of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 8 ranked 3rd.

In 2017, Site 8 ranked 8th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 8 ranked 4th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 8 ranked 18th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 8 ranked 16th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 8 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	160	24,000+	2,646
2018	52	24,000+	4,586

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 8 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.12	0.06
2018	0.04	0.14	0.09

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 8 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.40	0.18
2018	0.11	1.30	0.37

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 8 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	8.7	1.9
2018	0.2	9.5	3.6

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

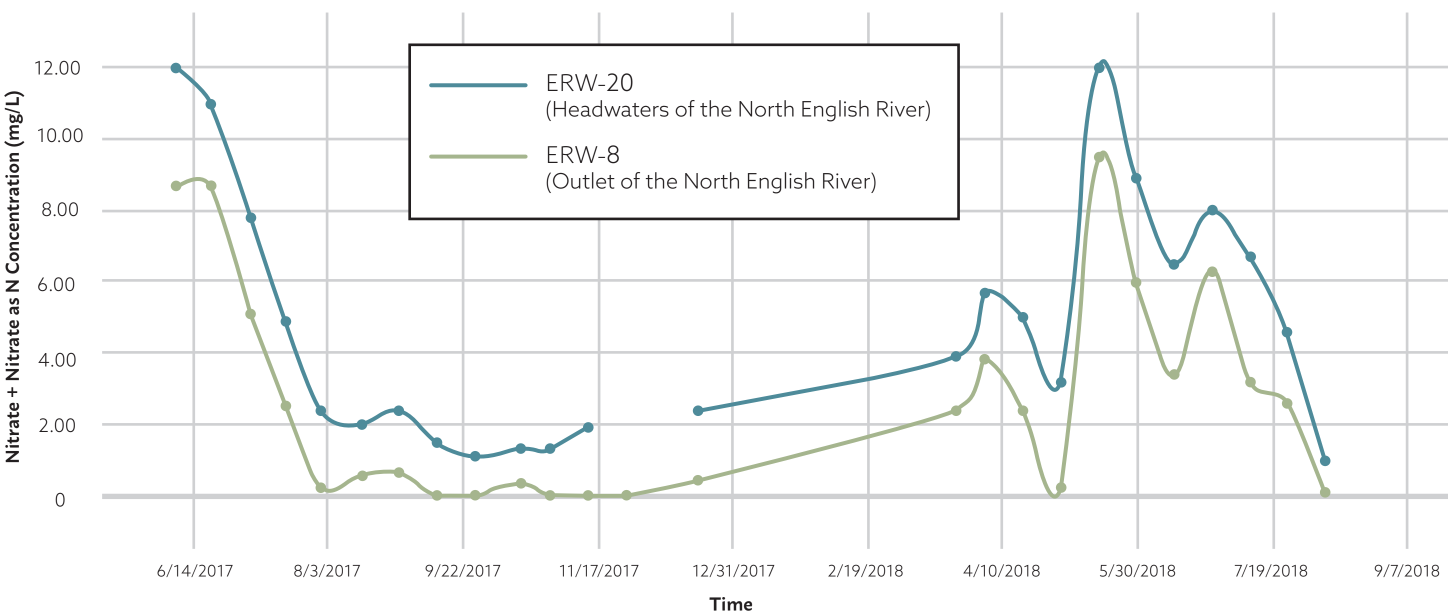

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/subwatershed-plans/monitoring

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Outlet North English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be slightly decreasing. Flooding in April of 2013 generated over 12 times the total erosion (152.12 mm) than Outlet North English River's average monthly erosion of 12.24 mm (0.48 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Outlet North English River's HUC is "070802090408"; see 408 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	301	406	**408**	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	12.75	12.59	12.26	**12.24**	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	82.23	83.68	82.65	**83.17**	84.61	82.92	82.29

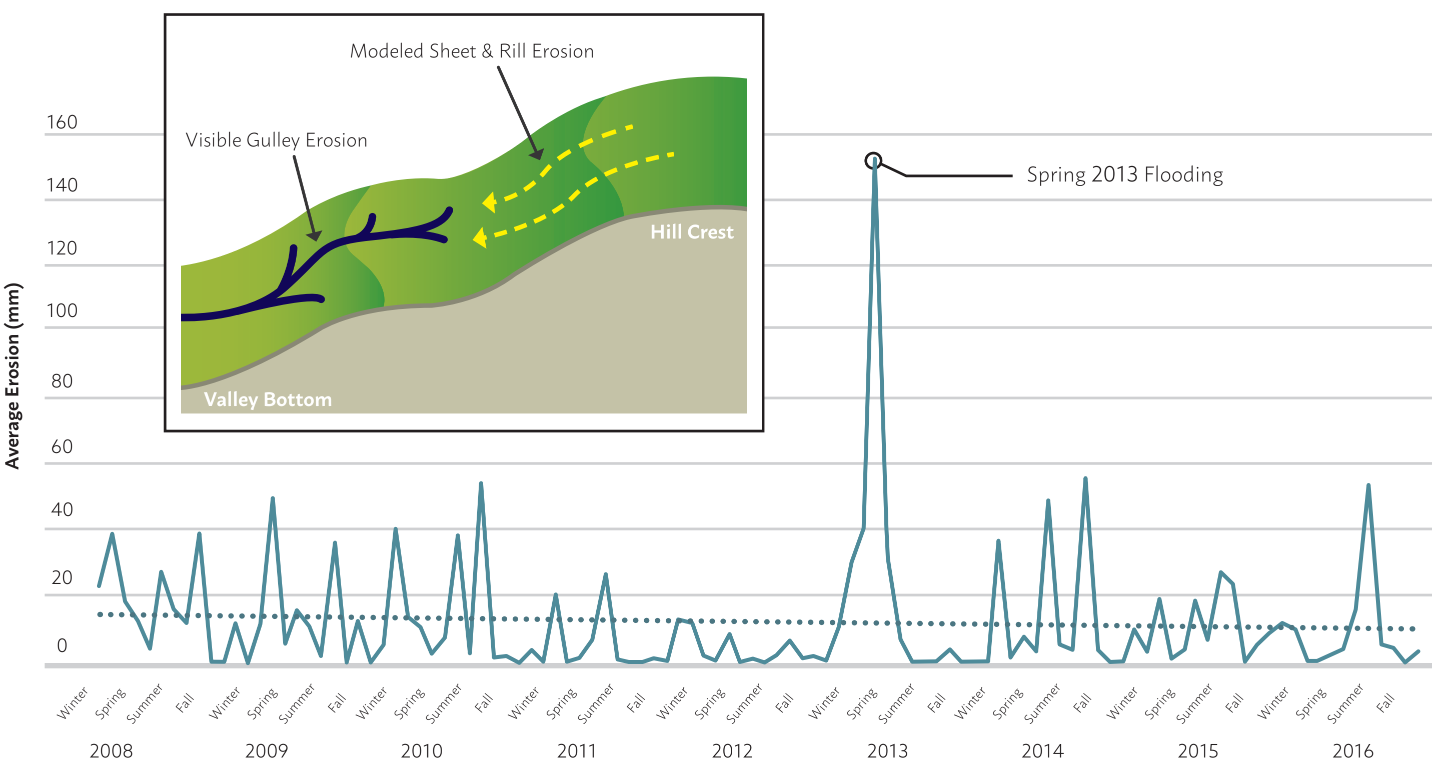

Figure 6. Soil Erosion in the Outlet North English River (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Lower North English River subwatershed experienced an average of 2.37 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Outlet North English River subwatershed ranks among the lowest of all subwatersheds for soil delivery at 4.41 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Outlet North English River subwatershed is below the state average and below the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Outlet North English River subwatershed.

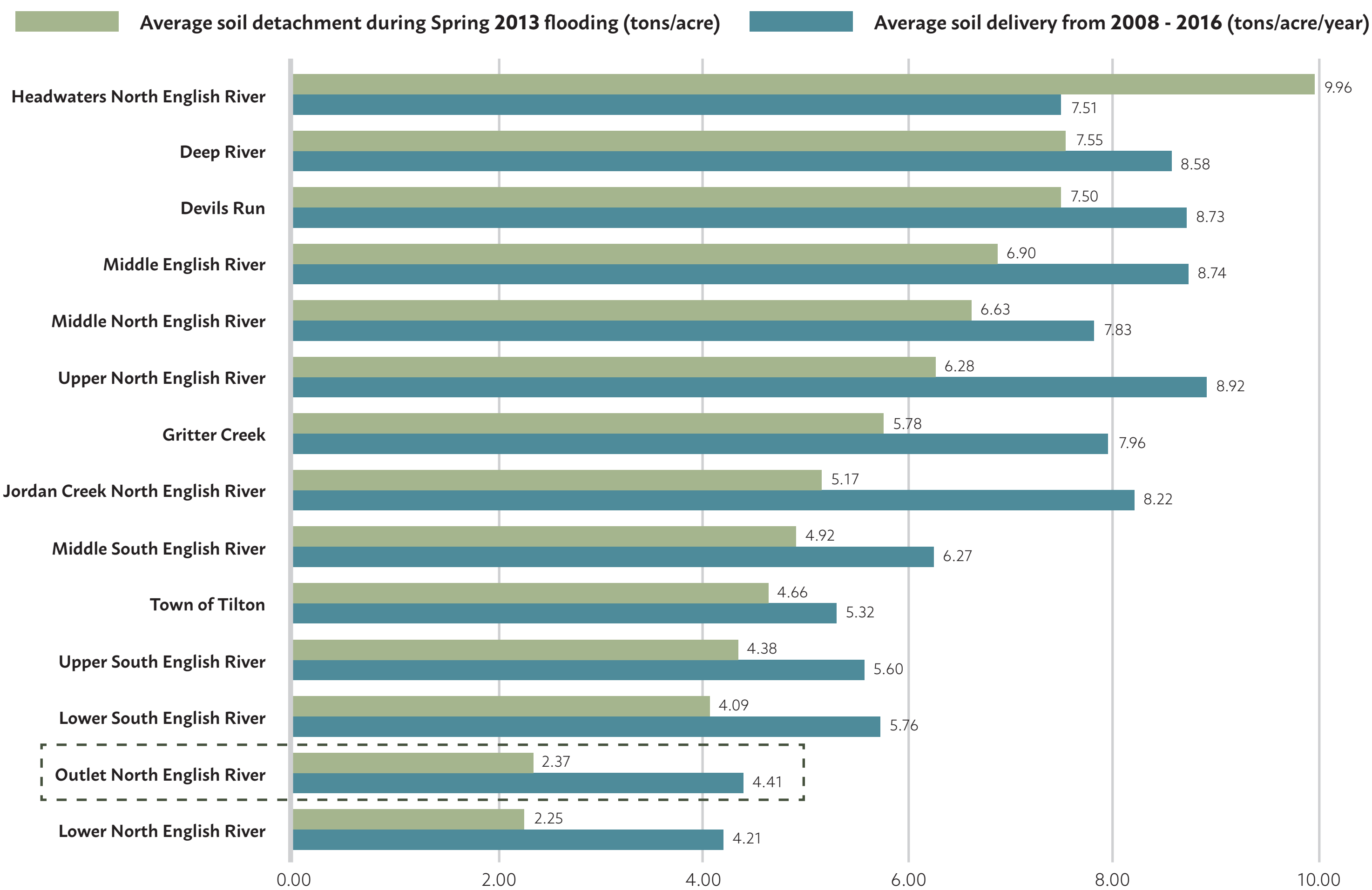

Figure 7. Soil Delivery and Detachment in the Outlet North English River (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR OUTLET NORTH ENGLISH RIVER:
https://bit.ly/2xXn8af

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Outlet North English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

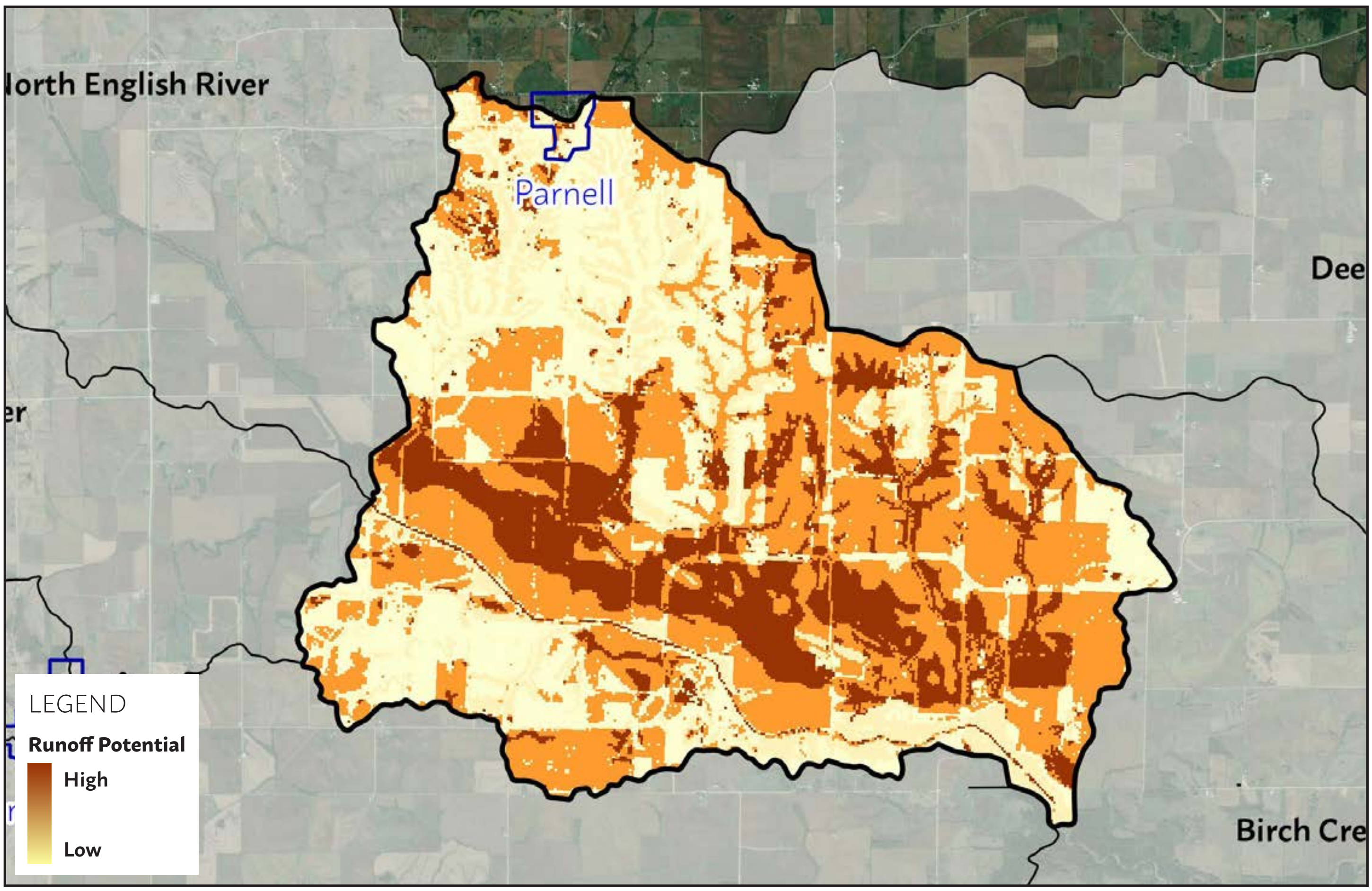

Figure 8. SCS-CN Runoff Potential Model for the Outlet North English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR OUTLET NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 185.31 miles of contour buffer strips, 12 bioreactors, 89 WASCOBs, 5 nutrient-removal wetlands, a total of 1,004.06 acres of drainage area for the wetlands, and 43.37 miles of grassed waterways in the Outlet North English River subwatershed (Table 11). If all 5 wetlands were installed in the subwatershed, roughly 8.5 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	**14,193**	**185.31**	**12**	**89**	**5**	**1,004.06**	**7.1 %**	**43.37**
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

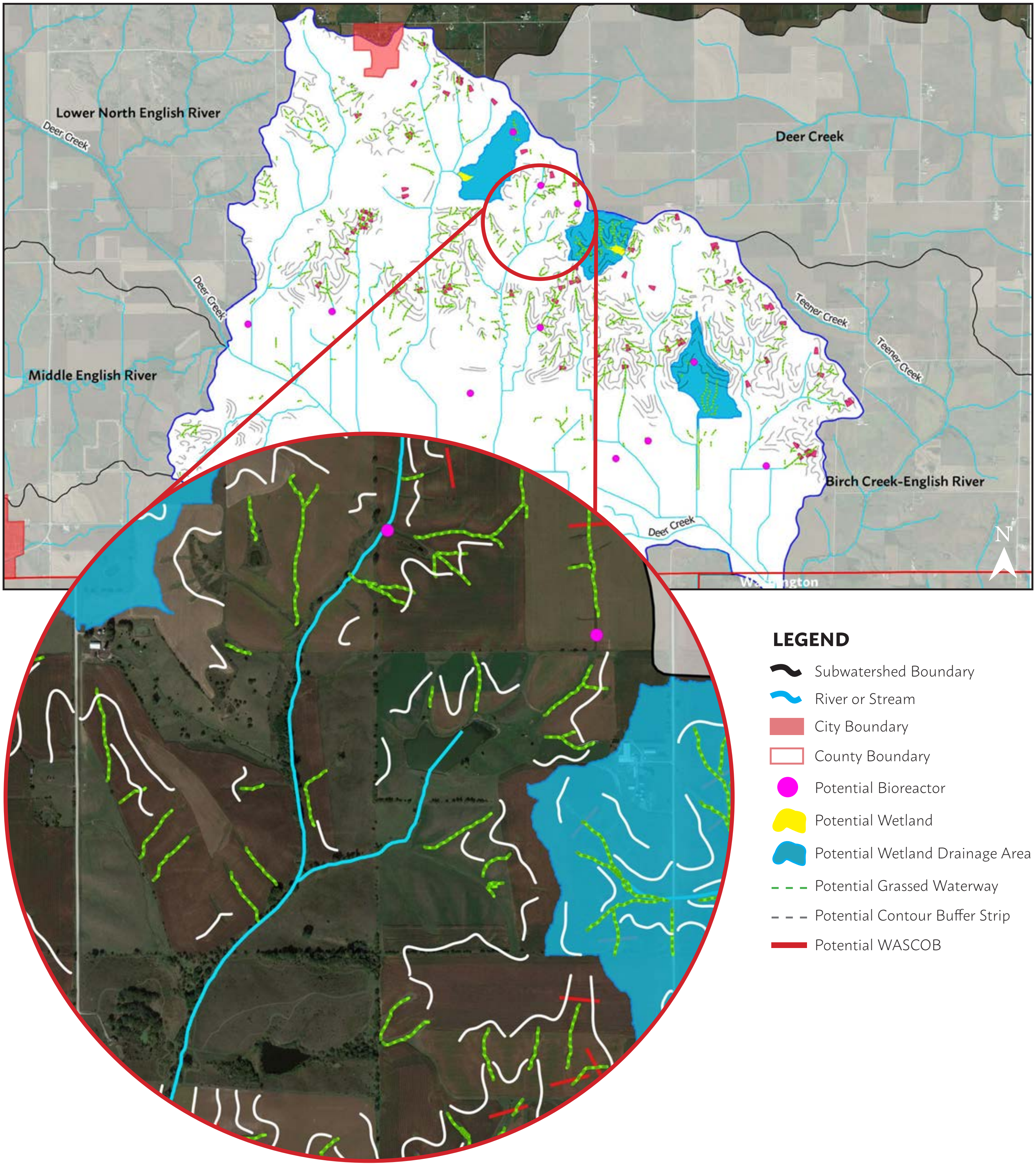

Figure 9. ACPF Model Results for the Outlet North English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR OUTLET NORTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Parnell is the only urbanized, incorporated area in the Outlet North English River subwatershed. Parnell is located at the northern tip of the subwatershed. The larger English River Watershed boundary cuts through the city. The southern half of the city, located within the watershed area, has both commercial and residential land uses.

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Outlet North English River subwatershed. Figure 10 represents the stormwater runoff volume for each catchment area within the city limits of North English where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

Figure 10. Modeled Runoff Volume in Parnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

NITRATE, PHOSPHORUS, AND SEDIMENT LOADING

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Figures 11 displays total nitrate loads for each catchment area within the city limits of Parnell where darker shades of red portray higher loads. These “hot spots” would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent.

Figures 12 and 13 display total phosphorus loads and total sediment loads for each catchment area within the city limits of Parnell where darker shades of red portray higher loads. These “hot spots” would be suitable locations for best management practices such as bioswales or rain gardens.

Figure 11. Modeled Nitrate Load in Parnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

Figure 12. Modeled Phosphorus Load in Parnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

Figure 13. Modeled Sediment Load in Parnell, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley’s High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW PARNELL INTERACTIVE WEBMAP:
https://arcg.is/jumij

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Iowa County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2015 and expires in 2020.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Outlet North English River subwatershed. The flood hazard area accounts for roughly 21.5 percent of the subwatershed area (largest area among subwatersheds). Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow thei r banks. Urban areas, such as the City of Parnell, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 3.7 percent of Iowa County's area. By contrast, the English River Watershed overlaps about 58 percent of Iowa County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

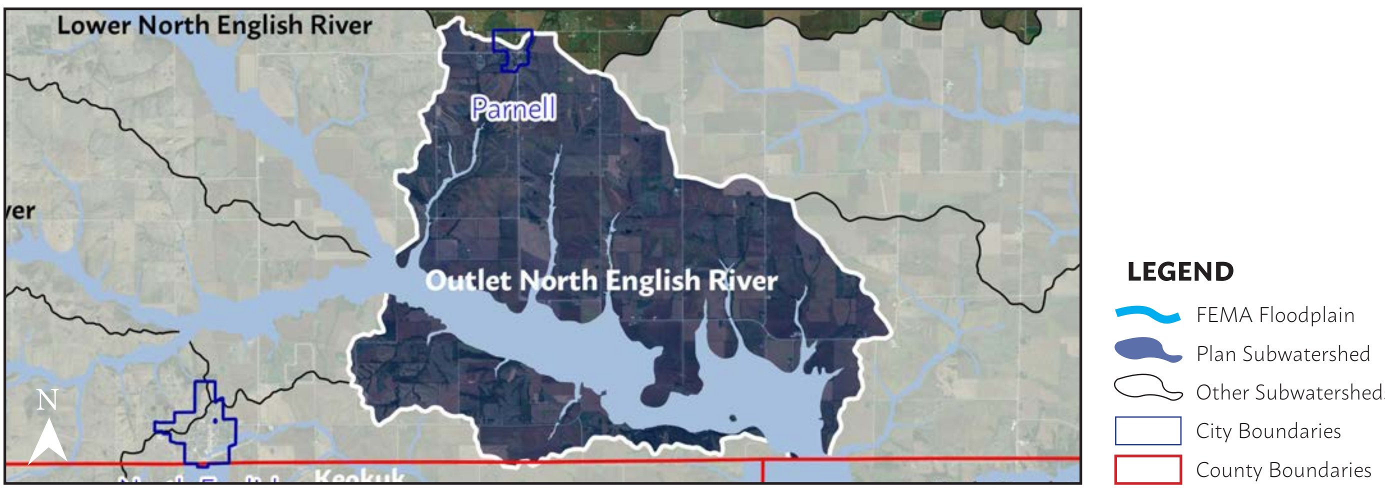

Figure 14. Flood hazard boundary areas for the Outlet North English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Iowa County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$ 1,694,636.89
Debris Removal	$ 28,080.32
Emergency Procedures	$ 217,482.02
Total	**$ 1,940,199.23**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Iowa County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at English River Gauge in Parnell
May 25 – August 13, 2008	$ 1,350,745.51	No historic data available
June 1 – August 31, 2010	$ 140,890.92	No historic data available
April 17 – April 30, 2013	$ 65,639.99	No historic data available
May 19 – June 1, 2013	$ 123,608.19	No historic data available
June 26 – July 8, 2014	$ 259,314.62	No historic data available
Total	**$ 1,940,199.23**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 1 structure vulnerable to losses from the 1 percent annual chance flood (red dots) and 6 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

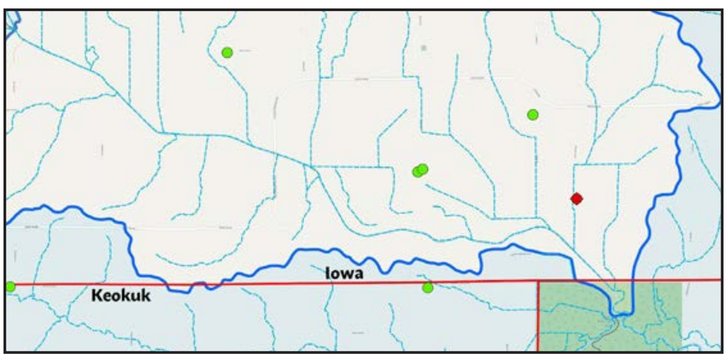

Figure 15. Vulnerable structures for flood hazards in the Outlet North English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW PARNELL NFIP FLOOD MAP:
http://arcg.is/1en9r

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	**Yes**
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	**No**
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	Keokuk	Gibson, Keswick, Webster	0.404	7 % Unemployed	15 % Poverty	25 % Children
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	**Iowa**	**Parnell**	**0.326**	**0.5 % Black or African American**	**10 % Poverty**	**19 % Age 65 or Older**

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Outlet North English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

The subwatershed is the outlet of the North English River into the English River and consequently presents high levels of E.Coli bacteria, orthophosphate, and total phosphate contamination as the nutrients accumulate from upstream subwatersheds. Likewise, the subwatershed presents the large floodplain area in the entire ERW, covering over 20 percent of the subwatershed area. These characteristics create potential for highly-effective nutrient-removal wetlands. Improvements in the subwatershed should also be focused on repairing the floodplain and riparian areas leading to the confluence. Although the Outlet North English River presents the lowest SVI, it is still classfied as "medium vulnerability" according to the Iowa Flood Center. One of the largest vulnerability indicators in the subwatershed is an aging population; nearly one-fifth of the population is 65 years of age or older.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Outlet North English River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along North English River in the City of Parnell	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Outlet North English subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa SWCD, NRCS	Iowa County, Parnell	Medium/ High
	1.3	Flood protection for population safety in Outlet North English subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	IWA, PDM	City of Parnell, ERW	City of Parnell	Low
2	2.2	Acquire property at risk of flooding near North English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in Parnell	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Outlet North English subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	IWA, WQI	Iowa SWCD, NRCS, ERW	City of Parnell	Medium/ High
	3.2	Improve water quality in rural areas in Outlet North English subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319, IWA	Iowa SWCD, NRCS, ERW	Iowa County	High
4	4.1	Provide flood protection for roads and in Outlet North English subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM, IWA	Secondary Roads, Iowa SWCD, NRCS	Iowa County, Parnell	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

TOWN OF TILTON

HUC-12: 070802090501

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Town of Tilton subwatershed is located in the north central region of the ERW. It overlaps two counties (Poweshiek and Iowa). There are no incorporated areas that overlap the subwatershed. The Town of Tilton subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features average depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 54-56.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 11,016 acres (17.2 square miles) of land, which is predominately row crops (corn and soybeans). An unnamed creek stretches approximately 12.68 miles through the subwatershed in northwest to southeast direction, and eventually meets the South English River about 7 miles south east of the City of Barnes City.

It was determined in Phase 1 planning that the primary resource concern in in the Town of Tilton subwatershed is nitrate and nitrite contamination. Additionally, the subwatershed ranked near the middle in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

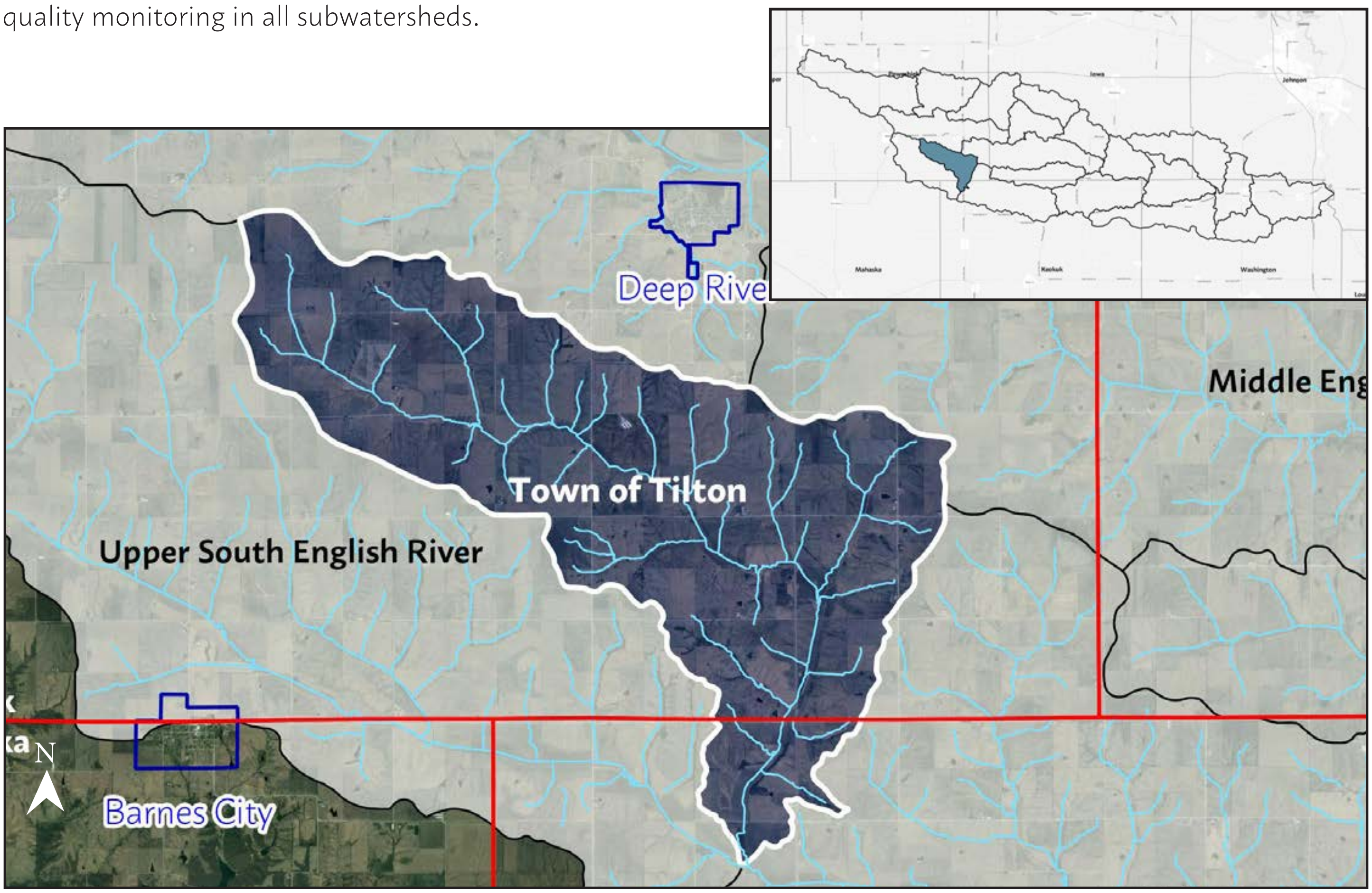

Figure 1. Town of Tilton Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

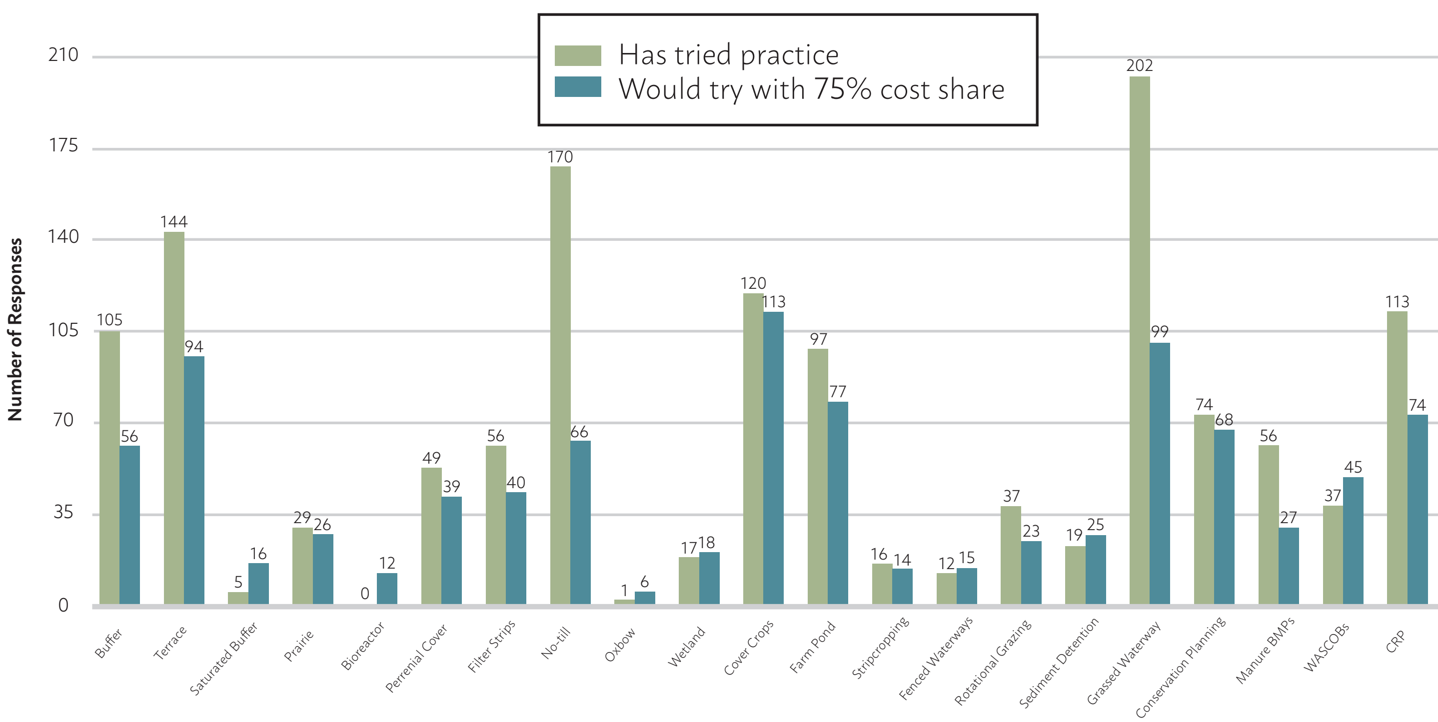

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

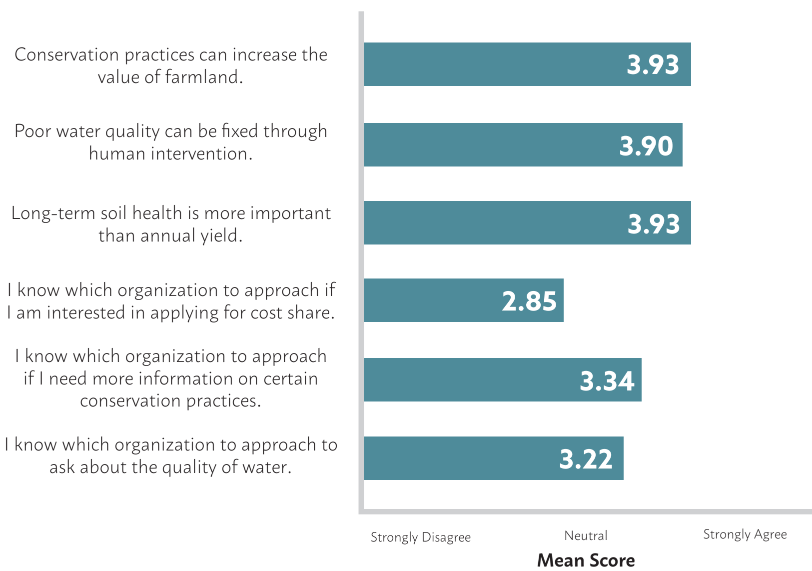

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 17 is near the outlet of the Town of Tilton subwatershed. The sampling site is located on the 110th Street bridge over an unnamed creek in the extreme NW corner of Keokuk County, just a little NE of the South English River and the City of Gibson (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

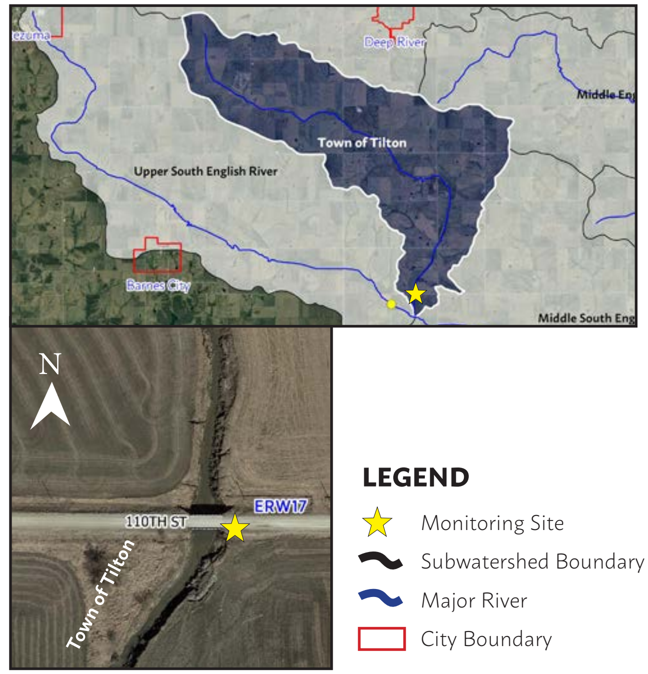

Figure 4. Water quality monitoring location for Town of Tilton subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 17 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 17 ranked 19th (nearly the lowest) of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 17 ranked 16th. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 17 ranked 17th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 17 ranked 19th (nearly the lowest).

In 2017, Site 17 ranked 17th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 17 ranked 20th (the lowest). Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 17 ranked 5th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 17 ranked 13th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 17 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	110	700	423
2018	20	1,400	700

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 17 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.05	0.03
2018	0.03	0.04	0.04

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 17 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.08	0.17	0.14
2018	0.08	0.13	0.10

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 17 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.3	15.0	4.2
2018	2.8	5.9	4.1

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

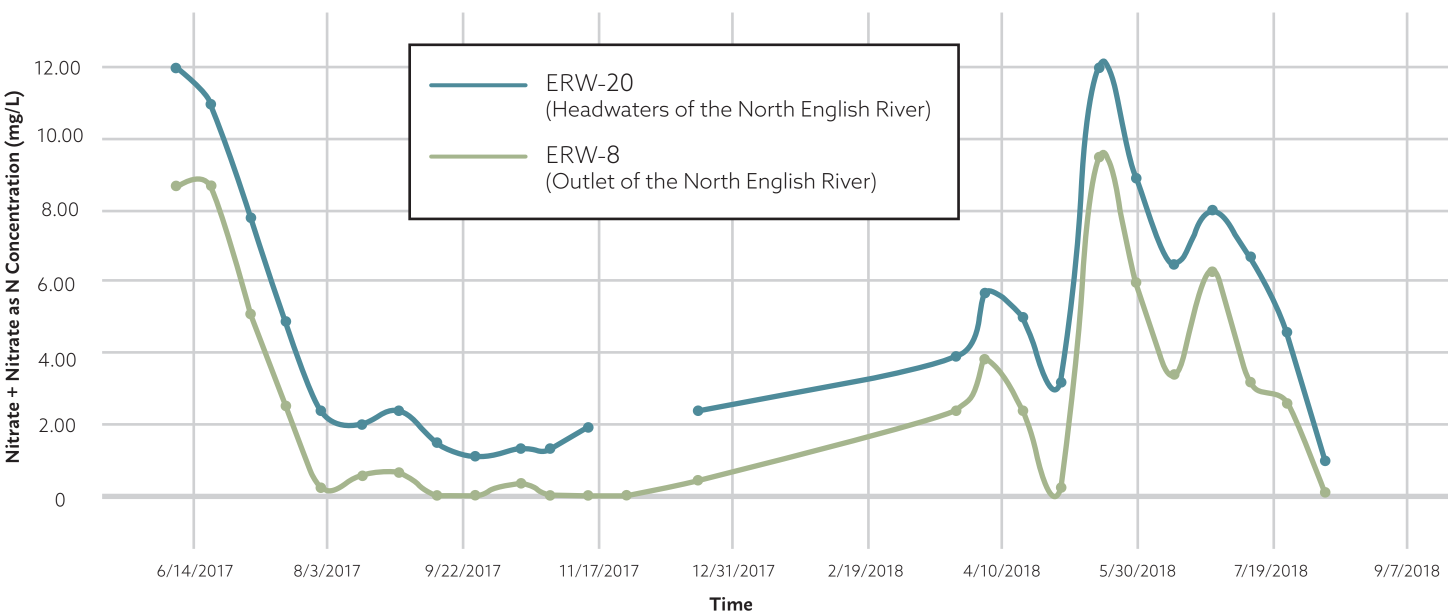

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Town of Tilton subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 7 times the total erosion (118.86 mm) than Town of Tilton's average monthly erosion of 12.89 mm (0.50 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Town of Tilton's HUC is "070802090501"; see 501 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	**501**	403	502	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	**12.89**	12.76	12.75	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	**82.04**	81.65	82.23	83.68	82.65	83.17	84.61	82.92	82.29

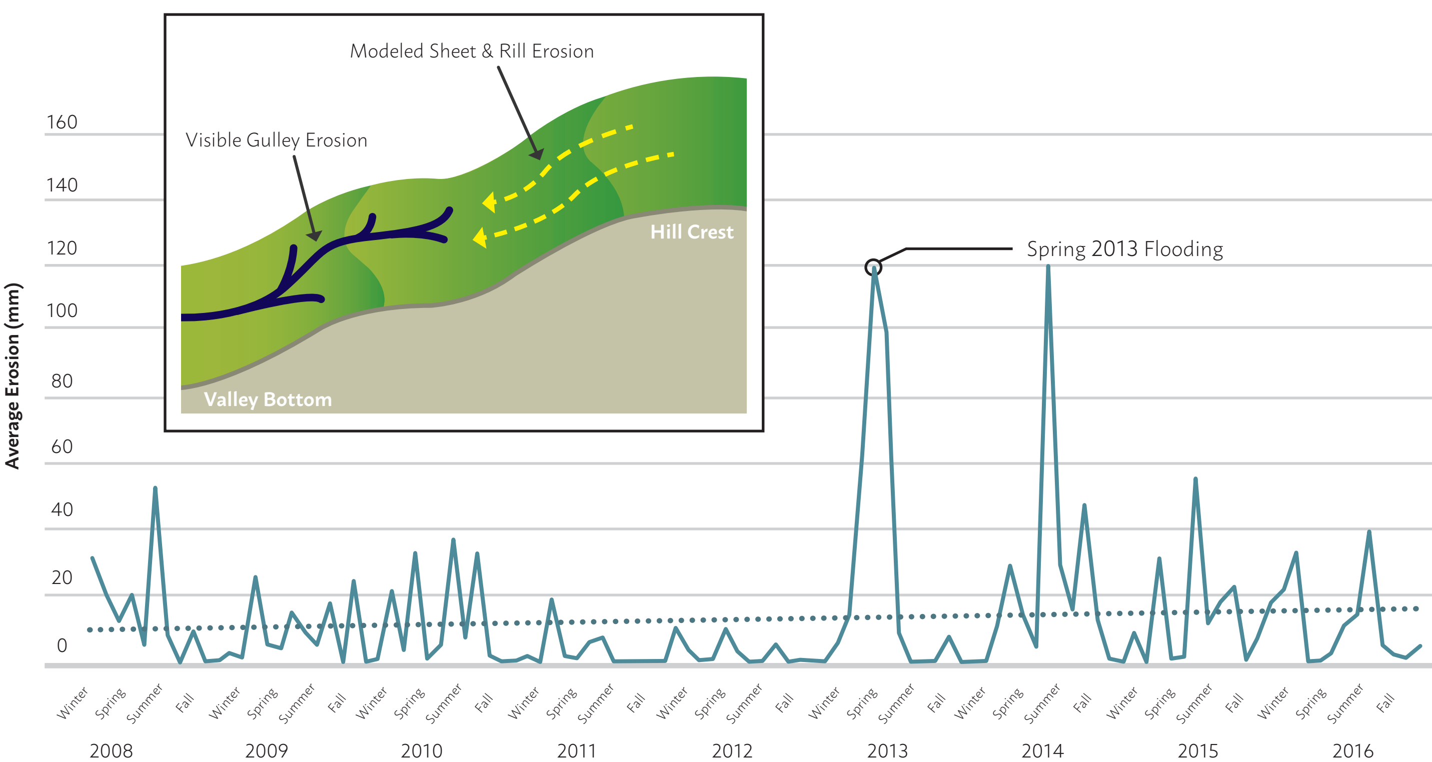

Figure 6. Soil Erosion in Town of Tilton (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Town of Tilton subwatershed experienced an average of 4.66 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Town of Tilton subwatershed ranks near below average of all subwatersheds for soil delivery at 5.32 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Town of Tilton subwatershed is above the state average and below the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Town of Tilton subwatershed.

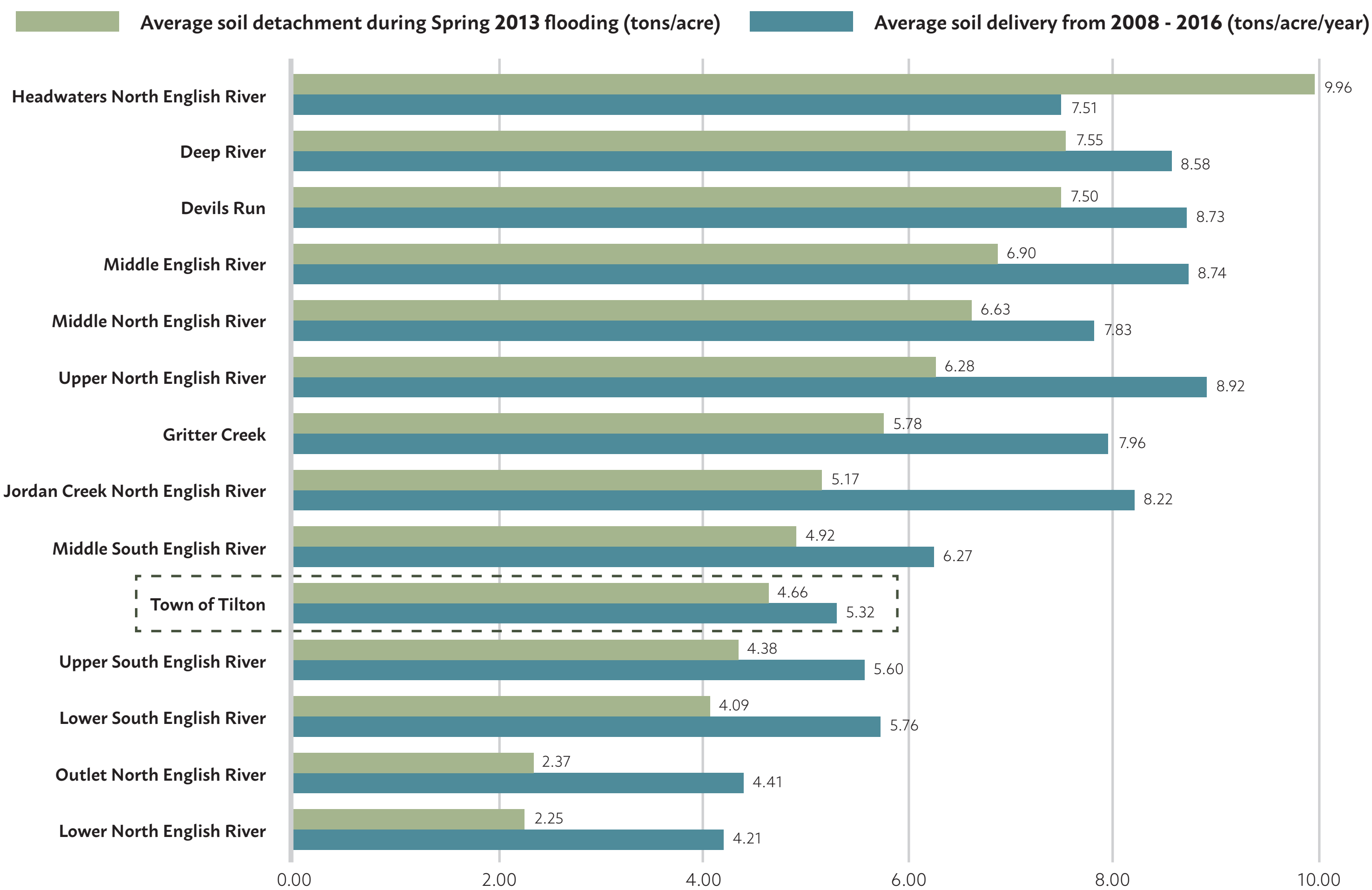

Figure 7. Soil Delivery and Detachment in Town of Tilton (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR TOWN OF TILTON:
https://bit.ly/2P714R5

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Town of Tilton subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

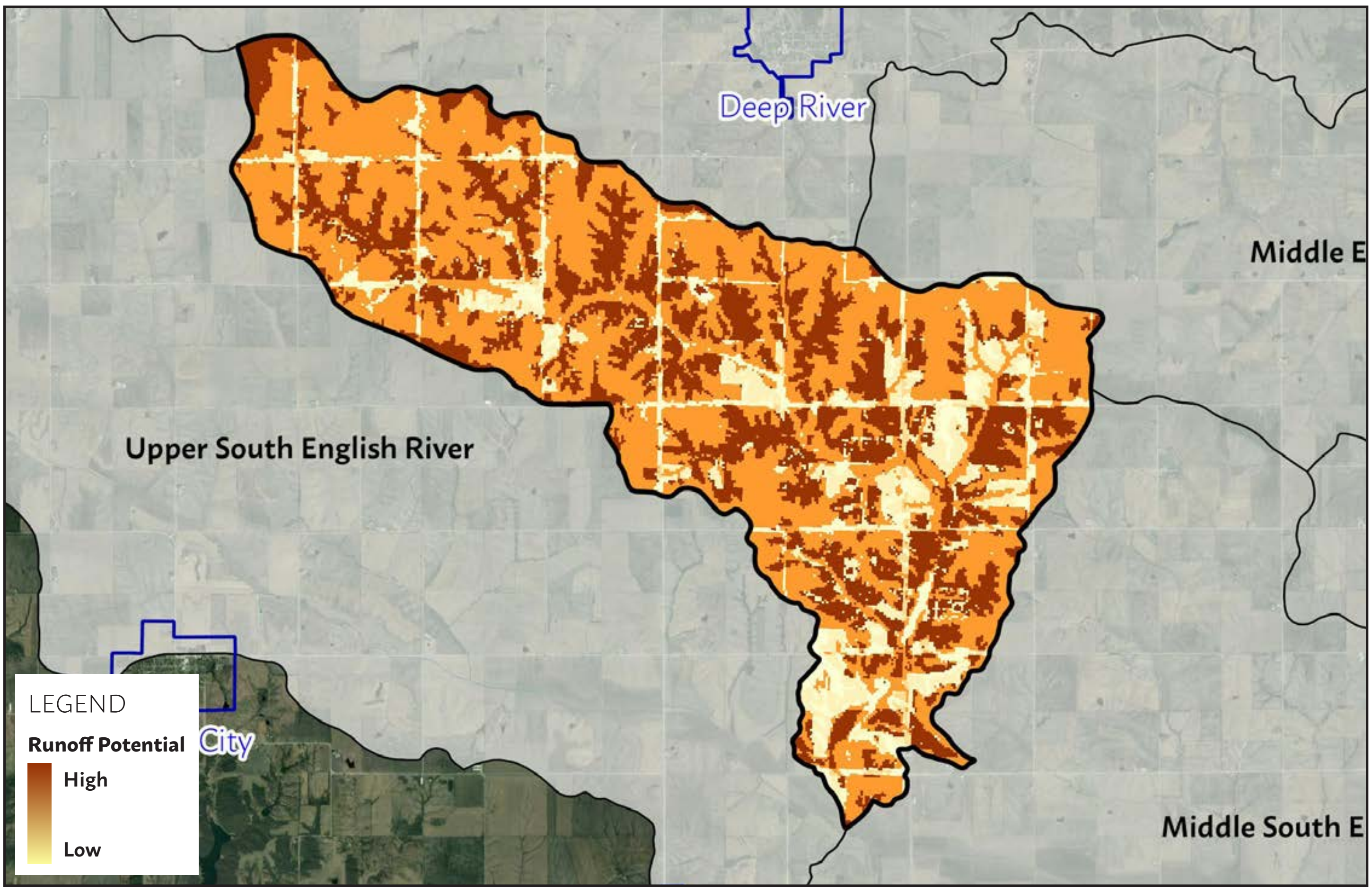

Figure 8. SCS-CN Runoff Potential Model for Town of Tilton Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR TOWN OF TILTON:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 271.67 miles of contour buffer strips, 18 bioreactors, 246 WASCOBs, 6 nutrient-removal wetlands, a total of 1,106.28 acres of drainage area for the wetlands, and 101.12 miles of grassed waterways in the Town of Tilton subwatershed (Table 11). If all 6 wetlands were installed in the subwatershed, roughly 10.0 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	**11,016**	**271.67**	**18**	**246**	**6**	**1,106.28**	**10.0 %**	**101.12**
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

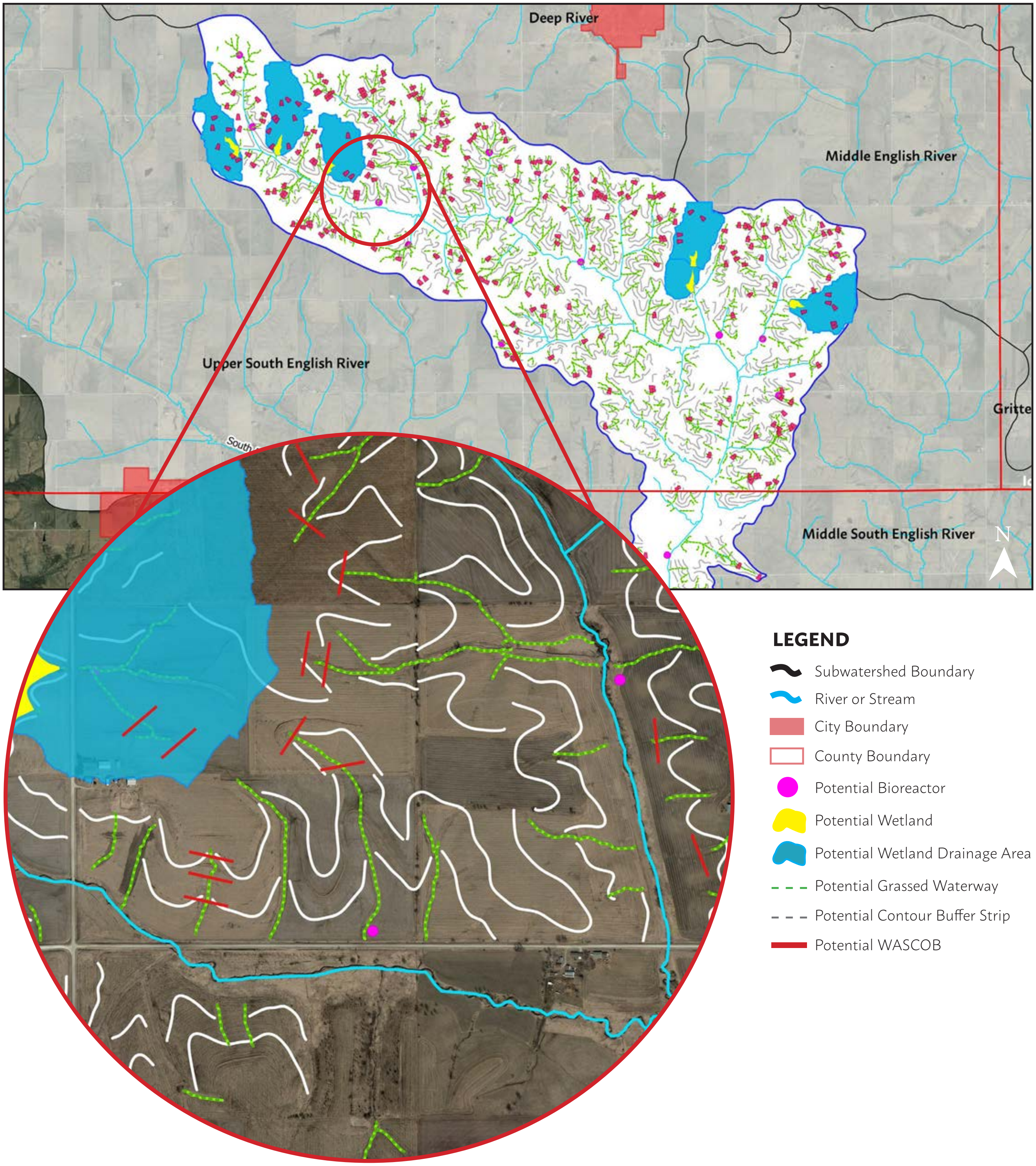

Figure 9. ACPF Model Results for Town of Tilton Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR TOWN OF TILTON:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Poweshiek County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2016 and expires in 2021.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 shown below represents the flood hazards that exist in the Town of Tilton subwatershed. The flood hazard area accounts for roughly 6.4 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, although none exist in the subwatershed, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 2.9 percent of Poweshiek County's area. By contrast, the English River Watershed overlaps about 45 percent of Poweshiek County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

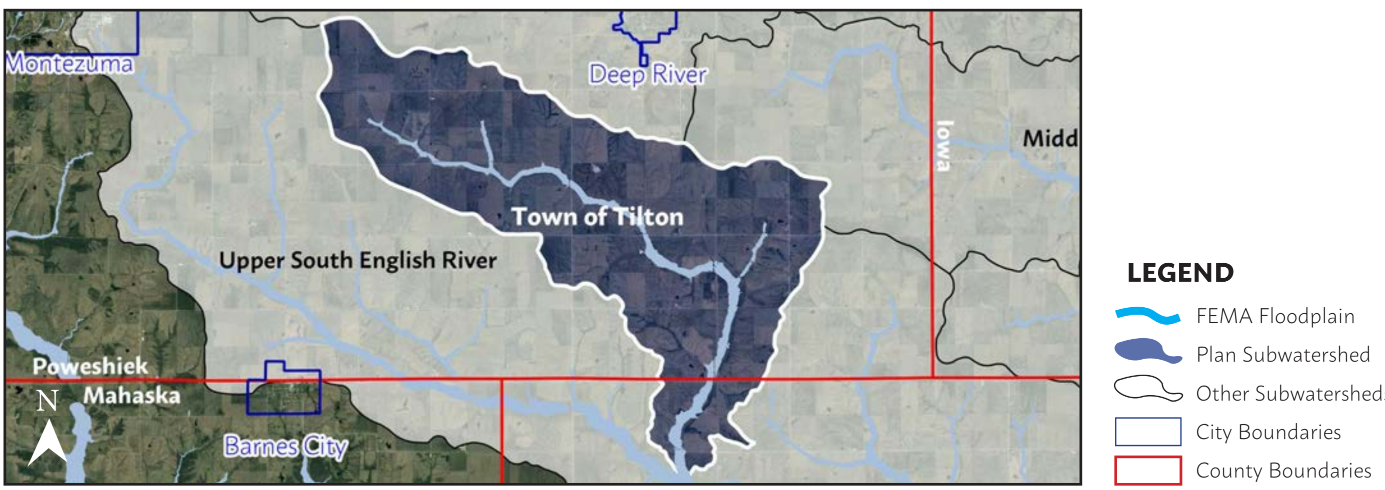

Figure 14. Flood hazard boundary areas for Town of Tilton Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Poweshiek County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$623,826.13
Debris Removal	$133,878.41
Emergency Procedures	$40,166.52
Total	**$797,171.06**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Poweshiek County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at Deep River Monitoring Gauge
May 25 - August 13, 2008	$249,331.52	No historic data available
May 19 - June 1, 2013	$352,811.41	81.53' (6th Highest)
June 26 - July 8, 2014	$195,728.13	81.94' (7th Highest)
Total	**$797,171.06**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 1 structure vulnerable to losses from the 1 percent annual chance flood (red dots) and 4 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

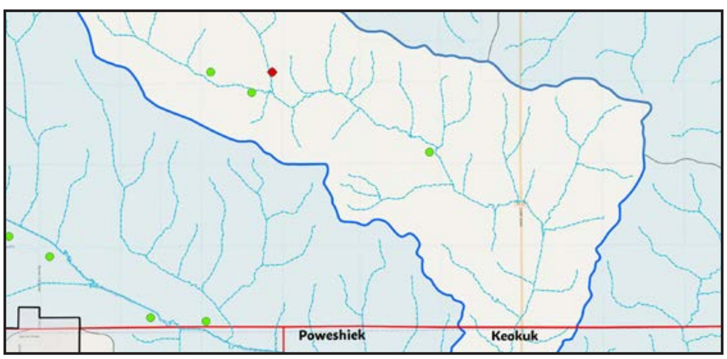

Figure 15. Vulnerable structures for flood hazards in the Town of Tilton Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW POWESHIEK NFIP FLOOD MAP:
http://arcg.is/1bDHWT

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	Yes
Iowa County	Yes
Poweshiek County	**Yes**
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/ high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	**Poweshiek**	**Montezuma, Guernsey, Deep River**	**0.44**	**1 % Black or African American**	**12 % Poverty**	**5 % Unemployed**
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	**Keokuk**	**Gibson, Keswick, Webster**	**0.404**	**7 % Unemployed**	**15 % Poverty**	**25 % Children**
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 7: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Town of Tilton subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

There are not any incorporated areas in the subwatershed but the SVI does rank high among all subwatersheds. The primary indicators of vulnerabilty are high poverty and unemployment rates. Flood hazards in the subwatershed are low, however, with only a few structures at risk and overall a small floodplain area. The primary resource concern in the subwatershed is soil erosion, ranking in the middle for average annual soil erosion, soil detachment during sping 2013 flooding, and soil delivery. Soil erosion can be combated through a variety of in-field and edge-of-field BMPs like contour buffer strips and bioreactors. These practices present strong potential in the subwatershed based on the ACPF model presented in Section 5. Practices should be implemented along ACPF guidelines and in areas that are identified as highly prone to soil erosion, which can be found using the SCS-CN results presented in Section 4.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Town of Tilton subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along unnamed creek	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Town of Tilton subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/ Keokuk SWCD, NRCS	Poweshiek/ Keokuk Counties	Medium/ High
	1.3	Flood protection for population safety in Town of Tilton subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	ERW	N/A	Low
2	2.2	Acquire property at risk of flooding near Town of Tilton; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Town of Tilton subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Poweshiek/ Keokuk SWCD, NRCS, ERW	N/A	Medium/ High
	3.2	Improve water quality in rural areas in Town of Tilton subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Poweshiek/ Keokuk SWCD, NRCS, ERW	Poweshiek/ Keokuk Counties	High
4	4.1	Provide flood protection for roads and in Town of Tilton subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/ Keokuk SWCD, NRCS	Poweshiek/ Keokuk Counties	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

SUBWATERSHED TOOLKITS

UPPER SOUTH ENGLISH RIVER

HUC-12: 070802090502

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/ rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Upper South English River subwatershed is located in the north central region of the ERW. It overlaps three counties (Poweshiek, Keokuk, and Iowa). The City of Montezuma (population 1,462), Barnes City (population 176), and Gibson (population 61) are incorporated area sthat overlaps the subwatershed. The Upper South English River subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features average depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 54-56.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 18,411 acres (28.7 square miles) of land, which is predominately row crops (corn and soybeans). The South English River stretches approximately 13.71 miles through the subwatershed in northwest to southeast direction, which meets an unnamed creek about 2 miles northeast of Gibson.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is nitrate and nitrite contamination. Additionally, the Upper South English River subwatershed ranked average in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

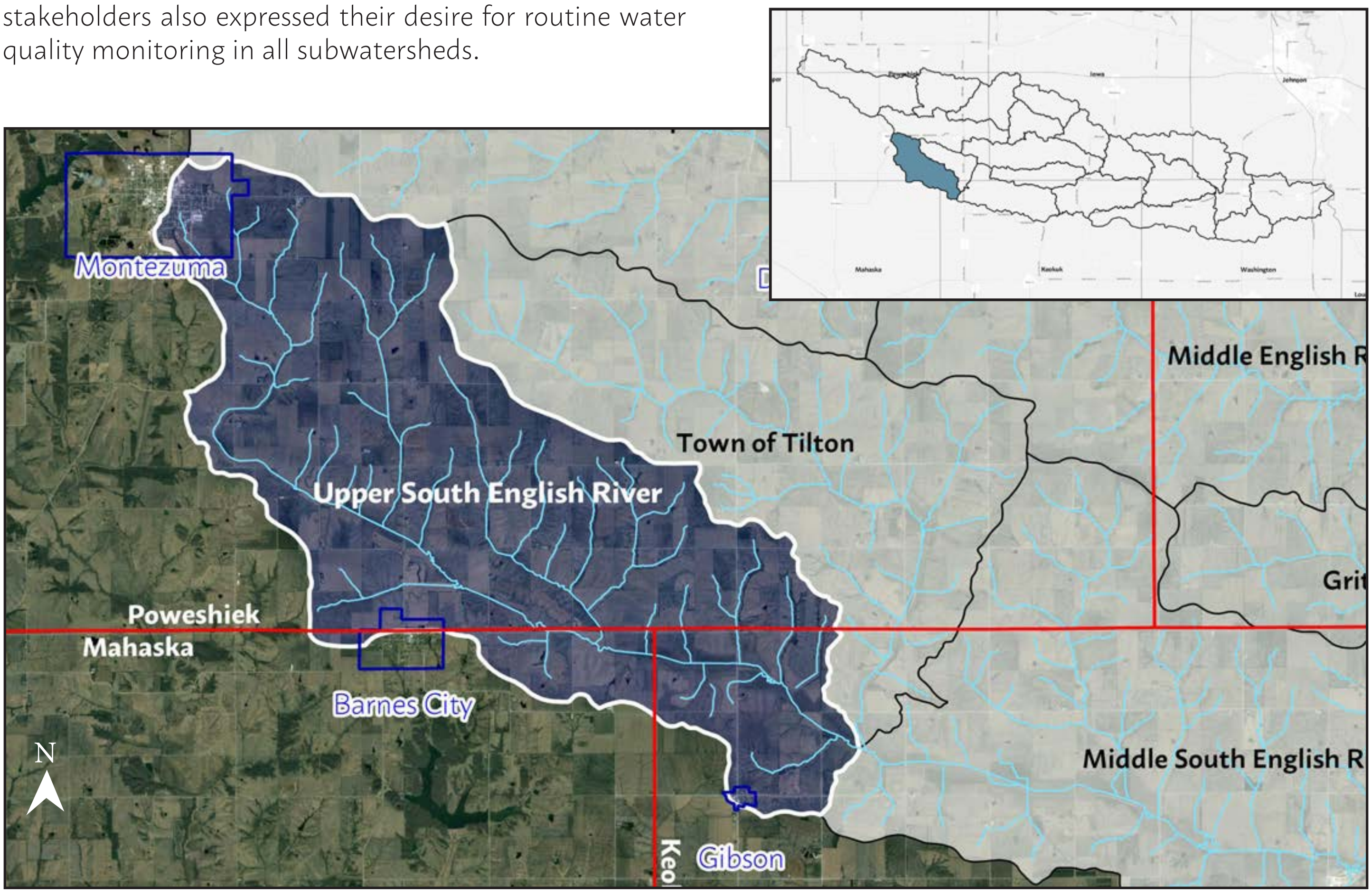

Figure 1. Upper South English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

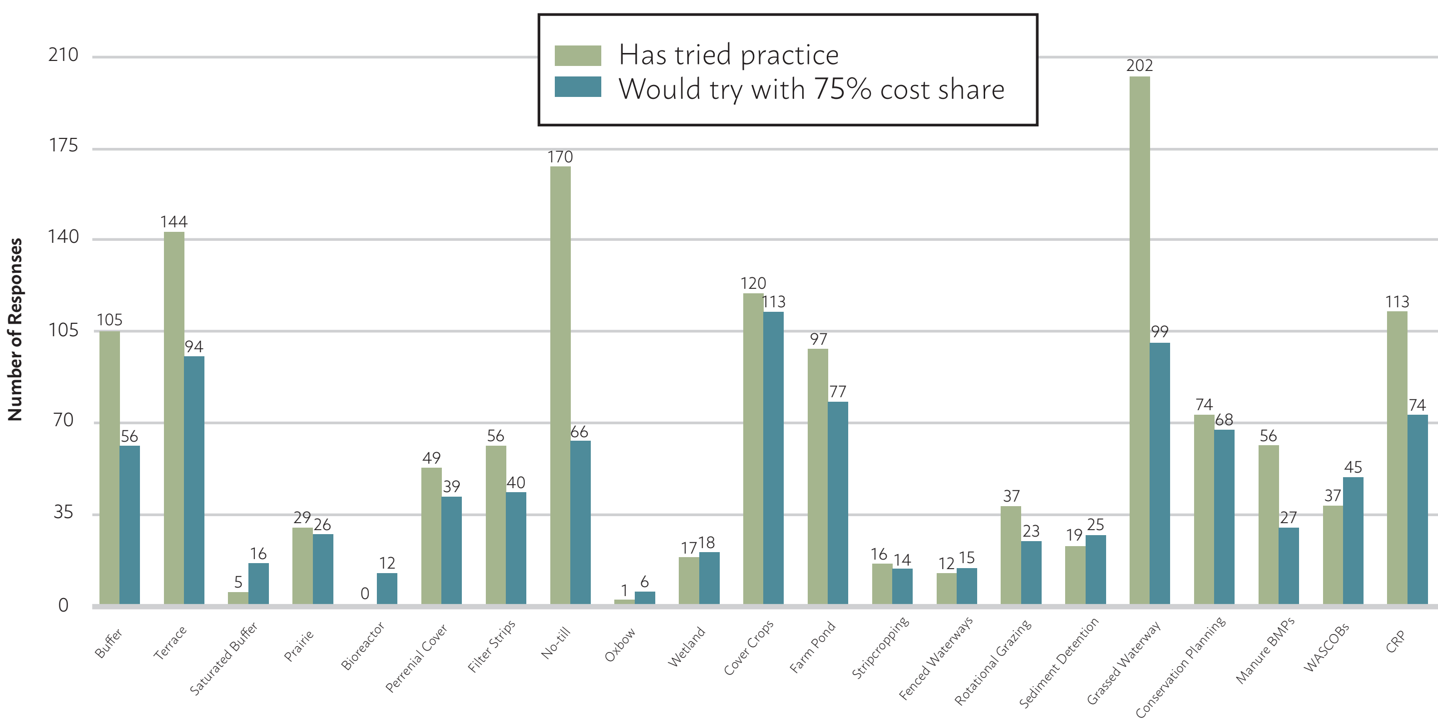

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

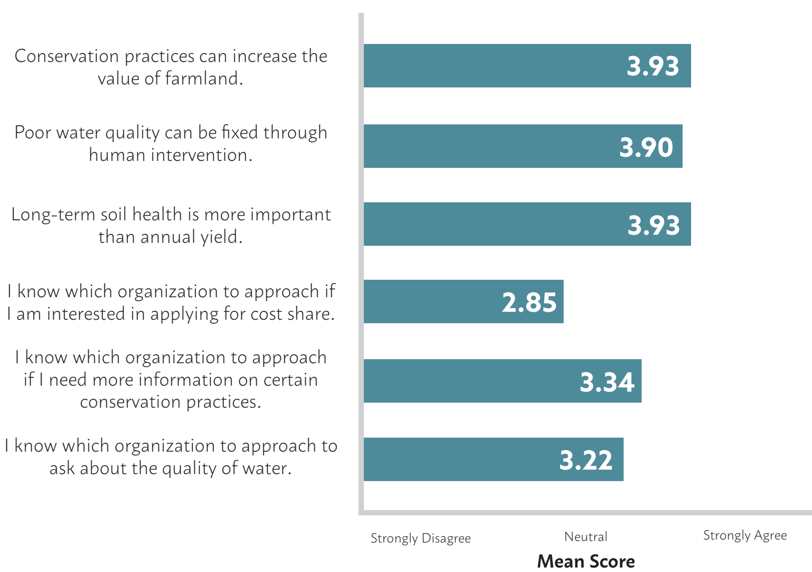

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 18 is near the outlet of the Upper South English River subwatershed. The sampling site is located on the 120th Avenue bridge over the upper portion of the South English River, just NE of the City of Gibson.

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

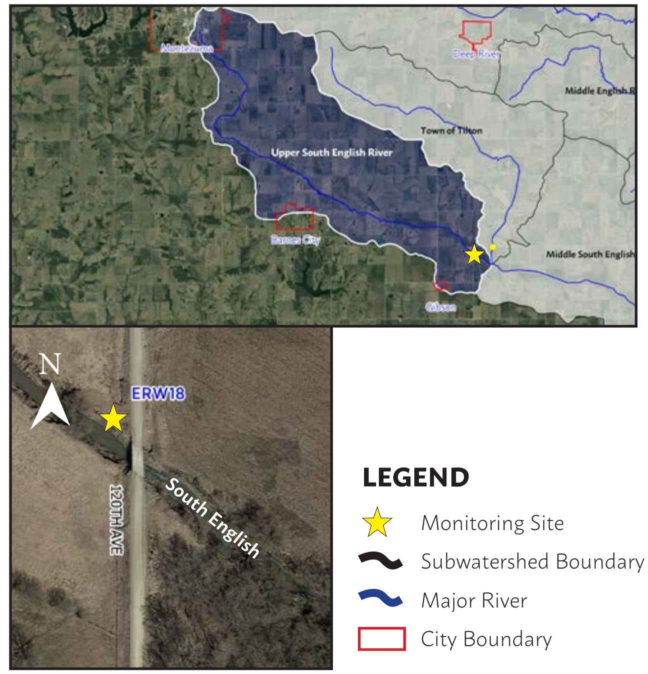

Figure 4. Water quality monitoring location for Upper South English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 18 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 18 ranked 12th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 18 ranked 20th (the lowest). Values in red exceed the Iowa beach advisory standards of 235 CFUs/100mL.

In 2017, Site 18 ranked 19th (nearly the lowest) of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 18 ranked 20th (the lowest).

In 2017, Site 18 ranked 13th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 18 ranked 19th (nearly the lowest). Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 18 ranked 2nd (nearly the highest) of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 18 ranked 9th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	360	1,000	780
2018	300	840	570

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.05	0.03
2018	0.02	0.04	0.03

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.14	0.20	0.17
2018	0.09	0.13	0.11

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 18 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	14.0	4.7
2018	2.9	8.3	4.7

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

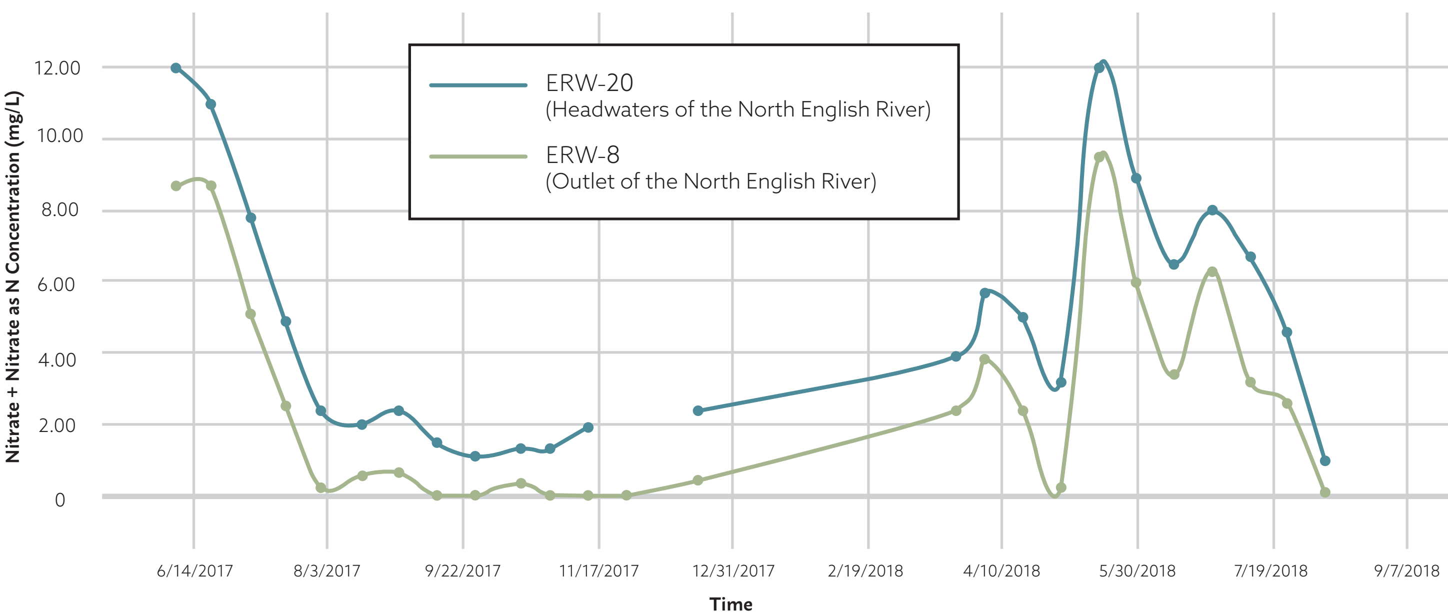

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Upper South English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 7 times the total erosion (109.21 mm) than Upper South English River's average monthly erosion of 12.75 mm (0.50 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Upper South English River's HUC is "070802090502"; see 502 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	**502**	301	406	408	407	503	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	**12.75**	12.59	12.26	12.24	12.23	11.78	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	**82.23**	83.68	82.65	83.17	84.61	82.92	82.29

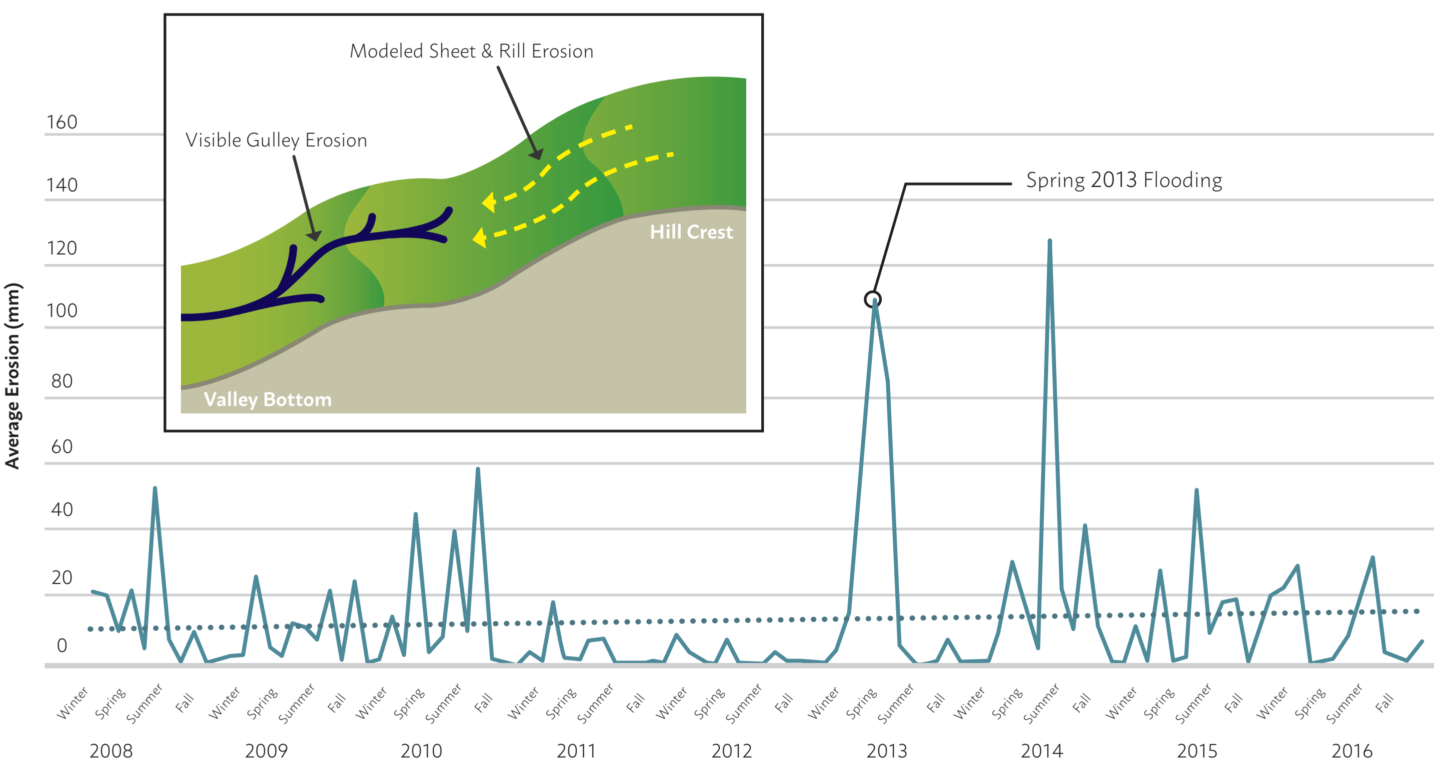

Figure 6. Soil Erosion in Upper South English River (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Upper South English River subwatershed experienced an average of 4.83 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Upper South English River subwatershed ranks near the middle of all subwatersheds for soil delivery at 5.60 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Upper South English River subwatershed is slightly above the state average and below the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Upper South English River subwatershed.

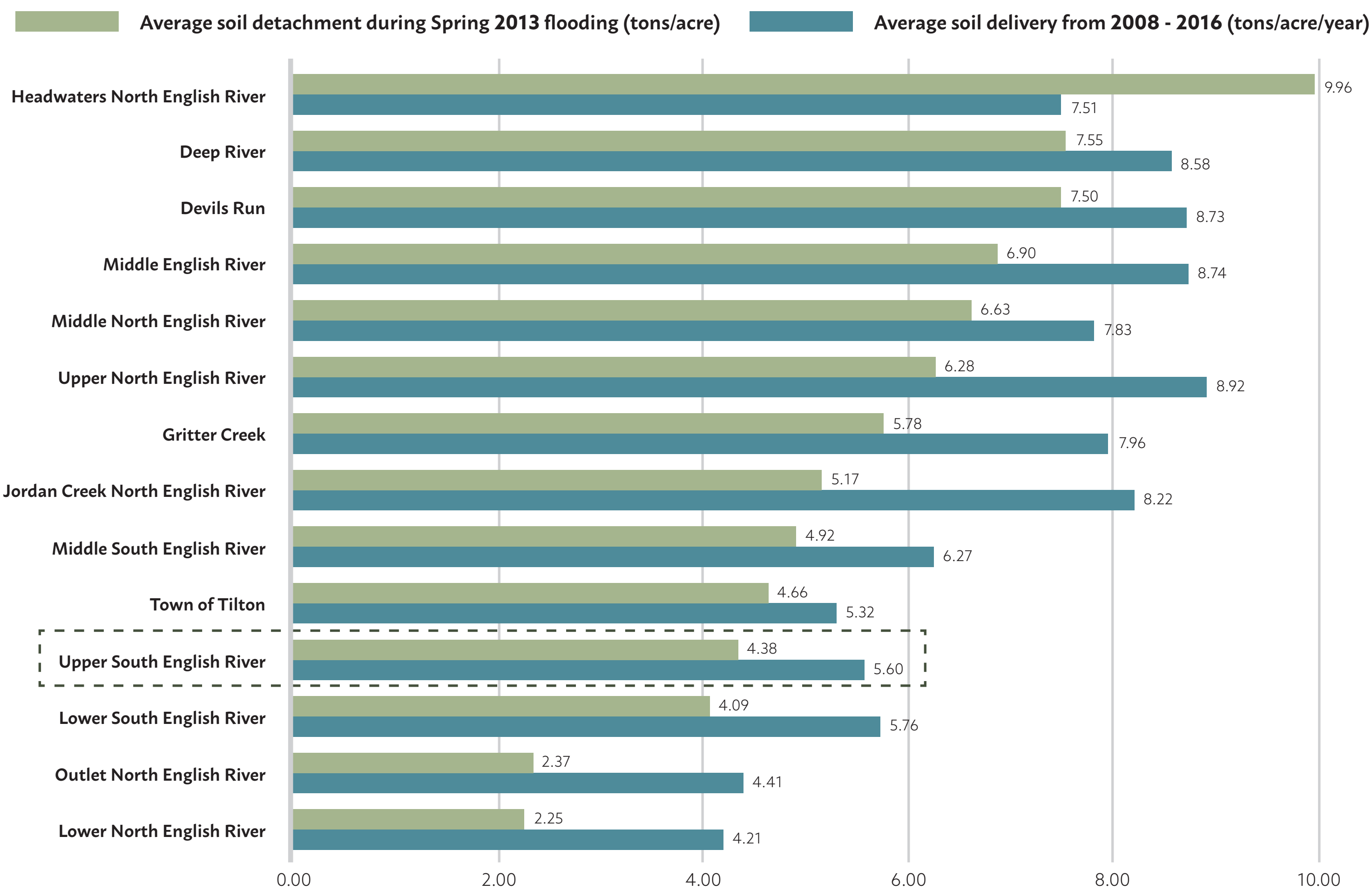

Figure 7. Soil Delivery and Detachment in Upper South English River (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR UPPER SOUTH ENGLISH RIVER:
https://bit.ly/2OCf8Vy

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Upper South English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

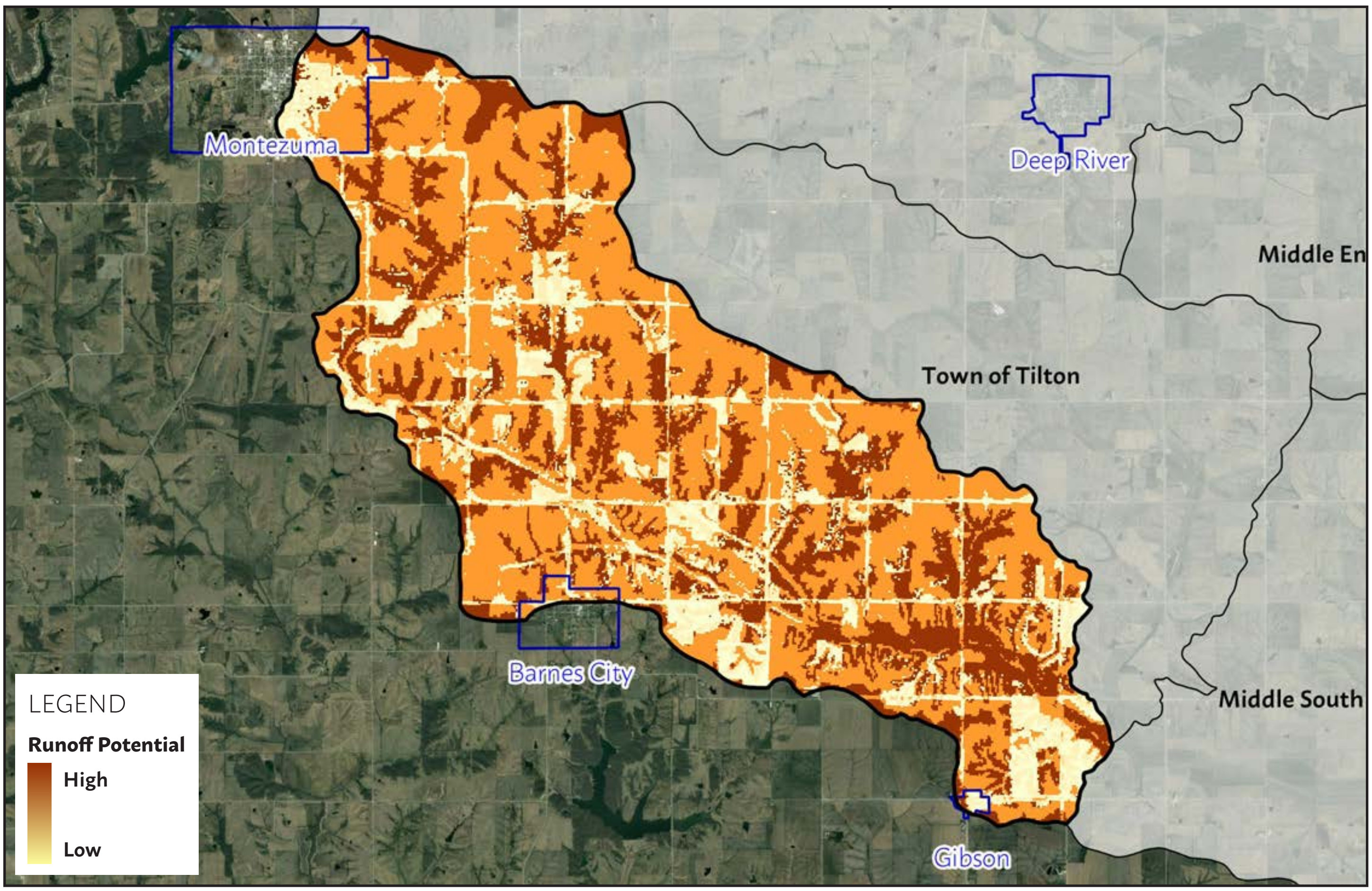

Figure 8. SCS-CN Runoff Potential Model for Upper South English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR UPPER SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 414.42 miles of contour buffer strips, 33 bioreactors, 444 WASCOBs, 18 nutrient-removal wetlands, a total of 3,699.51acres of drainage area for the wetlands, and 148.87 miles of grassed waterways in the Upper South English River subwatershed (Table 11). If all 18 wetlands were installed in the subwatershed, roughly 20.1 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	**18,411**	**414.42**	**33**	**444**	**18**	**3,699.51**	**20.1 %**	**148.87**
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

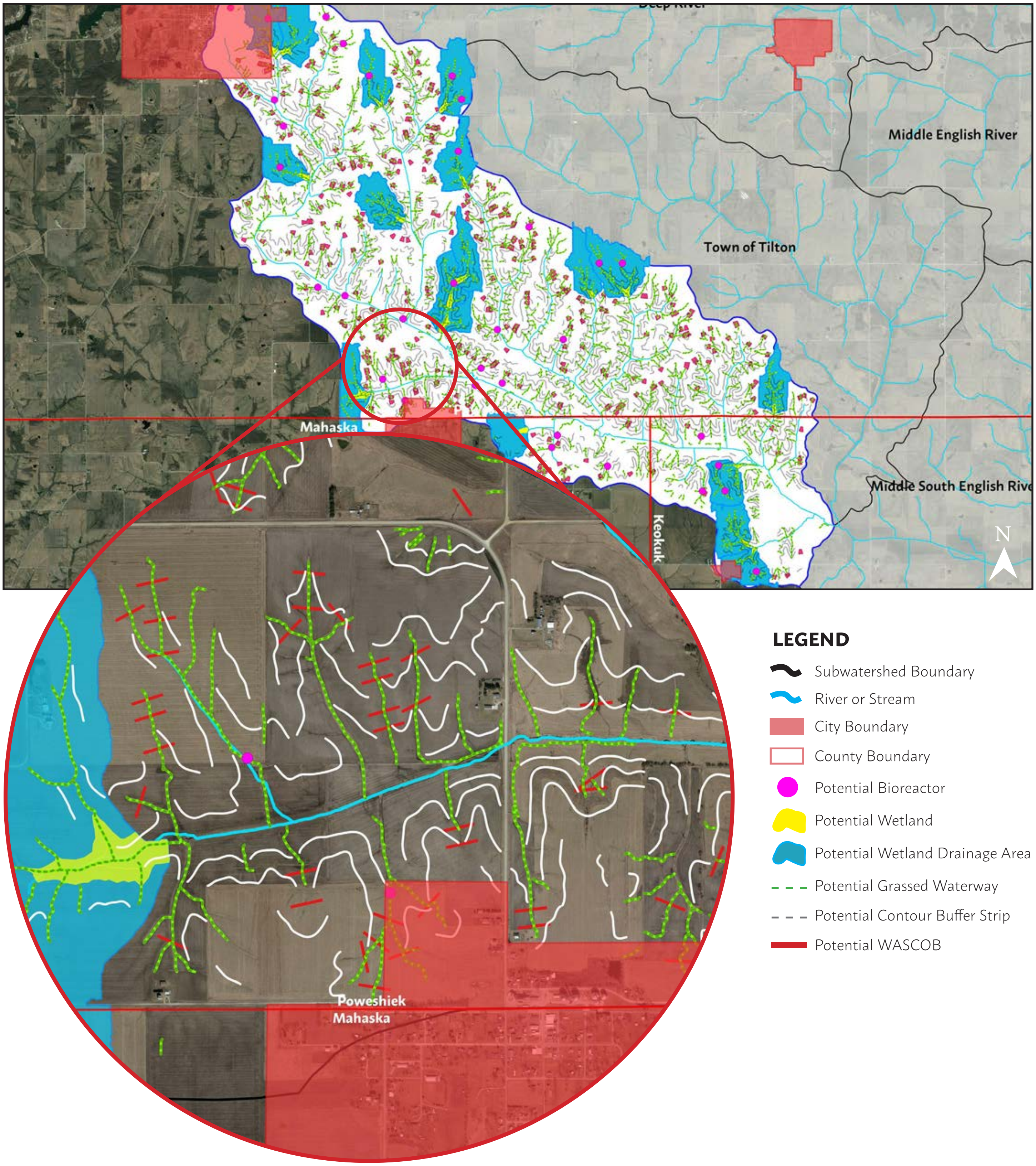

Figure 9. ACPF Model Results for Upper South English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR UPPER SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of North English is the only urbanized, incorporated area in the Upper South English River subwatershed. English River Watershed boundaries encompass the entirety of North English. However, the Upper South English River subwatershed only spans a portion of northwest North English, which is primarily residential land uses. The majority of urbanized area lies in the Lower South English River subwatershed.

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Upper South English River subwatershed. Figures 11-13 represents the stormwater runoff volume for each catchment area within the city limits of North English where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

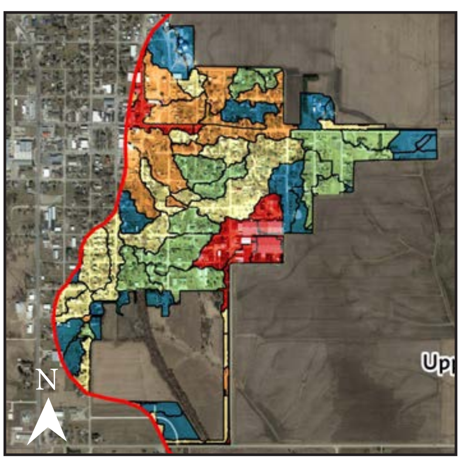

Figure 11. Modeled Runoff Volume in Montezuma, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

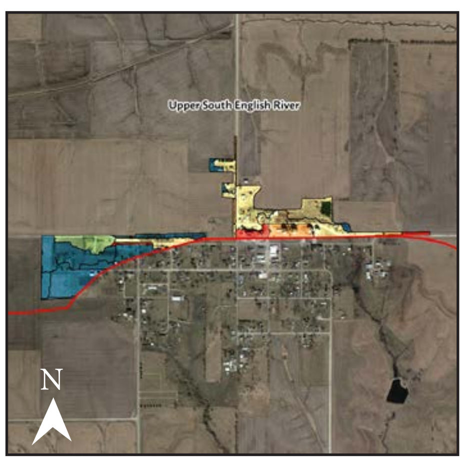

Figure 12. Modeled Runoff Volume in Barnes City, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Figure 13. Modeled Runoff Volume in Gibson, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Runoff Volume (Cubic feet/acre/year)

- 5,741 - 13,819
- 13,918 - 19,751
- 19,751 - 26,169
- 26,169 - 43,357
- 43,357 - 88,749

NITRATE, PHOSPHORUS, & SEDIMENT LOADING LOADING

Figures 14-16 displays total nitrate loads for each of the catchment areas where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent. Figures 17-19 and Figures 20-22 display total phosphorus loads and total sediment loads, respectively, for catchment areas where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

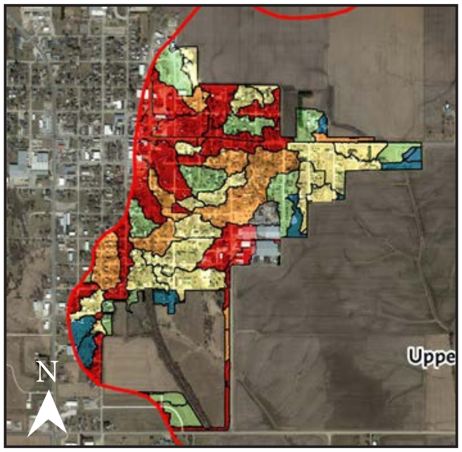

Figure 14. Modeled Nitrate Load in Montezuma, IA (lbs/acre/year). *Source: UNI GeoTREE*

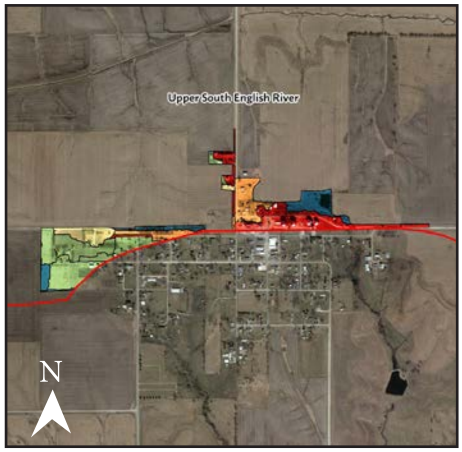

Figure 15. Modeled Nitrate Load in Barnes City, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 16. Modeled Nitrate Load in Gibson, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)
- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

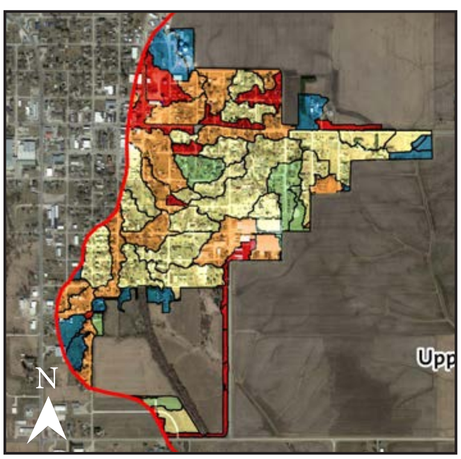

Figure 17. Modeled Phosphorus Load in Montezuma, IA (lbs/acre/year). *Source: UNI GeoTREE*

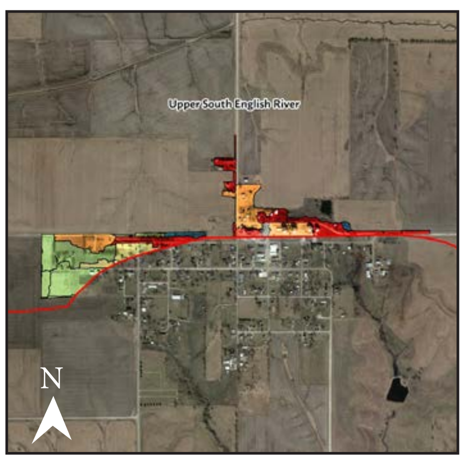

Figure 18. Modeled Phosphorus Load in Barnes City, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 19. Modeled Phosphorus Load in Gibson, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)
- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

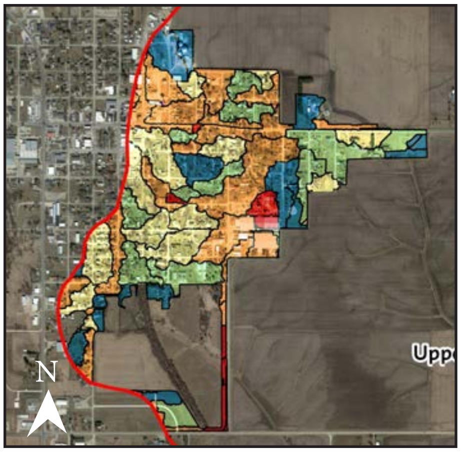

Figure 20. Modeled Sediment Load in Montezuma, IA (lbs/acre/year). *Source: UNI GeoTREE*

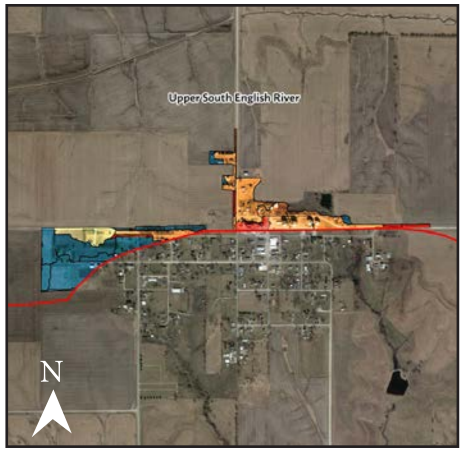

Figure 21. Modeled Sediment Load in Barnes City, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 22. Modeled Sediment Load in Gibson, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)

- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW MONTEZUMA INTERACTIVE WEBMAP:
https://arcg.is/0Da4nb

VIEW BARNES CITY INTERACTIVE WEBMAP:
https://arcg.is/0THq81

VIEW GIBSON INTERACTIVE WEBMAP:
https://arcg.is/rSSPP

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Poweshiek County Multi-Jurisdictional Hazard Mitigation Plan was adopted in 2016 and expires in 2021.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 23 shown below represents the flood hazards that exist in the Upper South English River subwatershed. The flood hazard area accounts for roughly 8.2 percent of the subwatershed area. Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the cities of Montezuma, Barnes City, and Gibson, are also subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 4.9 percent of Poweshiek County's area. By contrast, the English River Watershed overlaps about 45 percent of Poweshiek County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

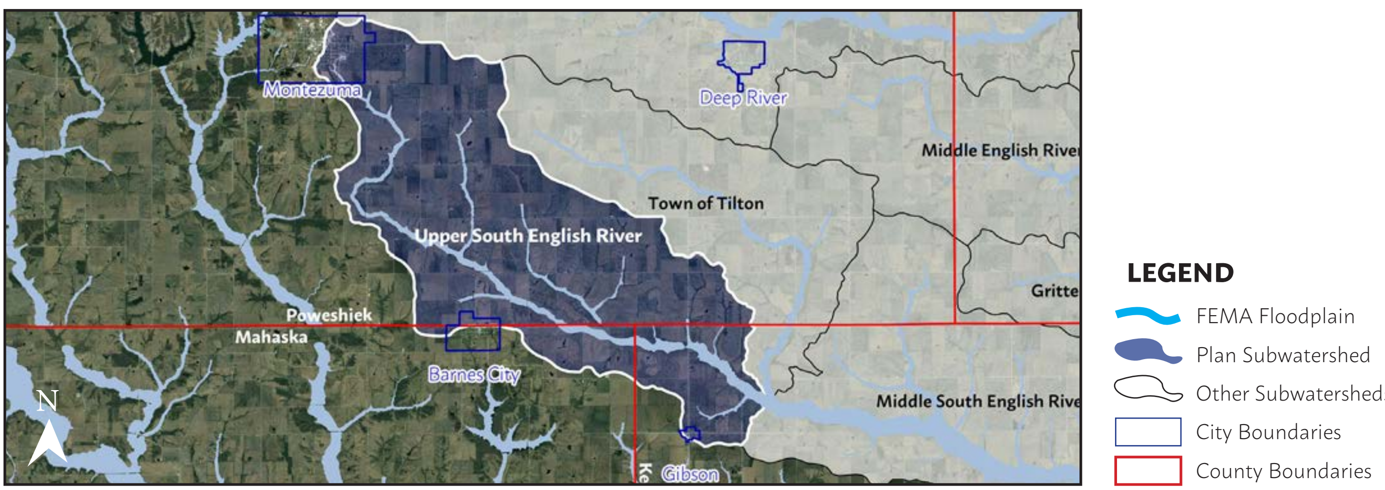

Figure 23. Flood hazard boundary areas for Upper South English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Poweshiek County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$623,826.13
Debris Removal	$133,878.41
Emergency Procedures	$40,166.52
Total	**$797,171.06**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Poweshiek County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at Deep River Monitoring Gauge
May 25 - August 13, 2008	$249,331.52	No historic data available
May 19 - June 1, 2013	$352,811.41	81.53' (6th Highest)
June 26 - July 8, 2014	$195,728.13	81.94' (7th Highest)
Total	**$797,171.06**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 1 structure vulnerable to losses from the 1 percent annual chance flood (red dots) and 10 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

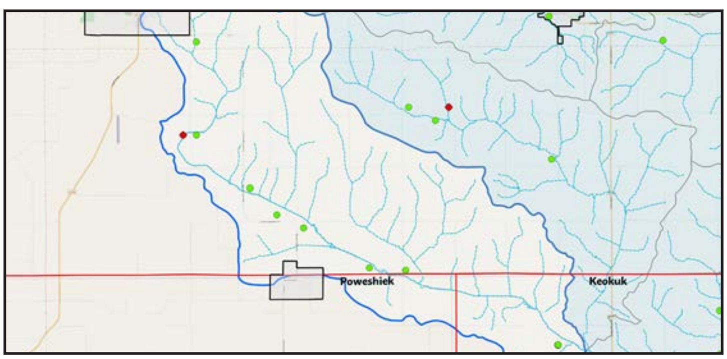

Figure 15. Vulnerable structures for flood hazards in the Upper South English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW NORTH ENGLISH NFIP FLOOD MAP:
http://arcg.is/SLfjH

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	**Yes**
Webster	Yes
Kinross	Yes
Johnson County	Yes
Keokuk County	**Yes**
Iowa County	Yes
Poweshiek County	**Yes**
Barnes City	**No**
Deep River	No
Gibson	**No**
Keswick	No
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	**Poweshiek**	**Montezuma, Guernsey, Deep River**	**0.44**	**1 % Black or African American**	**12 % Poverty**	**5 % Unemployed**
9501	**Mahaska**	**Barnes City**	**0.418**	**2 % Black or African American**	**7 % Unemployed**	**27 % Children**
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	**Keokuk**	**Gibson, Keswick, Webster**	**0.404**	**7 % Unemployed**	**15 % Poverty**	**25 % Children**
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Iowa County's Hazard Mitigation Plan. The following recommendations for the Upper South English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

As the uppermost subwatershed in the South English River basin, it is imperative to treat runoff for water quality and quantity prior to sediment and excess nutrient entering the waterway. The subwatershed presents the second highest potential to treat 20 percent of the drainage area in the watershed through implementation of nutrient-removal wetlands, which can also slow rainwater velocities. Contour buffer strips, WASCBOs, and grassed waterways are suitable throughout the subwatershed and can aid in protecting vulnerable structures in rural areas. See Section 4 for locations prone to higher runoff rates, which would be effective locations for such practices. Urban areas (Gibson, Montezuma, and Barnes City) should consider implementation of BMPs designed to treat stormwater runoff locally before entering the storm sewer or waterway (also known as green stornwater infrastructure).

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Upper South English River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Upper South English River in Incorporated areas	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Upper South English River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/Keokuk/ Mahaska SWCD, NRCS	Poweshiek/ Keokuk/Mahaska Counties, Montezuma, Barnes City, Gibson	Medium/ High
	1.3	Flood protection for population safety in Upper South English River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	Montezuma, Barnes City, Gibson, ERW	Montezuma, Barnes City, Gibson	Low
2	2.2	Acquire property at risk of flooding near Upper South English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in in Incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Upper South English River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Poweshiek/Keokuk/ Mahaska SWCD, NRCS, ERW	Montezuma, Barnes City, Gibson	Medium/ High
	3.2	Improve water quality in rural areas in Upper South English River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Poweshiek/Keokuk/ Mahaska SWCD, NRCS, ERW	Poweshiek/ Keokuk/Mahaska Counties	High
4	4.1	Provide flood protection for roads and in Upper South English River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/Keokuk/ Mahaska SWCD, NRCS	Poweshiek/ Keokuk/Mahaska Counties, Montezuma, Barnes City, Gibson	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

Jody Bailey, Watershed Coordinator
jbailey@englishriverwma.org
(319) 656-2310
511 C Avenue, Kalona IA, 52247

2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

MIDDLE SOUTH ENGLISH RIVER

HUC-12: 070802090503

TABLE OF CONTENTS

Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Middle South English River subwatershed is located in the north central region of the ERW. It overlaps three counties (Poweshiek, Keokuk, and Iowa). The cities of Keswick (population 246) and Webster (population 88) are the incorporated areas that overlap the subwatershed. The Middle South English River subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features shallow depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 47-50.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 27,397 acres (42.8 square miles) of land, which is predominately row crops (corn and soybeans). The South English River stretches approximately 15.88 miles through the subwatershed in west to east direction, and eventually joins the English River near the tri-county wetland area.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is flooding. Additionally, the Middle South English River subwatershed ranked near the middle in comparison to all subwatersheds for water quality contamination. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

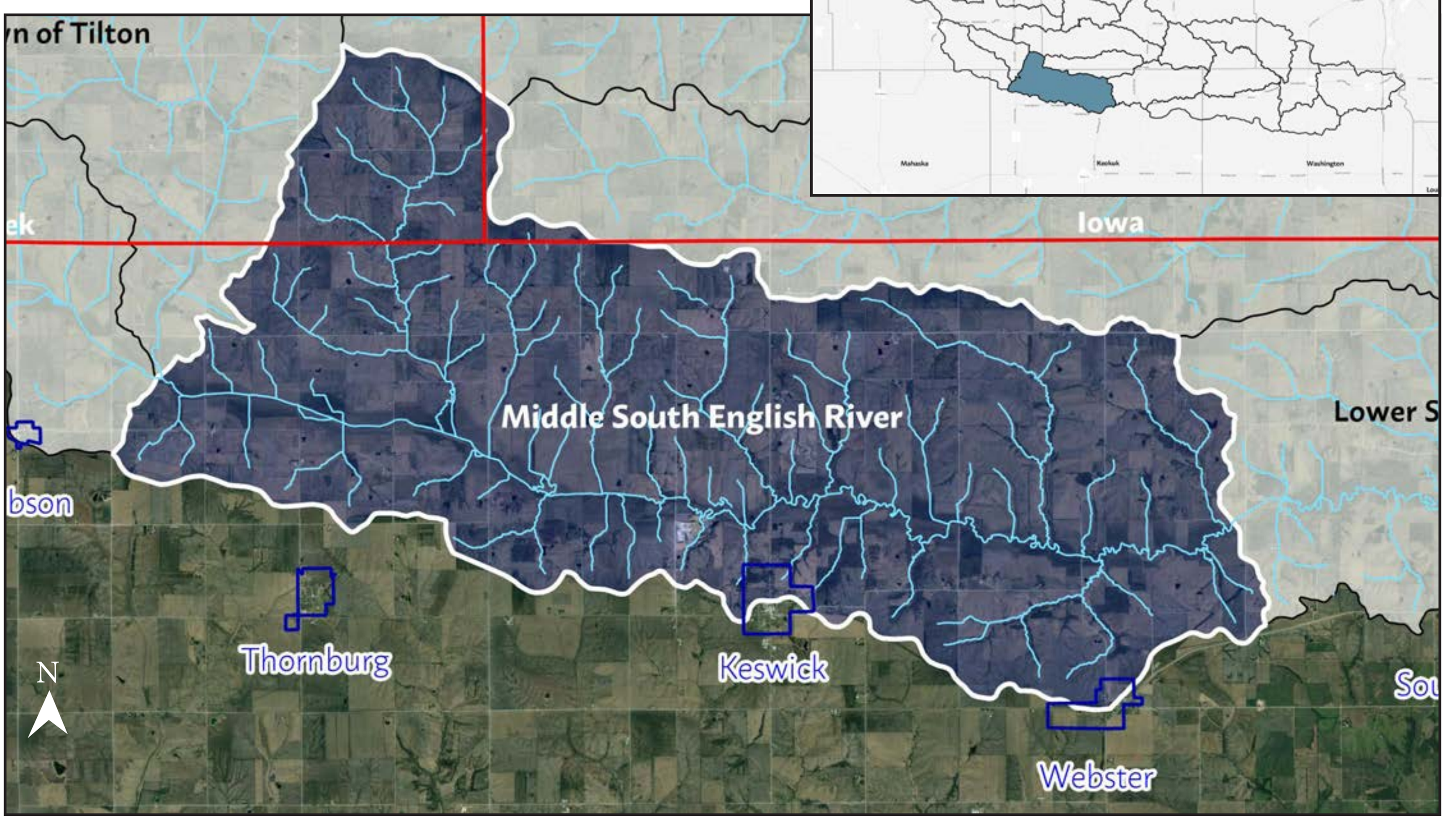

Figure 1. Middle South English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

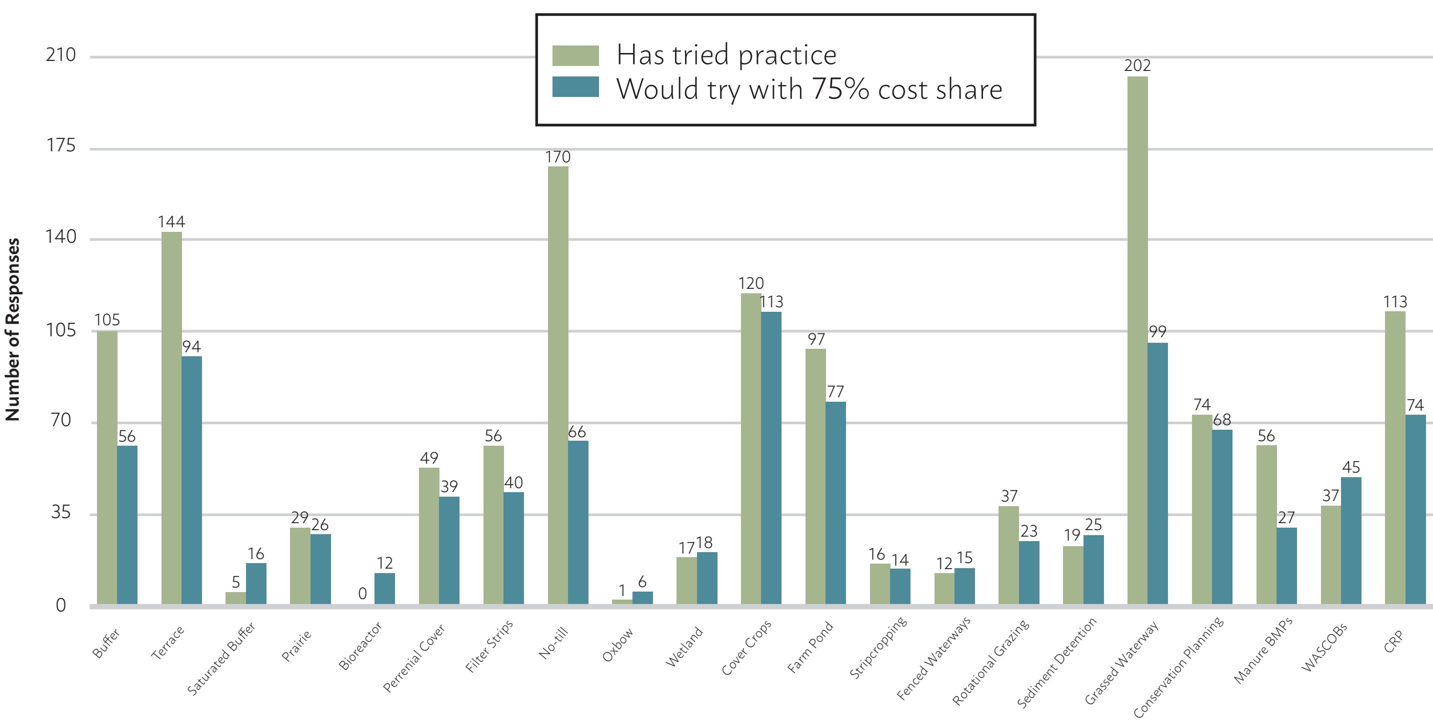

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

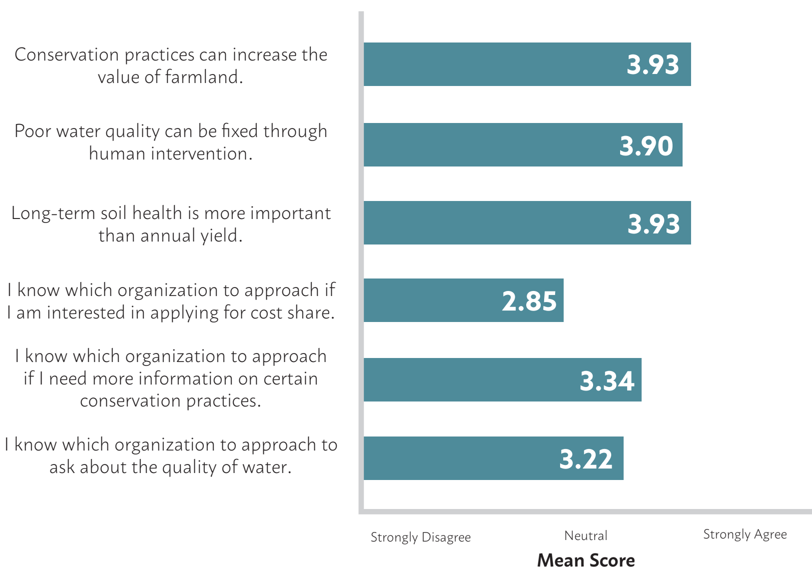

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 12 is the 240th Avenue bridge at the outlet of the Middle South English River. The site is located just NE of the City of Webster, in Keokuk County (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

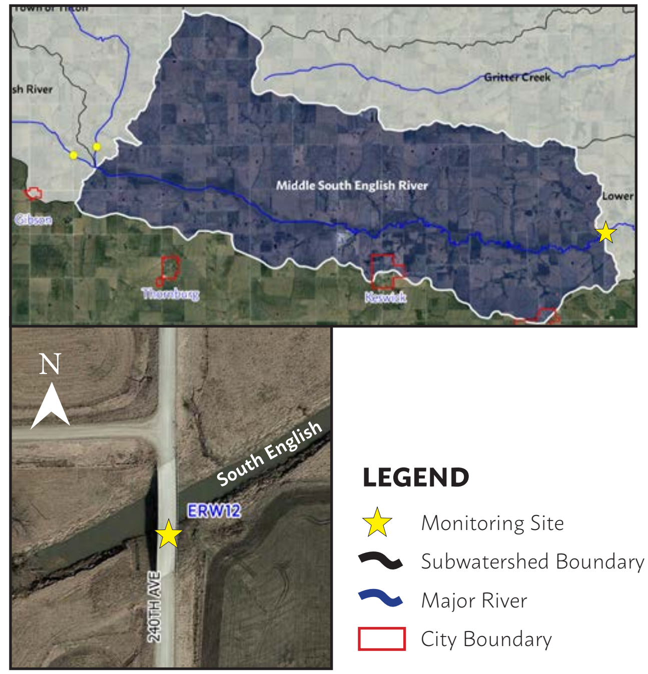

Figure 4. Water quality monitoring location for Middle South English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 12 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 12 ranked 11th of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 12 ranked 13th. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 12 ranked 18th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 12 ranked 12th.

In 2017, Site 12 ranked 7th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 12 ranked 14th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 12 ranked 8th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 12 ranked 11th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	240	1,800	883
2018	41	2,500	1,134

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.08	0.03
2018	0.04	0.07	0.06

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.12	0.25	0.18
2018	0.12	0.22	0.17

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 10 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	14.0	3.6
2018	1.3	9.0	4.2

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

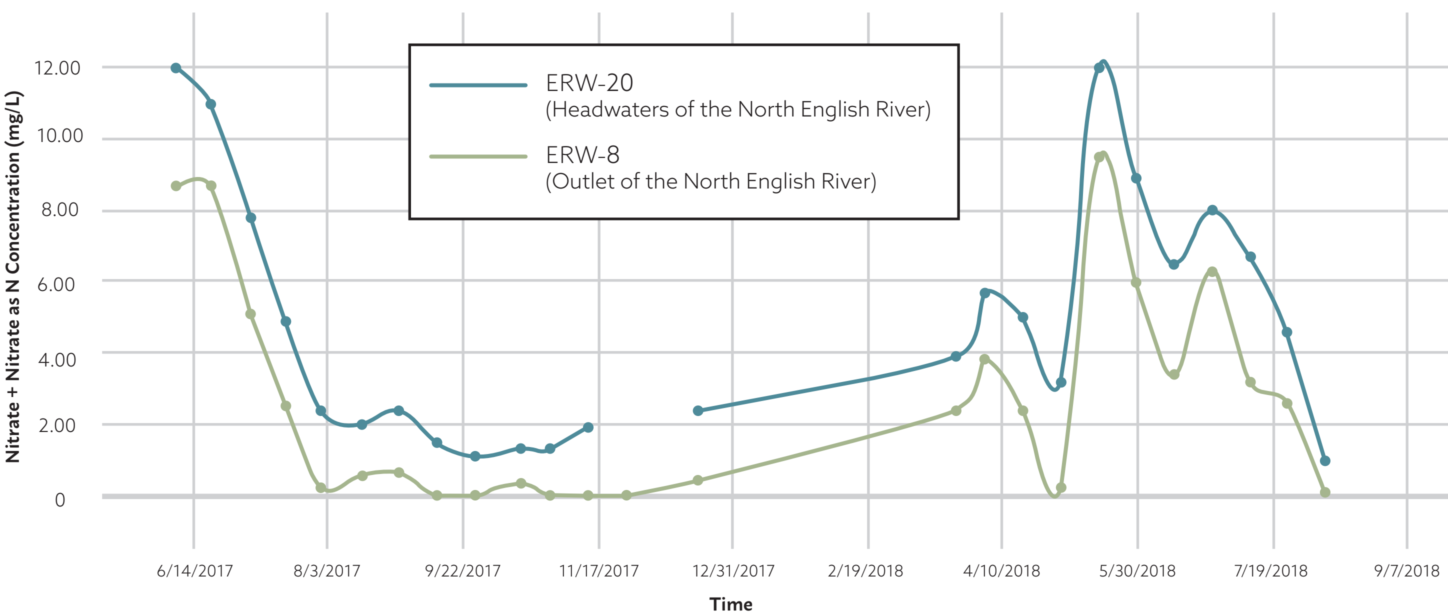

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Middle South English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 9 times the total erosion (109.21 mm) than Middle South English River's average monthly erosion of 11.78 mm (0.49 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Middle South English River's HUC is "070802090503"; see 503 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	301	406	408	407	**503**	504
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	12.75	12.59	12.26	12.24	12.23	**11.78**	10.80
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	82.23	83.68	82.65	83.17	84.61	**82.92**	82.29

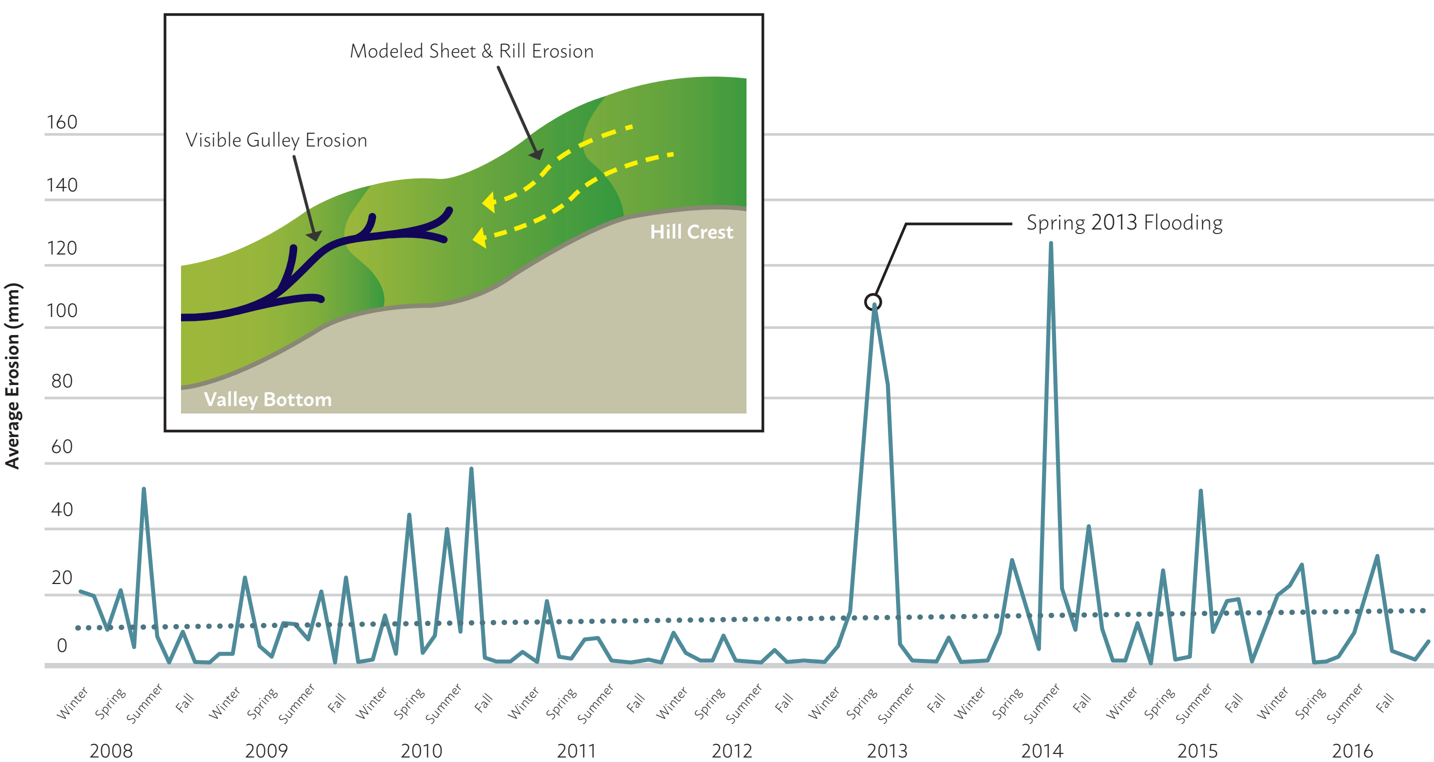

Figure 6. Soil Erosion in Middle South English River (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. Gritter Creek experienced an average of 4.38 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 14 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Upper South English River subwatershed ranks near the middle of all subwatersheds for soil delivery at 5.60 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in Upper South English River subwatershed is above the state average and above the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the middle South English River subwatershed.

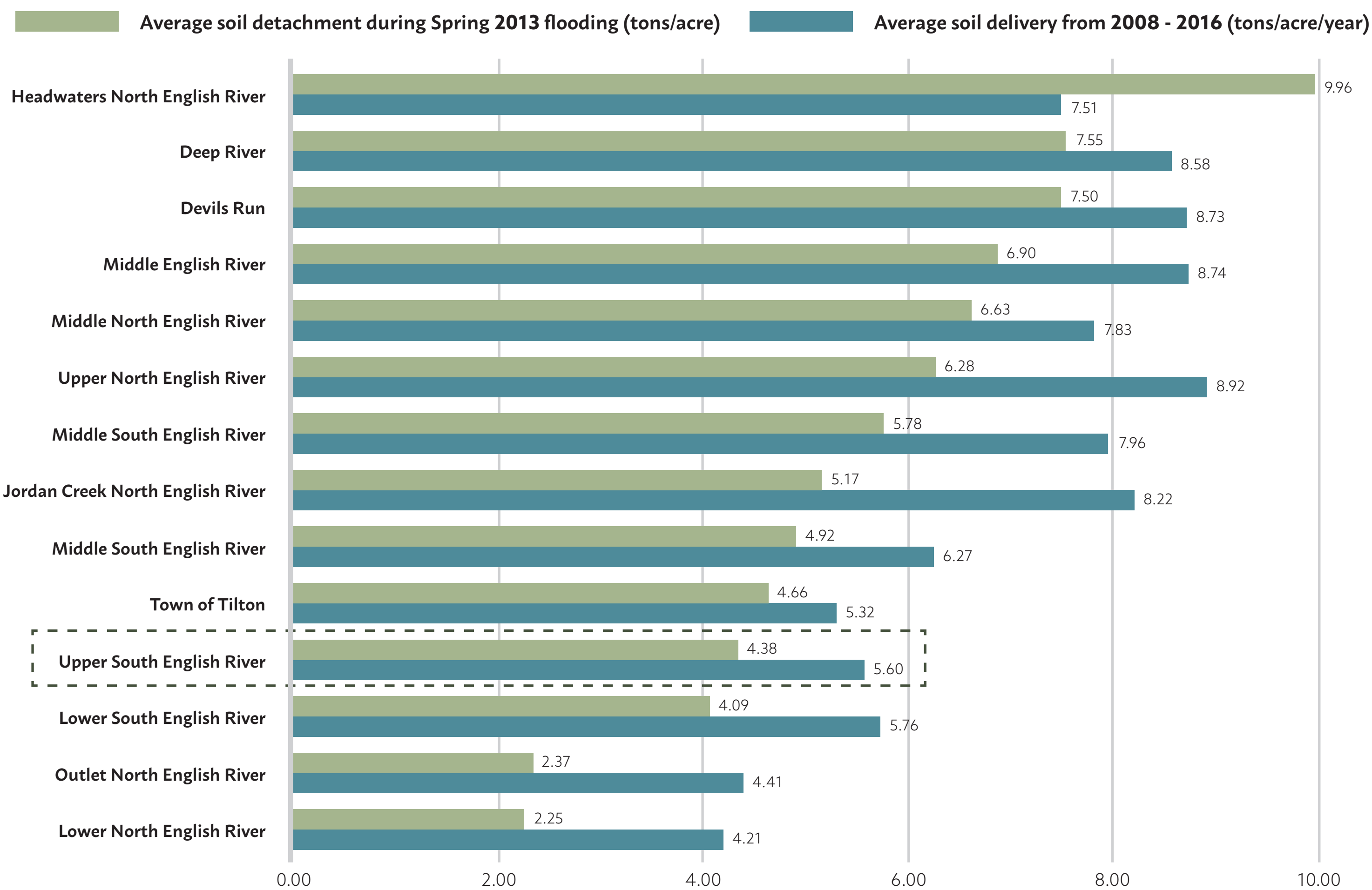

Figure 7. Soil Delivery and Detachment in Middle South English River (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR MIDDLE SOUTH ENGLISH RIVER:
https://bit.ly/2Q9vKlh

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour. This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Middle South English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

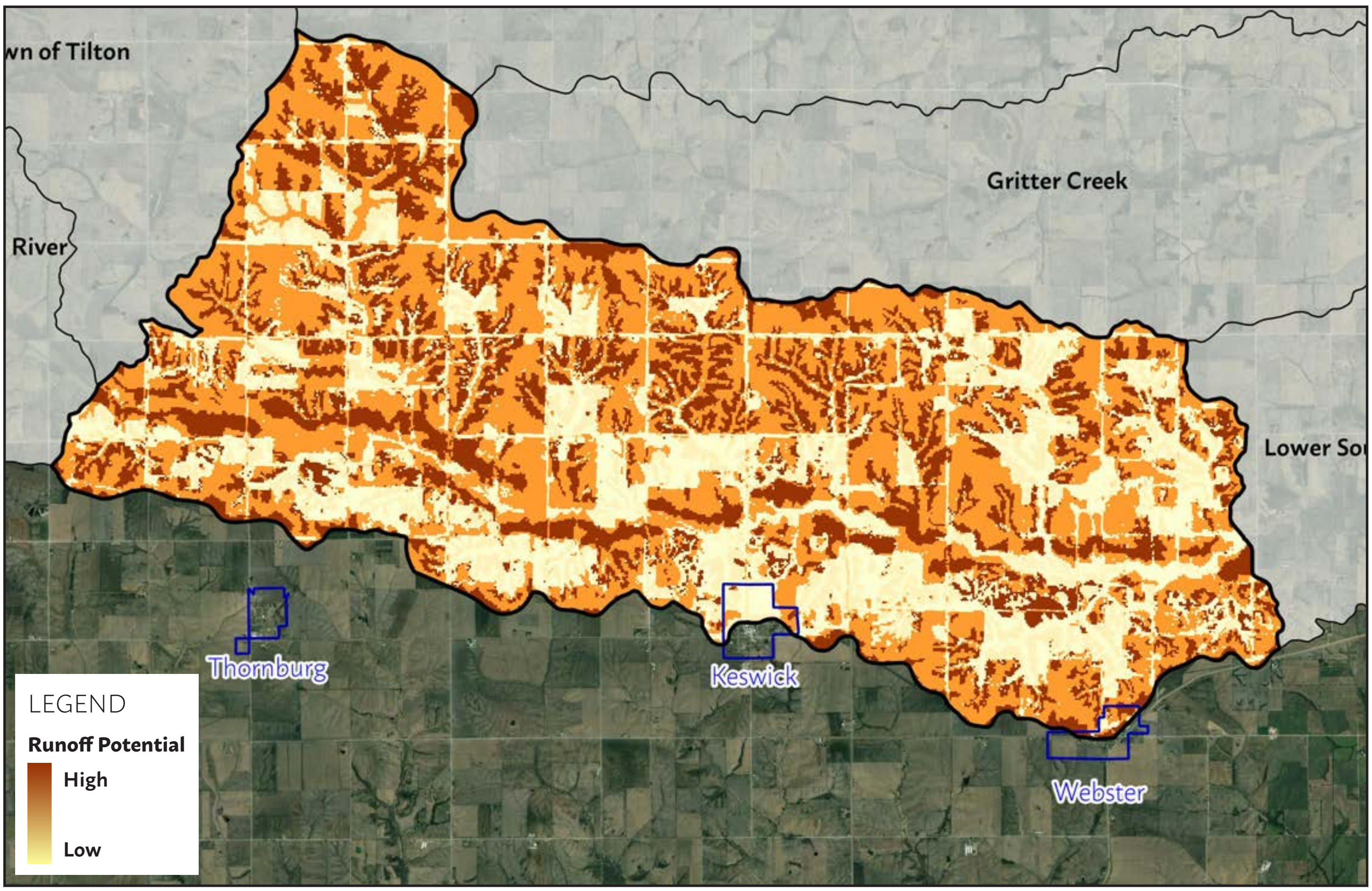

Figure 8. SCS-CN Runoff Potential Model for Middle South English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR MIDDLE SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 615.76 miles of contour buffer strips, 37 bioreactors, 451 WASCOBs, 8 nutrient-removal wetlands, a total of 1,687.15 acres of drainage area for the wetlands, and 190.94 miles of grassed waterways in the Middle South English River subwatershed (Table 11). If all 8 wetlands were installed in the subwatershed, roughly 6.2 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	**27,397**	**615.76**	**37**	**451**	**8**	**1,687.15**	**6.2 %**	**190.94**
504	25,728	533.86	49	291	1	158.05	0.6 %	98.27

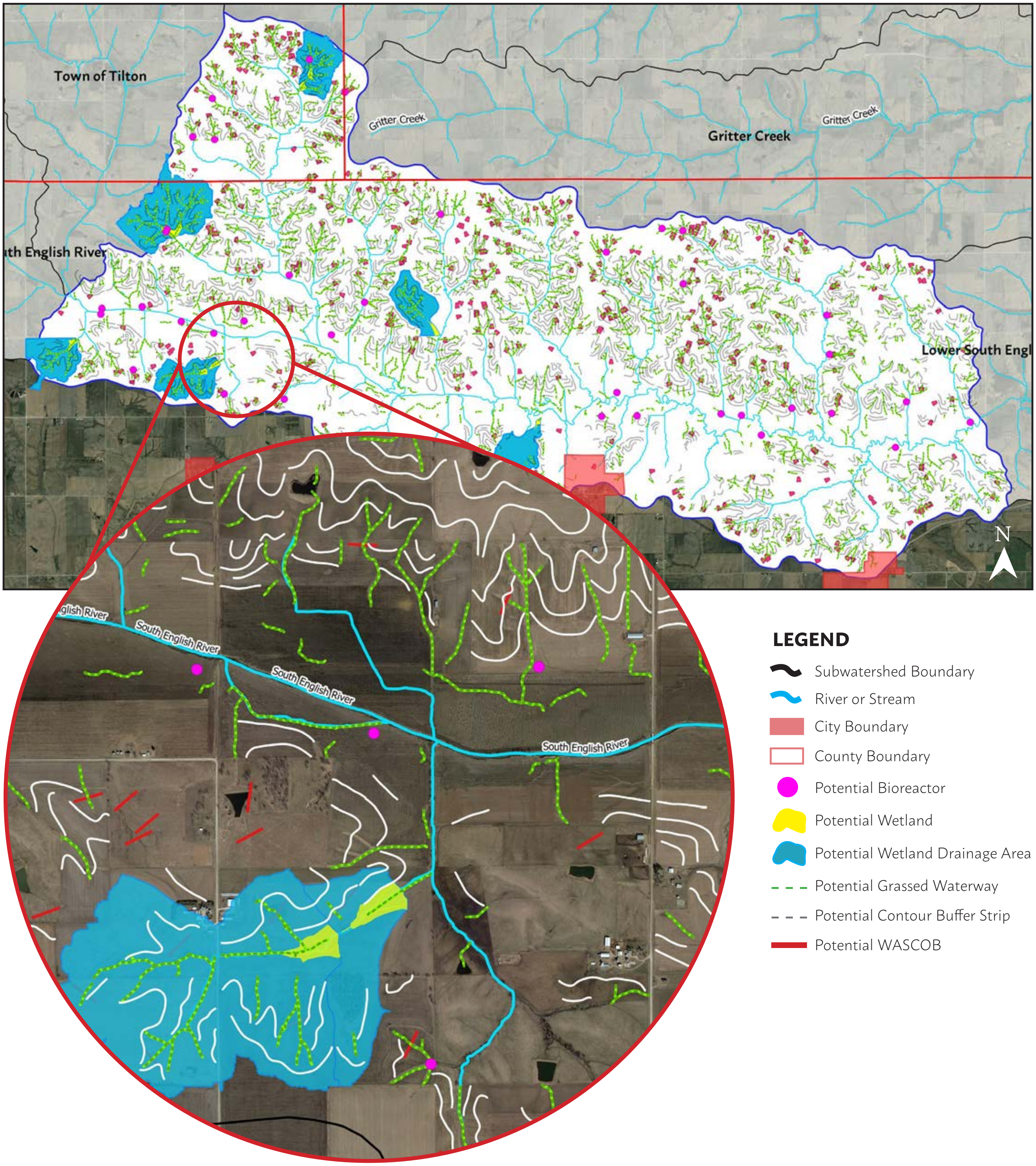

Figure 9. ACPF Model Results for Middle South English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR MIDDLE SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or "hot spots". The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of Keswick and the City of Webster are the urbanized, incorporated areas in the Middle South English River subwatershed. The northern half of Keswick is located within the ERW boundaries and primarily includes residential land uses. The ERW encompasses nearly the entire City of Webster and is also comprised primarily of residential land uses.

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Middle South English River subwatershed. Figures 10-11 represents the stormwater runoff volume for each catchment area within the city limits of North English where orange and red portray higher runoff volumes. These "hot spots" would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

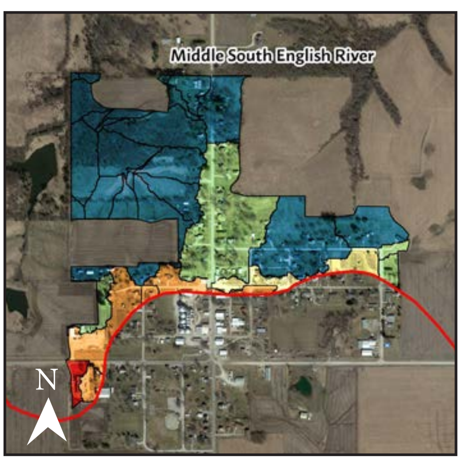

Figure 10. Modeled Runoff Volume in Keswick, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

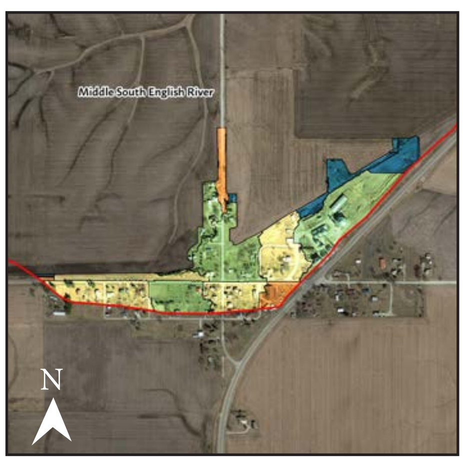

Figure 11. Modeled Runoff Volume in Webster, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Runoff Volume (Cubic feet/acre/year)
- 5,741 - 13,819
- 13,918 - 19,751
- 19,751 - 26,169
- 26,169 - 43,357
- 43,357 - 88,749

NITRATE, PHOSPHORUS, & SEDIMENT LOADING LOADING

Figures 13-14 displays total nitrate loads for each of the catchment areas where darker shades of red portray higher loads. These “hot spots” would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent. Figures 15-16 and Figures 17-18 display total phosphorus loads and total sediment loads, respectively, for catchment areas where darker shades of red portray higher loads. These “hot spots” would be suitable locations for best management practices such as bioswales or rain gardens.

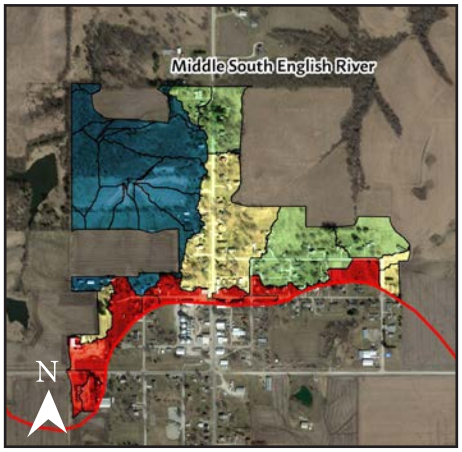

Figure 13. Modeled Nitrate Load in Keswick, IA (lbs/acre/year). *Source: UNI GeoTREE*

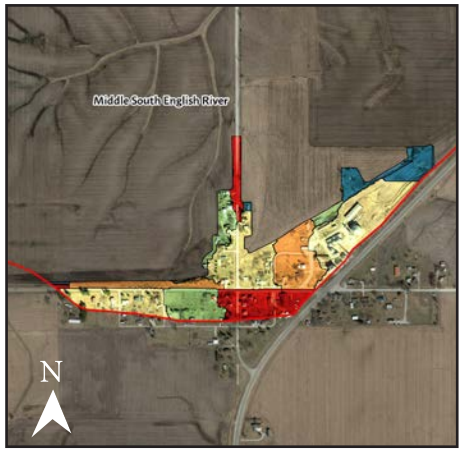

Figure 14. Modeled Nitrate Load in Webster, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)

- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

Figure 15. Modeled Phosphorus Load in Keswick, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 16. Modeled Phosphorus Load in Webster, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)

- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

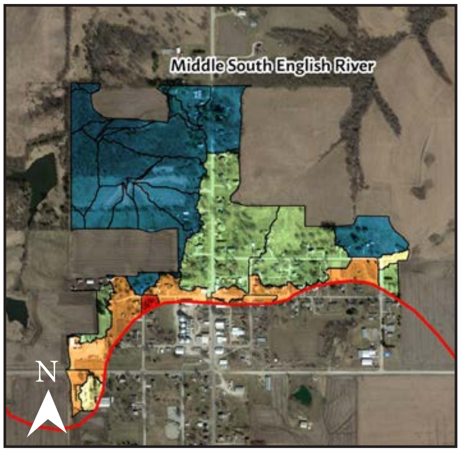

Figure 17. Modeled Sediment Load in Keswick, IA (lbs/acre/year). *Source: UNI GeoTREE*

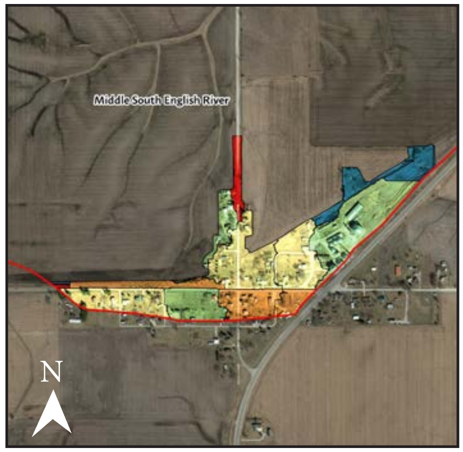

Figure 18. Modeled Sediment Load in Webster, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)
- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW KESICK INTERACTIVE WEBMAP:
https://arcg.is/0eKKCP

VIEW WEBSTER INTERACTIVE WEBMAP:
https://arcg.is/1CWDOb

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Keokuk County Hazard Mitigation Plan was adopted in 2012 and expired in 2017. An update to the plan is currently being adopted per jurisdiction.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 19 shown below represents the flood hazards that exist in the Middle South English River area. The flood hazard area accounts for roughly 14.5 percent of the subwatershed area (3rd largest area among subwatersheds). Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the cities of Keswick and Webster, are subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 4.9 percent of Keokuk County's area. By contrast, the English River Watershed overlaps about 26 percent of Keokuk County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

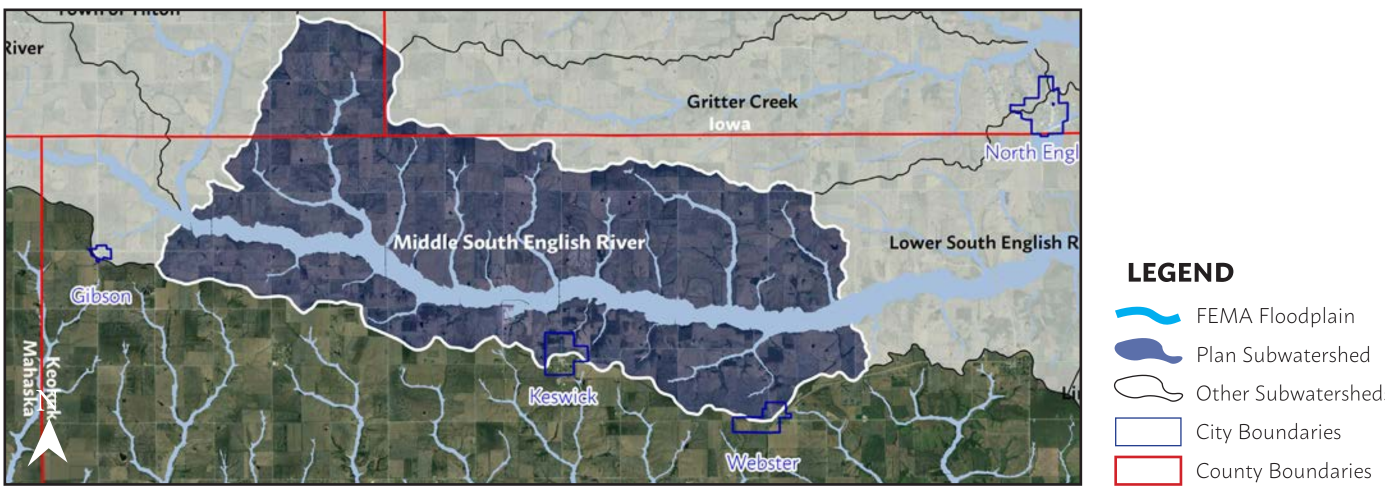

Figure 19. Flood hazard boundary areas for Middle South English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Keokuk County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$1,350,486.03
Emergency Procedures	$11,406.96
Total	**$1,361,892.99**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Keokuk County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at North Skunk Near Sigourney
May 25 – August 13, 2008	$468,517.74	21.15' (24th Highest)
June 1 – August 31, 2010	$484,787.24	23.65' (6th Highest)
April 17 – April 30, 2013	$192,048.29	23.27' (7th Highest)
May 19 – June 1, 2013	$41,696.74	25.93' (1st Highest)
June 26 – July 8, 2014	$174,842.98	23.12' (8th Highest)
Total	**$1,361,892.99**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 0 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 11 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

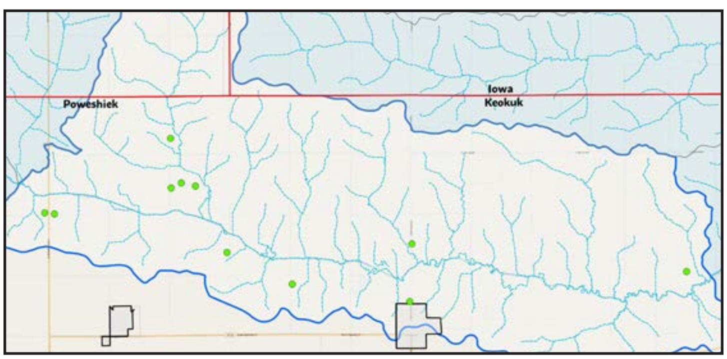

Figure 15. Vulnerable structures for flood hazards in the Middle South English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW KESWICK NFIP FLOOD MAP:
http://arcg.is/1nPieS

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	**Yes**
Kinross	Yes
Johnson County	Yes
Keokuk County	**Yes**
Iowa County	Yes
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	**No**
Millersburg	No
Parnell	No
North English	No

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	**Keokuk**	**Gibson, Keswick, Webster**	**0.404**	**7 % Unemployed**	**15 % Poverty**	**25 % Children**
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 17) supplement recommendations stated in Keokuk County's Hazard Mitigation Plan. The following recommendations for the Middle South English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

The Middle South English River presents many opportunties for contour buffer strips, WASCOBs, and grassed waterways. Suitable locations for such practices can be found in Section 5 of this plan. Smaller scale urban BMPs for targeted implementation in Keswick and Webster can be found in Section 6 of this plan. A combination of urban and rural practices in the Middle South English River is recommended. The subwatershed ranks in the middle for the four water quality contaminants and in the lower third for soil erosion characteristics. The majority of structures that are vulnerable to loss from flooding are location in rural areas. Accordingly, the floodplain area accounts for about fifteen percent of the entire subwatershed. As Section 4 illustrates, riparian areas along the South English River are prone to high levels of soil erosion and should be addressed through contour buffer strips or floodplain restoration techniques.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) https://bit.ly/2wiKqq7	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) https://bit.ly/2wiKqq7	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) https://bit.ly/2P7ibSi	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) https://bit.ly/2BSCjWG	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program https://bit.ly/2BTXTtS	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Middle South English River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Middle South English River in Incorporated areas	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Middle South English River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/Keokuk/Iowa SWCD, NRCS	Poweshiek/Keokuk/Iowa Counties, Webster and Keswick	Medium/ High
	1.3	Flood protection for population safety in Middle South English River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	Webster and Kes-wick, ERW	Webster and Keswick	Low
2	2.2	Acquire property at risk of flooding near Middle South English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in in Incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Middle South English River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Poweshiek/Keokuk/Iowa SWCD, NRCS, ERW	Webster and Keswick	Medium/ High
	3.2	Improve water quality in rural areas in Middle South English River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Poweshiek/Keokuk/Iowa SWCD, NRCS, ERW	Poweshiek/Keokuk/Iowa Counties	High
4	4.1	Provide flood protection for roads and in Middle South English River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Poweshiek/Keokuk/Iowa SWCD, NRCS	Poweshiek/Keokuk/Iowa Counties, Webster and Keswick	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework	**ISWMM**	Iowa Stormwater Management Manual
BMP	Best Management Practice	**IWA**	Iowa Watershed Approach
DEP	Daily Erosion Project	**NFIP**	National Flood Insurance Program
EPA	Environmental Protection Agency	**NRCS**	Natural Resource Conservation Service
ERW	English River Watershed	**NRS**	Nutrient Reduction Strategy
FEMA	Federal Emergency Management Agency	**SCS-CN**	Soil Conservation Service - Curve Number
HSEM	Homeland Security & Emergency Management	**SWCD**	Soil & Water Conservation District
HUC	Hydrologic Unit Code	**WMA**	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

The Iowa Flood Center

Iowa County, Iowa

The University of Northern Iowa's GeoTREE Center

The Iowa Department of Natural Resources

Iowa Homeland Security & Emergency Management

The Iowa Water Center & The Daily Erosion Project

Center for Evaluation and Assessment

The State Hygenic Laboratory

Iowa Department of Agriculture & Land Stewardship

Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

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2018

ENGLISH RIVER WATERSHED

SUBWATERSHED TOOLKITS

LOWER SOUTH ENGLISH RIVER

HUC-12: 070802090504

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Funding for development and printing of this plan was provided by the Iowa Watershed Approach.

The Iowa Watershed Approach is a collaborative program that brings together local, state, federal, and private organizations to work together to address factors that contribute to floods and nutrient flows. Iowans will enjoy improvements in quality of life and health resulting from upstream watershed investments tied to community resilience activities. This adaptive model, supported by U.S. Housing and Urban Development (HUD) dollars, will leverage the principles of Iowa's innovative Nutrient Reduction Strategy to make our communities more resilient to flooding and help improve water quality.

SECTION 1: PLANNING PROCESS

The English River Watershed (ERW) completed "Phase 1" comprehensive watershed planning in 2015. The goal of this project was to take an inventory of the physical environment, complete hydrologic modeling on the basin scale (HUC-8), collect baseline water quality data, engage landowners in the planning process, and formulate watershed improvement recommendations based on data public input. The entire plan, titled the *English River Watershed Improvement and Resiliency Plan*, can be found on the English River Watershed website.

PHASE 2 KEY QUESTIONS & OUTCOMES

Beginning in Fall 2017, the English River Watershed began the "Phase 2" subwatershed planning process, which was completed in December of 2018. The goal of this phase was to discover priority areas on the subwatershed level (HUC-12) for targeted implementation of cost-share funds. The plans are intended to introduce many of the tools and analyses that can be used by municipalities, SWCDs, the WMA, and other organizations when considering watershed improvement projects.

The ERW consists of 20 HUC-12 subwatersheds. Due to limitations on where funding could be spent for this project, if the majority of the subwatershed's area overlapped Washington County it was not included and a Phase 2 plan was not created. Thus, 14 total subwatershed plans were developed. Table 1 shown below highlights the differences between the 9-step planning process in Phases 1 and 2.

Table 1. The 9-Step Planning Process for Phase 1 and Phase 2. *Source: ERW*

Planning Step	Phase 1 Outcomes	Phase 2 Key Questions	Phase 2 Outcomes
1. Engage the Public	Determined of the community's concerns and perceived threats to water quality and quantity.	What concerns are specific to the HUC-12 subwatershed?	Completed a mail survey to all 14 subwatersheds and gained input at various meetings and events.
2. Inventory Resources	Determined the broad land uses, environmental characteristics, and history of the watershed.	What data exists on the subwatershed level and can be analyzed in comparison between subwatersheds?	Compiled data on soil erosion, flooding and social risks, water quality, and detailed urban land uses.
3. Develop Problem Statements	Determined the broad causes and sources of impairments in the watershed.	What tools can be developed to provide support for watershed entities seeking grant or cost share funding?	Designed a "toolbox" of resources for watershed entities that address problems specific to each subwatershed.
4. Identify Target Conditions	Identified recommendations for HUC-8 scale watershed improvements to water quality and quantity.	What are the HUC-12 level specific water quality and quantity conditions?	Analyzed historical erosion data, developed erosion potential maps, and completed 2 seasons of water quality monitoring.
5. Develop Restoration Targets	Determined priority issues throughout the watershed through public participation.	What is the potential for conservation practices (amount or type)?	Completed the Agricultural Conservation Planning Framework (ACPF) and urban modeling.
6. Evaluate Alternatives	Prepared BMP benefits table with associated reductions in contaminants or flood volumes.	What do the recommended practices achieve?	Matrix for cost/benefits of urban/rural practices and risk analysis based on community assets.
7. Prepare the Implementation Plan	Assigned responsibility to the WMA for continued research and pursuit of cost share funding.	Who is responsible for implementing programs? Who can provide technical assistance?	Matrix for responsible parties, funding opportunities, and resources provided by ERW.
8. Implement the Plan	Physical and digital copies of the plan were delivered to watershed entities.	How will the results and recommendations of the plan be communicated to the public?	Physical and digital copies of the plan delivered to watershed entities and interactive webmaps.
9. Evaluate the Plan	Determined a routine for updating the plan and monitoring implementation goals.	How will practices be measured and who will update the plan?	Developed a monitoring plan, including metrics for success.

ABOUT THE SUBWATERSHED

The Lower South English River subwatershed is located in the south central region of the ERW. It overlaps three counties (Iowa, Keokuk, and Washington). The City of North English (population 1,041) and the City of Kinross (population 73) are the incorporated areas that overlap the subwatershed. The subwatershed primarily consists of Mississippian soils and, in comparison to the entire ERW, features very shallow depth to bedrock. The mean Corn Suitability Rating for the subwatershed is between 47-50.

Figure 1 is a location map of the subwatershed. The subwatershed encompasses 25,728 acres (40.2 square miles) of land, which is predominately row crops (corn and soybeans). The South English River stretches approximately 15.5 miles through the subwatershed in southwest to northeast direction, and joins the Norh English River near the tri-county wetland area.

It was determined in Phase 1 planning that the primary resource concern in in the subwatershed is sediment and phosphorus contamination. Additionally, the Deep River subwatershed ranked low in comparison to all subwatersheds for annual flood risks. Watershed stakeholders also expressed their desire for routine water quality monitoring in all subwatersheds.

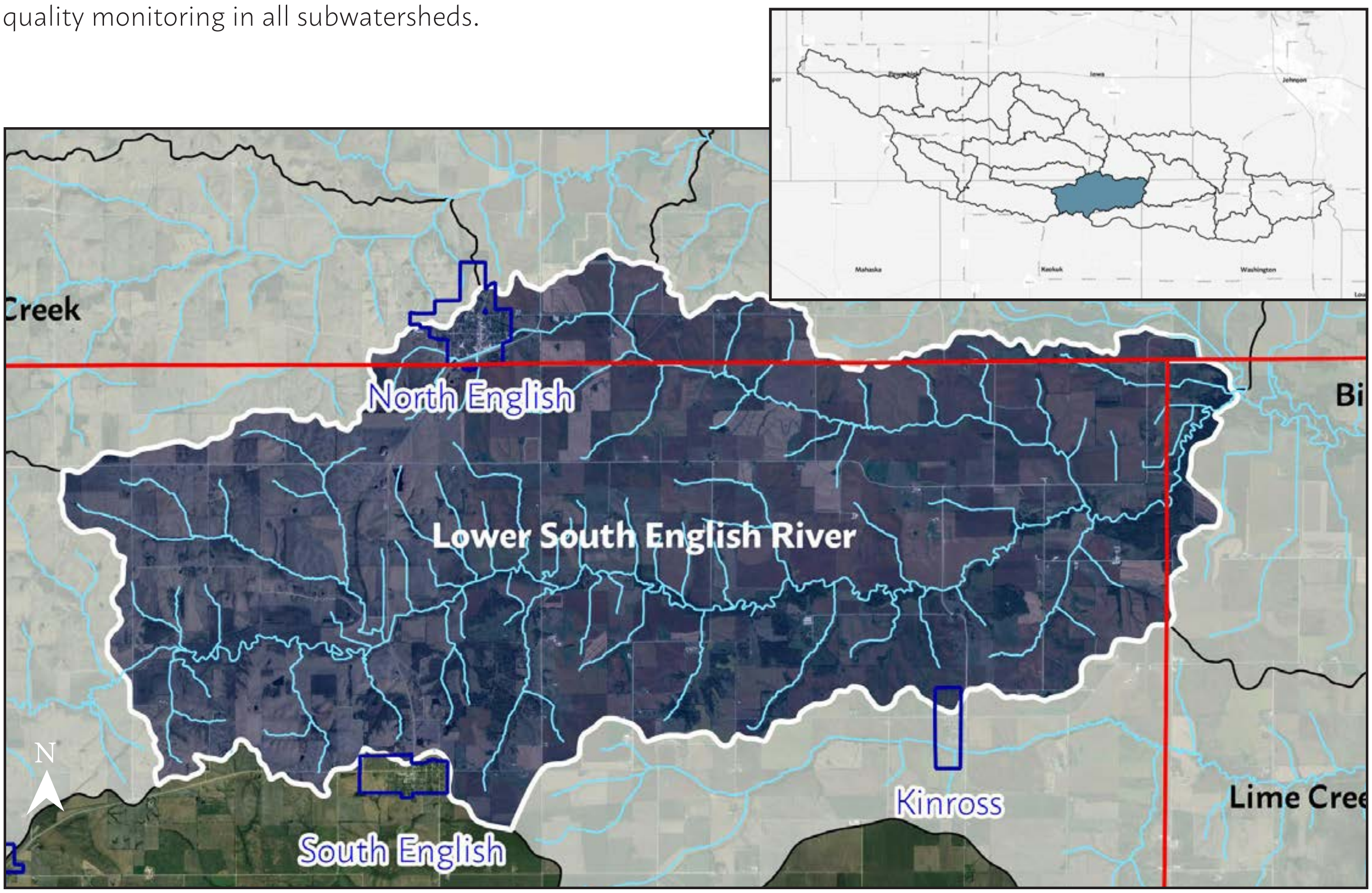

Figure 1. Lower South English River Subwatershed Boundary Map. *Source: ERW*

SECTION 2: 2018 CONSERVATION SURVEY

The English River Watershed completed the "2018 Conservation Survey" in the spring of 2018. The survey builds upon the landowner survey completed in Phase 1 and seeks to better understand the barriers farmers face when considering adoption of conservation practices.

A random sample of agricultural properties of at least 10 acres in size in the watershed were sampled via mail. The sample totaled 986 properties in Iowa, Poweshiek, Johnson, and Keokuk Counties. 264 surveys were completed, which is a response rate of 26.8 percent.

Among the entire sample, the majority of respondents indentified in the age group of 55 - 64 years old (27.7%). Table 2 shows the breakdown of farm size in the survey. Table 3 shows the breakdown of type of farm operations in the survey.

CONSERVATION ADOPTION AND WILLINGNESS

The survey first sought to understand which conservation practices are currently being implemented and which practices, dependent on availability of cost-share funding, are in demand. This information allows conservation organizations to provide more relevant information to landowners. Figure 2 shows the number of respondents that have tried a specific practice (green bars) and the number of respondents who would try specific practices with the availability of 75 percent cost-share (blue bars).

Table 2. Farm size in survey sample. *Source: ERW*

Farm Size	% of Respondents
Less than 25 acres	7%
25 - 75 acres	14%
75 - 250 acres	32%
250 - 500 acres	21%
500 - 1,000 acres	13%
More than 1,000 acre	13%

Table 3. Type of farm operation in survey sample. *Source: ERW*

Crops/Livestock	Number of Respondents / % of Sample
Corn	211 / (35.2%)
Soybeans	210 / (35.1%)
Hogs	30 / (5.0%)
Beef Cattle	68 / (11.4%)
Dairy Cattle	11 / (1.8%)
Other	69 / (11.5%)

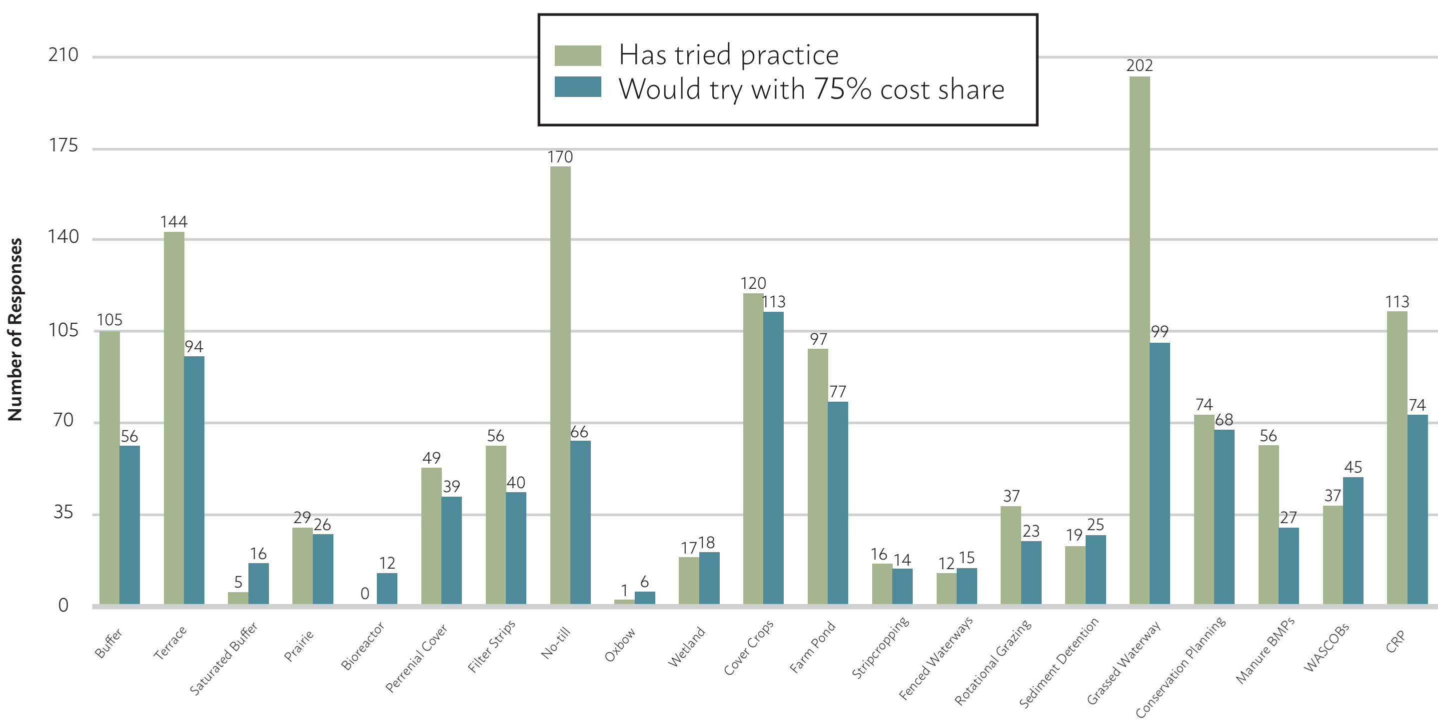

Figure 2. Conservation adoption and willingness to adopt conservation practices with cost share among survey sample. *Source: ERW*

CONSERVATION ORGANIZATIONS

Farmers face a plethora of options when seeking information about conservation. This situation can lead to confusion among various conservation organizations and produce conflicting information. Table 4 shows survey respondent's familiarity with the purpose of each group and how respondents are interacting with various groups in Iowa.

Table 4. Familiarity with organizational purposes and groups distributing conservation information among survey sample. *Source: ERW*

Organization	Mean Familiarity with Mission or Purpose (5 = Very Familiar)	Distribution of Conservation Information (Total # of Responses)
Natural Resource Conservation Service	3.21	140
Iowa Department of Natural Resources	3.16	67
County Conservation	2.99	71
Iowa State University Extension and Outreach	2.81	83
Iowa Department of Agriculture and Land Stewardship	2.70	57
Soil and Water Conservation District	2.67	84
English River Watershed	2.40	61
Iowa Flood Center	1.49	N/A
Crop Advisor	N/A	22
Growers or Producers Associations	N/A	33
Fertilizer or Agricultural Products Dealer	N/A	35

BARRIERS TO CONSERVATION

Finally, the survey attempted to uncover barriers to conservation according to farmers in the watershed. Figure 5 displays the respondent's level of agreement with various statements related to conservation and Table 5 shows some of the barriers that exist for farmers considering adopting conservation practices. Data specific to Iowa and Keokuk Counties can be found in the full report at the link below.

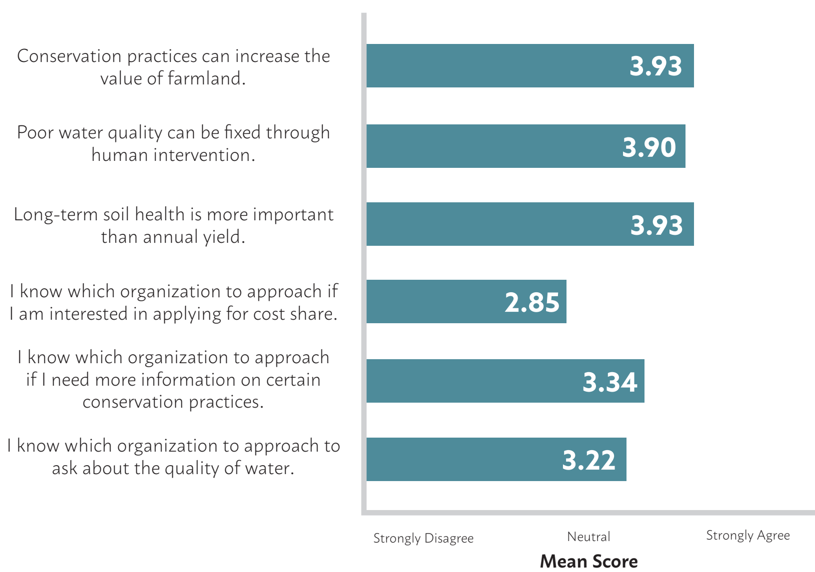

Figure 5. Mean level of agreement among conservation statements. *Source: ERW*

Table 5. Top barriers to conservation identified by survey sample. *Source: ERW*

Rank	Barrier	# of Responses
1	Cost of practice	142
2	Too many "strings attached" with state/federal programs	116
3	Loss of productive land / impact on yields	74
4	Uncertainty of crop values year to year	52
5	Maintenance plans are too strict or confusing	38
6	Unsure of actual environmental benefits	28
7	Other	14

VIEW ENTIRE "2018 CONSERVATION SURVEY" REPORT:
http://www.englishriverwma.org/subwatershed-plans/survey

SECTION 3: WATER QUALITY MONITORING

Stakeholders in the ERW identified continued water quality monitoring as the organization's number one priority during the Phase 1 comprehensive planning process. Long-term water quality monitoring is essential in the establishment of reliable water quality baselines and changes over time and in assessing the effectiveness of targeted implementation projects.

Sampling Site 7 is near the outlet of the South English River, at the 120th Street bridge near the Keokuk/ Washington County line (Figure 4).

Water quality snapshots, 5 samples in total, were conducted in 2014 during Phase 1 planning. Samples were collected and analyzed by the Iowa Soybean Association. Samples taken in 2017 and 2018 were collected by ERW staff and analyzed at the State Hygenic Laboratory. Both the 2017 and 2018 monitoring season were funded through the Iowa Watershed Approach.

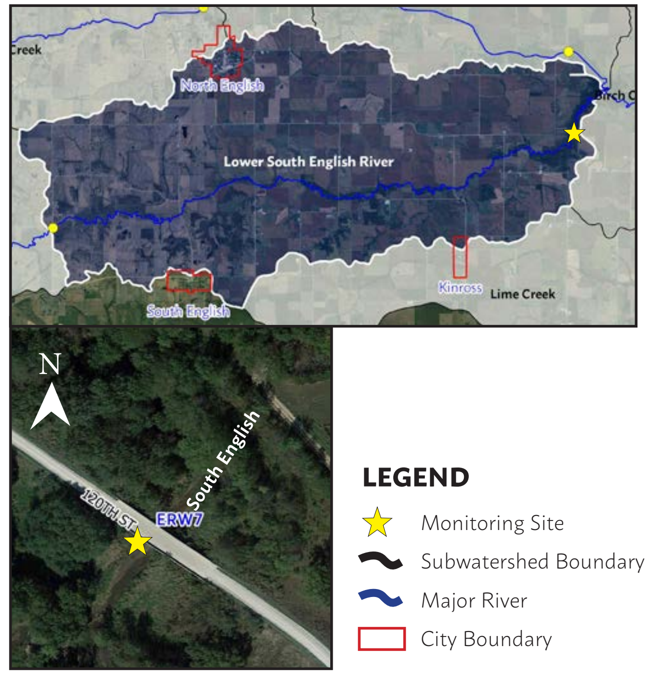

Figure 4. Water quality monitoring location for Lower South English River subwatershed. *Source: ERW*

MONITORING RESULTS

Tables 6, 7, 8, and 9 shown on the following page display monthly concentration minimums, maximums, and averages for E.Coli, orthophosphate, total phosphorus, and nitrate and nitrate, respectively, at the Deep River sampling location. An overabundance of these contaminants in the watershed is a resource concern because of their ability to negatively impact plants, wildlife, and human health through poor water quality. Values in red exceed standards for freshwater streams as defined by the Environmental Protection Agency (EPA). A more detailed explanation on standards for each of the contaminants can be found on the English River Watershed website.

During the 2017 sampling season (June 7 – December 18), the site was sampled 4 times for Nitrate+Nitrite as N, 4 times for E. coli Bacteria, 3 times for ortho-Phosphate as P, and 4 times for Total Phosphorus as P. During the 2018 sampling season (March 23 – September 4), Site 7 was sampled 3 times for Nitrate+Nitrite as N, 3 times for E. coli Bacteria, 2 times for ortho-Phosphate as P, and 3 times for Total Phosphorus as P. 2017 sampling events occurred at regular intervals between June 7 – December 18. Sampling events in 2018 occurred at regular intervals between March 23 – September 17.

In 2017, Site 7 ranked 20th (the lowest) of the English River's 20 subwatersheds for its seasonal average E. coli Bacteria values. In 2018, Site 7 ranked 5th. Values in red exceed the Iowa beach advisory/health standards of 235 CFUs/100mL.

In 2017, Site 7 ranked 9th of the English River's 20 subwatersheds for its seasonal average ortho-Phosphate as P values. In 2018, Site 7 also ranked 9th.

In 2017, Site 7 ranked 6th of the English River's 20 subwatersheds for its seasonal average Total Phosphorus as P values. In 2018, Site 7 ranked 7th. Values in red exceed EPA standard of 0.075 mg/L for freshwater streams.

In 2017, Site 7 ranked 10th of the English River's 20 subwatersheds for its seasonal average Nitrate+Nitrite as N values. In 2018, Site 7 ranked 14th. Values in red exceed EPA drinking water standard of 10 mg/L.

Table 6. E.Coli ([CFUs]/100mL) monitoring results by monthly averages at ERW 7 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	31	810	413
2018	20	10,000	3,503

Table 7. Ortho-Phosphate as P (mg/L) monitoring results by monthly averages at ERW 7 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.00	0.08	0.04
2018	0.05	0.07	0.06

Table 8. Total Phosphorus as P (mg/L) monitoring results by monthly averages at ERW 7 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.14	0.23	0.19
2018	0.12	0.48	0.25

Table 9. Nitrate + nitrite as N (mg/L) monitoring results by monthly averages at ERW 7 (2017-2018). *Source: ERW*

Year	Min	Max	Average
2017	0.0	13.0	3.3
2018	1.2	8.3	3.9

DATA AVAILABILITY

All water quality monitoring data collected during Phase 1 and Phase 2 is publicly available and accessible on the English River Watershed website. Watershed staff are able to create graphs and charts upon request that can be used to support grant applications or other funding opportunities. Figure 5 shown below is an example of how water quality monitoring results can be reproduced for the various contaminants tested shown above, including results from transparency field tests.

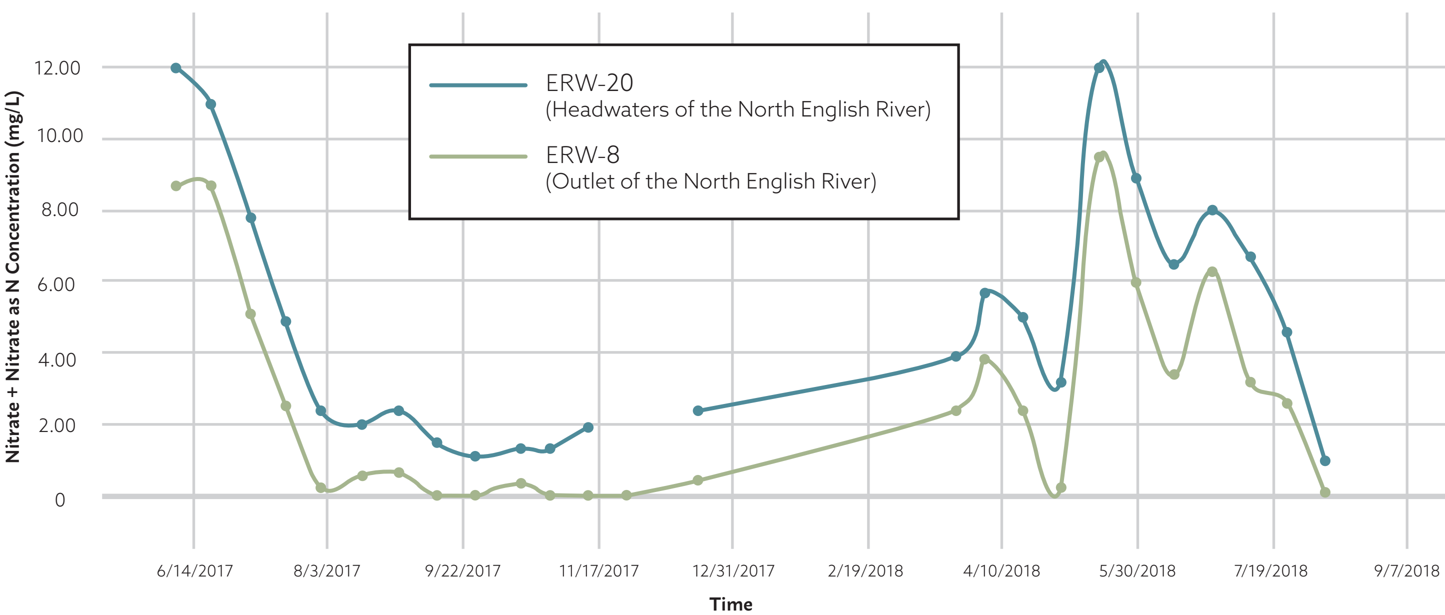

Figure 5. Example graph of Nitrate + Nitrite as N monitoring results for Sites 20 and 8 in the ERW. (2017-2018). *Source: ERW*

VIEW INTERACTIVE WATER QUALITY MONITORING MAP:
http://www.englishriverwma.org/water-quality-monitoring-1

SECTION 4: SOIL EROSION

The ERW *Resiliency and Improvement Plan* seeks to reduce soil loss from farm fields, urban areas, and construction sites through best management practices that promote soil retention and stability. In order to target specific areas of concern where practices would be most beneficial, a deeper understanding of soil erosion on the subwatershed level is necessary. Data presented in the following analysis was provided by the Iowa State University Daily Erosion Project (DEP), at https://dailyerosion.org/map. The illustration below shows what is modeled by the DEP in comparison to visible gulley erosion.

SOIL EROSION

One method for estimating erosion is to calculate the average amount of water that left the hillslopes by above ground transport. Figure 6 shown below portrays monthly variation in average erosion in the Lower South English River subwatershed. As indicated by the linear treadline, estimated erosion from 2008 to 2016 appears to be increasing. Flooding in April of 2013 generated over 12 times the total erosion (138.89 mm) than Lower South English River's average monthly erosion of 10.80 mm (0.42 inches).

Subwatersheds are identified by the last 3 digits of their 12-digit hydrologic unit code (HUC) in Table 10. For example, Lower South English River's HUC is "070802090504"; see 504 Table 10 below.

Table 10. Estimated Average Monthly Soil Runoff and Average Monthly Precipitation (2008-2016). *Source: DEP*

	405	404	402	302	401	501	403	502	301	406	408	407	503	**504**
Average Monthly Soil Runoff (mm)	13.43	13.42	13.28	13.05	13.02	12.89	12.76	12.75	12.59	12.26	12.24	12.23	11.78	**10.80**
Average Monthly Precipitation (mm)	82.68	81.97	80.54	83.21	79.25	82.04	81.65	82.23	83.68	82.65	83.17	84.61	82.92	**82.29**

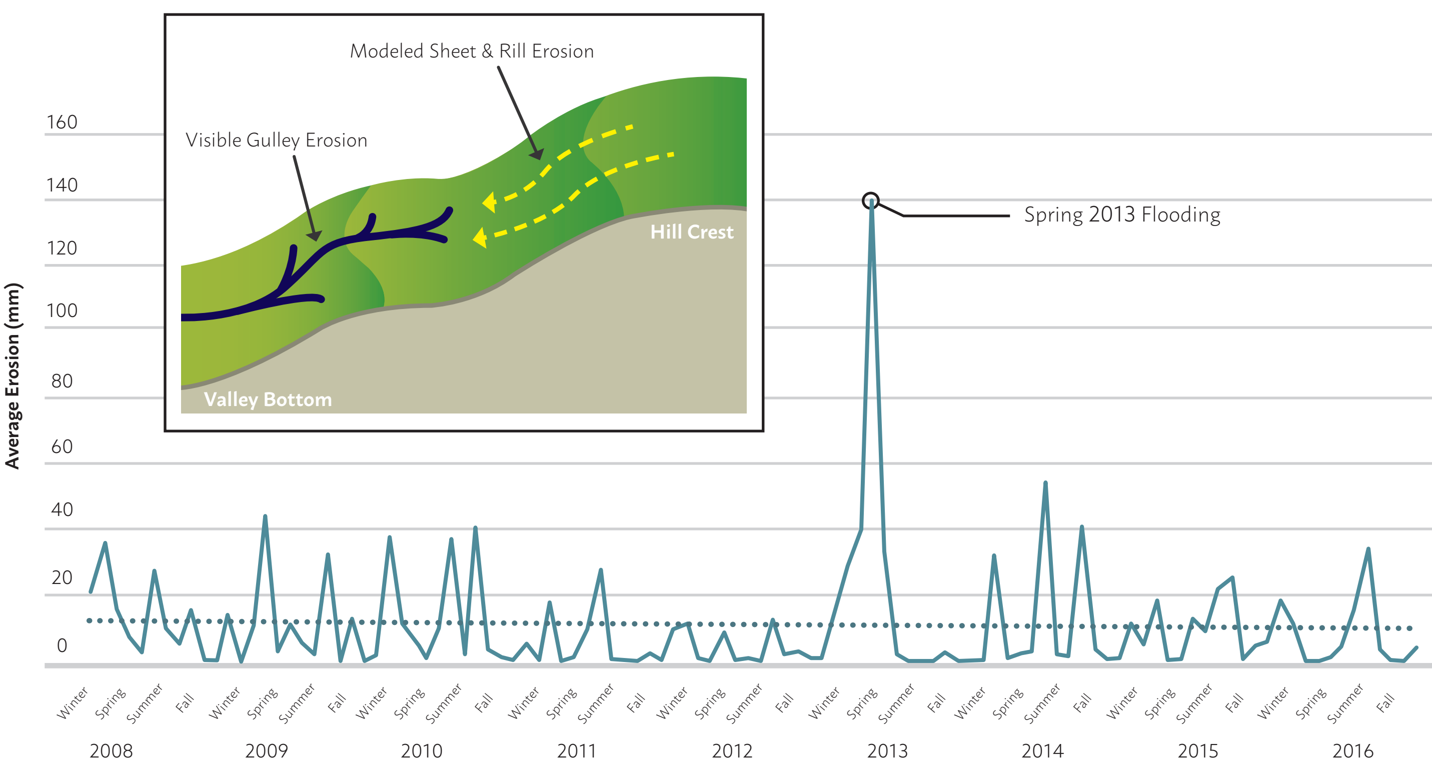

Figure 6. Soil Erosion in Lower South English River (2008-2016). *Source: DEP*

SOIL DETACHMENT & DELIVERY

Detachment is the amount of soil that is disturbed on the hillslopes during various rain events. For this analysis, historic flooding in 2013 was utilized for comparison among subwatersheds regarding their ability to hold soil. The Lower South English River subwatershed experienced an average of 4.09 tons per acre of disturbed soil during the given flood period. By comparison, the average soil detachment among the 8 subwatersheds was 6.47 tons per acre. This data is shown below (Figure 7) as light green bars.

Soil delivery is the average amount of soil transported to the bottom of hillslopes. Blue bars in the bar graph shown below (Figure 7) display average soil delivery from 2008 to 2016. The Lower South English River subwatershed ranks in the lower half all subwatersheds for soil delivery at 5.76 tons per acre per year. It is estimated that erosion rates in Iowa are about 5.1 tons per acre per year (Mike Duffy, 2012). Based on this average, soil loss in the Lower South English River subwatershed is above the state average and below the average (7.00 tons per acre per year) of all subwatersheds in the English River Watershed.

All data presented in this section is publicly available via an interactive webmap hosted by the DEP. Visit the link below to access soil erosion data specifically for the Lower South English River subwatershed.

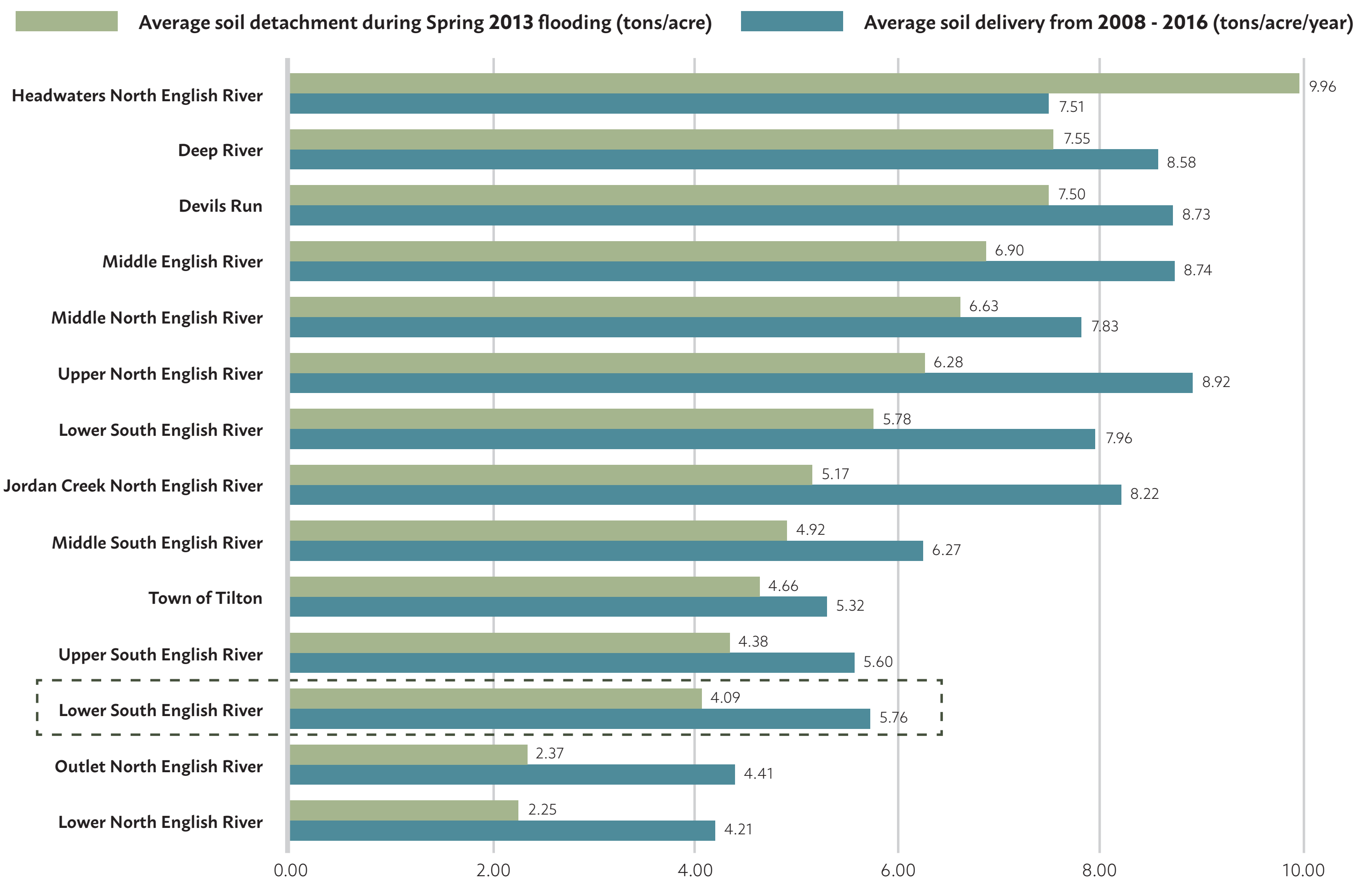

Figure 7. Soil Delivery and Detachment in Lower South English River (2008-2016). *Source: DEP*

VIEW DAILY EROSION PROJECT FOR LOWER SOUTH ENGLISH RIVER:
https://bit.ly/2P83WgC

Source: Duffy, Mike. Value of Soil Erosion to the Land Owner, August 2012. https://www.extension.iastate.edu/agdm/crops/pdf/a1-75.pdf

SOIL EROSION POTENTIAL

The following analysis uses the Natural Resource Conservation Service's (NRCS), formerly the Soil Conservation Service (SCS), curve number (CN) runoff equation to spatially illustrate the potential for soil erosion in the subwatershed. The equation examines the interaction between land cover type and hydrologic soil type to estimate runoff from a specific storm event. This analysis was completed by a group of graduate students through a partnership University of Iowa Urban and Regional Planning Department.

For this analysis, a 2-year storm event is assumed, which equals 1.41 inches of rain in 1 hour.This analysis *predicts* soil erosion and is merely a model that uses the best available data. Such data may still be outdated or contain inaccuracies. The model also assumes specific runoff percentages that may not truly represent all storm scenarios. The goal of this assessment is to highlight "problem areas" in the subwatershed where BMPs would likely have the most impact.

Figure 8 shows "High" runoff potential in dark orange colors and "Low" runoff potential in lighter shades. In the Lower South English River subwatershed, the higher areas of runoff potential are located primarily along the banks of upstream tributaries. An interactive webmap of this data is available on the ERW website. Click the link below to view the map.

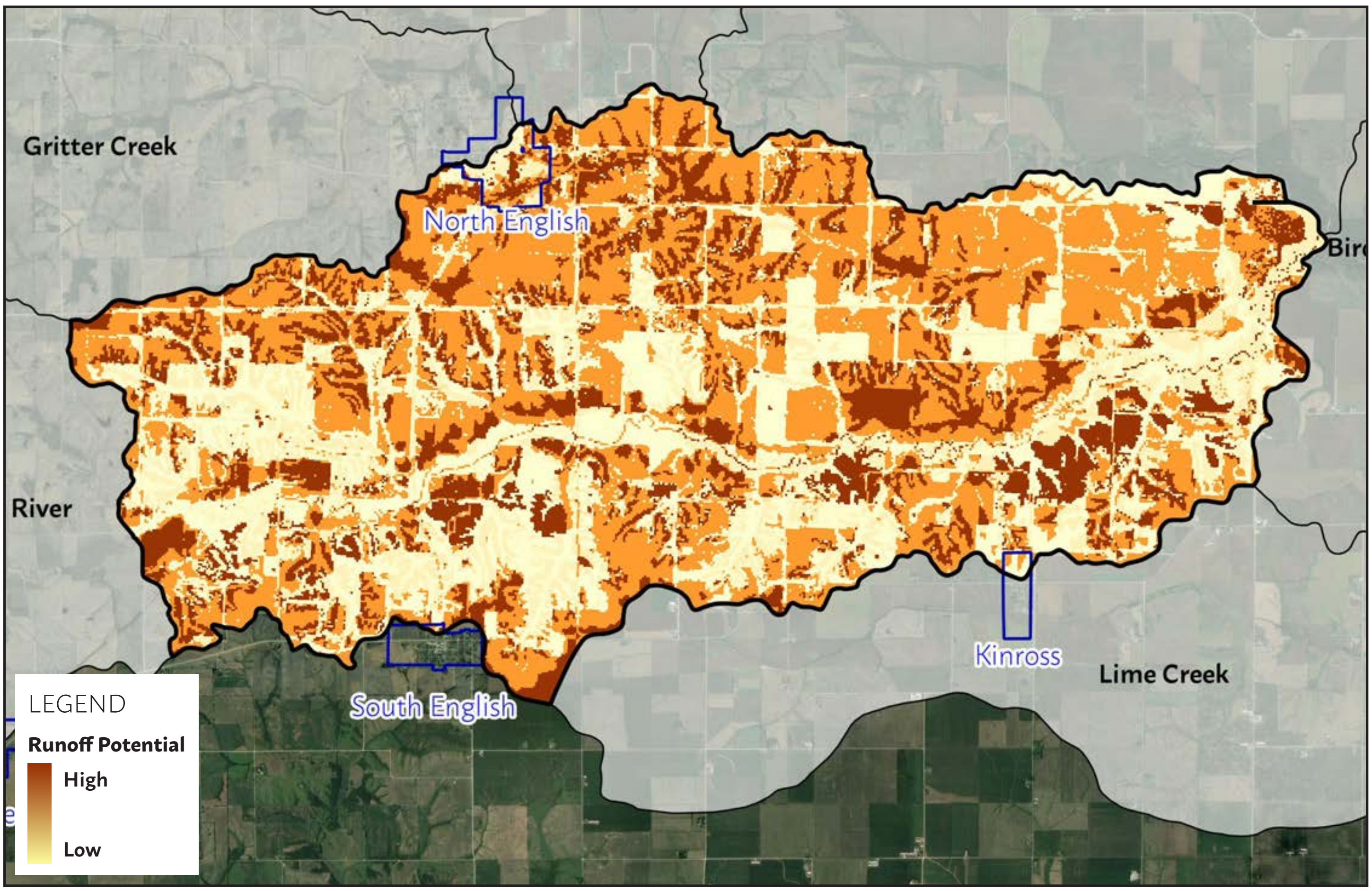

Figure 8. SCS-CN Runoff Potential Model for Lower South English River Subwatershed. *Source: ERW*

VIEW SOIL EROSION POTENTIAL WEBMAP FOR LOWER SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/erosion

SECTION 5: AGRICULTURAL CONSERVATION PLANNING FRAMEWORK

The Agricultural Conservation Planning Framework (ACPF) is a digital toolbox watershed planning and research. Utilizing a geographic information system (GIS), ACPF processes topographic data for terrain in the watershed. These data can determine land and agricultural fields within a watershed that are most prone to contribute runoff to streams. Furthermore, ACPF can identify where in-field and edge-of-field practices could be installed throughout the watershed. Such practices include surface intake filters, restored wetland, grassed waterways, buffer strips, water and sediment control basins (WASCOBs), bioreactors, saturated buffers, and floodplain reconnections. The Iowa Flood Center executed the ACPF for all subwatersheds in the English River Watershed as part of the Phase II planning project.

POTENTIAL BEST MANAGEMENT PRACTICES

According to the ACPF results, there exists the potential for 533.89 miles of contour buffer strips, 49 bioreactors, 291 WASCOBs, 1 nutrient-removal wetlands, a total of 158.05 acres of drainage area for the wetlands, and 158.05 miles of grassed waterways in the Lower South English River subwatershed (Table 11). If the wetland was installed in the subwatershed, roughly 0.6 percent of the subwatershed drainage area would be treated. These practices are spatially depicted in Figure 9. In order to see the map in greater detail and to locate the exact position of potential practices, access the ACPF webmap via the link on the following page. Locations for BMPs are not prioritized in this analysis. Further analysis is needed to determine which practices present the highest potential.

Actual implementation of practices in the subwatershed was also analyzed in comparison to potential practices identified by the ACPF tool. Refer to the Iowa Flood Center's full report for a complete analysis, which can be found on the English River WMA website.

Table 11. Count of Potential Best Management Practices as identified by ACPF in the ERW by subwatershed. *Source: Iowa Flood Center*

HUC-12	Area (acres)	CBS (miles)	Bio-reactors	WASCOBs	Nutrient Removal-Wetlands	Wetland Drainage (Acres)	% of HUC-12	Grassed Waterways (miles)
301	14,836	389.52	23	255	7	1,728.87	11.7 %	35.18
302	29,845	693.60	53	464	14	2,520.01	8.5 %	104.88
401	36,075	885.55	80	826	39	8,608.98	23.8 %	313.86
402	19,076	381.94	49	245	2	348.79	1.8 %	58.52
403	26,535	579.03	65	393	5	1,156.23	4.4 %	91.17
404	19,540	328.89	36	195	5	903.01	4.6 %	137.75
405	13,007	155.69	8	113	1	226.90	1.7 %	57.89
406	12,841	79.46	27	65	0	0	0.0 %	120.80
407	12,611	107.77	20	66	1	183.03	1.5 %	28.28
408	14,193	185.31	12	89	5	1,004.06	7.1 %	43.37
501	11,016	271.67	18	246	6	1,106.28	10.0 %	101.12
502	18,411	414.42	33	444	18	3,699.51	20.1 %	148.87
503	27,397	615.76	37	451	8	1,687.15	6.2 %	190.94
504	**25,728**	**533.86**	**49**	**291**	**1**	**158.05**	**0.6 %**	**98.27**

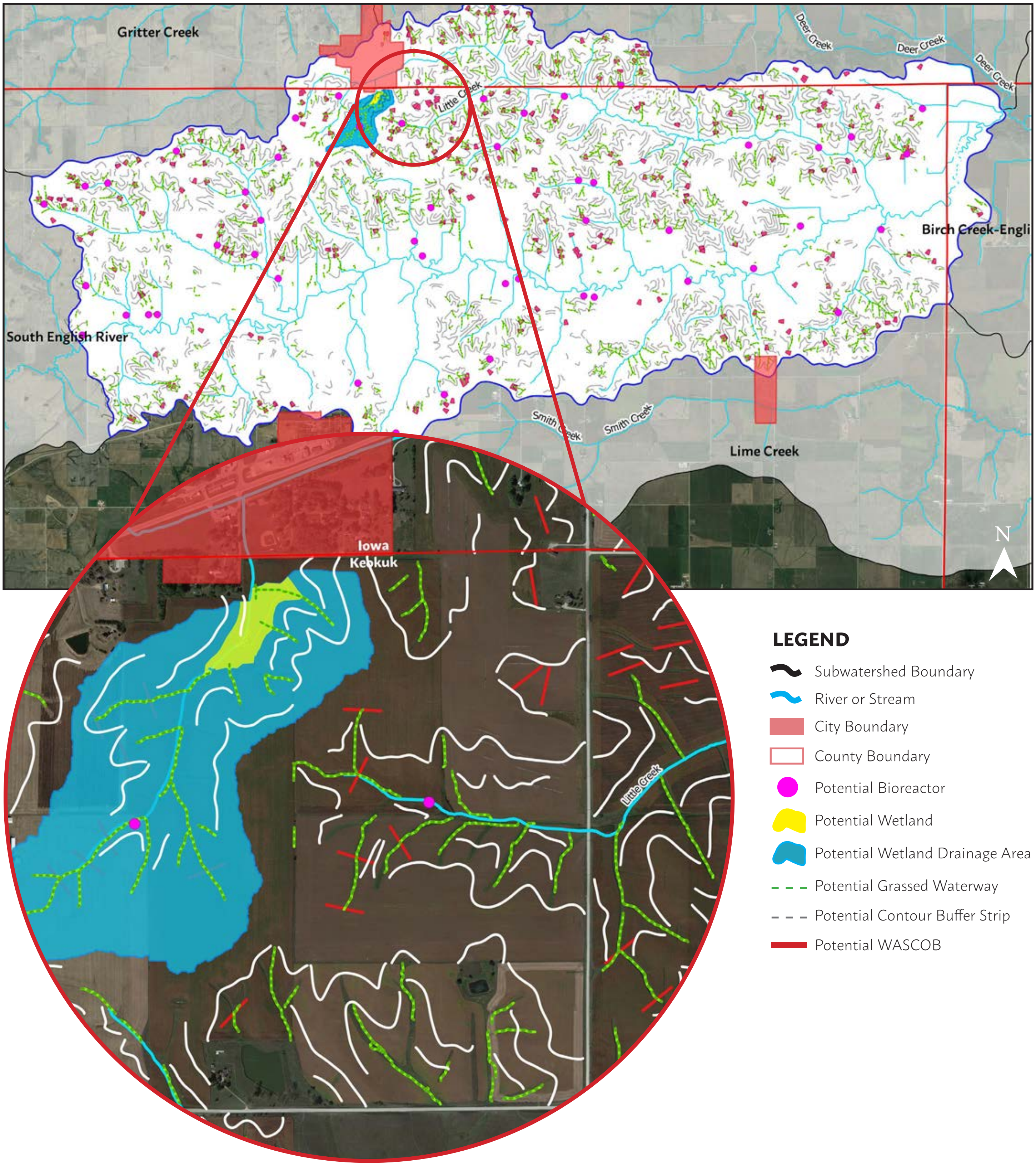

Figure 9. ACPF Model Results for Lower South English River Subwatershed. *Source: Iowa Flood Center*

VIEW ACPF WEBMAP FOR LOWER SOUTH ENGLISH RIVER:
http://www.englishriverwma.org/subwatershed-plans/acpf

SECTION 6: URBAN ASSESSMENT

The purpose of the following assessment was to quantify stormwater runoff per catchment area and to calculate pollutant loads, which provides data that can indicate higher runoff and pollutant contributing areas or “hot spots”. The analysis improves the understanding of where urban best management practices (BMPs) can provide the most benefit. These results are critical in securing grant funds and can help communities and public or private organizations better plan for utilizing limited funding.

The City of North English and the City of Kinross are the urbanized, incorporated areas in the Middle South English River subwatershed. The entire area of both cities are located within the ERW boundaries. The majority of the City of North English overlaps the Lower South English River subwatershed, while only the northernmost portions of the City of Kinross overlap the Lower South English River subwatershed (majority lies in the Lime Creek subwatershed).

Urbanization increases the amount of impermeable surfaces in a watershed. Rainfall can water contaminants over urban areas, into storm sewer system, and consequently into waterbodies. Nitrogen, phosphorus, and sediment are of primary concern if they exceed natural levels in streams and rivers, and are the principal contaminants prioritized by the Iowa Nutrient Reduction Strategy (NRS).

Runoff volume and pollutant models take into account a variety of environmental and physical conditions, including land use and impervious surfaces, soil types, and slope. Modeling was provided by the University of Northern Iowa GeoInformatics Training Research Education and Extension (GeoTREE) Center.

RUNOFF VOLUME

Comprehensive watershed planning completed in 2015 identified that runoff and flooding are primary resource concerns in the Lower South English River subwatershed. Figures 10-11 represents the stormwater runoff volume for each catchment area within the city limits of North English where orange and red portray higher runoff volumes. These “hot spots” would be suitable locations for BMPs that capture and retain water. The Iowa Stormwater Management Manual (ISWMM), a guide for the design and installation of stormwater BMPs in urban and rural areas, recommends wet ponds, wetlands, and infiltration basins for the purpose of water retention and flood control.

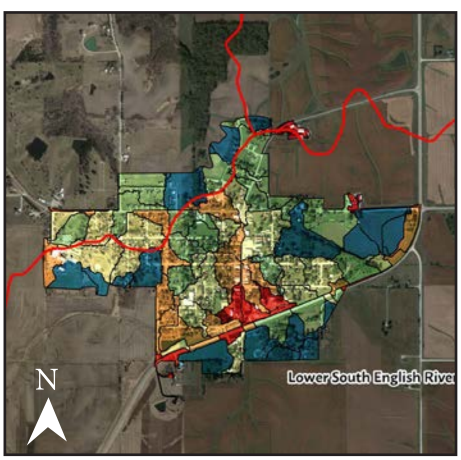

Figure 10. Modeled Runoff Volume in North English, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

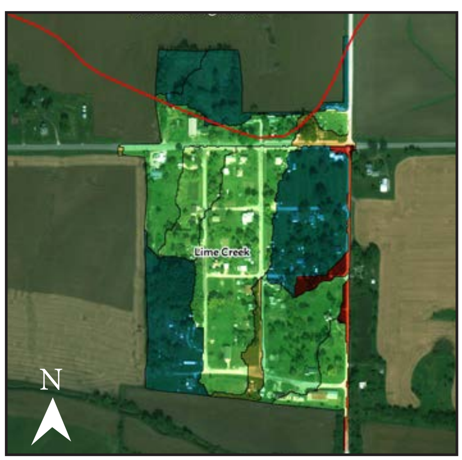

Figure 11. Modeled Runoff Volume in Kinross, IA (cubic feet/acre/year). *Source: UNI GeoTREE*

Runoff Volume (Cubic feet/acre/year)

- 5,741 - 13,819
- 13,918 - 19,751
- 19,751 - 26,169
- 26,169 - 43,357
- 43,357 - 88,749

NITRATE, PHOSPHORUS, & SEDIMENT LOADING LOADING

Figures 13-14 displays total nitrate loads for each of the catchment areas where darker shades of red portray higher loads. These "hot spots" would be suitable locations for structural BMPs such as porous paver systems, bioretention areas, and infiltrating trenches. According to the ISWMM, these practices are proven to provide total nitrogen reductions between 60 and 80 percent. Figures 15-16 and Figures 17-18 display total phosphorus loads and total sediment loads, respectively, for catchment areas where darker shades of red portray higher loads. These "hot spots" would be suitable locations for best management practices such as bioswales or rain gardens.

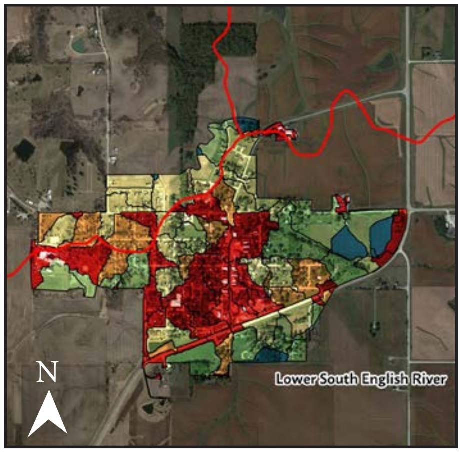

Figure 13. Modeled Nitrate Load in North English, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 14. Modeled Nitrate Load in Kinross, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Nitrate Load (lbs/acre/year)

- 0.000 - 0.201
- 0.201 - 0.331
- 0.331 - 0.469
- 0.469 - 0.549
- 0.549 - 2.000

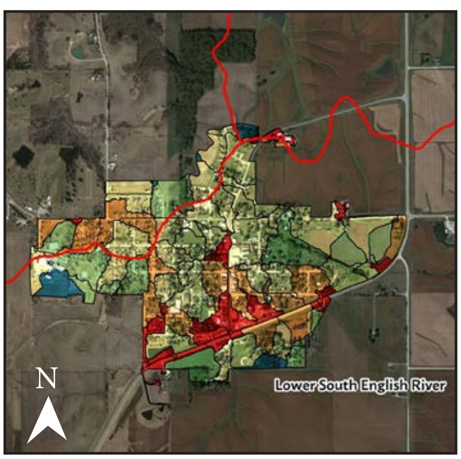

Figure 15. Modeled Phosphorus Load in North English, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 16. Modeled Phosphorus Load in Kinross, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Phosphorus Load (lbs/acre/year)

- 0.525 - 0.646
- 0.646 - 0.828
- 0.828 - 1.128
- 1.128 - 1.424
- 1.424 - 3.035

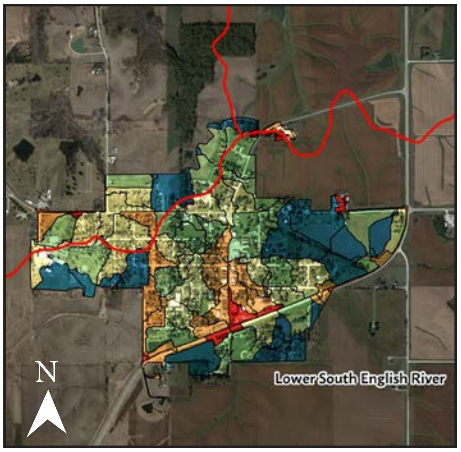

Figure 17. Modeled Sediment Load in North English, IA (lbs/acre/year). *Source: UNI GeoTREE*

Figure 18. Modeled Sediment Load in Kinross, IA (lbs/acre/year). *Source: UNI GeoTREE*

Total Sediment Load (lbs/acre/year)

- 124 - 276
- 276 - 376
- 376 - 483
- 483 - 799
- 799 - 3143

BMP SCENARIOS

These data allow for modeling the impacts of BMP introduction in various catchment areas in urban areas in the ERW. For example, a bioretention cell (roughly 21,000 square feet in area) was introduced near English Valley's High School to gauge the potential impacts of this practice. The results of modeling suggest implementation of this practice would result in a 81.1 percent reduction in runoff and a 79.6 percent reduction in particulate solids in the catchment area. This scenario is hypothetical and likely would not represent actual implementation locally, but provides an example of the impact urban conservation practices can make to both runoff volume and water quality.

Please contact staff at the ERW if you are interested in having these types of scenarios completed in your watershed community. All data presented in Section 6 is available via an interactive webmap produced by the UNI GeoTree Center, and can be accessed at the link below.

VIEW NORTH ENGLISH INTERACTIVE WEBMAP:
https://arcg.is/1WLjO4

VIEW KINROSS INTERACTIVE WEBMAP:
https://arcg.is/1auriS

SECTION 7: HAZARD MITIGATION

Hazard mitigation planning is defined as the effort to reduce loss of life and property by lessening the impact of disasters. Most counties in Iowa are required to complete a county-wide Hazard Mitigation Plan, which makes the county and its cities eligible for federal funding for emergency and non-emergency disaster assistance programs. English River Watershed stakeholders identified in Phase 1 Comprehensive Planning that reducing flood severity is a priority for watershed improvement. A brief analysis of flooding hazards is included in this plan as supplemental information and support for county Hazard Mitigation Plans. The Keokuk County Hazard Mitigation Plan was adopted in 2012 and expired in 2017. An update to the plan is currently being adopted per jurisdiction.

EXTENT OF HAZARDS

As determined by the Federal Emergency Management Agency (FEMA), Figure 14 below shows the flood hazards that exist in the Lower South English River. The flood hazard area accounts for about 16.1 percent of the subwatershed area (2nd largest area among subwatersheds). Riverine flooding can cause damage to crops, roads, homes, and businesses when river levels rise and overflow their banks. Urban areas, such as the cities of Kinross and North English, are subject to impacts from flash flooding, or flooding that develops within 6 hours of the immediate storm.

Tables 12 and 13 show previous flooding events in the county from 2008 to present (August 2018) and public assistance costs per flood event. Not all assistance costs were incurred directly within the subwatershed because data is only available on the county level. The subwatershed covers about 6.9 percent of Keokuk County's area. By contrast, the English River Watershed overlaps about 26 percent of Keokuk County. Figures presented are not exhaustive; many flash flood events do not meet the threshold to trigger public assistance.

Figure 14. Flood hazard boundary areas for Lower South English River Subwatershed. *Source: FEMA*

Table 12. 10-Year Disaster Assistance Funding by Type of Work in Keokuk County. *Source: HSEM*

Type of Work	Assistance Costs
Roads/Culverts	$1,350,486.03
Emergency Procedures	$11,406.96
Total	**$1,361,892.99**

Table 13. 10-Year Disaster Assistance Funding by Flood Event in Keokuk County. *Source: Iowa Homeland Security & Emergency Management (HSEM)*

Flood Event Period	Assistance Cost	Flood Height at North Skunk Near Sigourney
May 25 – August 13, 2008	$468,517.74	21.15' (24th Highest)
June 1 – August 31, 2010	$484,787.24	23.65' (6th Highest)
April 17 – April 30, 2013	$192,048.29	23.27' (7th Highest)
May 19 – June 1, 2013	$41,696.74	25.93' (1st Highest)
June 26 – July 8, 2014	$174,842.98	23.12' (8th Highest)
Total	**$1,361,892.99**	

POTENTIAL LOSSES

Hazards United States (HAZUS) is a nationally-applicable, standardized method for estimating potential losses from floods and other hazards. Table 14 provides estimations of building and content damage from flooding events in ERW counties. There exists 4 structures vulnerable to losses from the 1 percent annual chance flood (red dots) and 29 structures vulnerable to the 0.2 percent annual chance flood (green dots) in the subwatershed (Figure 15).

Table 14. Estimated Losses from Flood Hazards by County in the ERW. *Source: HSEM*

County	Building Count	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Average Annual Loss Vulnerability						
Iowa	20	$1,374,100.00	$1,000,000.00	$2,921.00	$1,379.00	$4,300.00
Poweshiek	5	$407,220.00	$203,610.00	$5,274.00	$2,563.00	$7,837.00
Keokuk	2	$11,620.00	$5,810.00	$484.00	$268.00	$752.00
100-Year Loss Vulnerability (1% Annual Chance Flood)						
Iowa	10	$1,002,150.00	$814,025.00	$82,248.00	$35,149.00	$117,397.00
Poweshiek	4	$372,360.00	$186,180.00	$60,882.00	$34,394.00	$95,276.00
Keokuk	2	$11,620.00	$5,810.00	$5,653.00	$3,117.00	$8,770.00
500-Year Loss Vulnerability (0.2% Annual Chance Flood)						
Iowa	20	$1,374,100.00	$1,000,000.00	$183,065.00	$100,204.00	$283,269.00
Poweshiek	5	$407,220.00	$203,610.00	$83,011.00	$50,406.00	$133,417.00
Keokuk	2	$11,620.00	$5,810.00	$5,997.00	$3,289.00	$9,286.00

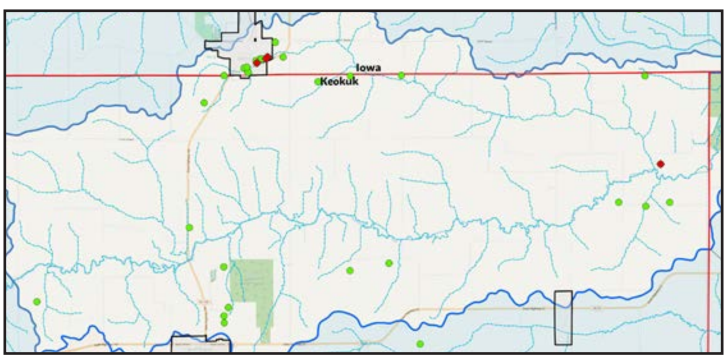

Figure 15. Vulnerable structures for flood hazards in the Lower South English River Subwatershed. *Source: HSEM*

VIEW INTERACTIVE HAZUS DATA:
http://www.englishriverwma.org/subwatershed-plans/hazus

The National Flood Insurance Program (NFIP) is a federal program that provides flood insurance for residential and commercial landowners in participating communities and counties (Table 15).

VIEW NORTH ENGLISH NFIP FLOOD MAP:
http://arcg.is/1WXmPD

Table 15. City or County Participation in NFIP. *Source: FEMA*

Municipality/Entity	Participation in NFIP
Grinnell	Yes
Guernsey	Yes
Montezuma	Yes
Webster	Yes
Kinross	**Yes**
Johnson County	Yes
Keokuk County	**Yes**
Iowa County	**Yes**
Poweshiek County	Yes
Barnes City	No
Deep River	No
Gibson	No
Keswick	No
Millersburg	No
Parnell	No
North English	**No**

SOCIAL VULNERABILITY

Community disaster resilience is the ability of people living in a subwatershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to, and recover from hazards like flooding. Understanding the social barriers present in a subwatershed may aid in targeting specific actions that watershed residents can utilize when preparing for or responding to a flood event.

The Iowa Flood Center Resilience Program conducted social vulnerability research as part of the Iowa Watershed Approach in 2018. The social vulnerability (SVI) is a combined metric of 12 indicators: African American, language barrier, renters, unemployed, poverty, children, elderly, Hispanic or Latino, low education, female head of household, disabled, and no vehicle access. They represent a percent of the population at the census tract level.

SVI scores are ranked on a scale of low/low-medium (0.000 - 0.300), medium (0.301 - 0.450), and medium-high/ high (0.451-max). Table 16 displays the SVI and the top vulnerability indicators for each of the census tracts that overlap the ERW. The highlighted row(s) represent a census tract(s) that overlaps the subwatershed.

Table 16. Top Vulnerability Factors in English River Watershed by Census Tract. *Source: IFC, ACS 2016 5-Year Estimates*

Census Tract	County	Incorporated Cities	SVI	1st Indicator	2nd Indicator	3rd Indicator
3704	Poweshiek	Grinnell	0.725	2 % Black or African American	24 % Age 65 or Older	7 % Unemployed
9601	Washington	Kalona, Riverside	0.449	27 % Children	4 % Limited English	13 % No High School Diploma
3705	Poweshiek	Montezuma, Guernsey, Deep River	0.44	1 % Black or African American	12 % Poverty	5 % Unemployed
9501	Mahaska	Barnes City	0.418	2 % Black or African American	7 % Unemployed	27 % Children
9602	Washington	Wellman	0.411	1 % Black or African American	23 % Children	3 % Hispanic or Latino
802	**Keokuk**	**Gibson, Keswick, Webster**	**0.404**	**7 % Unemployed**	**15 % Poverty**	**25 % Children**
9603	Iowa	North English, Millersburg	0.401	27 % Children	11 % Poverty	0.5 % Black or African American
104	Johnson	None	0.381	2 % Black or African American	5 % Limited English	12 % No Vehicle Access
801	Keokuk	Kinross	0.375	27 % Children	13 % Poverty	4 % Unemployed
3702	Poweshiek	Grinnell	0.363	5 % Unemployed	20 % Age 65 or Older	3 % Hispanic or Latino
3701	Poweshiek	None	0.339	5% Age 65 or Older	5% Unemployed	5 % Black or African American
9604	Iowa	Parnell	0.326	0.5 % Black or African American	10 % Poverty	19 % Age 65 or Older

Social vulnerability maps are available to the public online via the Iowa Flood Center's Iowa Watershed Approach mapping application. Click the link below and then select your watershed of interest. Then, hover over the "IWA" icon within the menu on the top-right side of the page. From there, you will see a "Flood Resilience" heading and a button to turn on the social vulnerability map layer. Users can click around on the various census tracts within the English River Watershed to see more information regarding the social vulnerability, including the top three indicators of vulnerability for that particular census tract in comparison to the rest of the watershed.

VIEW FLOOD RESILIENCY MAP:
http://iwa.iowawis.org/app/

VIEW SOCIAL VULNERABILITY MAPS:
http://www.englishriverwma.org/subwatershed-plans/resilience

SECTION 8: ACTION PLAN

This plan is intended to serve as a guide in decision-making and planning by the ERW, local agencies, local government, and citizens. Mitigation actions stated in this section are the result of data obtained through the Phase 2 planning process, the 2018 Conservation Survey, and other stakeholder input. The priority mitigation actions should be re-evaluated at least every 5 years and adjusted as necessary to keep pace with accomplished projects, current policies and practice, and availability of funding.

Mitigation actions presented in this plan (Table 18) supplement recommendations stated in Keokuk County's Hazard Mitigation Plan. The following recommendations for the Lower South English River subwatershed are based on a comparative analysis among all 14 subwatershed analyzed in this planning project.

Flooding is the primary resource concern in the subwatershed. The Lower South English River leads the entire ERW for number of structures vulnerable to financial losses from flooding. In fact, a large percentage of the total financial estimated loss for Iowa County ($1.34M), can be attributed to structures within or nearby the city limits of North English. The City of North English should consider participation in the NFIP program. The subwatershed also overlaps a census tract that presents the highest rate of poverty and a high percentage of children in comparison to the entire ERW. These vulnerabilities should be addressed given the flood risks present in the subwatershed. E.Coli bacteria contamination is the primary resource concern with respect to water quality in the subwatershed. Total phosphorus, orthophosphates, and nitrates also present levels that routinely exceed relevant water quality standards in Iowa.

FUNDING SOURCES

Mitigation actions can be financially supported through a variety of state and federal programs (Table 17). Examples of BMPs that can be funded by each program are shown in Table 18. More information on each program can be found on by accessing the links shown for each program. The following table is not exhaustive.

Table 17. State and Federal Conservation Programs. *Source: ERW*

Program	Eligible Applicants	Funding	Notes
Hazard Mitigation Grant Program (HMGP) *https://bit.ly/2wiKqq7*	Individuals, state agencies, tribal agencies, private non-profits, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Non-profits must partner with municipality or county
Pre-Disaster Mitigation Program (PDM) *https://bit.ly/2wiKqq7*	State agencies, U.S. territories, tribal agencies, municipalities, counties	Grants vary	• Requires project to be directly attributable to action stated in local Hazard Mitigation Plan • Funded annually by Congressional action and subject to a national competition
Iowa Watershed Approach (IWA) *https://bit.ly/2P7ibSi*	Individuals, municipalities, counties, private non-profits	75% cost share, no max as funds are available	• Project must be within eligible area defined by HUD • Funding period closes December 2022
Water Quality Initiative (WQI) *https://bit.ly/2BSCjWG*	SWCDs, counties, county conservation boards, municipalities, private non-profits, public water utilities, WMAs	Grants vary; Typical range: $100-$300K	• Established in 2013 to help implement Nutrient Reduction Strategy • Funding is steered toward priority watershed projects across the state
EPA 319 Non-Point Source Program *https://bit.ly/2BTXTtS*	WMAs, SWCDs	Grants vary; Typical range: $100-$300K	• Funding includes technical assistance, financial assistance, demonstration projects, training • Funding decisions are made by states; states receive annual allocation from EPA

Table 18. Mitigation Action Plan for the Lower South English River subwatershed. *Source: ERW*

Plan Objective	Action Number	Mitigation Action	Recommended Practices	Recommended Sites for Implementation	Timeframe	Potential Funding Source	Potential Partners	Jurisdiction Benefitting from Action	Action Priority
1	1.1	Flood protection of critical facilities along Lower South English River in Incorporated areas	None	None	N/A	N/A	N/A	N/A	None
	1.2	Flood protection of bridges in Lower South English River subwatershed	Perrenial Cover, Floodplain Restoration	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Washington/Keokuk/Iowa SWCD, NRCS	Washington/ Keokuk/Iowa Counties, North English and Parnell	Medium/ High
	1.3	Flood protection for population safety in Lower South English River subwatershed	Detention Basins, Ponds	See Urban Analysis (Section 6)	1-3 Years	PDM	North English and Parnell, ERW	North English and Parnell	Low
2	2.2	Acquire property at risk of flooding near Lower South English River; convert to open space	None	None	N/A	N/A	N/A	N/A	N/A
	2.3	Elevation of structures at risk to flooding in in Incorporated areas	None	N/A	N/A	N/A	N/A	N/A	N/A
3	3.1	Improve water quality in urban areas in Lower South English River subwatershed	Perennial Cover, Grass, Stormwater Detetion Basin, Urban BMPs	See Urban Analysis (Section 6)	5-7 Years	WQI	Washington/Keokuk/Iowa SWCD, NRCS, ERW	North English and Parnell	Medium/ High
	3.2	Improve water quality in rural areas in Lower South English River subwatershed	Saturated Buffers, Bioreactors, Wetlands, Sediment Detention Basins	See Soil Erosion and ACPF Analysis (Sections 4 & 5)	1-3 Years	319	Washington/Keokuk/Iowa SWCD, NRCS, ERW	Washington/ Keokuk/Iowa Counties	High
4	4.1	Provide flood protection for roads and in Lower South English River subwatershed	Floodplain Restoration, Perennial Cover	See HAZUS Analysis (Section 7)	5-7 Years	HMGP, PDM	Secondary Roads, Washington/Keokuk/Iowa SWCD, NRCS	Washington/ Keokuk/Iowa Counties, North English and Parnell	Low

ACRONYMS

ACPF	Agriculture Conservation Planning Framework
BMP	Best Management Practice
DEP	Daily Erosion Project
EPA	Environmental Protection Agency
ERW	English River Watershed
FEMA	Federal Emergency Management Agency
HSEM	Homeland Security & Emergency Management
HUC	Hydrologic Unit Code
ISWMM	Iowa Stormwater Management Manual
IWA	Iowa Watershed Approach
NFIP	National Flood Insurance Program
NRCS	Natural Resource Conservation Service
NRS	Nutrient Reduction Strategy
SCS-CN	Soil Conservation Service - Curve Number
SWCD	Soil & Water Conservation District
WMA	Watershed Management Authority

ACKNOWLEDGEMENTS

This report is one of fourteen subwatershed plans developed as part of Phase 2 planning in the English River Watershed. These plans would not have been possible without the hardwork by the Iowa Flood Center and their participation in the National Disaster Resiliency program, a federal grant administered by the Housing and Urban Development department. The following is a list of project partners that were instrumental in providing data, technical assistance, and support through the planning process.

- The Iowa Flood Center
- Iowa County, Iowa
- The University of Northern Iowa's GeoTREE Center
- The Iowa Department of Natural Resources
- Iowa Homeland Security & Emergency Management
- The Iowa Water Center & The Daily Erosion Project
- Center for Evaluation and Assessment
- The State Hygenic Laboratory
- Iowa Department of Agriculture & Land Stewardship
- Eldon C. Stutsman, Inc.

CONTACT INFORMATION

All of the data, assessments, and tools highlighted in this plan are available to the public. Please contact staff at the English River Watershed to discuss how we can assist you in conservation planning and implementation.

The English River Watershed organization operates out of the Kalona City Hall offices. Our team is available by email, phone, or via our website: (http://englishriverwma.org/contact).

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> (319) 656-2310
> 511 C Avenue, Kalona IA, 52247