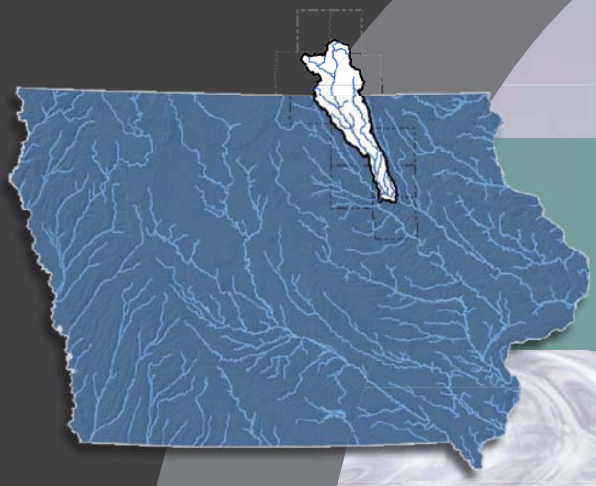
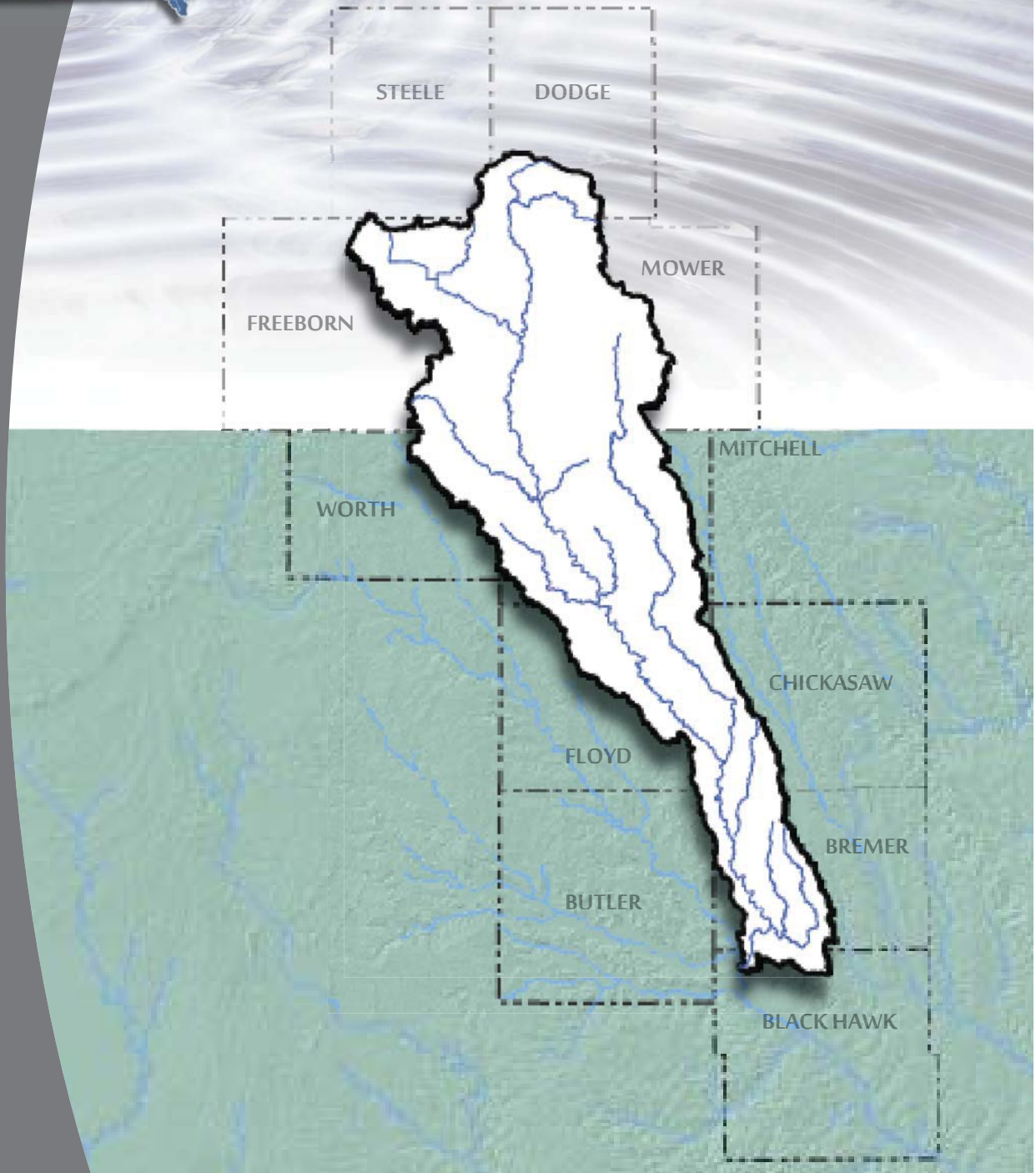


UPPER CEDAR WATERSHED MANAGEMENT IMPROVEMENT AUTHORITY

WATERSHED MANAGEMENT PLAN



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Upper Cedar Watershed Management Plan

Prepared for
Upper Cedar Watershed Management Improvement Authority

March 2015

Acknowledgments

Upper Cedar Watershed Management Improvement Authority Participants:
Black Hawk County
Bremer County
Butler County
Chicaksaw County
Floyd County
Mitchell County
Worth County
City of Charles City
City of Colwell
City of Denver
City of Floyd
City of Nashua
City of Northwood
City of Osage
City of Plainfield
City of St. Ansgar
City of Stacyville
City of Waverly
Black Hawk County Soil & Water Conservation District
Bremer County Soil & Water Conservation District
Butler County Soil & Water Conservation District
Chickasaw County Soil & Water Conservation District
Floyd County Soil & Water Conservation District
Mitchell County Soil & Water Conservation District
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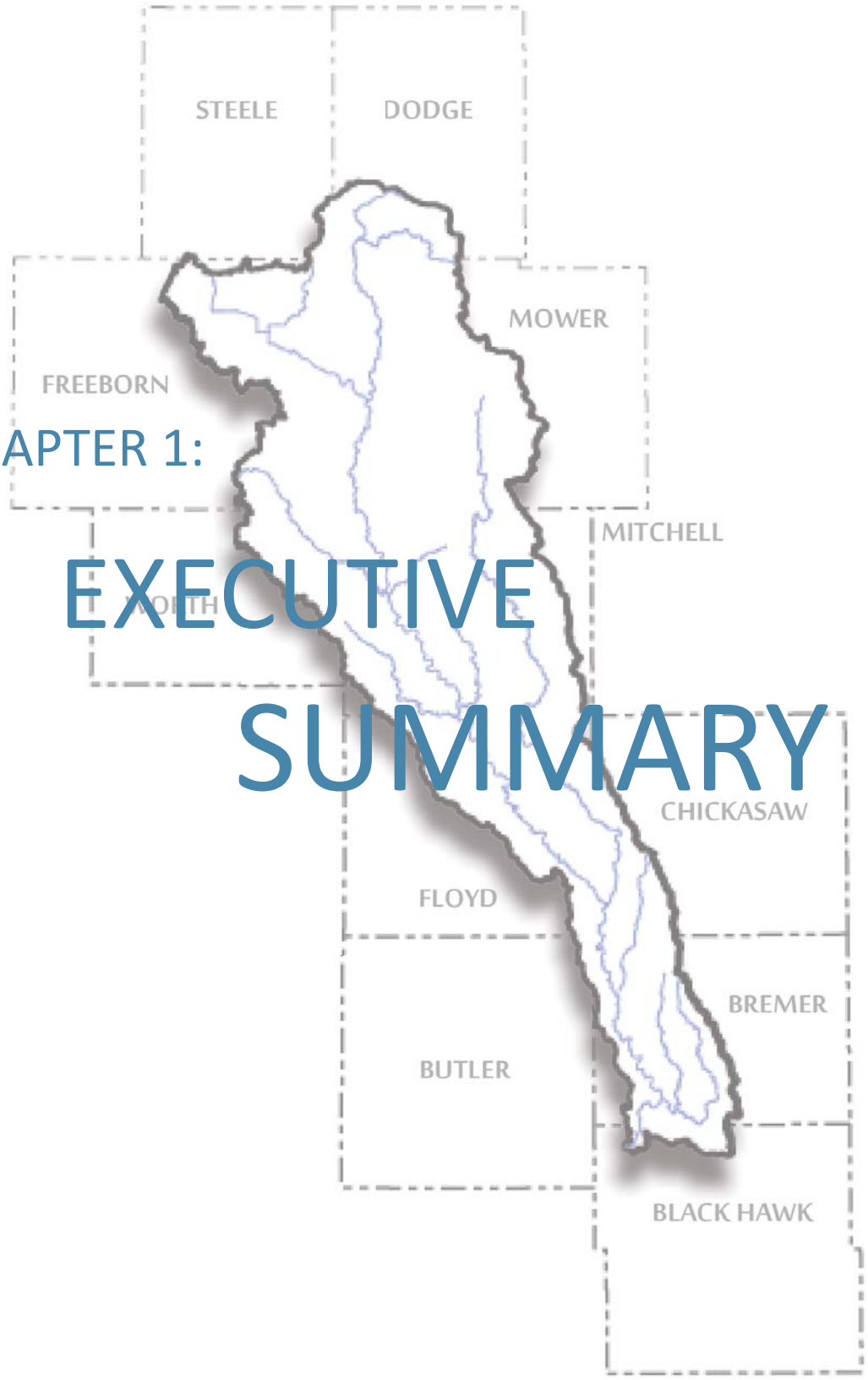

CHAPTER 1:

EXECUTIVE SUMMARY

CHAPTER 1: EXECUTIVE SUMMARY

The Upper Cedar Watershed (UCW) is part of the larger Cedar Watershed and encompasses 1,685 square miles – an exceptionally large geographic area. The Upper Cedar Watershed Management Plan identifies the broad goals, policies, action plans, and an implementation schedule for the entire watershed. However, this document should be viewed as a 'plan for a plan'; it presents a coarse evaluation of the water resources within the watershed and presents an action plan which places priorities on establishment of stakeholder groups, funding opportunities, and additional detailed assessments of subwatersheds within the Iowa portion of the Upper Cedar Watershed.

1-1 LOCATION AND HISTORY

The Upper Cedar Watershed is located in northeast Iowa and southeast Minnesota as indicated in Figure 2-1-1. The Upper Cedar Watershed Management Improvement Authority (UCWMIA) was established through a 28E agreement filed on July 2, 2012. Twenty three entities signed the agreement including the following:

Counties:	Blackhawk, Bremer, Butler, Chickasaw, Floyd, Worth
Cities:	Charles City, Colwell, Denver, Floyd, Nashua, Northwood, Plainfield, St. Ansgar, Stacyville, Waverly
Soil and Water Conservation Districts:	Blackhawk, Bremer, Butler, Chickasaw, Floyd, Mitchell, Worth

In 2010, Iowa lawmakers passed legislation that allowed for the creation of Watershed Management Authorities (WMAs). WMAs consist of two or more political subdivisions, including cities, counties, Soil and Water Conservation Districts; all parties work cooperatively through the WMA for watershed management and planning. The WMA is governed by a board of directors, including individuals from each political subdivision, and serve for staggered terms of four (4) years. The WMAs do not have taxing authority, but can allocate money that has been made available for the purposes of water quality and flood mitigation. More information on the creation and duties of WMAs can be found within Iowa Code Chapter 466B.2.

The UCWMIA typically has quarterly meetings that are open to the public. The dates, times, and location of the quarterly meetings change, but are typically held in Charles City.

The Upper Cedar Watershed is a 'working watershed', with more than 75% of the total land area associated with agricultural activities. Historically the region was dominated by prairies, but since European settlement the area has remained primarily agricultural, with corn and soybeans as the dominant crops. The 2010 Census reported a total population of 31,203 for all of the 25-Iowan communities that are at least partially within the UCW.

The Upper Cedar Watershed has its headwaters in the State of Minnesota; however, the UCWMIA's area of direct influence is limited to lands within the State of Iowa. Of the entire Upper Cedar Watershed (1,685 square miles), 58% is within the State of Iowa. Approximately 18 square miles are in Black Hawk County, 174 square miles are in Bremer County, 5 square miles are in Butler County, 81 square miles are in Chickasaw County, 210 square miles are in Floyd County, 405 square miles are in Mitchell County, and 80 square miles are in Worth County. Table 2-1-2 lists the Iowan communities that are within or partially within the Upper Cedar Watershed. Although the UCWMIA

operates within Iowa, strong partnerships with groups and citizens in Minnesota is imperative in order to see large-scale improvements within the entire watershed overtime. Any changes and improvements made within the headwaters will affect watershed dynamics further downstream.

1-2 PURPOSE AND SCOPE

The UCWMIA was established to enable cooperation in supporting watershed planning and improvements for the mutual advantage of the political subdivisions involved. A watershed is defined as the area of land were all of the water that falls in it or drains off it does to the same place, or outlet. Therefore, a watershed boundary is defined by the topography of the land, and can include portions of many political subdivisions. Any changes made within the watershed can affect the watershed as a whole, and therefore wide-scale cooperation is imperative for effective management. As President Lyndon Johnson said when signing a precursor to the Clean Water Act: *"The banks of a river may belong to one man or one industry or one state, but the waters which flow between the banks should belong to all the people."*

With this understanding, the UCWMIA's duties include:

1. Assessment of flood risks within the watershed
2. Assessment of the water quality within the watershed
3. Assessment of options for reducing flood risk and improving water quality
4. Monitoring of Federal flood risk planning and activities
5. Education of residents of the watershed regarding water quality and flood risks.
6. Allocation of moneys made available to the authority for purposes of water quality improvement and flood mitigation
7. Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the authority. Note that the watershed authority is not permitted to acquire property through eminent domain.

The UCMWIA board chose to adopt a Watershed Management Plan to help achieve these duties in order to protect and restore waters within the Upper Cedar Watershed.

1-3 PLAN ORGANIZATION

This plan was prepared according to EPA and Iowa DNR guidelines which identify nine elements of a complete watershed management plan. These nine elements are described in the left-hand column of Table 1-3-1. The right hand column of the table describes how these elements have been combined to form this document. The four (4) major chapters within the plan are summarized in Table 1-3-2.

Table 1-3-1: Nine Elements of a Watershed Plan as it related to the Upper Cedar Watershed Management Plan

EPA 9 Elements of a Watershed Plan		UCWMIA Watershed Management Plan Outline
		Chapter 1: Executive Summary
1	Identify causes/sources of pollution	Chapter 2: Physical Environment Inventory
2	Determine necessary load reductions	
3	Develop management measures to achieve goals	Chapter 3: Watershed Action Plan
4	Develop implementation schedule	
5	Develop milestones for measuring progress	Chapter 4: Implementation and Evaluation Program
6	Develop criteria to measure progress	
7	Develop monitoring component	
8	Develop information/education component	
9	Develop Implementation Plan	

Table 1-3-2: Upper Cedar Watershed Management Plan Chapter Descriptions

Chapter 1 Executive Summary
The Executive summary provides background information about the Upper Cedar Watershed Management Improvement Authority and major highlights from the entire watershed plan. It includes a purpose and scope, the broad goals for the watershed, and how the plan incorporates the EPA's nine key elements of watershed planning.
Chapter 2 Physical Environment Inventory
The Physical Environment Inventory provides detailed technical information about the watershed. This includes information on land use, population centers, topography, climate, soils, geology, ground and surface waters, existing recreation areas, wildlife, wetlands, water quality monitoring and modeling, known water quality impairments, pollutant sources, and flood risks. This section also references a wide variety of maps, all located within the appendix.
Chapter 3 Watershed Action Plan
The Watershed Action Plan first highlights the designated and desired uses of surface waters and the known impairments and their causes related to flooding and water quality. It then describes the goals and objectives for the UCWMIA, highlights some best management practices, and then offers a detailed action plan for the watershed. The action plan is then grouped into 'phases' by the lead responsible party for each action. This can help prioritize action items in the near term, and assist in delegating responsibilities within the UCWMIA.
Chapter 4 Implementation and Evaluation Program
The Implementation and Evaluation Program outlines how the plan will be implemented specifically addressing the creation of subcommittees, identifying funding sources, promoting community involvement, developing a monitoring strategy, and prioritizing subwatersheds for more detailed planning efforts. It then outlines how the UCWMIA will evaluate progress towards its goals and provides a list of interim milestones.

1-4 SUMMARY OF WATERSHED ISSUES AND GOALS

Opportunities for improvement have been identified within the Upper Cedar Watershed, all of which are described in further detail in Chapter 3 of the watershed management plan. They were broadly categorized into three (3) groups: Flood Control, Water Quality, and Overarching Issues.

Flood Control – Need for a comprehensive plan to control runoff, an evaluation of infrastructure, regulations for new development, and fostering watershed-wide coordination.

Water Quality – Current issues with high pollutant loading (nutrients and sediment) within watershed cause hypoxia and health threats, and are disadvantageous to state-mandated nutrient reductions.

Overarching Challenges – Desire for public awareness and cooperation/involvement, recognition as a priority by government agencies, and the necessity for long-term monitoring, sampling, and evolving goals/plans for watershed health and productivity.

To address these issues, representatives of the UCWMIA developed a priority list of goals for the watershed plan which include the following:

1. Encourage watershed stewardship at all levels
2. Protect and improve surface water quality
3. Reduce flood damage
4. Protect and improve groundwater quality
5. Monitor and collect data for water quality and water quantity

Each broad goal was further broken down into specific long-term goals and a series of objectives (Table 3-3-1). A plan to achieve these goals has been developed which describes actions including: development of county and municipal stormwater management ordinances; refinement of governmental policies as regards the construction, maintenance and operation of existing and future stormwater management practices; identification of short- and long-term funding programs to support UCWMIA activities; formation of a public education and outreach programs; additional study and planning activities; planning, design, and construction of additional flood control and water quality management practices throughout the watershed. long-term funding programs to support UCWMIA activities; formation of a public education and outreach programs; additional study and planning activities; planning, design, and construction of additional flood control and water quality management practices throughout the watershed.

The UCWMIA board has repeatedly stated the greater need for ongoing collaboration between all of the members of the Watershed Management Improvement Authority, as well as neighboring watershed groups in Minnesota. Communication and collaboration are needed to take advantage of all skill sets that individual stakeholders have to offer. In the immediate term, the plan calls for the formation of five (5) committees: Legislative, Funding, Education & Outreach, Studies & Inventories, and Technical Advisory Committees. These groups would be comprised of stakeholders with a passion for specific components of this plan, and provide leadership and guidance for the entire UCWMIA.

For example, the UCWMIA does not have taxing authority, and therefore funding opportunities (e.g. grants, cost shares, etc) for individual projects are needed to advance towards the watershed goals. Those individuals who are interested/skilled at identifying funding opportunities would take part in the "Funding Committee" and streamline application efforts. Another example is the need for a wide-scale water monitoring dataset (e.g. flow and water quality sampling throughout the Upper Cedar). Those stakeholders with the expertise in coordinating large data collection efforts would comprise the "Studies & Inventories Committee". They would team with partner organizations (e.g. Iowa DNR, Iowa Flood Center, etc.) to initiate monitoring efforts with a long-term mindset in order to both understand current watershed dynamics and quantify improvements over time. Ultimately, the success of the Upper Cedar Watershed Management Plan hinges on continued support and collaboration from all stakeholders.

It is intended that this plan serve as an "umbrella plan" for the entire watershed, and it is recommended for the UCWMIA to develop more focused planning efforts to take place at the smaller, subwatershed scale. Since this plan is broad in scope, the evaluation and recommended action items (Tables 3-5-1 and 4-2-1) are also broad and less specific than what will be recommended in subwatershed plans. For example, this plan offers a variety of potential Best Management Practices (BMPs) to be implemented within the watershed, whereas a subwatershed plan will recommend specific site placement for these BMPs.

Stakeholders within the Upper Cedar Watershed are encouraged to refer to subwatershed plans as they are developed and implemented. Table 4-1-2 offers a prioritized list of the HUC-12 subwatersheds for more targeting planning efforts. Finally, it is important to draw lessons from completed subwatershed planning before developing new plans elsewhere within the watershed. For example, subwatershed plans have been created for Rock Creek and Beaver Creek, and these two subwatersheds have different significantly topography. Beaver Creek has more 'rolling' terrain, which might allow for more structural BMPs (such as CREP wetlands or detention ponds) in addition to vegetative and land use BMPs. Rock Creek has gentler slopes, which are not conducive to structural practices; therefore recommended BMPs focused on more vegetative practices that do not require steep terrain, such as saturated buffers and cover-crops. Figure 2-4-3 shows the average slope by subwatershed; this can be used as a pre-planning tool for selecting potential BMP-types throughout the Upper Cedar.

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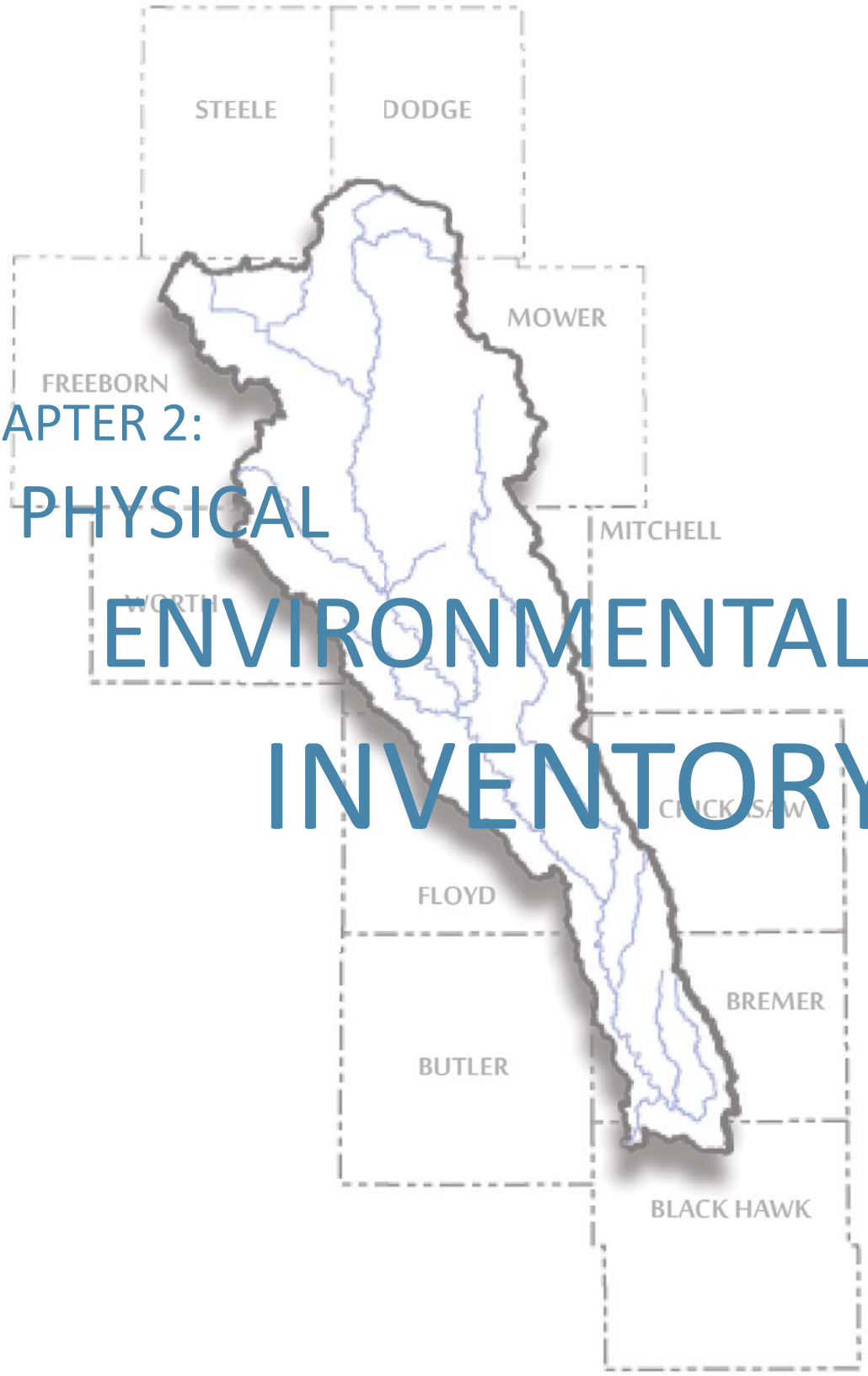


CHAPTER 2:
PHYSICAL ENVIRONMENTAL INVENTORY

CHAPTER 2: PHYSICAL ENVIRONMENTAL INVENTORY

2-1 LAND USE

The Upper Cedar Watershed (UCW) is an 8-digit Hydrologic Unit (HUC 8, #07080201) within the Upper Mississippi Region, and covers an area of 1,685 square miles. The watershed extends across two states with 58% of the total land area within Iowa and 42% in Minnesota. The Iowa portion of the watershed falls within seven counties, while the Minnesota portion falls within four counties (Table 2-1-1, Figure 2-1-1*).
Twenty-five populated places are completely or partially within the Iowa portion of the Upper Cedar Watershed, with a total population of 31,203 based on the 2010 US Census (Table 2-1-2). This equates to approximately 32 people per square mile; however, five communities straddle the boundary of the watershed (Bolan, Grafton, Ionia, Northwood, and Waverly) and therefore a portion of these residents live outside of the Upper Cedar Watershed.

Historically, the Iowa portion of the Upper Cedar Watershed was dominated by prairies. The US General Land Office (GLO) conducted field surveys in Iowa between 1832 and 1859, and documented the existing vegetation. Iowa State University, in conjunction with the Iowa DNR and the State Preserves Board, made a digitized version of this survey work, allowing for a historical comparison of land cover. Figure 2-1-2 shows the historical land cover based on the Iowa GLO survey in tandem with a Minnesotan pre-settlement vegetation survey, developed using public land survey notes from 1895. Based on the combination of the Iowan and Minnesotan surveys, 65% of the the watershed was classified as 'prairie', with only 0.1% classified as 'field'.

Table 2-1-1: Upper Cedar Watershed Area by County

		Area within Watershed (square miles)	Percent of Total Watershed Area
Iowa	Black Hawk	18	1%
	Bremer	174	10%
	Butler	5	0%
	Chickasaw	81	5%
	Floyd	210	12%
	Mitchell	405	24%
	Worth	80	5%
Minnesota	Dodge	69	4%
	Freeborn	233	14%
	Mower	400	24%
	Steele	7	0%
Total		***1685***	***100%***

*Note: All Figures excluding Figures 2-2-2 and 4-1-1 can be found in Appendix A.

Table 2-1-2: US Census Designated Places (2010) for communities within/partially within the Upper Cedar Watershed*

Name	County	Census Classification	2010 Population	Land Area (sq miles, 2010)
Janesville	Black Hawk and Bremer	City	930	1.4
Denver	Bremer	City	1780	1.6
Plainfield	Bremer	City	436	0.3
Waverly	Bremer	City	9874	11.0
Bassett	Chickasaw	City	66	0.4
Ionia	Chickasaw	City	291	0.6
Nashua	Chickasaw and Floyd	City	1663	2.9
Charles City	Floyd	City	7652	6.2
Colwell	Floyd	City	73	0.2
Floyd	Floyd	City	335	0.6
Carpenter	Mitchell	City	109	0.2
Little Cedar	Mitchell	Census Designated Place	60	1.8
Meyer	Mitchell	Census Designated Place	31	0.7
Mitchell	Mitchell	City	138	0.5
Mona	Mitchell	Census Designated Place	34	1.5
New Haven	Mitchell	Census Designated Place	91	1.9
Orchard	Mitchell	City	71	0.1
Osage	Mitchell	City	3619	2.2
Otranto	Mitchell	Census Designated Place	27	0.4
St. Ansgar	Mitchell	City	1107	1.0
Stacyville	Mitchell	City	494	0.5
Toeterville	Mitchell	Census Designated Place	48	0.9
Bolan	Worth	Census Designated Place	33	2.9
Grafton	Worth	City	252	0.3
Northwood	Worth	City	1989	3.8
TOTAL			***31203***	***44.0***

*Census designated place: A settled concentration of population that identifiable by name but are not legally incorporated

Table 2-1-3 compares the pre-settlement land cover with the post-settlement land use (as listed in the 2006 National Land Cover Dataset, NLCD). The current three dominate land uses are cultivated crops (77.2%), developed open space which includes roads (6.2%), and grasslands (5.8%). Figure 2-1-3 shows the geographic distribution of these land uses across the watershed.

Within the Iowa portion of Upper Cedar Watershed, corn and soybeans are the dominant cultivated crops comprising 57.3% and 41.0% of the total crop land, respectively, based on the 2013 USDA Cropland Data Layer. Many landowners adopt a corn/soybean annual crop rotation to increase corn yields and reduce nitrogen application expenses. Table 2-1-4 and Figure 2-1-4 show the percent coverage of the major crop types within the Iowa portion of the Upper Cedar Watershed, again based on the 2013 USDA Cropland Data Layer.

Table 2-1-4: Iowa Portion of the Upper Cedar Watershed Cropland (2013 USDA Cropland Data Layer)

Crop*	Percent of all cropland
Corn	57.25%
Soybeans	41.03%
Alfalfa	1.19%
Other Hay/Non Alfalfa	0.21%
Peas	0.10%

**Barley, Oats, Sweet Corn, Rye, Sorghum, Spring Wheat, Winter Wheat, and Other Crops each individually account for less than 0.1% of the total cropland.*

2-2 Subwatersheds

The Upper Cedar Watershed is divided into of forty-seven 12-digit Hydrologic Unit major subwatersheds (HUC-12), ranging in size from 11,081 to 40,456 acres. Thirty-two subwatersheds are completely within or partially within Iowa; the remaining fifteen are entirely within Minnesota.

The headwaters of the Upper Cedar River originate in Minnesota in Freeborn, Dodge, Steele and Mower Counties. The mouth of the watershed occurs where the Cedar River joins with the West Fork of the Cedar River, approximately 2 miles southeast of the City of Janesville in Black Hawk County, Iowa. The USGS National Hydrology Dataset (NHD) identifies forty-four uniquely named flow lines within the Upper Cedar Watershed, based in the Geographic Names Information System (GNIS) with many other unnamed tributaries. Table 2-2-1 provides basic information on all of the forty-seven HUC-12 subwatersheds, identifying the named flow lines and populated places within each, and Figure 2-2-1 shows the geographic location of each subwatershed.

Since the Upper Cedar Watershed covers such a large area, subwatersheds are often targeted for more focused research and planning efforts to better address the specific needs of the local residents and unique land characteristics. It is intended that this WMP serves as an "umbrella" plan, addressing the broader goals for the larger watershed area and incorporating the recommendations from any subwatershed plans. For example, the Upper Cedar WMP might recommend best management practices (BMPs) within broad targeted areas, and subwatershed plans will then recommend specific locations to implement those BMPs for the greatest possible return on investment.

Table 2-1-3: Approximate Historical Land Use and 2006 National Land Cover within the Upper Cedar Watershed. Historic land use is a combination of Iowa Historic Land Cover (General Land Office Survey, between 1832 and 1859) and Minnesota Pre-settlement Vegetation (Marschner's original analysis of the public land survey and landscape patterns, 1895). Historic classifications were grouped to approximately match those within the 2006 National Land Cover Dataset.

Iowa Historic Land Cover Classifications (between 1832 and 1859); Minnesota Pre-settlement Vegetation Classifications (1895)	Combined Area (sq miles)	Percent Area of Total Area
Lake, Pond; Lakes (open water)	7	0.4%
Village	0.1	0.0%
Openings; Undefined	15	0.9%
Timber, Timber/barrens, Timber/scattering/openings, Scattering trees, Grove, Ticket, Brush, Rough, Part Prairie/Part Timber; Big Woods, Oak Openings and barrens, River Bottom Forest	498	29.7%
Prairie	1090	65.0%
Field	1	0.1%
Marsh, Slue [sic], Swamp, Bayou;Wet Prairie	66	3.9%
TOTAL	***1677***	***100.0%***

National Land Cover Land Dataset (2006)	Area (sq miles)	Percent Area of Total Area
Open Water	10	0.6%
Developed, Open Space	105	6.2%
Developed, Low Intensity	29	1.7%
Developed, Medium Intensity	5	0.3%
Developed, High Intensity	2	0.1%
Barren Land	1	0.0%
Deciduous Forest	44	2.6%
Evergreen Forest	1	0.0%
Mixed Forest	0	0.0%
Shrub/Scrub	0	0.0%
Grasslands/Herbaceous	98	5.8%
Pasture/Hay	58	3.4%
Cultivated Crops	1301	77.2%
Woody Wetlands	25	1.5%
Emergent Herbaceous Wetlands	7	0.4%
TOTAL	***1685***	***100.0%***

Table 2-2-1: Upper Cedar Subwatersheds, 12-digit Hydrologic Unit (HUC-12)

HUC-12 ID	Subwatershed Name	Named Flowline (USGS NHD)	Area (acres)	State	Populated Place (US Census)
070802010101	Deer Creek	Deer Creek, Judicial Ditch Number Thirty, Magnuson Ditch	19,914	MN	
070802010102	Geneva Lake	County Ditch Number Eight, County Ditch Number Thirty, Judicial Ditch Number Twelve, Judicial Ditch Number Twentyeight, Judicial Ditch Number Twentyseven, Knotvold Branch, Mud Creek, Turtle Creek	40,456	MN	Clarks Grove, Geneva, Hollandale
070802010103	Judicial Ditch No 24	Judicial Ditch Number Eighteen	18,850	MN	
070802010104	Turtle Creek	Turtle Creek	18,700	MN	Austin
070802010201	Headwaters Cedar River	Cedar River	32,252	MN	Hayfield, Waltham
070802010202	Little Cedar River-Cedar River	Little Cedar River, Westfield-Ripley Ditch	13,930	MN	
070802010203	Roberts Creek	Roberts Creek	25,040	MN	Brownsdale, Sargeant, Waltham
070802010204	Green Valley Ditch-Cedar River	Cedar River	31,029	MN	Blooming Prairie, Lansing
070802010205	Dobbins Creek	Dobbins Creek	24,585	MN	Austin
070802010206	City of Austin-Cedar River	Cedar River, Judicial Ditch Number Five, Murphy Creek, Wolf Creek	35,031	MN	Austin, Brownsdale, Lansing, Mapleview
070802010301	Upper Rose Creek	Rose Creek, Schwerin Creek	16,928	MN	Dexter, Elkton
070802010302	Lower Rose Creek	Rose Creek	26,508	MN	Rose Creek
070802010401	Drainage Ditch 11-Deer Creek		19,512	IA	Bolan, Northwood
070802010402	Upper Deer Creek-Cedar River	Deer Creek	22,129	IA,MN	Myrtle
070802010403	Lower Deer Creek-Cedar River	Deer Creek	23,613	IA	Carpenter
070802010501	Orchard Creek	Orchard Creek	20,403	MN	Austin
070802010502	Judicial Ditch No 77-Cedar River	Cedar River	23,892	MN	Lyle
070802010503	Woodbury Creek	Mud Lake Creek, Woodbury Creek	26,883	IA,MN	
070802010504	Unnamed Creek-Otter Creek-Toeterville	Otter Creek	39,947	IA,MN	Mona, Toeterville, Lyle
070802010505	Cedar River-Otter Creek	Cedar River	22,890	IA,MN	Mona, Otranto, Lyle
070802010601	Turtle Creek	Turtle Creek	14,477	IA	St. Ansgar, Toeterville
070802010602	Spring Creek-Upper Cedar River	Slough Creek, Spring Creek	25,724	IA	Orchard, Osage
070802010603	Rock Creek-Goose Creek	Rock Creek	24,414	IA	Grafton

070802010604	Rock Creek-Upper Cedar River	Rock Creek	20,374	IA	
070802010605	Cedar River-Sugar Creek	Cedar River, Sugar Creek, Willow Creek	36,946	IA	Mitchell, Osage, St. Ansgar
070802010701	City of Adams		19,081	MN	Adams
070802010702	Little Cedar River-Meyer	Little Cedar River	22,769	IA,MN	Meyer
070802010703	Little Cedar River-Stacyville	Little Cedar River	29,170	IA,MN	Little Cedar, Meyer, Stacyville
070802010801	Burr Oak Creek-Little Cedar River	Burr Oak Creek	18,427	IA	Little Cedar
070802010802	Little Cedar River-Burr Oak	Beaver Creek, Little Cedar River	31,135	IA	Little Cedar, New Haven
070802010803	Little Cedar River-Uphams Slough	Fish Creek, Little Cedar River	28,292	IA	New Haven
070802010901	Beaver Creek-Little Cedar River	Beaver Creek	11,081	IA	Bassett, Colwell
070802010902	Little Cedar River-Beaver Creek	Little Cedar River	24,678	IA	Colwell
070802010903	Little Cedar River-Cedar River	Little Cedar River	15,065	IA	Bassett, Ionia, Nashua
070802011001	Cedar River-Skunk Creek	Cedar River, Sunken Creek	29,253	IA	Floyd
070802011002	Drainage Ditch 3-Cedar River		13,606	IA	Charles City
070802011003	Cedar River-Stewart Creek	Cedar River, Stewart Creek	19,718	IA	Charles City, Floyd
070802011004	Gizzard Creek	Gizzard Creek, Schultz Creek	16,260	IA	
070802011005	Cedar River-Bloody Run	Bloody Run, Cedar River	21,984	IA	Charles City, Nashua
070802011101	Upper Quarter Section Run	Quarter Section Run	22,820	IA	Denver
070802011102	Baskins Run	Baskins Run	15,974	IA	
070802011103	Lower Quarter Section Run	Quarter Section Run	16,431	IA	Denver
070802011201	Dry Run-Upper Cedar River	Dry Run, Twomile Creek	16,309	IA	
070802011202	Horton Creek	Horton Creek	15,812	IA	
070802011203	Cedar River-Dry Run	Cedar River	23,719	IA	Nashua, Plainfield
070802011204	Cedar River-Quarter Section Run	Cedar River	28,853	IA	Waverly
070802011205	Cedar River-West Fork Cedar River	Cedar River	12,403	IA	Janesville, Waverly

2-3 Climate, Precipitation, and Flooding

2-3.1 Climate and Precipitation

The climate of the Upper Cedar Watershed has marked seasonal variations due to the latitude and interior continental location. The average monthly temperatures at Osage range from 15°F in January to 72°F in July (1981-2010, Midwestern Regional Climate Center, Osage USC00136305). The highest recorded temperature was 107°F in July of 1936 and the lowest recorded temperature was -35°F, occurring twice, once in January of 1912 and once in February of 1996. Figure 2-2-2 shows the monthly temperature and precipitation normals at the Osage station between 1981 and 2010.

Figure 2-2-2: Monthly Temperature and Precipitation Normals for Osage Station (USC00136305) between 1981 and 2010.

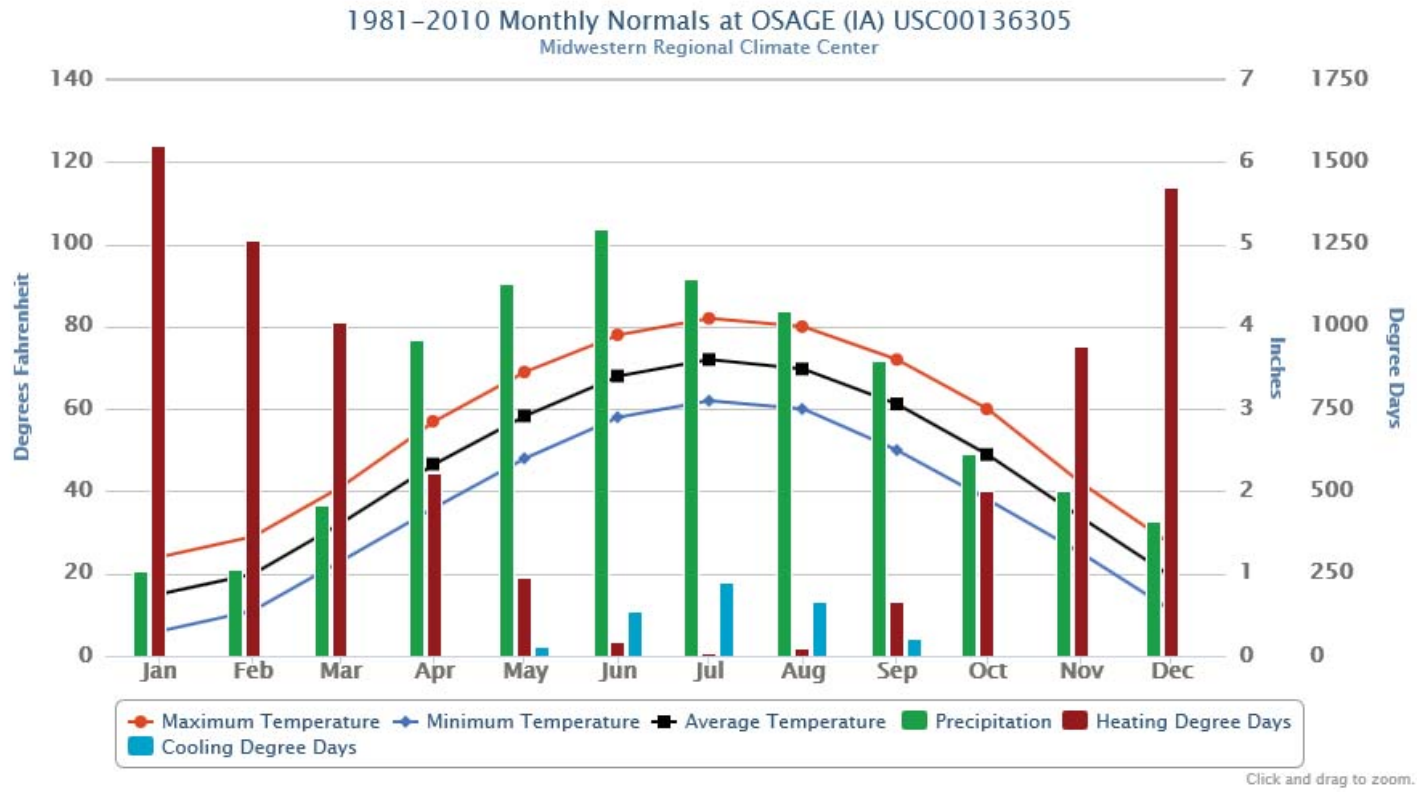


Figure courtesy of the Midwestern Regional Climate Center, Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign.

Table 2-3-1 is a summary of the monthly precipitation at the Osage station. The average total annual precipitation between 1983-2013 (excluding years with missing records) was 35.6 inches. Additional precipitation stations within the Upper Cedar include Charles City, IA, Northwood, IA, and Austin, MN. Data from these gages can be retrieved from the Midwestern Regional Climate Center (http://mrcc.isws.illinois.edu).

2-3.2 Flooding

Flooding is a serious concern within the Upper Cedar Watershed. Reports on flooding events often use 'flood probability' to estimate the likelihood of certain size of flood flow occurring in any one year (Annual Exceedance

Table 2-3-1: Precipitation Summary for Osage Iowa (USC00136305). Average values between 1983-2013. 1-Day Maximum Value between 1893-2013.

	Total Precipitation, Inches							Snow, Inches		
Month	**Mean**	**High**	**Year**	**Low**	**Year**	**1-Day**	**Year**	**Mean**	**High**	**Year**
Jan	0.8	1.8	1992	0.0	99, 00, 02	1.6	1947	9.1	28.6	1996
Feb	0.9	2.7	2007	0.0	97, 99	1.3	2007	7.2	21.3	2007
Mar	1.9	4.4	1990	0.0	1999	2.1	1959	5.9	19.0	1995
Apr	4.1	7.6	2008	0.9	1997	3.1	1975	1.6	9.5	2003
May	4.9	12.5	2013	1.4	1985	4.9	1938	0.4	13.0	2013
Jun	5.0	12.4	2008	1.6	1987	6.3	1914	0.0	0.0	
Jul	4.4	14.2	1999	0.8	1988	5.8	1999	0.0	0.0	
Aug	3.9	9.8	1993	0.5	2003	6.4	1980	0.0	0.0	
Sep	3.4	10.4	1985	1.1	2003	5.2	1983	0.0	0.0	
Oct	2.3	8.9	2009	0.4	2003	2.7	1970	0.2	3.6	2002
Nov	2.0	4.9	1992	0.0	2007	4.0	1995	2.7	16.8	1985
Dec	1.4	3.6	2010	0.0	1998	1.8	1982	9.8	28.7	2010

Probability, AEP). For example, a 1% AEP flood flow has a 1 in 100 chance of occurring in any one year; this is often referred to as the 100-year flood. Note that it is statistically possible to have several 100-year floods within a single period of 100 years. The opposite is also true, meaning that it is possible for 100 years to pass without a single 100-year flood occurring. Table 2-3-2 provides a comparison between the flood probability (AEP) and the equivalent flood recurrence interval.

Table 2-3-2: Annual Excedence Probabilities and corresponding Recurrence Intervals

Annual Exceedance Probability	Recurrence interval (years)
99%	1
50%	2
20%	5
10%	10
4%	25
2%	50
1%	100
0.5%	200
0.2%	500

Table 2-3-3: Largest Flood Events on record at Charles City and Janesville USGS Gages

Year	Flooding Month	USGS Station†	Peak Streamflow Date	Peak Streamflow (ft3/s)	AEP*	Notes*
1851	June	Cedar Rapids	*Unknown*	*Unknown*	4-10%	Possibly fifth largest known flood. Little/no accurate information available to evaluate flooding conditions.
1961	March-April	Charles City	3/27/1961	29,200	1-2%	Third largest known flood. Result of rapid snow melt coupled with rainfall.
		Janesville	3/28/1961	37,000	1-2%	
1993	April (snowmelt runoff and rain), August (rainfall and saturated soils)	Charles City	8/16/1993	26,400	2-4%	Fourth largest known flood. Wettest year on record in Iowa with an average rainfall of 48.22 inches.
		Janesville	8/18/1993	35,000	2-4%	
1999	July	Charles City	7/21/1999	31,200	1-2%	Second largest known flood. Cumulative effect of two thunderstorms.
		Janesville	7/22/1999	42,200	0.2-1%	
2008	May-June	Charles City	6/9/2008	34,600	0.2-1%	Largest known flood. Prolonged, intense rainfall coupled with snowmelt.
		Janesville	6/10/2008	53,400	0.2-1%	

† Cedar Rapids: Cedar River Gage 05464500; Charles City: Cedar River Gage 05457700; Janesville: Cedar River Gage 05458500
*Flood probabilities and notes provided by the USGS report "Floods of May 30 to June 15, 2008, in the Iowa River and Cedar River Basins, Eastern Iowa". http://pubs.usgs.gov/of/2010/1190/pdf/of2010-1190.pdf

AEP values are often given within a range, to express the uncertainty associated with these estimates. Flood probabilities also change over time; they are recalculated as more stream flow data is recorded. The USGS currently maintains three gaging stations along the Cedar River within the Upper Cedar Watershed: 05457000, near Austin, MN, 05457700 at Charles City, IA, and 05458500 at Janesville, IA. Table 2-3-3 lists the five largest flood events on record for the Upper Cedar Watershed, with peak flow information for the USGS gages at Charles City and Janesville.

The largest known flood on record at the outlet of Upper Cedar Watershed was in May-June of 2008. Flooding in the Cedar River Basin began on May 30, 2008 with peak discharges recorded on the Cedar River at Charles City on June 9th (34,600 ft^3/s) and at Janesville on June 10th (53,400 ft^3/s). The floods of 2008 forced thousands of Iowans to evacuate their homes, prompted the closure of roads and major highways, significantly impacted agricultural lands due to erosion and soil deposition, and caused severe damage in urban areas. The flooding was declared a Federal disaster for 85 Iowan counties, and the Federal Emergency Management Agency (FEMA) issued aid to those impacted by the floods.

The magnitude of the 2008 flood made flood-control a top priority within the state. The Iowa Flood Center (IFC) at the University of Iowa was established just one year after the event, specifically to monitor, research, and mitigate flooding within the region. Several Watershed Management Authorities (WMA) including the Upper Cedar WMA were created to bring together local shareholders to discuss and develop options for reducing flood-risks as well as improving water quality. The funding used to develop these WMA's was provided by the Community Development Block Grant (CDBG) Disaster Relief allocation, which was only available to those counties within the 2008 Federal disaster area.

2-4 Topography

Elevation in the Upper Cedar ranges from approximately 1,440 feet above sea level (in Mower County, MN) to 850 feet (watershed outlet in Black Hawk County, IA). The topography is characterized by gentle slopes, with an average of 1.8% based on analysis of a 30 m digital elevation model (DEM). Figures 2-4-1 and 2-4-2 show the relief of the watershed and slope ranges.

Topography can be a driving factor for selecting feasible BMPs for improving water quality and flood reduction. Certain BMPs are better suited for rolling terrain (e.g. CREP wetland projects) while others can be implemented in flat terrain (e.g. cover crops). Therefore, slope can be used when prioritizing areas for specific types of BMP projects. Figure 2-4-3 shows the average slope within the HUC-12 subwatersheds.

2-5 Soils

Soils vary significantly within the Upper Cedar, as anticipated for such a large area. The NRCS updates soils survey datasets on a regular basis, providing the data online through the Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/).

The infiltration properties of a soil have an effect on how much rainfall will become direct runoff. Soils that have higher infiltration rates can absorb more of the rainfall, resulting in less direct runoff. Conversely, soils with lower infiltration rates will have a higher amount of direct runoff. The USDA NRCS soils data has four hydrologic soil

group (HSG) classifications that describe infiltration capabilities of any particular soil: A, B, C and D. Soils in the "A" group have low runoff potential, soils in the "D" group have high runoff potential with Groups "B" and "C" falling in between.

Some soils have mixed classifications (A/D, B/D and C/D) in situations of a high water table. If these soils can be drained (through added infrastructure) the soils will be assigned to the group with the lower runoff potential. An abbreviated description of the hydrologic soil groups from the USDA-NRCS handbook is below:

> *Group A—Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Some soils having loamy sand, sandy loam, loam or silt loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments...*
>
> *Group B—Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock*
>
> *Group C—Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.*
>
> *Group D—Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential. All soils with a depth to a water impermeable layer less than 50 centimeters [20 inches] and all soils with a water table within 60 centimeters [24 inches] of the surface are in this group, although some may have a dual classification, as described in the next section, if they can be adequately drained.*
>
> *Dual hydrologic soil groups—Certain wet soils are placed in group D based solely on the presence of a water table within 60 centimeters [24 inches] of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition."*
>
> *USDA, NRCS: Part 640 Hydrology. National Engineering Handbook. Jan 2009. Chapter 7, Hydrologic Soils Groups. ftp://ftp.wcc.nrcs.usda.gov/wntsc/H&H/NEHhydrology/ch7.pdf*

Within the Iowa portion of the Upper Cedar, 6% are classified A soils, 21% are B, 10% are B/D, 15% are C, 43% are C/D and 3% are D. The remaining 2% are not assigned to a hydrologic soil group. Figure 2-5-1a and Figure 2-5-1b shows the distribution of the hydrologic soils groups within the Iowa-portion of the Upper Cedar.

2-6 Geology and Groundwater Resources

The bedrock underlying the Iowa portion of the Upper Cedar Watershed is part of the Cretaceous, Devonian, Ordovician and Silurian Systems. The Cedar Valley Group underlies much of the northern and western portions of the watershed (approximately 85% of the Iowa portion) with a few isolated pockets of the Dakota and Windrow Formations. Further southwest, the bedrock is more diverse including the Wapsipinicon Group, the Hopkinton, Blanding, Tete des Morts, Mosalem Formations, and the Maquoketa Formation. These groups and formations are comprised mainly of limestone, dolomite and shale, with the exception of the Dakota and Windrow Formations (primarily sandstone). More details regarding the bedrock geology can be found at the USGS National Geologic Map Database: http://ngmdb.usgs.gov/ngmdb/ngmdb_home.html. Figure 2-6-1 displays the bedrock geology within the Iowa portion of the Upper Cedar Watershed.

In 1991, the Iowa DNR has identified regions of Iowa with similar hydrogeological characteristics that can affect the relative vulnerability of groundwater to contamination from surface sources. This makes it possible to see larger regional characteristics within the watershed (although it should be not be solely relied on for site specific issues). Within the Upper Cedar, there are five map unit classifications:

Alluvial Aquifers: Areas underlain by sand and gravel aquifers situated beneath floodplains along stream valleys and includes alluvial deposits associated with stream terraces and benches, continuous wind-blown sand deposits, and glacial outwash deposits; natural water quality generally excellent (less than 500 mg/L total dissolved soils) and yields vary with texture and thickness of alluvium (commonly greater than 100 gallons/minute in larger valleys, less in smaller valleys); most wells are very shallow; high potential for aquifer contamination; high potential for well contamination. Some of the areas underlain by alluvial aquifers are not shown because of map scale.

Good Bedrock Aquifers: Area underlain by regional bedrock aquifers, primarily fractured carbonate units; other regional aquifers usually available at various depths; natural water quality usually excellent (less than 500 mg/L total dissolve solids) and high yields commonly available (greater than 100 gallons/minute).

Thin Drift Confinement: Less than 100 feet (30 meters) of glacial drift overlie regional aquifers; most wells are deep and completed in the bedrock aquifers; high potential for aquifer contamination; high potential for well contamination.

Moderate Drift Confinement: 100 to 300 feet (30 to 90 meters) of glacial drift overlie regional aquifers; most wells are deep and completed in the bedrock aquifers; low potential for aquifer contamination low potential for well contamination.

Sinkholes: Naturally occurring depressions in the landscape caused by solution or the collapse of carbonate rocks; common where limestone is less than 30 feet (10 meters) below land surface; contaminated surface water may enter the aquifer via the sinkholes, contaminating the aquifer in a localized area; contaminate levels can fluctuate significantly during periods varying from minutes to weeks; increases contamination potential in areas with thin drift confinement; mapped from county soil survey publications.

Agricultural Drainage Wells: Wells drilled to drain surface water and soil water into carbonate aquifers; their presence allows contaminants in surface or tile water to enter the aquifers at much higher rates than naturally would be possible; increases contamination potential much like sinkholes; mapped from registration records at the Iowa Department of Natural Resources.

Map unit descriptions reproduced from: Groundwater Vulnerability Regions of Iowa, Special Map Series II, Prepared by Bernard E. Hoyer and George R. Hallberg, Energy and Geological Resources Division, Geological Survey Bureau, Iowa Department of Natural Resources, June 1991.

In the Iowa portion of the Upper Cedar, 51% of the land is classified as having "good bedrock aquifers with thin drift confinement", 19% is classified with "good bedrock aquifers with moderate drift confinement", 20% is classified with "alluvial aquifers", 9% is classified with a "sinkhole" present within a 400 meter radius, and <1% is classified with having an "agricultural drainage well" within a 400 meter radius. Figure 2- 6-2 displays the geographic distribution of the DNR's groundwater vulnerability map units, as well as the known agricultural drainage wells, and source water wells. Note that since the development of the DNR's groundwater vulnerability map units, many agricultural drainage wells have been closed. Figure 2-6-3 displays the depth to bedrock within the Upper Cedar.

Agricultural drainage wells (ADWs) were constructed in the early 1900s as an outlet for surface water runoff from fields, but can potentially move contaminants into underground drinking waters. Since these wells are located in agricultural areas, there is the potential for agricultural chemicals, including fertilizers, to directly contaminate water in the subsurface aquifers. Specific concern is for increased nitrate concentrations. Nitrate is a chemical compound containing nitrogen, which is a component of fertilizers often used on crops. High levels of nitrate in drinking water can pose a health risk, particularly for infants. Efforts have been underway to close many of these wells with funds available through the "Agricultural Drainage Well Water Quality Assistance Fund", established in 1997. Only one ADW is classified by in the Iowa DNR's ADW dataset as 'Fully Functional' within the Upper Cedar Watershed (Figure 2-6-2) south of Charles City in Floyd County.

There are at least 105 source water wells within the Iowa portion of the Upper Cedar, as included in the DNR's Source Wells dataset. Table 2-6-1 lists the wells owned by a municipality (50 within the Upper Cedar) with associated depths for those within the Upper Cedar; the remaining 55 wells are listed with non-municipal owners.

The Iowa DNR operates a Source Water Protection Program, and all communities within the state automatically have a Phase 1 assessment. This assessment defines the source water area, susceptibility to contamination, and locates potential contaminant sources. Communities with a known existing contaminant problem are classified as Targeted; all other communities are listed as Non-Targeted. Targeted communities can coordinate with the IDNR to conduct a site investigation to determine if the contaminant is from a point or non-point source.

Any community (Targeted and Non-Targeted) can choose to develop a Source Water Protection Plan (Phase 2). This plan usually entails monitoring/managing the land in which drinking water travels through to improve natural water quality. A successful plan can reduce the necessary treatment by municipal water suppliers, and decrease the risk of a large contaminant spill affecting drinking water supplies. Preparing Phase 2 documents within the Source Water Protection Program is voluntary. Currently, 8 of the 15 communities with municipal wells in the Upper Cedar have prepared Phase 2 documents. Of the remaining 7 communities, two are listed as having a highly susceptible community water supply: Janesville and Staceyville. Table 2-6-1 includes the dates for the Phase 1 assessments, dates of the Phase 2 documents (if available), and if the community is current listed as highly susceptible for contamination.

Table 2-6-1: Municipal source water wells within the Upper Cedar Watershed

Municipality	Number of Wells within the Upper Cedar Watershed	Depth of Well(s) within the Upper Cedar (ft)	Phase 1 Assessment Date	Phase 2 Document Date	Highly Susceptible Community Water Supply?
Charles City	9 total, 3 active, 1 standby	185, 187, 230, 245, 245, 1305, 1355, 1385, 1587	2014	2012	Yes
Colwell	1 total, 1 active	286	2012	--	
Denver	4 total, 2 active	181, 190, 225, 1060	2014	2012	
Floyd	2 total, 2 active	193, 280	2012	2005	
Grafton	4 total for community, 0 within the Upper Cedar		2012	--	
Ionia	2 total for community, 0 within the Upper Cedar		2012	--	
Janesville	4 total, 2 active	97, 105, 150, 727	2014	--	Yes
Nashua	5 total, 3 active	100, 150, 160, 245, 245	2014	2001	Yes
Northwood	4 total for community, 2 active within the Upper Cedar	65, 67	2014	2006	
Orchard	2 total, 1 active, 1 standby	220, 400	2012	--	
Osage	5 total, 3 active	650, 676, 710, 780, 1265	2014	--	
Plainfield	3 total, 2 active	96, 150, 150	2014	2000	**Priority**
Saint Ansgar	3 total, 1 active, 1 standby	240, 240, 363	2014	2007	**Priority**
Stacyville	3 total, 2 active	117, 289, 290	2014	--	**Priority**
Waverly	8 total, 4 active	137, 150, 160, 170, 172, 228, 1263, 1300	2014	2006	**Priority**

2-7 Surface Water System

Surface water in the Upper Cedar Watershed is dominated by the river and stream network with few large open bodies of water. The entire watershed has more than 2,500 miles of streams based on the National Hydrology Dataset (24K GIS dataset); approximately 1,550 miles of the stream network are within Iowa.

2-7.1 Lakes

The largest waterbody within the Iowa portion of the watershed is Cedar Lake (Nashua Impoundment), a man-made lake formed by a dam along the Cedar River, situated north of the City of Nashua in Chickasaw and Floyd counties. The lake covers roughly 200 acres with an approximate depth of 10 feet. The lake is regularly used for recreation including boating, water skiing, camping, and fishing. The site is listed an excellent location for shore fishing, with popular species including: bluegill, bullhead, channel catfish, crappie, largemount bass, smallmouth bass and walleye.

The second largest waterbody in Iowa is Markhams Pond which is located just west of the City of Mona and northwest of the City on Otranto in Mitchell County. The pond covers approximately 19 acres and is classified as a prairie pothole (depressional wetland). The site attracts migrating Tundra swans in the spring, and is classified as a Public Hunting Area.

2-7.2 Rivers and Streams Designations

Segments of streams and rivers are classified by the Iowa DNR based on how they are used: for recreation activities, for drinking water, and/or for maintaining aquatic life habitat. The designations follow a set of assessment standards and help to determine the level of protection afforded for each waterbody relative to others. A complete description on how stream segments are assessed is available from the DNR:

www.iowadnr.gov/InsideDNR/RegulatoryWater/WaterQualityStandards/DesignatedUses

The following are brief descriptions for each type of designated use within the state (courtesy of the Iowa DNR). Those with a (*) are present within the Upper Cedar Watershed:

*Class A1 - Primary contact recreational use: The water's recreation uses involve full body immersion with prolonged and direct contact with the water, such as swimming and water skiing.

*Class A2 - Secondary contact recreational use: Water recreation uses involve incidental or accidental contact with the water, where the probability of ingesting water is minimal, such as fishing and shoreline activities.

*Class A3 - Children's recreational use: Water recreation uses where children's activities are common, like wading or playing in the water. These waters are commonly located in urban or residential areas where the banks are defined and there is visible evidence of flow.

*Class B(WW-1) - Typically large interior and border rivers and the lower segments of medium-size

tributary streams capable of supporting and maintaining a wide variety of aquatic life, including game fish.

*Class B(WW-2) - Typically smaller, perennially flowing streams capable of supporting and maintaining a resident aquatic community, but lack the flow and habitat necessary to fully support and sustain game fish populations.

Class B(WW-3) - Intermittent stream with non-flowing perennial pools capable of supporting and maintaining a resident aquatic community in harsher conditions. These waters lack the flow and habitat necessary to fully support and sustain a game fish population.

Class B(CW-1) - Waters in which the temperature and flow are suitable for the maintenance of a variety of cold water species, including reproducing and nonreproducing populations of trout (*Salmonidae* family) and associated aquatic communities.

Class B(CW-2) - Waters that include small, channeled streams, headwaters, and spring runs that possess natural cold water attributes of temperature and flow. These waters usually do not support consistent populations of trout (*Salmonidae* family), but may support associated vertebrate and invertebrate organisms.

*Class HH - Human Health: Waters in which fish are routinely harvested for human consumption or waters both designated as public water supply and routinely harvested for human consumption.

Class C - Drinking Water Supply: Waters which are used as a raw source of potable water supply.

All three types of Recreation uses (A1, A2 and A3) are present within the watershed as well as two of the warm water aquatic life designations, B(WW-1) and B(WW-2). Several stream segments also received the Human Health designation, because of regular fishing in the area. Table 2-7-1 lists the different stream segments with the associated designated uses and Figure 2-7-1 displays the geographic distribution of these streams. The DNR is still assessing streams across all of Iowa, and designations may change over time.

Table 2-7-1: River and Stream Designations within the Upper Cedar WMA

Name	Legal Description	Recreation Designation	Aquatic Designation	Human Health Designation	Designation Approved by the EPA as of July 2014
Cedar River	Confluence with Beaver Cr. to dam at Waverly	A1	B(WW-1)	HH	
Cedar River	Waverly impoundment Dam to confluence with Unnamed Creek (NE 1/4, SW 1/4, S20, T94W, R14W Chickasaw Co.)	A1	B(WW-1)	HH	
Cedar River	S. corporate limits of Nashua to dam at Nashua	A1	B(WW-1)	HH	
Cedar River	Nashua impoundment Dam to Chickasaw-Floyd Co. line	A1	B(WW-1)	HH	
Cedar River	Nashua impoundment to Charles City Dam #2	A1	B(WW-1)	HH	
Cedar River	Charles City impoundment Dam #2 to Iowa-Minnesota state line	A1	B(WW-1)	HH	
Little Cedar River	Mouth of Little Cedar River (S20, T94N, R14W, Chickasaw Co.) to 220th St. (S21, T95N, R14W Chickasaw Co.)	A2	B(WW-1)	HH	
Little Cedar River	From 220th Street (S21, T95N, R14W, Chickasaw Co.) to (N. Line S21, T95N, R14W, Chickasaw Co.)	A1	B(WW-1)	HH	Yes
Little Cedar River	From (N. line S21, T95N, R14W Chickasaw Co.) to the manmade dam near staceyvile (NW1/4,SE1/4, S31, T100N, R16W Mitchell Co.)	A1	B(WW-1)	HH	Yes
Little Cedar River	From manmade dam near staceyvile (NW1/4,SE1/4, S31, T100N, R16W Mitchell Co.) to the Iowa-Minnesota state line (S9, T100N, R16W Mitchell Co.)	A1	B(WW-1)	HH	Yes
Quarter Section Run	Mouth (S19, T91N, R13W, Bremer Co.) to the (East Line S23, T91N, R13W, Bremer Co).	A2	B(WW-2)		
Quarter Section Run	East Line S23, T91N, R13W, Bremer Co) to confluence with an unnamed tributary (NE1/4, NW1/4, S26, T92N, R13W, Bremer Co.)	A1	B(WW-2)		Yes
Stewart Creek	From its mouth (SE¼, S22, T96N, R16W, Floyd Co.) to Verasun Charles City's outfall on the downstream side of the Quarry Road bridge crossing (S28, T96N, R16W, Floyd Co.).	A2	B(WW-2)		
Sugar Creek	Crossing at Harry Cook Nature Trail (NW 1/4 of S26, T98N, R17W, Mitchell co.) to the road crossing at highway 9 west of Osage (NE 1/4 of S27, T98N, R17W, Mitchell County).	A2	B(WW-2)		
Unnamed Creek	From the mouth (NW ¼, S1, T95N, R16W, Floyd Co.) to Cleveland Ave (West Line, East ½, S6, T95N, R15W, Floyd County	A3	B(WW-2)		Yes

2-8 Recreational Areas

Although much of the Upper Cedar Watershed is agricultural, many areas are also used for recreational activities including boating, paddle-sports, fishing, snowmobiling, and hunting. The watershed area includes 13 boat ramps, 2 fishing access locations, and 15 paddling access locations. Canoeing routes include 99 miles along the Cedar River and an additional 60 miles along the Little Cedar River. Several reaches are viable trout streams, including Spring Creek, Turtle Creek, and Burr Oak Creek. Deer Creek has been classified by the Iowa DNR as an Outstanding Iowa Water (OIW) for having high water quality and therefore to be maintained and protected. The watershed also contains 230 miles of snowmobile trails and 16 miles of other tails/paths. Public hunting lands are distributed throughout the watershed, for a total of approximately 5.3 square miles. Figure 2-8-1 displays the recreational areas within the watershed.

2-9 Fish and Wildlife Habitat

Although land in the Upper Cedar Watershed is primarily used for agriculture, the region still supports fish and wildlife populations. The Iowa DNR maintains a species inventory for invertebrates and plants on a county-level scale. Table 2-9-1 lists those species present within those Iowan counties in the UCW. A specific review of each species' habitat range is required to determine if there are likely populations within the watershed which is currently outside the scope of this project.

The Iowa Gap Analysis Program (GAP) systematically reviewed and identified the status of ordinary species and their habitats throughout the state. This resulted in a series of Species Range Maps showing the predicted distribution for individual vertebrate species. Table 2-9-1 also indicates if the predicted distribution falls within the Upper Cedar for those species included with the GAP Analysis.

2-10 Wetlands

The Iowa portion of the Upper Cedar Watershed has approximately 21 square miles of wetlands (13,450 acres) as classified by the National Wetland Inventory *(note this is a different data source than used within Table 2-3-1 resulting in a different wetland area estimate).* Wetlands are valuable environmental assets because they can improve water quality, provide water storage that can potentially help protect against flooding, and offer a critical habitat for wildlife.

Wetland soils and plants can filter pollutants out of the water column. Because the water in these areas are relatively slow moving, any toxins or pollutants have more time to settle out of the water. Wetland plants, especially when vegetation is dense, absorb nutrients from the water; this is particularly valuable in Iowa as nutrients from agricultural fertilizers are often washed into the stream before they are taken up by the intended crop.

During storm events, wetlands can also retain stormwater and reduce peak flows downstream. Wetlands situated in the middle or lower portions of a watershed typically provide more flood control in comparison to those located further upstream (since less water will pass through the upstream wetlands).
Wetlands also provide a critical habitat for breeding, resting, and feeding for a variety of fish, birds, amphibians, and other wildlife. These locations also support specific plant varieties that offer shelter and food for other creatures.

Table 2-9-1: Species present within the Iowan Counties within the Upper Cedar Watershed. For those species with available predicted distribution range maps (GAP Analysis Program), indication if the range falls within the Upper Cedar.

	Common Name	Scientific Name	State Status	Federal Status	Black Hawk	Bremer	Butler	Chickasaw	Floyd	Mitchell	Worth	GAP Predicted Species Distribution within the Upper Cedar
AMPHIBIANS	Blue-spotted Salamander	Ambystoma laterale	E		X							Yes
	Central Newt	Notophthalmus viridescens	T		X	X		X				Yes
	Mudpuppy	Necturus maculosus	T		X		X		X			Yes
BIRDS	Bald Eagle	Haliaeetus leucocephalus	S		X	X	X	X	X	X	X	Yes
	Barn Owl	Tyto alba	E		X		X					No
	Black Tern	Chlidonias niger	S								X	No
	Henslow's Sparrow	Ammodramus henslowii	T		X				X			Yes
	Northern Harrier	Circus cyaneus	E					X			X	Yes
	Red-shouldered Hawk	Buteo lineatus	E		X	X	X	X				Yes
	Short-eared Owl	Asio flammeus	E			X						Yes
FISH	American Brook Lamprey	Lampetra appendix	T		X	X	X	X		X		--
	Black Redhorse	Moxostoma duquesnei	T		X			X	X	X		--
	Blacknose Shiner	Notropis heterolepis	T			X	X					--
	Least Darter	Etheostoma microperca	E							X		--
	Pearl Dace	Margariscus margarita	E								X	--
	Topeka Shiner	Notropis topeka	T	E		X						--
	Weed Shiner	Notropis texanus	E				X					--
	Western Sand Darter	Ammocrypta clara	T		X	X	X					--
FRESHWATER MUSSELS	Creek Heelsplitter	Lasmigona compressa	T		X	X		X	X	X		--
	Creeper	Strophitus undulatus	T		X	X		X	X	X		--
	Cylindrical Papershell	Anodontoides ferussacianus	T		X	X		X	X	X		--
	Ellipse	Venustaconcha ellipsiformis	T			X		X	X	X		--
	Round Pigtoe	Pleurobema sintoxia	E						X			--
	Slippershell Mussel	Alasmidonta viridis	E						X	X		--
	Yellow Sandshell	Lampsilis teres	E		X	X			X	X		--

	Common Name	Scientific Name	State Status	Federal Status	Black Hawk	Bremer	Butler	Chickasaw	Floyd	Mitchell	Worth	GAP Predicted Species Distribution within the Upper Cedar
INSECTS	Arogos Skipper	Atrytone arogos	S				X					--
	Baltimore	Euphydryas phaeton	T				X	X	X	X	X	--
	Broad-winged Skipper	Poanes viator	S		X	X						--
	Dion Skipper	Euphyes dion	S		X	X		X				--
	Pipevine Swallowtail	Battus philenor	S		X	X						--
	Purplish Copper	Lycaena helloides	S		X							--
	Regal Fritillary	Speyeria idalia	S		X		X		X			--
	Silvery Blue	Glaucopsyche lygdamus	T								X	--
MAMMALS	Plains Pocket Mouse	Perognathus flavescens	E		X							No
	Southern Bog Lemming	Synaptomys cooperi	T				X					Yes
	Southern Flying Squirrel	Glaucomys volans	S							X		Yes
	Southern Red-backed Vole	Clethrionomys gapperi	E								X	--
	Spotted Skunk	Spilogale putorius	E		X							Yes
REPTILES	Blanding's Turtle	Emydoidea blandingii	T		X	X	X	X	X	X	X	Yes
	Bullsnake	Pituophis catenifer sayi	S		X	X						Yes
	Eastern Massasauga	Sistrurus catenatus cate-	E	C				X				No
	Eastern Massasauga	Sistrurus catenatus	E			X						Yes
	Ornate Box Turtle	Terrapene ornata	T		X			X				Yes
	Smooth Green Snake	Liochlorophis vernalis	S			X	X	X			X	--
	Wood Turtle	Clemmys insculpta	E		X	X	X		X	X		Yes
SNAILS	Iowa Pleistocene Ambersnail	Novisuccinea sp 4	E							X		--

	Common Name	Scientific Name	State Status	Federal Status	Black Hawk	Bremer	Butler	Chickasaw	Floyd	Mitchell	Worth	GAP Predicted Species Distribution within the Upper Cedar
PLANTS (DICOTS)	Bent Milk-vetch	Astragalus distortus	S		X	X						--
	Bog Bedstraw	Galium labradoricum	E					X		X	X	--
	Bog Birch	Betula pumila	T		X	X		X		X		--
	Bog Willow	Salix pedicellaris	T		X	X		X		X	X	--
	Brittle Prickly Pear	Opuntia fragilis	T		X							--
	Buckbean	Menyanthes trifoliata	T			X					X	--
	Cleft Phlox	Phlox bifida	S		X							--
	Earleaf Foxglove	Tomanthera auriculata	S		X	X						--
	False Mermaid-weed	Floerkea proserpinacoides	E			X						--
	Flat Top White Aster	Aster pubentior	S		X	X				X		--
	Fragrant False Indigo	Amorpha nana	T			X						--
	Glade Mallow	Napaea dioica	S		X		X		X	X		--
	Hawksbeard	Crepis runcinata	S		X							--
	Hill's Thistle	Cirsium hillii	S		X	X			X	X		--
	Kitten Tails	Besseya bullii	T		X	X			X	X		--
	Lance-leaved Violet	Viola lanceolata	S			X						--
	Large-leaf White Violet	Viola incognita	E							X		--
	Marsh-speedwell	Veronica scutellata	S		X							--
	Missouri Lambsquarters	Chenopodium missouriensis	S			X						--
	Muskroot	Adoxa moschatellina	S						X	X		--
	Narrowleaf Pinweed	Lechea intermedia	T		X					X		--
	Pearly Everlasting	Anaphalis margaritacea	S		X							--
	Pink Milkwort	Polygala incarnata	T		X				X			--
	Prairie Bush Clover	Lespedeza leptostachya	T	T	X		X		X			--
	Pretty Dodder	Cuscuta indecora	S		X							--
	Purple Angelica	Angelica atropurpurea	S					X	X	X	X	--
	Ragwort	Senecio pseudaureus	S		X							--

	Common Name	Scientific Name	State Status	Federal Status	Black Hawk	Bremer	Butler	Chickasaw	Floyd	Mitchell	Worth	GAP Predicted Species Distribution within the Upper Cedar
PLANTS (DICOTS)	Rose Turtlehead	Chelone obliqua	S							X		--
	Rush Aster	Aster junciformis	T					X		X	X	--
	Sage Willow	Salix candida	S		X	X	X	X	X	X	X	--
	Sessile-leaf Tick-trefoil	Desmodium sessilifolium	S		X							--
	Shadbush	Amelanchier sanguinea	S							X		--
	Shining Willow	Salix lucida	T			X		X			X	--
	Shrubby Cinquefoil	Potentilla fruticosa	T						X			--
	Silky Prairie Clover	Dalea villosa	E		X							--
	Silver Bladderpod	Lesquerella ludoviciana	S		X							--
	Small Fringed Gentian	Gentianopsis procera	S				X	X	X	X	X	--
	Small Sundrops	Oenothera perennis	T					X				--
	Spring Avens	Geum vernum	S			X						--
	Swamp Thistle	Cirsium muticum	S			X		X	X	X	X	--
	Sweet Indian Plantain	Cacalia suaveolens	T		X	X	X	X		X		--
	Toothcup	Rotala ramosior	S		X							--
	Tunnel-formed Penstemon	Penstemon tubiflorus	S			X						--
	Valerian	Valeriana edulis	S		X	X	X	X	X	X	X	--
	Violet	Viola macloskeyi	S		X			X		X		--
	Water Milfoil	Myriophyllum verticillatum	S		X							--
	Water Shield	Brasenia schreberi	S		X						X	--
	Water Starwort	Callitriche heterophylla	S							X		--
	Waxleaf Meadowrue	Thalictrum revolutum	E						X			--
	Winterberry	Ilex verticillata	E			X		X		X		--
	Wooly Milkweed	Asclepias lanuginosa	T		X							--
	Yellow Monkey Flower	Mimulus glabratus	T							X	X	--
PLANTS (GYMNO-SPERMS)	Creeping Juniper	Juniperus horizontalis	T						X			--

	Common Name	Scientific Name	State Status	Federal Status	Black Hawk	Bremer	Butler	Chickasaw	Floyd	Mitchell	Worth	GAP Predicted Species Distribution within the Upper Cedar
PLANTS (MONOCOTS)	Beakrush	Rhynchospora capillacea	T				X	X				--
	Bulrush	Scirpus pedicellatus	S					X				--
	Crawe Sedge	Carex crawei	S						X		X	--
	Field Sedge	Carex conoidea	S		X	X	X	X	X	X		--
	Glomerate Sedge	Carex aggregata	S			X						--
	Grass Pink	Calopogon tuberosus	S						X	X		--
	Great Plains Ladies'-tresses	Spiranthes magnicamporum	S			X			X			--
	Green's Rush	Juncus greenei	S		X			X				--
	Large-leaf Pondweed	Potamogeton amplifolius	S						X		X	--
	Leafy Northern Green Orchid	Platanthera hyperborea	T							X	X	--
	Low Nut Rush	Scleria verticillata	T					X				--
	Meadow Onion	Allium mutabile	S		X							--
	Northern Panic-grass	Dichanthelium boreale	E		X							--
	Nuttall Pondweed	Potamogeton epihydrus	S			X						--
	Pale Green Orchid	Platanthera flava	E			X		X		X		--
	Purple Fringed Orchid	Platanthera psycodes	T			X		X		X		--
	Showy Lady's Slipper	Cypripedium reginae	T					X		X		--
	Slender Arrow Grass	Triglochin palustris	T					X				--
	Slender Sedge	Carex tenera	S			X						--
	Slender Sedge	Carex leptalea	S		X							--
	Small White Lady's Slipper	Cypripedium candidum	S		X	X		X	X	X	X	--
	Soft Rush	Juncus effusus	S			X						--
	Tall Cotton Grass	Eriophorum angustifolium	S		X	X	X	X	X	X	X	--
	Vasey Pondweed	Potamogeton vaseyi	S								X	--
	Vasey's Rush	Juncus vaseyi	S		X							--
	Western Prairie Fringed	Platanthera praeclara	T	T	X	X		X				--
	Yellow-eyed Grass	Xyris torta	E				X					--

PLANTS (PTERIODOPHYTES)

Common Name	Scientific Name	State Status	Federal Status	Black Hawk	Bremer	Butler	Chickasaw	Floyd	Mitchell	Worth	GAP Predicted Species Distribution within the Upper Cedar
Crowfoot Clubmoss	Lycopodium digitatum	S					X				--
Leathery Grape Fern	Botrychium multifidum	T		X	X						--
Ledge Spikemoss	Selaginella rupestris	S		X	X		X				--
Little Grape Fern	Botrychium simplex	T		X							--
Meadow Spikemoss	Selaginella eclipes	E								X	--
Northern Adder's-tongue	Ophioglossum pusillum	S		X	X	X	X	X	X		--
Prairie Moonwort	Botrychium campestre	S		X		X		X			--
Rock Clubmoss	Lycopodium porophilum	T					X				--
Woodland Horsetail	Equisetum sylvaticum	T			X		X				--
County Total				**68**	**56**	**27**	**47**	**38**	**47**	**28**	

Wetland diversity also provides recreational opportunities for residents such as birding, canoeing, hiking, and general exploration.

Iowa encourages the restoration of wetlands, and the USDA Natural Resource Conservation Service (NRCS) manages the Wetlands Reserve Program (WRP) to help landowners restore wetlands or improve existing wetlands on private property. In 2012, the total obligations from binding agreements for the WRP across all of Iowa was $31,368,500 with approximately 92% of funds used for financial assistance (payments that help producers/ landowners implement the conservation measure) and the remaining amount for technical assistance. Data is not available at the watershed scale to know how much of this funding was applied to Upper Cedar projects. In 2014, the WRP was merged with the Grassland Reserve Program and the Farm and Ranch Land Protection Program to form the Agricultural Conservation Easement Program (ACEP). More information about this program and eligibility can be found on the NRCS website below:

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/easements/acep/

The Iowa Conservation Reserve Enhancement Program (CREP) designs and builds wetlands in drain-tiled regions of North Central Iowa, with the specific goal of removing nitrate from water in cropland areas. The program is available for private landowners in agricultural watersheds with funding for annual land payments and reimbursement for the construction of the wetlands and buffer areas. CREP wetlands can remove 40-90% of nitrate and 90+% of herbicides from drain-tile water while also providing a new wildlife habitat. Eleven CREP projects have been completed in the Upper Cedar Watershed, with 105 acres of wetlands treating a total of 12,812 watershed acres. All of the projects are in Floyd and Mitchell counties, and an estimated 157,500 pounds of nitrogen are removed annually through these wetlands. Figure 2-10-1 shows the extent of wetlands within the watershed and approximate CREP wetland locations. More details about CREP eligibility can be found on the website below:

http://www.iowaagriculture.gov/waterresources/CREP.asp

2-11 Water Resource Monitoring Information

Water resource monitoring data is collected by several groups throughout the watershed. Figure 2-11-1 displays the sampling locations.

2-11.1 Water Quality Sources

The United State Environmental Protection Agency (EPA) maintains a dataset of water quality data, which can be retrieved from the STORET/WQX Data Warehouse. This dataset is a compilation of water quality monitoring data collected by many different organizations (e.g. states, volunteer groups, universities, etc) into a centralized database for easy access. Figure 2-11-1 only displays those sites with data that originated with the Iowa DNR, but many more organizations contribute data including the Minnesota Pollution Control Agency (MPCA), IOWATER, and the EPA. More information about STORET/WQX and available datasets can be found on the EPA website below:

http://www.epa.gov/storet/

The United States Geological Survey (USGS) has collected water quality data at five locations in the Upper Cedar,

three of which are in Iowa. Sampling is typically not continuous, but can provide a snapshot view in time of water quality. Station information can be found in Table 2-11-1, and site specific data can be obtained from the USGS National Water Information System (NWIS):

http://waterdata.usgs.gov/usa/nwis/qw

IOWATER is a volunteer water quality monitoring program that teaches Iowans to conduct basic water measurements. Citizens volunteer their time to learn appropriate sampling techniques, conduct assessments, and raise awareness about water quality within the state. There are at least 69 IOWATER sites within the Upper Cedar Watershed; more information about the collected data can be found at their website:

http://www.iowadnr.gov/Environment/WaterQuality/WaterMonitoring/IOWATER.aspx

2-11.2 Select Water Quality Data

A subset of the water quality data collected by the Iowa DNR is presented here to provide additional insight on specific water quality concerns within the Upper Cedar, specifically indicator bacteria *E. Coli*, total nitrogen and total phosphorus. More information on known impairments within the watershed can be found in Sections 2-12 and 3-2.

2-11.2.1 Indicator Bacteria *E. Coli*

The Iowa DNR has collected monthly grab samples of indicator bacteria *E. Coli* in the Cedar River upstream of Charles City in two locations. Reported concentrations from 1999 to 2013 during the recreational use season (March 15th – November 15th) ranged from 10 to 33,000 organisms per 100 milliliters of water. Graph 11-1 and 11-2 show the geometric mean and the sample maximum for the two different sampling locations relative to the Water Quality Standard (WQS) limits.

2-11.2.2 Total Nitrogen

The Iowa DNR has collected monthly grab samples for nitrate, nitrate, ammonia and kjeldahl-nitrogen (organically bound). Total nitrogen concentration is assumed to be the summation of all of these different nitrogen-based compounds. Near Charles City, reported total nitrogen concentrations from October 1998 to September 2014 ranged from 2.6 to 19.9 mg N/L. The average concentration was 7.8 mg N/L. Near Janesville (effectively the outlet of the Upper Cedar Watershed), reported total nitrogen concentrations from October 1998 to September 2014 ranged from 1.6 to 17.7 mg N/L. The average concentration was 7.1 mg N/L. Graphs 11-3 and 11-4 show the monthly grab sample concentrations at Charles City and Janesville between 1998 and 2014.

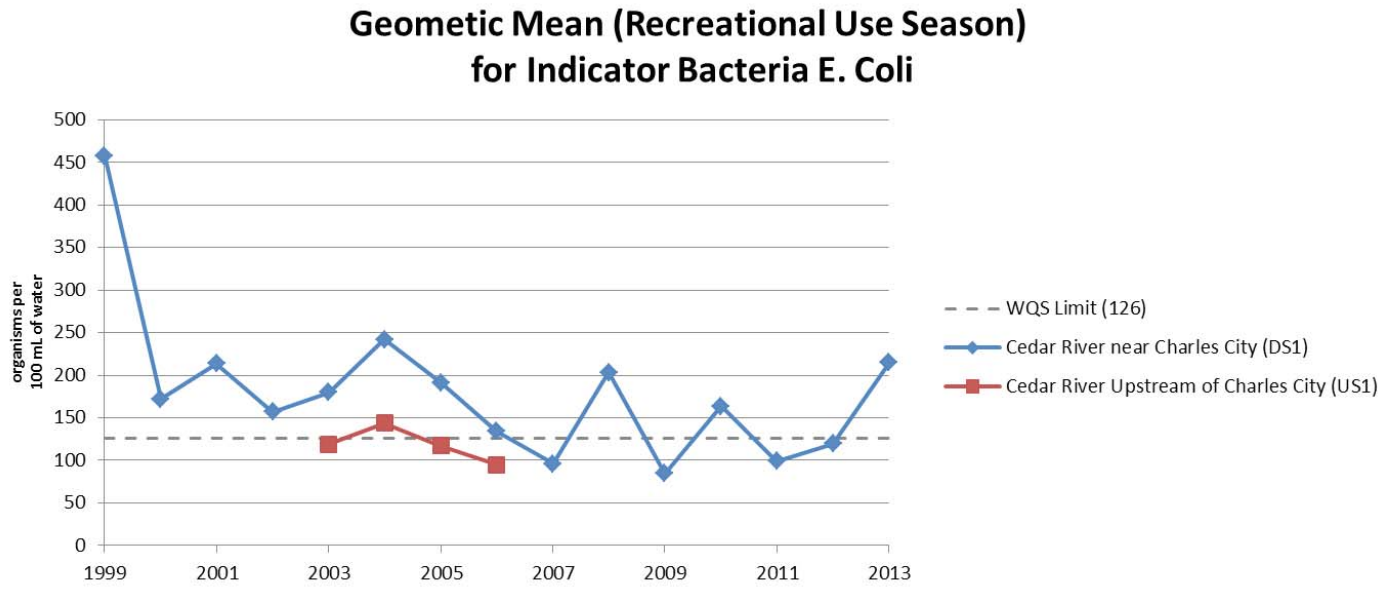
2-11.2.3 Total Phosphorus

The Iowa DNR has collected monthly grab samples of unfiltered water for phosphate, assumed to be total phosphorus. Near Charles City, reported total phosphate concentrations from October 1998 to September 2014 ranged from 0.6 to 1.4 mg P/L. The average concentration was 0.2 mg P/L. Near Janesville (effectively the outlet of the Upper Cedar Watershed), reported total phosphate concentrations from October 1998 to September 2014 ranged from 0.6 to 0.58 mg P/L. The average concentration was 0.2 mg P/L. Graphs 11-5 and 11-6 show the monthly grab sample concentrations at Charles City and Janesville between 1998 and 2014.

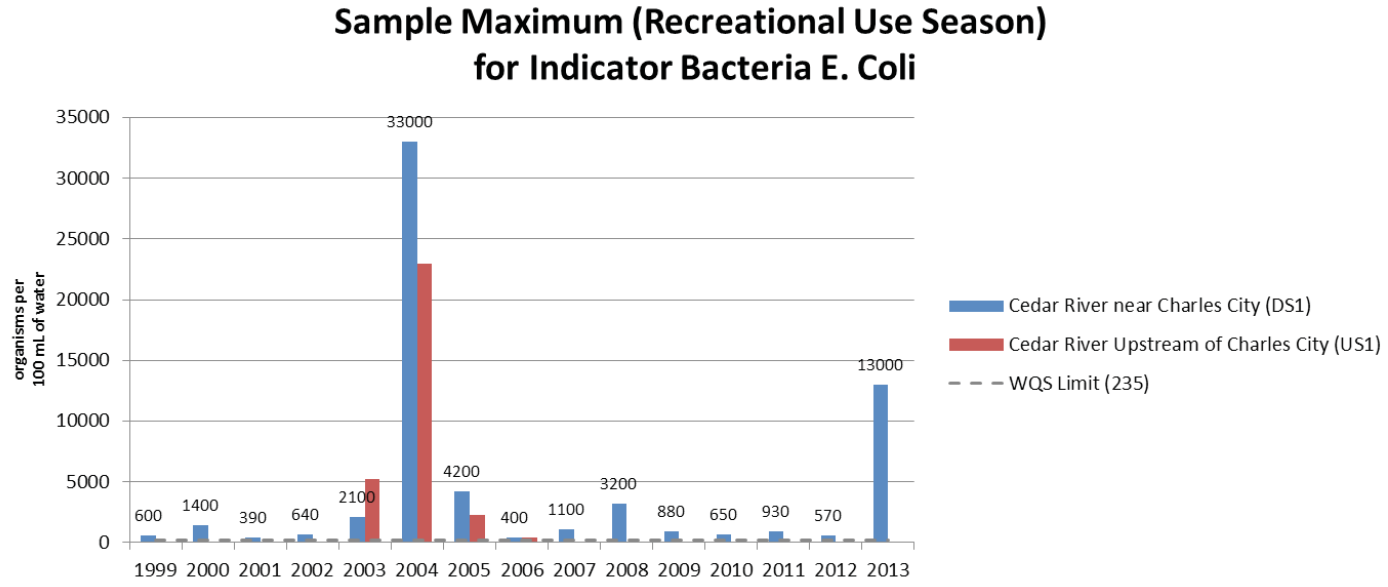
Table 2-11-1: USGS Gages (water quality and water quantity) within the Upper Cedar Watershed

USGS ID	Site Name	Latitude	Longitude	County	River Mile	Gage currently collecting stream discharge data	Beginning date of discharge record	Ending date of discharge record	Water Quality Data Available	Notes
05458500	Cedar River at Janesville, IA	42.65	-92.47	BREMER	207.7	Y	10/1/1904	present	Yes	Water quality sampling includes pH, nitrate plus nitrite, dissolved oxygen, and others. 22 nutrient samples between 4/27/1988 and 9/25/2012.
05457000	Cedar River near Austin, MN	43.64	-92.97	MOWER		Y	6/1/1909	present	Yes	Water quality sampling includes suspended sediment and a few others.
05458000	Little Cedar River near Ionia, IA	43.03	-92.50		6.4	Y	10/1/1954	present	Yes	Water quality sampling includes pH, nitrate plus nitrite, dissolved oxygen, and others. 4 nutrient samples between 7/23/1988 to 8/18/2009.
05457700	Cedar River at Charles City, IA	43.06	-92.67	FLOYD	252.9	Y	10/1/1964	present	Yes	Water quality sampling includes pH, nitrate plus nitrite, dissolved oxygen, and others. 20 nutrient samples between 4/26/1988 and 9/25/2012.
05457500	Cedar River at Mitchell, IA	43.32	-92.88			N	7/1/1933	9/30/1942	No	
05458300	Cedar River at Waverly, Iowa	42.74	-92.47	BREMER		Y	8/30/2000	present	No	
05457200	Cedar River at 100th St near Lyle, MN	43.51	-93.00	MOWER		N	--	--	Yes	Only water quality sampling. Water quality sampling includes nitrate, nitrite, suspended sediment, ammonia, and others.
05457778	Little Cedar River near Johnsburg, MN	43.51	-92.76	MOWER		N	--	--	No	Only peak flow measurements (28 in total).
05457505	Cedar River at Osage, IA	43.28	-92.85			Y	4/16/2010	present	No	
05455940	Cedar River at Lansing, MN	43.75	-92.96	MOWER		N	--	--	No	Only peak flow measurements (7 in total).

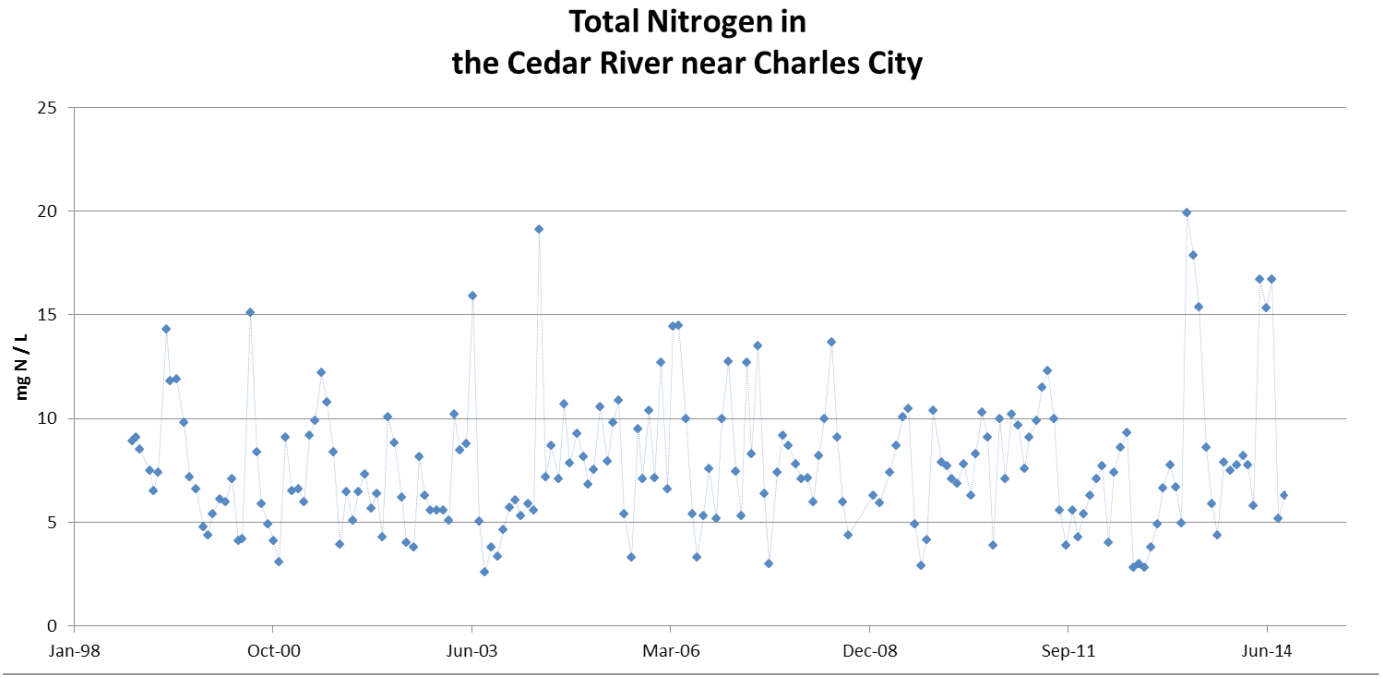
Graph 11-1: The annual geometric mean of E. Coli (# organisms in 100 mL of water) during the recreation use season (March 15th – November 15th) at two locations along the Cedar River. The Water Quality Sample (WQS) limit is for Class A1 use.



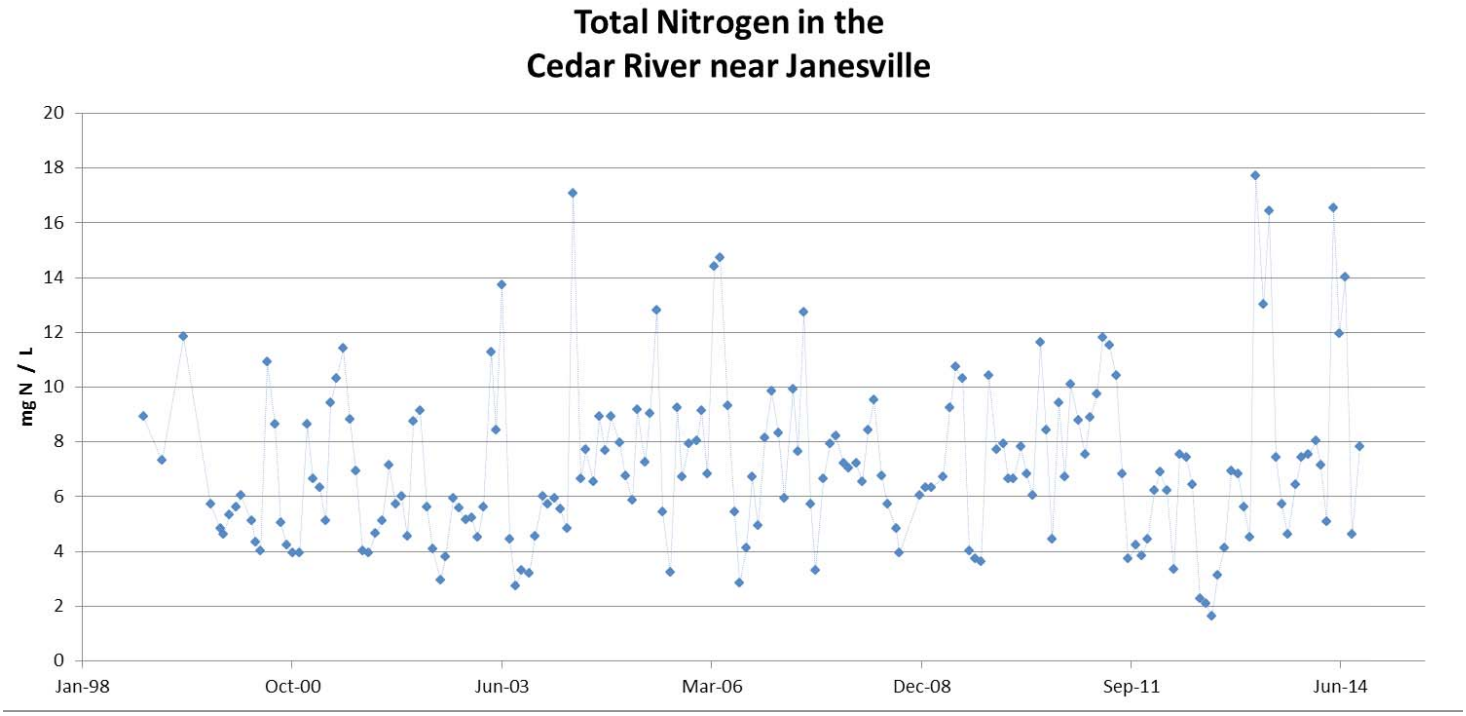
Graph 11-2: The annual sample maximum of E. Coli (# organisms in 100 mL of water) during the recreation use season (March 15th – November 15th) at two locations along the Cedar River. Only site DS1 values are labeled, for clarity. The Water Quality Sample (WQS) limit is for Class A1 use.



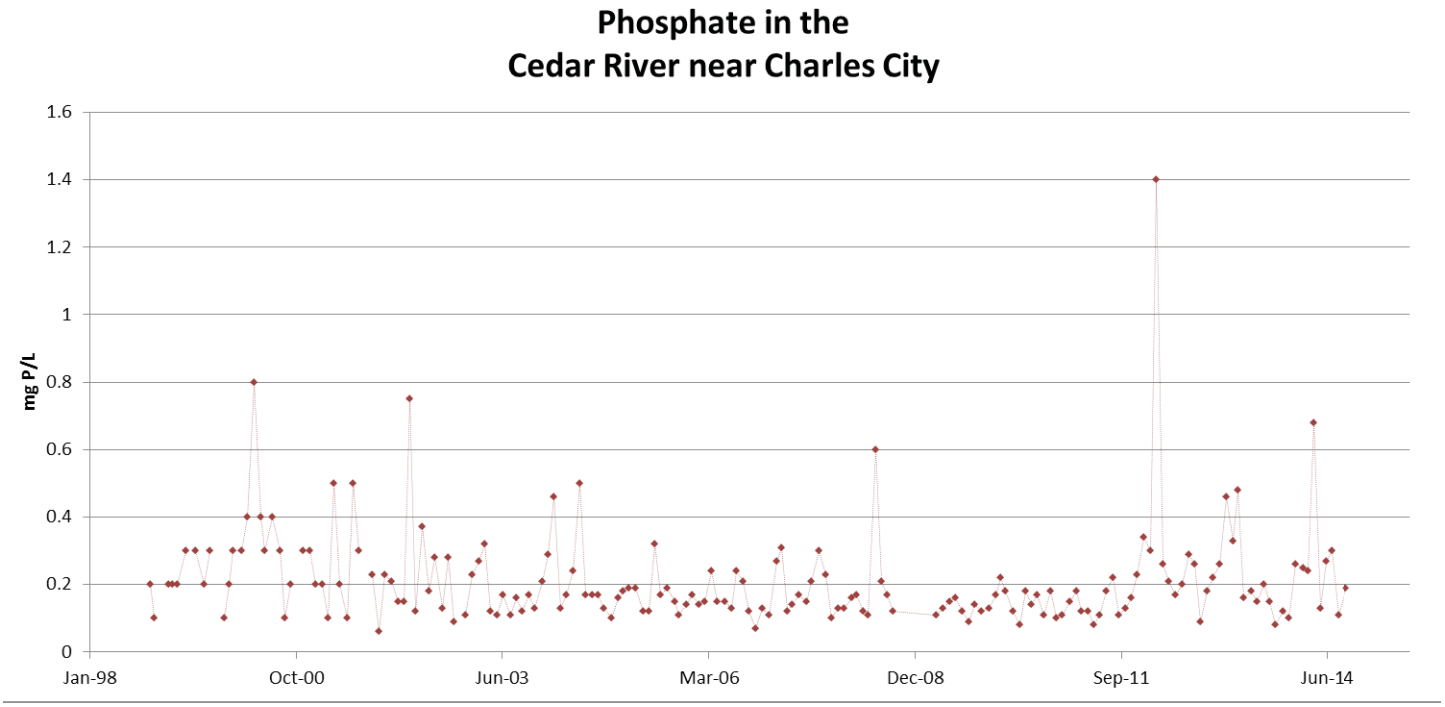
Graph 11-3: Total nitrogen (mg N/L) in samples taken from Cedar River by the Iowa DNR near Charles City between October 1998 and September 2014. Total nitrogen is assumed to be a combination of nitrate, nitrate, ammonia, and kjeldahl-nitrogen concentrations.



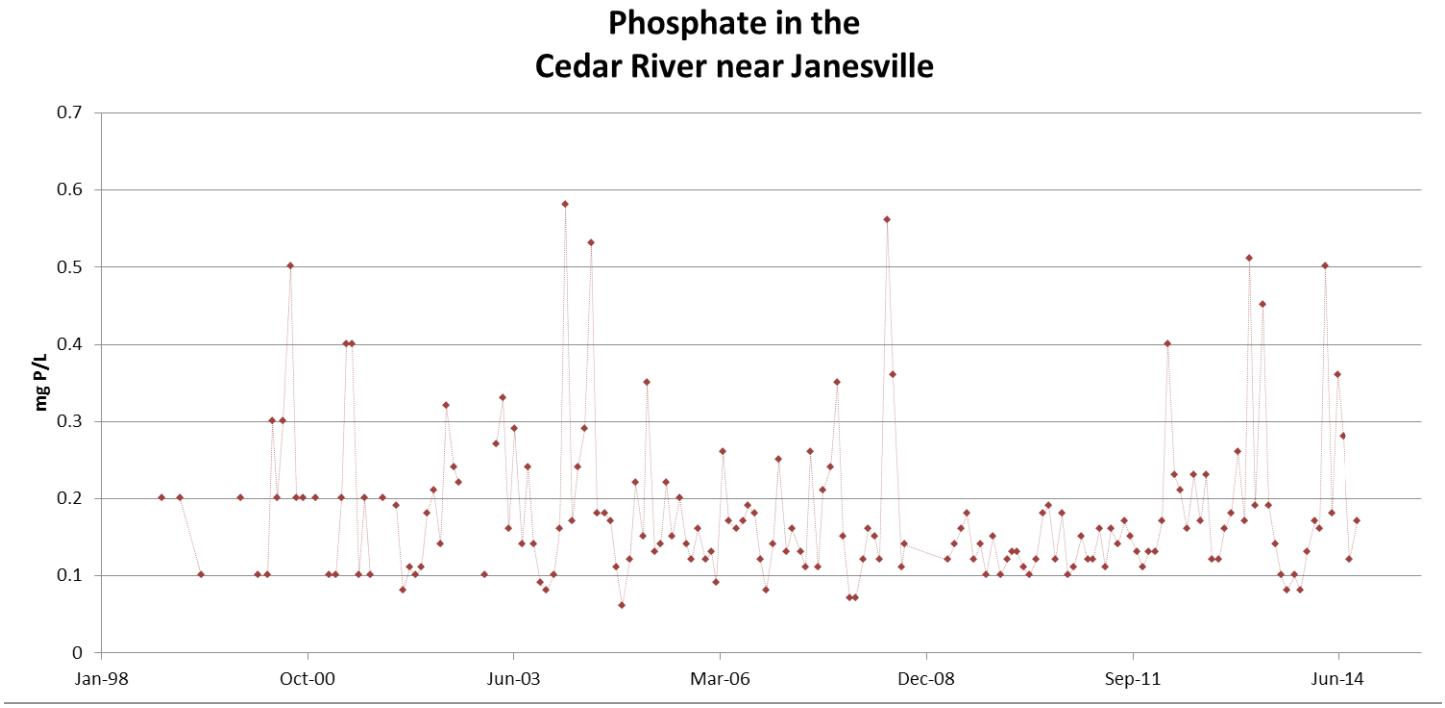
Graph 11-4: Total nitrogen (mg N/L) in samples taken from Cedar River by the Iowa DNR near Janesville between October 1998 and September 2014. Total nitrogen is assumed to be a combination of nitrate, nitrate, ammonia, and kjeldahl-nitrogen concentrations.



Graph 11-5: Total phosphate (mg P/L) in samples taken from Cedar River by the Iowa DNR near Charles City between October 1998 and September 2014.



Graph 11-6: Total phosphate (mg P/L) in samples taken from Cedar River by the Iowa DNR near Janesville between October 1998 and September 2014.



2-11.3 Water Quantity Sources

The USGS currently collects discharge data at six sites within the Upper Cedar Watershed, five of which are in Iowa (Table 2-11-1). Daily discharge data is available for the following locations: Cedar River at Janesville, IA (#05458500) beginning in 1904, Cedar River near Austin, MN (#05457000) beginning in 1909, Little Cedar River near Ionia, IA (#05458000) beginning in 1954, Cedar River at Charles City, IA (#05457700) beginning in 1964, Cedar River at Waverly, IA (#05458300) beginning in 2000, and Cedar River at Osage, IA (#05457505) beginning in 2010. As with most long term datasets, gaps are present usually due to equipment malfunction and/or funding shifts within the organization.

The long term discharge datasets provide context for recent drought and flood events within the watershed. The USGS has published several reports on the Iowa/Cedar River basin utilizing this long term dataset, with major reports issued after large flood events:

http://ia.water.usgs.gov/flood/reports.html

2-12 Impaired Waters

Section 303(d) of the federal Clean Water Act (CWA) requires states to identify waters that are impaired and do not meet state specific water quality standards (see Section 2-7.2). The goal of the CWA is to "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters". In order to improve the overall water quality, each state is required to set a priority ranking of all impaired waters, and then develop a Total Maximum Daily Load (TMDL) for each.

A TMDL is the maximum amount of a particular pollutant that a water body can receive while still supporting its designated use(s). It also develops a distribution scheme for all of the various pollutant contributors. For the point-sources, a waste load allocation (WLA) is developed to establish the allowable loadings for each source; for the non-point sources a load allocation (LA) is determined to establish the allowable pollutant load from all non-point sources and the natural background levels. There are also a "margin of safety" component which makes up a TMDL, to account for limitations in the ability to accurately define LA's and WLA's.

Within the Iowa portion of the Upper Cedar Watershed, 15 impairments were identified as a requiring a TMDL for a Category 5 Impairment along 11 stream segments in the DNR's final 2012 Integrated Report (approved by the EPA on April 24, 2013). The impaired segments are portions of the following streams: Burr Oak Creek, Cedar River, Deer Creek, Little Cedar River, Otter Creek, Rock Creek, Spring Creek and Turtle Creek. Once a TMDL is prepared for a specific impairment, the classification is downgraded to Category 4. Further changes in category number may occur as water quality conditions improve if and when TMDL recommendations are implemented and/or water quality sampling shows improvement.

Figure 2-12-1 shows the location of the impaired stream segments within the watershed, and Table 2-12-1 provides the specifics for each impairment with a Category 5 classification (data provided by the Iowa DNR 2012 Integrated Report). The subcategories refer to the source of the impairment:

Category 5a: cause of impairment due to known pollutant
Category 5b: biological impairment with cause unknown, or fish-kill impairment
Category 5p: impairment of presumptive use; EPA-approved use attainability analysis (UAA) is needed to determine appropriate use.

To date, two TMDL studies have been completed that impact the Upper Cedar (see Sections 2-12.1 and 2-12.2). The Iowa DNR maintains a schedule for water quality improvement plans to be drafted within the next few years, which can be found on their website. At this time, there is not an estimate time for completion for future TMDL studies for the remaining Category 5 impaired waters within the Upper Cedar. It should be noted that other stream segments within the Upper Cedar Watershed could be impaired, but this impairement is currently unknown due to the lack of adequate sampling data. More long-term monitoring across the watershed is needed to fully account for all impairments.

Table 2-12-1: Impaired waters within the Iowa portion of the Upper Cedar Watershed with a Class 5 Classification (2012)

Year Added to the List	Category	River ID (ADB Code)	Waterbody Name	Location Description	Impaired Use	Use Support	Cause/ Stressor	TMDL Priority
2008	5a	IA 02-CED-0070_0	Cedar River	From W. Fk. Cedar R.to lowhead dam at Waverly	Primary Contact	Partial	Indicator Bacteria	Low
2008	5a	IA 02-CED-0110_1	Cedar River	From upper end of Nashua Impoundment to Dam No. 2 at Charles City	Primary Contact	Not supporting	Indicator Bacteria	Low
2006	5a	IA 02-CED-0110_2	Cedar River	from Charles City Dam No. 2 to confluence with Rock Cr.	Fish Consumption	Not supporting	Mercury	Low
2004	5b	IA 02-CED-0110_3	Cedar River	from Rock Cr. nr Orchard to Iowa / Minnesota state line	Aquatic Life	Not supporting	Biological	Low
2006	5a	IA 02-CED-0110_3	Cedar River	from Rock Cr. nr Orchard to Iowa / Minnesota state line	Fish Consumption	Not supporting	Mercury	Low
2008	5a	IA 02-CED-0470_1	Little Cedar River	mouth to the Chickasaw/ Floyd county line	Primary Contact	Not supporting	Indicator Bacteria	Low
2006	5b	IA 02-CED-0490_1	Burr Oak Creek	mouth to Mitchell County Road T46	Aquatic Life	Partial	Biological (Flow Alteration; Habitat Modification; Nutrients; Siltation)	High
2008	5p	IA 02-CED-0510_1	Rock Creek	mouth to confluence with unnamed tributary	Primary Contact	Not supporting	Indicator Bacteria	Low
2012	5p	IA 02-CED-0520_0	Spring Creek	mouth to N line S8 T97N R16W Mitchell Co.	Secondary Contact	Not supporting	Indicator Bacteria	Low
2008	5p	IA 02-CED-0520_0	Spring Creek	mouth to N line S8 T97N R16W Mitchell Co.	Primary Contact	Not supporting	Indicator Bacteria	Low
2010	5p	IA 02-CED-0520_0	Spring Creek	mouth to N line S8 T97N R16W Mitchell Co.	Aquatic Life	Not supporting	Organic Enrichment/ Low DO	Low
2008	5p	IA 02-CED-0530_0	Turtle Creek	mouth to E line S7 T99N R17W Mitchell Co.	Primary Contact	Not supporting	Indicator Bacteria	Low
2008	5p	IA 02-CED-0540_1	Deer Creek	mouth to the Mitchell-Worth county line	Primary Contact	Not supporting	Indicator Bacteria	Low
2012	5a	IA 02-CED-0550_0	Otter Creek	mouth to Iowa/Minnesota line	Aquatic Life	Partial	Animal waste (ammonia; low DO)	Medium
2008	5p	IA 02-CED-0550_0	Otter Creek	mouth to Iowa/Minnesota line	Primary Contact	Not supporting	Indicator Bacteria	Low

2-12.1 Cedar River TMDL: Indicator Bacteria, *Escherichia coli (E. Coli)*

In February 2010, the Iowa DNR published the final TMDL report for Indicator Bacteria, Escherichia coli (*E. Coli*) covering the entire Cedar River Watershed. A stream segment is considered impaired when the maximum allowable pathogen loads exceed the Iowa water quality standards (WQS). The applicable WQS for Class A1 waters (IAC, 61.3) is based on the recreational use season; the applicable *E. coli* bacteria WQS criteria are shown in Table 2-12-2.

Table 2-12-2: Iowa Water Quality Standards (WQS) for the Indicator Bacteria Escherichia coli (E. Coli)

Class A1 Use	Geometric mean (organisms per 100 milliliters of water)	Sample maximum (organisms per 100 milliliters of water)
3/15 - 11/15	126	235
11/16 - 3/14	Does not apply	Does not apply

Within the Upper Cedar Watershed, the impaired streams include the contiguous segments of IA 02-CED-0110_3 and IA 02-CED-0110_2 along the Cedar River, stretching from Charles City north to the Minnesota border, for not supporting primary contact recreation (Class A1). Note that since the publication of the TMDL report, additional segments of the Cedar River were classified as impaired by Indicator Bacteria *E. Coli*; these segments are therefore still listed as Category 5 and requiring a TMDL.

Bacteria can reach stream segments through point and non-point sources. The IOWA DNR used data from 17 USGS gages with flow and water quality concurrently collected, and generally saw E.Coli concentration exceedances at all flow ranges, but typically larger exceedances at high flow coinciding with precipitation runoff events. It was therefore inferred that non-point sources were the main cause of exceedances during high flow events, but exceedances at low flow were likely caused by point sources.

Non-point sources include open feedlots, grazing livestock, manure application and wildlife. Based on modeling of both of the impaired stream segments in the Upper Cedar, runoff from open feedlots was determined to be by far the largest pollutant source, accounting for 81-82% of the total allocation; manure application on cropland was the second largest source (16%). A load allocation (LA) is determined for all of the non-point sources including unregulated animal feeding operations; this is effectively the total pollutant output allowed from non-point sources that would keep total pollutant loads below the acceptable TMDL limit. The flow variable LA loads for the two impaired stream segments in the Upper Cedar are show in Table 2-12-3 in expressed as *E. coli* colony forming unit (cfu) per day.

Point sources of bacteria include failing septic systems, direct defecation, and waste water treatment plants; permitted point sources are assigned a Waste Load Allocation (WLA). Within the drainage areas for the impaired stream segments in the Upper Cedar, there were 16 point source dischargers with National Pollutant Discharge Elimination System (NPDES) permits (12 in MN and 4 in Iowa). In addition, there were 8 additional permitted facilities in the Upper Cedar that contribute to an impaired stream segment further downstream (although not within the Upper Cedar Watershed). Table 2-12-4 is from the TMDL report (Appendix D) listing the Waste Load Allocations for those facilities with NPDES Permits at the time of the TMDL publication, only showing those facilities within the Upper Cedar Watershed. Figure 2-12-2 shows the location for the two impaired stream segments within

Table 2-12-3: Flow variable load allocation (LA) for stream segments impaired by the Indicator Bacteria E. Coli in the Upper Cedar. Units are E. coli colony forming unit (cfu) per day.

Segment IA 02-CED-0110_3				
LA	**Flow quartile (low to high flows)***			
	<25	**25–50**	**50–75**	**>75**
Daily median load (cfu/day)	3.88E+11	8.12E+11	1.40E+12	3.15E+12
Daily maximum load (cfu/day)	1.09E+12	1.95E+12	3.45E+12	2.46E+13

Segment IA 02-CED-0110_2				
LA	**Flow quartile (low to high flows)***			
	<25	**25-50**	**50-75**	**>75**
Daily median load (cfu/day)	4.49E+11	9.36E+11	1.63E+12	3.63E+12
Daily maximum load (cfu/day)	1.27E+12	2.26E+12	4.04E+12	2.76E+13

**The quartiles are listed from the lowest to highest flows; e.g., 0.00-0.25 represents the lowest 25 percent of flows over the time period.*

the Upper Cedar, and those NPDES permits with WLAs assigned within Iowa.The TMDL recommended an implementation plan consisting of five management practices thought to be highly effective at improving water quality conditions within the Cedar River Watershed:

- All Waterwater Treatment Plant (WWTP) effluent and rivers entering Iowa will have bacteria concentrations less than or equal to the Iowa WQS
- Unpermitted feedlots will control/capture the first one-half inch of rain
- Cropland bacteria loading will be reduced by 40 percent through proper timing and application of animal waste
- Cattle in streams will be reduced by 40 percent
- Leaking septic systems will be eliminated

Table 2-12-4: Waste Load Allocations (WLAs) for NPDES permitted facilities within the Upper Cedar Watershed for Indicator Bacteria E. Coli. Units are E. coli colony forming unit (cfu) per day.

Cedar River Watershed: Total Maximum Daily Load						
EPA ID	**Facility Name**	**Geometric Mean WLA *E. coli* (cfu/day)**	**Daily Maximum WLA *E. coli* (cfu/day)**	**TMDL Drainage Area for IA 02-CED-0110_3**	**TMDL Drainage Area for IA 02-CED-0110_2**	**TMDL Drainage Area further downstream, outside of the Upper Cedar**
MN0021882*	Blooming Prairie, City of	n/a	n/a	x	x	x
MN0023612*	Hayfield, City of	n/a	n/a	x	x	x
MN0063461*	Lansing Township	n/a	n/a	x	x	x
MN0021601*	Sargeant, City of	n/a	n/a	x	x	x
MN0022934*	Brownsdale, City of	n/a	n/a	x	x	x
MN0025186*	Waltham, City of	n/a	n/a	x	x	x
MN0022683*	Austin, City of	n/a	n/a	x	x	x
MN0048992*	Hollandale, City of	n/a	n/a	x	x	x
MNG580013*	Elkton, City of	n/a	n/a	x	x	x
MNG580072*	Rose Creek, City of	n/a	n/a	x	x	x
MN0040631*	Oakland Sanitary District	n/a	n/a	x	x	x
MN0022101*	Lyle, City of	n/a	n/a	x	x	x
IA0033723	St. Ansgar, City of (STP)	8.59E+8	1.60E+9	x	x	x
IA0032956	Osage, City of (STP)	3.58E+9	6.67E+9	x	x	x
IA0064271	Orchard, City of (STP)	6.20E+7	1.16E+8	x	x	x
IA0028894	Floyd, City of (STP)	3.34E+8	6.23E+8		x	x
IA0003557	Cambrex Charles City, Inc					x
IA0022039	Charles City, City of (STP)					x
IA0024503	Nashua, City of (STP)					x
IA0033693	Plainfield, City of (STP)	1.62E+8	3.02E+8			x
IA0035254	Stacyville, City of (STP)	7.54E+8	1.41E+9			x
IA0033197	Waverly, City of (STP)	1.11E+10	2.07E+10			x
IA0044156	Denver, City of (STP)	1.79E+9	3.34E+9			x
IA0026506	Janesville, City of (STP)	7.87E+8	1.47E+9			x

** As this TMDL is written for the state of Iowa, WLAs are not assigned to Minnesota facilities. STP: Sewage Treatment Plant*

2-12.2 Cedar River TMDL: Nitrate

In 2006, the Iowa DNR prepared a TMDL study of the Cedar River Watershed to determine the maximum allowable nitrate loading for the river that can occur without exceeding the drinking water standard of 10 mg/l NO3-N. The study found that wastewater and urban stormwater runoff nitrogen loads (point sources) to the Cedar River were comparatively minor. Row crop activities were found to be the major source of nitrates in the river.

The entire Cedar River watershed was divided into seven major subwatersheds for modeling in order to prioritize areas of concern; one of the subwatersheds was the Upper Cedar. The furthest downstream subwatershed (the Middle Cedar River) was excluded from the results since discharge and nitrate loads are influenced by the up-stream subwatersheds. The Upper Cedar River was the largest contributor of both flow and nitrate load to the Middle Cedar River.

Within the Upper Cedar Watershed, nitrate point-sources included NPDES permitted sites, with 12 facilities in Iowa and 10 in Minnesota (Table 2-12-5, Figure 2-12-3). It was estimated that the average daily point source contributions to the Cedar River was 13,815 lbs N/day with 4,351 lbs N/day (31.5%) originating in the UCW.

Non-point sources of nitrate include agricultural sources (manure, fertilizer, and legume fixation), residential sources (septic tanks, residential fertilizers), atmospheric sources (wet and dry deposition), and natural sources (decomposing organic material and wildlife). Table 2-12-6 lists the estimated non-point source loads for the entire Cedar River Watershed and the Upper Cedar subwatershed as modelled in the TMDL.

In order to reduce the highest measured nitrate load from impaired streams (14.7 mg/L) to the nitrate loading capacity of 9.5 mg/L (5% less than the drinking water standard to account for a margin of safety) the targeted nitrate reduction is 35%. The estimated total nitrate load was 28,561 tons/year; therefore, a 35% reduction goal translates to a removal of 9,999 tons-N/year. The waste load allocation for all of the point sources is 9%, and the load allocation for all non-point sources is 91%.

The TMDL implementation plan calls for the following:

- Spring or split nitrogen application (in lieu of fall application) to better time nitrogen availability with crop demand
- Use nitrogen application rates based on the Late-Spring Soil Nitrate Test (LSNT)
- Adoption of no-till or strip-till systems combined with injection of nitrogen, crop nitrogen use efficiency, and decrease leaching of nitrogen-laden soil water through macro pores
- Ensuring that an appropriate nitrogen credit is subtracted from application rates for corn when rotating from a legume crop such as soybeans or alfalfa
- Addition of perennial species to crop rotation to reduce both nitrate and water losses to subsurface drainage systems and groundwater

Table 2-12-5: Waste Load Allocations (WLAs) for NPDES permitted facilities within the Upper Cedar Watershed for Nitrate.

Permit Number	Facility Name	Current Allocation (tons N/yr)	Controlled TMDL Allocation (tons/yr)	Continuous TMDL Allocation (lbs/day)
6658001	Orchard Sewage Treatment Plant	0.4	0.4	--
0960001	Plainfield Sewage Treatment Plant	2.2	2.2	--
6677001	Stacyville Sewage Treatment Plant	2.3	2.3	--
3414001	Floyd Sewage Treatment Plant	1.8	--	9.7
0932001 [sic]	Janesville Sewage Treatment Plant	4.1	--	22.4
6673001	St. Ansgar Sewage Treatment Plant	5.1	--	27.8
1967001	Nashua Sewage Treatment Plant	8.2	--	45.1
0915001	Denver Sewage Treatment Plant	8.0	--	43.9
6663001	Osage Sewage Treatment Plant	23.0	--	125.9
3405001	Charles City Sewage Treatment Plant	35.6	--	195
0990001	Waverly Sewage Treatment Plant	45.5	--	249.1
3405100	Cambrex Charles City, Inc.	1.7	1.7	--
Minnesota*	*Austin*	635.7	na	na
	Elkton	0.7	na	na
	Hollandale	1.6	na	na
	Jim's Motor Mart	0.0	na	na
	Lyle	2.8	na	na
	Oakland S.D.	0.0	na	na
	Blooming Prairie	9.5	na	na
	Adams	3.9	na	na
	Walham	1.0	na	na
	Osmundson Bros.	0.0	na	na

** As the TMDL was written for the state of Iowa, WLAs are not assigned to Minnesota facilities.*

Table 2-12-6: Estimated non-point source nitrate loads within the entire Cedar River Basin and the Upper Cedar Subwatershed

		Entire Cedar River Watershed (lbs N/day)	Upper Cedar Subwatershed (lbs N/day)	*Percent contribution from the Upper Cedar*
Atmospheric		353,571	90,236	*25.5%*
Wildlife		2,094	578	*27.6%*
Septic Systems		2,323	626	*26.9%*
Legume Fixation		476,029	121,652	*25.6%*
Manure	***Hog***	150,913	39,470	*26.2%*
	Poultry	12,333	1,282	*10.4%*
	Beef Cattle	71,345	22,628	*31.7%*
	Dairy Cattle	14,544	8,027	*55.2%*
	Sheep	991	211	*21.3%*
Fertilizer	***Turf***	88,558	15,648	*17.7%*
	Row Crops	692,963	165,494	*23.9%*

2-13 Pollutant Sources

2-13.1 Non-Point Sources

Non-point source pollution comes from surface runoff, direct precipitation, atmospheric deposition, and drainage. As runoff moves over the land surface, the water can collect and transport pollutants into waterbodies, wetlands, or groundwater. The Iowa DNR published a non-point source management plan in July of 2012, which broadly highlights some of the major non-point source pollutants within the state and recommended some key actionable tasks for reducing non-point source water pollution.

http://www.iowadnr.gov/Environment/WaterQuality/WatershedImprovement/WatershedPlanning/NonpointSourcePlan

Common surface runoff pollutants include: nutrients, fertilizers, and pesticides from agricultural and residential areas; oil, heavy metals and salts form urban runoff and roads; sediment from agricultural/forest lands and eroding stream banks; bacteria from livestock waste, manure application on agricultural lands, and failing septic systems.

2-13.2 Point Sources

There are several permitted/regulated point source dischargers within the Upper Cedar Watershed including Wastewater Treatment Facilities. Table 2-13-1 shows the individual NPDES permits within the Upper Cedar Watershed including 8 industrial sites, 12 municipal sewage treatment plants, 1 municipal water treatment plant, and 1 operation permit (Source: Iowa DNR, NPDES Permits as of July, 2014).

The Upper Cedar Watershed also has animal feeding operations (AFOs) including both open feedlots (where animals are kept in unroofed or partially roofed areas) and confinements (where animals are kept in totally roofed areas). AFO's are defined as facilities that animals are feed and maintained in pens for at least 45 days per year, and the Iowa DNR currently regulates 152 AFOs that are classified as 'actively operating'. Open feedlots in the Upper Cedar Watershed are predominantly beef cattle, but also include some dairy cattle, swine, and sheep/lambs. Confinement operations house swine, dairy cattle, beef cattle, turkeys, and chickens.

Open feedlots are required to manage their manure, process any wastewater, remove settleable soils prior to discharge, and prevent direct discharge into any public waters. If the operation has more than 1,000 animal units, a NPDES permit is required to discharge into waters of the state under certain conditions. Confinement operations must also manage their manure and land application practices. Large confinement operations (more than 500 animal unit capacity) must have a manure management plan and use a certified manure applicator.

AFOs that are meeting management requirements should not be a significant contributor to runoff pollution. However, land application of manure can be a significant non-point source. Table 2-13-2 lists the number of actively operating AFOs within the Upper Cedar Watershed sorted by County (Source: Iowa DNR, date unknown). Additional information about specific operations can be obtained from the Iowa DNR. Figure 2-13-1 shows the location of NPDES permits and the AFOs within the Upper Cedar Watershed.

Table 2-13-1: National Pollutant Discharge Elimination System (NPDES) permit holders within the Upper Cedar Watershed (July 2014)

Permit Number	EPA ID	Facility Name	Facility City	Permit Type	Class	Treatment Type
6600110	80896	Absolute Energy	Saint Ansgar	Industrial	Minor	No Treatment
0000112	75230	Alliance Pipeline, L.P.-(Blanket Permit-Iowa)	Des Moines	Industrial	Minor	No Treatment
3405100	3557	Cambrex Charles City, Inc.	Charles City	Industrial	Significant Minor	Activated Sludge
6600903	75761	Iowa DOT Maintenance Garage-Osage	Osage	Industrial	Minor	Other
0990105	71714	Wartburg College	Waverly	Industrial	Minor	No Treatment
3400501	80225	Washington Elementary School	Charles City	Industrial	Minor	No Treatment
0990106	80268	Waverly Municipal Fire Department	Waverly	Industrial	Minor	No Treatment
3405103	72150	Zoetis WHC 2 LLC	Charles City	Industrial	Minor	No Treatment
6616001	81566	Carpenter Sewage Treatment Plant	Carpenter	Municipal	Minor	Waste Stabilization Lagoon
3405001	22039	Charles City Sewage Treatment Plant	Charles City	Municipal	Major	Trickling Filter
0915001	44156	Denver Sewage Treatment Plant	Denver	Municipal	Minor	Aerated Lagoon
3414001	28894	Floyd Sewage Treatment Plant	Floyd	Municipal	Minor	Aerated Lagoon
0732001	26506	Janesville Sewage Treatment Plant	Janesville	Municipal	Minor	Aerated Lagoon
1967001	24503	Nashua Sewage Treatment Plant	Nashua	Municipal	Minor	Activated Sludge
6658001	64271	Orchard Sewage Treatment Plant	Orchard	Municipal	Minor	Waste Stabilization Lagoon
6663001	32956	Osage Sewage Treatment Plant	Osage	Municipal	Minor	Activated Sludge
0960001	33693	Plainfield Sewage Treatment Plant	Plainfield	Municipal	Minor	Waste Stabilization Lagoon
6673001	33723	St. Ansgar Sewage Treatment Plant	Saint Ansgar	Municipal	Minor	Aerated Lagoon
6677001	35254	Stacyville Sewage Treatment Plant	Stacyville	Municipal	Minor	Waste Stabilization Lagoon
0990001	33197	Waverly Sewage Treatment Plant	Waverly	Municipal	Major	Trickling Filter
3405000	3182	Charles City Water Treatment Plant	Charles City	Municipal-Wt	Minor	Primary Treatment
6600801	82538	Alan & Joann Wagner Farming & Trucking	Orchard	Operation Permit	Minor	Land Application

Table 2-13-2: Actively operating Animal Feeding Operations by county within the Upper Cedar.

County	Open Feedlots	Confinements
Black Hawk	1	0
Bremer	3	13
Butler	1	1
Chickasaw	8	11
Floyd	3	21
Mitchell	20	69
Worth	0	1
Total	***36***	***116***

2-14 Water Quality Modeling

The U.S. Geological Survey and the IOWA DNR used the Soil and Water Assessment Tool (SWAT) to simulate streamflow and nitrate loads within the Cedar River Basin (published in 2013). The Cedar basin is relatively densely gaged in comparison to other watersheds in Iowa, and the goal of the project was to assess the ability of SWAT to model both gaged and ungaged watersheds in the state. The model was calibrated for 2000-2004 and then validated for 2005-2010.

A modified version of this SWAT model was used by the Upper Cedar Watershed Management Improvement Authority to focus specifically on the Upper Cedar Watershed and water quality. The model was subdivided to approximately align with the HUC-12 watershed boundaries, and calibrated (1990-2000) and validated (2000-2010) using USGS gauges near Charles City and Janesville. Land use was derived from the USDA-NRCS Cropland Data layer incorporating the years 2009-2012 (30 m grid resolution), simplifying crop rotations to the following: continuous corn, corn/soybean, and corn/corn/soybean. Any other crop types/rotations were assigned to one of these dominant rotations. Drain tiles were applied across all cropped land within the watershed, and a uniform set of management practices (e.g. tillage type and timing, fertilizer application quantity and timing, planting/harvesting timing, etc) was applied to all cropped areas based on crop type. Actual practices will vary across the watershed, but this level of data is not currently available. If new surveys are conducted on different management practices, they can be incorporated into the model at a later date to improve accuracy. A complete report describing the model construction, calibration and validation, and other considerations can be found in Appendix B.

A base output of this model was used to determine which subwatersheds had the highest N and P loading on a per acre basis in order to prioritize watersheds for future work. Figure 2-14-1 and 2-14-2 display the annual N and P loadings from the HUC-12 watersheds. Note that nutrient loadings are highly dependent on the input parameters within the SWAT model. As precise data is not available for the entire watershed, the model was built under basic assumptions (e.g. all landowners applying fertilizer on the same day every year), which results in over-/under-predicting output values for any discrete sampling period. However, the model is useful in comparing the relative contribution of nutrient loading in comparison to other subwatersheds within the Upper Cedar.

2-15 Water Quantity and Floodplain Information

2-15.1 Flood Insurance Rate Maps

The Federal Emergency Management Agency (FEMA) identifies flood hazards and assesses flood risks to help guide land use, planning, and hazard mitigation actions. As a part of this effort, FEMA maintains and periodically updates Flood Insurance Rate Maps (FIRMs) to outline the flood risk areas. Water quantity (hydraulic/hydrologic) modeling is utilized to delineate the floodplain for Flood Insurance Studies (FISs). Homeowners within the areas that are likely to be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year (also known as the 100-year flood, or "base flood") are designated as high-risk. Anyone may voluntarily obtain flood insurance. However, owners of homes within mapped 100-year floodplains who have federally insured mortgages are required to carry flood insurance. Annual premiums for insurance are determined according to information included in applicable FIRMs.

Flood Insurance Studies take into account statistical data for river flow, hydrologic/hydraulic analysis, rainfall, and elevation data. Flood insurance studies are not uniform – some are more detailed than others – and the study areas are divided into groups or Zones. The descriptions below are for the most commonly encountered Zones, derived from the FEMA definitions. Additional information on these and other Zones can be found on FEMA's website.

- **Zone AE:** These areas are subject to inundation by the 1-percent-annual-chance flood event (i.e. 100-year flood, also referred to as the "base flood"), determined by detailed hydrologic/hydraulic analysis. Base Flood Elevations (BFEs) have been determined. Zone AE is designated as a Special Flood Hazard Area (SFHA), and mandatory flood insurance purchase requirements for federally insured mortgages (in addition to traditional homeowner insurance that most owners carry) and floodplain management standards apply.

  Zone AE areas are generally subdivided into either 'Floodway' or 'Flood Fringe' areas. The floodway is the channel of the river/stream and the adjoining areas, typically associated with moving water during a flood event. The flood fringe is the remainder of the floodplain, typically associated with standing water rather than flowing water.

- **Zone A:** These are areas that will be inundated by the 1-percent-annual-chance flood event (i.e. 100-year flood), determined using approximate methodologies. A detailed hydraulic analysis usually has not been performed. Zone A is also designated as a SFHA; flood insurance requirements and floodplain management standards apply.

• **Zone B or Zone X (shaded):** These regions are moderate flood hazards areas, between the limits of the base flood and the 0.2-percent-chance flood event (i.e. 500-year flood). Federal rules for mandatory flood insurance purchase requirements and floodplain management standards do not apply, although local zoning standards and/or lenders may adopt rules governing such zones.

• **Zone C or Zone X (unshaded):** These are regions of minimal flood hazard, and outside of the 500-year flood zone. Federal rules for mandatory flood insurance purchase requirements and floodplain management standards do not apply, although local zoning standards and/or lenders may adopt rules governing such zones.

Digital versions of effective FIRMs are available for all seven of the counties within the Iowa portion of the Upper Cedar Watershed. The more detailed studies (resulting in areas classified as Zone AE) have been conducted close to the more densely populated areas (Charles City, Nashua, Plainfield, Waverly, Janesville and Denver). Figure 2-15-1 shows the SFHA within Zones A and AE.

The most current flood information and maps for areas within the Upper Cedar WMA are as follows:

• **Black Hawk County:** 19013C, effective July 18, 2011

• **Bremer County:** 19017C, effective March 4, 2008

• **Butler County:** 19023C, effective September 16, 2011

• **Chickasaw County:** 19037C, effective September 28, 2012

• **Floyd County:** 19067C, effective February 20, 2008
Charles City has pending new FIRMs to be issued in January 2015.

• **Mitchell County:** 19131C, effective February 6, 2013

• **Worth County:** 19195C, effective August 2, 2012

The Iowa Flood Center is currently undertaking a Statewide Floodplain Mapping Project in partnership with the Iowa DNR. Their focus is on the 85 counties that were declared part of the Federal Disaster Area after the substantial 2008 floods. All seven counties within the Upper Cedar WMA will be studied as part of this effort, and new Digital Flood Insurance Rate Maps (DFIRMs) will be created for all watercourses draining areas one square mile and greater. Many, if not all, studies will be approximate Zone A studies. Their efforts started in the southwestern corner of the state, working towards the northeast. Therefore, the Upper Cedar counties will likely to be completed towards the middle/end of the project timeline.

2-15.2 Hydrologic Assessment

The Iowa Flood Center recently completed a hydrologic assessment of the Upper Cedar Watershed, outlining the trends and hydrologic conditions of the watershed using a HEC-HMS model. Part of this report designated regions within the watershed with high runoff potential. The runoff potential for subwatersheds was determined using

a SCS Curve Number (CN), which is based both on the current land use and the underlying soils. During a rain event, a fraction of the precipitation becomes runoff; those areas with a higher potential runoff offer the greatest opportunities for flood mitigation sites. These can potentially retain more water from large rain events, and reduce the flood peaks downstream. Results from this modeling were aggregated to the HUC-12 watershed scale, and can be used as one component in prioritizing subwatersheds for flood mitigation projects. It should be reinforced that runoff potential is just one element in choosing mitigation sites. Other factors, such as water quality issues and stakeholder enthusiasm, should also be incorporated into prioritizing locations for focused improvements.

Table 2-15-1 and Figure 2-15-2 present the average SCS Curve Numbers for each of the HUC-12 subwatersheds within the Upper Cedar. Note that Curve Numbers do not incorporate a subwatershed's relative size. For

Table 2-15-1: Average SCS Curve Number and Runoff Potential for the 25-year and 100-year 24-hour storm event by HUC-12 Subwatershed. Curve Numbers provided by the Iowa Flood Center.

Subwatershed (HUC-12)	SCS Curve Number	Runoff Potential (%), 25-year, 24-hour storm (5.05 inches)	Runoff Potential (%), 100-year, 24-hour storm (6.81 inches)
Baskins Run	75	49	58
Beaver Creek	75	49	58
Beaver Creek-Little Cedar River	76	52	60
Bloody Run-Cedar River	73	46	56
Burr Oak Creek	79	56	64
Cedar Bend County Park-Cedar River	72	44	54
City of Adams	76	51	60
City of Austin-Cedar River	76	50	59
City of Stacyville-Little Cedar River	76	51	60
Colwell County Park-Little Cedar River	74	47	57
Deer Creek (NM)	74	48	57
Deer Creek (TF)	79	57	65
Dobbins Creek	76	52	61
Drainage Ditch 11	78	55	64
Drainage Ditch 3	77	54	62
Dry Run	75	48	58
Geneva Lake	75	49	58
Gizzard Creek	74	47	56

Green Valley Ditch-Cedar River	76	51	60
Headwaters Cedar River	76	52	61
Headwaters Deer Creek	75	49	58
Headwaters Quarter Section Run	76	51	60
Headwaters Rock Creek	80	57	66
Horton Creek	75	50	59
Judicial Ditch No 24	74	48	58
Judicial Ditch No 77-Cedar River	76	52	61
Little Cedar River	70	41	51
Little Cedar River-Cedar River	76	51	60
Lower Rose Creek	77	52	61
Orchard Creek	76	50	59
Otter Creek	75	50	59
Quarter Section Run	73	46	55
Roberts Creek	77	52	61
Rock Creek	78	54	63
Skunk Creek-Cedar River	75	49	58
Spring Creek	78	55	63
Stewart Creek-Cedar River	75	50	59
Sugar Creek-Cedar River	77	54	62
Town of Otranto-Cedar River	77	53	62
Turtle Creek (NM)	74	48	57
Turtle Creek (TF)	79	56	65
Uphams Slough Creek-Little Cedar River	77	54	62
Upper Rose Creek	76	52	61
Village of Janesville-Cedar River	74	47	57
Village of Meyer-Little Cedar River	75	50	59
Village of Plainfield-Cedar River	74	47	57
Woodbury Creek	75	49	59

example, a very large subwatershed with a low curve number can produce relatively more runoff than a different subwatershed with a higher curve number, simply because of the larger surface area. The runoff potential for two different rain events were also reviewed (25-year and 100-year 24-hour events) and included in Table 2-15-1.

Individual junctions along the Upper Cedar were selected for modeling a 100-year, 24-hour precipitation event. Peak flows and peak timing (number of hours after the start of the storm before the crest) are listed in Table 2-15-2 and in Figure 2-15-3. These values can be used when defining and evaluating goals pertinent to flooding. For example, aiming to decrease flooding by 20 percent during the critical 100-year, 24-hour precipitation event.

The hydrologic assessment also reviewed various BMP implementation scenarios including converting row crops to tall-grass prairie, planting cover crops, improving soil quality, and constructing flood storage ponds.

Table 2-15-2: Peak flows (cfs) and peak timing (hours after the event start) for a 100-year, 24- hour rain event for junctions along the Upper Cedar. Based on HEC-HMS modeling conducting by the Iowa Flood Center.

Junction Along the Cedar River	Peak Flow (cfs)	Peak Timing (hours)
Austin	23,939	32
J2568	33,961	37
J2505	43,099	41
Osage	45,089	47
J2392	49,575	50
J2354	50,512	56
J2334	51,520	60
Charles City	51,534	60
J2221	63,411	67
J2274	64,314	74
Waverly	64,403	78
J2246	65,177	82
Janesville	65,219	85

Hydrographs and peak discharge reductions are reported for each scenario, providing an understanding of how much flood mitigation can be anticipated by large scale changes across the watershed.

2-15.3 Floodplain Management Ordinances

Several counties and communities within the UCWMIA have existing floodplain management ordinances to reduce the potential for flood damage. The measures can take various forms including requirements for zoning and building standards for new and existing development. Currently Floyd and Chickasaw counties have floodplain management ordinances, as well as the City of Janesville, the City of Nashua, the City of Northwood, the City of Plainfield, and the City of Waverly.

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CHAPTER 3:

WATERSHED ACTION PLAN

CHAPTER 3: WATERSHED ACTION PLAN

Watershed management master planning provides an opportunity for communities and stakeholders to assess the current state of their watershed and to look beyond the present-day to evaluate the needs for future generations. This process can guide the creation of programs to address issues/problems, impact the direction of future development in urban areas, and support education and outreach to change how individual residents see their own role within the watershed.

This chapter first addresses the designated and desired uses of waterbodies within the watershed to highlight the features that shareholders aim to preserve, protect, and improve. Secondly, it addresses the problems and impairments within the watershed that need to be corrected to achieve the designated and desired uses. Information has been compiled to identify and understand the sources and causes for these impairments, and to rank them in terms of the most pressing-concerns for watershed stakeholders so that resources can be spent cost-effectively to target those considered to be the greater threat. As more information is collected about the watershed, and as improvements are made, this priority ranking will need to be adjusted to reflect current needs and concerns.

A series of Goals and Objectives outlines how the UCWMIA will move forward to achieve those uses in a systematic way, knowing that a wide range of efforts will be required to achieve them. Finally, an Action Plan provides a pathway for the UCWMIA to start working collectively to meet their goals.

3-1 Designated and Desired Uses

The primary criterion for water quality is whether a waterbody meets the necessary standards to support its designated uses. The Iowa DNR determines a stream segment's designation according to broad categogies including: recreation, fishing, drinking water, and providing a healthy habitat for aquatic organisms. The overarching goal for the state is for all waterbodies to meet the necessary water quality standards. This goal is likely not achievable in the short term, but can serve as a target for watershed planning efforts.

The Iowa DNR classifies stream segments into the following designations. Those in bold-text are designations that exist within the Upper Cedar Watershed and Table 2-7-1 (Chapter 2) lists the designations for individual stream reaches. Figure 2-7-1 (Chapter 2) is a map of all the designated uses within the Upper Cedar.

Recreational Use

- **A1: Primary contact recreational use**
- **A2: Secondary contact recreational use**
- **A3: Children's recreational use**

Warm waterbodies that protect aquatic life

- **B(WW-1): Typically large interior/border rivers**
- **B(WW-2): Typically smaller, perennially flowing streams**
- B(WW-3): Intermittent streams with non-flowing perennial pools

Cold Water bodies that protect aquatic life

• B(CW-1): Waters that can maintain a variety of cold water species, including in trout populations
• B(CW-2): Waters that include small, channeled streams, headwater and spring runs that support some cold water species, but do not consistently support trout populations

Other

•B(LW): Lakes and wetlands including both artificial and natural impoundments.
•HH: Waters where fish are routinely harvested for human consumption and/or used as a drinking water supply (Human Health).
•C: Waters which are used as a raw water source of potable water supply.

Human actions can impact stream water quality; currently there are eleven (11) stream segments classified as impaired and not meeting the water quality standards in the Upper Cedar Watershed. Note that some stream segments have multiple impairments. Two (2) segments are impaired for Fish Consumption due to mercury, eight (8) are impaired for Primary Contact for Indicator Bacteria *E. Coli*, one (1) is impaired for Secondary Contact for Indicator Bacteria *E. Coli*, and four (4) are impaired for Aquatic Life due to various reasons (biological, flow alternation, habitat modification, excess nutrients, siltation, organic enrichment, low dissolved oxygen and/or ammonia).

Stakeholders within the Upper Cedar Watershed have added additional desired uses, outside of the state-issued designations, that reflect the ideals and goals of the watershed as a whole. These uses might not be based on water quality criteria; instead they can address the ways in which people use the watershed and how it can be preserved for future generations. For example:

•**Flood Control**: Improve and augment stormwater best management practices and policies, improve existing infrastructure (bridges, culverts, storm drains), and increase/restore floodplain connectivity.

•**Preserve Natural Hydrologic Features**: Protect and preserve hydrologic features that improve water quality and reduce flooding including wetlands, floodplains, riparian buffer zones, and stream channels that reduce soil erosion and attenuate flow.

•**Sustainable Economic Development:** Promote development that incorporates both environmental and economic considerations in order to meet present needs without compromising the needs of future generations.

•**Open Space Preservation:** Protect open space, recreational areas, parks, trails and agricultural lands from development to maintain their natural function, preserve the rural character of the watershed, and enhance recreational opportunities.

3-2 Assessment of Impairments and Issues

The UCWMIA was established in 2012 to bring together local shareholders to discuss and develop options for reducing flood-risks as well as for improving water quality. The floods of 2008 prompted community leaders across Iowa to focus on watershed-based solutions to water problems, as these issues cross municipal and county lines necessitating large-scale collaboration. The Iowa Legislature authorized the creation of Watershed Management Authorities in 2010, and the UCWMIA was one of the initial entities formed within the state. Although flooding was the initial spark for the formation of the UCWMIA, water quality issues are also best addressed using a watershed-based approach.

The UCWMIA board identified several key challenges throughout the watershed, which are identified below. In addition, the Environmental Law Institute and the University of North Carolina coordinated with the Cedar River Watershed Working Group to distribute a web-based survey regarding watershed issues. The survey respondents indicated that balancing agricultural productivity with natural resource protection was the most significant challenge within the larger Cedar River Watershed. Other top challenges included loss of natural habitats like wetlands and floodplains, declining water quality, and flooding. A copy of this report was not available on a website at the time of writing, but a copy of the report was provided to the UCWIA board.

3-2.1 Flood Control Problems

Floods are a naturally occurring phenomenon, but when they occur where people live and work, it can have tragic results including damage to critical infrastructure (structures, utilities, and transportation networks), valuable farmland being removed from production, and significant economic losses for local businesses. The Upper Cedar has a history of regular flooding problems, most recently seen in the floods of 2008. Flood management includes policies and practices that addresses flood prevention and mitigation, and can also include public education and outreach about flooding issues.

Flooding is driven by the interaction of precipitation (e.g. rainfall, snow) and the drainage basin or watershed response. Short, intense precipitation events or long periods of precipitation can strain the watershed resulting in increased surface-runoff and potential flooding. Urban areas typically have more impervious (impermeable) surfaces, and short rainfall events can result in comparatively high surface water runoff. Flooding across a wide geographic scale is often a result of prolonged rainfall within the watershed and can sometimes be coupled with a rapid snowmelt in the spring. Table 2-3-3 (Chapter 2) lists the five (5) largest floods on record within the Upper Cedar, all of which are attributable to long-periods of precipitation.

Flooding problems/needs within the watershed include:

- A comprehensive plan is needed to reduce or effectively control runoff that causes significant flood damage. A watershed-wide coordinated effort is required to systemically implement changes in a cost effective manner.

- Quantitative data is needed on the amount and frequency of flooding across the watershed, and stakeholders need to better understand where water is stored/drained within the watershed. This includes identifying areas within the watershed with the potential for water storage, such as riparian wetlands.

- Communities with stormwater infrastructure (pipes, culverts, drainage-ways, etc) require systematic review

to determine if the existing system is adequate or if it requires improvements.

• Homes and businesses within the floodplain are at high risk for damage during flood events and need flood proofing or removal. Agricultural lands that are chronically prone to flooding, resulting in significant loss to productivity, might consider a land use change, including permanent-retirement programs.

• New development and redevelopment projects require guidance for flood prevention, including clear direction and policy from local governments.

• Local leaders need to build inter-agency, inter-community relationships with regard to the management of water resources.

• Communities need to coordinate educational outreach opportunities, such as field days, to help raise awareness about practices that allow for runoff infiltration in both urban and rural areas.

3-2.2 Water Quality

Water quality in Iowa has become a top environmental priority, and any improvements will require coordination between local land owners, communities, businesses, and government agencies. In agricultural areas like the Upper Cedar, specific attention is given to nutrient runoff (nitrogen and phosphorus) from agricultural fields. Permitted point sources (e.g. wastewater treatment plants) are typically limited with a maximum loading amount, and regulations will likely become more stringent in the future.

3-2.2.1 Excess Nitrogen

Nitrogen (N), like other nutrients, is a simply chemical element that are necessary organisms to survive. It is needed to maintain a healthy aquatic ecosystem. However, high concentrations of nitrogen can lead to water quality concerns and impaired waters. Excess nitrogen can promote algal growth that reduces water clarity, creates dissolved oxygen deficiencies which can result in fish kills, and can contaminate groundwater supplies.

Nitrogen exists in several forms including nitrate, nitrite, and ammonia. Nitrogen is needed for plant growth and is commonly used on agriculture lands as a fertilizer (manure and chemical fertilizers) to improve crop yields. Excess water soluble nitrogen on fields can be introduced to streams, and drain into larger rivers and can ultimately end up in the Gulf of Mexico, which is currently experiencing hypoxic conditions (low dissolved oxygen).

Wastewater treatment facilities that do not remove nitrogen can also contribute to excess concentrations in surface waters. Septic systems, atmospheric deposition, wildlife, and legume fixation are additional nitrogen inputs. However, only 5% of the total nitrogen inputs ever reach the stream; most of the inputs are removed by harvesting crops, grazing, volatilizing into the atmosphere, or becoming immobilized in the soil. *(Nitrogen and Phosphorus Budgets for Iowa and Iowa Watersheds, Iowa Geological Survey, 2004)*

The Upper Cedar Watershed was included in the 2006 nitrate TMDL study of the entire Cedar River basin (see Section 2-12.2). For the Upper Cedar, non-point source inputs were estimated to be: 19.4% from atmospheric deposition, 0.1% from wildlife, 0.1% from septic systems, 26.1% from legume fixation, 15.4% from manure and 38.9% from chemical fertilizers. The TMDL nitrate reduction target is 35%.

In 2004, the Iowa Geological Survey issued a report entitled "Nitrogen and Phosphorus Budgets for Iowa and Iowa Watersheds" which estimates the nitrogen inputs and outputs for various watersheds. The average total-N load to the stream at the Upper Cedar Watershed outlet (near Janesville, IA) was estimated to be 17.6 lbs-N/acre. Point sources were estimated to account for 7.4% of the total-N load in the stream, while non-point sources accounted for the remaining load. The average concentration at the watershed outlet was 8.2 mg-N/L.

The state of Iowa is currently aiming to reduce the total riverine nitrogen load by 45% which exceeds the goal of the nitrate TMDL for the Cedar River. This effort was originally driven by the EPA's 2008 Gulf Hypoxia Action Plan that mandates that all states along the Mississippi River develop strategies to reduce nitrogen inputs. Iowa developed a Nutrient Reduction Strategy in 2013, a science and technology-based approach that outlines different voluntary efforts that can be implemented to reduce nitrogen outputs from various sources, focusing on those practices that are most cost effective. Major permitted wastewater treatment and industrial facilities (point sources) that currently discharge nitrogen will have a targeted reduction of at least two-thirds (2/3) of total nitrogen outputs. However, this reduction would only account for 4% of the state-wide goal of 45%. Wastewater treatment facilities in Charles City and Waverly will be subject to more stringent NPDES permit requirements under the Nutrient Reduction Strategy.

Nitrate problems/needs within the watershed include:

- High nitrate levels can stimulate algae growth and contributes to hypoxia (low dissolved oxygen) downstream of the watershed.

- Excess nitrogen in drinking water supplies can be harmful to infants and young livestock (restricts oxygen transport in the blood stream). This is of particular concern in areas with active agricultural drainage wells, (ADW) where nitrates have fast access to groundwater supplies. Only one ADW is classified by the IDNR's ADW dataset as 'fully functional' within the Upper Cedar Watershed (Floyd County).

- The state of Iowa is aiming to reduce nitrogen loading to the Mississippi River by 45%.

3-2.2.2 Excess Phosphorus

Phosphorus (P), like nitrogen and potassium, occurs naturally and is necessary for biological organisms. Phosphorus is typically the limiting nutrient for algae growth in freshwater systems, and excess phosphorus can lead to eutrophication: a process of excessive plant growth, often algae growth. Eutrophication can lead to hypoxia (low dissolved oxygen) as the decay of large quantities of material uses much of the available oxygen, negatively impacting fish and other aquatic organisms. The excess plant growth on the surface also limits the amount of light entering the lower water columns, significantly altering the habitat for other organisms. Recreational opportunities in lakes can also be impacted due to reduced water clarity, poor swimming conditions, and interference with boating.

Phosphorus binds to sediment, and therefore the majority of inputs to aquatic systems are bound to soils. Sediment delivery, with the bound phosphorus, is typically the greatest from eroding bare soils. However, dissolved phosphorus can also be a significant source to streams. Fields that apply liquid manure or chemical fertilizers containing phosphorus likely contribute more dissolved phosphorus than other fields.

Non-point sources, such as agricultural runoff, account for the majority of phosphorus inputs in Iowa. An estimated 80% of the total phosphorus entering streams in Iowa comes from non-point sources. However, only 4% of the total phosphorus inputs ever reach the stream; most of the inputs are removed by harvesting crops or grazing. *(Nitrogen and Phosphorus Budgets for Iowa and Iowa Watersheds, Iowa Geological Survey, 2004)*

The 2013 Nutrient Reduction Strategy outlines voluntary strategies for reducing the total riverine phosphorus load by 45%. It is hypothesized that phosphorus is the limiting nutrient in the Gulf of Mexico, where hypoxia is a known issue, and therefore states along the Mississippi River are addressing how to reduce P-levels before reaching the Gulf. The report focused on practices that reduce loads from agricultural land since less research/information was available on agricultural P reduction techniques. Major permitted wastewater treatment and industrial facilities (point sources) will be asked to account for 16% of the state-wide reduction goal of 45%. The targeted goal for non-point sources is the remaining 29%.

The 2004 Iowa Geological Survey issued a report entitled "Nitrogen and Phosphorus Budgets for Iowa and Iowa Watersheds" which estimates the phosphorus inputs and outputs for various watersheds. The average total-P load to the stream at the Upper Cedar Watershed outlet (near Janesville, IA) was estimated to be 0.61 lbs-P/acre. Point sources were estimated to account for 15.2% of the total-P load in the stream, while non-point sources accounted for the remaining load. The average concentration at the watershed outlet was 0.29 mg-P/L.

Phosphorus problems/needs within the watershed include:

- High phosphorus levels can stimulate algae growth and contributes to hypoxia (low dissolved oxygen) downstream of the watershed.

- The state of Iowa is aiming to reduce phosphorus loading to the Mississippi River by 45%.

3-2.2.3 Pathogens

Excess pathogens in surface waters can be a human health concern and reduces recreational opportunities within the watershed including swimming and boating. The bacteria *E. coli* is commonly used as an indicator for the possible presence of pathogenic (disease-causing) bacteria in a water system from fecal contamination. Sources for fecal contamination include wastewater treatment plants, failing septic systems, wild animals, domesticated animals (including feedlots), and illicit discharge to stormwater systems. Elevated levels of fecal bacteria pose a risk to human health, and can also cloud the water and create unpleasant odors.

In 2010, the Iowa DNR prepared a TMDL study for the entire Cedar River basin, focusing on the Indicator Bacteria *E. Coli* (see Section 2-12.1). Two stream segments along the Cedar River (and within the Upper Cedar Watershed) were classified as impaired: (a) the reach from Charles City Dam Number 2 to the confluence with Rock Creek and (b) the reach from Rock Creek near the City of Orchard to the Minnesota state line. Nine (9) other stream segments are currently listed as either partially supporting or not supporting their designated uses (Primary or Secondary Contact due to Indicator Bacteria), but are not specifically identified within the TMDL. The study inferred that non-point sources were the main cause of exceedances during high flow events, but exceedances at low flow were likely caused by point sources.

Non-point sources include open feedlots, grazing livestock, manure application and wildlife; the TMDL study determined that runoff from open feedlots was the largest non-point source (approximately 81-82%) and manure application to farmland was the second largest source (approximately 16%).

Point sources include failing septic systems, illicit discharge to stormwater systems, and wastewater treatment plants. The TMDL specifically addressed the permitted wastewater treatment plants (12 within the Upper Cedar Watershed), and provided a target Waste Load Allocation (WLA) for each. See Section 2-12.1 for more detailed information on the WLAs for these facilities. Information regarding the scale/extent of illicit discharge within the watershed is currently not available.

Pathogen problems/needs within the watershed include:

- Excess pathogens from fecal contamination can create a human health risk and reduce recreational opportunities.

- The scale and extent of failing septic systems and illicit discharge within the watershed is currently unknown.

3-2.2.4 Sediment

Erosion is a natural process where water, wind, ice, and human/animal activities loosen, remove and transport soil and rock material. The rate of erosion is highly dependent on the soil characteristics, the local climate, rainfall intensity and duration, the extent of vegetation or other surface cover, and the land topography. Disturbing the soil surface can increase the rate of erosion, resulting in increased transport and deposition of sediment, reduced stream capacity, and increased stream scour and flooding. Suspended sediment in surface waters can also contribute to water quality problems, including blocking sunlight, modifying the aquatic habitat and carrying additional sediment-bound pollutants into the water ecosystem. Soil erosion is of specific concern in productive agricultural areas, where the loss of topsoil can have a considerable impact on yields, particularly if the subsoil has unfavorable conditions for crop production.

An effective control for erosion is to maintain a permanent surface cover on the land, commonly vegetation. Vegetation can protect the underlying soils from the force of the falling raindrops, disperse and decrease the speed of surface water flow, act as a physical barrier for soil movement, increase infiltration rates by improving the soils' structure and porosity, and decrease soil moisture control (thereby increasing the soil moisture storage capacity) through transpiration. Non-vegetative cover (armoring) can also reduce erosion by shielding soils from the erosive forces of wind and water.

A segment of Burr Oak Creek in Mitchell County is listed as impaired for aquatic life, partially due to siltation from bank modification/destabilization. Other portions of the watershed likely have regions with significant streambank erosion, and erosion rates are of high concern for agricultural lands where fertile topsoil is key to maintaining crop yields.

Sediment problems/needs within the watershed include:

- Increased erosion can reduce stream capacity and increase flooding downstream.

- Erosion can remove topsoil and impact yields for agricultural areas.

- Suspended sediment can affect water quality by modifying a stream's ecology and carry sediment-bound pollutants into the water system.

- Research is needed to determine the locations within the watershed with high erosion rates.

3-2.2.5 Mercury

Mercury is a naturally occurring element, but can be a toxic pollutant. Natural sources of mercury include geological deposits and atmospheric emission from volcanoes. Human activities, including coal combustion, chlorine alkali processing (industrial processing), waste incineration, and mining, have increased the release of mercury into the atmosphere where it can be widely circulated around the globe and re-deposited to the surface (either land or water). The toxic effects of mercury depend on the form of mercury and it's cycling through the environment. Methylmercury is the most toxic form, which can be bioaccumulated in the food chain and poses a risk for humans through the consumption of fish and seafood.

Within the Upper Cedar Watershed, two (2) stream segments of the Cedar River are listed as impaired by mercury for fish consumption, stretching from Charles City north to the Minnesota border. A TMDL for mercury has not been issued to date.

Mercury problems/needs within the watershed include:

- Atmospheric deposition is likely the dominant source for mercury deposition in the watershed, and the original source of the mercury could originate outside of the state of Iowa.

- Mercury can accumulate in fish, posing a potential risk for human consumption.

3-2.3 Altered Hydrology

Hydrology is the study of the distribution and movement of water. The Upper Cedar has a long history of agricultural use, and modifications to the hydrologic system in Iowa have resulted in one of most productive agricultural areas in the United States. Stream channels have been straightened and extensive drain tile networks and ditches developed to move water more efficiently away from fields. Some wetlands have been drained and converted to cropland, and upland prairies and riparian forests were also converted for agricultural use. Unfortunately, some of these alterations have the unintended consequence of increasing the rate of pollutant runoff, flow rates, runoff volumes, and the potential for flooding in downstream areas.

Drain tiles and ditch networks help to move water effectively from cropland into stream channels. However, this also provides nutrients a quick pathway to water networks, bypassing riparian vegetation that historically would have intercepted both water and nutrients before entering the stream. Tiles can significantly increase nitrate loading (NO_3^-, a water soluble form of nitrogen) from nitrogen fertilizers. Channelized streams generally increase water velocity in comparison to natural, meandering streams; this can result in higher erosion rates and bank destabilization.

Altered hydrology can also impact the extent and frequency of flooding. The watershed has lost some of its natural

storage due to the loss of wetlands, removal of riparian vegetation, increased ditch networks, and extensive tiling. Wetlands and riparian vegetation can help attenuate the flow of water and reduce flow rates. In addition, much of cropland only has extensive vegetative cover during the summer months; perennial vegetative cover can more effectively take up soil moisture and protect soils form the impact of rainfall year-round, which has the potential to reduce flow rates and sediment loss to the streams. Drain tiles expedite the movement of water from the land surface into streams, and channelized stream networks also water to move more quickly downstream. The cumulative effect of all of these modifications can significantly impact the magnitude of flood events downstream.

Urban areas typically have more impervious (hard) surfaces than naturally vegetated areas, and impervious surfaces have higher runoff rates than pervious land where water infiltrates (at least partially) into the soil. Runoff from urban areas is also typically directed to a constructed stormwater system, efficiently conveying water away from the developed areas into rivers and streams. The combined higher runoff rates and delivery mechanism from urban and well drained agricultural areas can result in a "flashy" system, where flow rates in the river/stream increases significantly after a rainfall event. The increased flows can cause flooding, rapidly erode streambanks, and increase sedimentation.

Altered hydrology problems/needs within the watershed include:

- Increased flow rates and flooding in downstream areas.
- Increase pollutant loading (nutrients and sediment) to rivers and streams.

3-2.4 Overarching Challenges

Several broad challenges exist within the Upper Cedar and need to be addressed in order to mitigate the causes of the impairments listed above. These challenges include 1) a need for increased general public awareness about watershed-related issues, 2) a need for broad base of unified support by communities and administration to embrace projects and programs related to water-issues and 3) a need for a set monitoring regime that can gage the current extent of existing impairments and track improvement progress.

The general public needs to be better aware of water-related problems within the Upper Cedar, and what role they can play as individuals to make progress towards improvements. Some individuals do not understand the concept of a 'watershed' and that smaller actions can have a significant, cumulative impact both locally and further downstream. The significance of non-point sources can be a stumbling block as well, as many individuals might assume that point sources (e.g. wastewater treatment plants) are the largest contributor to water quality problems. Such misconceptions can lead to individuals feeling complacent and lacking a sense of personal responsibility to make changes to their individual practices. This complacency can extrapolate to local governments which may then fail to instigate water-improvement programs if their constituents are not engaged or passionate about watershed issues.

Local governments need to make watershed planning a priority in order to improve water quality and reduce flooding. Many projects require substantial advanced planning, delegation of funds, and local participation. Some goals cannot be achieved in the short-term, and require a combination of projects/programs that can span decades. Local officials need to promote the importance of considering these plans, research the availability of funding options (ranging from grants to loans to fees), and consider new partnerships that leverage the best available skills and funds.

Currently, there is a lack of consistent water quality monitoring within the Upper Cedar. A coordinated monitoring regime is needed to better model the watershed and to evaluate the potential for different Best Management Practices (BMPs) that will improve water quality. It also poses a challenge for tracking long-term trends. In order to reach the target goals, a long-term dataset is required to see improvements, and help eliminate any background noise within the collected data (e.g. seasonal fluctuations, difference between base-flow and large scale events, etc). Long-term monitoring can be costly and adequate forethought is required to maintain the necessary funds to continue these efforts. Such planning will require the coordinated effort of all member entities within the watershed. Mitchell County coordinated with the IDNR to collect water quality samples over a 10-year period. The final sampling took place in 2014, but had to be discontinued due to lack of funding. Restarting this effort, and beginning similar sampling projects throughout the Upper Cedar Watershed is key to understanding long-term nutrient dynamics.

Overarching challenges within the watershed include:

- A need for public awareness of watershed issues, and a better understanding of how individuals, governments and organizations can implement changes that will address the desired watershed goals. Specifically, there is a need for a representative survey of stakeholders (particularly landowners) in the watershed to a) gage public understanding and awareness and b) assess potential barriers/educational gaps regarding conservation practices.

- A need for government agencies too prioritize watershed issues (both water quality and flooding), recognize the long-term nature of these projects, and research different funding options to implement programs and projects.

- A need for long-term water quality sampling within the watershed to use for modeling (to select the best available BMPs), to gage the long-term trends within the watershed, and to recognize/highlight progress towards improvements.

3-3 Goals and Objectives for the Upper Cedar

The long-term goals and objectives for the Upper Cedar Watershed are designed to meet the designated and desired uses for the region. It is generally understood that the long-term goals will not be achievable in the immediate future, and will require extensive collaboration and input from local stakeholders in order make steady, measurable progress. No single government agency or community will be able to achieve these goals individually, and a wide variety of Best Management Practices (BMPs) will need to be implemented watershed-wide in order to reach the targeted goals.

The Upper Cedar Watershed covers a very large geographic area, and the outlined goals and objectives are meant to serve as an “umbrella” plan, addressing the broad needs and desires for the watershed as a whole. Subwatersheds (such as those defined by HUC-12 boundaries) should be targeted for more focused study and planning. This will allow local residents to clearly vocalize their needs and desires, and will help determine specific locations for implementing BMPs that provide the greatest return on investment. As smaller watershed plans are developed, they should be incorporated into this plan so as to highlight successful projects and document the measured progress towards the defined goals.

Watershed dynamics are complex, and it is challenging to predict when specific goals will be met. Some of the short-term objectives pertaining to Administrative changes could be implemented within the next 5 years, while those targeting water quality improvements and reduced flooding will take considerable more planning, time and funding to implement. As individual BMPs are put into place, the UCWMIA will need to periodically review their contribution to reaching targeted goals, gauge their efficiency in comparison to cost, assess any problems encountered throughout the project, and document the degree of improvement. Progress towards the larger goals will be tracked after each BMP is installed, and regular monitoring of stream reaches will confirm to accuracy of individual improvements.

The long-term goals are organized into broad classifications, which are then further subdivided into specific goals to target the greatest areas of need. A series of objectives are listed for each goal; these are actions items that can be implemented in order to reach the target goals. The long-term goals are listed in priority order, as determined from feedback of a survey of the UCWMIA board members. As progress is made towards individual goals, the prioritization will be updated accordingly to address any improvements that have been made and the changing needs of the watershed (Table 3-3-1).

3-4 Watershed Best Management Practices

A Best Management Practice (BMP) is a technique or tool that improves water quality and/or manages the quantity of stormwater runoff. Once implemented, BMPs can help achieve the Upper Cedar Watershed's goals and objectives. There are a wide variety of tried and tested BMPs that are commonly used, each with unique siting requirements, efficiencies, and costs. Therefore, the UCWMIA should carefully review all potential BMP options before selecting a BMP based on the desired outcomes, availability of funds for the initial implementation and long-term maintenance, and stakeholder acceptance. The Watershed Action Plan (Section 3-5.9) offers a set list of recommended steps to implement BMPs appropriate for the Upper Cedar.

Past experience is invaluable when selecting new BMPs. Those practices known to be widely-accepted, effective, and low-cost should be considered first and foremost, and it is strongly encouraged to review the history of older projects to uncover lessons-learned. Governments, universities, and non-profits also conduct pilot studies that can offer better estimates for efficiency rates and steps for implementation. Table 3-3-2 is a compiled list of different BMPs that could be used within the Upper Cedar, including ranges of efficiencies for flood reduction and water quality improvement (Total Suspended Sediment, Total Nitrogen and Total Phosphorus), basic siting requirements, and appropriate settings (Urban or Rural). This is not an exhaustive list, and is meant to be a live document that is regularly updated to incorporate BMP efficiencies and siting requirements specific to the Upper Cedar. Local knowledge, specifically through the Soil and Water Conservation Districts, should be utilized to the full extent when making updates, and selecting BMP types.

Information regarding the pollutant removal efficiency, costs, and designs of structural stormwater management alternatives is evolving and improving constantly. As a result, information contained in Table 3-3-2 is dynamic and subject to change. While potential locations are recommended for some management alternatives in the Action Plan, general guidelines can be consulted for their common sense placement. This table is in no way an exhaustive list of BMPs. Finally, it is important to note that BMPs require maintenance, some more so than others. Having a proper maintance plan in place specific to each BMP will ensure long term functionality and expected removal efficiencies.

Table 3-3-1 Prioritized Goals and Objectives and the Designated and Desired Uses they Address

Broad Long-Term Goal	Specific Long-Term Goal	Objective	Designated and Desired Uses Addressed
Encourage watershed stewardship at all levels	1) Raise public awareness of water resources issues within the watershed 2) Build inter-agency, inter-community relationships with regard to management of water resources within the watershed 3) Develop a set of model policy statements regarding water resources issues which may be adopted by local government 4) Promote and enhance recreation within the watershed 5) Provide for transition of water management to local units of government	a) Develop and share education programs on water and land practices that impact: i) Surface water quality ii) Ground water quality and drinking water supplies iii) Flooding b) Develop model ordinances/policy statements related to water quality and flooding that can be readily adopted by local agencies c) Prepare a public relations program that raises the public profile of the WMA and its ongoing efforts d) Create a Upper Cedar WMA website to promote educational opportunities and track progress towards WMA goals e) Promote intergovernmental coordination in land use planning, natural resource protection, point and non-point source pollution control and stormwater management f) Develop and maintain a legislative program that promotes watershed efforts and concerns to state legislators g) Develop a long term strategy for funding Best Management Practices (BMPs) that address water quality and flooding issues and for long-term monitoring efforts h) Explore opportunities for water and trail designation for Upper Cedar Watershed rivers and streams i) Develop a log term strategy for funding the Upper Cedar WMA facilitation and coordination	Flood Control; Hydrologic Features; Sustainable Economic Development; Open Space Preservation; Designated uses: A1, A2, A3, B(WW-1), B(WW-2)
Protect and improve surface water quality	1) Preserve and protect topsoil, while reducing sedimentation runoff to surface waters 2) Achieve all designated uses (water quality) for all water resources within the Watershed 3) Reduce total riverine nitrogen and total riverine phosphate loads 4) Protect and enhance fish and wildlife habitat	a) Develop and maintain water quality programs in order to: i) Reduce pollutant loads to comply with TMDL requirements (currently for nitrogen and indicator bacteria *E. Coli*) ii) Reduce total riverine nitrogen and phosphate loads by 45% as was stated in the Iowa Nutrient Reduction Strategy. b) Review past Best Management Practices (BMPs) that were designed to improve surface water quality, and rank them according to effectiveness in reducing pollutant loads, acceptance by local stakeholders, and siting condition requirements. c) Plan, develop and implement Best Management Practices (BMPs) that improve surface water quality focusing efforts on targeted subwatersheds within the Upper Cedar d) Minimize discharge of untreated stormwater to surface waters e) Encourage the development of nutrient management plans for agricultural activities in accordance with the NRCS 590 Standard f) Adopt county and local stormwater management requirements g) Encourage local ordinances that minimize stormwater runoff from highways, encourage the development of native landscapes and reduce the use of chemical applications h) Ensure application of soil erosion and sediment controls during construction activates i) Identify and repair highly eroded and susceptible stream channels and banks	Designated uses: A1, A2, A3, B(WW-1), B(WW-2); Hydrologic Features; Open Space Preservation

Broad Long-Term Goal	Specific Long-Term Goal	Objective	Designated and Desired Uses
Reduce flood damage	1) Reduce peak flows and flood elevations within the watershed	a) Understand where flooding occurs and the current water storage and conveyance functions of the watershed	Flood Control; Hydrologic Features; Sustainable Economic Development; Open Space Preservation
	2) Increase/restore floodplain connectivity	b) Map existing floodplains	
	3) Minimize the potential for damage by floods by removing existing development from the floodplain, preventing new construction in the floodplain and minimize filling of the floodplain	c) Identify any existing development within the floodplain and relocate to prevent structural damage from a 100-year precipitation event	
	4) Identify, to the maximum extent practicable, areas of floodplain within the watershed	d) Modify regulations to reduce flood damage, specifically to prevent structural damage for a 100-year precipitation event i) Prevent construction of new development within the floodplain ii) Prevent filling of the floodplain which causes adverse impact to flood	
		e) Reduce the risk of flooding by decreasing flow and volume by 10% at Janesville (the outlet of the Upper Cedar Watershed) based on current precipitation and runoff design	
Protect and improve groundwater quality	1) Promote groundwater recharge	a) Develop an implementation plan for removal of existing agricultural drainage wells	
	2) Continue to eliminate agricultural drainage wells	b) Develop source water protection plans	
	3) Encourage compliance with proper management standards for subsurface sewage treatment systems, feedlot operations, landfills and storage tanks	c) Promote agricultural practices that protect and maintain groundwater supplies	
		d) Educate local stakeholder and government agencies on practices that enhance high quality groundwater recharge	
Monitor and collect data for water quality and	1) Evaluate the effectiveness of different BMP practices	a) Develop an adaptive monitoring strategy that provides adequate data to determine a baseline for existing conditions and impairments	Flood Control; Hydrologic Features; Designated uses: A1, A2, A3, B(WW-1), B(WW-2)
	2) Track measurable progress in meeting other watershed goals	b) Adjust the adaptive monitoring strategy to monitor short and long term changes in water quality and flooding to track progress towards the WMA's goals and objectives	
	3) Educate landowners on progress within the Upper Cedar and smaller subwatersheds	c) Support continued management of IDNR's STORET/WQX database (a comprehensive repository for water monitoring data) and promote use of data by members of the public	
		d) Design monitoring programs on smaller scales to determine individual BMP effectiveness	
		e) Partner with other governmental agencies, academic researchers, non-profits, and others to review BMP effectiveness within the watershed in order to prioritize future projects	
		f) Report short and long term measureable progress towards goals and objectives	
		g) Raise awareness for new individual developments (e.g. BMPs, changed polices, etc) and the state of overall progress towards goals and objectives to the general public	

Table 3-3-2: Best Management Practices (BMPs) for flood reduction and water quality improvement

				Reduction Efficiencies					
BMP	*Description*	*Comments*	*Setting*	*Runoff (Flooding)*	*Total Suspended Sediment (TSS)*	*Total Nitrogen (TN)*	*Total Phosphorous (TP)*	*Bacteria*	*Citation*
No-till	Growing crops or pasture from year to year without disturbing the soil profile through tillage.		Rural	*No data available*	*No data available*	*No data available*	27-100%[b]	*No data available*	b
Cover crop	A crop grown for the protection and enrichment of the soil, primarily to reduce risk of erosion and also manage soil quality.		Rural	*No data available*	15%[d]	28-31%[b] ; 43%[d]	-39-68%[b]; 32%[d]	*No data available*	b, d
Vegetated filter strips/ riparian buffers	Vegetated land designed to intercept sheet flow from upstream development. A vegetated protective zone of variable width located along both sides of a waterway.		Urban and rural	50%[c]	40-90%[a]; 73%[c]; 58%[d]	20-80%[a]; 33-99%[b]; 40%[c]; 56%[d]	40-80%[a]; -10-98%[b]; 45%[c]; 52%[d]; 30-80%[e]	43-57%[g]	a, b, c, d, e
Fertilizer reduction/ precision fertilizer application	The gross amount of fertilizer applied is reduced or yield studies are done to target on those specific areas of the field where fertilizer should be applied and at what rate.		Rural	*No data available*	*No data available*	19%[d]	0.6-17%[b]; 28%[d]	*No data available*	b, d
Residue management/ conservation tillage	Practice in which crop residue is left on the field until the next planting season.		Rural	*No data available*	64%[d]	50%[d]	-47-100%[b]; 38%[d]	*No data available*	b, d
Constructed wetland	Man-made systems engineered to approximate the water-cleansing process of natural wetlands.		Rural	*No data available*	69%[a]; 80-90%[c] ; 50-90%[e]	56%[a]; 11-92%[b] ; 55-85%[c] ; 0-40%[e]	39-83%[a] ; 45-64%[c] ; (-5)-80%[e]	76%[a] ; 78-90%[g]	a, b, c, e, g
Grassed swales (urban and rural)	Open vegetated channel used to convey runoff and provide treatment by filtering pollutants and sediment.		Urban and rural	60%[c]	65-95%[a]; 20-40%[e]; 70%[g]	15-45%[a]; 10-30%[e]; 25%	15-77%[a]; 20-40%[e]; 34%[g]	(-50) – (-25)%[a]	a, c, e

				Reduction Efficiencies					
Infiltration basin/ detention pond/ constructed pond/ biofilter/ infiltration trench	Designed to allow stormwater to infiltrate into permeable soils. It may include a back-up underdrain pipe to ensure eventual removal of standing water.	Maintenance practice done to ensure that stormwater collection and treatment systems are operating as designed.	Urban and rural	50-100%[a]; 90%[c]	50-100%[a] 45-100%[e]	10-60%[a]; 45-100%[e]	60-100%[a]; 40-100%[e]	90%[a]	a, c, e
Stabilize soils on construction sites	Design and implementation of site-specific plan to reduce on-site erosion and off-site sedimentation.	Requires site-specific evaluation, planning, implementation, and site sampling.	Urban	*No data available*	80-90%[a]	*No data available*	*No data available*	*No data available*	a
Street Sweeping	Measure used to remove pollutants on roadways before they are transported in stormwater runoff.	Should be performed with degree of frequency as well as with properly maintained equipment.	Urban	*No data available*	45-90%[a]	*No data available*	30-90%[a]	*No data available*	a
Permeable pavement	A porous asphalt surface designed to have bearing strength similar to conventional asphalt but provides a rapid conduit for runoff to reach a subsurface stone reservoir.	Should have comprehensive maintenance plan to ensure long term pollutant removal. Critical to install correctly. No sand used to treat snow/ice.	Urban	*45%-75% c; 97%f*	60-90%e ; 91%f	*60-90%e ; 84.6%f*	60-90%e; 77.5%f	*No data available*	c, e, f
Drainage water management	Controlled drainage where a control structure is installed at drain tile outlets. This allows the depth to water table to be adjusted whenever drainage is occuring.	Typically the outlet is adjusted to have a high water table in the winter, when it would not interfere with optimum crop growth.	Rural	*No data available*	*No data available*	29% nitrate	*No data available*	*No data available*	h
Bioreactors	A bioreactor intercepts water from drain tiles before it reaches a surface water body. The bioreactor consists of a buried trench, often filled with woodchips. The woodchips support denitrifying microbes that convert the aqueous nitrate into nitrogen gas.		Rural	*No data available*	*No data available*	55% nitrate	*No data available*	*No data available*	i

				Reduction Efficiencies					
Saturated buffers	Flow through tile drainage is re-routed through a riparian buffer, where nitrates are removed through plant uptake, microbial immobilization or denitrification.		Rural	*No data available*	*No data available*	up to 100% nitrate	*No data available*	*No data available*	j

a. Watershed Management Plan for the Huron River in the Ann Arbor – Ypsilanti Metropolitan Region. September 2008.
b. Iowa Nutrient Reduction Strategy. May 2013.
c. Appendix E. BMP Pollutant Removal Efficiency. March 2011. http://des.nh.gov/organization/divisions/water/stormwater/documents/wd-08-20b_apxb.pdf
d. BMP Reduction Guidance Document, December 2001. http://www.mapshed.psu.edu/Downloads/BMPManual.pdf
e. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. US EPA. 1990. http://water.epa.gov/polwaste/nps/czara/upload/czara_chapter4_urban.pdf

f. Efficiency of permeable pavement systems for the removal of urban runoff pollutants under varying environmental conditions. Kiran Tota-Maharaj and Miklas Scholz. February 2010.

g. Reducing Bacteria with Best Management Practices. Allison Boyer. 2006.
h. Changes in yield and nitrate losses from using drainage water management in central Iowa, United States. Dan Jaynes, 2012.
i. In Situ Bioreactors and Deep Drain-Pipe Installation to Reduce Nitrate Losses in Artificially Drained Fields. Dan Jaynea, Tom Kaspar, Tom Moorman and Tim Parkin, 2008.
j. Reconnecting Tile Drainage to Riparian Buffer Hydrology for Enhanced Nitrate Removal. Dan Jaynes and T. Isenhart, 2014.

Information regarding the pollutant removal efficiency, costs, and designs of structural stormwater management alternatives is evolving and improving constantly. As a result, information contained in Table 3.4 is dynamic and subject to change. While potential locations are recommended for some management alternatives in the Action Plan, general guidelines can be consulted for their common sense placement. This table is in no way an exhaustive list of BMPs; there are several available resources if the WMA is interested in exploring other options. Finally, it is important to note that BMPs require maintance, some moreso than others. Having a proper maintance plan in place specific to each BMP will ensure long term functionality and expected returns.

3-5 Watershed Action Plan

Given the breadth and scope of the UCWMIA's goals and objectives, a detailed action plan is helpful by offering concrete steps for individual stakeholders and can be used to document progress towards achieving goals. Since individual action items often address more than one targeted goal, they were instead grouped by Action Type: Administrative (Ordinances and Policies, Practices, Funding and Coordination, Public Information & Education), Studies and Inventories, Structural Practices, Vegetative Practices, and Land Use Practices.

Many of action items hinge on having a select subgroup of the UCWMIA board (a committee) become a champion for a specific aspect of the Management Plan. This will become the core group for gathering existing information, preparing yearly sub-action plans, and distributing information to the larger UCWMIA board for a specific topic. For example, a committee on "Public Involvement within the Watershed" will be tasked with developing a public education and outreach program, coordinating with existing agencies (e.g. IDNR) to utilize resources, and reporting progress back to the UCWMIA board. Having a sense of ownership within the UCWMIA board is key in order to reach and influence members of the public within the watershed.

3-5.1 Administrative: Ordinances and Policies

Counties and municipalities can adopt ordinances and polices that promote water quality improvements and address flooding concerns. By implementing an ordinance, local officials as well as developers have a clearly defined "rulebook" for how new developments and improvements must be conducted so that water quality may be preserved and flood damage mitigated. When counties and municipalities work in tandem, ordinances can be written in a complementary manner; conflicting language can be troublesome when considering new development options, and therefore clear communication is required between all local authorities to ensure that ordinances can be easily followed and reviewed.

The Iowa Stormwater Education Program has a set of model ordinances that can be used as a template for communities; additional model templates were also created as a part of this Watershed Plan and can be found in Appendix B.

3-5.2 Administrative: Practices

Individual communities can take concrete steps to improve water quality and reduce flooding within their own jurisdictions. These practices often require a physical action (vs. a change to administrative code) such as inspections or maintenance of existing infrastructure. For example, a municipality might regularly monitor outfalls for illicit discharge by developing a monitoring schedule that becomes routine, and prevents surface water contamination. The EPA requires MS4 communities to follow pollution prevention/good housekeeping minimum control measures. These activities can include items like street sweeping and storm drain system cleaning. Smaller municipalities can follow similar guidlines to improve water quality.

A watershed-champion within each of the local governments can help to promote Administrative Practices. Once aware of potential ways to improve water quality and reduce flooding, they can contact the appropriate branch of their local government to brainstorm new techniques. These individuals can also report success stories to the UCWMIA board so that other communities might benefit from their ingenuity.

3-5.3 Administrative: Funding and Coordination

The Upper Cedar is a very large watershed, with a wide variety of participating stakeholders. Therefore, reaching any of the targeted goals will require extensive coordination between all parties to find the best individual/ organization to spearhead new projects and to eliminate duplication of effort. A high level of communication is required to effectively coordinate new projects, relay specific needs/concerns to all involved, and to promote success stories. The Upper Cedar Watershed crosses into Minnesota, and therefore coordinating with neighboring watershed districts is imparative in order to see large-scale effects in the downstream reaches.

The UCWMIA does not have the ability to leverage funds (e.g levy taxes), therefore those items which require funding need to be supported through an outside source: state and federal grants, contributions from communities, etc. Section 4-1.2 provides additional information on available funding opportunities that currently exist, and the Action Plan recommends instating an advisory committee focused on identifying funding opportunities that could be used to achieve the UCWMIA goals.

3-5.4 Administrative: Public Outreach and Education

Engaging the public with watershed-issues is key to reaching the UCWMIA goals. Members of the public might not be aware of how their individual actions affect the watershed as a whole, and many recommended Best Management Practices require extensive cooperation with private landowners. Some require changes to agricultural land use, which naturally raises concerns about how the changes could impact an individual's livelihood. The Upper Cedar is a 'working watershed' and therefore it is imperative that education programs are couched in the economic realm as well, including pilot projects where results are shared with the public at large to gauge both the environmental and economic impacts of any best management practice.

3-5.5 Studies and Inventories

In order to track progress towards watershed goals, it is necessary to understand the existing "baseline" conditions and take long- term measurements to see quantifiable changes over time. Many of the goals require a long-term commitment from the UCWMIA to implement a suite of projects and administrative changes. No single project will reach any of the goals on its own. Instead, the combined effects of multiple projects over many years will take the watershed in the desired direction, which can only be tracked with regular monitoring.

Studies and inventories can also provide invaluable feedback about individual BMP projects, which can be incorporated into future developments. Communities, landowners, and organizations can gauge the measurable effectiveness and ease of installing a Best Management Practice, and that feedback is specific to the Upper Cedar. They can offer changes in design, location recommendations for similar projects down the road, and gage the true value of the installation.

3-5.6 Structural Best Management Practices

A structural BMP is an engineered and constructed system that can treat stormwater runoff improving water quality and/or detain stormwater, releasing the water at a slower rate into the surface water systems (e.g. streams, lakes, etc) to reduce flooding. Some examples of structural BMPs are constructed wetlands and detention ponds. The design and effectiveness of these BMPs are site specific, and so require careful consideration in choosing the most cost effective option prior to construction. They can be designed to meet a variety of goals, and there are many types commonly implemented for pollutant removal and stormwater retention.

3-5.7 Vegetative Best Management Practices

A vegetative BMP could be considered a sub-group of structural BMPs; these are natural processes that use vegetation/ground cover to minimize soil erosion. These practices can include grass swales (convey stormwater runoff thought a vegetated channel) and vegetated filter strips (a zone of vegetation adjacent to a waterway, that surface runoff pass through before reaching the channel).

3-5.8 Land Use Best Management Practices

A land use BMP relies on an individual landowner to modify their personal practices, resulting in improved water quality and improved stormwater retention. Such practices can include restricting livestock access to public waterways, planting cover crops, and contour farming. Some of these practices could also be considered a vegetative BMP.

3-5.9 Action Plan Schedule

The Action Plan schedule (Table 3-5-1) was designed to give a broad overview of potential action items that can be implemented in order to meet the UCWMIA's goals and objectives. This is not intended to be a complete list, and should be a live document that continues to change over time reflecting the UCWMIA's growth, accomplishments, and shift in focus. Each Action item is numbered, and includes the following:

- Management Action: A short description of the action item
- Goals Addressed: Which goals are targeted by the action item
- Recommended Locations: Where the action item could be implemented
- Responsible Parties: Which individual/group should take the lead on the action item
- Timeline: A preliminary timeline of when the action item should be started and/or completed
- Technical Resources/Funding Options: Additional resources or funding options than might assist in completing the action item

3-5.10 Phased Action Plan Schedule

Considering the broad scale and scope of the Action Plan, it is useful to group those Action items by responsible party, and prioritze those items that should take place in the near term. This allows members of the UCWMIA to take ownership of specific tasks, make forward progress in achiving watershed goals, and report sucess stories/ learning moments to the larger UCWMIA body. The phased action plan schedule is also meant to be a dynamic document and should be reassessed on a regular basis (e.g. every 5 years) to ensure actions are appropriately priortized. Table 3-5-2 outlines an intital Phased Action Plan schedule, where every Action item is assigned to a responsible party.

The value within a watershed management plan is not in the text of the written document, but in how the recommendations are put into action. At this point, the UCWMIA has identified sources of pollutants within the

Table 3-5-1: Upper Cedar River Watershed Action Plan

		Goals Addressed							
Action #	**Management Action**	**1. Encourage watershed stewardship at all levels**	**2. Protect and improve surface water quality**	**3. Reduce flood damage**	**4. Protect and improve groundwater quality**	**5. Monitor and collect data for water quality and quantity**	**Responsible Parties**	**Timeline/Milestones**	**Technical Resources/ Funding Options**
	Administrative: Ordinances & Policies								
1	Develop and adopt ordinances/policy statements for floodplain management	x		x			Counties and Local Governments	Develop model ordinance/policy statement: 1 year. 50% adoption by year 3.	Model ordinance provided by MSA
2	Develop and adopt ordinances/policy statements for construction site erosion	x	x				Counties and Local Governments	Develop model ordinance/policy statement: 1 year. 50% adoption by year 3.	Iowa Stormwater Education Program
3	Develop and adopt ordinances/policy statements for post-construction stormwater management	x	x	x			Counties and Local Governments	Develop model ordinance/policy statement: 1 year. 50% adoption by year 3.	Iowa Stormwater Education Program
4	Develop and adopt ordinances/policy statements for illicit discharge detection and elimination	x	x		x		Counties and Local Governments	Develop model ordinance/policy statement: 1 year. 50% adoption by year 3.	Iowa Stormwater Education Program
5	Develop and adopt ordinances/policy statements for low-impact development	x	x	x			Counties and Local Governments	Develop model ordinance/policy statement: 1 year. 50% adoption by year 3.	Model ordinance provided by MSA
6	Advocate for the development of source water protection plans for municipal and rural water supplies	x			x		Counties and Local Governments	Identify communities with greatest need by year 2. Ongoing.	Volunteers and local government staff
7	Regulate maintenance of stormwater control facilities by requiring routine inspections and maintenance	x	x	x	x		Counties and Local Governments	25% of municipalities adopt a schedule/ structure by year 3. Ongoing.	Local government staff
	Administrative: Practices								
8	Operate, inspect and maintain existing and future flood control and water quality practices		x	x			Counties and Local Governments	Inspect 25% of existing projects by year 3. Ongoing.	Local government staff
9	Locate and inspect sanitary sewer and septic systems to eliminate/ minimize infiltration		x		x		Counties: Septic Systems; Municipalities: Sanitary Sewer Systems	Develop strategy to map existing systems: 2 year. Begin mapping/inspections by year 3. Complete mapping/inspections by year 5.	Local government staff
10	Locate, map, inspect, and maintain existing municipal stormwater systems		x	x	x		Local Governments	Develop strategy to map existing systems: 2 year. Begin mapping/inspections by year 3. Complete mapping/inspections by year 5.	Local government staff
11	Prepare and implement pollution prevention plans		x				Counties and Local Governments	Locate facilities and develop inspection schedule by year 2. Ongoing inspections.	Local government staff
12	Organize a catch basin maintenance and inspection program		x				Local Governments	Locate catch basins and develop inspection schedule by year 3. Ongoing inspections.	Local government staff
13	Develop county-wide clean up programs	x	x				County government	Develop clean-up program by year 2. First clean-up program year 3.	Volunteers

		Goals Addressed							
Action #	**Management Action**	**1.**	**2.**	**3.**	**4.**	**5.**	**Responsible Parties**	**Timeline/Milestones**	**Technical Resources/ Funding Options**
14	Conduct illicit discharge detection and elimination program		x				Counties and Local Governments	Develop inspection schedule by year 2. Inspections ongoing.	Local government staff; EPA Illicit Discharge Detection and Elimination Program Development Guidelines
15	Incorporate water quality treatment into flood control projects so as to improve project efficiency	x	x	x			Counties and Local Governments	As needed.	Engineering Review
16	Develop a groundwater recharge map based on available information and distribute to local officials for use when considering land development	x			x		Counties and Local Governments	By year 4.	Grant Funding
	Administrative: Funding and Coordination								
17	Designate an entity within the WMA to collect and distribute technical information regarding watershed issues	x	x	x	x	x	WMA Board	By year 1. Renew biennially.	WMA Board
18	Create a list of all locally elected officials, media outlets (e.g. newspapers), state and federal organizations, non-profits affiliated with surface and groundwater issues, and schools within the watershed	x					WMA Board	Prepare list by year 2.	Local Government Staff
19	Collaborate with other organizations on watershed projects	x	x	x	x	x	WMA Board, Counties and Local Governments, other agencies and organizations	Ongoing.	WMA Board
	a) Maintain a relationship with SWCD's and Cedar River Watershed District (MN) to encourage collaboration and ensure avoid duplication of effort	x					WMA Board and SWCD's	Ongoing. Invite SWCD's and CRWD to regular meetings	SWCD's, MN Cedar River Watershed District
	b) Maintain a relationship with non-profit organizations and academic institutions to encourage collaboration	x					WMA Board and other agencies and organizations	Ongoing. Invite other organizations to regular meetings.	Non-profits and universities
	c) Identify any overlapping goals with partner organizations in order to streamline projects, reduce duplication of efforts, and improve efficiency	x					WMA Board and other agencies and organizations	Ongoing.	Staff
20	Develop and implement watershed management plans for subwatersheds within the Upper Cedar		x	x	x		WMA Board, other agencies and organizations	Create a list of top prioritized watersheds for flooding and water quality by year 2. Prepare plans as funding allows. Ongoing.	Grant funding
21	Establish an advisory committee and develop a legislative program that promotes watershed efforts and concerns to the state legislature	x					WMA Board	Establish advisory committee by year 1. Renew biennially. Prepare program schedule by year 2.	WMA Board, State Officials

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
22	Review and analyze new farm bills and other legislation that impacts watershed-issues including conservation programs that offer funding for water quality improvement or flood reduction projects	x					Legislative advisory committee (WMA Board)	Annually.	ISU Extension
23	Monitor state and federal changes to water policy and programs	x					Legislative advisory committee (WMA Board)	Annually.	IDNR
24	Establish a single unit/individual within each local government that is a champion for watershed-related issues, programs and projects	x					Counties and Local Governments	Select champions by year 1. Renew biennially.	Local Government Staff
25	Establish an advisory committee for identifying funding opportunities for water quality and flooding control projects		x	x	x		WMA Board	Establish advisory committee by year 1. Renew biennially . Publish funding opportunities annually, and distribute information more regularly as opportunities arise.	WMA Board
	a) Pursue financial resources for the development of well-head protection plans	x			x		Funding Advisory Committee (WMA Board), Counties and Local Governments	As opportunities arise.	State and Federal Grants (e.g. IDNR)
	b) Pursue financial resources to assist communities in purchasing development rights for vulnerable land within well-head protection areas	x			x		Funding Advisory Committee (WMA Board), Counties and Local Governments	As opportunities arise.	State and Federal Grants (e.g. IDNR)
	c) Apply for grants to support the funding of flood control/reduction projects	x		x			Funding Advisory Committee (WMA Board), Counties and Local Governments	As opportunities arise.	State and Federal Grants (e.g. FEMA)
	d) Apply for grants to support the funding of water quality improvement projects	x	x				Funding Advisory Committee (WMA Board), Counties and Local Governments	As opportunities arise.	State and Federal Grants (e.g. IDNR)
	e) Develop an annual budget for the WMA based on proposed projects and available funding opportunities	x	x	x	x	x	WMA Board	First report by year 2. Annually.	WMA Board
26	Prepare and distribute an annual report, documenting the WMA's activities including current projects, funding opportunities, and outreach activities	x					WMA Board	First report by year 2. Annually.	WMA Board
27	Update the implementation program every five (5) years to reflect changing needs within the watershed and funding availability	x					WMA Board	First update in year 4.	WMA Board, Grant Funding

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
	Administrative: Public Outreach and Education								
28	Establish an advisory committee to promote public involvement in watershed issues/projects	x					WMA Board	By year 1. Renew biennially.	WMA Board
29	Develop a public education and outreach program for the Upper Cedar	x	x	x	x	x	Public involvement committee (WMA Board)	Develop program structure by year 3. Begin program in year 4.	IDNR (Iowa-Cedar Basin Coordinator)
30	Develop and maintain an Upper Cedar WMA website that describes the watershed, highlights current and future projects, documents progress towards WMA goals, and educates the public on how they can help reduce flooding and improve water quality	x	x	x	x	x	Public involvement committee (WMA Board)	Develop Upper Cedar WMA website by year 2. Ongoing updates (biannually or more frequently) highlighting WMA activities.	WMA Board, Grant Funding
31	Develop a WMA logo to be used on all publications and outreach efforts	x					Public involvement committee (WMA Board)	Develop Upper Cedar Watershed logo by year 1.	WMA Board, Grant Funding
32	Increase mass media efforts (e.g. newspaper, flyers, television, radio) that promote watershed awareness	x					Public involvement committee (WMA Board)	As determined by the public education and outreach program (to be completed by year 3).	Local Media Groups, Grand Funding
33	Create and distribute an annual report of WMA activities to local residents (e.g. flyers, emails, etc)	x					Public involvement committee (WMA Board)	First report by year 2. Annually.	WMA Board, Grant Funding
34	Create and distribute educational handouts describing municipal ordinances and citizen stewardship	x					Public involvement committee (WMA Board), Local Government Watershed Champions	Create educational materials by year 3. Ongoing.	Local Government Staff, Iowa Stormwater Education Program
35	Create a hotline/website portal for reporting soil erosion, illicit discharge, and improper disposal of hazardous wastes	x	x				Public involvement committee (WMA Board)	Develop hotline/website portal by year 5.	Local Government Staff, Grant Funding
36	Increase watershed and stream crossing signage	x					Public involvement committee (WMA Board), Local Government Watershed Champions	Determine best locations and obtain funding by year 5.	Local Government Staff, Grant Funding
37	Train local officials and staff to implement and enforce soil erosion/sediment control procedures	x	x				Public involvement committee (WMA Board), SWCD's, Iowa Soybean Association	Determine training schedule by year 2. Begin regular training in year 3.	SWCD's, Local Government Staff
38	Create a recreational map of the watershed indicating all of the sites with existing recreational opportunities (e.g. canoe routes, public hunting areas) to be distributed to local tourism organizations	x					Public involvement committee (WMA Board)	Map prepared by year 3. Updated biennially or as needed.	IDNR, Local Government Staff, Tourism Organizations
39	Support the development of marketing materials highlighting recreational opportunities within the watershed	x					Public involvement committee (WMA Board)	As determined by the public education and outreach program (to be completed by year 3)	IDNR, Local Government Staff, Tourism Organizations, Grant Funding

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
40	Collect and distribute information materials on existing land conservation programs that protect and improve water quality	x	x				Public involvement committee (WMA Board)	Gather preliminary materials and identify best outreach locations by year 2. Ongoing	SWCD's, Local Government Staff
41	Engage and educate communities about the concept of a 'watershed' and the ultimate discharge point of pollutants	x	x				Public involvement committee (WMA Board)	Ongoing, incorporated into other action items	IDNR (Iowa-Cedar Basin Coordinator), Local Government Staff
42	Engage and educate communities about the potential impacts of stormwater pollutants in both local and downstream environments	x	x				Public involvement committee (WMA Board)	Ongoing, incorporated into other action items	IDNR (Iowa-Cedar Basin Coordinator), Local Government Staff
43	Engage and educate communities about the current ordinances and policies related to flooding and water-quality within the watershed	x	x	x			Public involvement committee (WMA Board), Local Government Watershed Champions	Gather preliminary materials and identify best outreach locations by year 2. Ongoing.	Iowa Stormwater Education Program, Local Government Staff
44	Engage and educate communities about the management of riparian lands and the importance of floodplains	x	x	x			Public involvement committee (WMA Board), SWCD's	Ongoing, incorporated into other action items.	SWCD's, Local Government Staff
45	Engage and educate communities about native vegetation and non-native (invasive) species	x					Public involvement committee (WMA Board), SWCD's	Ongoing, incorporated into other action items.	SWCD's, Local Government Staff
46	Engage and educate communities about soil erosion and sediment control	x	x				Public involvement committee (WMA Board), SWCD's, Iowa Soybean Association	Ongoing, incorporated into other action items.	SWCD's, Iowa Soybean Association, Local Government Staff
47	Engage and educate landowners on the application of fertilizers and pesticides in both urban environments and agricultural landscapes	x	x				Public involvement committee (WMA Board), SWCD's, Iowa Soybean Association	Ongoing, incorporated into other action items.	SWCD's, Iowa Soybean Association, Local Government Staff
48	Engage and educate communities about watershed stewardship, citizen responsibility, and the impacts of individual practices on flooding and water quality concerns	x	x	x	x		Public involvement committee (WMA Board), Local Government Watershed Champions	Ongoing, incorporated into other action items.	IDNR (Iowa-Cedar Basin Coordinator), Local Government Staff
49	Engage and educate landowners on different existing programs that encourage (and potentially offset associated costs) modifying land use practices or installing structural BMPs to reduce flooding/ improve water quality	x	x	x			Public involvement committee (WMA Board), SWCD's, Iowa Soybean Association	Ongoing, incorporated into other action items.	SWCD's, Iowa Soybean Association, Local Government Staff

		Goals Addressed							
Action #	**Management Action**	**1.**	**2.**	**3.**	**4.**	**5.**	**Responsible Parties**	**Timeline/Milestones**	**Technical Resources/ Funding Options**
50	Engage and educate communities on how & where to properly dispose of household hazardous waste, electronic waste, pharmaceuticals, and others	x	x				Public involvement committee (WMA Board), Local Government Watershed Champions	Ongoing, incorporated into other action items.	IDNR (Household Hazardous Materials)
51	Develop and support youth programs within local school districts focusing on surface water, ground water, and flooding within the watershed	x					Public involvement committee (WMA Board)	As determined by the public education and outreach program (to be completed by year 3).	Local Schools (K-12), IDNR (Iowa-Cedar Basin Coordinator)
52	Offer public presentations about WMA efforts and water resources workshops	x	x	x	x		Public involvement committee (WMA Board), SWCD's, Iowa Soybean Association, Local Government Watershed Champions	Ongoing, incorporated into other action items. 2+ per year.	SWCD's, Iowa Soybean Association, IDNR (Iowa-Cedar Basin Coordinator), Local Government Staff
53	Offer tours and field demonstrations that (1) highlight agricultural practices that reduce erosion, improve water quality and reduce flooding and (2) encourage stewardship and understanding water quality and flooding issues	x	x	x	x		Public involvement committee (WMA Board), SWCD's, Iowa Soybean Association, Local Government Watershed Champions	As determined by the public education and outreach program (to be completed by year 3).	SWCD's, Iowa Soybean Association, Local Government Staff
54	Develop a one-day watershed clean up event, where citizens pick up debris along waterways	x	x				Public involvement committee (WMA Board), Local Government Watershed Champions	First clean-up event by year 4.	Local Government Staff, Volunteers
55	Encourage the development of volunteer opportunities for sampling and outreach related to the watershed	x				x	Public involvement committee (WMA Board), Local Government Watershed Champions	As determined by the public education and outreach program (to be completed by year 3).	Local Government Staff, Volunteers
	Studies and Inventories								
56	Establish an advisory committee to coordinate any studies/ projects within the watershed in order to collect long-term datasets and communicate findings with the larger WMA board and the public	x				x	WMA Board	Establish committee by year 1.	WMA Board
57	Prepare a watershed-wide GIS dataset of drainage systems, including ditches, culverts, and bridge locations	x	x	x			WMA Board, County and Local Governments	Dataset started in year 2, completed by year 5.	Grant Funding

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
58	Develop a monitoring strategy to create an inventory of vegetation conditions and eroded areas within the watershed drainage system	x	x				WMA Board, County and Local Governments	Prepare monitoring strategy by year 2. Being monitoring in year 3.	IDNR, SWCD's, Local Government Staff
59	Develop a prioritized list of locations within the drainage system that require action to address water quality/quantity issues	x	x				WMA Board, County and Local Governments	Dependent upon completion of mapping drainage system and preparation of monitoring schedule. Upon completion, develop list within 2 years.	SWCD's, Iowa Soybean Association, Academic Institutions, Grant Funding
60	Develop an inventory of locations with erosion problems prioritized for BMP implementation	x	x				WMA Board, County and Local Governments	Dependent upon completion of mapping drainage system and preparation of monitoring schedule. Upon completetion, develop list of locations within two priority HUC 12 subwatersheds within 2 years.	SWCD's, Iowa Soybean Association, Academic Institutions, Grant Funding
61	Created an updated inventory of municipal, commercial and industrial point source discharges to surface waters	x	x				WMA Board, County and Local Governments	Dataset started in year 2, completed by year 4.	Local Government Staff, IDNR
62	Monitor new BMP installations (both structural and non-structural) to determine in situ effectiveness in order to help guide future BMP planning	x	x	x		x	WMA Board, County and Local Governments, Other organizations	Ongoing, on a per-project basis. Incorporate monitoring plan into BMP design and management schedule.	Academic Institutions, Engineering, Grant Funding
63	Coordinate with academic and government organizations to pilot BMP installations to determine ease of installation and effectiveness	x	x	x		x	WMA Board	Ongoing.	Academic Institutions, Engineering
64	Develop a water **quality** and **quantity** sampling routine to determine current conditions, seasonal trends, and effectiveness of new BMP installations focusing on water quality; adjust sampling routine to gather additional data during flood events		x	x		x	WMA Board and other agencies and organizations	Prepare monitoring strategy by year 2. Begin monitoring in year 3, dependent on funding.	IDNR, Academic Institutions, Grant Funding
65	Document flooding within the watershed, specifically including aerial images and surveying debris to determine the high water mark, during major flood events			x		x	WMA Board, County and Local Governments, Other organizations	During major flood events. Identify point-person for each community who will coordinate documentation of future damage within 2 years.	Local Government Staff, Volunteers
66	Collect rainfall data from other agencies within and near the watershed					x	WMA Board and other agencies and organizations	Ongoing, using publically available data (e.g. NOAA).	NOAA
67	Develop a ground water quality sampling routine in sensitive areas to determine current conditions and long term trends				x	x	WMA Board and other agencies and organizations	Prepare monitoring strategy by year 4. Begin monitoring in year 5, dependent on funding.	IDNR, Academic Institutions, Grant Funding
68	Develop and maintain a database of groundwater use within the watershed				x	x	Studies and Inventory Committee (WMA Board)	Prepared database structure by year 2. Ongoing maintenance, whenever new data is received.	Grant Funding

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
69	Gather and organize water quality and quantity sampling data in an active and easy to use database		x	x	x	x	Studies and Inventory Committee (WMA Board)	Prepared database structure by year 2. Ongoing maintenance, whenever new data is received.	STORET, Grant Funding
70	Present water quality and quantity sampling data in a web-based system that provides open access to the public	x	x	x	x	x	Studies and Inventory Committee (WMA Board)	Database prepared by year 8 (contingent on completion of WMA website).	STORET, Grant Funding
71	Coordinate an economic study that determines the economic benefits of clean water and riparian areas to the local economy within the Upper Cedar	x				x	Studies and Inventory Committee (WMA Board), and other organizations/agencies	Study completion by year 10.	Academic Institutions, Grant Funding
72	Coordinate with the Iowa Flood Center to obtain revised detailed floodplain maps within the Upper Cedar Watershed			x		x	Iowa Flood Center and Studies and Inventory Committee (WMA Board)	Studies completed by year 2+.	Iowa Flood Center
73	Set flow rate goals for the subwatersheds within the Upper Cedar based on hydrologic and hydraulic models, specifically those produced by the Iowa Flood Center			x		x	Studies and Inventory Committee (WMA Board), and the Iowa Flood Center	Contingent upon model completion by the Iowa Flood Center. Set rate goals within 2 years of model completion.	Iowa Flood Center, Engineering, Grant Funding
74	Designate priority subwatersheds for flood control measures, focusing new projects in regions with the largest return on investment			x		x	Studies and Inventory Committee (WMA Board)	Priority subwatersheds targeted by year 2.	SWCD's, WMA Board, Iowa Soybean Association, Engineering, Grant Funding
75	Review the upstream and downstream impacts of any proposed flood control measure, so as to mitigate problems in advance of implementation			x		x	WMA Board and other agencies and organizations	Ongoing, on a per-project basis. Incorporate upstream/downstream review as part of the design process.	Local Government Staff, Engineering
76	Assist in the preparation or revision of any TMDL studies of impaired waters		x			x	WMA Board	As needed.	IDNR
77	Develop a prioritized list of potential wetland restoration sites		x	x		x	Studies and Inventory Committee (WMA Board), Iowa Dept. of Agriculture, SWCD's, and IDNR	Priority subwatersheds targeted by year 4.	Local Government Staff, SWCD's, IDNR, Grant Funding
78	Assist in any inventories of fish and wildlife within the watershed, including identifying critical habitats					x	Studies and Inventory Committee (WMA Board)	As needed.	IDNR
79	Locate existing and abandoned potential point sources for groundwater contamination (e.g. fuel storage sites)				x	x	WMA Board, County and Local Governments, Other organizations	Begin to identify sources by year 3. Ongoing.	Local Government Staff, Grant Funding

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
	Structural Best Management Practices								
80	Support the removal of structures (e.g. homes, businesses, etc) from the floodplain			x			WMA Board, County and Local Governments	Begin to identify structures within the floodplain by year 3. Complete review of structure by year 8. Support removal of structures as funding allows.	FEMA, Local Government Staff
81	Support the implementation of flood proofing on those structures (e.g. homes, businesses, etc) that cannot be removed from the floodplain			x			WMA Board, County and Local Governments	Begin to identify structures within the floodplain by year 3. Support the flood proofing of structures as funding allows.	FEMA, Local Government Staff
82	Locate and eliminate active agricultural drainage wells within the watershed				x		Studies and Inventory Committee (WMA Board), County and Local Governments	Locate active wells by year 3. Eliminate wells as funding allows.	IDNR, Local Government Staff, Grant Funding
83	Develop guidelines for designing sediment ponds, basins, and other erosion and sediment control structural BMPs		x	x			Technical Committee (WMA Board)	Begin developing guidelines by year 2. Completion by year 6.	Local Government Staff
84	Construct new stormwater facilities and retrofit existing facilities to detain first flush and remove sediment, specifically targeting facilities in prioritized subwatersheds		x	x			County and Local Governments	Ongoing and as funding allows.	Local Government Staff, Grant Funding
85	Construct structural BMP demonstration projects	x	x	x			WMA Board, County and Local Governments, Other organizations	Ongoing and as funding allows.	Academic Institutions, SWCD's, Grant Funding
86	Stabilize roads and bridges		x	x			County and Local Governments	Identify priority roads/bridges for improvement within priority subwatershed by year 5. Repairs will be ongoing and as funding allows.	Grant Funding
87	Coordinate with the Iowa Department of Agriculture to install additional CREP wetlands in agricultural areas		x	x			WMA Board and Dept. of Agriculture	Ongoing and as funding allows.	Grant Funding
	Vegetative Best Management Practices								
88	Promote the installation of buffers adjacent to surface waters to reduce soil erosion, improve water quality, and reduce flooding		x	x			WMA Board, SWCD's	Ongoing and as funding allows.	SWCD's, Local Government Staff
89	Develop informative materials related to the selection and appropriate vegetative planting materials and maintenance of vegetation in riparian areas		x	x			Technical Committee (WMA Board), SWCD's	Begin developing materials by year 3. Completion by year 5.	SWCD's, Local Government Staff
90	Develop a list of suppliers who have the necessary equipment and expertise to install and maintain vegetation in riparian areas		x	x			Technical Committee (WMA Board), SWCD's	Begin developing list by year 3. Completion by year 5.	SWCD's, Local Government Staff
91	Encourage the use of filter strips between manure application areas and waterways		x	x			WMA Board, SWCD's	Ongoing and as funding allows.	SWCD's, Local Government Staff
92	Develop guidelines for designing contour farming, buffer strips, conservation tillage, grassed swales and other erosion and sediment control vegetative/land use BMPs		x	x			Technical Committee (WMA Board), SWCD's	Begin developing materials by year 3. Completion by year 5.	SWCD's, Grant Funding

		Goals Addressed							
Action #	Management Action	1.	2.	3.	4.	5.	Responsible Parties	Timeline/Milestones	Technical Resources/ Funding Options
93	Restore wetlands and natural areas		x	x			Technical Committee (WMA Board), SWCD's, Dept. of Agriculture, County and Local Governments	Ongoing and as funding allows.	Grant funding
94	Protect and restore grassed swales		x	x			Technical Committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	Grant funding
95	Plant buffer strips along sensitive waterways		x	x			Technical Committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	Grant funding
96	Protect, stabilize and restore banks of prioritized waterways to reduce erosion		x	x			Technical Committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	Grant funding
	Land Use Best Management Practices								
97	Encourage practices that prevent livestock from entering waterways, potentially including a fencing program that keeps livestock out of riparian areas		x				Public involvement committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	SWCD's, Local Government Staff
98	Coordinate with feedlot owners control runoff from feedlots in order to reduce nutrients and pathogens from reaching waterways		x				Public involvement committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	SWCD's, Local Government Staff
99	Promote adoption of conservation tillage and contour farming to reduce soil erosion and runoff		x				Public involvement committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	SWCD's, Local Government Staff
100	Promote adoption of cover crops to improve soil quality and reduce sediment erosion		x				Public involvement committee (WMA Board), SWCD's, County and Local Governments	Ongoing and as funding allows.	SWCD's, Local Government Staff

Table 3-5-2: Upper Cedar River Watershed Phased Action Plan, grouped by a lead responsible party

Phase	Timeline	Description/Responsible Party	Initial Action Item #(s)	Additional Action Items #(s)
A	Year 1	WMA: Establish Advisory Committees and Community Champions	21 , 24, 25, 28, 56	
B	Years 1-4	Begin Management Implementation, grouped by Lead Responsible Parties		
		Legislative Advisory Committee	22, 23	
		Funding Advisory Committee	25 a-e	
		Education & Outreach Advisory Committee	29	30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 97, 98, 99, 100
		Studies and Inventories Advisory Committee	64, 66, 68, 69, 72, 73, 74, 77, 78, 82	70, 71
		Technical Advisory Committee	83, 89, 90, 92	56, 60, 62, 93, 94, 95, 96
		Local Governments and Community Champions	1, 2, 3, 4, 5	6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 57, 58, 61, 65, 79, 80, 81, 84, 86
		WMA Board	17, 18, 19 a-c, 20	26, 63, 75, 76, 85, 87, 88, 91
C	Year 5	WMA: Review implementation progress and incorporate updates from Advisory Committees, Local Governments/Community Champions, and WMA Board	27	

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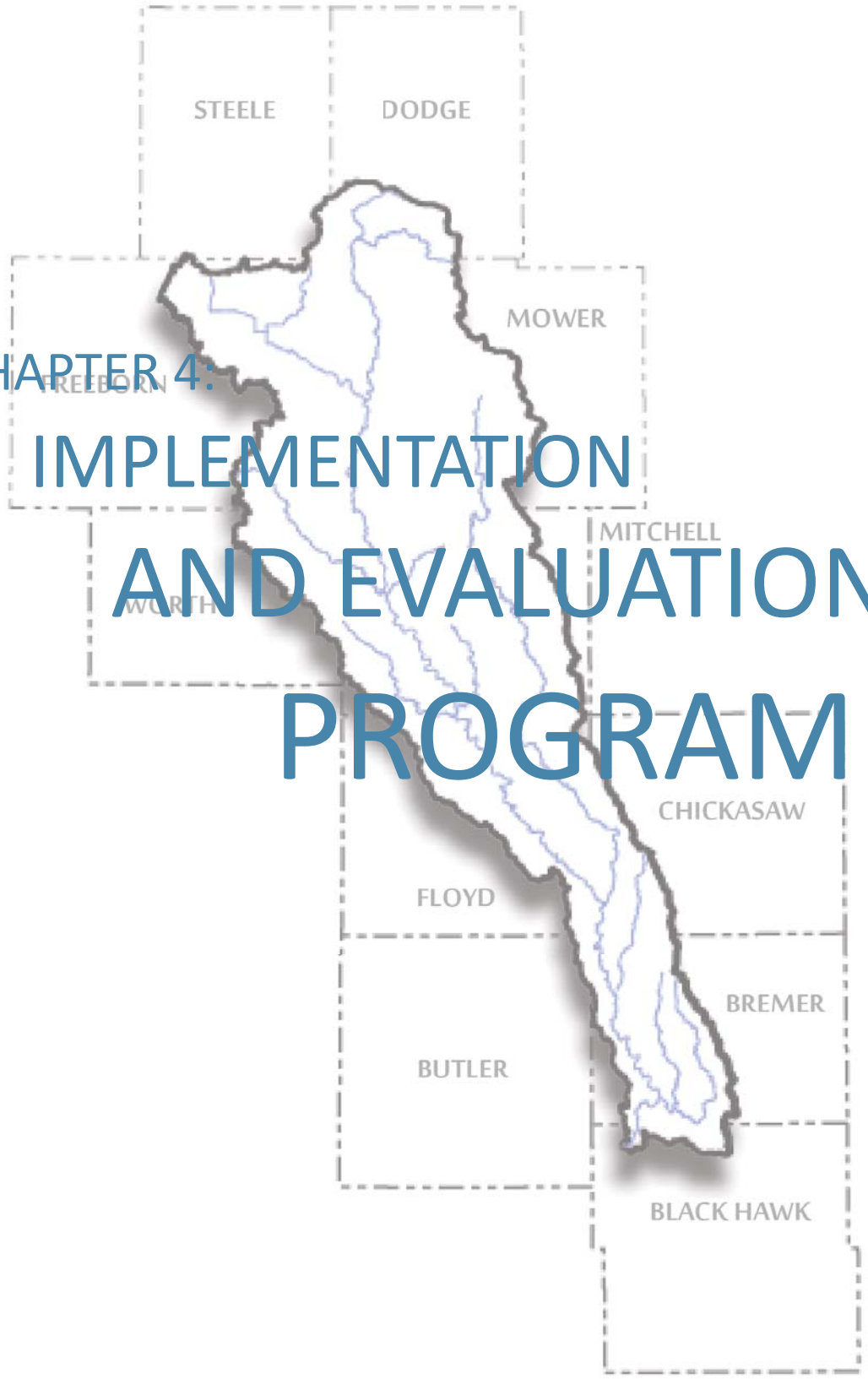


CHAPTER 4: IMPLEMENTATION AND EVALUATION PROGRAM

watershed, estimated the necessary reductions in pollutant loading and flooding to meet the watershed goals & objectives, and identified different best management practices that will help reach those goals.

This chapter outlines how to begin implementation of the Upper Cedar Watershed Management Plan, identify potential funding opportunities, encourage community involvement, and develop an evaluation program to gauge the effectiveness of individual actions. The watershed is dynamic, changing over time, just as the goals and actions of the UCWMIA will also continue to evolve. Therefore, through regular assessment and evaluation, the action items and implementation program within the plan should be adjusted to account for the changing conditions and better understanding of different best management practices.

4-1 Watershed Plan Implementation

4-1.1 Advisory Committees

The communities within the Upper Cedar will be responsible for implementing action items and reporting progress towards the outlined goals and objectives. The UCWMIA is comprised of twenty-five (25) different entities, including fourteen (14) counties and eleven (11) cities. Because it is such a large organization, solid communication between the individual communities and the UCWMIA board is critical. The UCWMIA board currently meets quarterly, and this regular meeting provides an initial opportunity for the following items:

a) Coordinating regional projects between communities and other organizations
b) Discussing new best management practices and projects
c) Researching and utilizing funding opportunities
d) Reporting progress towards UCWMIA goals and objectives
e) Soliciting public feedback
f) Educating local officials and the public
g) Reviewing and recommending changes to the WMP

However, to assist in the implementation of the action items it is recommended that a series of subcommittees take ownership of the watershed management plan. Figure 4-1-1 is an advisory committee structure that could be employed within the Upper Cedar. Subcommittees would develop an intimate understanding of select components of the plan; committee members could be comprised of:

- UCWMIA board members
- Local government officials
- Volunteers from the public
- Environmental organizations
- Scientists
- Planners

Ideally, individuals would volunteer to partake in a subcommittee based on their background/expertise/skill and their specific interest in the topic. These subcommittees would oversee the implementation and evaluation of

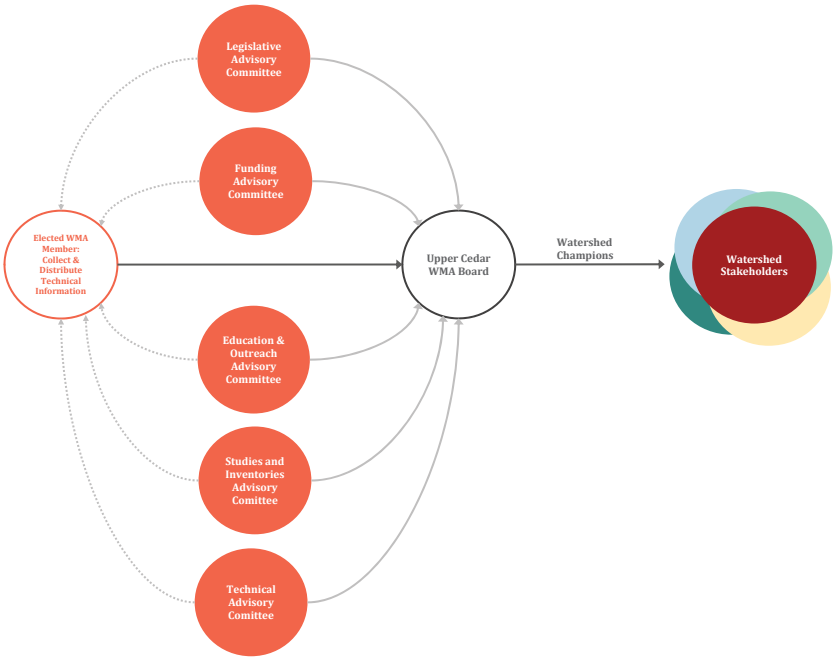
the WMP, and also report/solicit feedback to/from stakeholders within the watershed. A series of five (5) major subcommittees would be formed: **Legislative, Funding, Education & Outreach, Studies & Inventories, and Technical Advisory Committees.**

An optional elected UCWMIA member could act as "hub" for any technical documents generated through the watershed management activities; this would effectively create a library of all technical documents pertinent to the Upper Cedar. In the future, this role could be incorporated into the Education & Outreach advisory committee. However, it is anticipated that technical documents will be generated within the first year of this plan's adoption, perhaps prior to the formation of subcommittees. This temporary position would be responsible for maintaining the 'library' until such a time where a subcommittee is prepared to accept this additional role.

Subcommittees would meet independently of the UCWMIA board to address specific action items, plan for future projects, address questions and concerns, and evaluate the effectiveness of completed programs/projects. Each committee would provide a summary of their work to the UCWMIA Board and elicit feedback. It is imperative that subcommittees be comprised of a wide variety of stakeholders, including members of the public outside of the UCWMIA Board. They will be relied on to gather feedback from the community and build a support network to initiate best management practices within the Upper Cedar.

UCWMIA Board members are responsible for communicating with the watershed stakeholders, most likely through each local community's "watershed champion". These champions are aware of all of the different organizations/ leaders within their community (both public and private), and would be encouraged to propagate information related to the Upper Cedar. Watershed champions could be UCWMIA board members, or other interested parties.

Figure 4-1-1 Proposed advisory committee structure for the Upper Cedar UCWMIA



4-1.2 Funding Sources

Locating potential funding sources is critical to implementing the recommended action plan. The Upper Cedar UCWMIA does not have a taxing authority, and therefore any funds need to be sought from outside sources. This management plan was developed by leveraging grant funding, and future projects and programs will likely need to follow a similar pattern. In addition to grants, individual communities may elect to allocate municipal funds for flooding/water quality projects within their jurisdiction. The UCWMIA may help guide leaders in these community-based projects, and this type of community-effort will be imperative in the success of the WMP.

There are a variety of different existing grant/ loan funding focused specifically on stormwater. Each opportunity is unique in that each targets a specific area of need, focuses on a select region of the landscape/population, and provides different award amounts. Table 4-1-1 lists some of the current stormwater funding opportunities within Iowa. This is not an exhaustive list, and more opportunities will arise in the future. Both the Legislative Advisory Committee and the Funding Committee should regularly research different funding options, paying close addition to the allocation of state and federal funding.

Most funding options are targeted towards communities and land owners – not Watershed Management Authorities. Therefore, the communities and landowners need to take the lead on applying and administering any received funding. However, the UCWMIA can offer assistance and guidance with the planning, application process, reviewing program/project scope, and assist with issues as they arise. The Funding Advisory Committee might identify new funding options, approach communities with ideas, develop possible projects/programs, and provide assistance throughout the life of the project. Many communities might not be aware of potential funding options, and the UCWMIA can raise awareness, and help communities that have staff limitations and would appreciate guidance from the UCWMIA.

4-1.3 Community Involvement

The Upper Cedar Watershed covers a large geographic area, but the population within the Iowan portion of watershed is relatively dispersed, with only 32 people per square mile. Making strides towards watershed goals will require contributions from local governments, education and non-profit groups, as well as wide-spread support from individual landowners. Targeted education and outreach to the public can help develop a broad base of support for the watershed issues. The first step is raising awareness about the newly formed UCWMIA, highlighting the UCWMIA goals and how they can impact local individuals, and implementing action items to meet those goals.

To accomplish this, a UCWMIA Education and Outreach Advisory committee could be created and tasked with researching and developing an education & outreach program to promote conservation practice adoption. This committee should be representative of the watershed community, and can regularly report to the UCWMIA board new ideas, success and nonsuccess stories, and coordinate with the Funding committee to identify sources for education-related grants/loans.

The important first step the UCWMIA Education and Outreach Advisory committee should take is to establish clear goals and objectives for the group. The objectives should be prioritized to identify where certain activities rank in importance, and a timeline should be created as to when certain activities will occur. UCWMIA's message can also be strengthened by identifying uniform branding, such as a logo, so that it will become recognizable.

Table 4-1-1: Funding programs for watershed-related activities.

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
CDBG Community Facilities and Services Fund					
This annual competitive program offers grants to assist communities for a variety of projects including day care facilities, senior centers, vocational workshops and other community services such as stormwater projects. Projects must primarily benefit low- and moderate-income persons (per HUD's definition). Projects must incorporate and support Iowan's state sustainable principles.	Communities with populations less than 1,000 can receive up to $300,000, Communities with populations between 1,000 and 2,500 can receive up to $500,000, Communities with populations between 2,500 and 15,000 can receive up to $600,000. Communities with populations greater than 15,000 can receive up to $800,000.	Annually in January	Iowa Economic Development Authority	Water Quality, Flood Protection	Urban
Sponsored Projects					
Iowa law allows sewer utility revenues to finance a new category of projects, called "water resource restoration sponsored projects." This includes locally directed, watershed-based projects to address water quality problems. Wastewater utilities can also finance and pay for projects, within or outside the corporate limits, that cover best management practices for nonpoint source pollution control.	The dollar amount available for a sponsored project equals approximately $100,000 per $1 million wastewater loan, or about 10% of the wastewater loan amount.	Annually in March	Iowa State Revolving Loan Fund/Iowa Finance Authority	Water Quality	Urban and Rural
Iowa Water Quality Loan Fund					
Source of low-cost financing available to landowners. This opportunity is available specifically to assist and encourage landowners to address non-point source pollution of Iowa streams and lakes. Virtually all practices eligible for State Cost Share, REAP and EQIP are eligible for loans.	Loans from $5,000 up to a maximum of $500,000 per borrower. Term up to 15 years and can fund up to 100% of actual costs. Interest rates are no more than 3% and are fixed for the life of the loan.	Enrollment on a continuous basis	State Revolving Loan Fund, Local Soil and Water Conservation District (SWCD) Office, Iowa Department Agriculture and Land Stewardship (IDALS)	Water Quality	Rural
Livestock Water Quality Loan					
Low-interest loans to livestock producers for projects to prevent, minimize or eliminate non-point source pollution of Iowa's rivers and streams from animal feeding operations. Projects can include Development of manure management plans, lagoons, manure management structures, roofed manure storage structures, and vegetative filters. Available to existing facilities with animal feeding operations less than 1,000 total animal unit capacity.	$10,000 or greater with a maximum term of 15 years and interest rates not to exceed 3%	Enrollment on a continuous basis	State Revolving Fund (SRF) and local Soil and Water Conservation Districts (SWCDs)	Water Quality	Rural
General Non-Point Source Loan					
Low-interest loans for water quality projects including landfill closure, remediation of storage tanks, restoration of wildlife habitat, stream bank stabilization, and wetland flood prevention areas. Projects should be non-urban stormwater quality BMPs. Urban applicants should use the Stormwater Best Management Practices Loans.	$5,000 minimum loan amount to cover up to 100% of project costs, with terms up to 20 years	Enrollment on a continuous basis	State Revolving Fund (SRF)	Water Quality	Rural
On-Site Waste Water Assistance Program					
Low-interest loans to rural homeowners for the replacement of inadequate or failing septic systems. Applicants must own the home, must not be served by a public sewer system, include with the project both a septic tank and a secondary treatment system (e.g. leach field), and reside within a participating county.	$2,000 or greater with a maximum term of 10 years and 3% fixed interest rate to cover up to 100% of project costs	Enrollment on a continuous basis	State Revolving Fund (SRF)	Water Quality	Rural

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Local Water Protection					
Low-interest loans to landowners for projects to control the runoff of sediment, nutrients, pesticides or other nonpoint source pollutants from entering Iowa waters. Projects can include contour buffer strips, field borders or windbreaks, filter strips, grade stabilization structures, grassed waterways, and terraces.	$5,000 up to $500,000 with a maximum term of 10 years and interest rates not to exceed 3%. IFA will deposit funds equal to the principal amount of the loan at 0% interest.	Enrollment on a continuous basis	State Revolving Fund (SRF), local Soil and Water Conservation Districts (SWCDs), Iowa Department of Agriculture and Land Stewardship (IDALS), and Iowa Finance Authority (IFA)	Water Quality	Rural
Iowa Watershed Improvement Review Board (WIRB) Funding					
The authorizing legislation for WIRB is codified in Chapter 466A of the Iowa Code. The purpose of the program is to award grants to improve water quality and flood prevention. Eligible applicants are local watershed improvement committees, soil and water conservation districts, counties, county conservation boards, public water supply utilities and cities. The Iowa Legislature makes annual appropriations to the Watershed Improvement Fund. These funds are administered by the WIRB. Many types of water quality improvement and flood prevention projects may be eligible. Ranking criteria for projects are detailed in the specific Request For Applications from which funds are being requested.	The maximum amount requested per application is limited to 10% of the annual appropriation to the fund from the legislature. For example, if $5 million is appropriated to the Watershed Improvement Fund, the maximum allocation for an individual application that year is $500,000. Projects can be funded on a single application for multiple years. The allowable length of projects is specified in the RFA. If a multi-year project is funded, the WIRB will set aside funds for the entire project length to ensure the project can be completed as initially proposed eliminating the need to request funding in subsequent years.	Varies each year by appropriation	WIRB Board, Iowa Department Agriculture and Land Stewardship (IDALS)	Water Quality, Flood Protection	Urban and Rural
Conservation Reserve Enhancement Program (CREP)					
The Conservation Reserve Enhancement Program (CREP) is an offshoot for the Federal CRP program, specifically targeting performance-based water quality programs. The focus is on reducing nitrate loads to surface waters using strategically placed wetlands that intercept tile drainage. The Iowa CREP program is only available in certain areas (37 counties in north-central Iowa), and eligible practices include wetland restoration and erosion control structures (as needed with wetland establishment).	Federal Incentives: Annual rental payments of 150% of the weighted average soil rental rate, 50% cost-share for eligible cost s of establishing conservation practices, and Practice Incentive Payment (PIP) of 40% of the total eligible cost of practice installation. State Incentives: 30-year or permanent easement payment, 10% cost-share for restoration costs, and Survey, engineering, design, permitting, oversight, public bidding, and title services.	Enrollment on a continuous basis within eligible counties.	Farm Service Agency (FSA), Iowa Department of Agricultural and Land Stewardship (IDALS)	Water Quality	Rural
Urban Water Quality Demonstration Projects					
Projects should focus on conservation measures that capture and infiltrate stormwater and reduce a property's contribution to water quality degradation, stream flows and flooding and incorporate practices such bio retention cells, native landscaping, permeable pavement and soil quality restoration. Soil and Water Conservation Districts (SWCDs), counties, county conservation boards, cities or other units of government, not-for-profit non-governmental organizations (NGO's) authorized by the secretary of state, public water supply utilities or watershed management authorities are eligible to submit applications.	Varies each year	Varies each year by appropriation	Iowa Department Agriculture and Land Stewardship (IDALS)	Water Quality, Flood Protection	Urban

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Watershed Development and Planning Assistance Grants					
The WDPA program allows Districts and watershed partners to complete comprehensive watershed assessments, identify natural resource problem(s) and their potential sources, identify local partners, and determine landowner support for implementing identified projects. Sufficient information should be generated so that future requests can be made for various grant and cost-share programs including the Watershed Protection Fund (WSPF), Water Protection Fund (WPF), EPA Section 319 funding through the Iowa Department of Natural Resources (DNR), the Clean Water SRF Water Resource Restoration Program, the Water Quality Initiative (WQI) and the Watershed Improvement Fund administered by the Watershed Improvement Review Board (WIRB).	Varies each year	Varies each year by appropriation	Iowa Department Agriculture and Land Stewardship (IDALS)	Water Quality	Urban and Rural
Stormwater Best Management Practices Loans					
Low Interest Loans for Developers, Landowners, Watershed Organizations, Non-MS4 Cities and Others. The Stormwater BMP Loans are a new source of low-cost financing for long term / voluntary practices that manage storm water quality. This opportunity is available specifically to assist and encourage developers and cities to address non-point source pollution of Iowa streams and lakes through implementing stormwater quality BMPs that are included in the Iowa Stormwater Management Manual. These include: Infiltration practices, soil quality restoration, native landscaping, Detention basins, Pond / wetland system, Grassed waterways, Pervious concrete or asphalt, modular paving systems.	Loans from $5,000, Terms up to 20 years, Can fund up to 100% of BMP costs, Interest rate capped at 3% - fixed rate.	Quarterly	Local Soil and Water Conservation District (SWCD) Office, Iowa State Revolving Loan Fund, Iowa Department Agriculture and Land Stewardship (IDALS)	Water Quality	Urban
Financial Assistance for Conservation Practices					
A cost -share program for temporary and permanent conservation practices on privately owned land used for agricultural production. Funds cannot not be used to reimburse units of government for implementing soil and water conservation practices.	Funds are allocated through Soil and Water Conservation Districts	Enrollment on a continuous basis	Iowa Department Agriculture and Land Stewardship, Local Soil and Water Conservation District (SWCD)	Water Quality	Rural
Agricultural Drainage Well Closure Program					
Provides financial assistance to protect groundwater aquifers by closing ADWs and providing alternative drainage outlets to surface streams.	Cost-share program, maximum of 75%	Enrollment on a continuous basis	Iowa Department of Agriculture and Land Stewardship (IDALS)	Ground Water Quality	Rural
Iowa Buffer Initiative					
A direct initiative to stimulate and accelerate the adoption of USDA practices specifically buffers			Iowa Department of Agriculture and Land Stewardship (IDALS)	Water Quality	Rural

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Water Quality Protection Practices					
Resource Enhancement and Protection (REAP) program provides funding for practices that protect water quality focused on sediment, nutrient, and livestock waste pollution.	Fund allocated to soil and water conservation districts. 25% of all funds used to establish trees and native vegetation. Remaining 75% of all funds used for other water quality improvement practices including buffer establishment, erosion control, livestock waste management, agricultural drainage well closure and other stormwater practices.	Enrollment on a continuous basis. Soil and water conservation district set priorities and projects are subject to maintenance agreements.	Iowa Department of Agriculture and Land Stewardship (IDALS)	Water Quality	Rural
Water Quality Protection Projects					
Provides funding for water quality protection projects (led by the local soil and water conservation districts) commonly using a watershed approach. Funding of projects is provided through the Resource Enhancement and Protection (REAP) Program and the Watershed Protection fund and the Iowa Department of Natural Resources from US Environmental Protection Agency, Section 319 funds. Practices commonly utilized in projects include permanent soil and water conservation practices (terraces, basins, etc.), temporary management practices (no-till, nutrient management, etc.) as well as urban erosion and storm water management practices (silt fences, bio-swales, etc.)		Enrollment on a continuous basis. Soil and water conservation district set priorities and projects are subject to maintenance agreements.	Iowa Department of Agriculture and Land Stewardship (IDALS)	Water Quality	Rural
Watershed Protection Program					
Provides funding and support for watershed protection projects that reduce soil erosion, protect or improve water quality, provide flood control and protect natural resources. The program provides technical assistance, develoipment and planning assistance and funding for project implementation through grants.		Enrollment on a continuous basis	Iowa Department of Agriculture and Land Stewardship (IDALS)	Water Quality and Flood Protection	Urban and Rural
Section 319 Clean Water Act					
EPA funding to address non-point source pollution and maintain beneficial uses of waters. Grant funding is allocated to each state and funding decisions are made at the state level. To be eligible to receive Section 319 funds, NPS pollution control projects must be consistent with Iowa's State Nonpoint Source Management Program (NPSMP). Eligible activities can include controlling non-point source pollution, implementation of BMPs, public information and education programs, technical assistance programs, and waterbody restoration projects.	EPA allocates state funding annually. IDNR coordinates state funding decisions.		EPA, Iowa DNR		
Conservation Reserve Program (CRP)					
The Conservation Reserve Program (CRP) is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length	Rental rates are based on the relative productivity of the soils within the county and the average dry land cash rent.	General sign-up is a competitive application announced Secretary of Agriculture (no fixed schedule). Continuous sign-up is available through local FSA offices	Farm Service Agency (FSA), USDA-NRCS	Water Quality, Flood Protection	Rural

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Farmable Wetland Program (FWP)					
The Farmable Wetlands Program (FWP) is designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. The program is run through the Conservation Reserve Program (CRP)	Operated through the CRP program	Continuous sign-up is available through local FSA offices.	Farm Service Agency (FSA), USDA-NRCS	Water Quality, Flood Protection	Rural
Agricultural Conservation Easement Program (ACEP)					
The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. This program was established by the Agricultural Act of 2014 effectively combining the Farm and Ranch Lands Protection Program (FRPP), the Grassland Reserve Program (GRP), and the Wetlands Reserve Program (WRP).	Agricultural Land Easements: Up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, up to 75 percent of the fair market value of the agricultural land easement. Wetland Reserve Easements: Permanent (100 percent of the easement value for the purchase of the easement, and between 75 to 100 percent of the restoration costs), 30-Year Easement (50 to 75 percent of the easement value for the purchase of the easement, and between 50 to 75 percent of the restoration costs), Term Easement (50 to 75 percent of the easement value for the purchase of the term easement and between 50 to 75 percent of the restoration costs)	Enrollment on a continuous basis	USDA-NRCS	Water Quality, Flood Protection	Rural
Conservation Stewardship Program					
Provides financial and technical assistance to eligible producers to conserve and enhance soil, water, air, and related natural resources on their land. Eligible lands include cropland, grassland, prairie land, improved pastureland, rangeland, nonindustrial private forest lands, agricultural land under the jurisdiction of an Indian tribe, and other private agricultural land (including cropped woodland, marshes, and agricultural land used for the production of livestock) on which resource concerns related to agricultural production could be addressed.		Enrollment on a continuous basis	USDA-NRCS	Water Quality	Rural
Regional Conservation Partnership Program (RCPP)					
Promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. RCPP combines the authorities of four former conservation programs – the Agricultural Water Enhancement Program, the Chesapeake Bay Watershed Program, the Cooperative Conservation Partnership Initiative and the Great Lakes Basin Program. Partners will commit to activities to promote, implement, and evaluate the outcomes of conservation. Eligible partners include private institutions of higher education, city or township governments, public and state controlled institutions of higher education, state governments, county governments, nonprofits having a 501(c)(3) status with the IRS (other than institutions of higher education), special district governments, and federally recognized Native American tribal governments, and others.	$20,000,000 award ceiling for 2014 application period.	Annually	USDA-NRCS	Water Quality	Urban and Rural

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Emergency Watershed Protection Program (EWP)					
Offers assisantce for communities to address watershed impairements that pose imminent threats to lives and property. Land that has suffered damage from flood, fire, drought, wind or other natural event might qualify for the EWP program.	Up to 75% of construction costs. 90% for resource-limiited areas.	Enrollment on a continuous basis	USDA-NRCS	Flood Protection	
Environmental Quality Incentive Program (EQIP)					
The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. Within the Upper Cedar, this umbrella program includes funding for AWEP, CCPI, MRBI, Organic Imitative, Seasonal High Tunnel Initiative, and CIG.	10-year restoration agreements and 30-year or permanent easements for specific conservation actions. Payment limitations are set to $450,000	Enrollment on a continuous basis	USDA-NRCS	Water Quality	Rural
EQIP: Mississippi River Basin Healthy Watersheds Initiative (MRBI)					
The NRCS and partners helps producers in specific watersheds in the Mississippi River Basin to voluntarily implement conservation practices that avoid, control, and trap nutrient runoff; improve wildlife habitat; and maintain agricultural productivity. The Spring Creek Watershed and four HUC 12 watersheds (Beaver Creek, Colwell County Park-Little Cedar River, Gizzard Creek and the Little Cedar River) were selected to be part of the MRBI program.	Level of support varies based on the selected watershed and practice type. Contact local NRCS offices for award amounts and practice list.	Annually, sometimes more frequent	USDA-NRCS, Local Soil and Water Conservation District (SWCD) Office	Water Quality	Rural
EQIP: Organic Initiative					
Provides financial assistance to National Organic Program (NOP) certified producers, as well as producers in the process of transitioning to organic production.	$20,000 per year or $80,000 over six years for organic producers. Payments are limited to $300,00 a person or entity for all EQIP contracts within a 6 year period.	Annually, sometimes more frequent	USDA-NRCS	Water Quality	Rural
EQIP: Seasonal High Tunnel Initiative					
Provides financial and technical assistance to agricultural producers using seasonal polyethylene covered structures to cover crops, so as to extend the growing season for high value crops in an environmentally safe manner. The practice does not include greenhouses or low tunnel systems that may cover single crop rows.	Payments are limited to $300,00 a person or entity for all EQIP contracts within a 6 year period.	Annually, sometimes more frequent	USDA-NRCS	Water Quality	Rural
EQIP: Conservation Innovation Grants (CIG)					
The Conservation Innovation Grant program (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production.	Two-phase proposal process, with a nation and state-level competitive applications	Competitive application period announced annually	USDA-NRCS	Water Quality, Flood Protection	Rural

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Farmer Rancher Grant Program					
Competitive grant program for farmers and ranchers who want to explore sustainable solutions to problems through on-farm research, demonstration, and education projects. Farmer Rancher grants have funded a variety of topics including pest/disease management, crop and livestock production, education/outreach, networking, quality of life issues, marketing, soil quality, energy, and more.	Individual ($7,500 maximum), partner ($15,000 maximum), or group ($22,500 maximum) grants for ideas initiated by farmers and ranchers.	Annually in November	North Central Region Sustainable Agriculture Research & Education (NCR-SARE)	Water Quality, Education/ Outreach	Rural
Research and Education Grant Program					
Competitive grant program for researchers and educators involved in projects that explore and promote environmentally sound, profitable, and socially responsible food and/or fiber systems. Research and Education projects include a strong outreach component and significant farmer/rancher or other end user involvement from inception of the idea through implementation of the project.	Awards range from $10,000 to $200,000	Annually in October	North Central Region Sustainable Agriculture Research & Education (NCR-SARE)	Education/ Outreach	Urban and Rural
Professional Development Grant Program					
Supports state professional development programs and competitive grants for training agricultural professionals. Professional Development Program (PDP) competitive grants emphasize training agricultural educators in extension, Natural Resources Conservation Service, private, and not-for-profit sectors, using farmers as educators and addressing emerging issues in the farm community.	Awards range from $30,000 to $75,000	Annually in Mid-March	North Central Region Sustainable Agriculture Research & Education (NCR-SARE)	Education/ Outreach	Urban and Rural
Youth Educator Grant Program					
Supports opportunities for youth educators to research, demonstrate, and learn more about sustainable agriculture. Youth Educator Grants are competitive grants for educators to provide programming on sustainable agriculture for youth. Applicants are educators who often represent, but are not limited to, Extension, Natural Resources Conservation Service, and non-profit groups.	$2,000 maximum	Annually in November	North Central Region Sustainable Agriculture Research & Education (NCR-SARE)	Education/ Outreach	Urban and Rural
Partnership Grant Program					
Fosters cooperation between agriculture professionals and small groups of farmers and ranchers to catalyze on-farm research, demonstration, and education activities related to sustainable agriculture. Examples of appropriate projects include: developing a curriculum about food storage for farmers and processors, on-farm testing of cropping system strategies or grazing systems, cooperative efforts to develop new marketing approaches, or investigations into new approaches to processing and/or adding value to sustainably produced farm products.	$30,000 maximum	Annually in October	North Central Region Sustainable Agriculture Research & Education (NCR-SARE)	Water Quality, Education/ Outreach	Rural
Working Watersheds: Buffers and Beyond™					
A cost-share program to implement conservation practices and promote land stewardship that help to improve water quality, increase soil retention and promote habitat improvement. Trees Forever staff assists Working Watersheds program participants with project planning, planting and maintenance plans. Riparian buffer plantings are the main focus of the program, but other innovative projects are also considered.	50% cost-share up to $2,000	Enrollment on a continuous basis	Trees Forever	Water Quality	Urban and Rural

Funding Programs	Maximum Award	Application Due Date	Granting Agency	Project Type	Typical Project Location
Hazard Mitigation Grant Program (HMGP)					
Provides grants to states, local governments, and Native American tribes for long-term hazard mitigation projects after a major disaster declaration. The purpose of the program is to reduce the loss of life and property in future disasters by funding mitigation measures during the recovery phase of a natural disaster. States receive HMGP funding when a Presidential Disaster Declaration has been made. Funded projects might include: Acquisition, structural relocation or elevation of buildings located in a special flood hazard area; Structural and non-structural retrofitting of existing public buildings, facilities, or utilities to protect against wind, ice, or flood hazards; Minor structural hazard control or protection projects such as storm water management (e.g., culverts, floodgates, retention basins); Localized flood control projects, such as floodwall systems, that are designed specifically to protect critical facilities and do not constitute a section of a larger flood control system; Development of multi-jurisdictional hazard mitigation plans and plan updates.	Cost-share grant program. FEMA's share of eligible costs is 75%, non-federal share of eligible costs is 25%.	Availability varies. Current applications due in summer 2015	Federal Emergency Management Agency (FEMA)	Flood Protection	Urban
Pre-Disaster Mitigation (PDM) Program					
Provides funds on an annual basis for hazard mitigation planning and the implementation of mitigation projects prior to a disaster. The goal of the PDM program is to reduce overall risk to the population and structures, while at the same time, also reducing reliance on federal funding from actual disaster declarations.	Cost-share grant program. FEMA's share of eligible costs is 75%, non-federal share of eligible costs is 25%. Can be 90% FEMA/10% non-federal depending on eligibility.	Annually. Subject to availability of appropriations funding.	Federal Emergency Management Agency (FEMA)	Flood Protection	Urban
Flood Mitigation Assistance (FMA) Program					
Assist States and communities in implementing measures that reduce or eliminate the long-term risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP). There are three types of FMA grants available to states and communities: Planning Grants to prepare flood mitigation plans; Project Grants to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures; and Management Cost Grants for the State to help administer the FMA program and activities.	Cost-share grant program. FEMA's share of eligible costs is 75%, non-federal share of eligible costs is 25%.	Annually. Subject to availability of appropriations funding.	Federal Emergency Management Agency (FEMA)	Flood Protection	Urban

Non-point source pollution affects the entire community. Different user groups need specifically tailored messages and respond better to certain educational techniques. As an outreach and education plan is created, the audience needs to be considered so that the message and materials can have maximum impact. According to a USDA-NRCS review of thirteen (13) agricultural watershed projects from a list of outreach activities "lessons learned," issues that are most meaningful for farmers are profit, flexibility, and convenience. There will likely be other audiences that will be targeted, for example the general public will require a slightly different message and will have different priorities than the farming community.

The delivery of the message is important and will also vary from audience to audience. For example, the delivery of the message to the farming community will be more effective coming from someone from within the agricultural community or a group that works with the agricultural community, such as the Iowa Natural Heritage Foundation land trust or another organization with agricultural ties. These people and organizations have experience with the farming community and will likely have a very good understanding of their audience. Additionally, the message will be much better received when the community is involved directly in the creation of the solutions and not simply told what to do. All stakeholders should be encouraged to participate throughout this process and help craft solutions that best meet each group's needs. A variety of educational techniques should be considered to get the solutions and messages out to each target group: newsletters, newspaper articles, on-site demonstrations, on-site inspections, brochures/flyers/signage, meetings, training, and technical assistance.

Many local organizations are already partnering with communities to discuss issues, priorities, and potential solutions for water quality and flooding concerns. For example, the Nature Conservancy coordinated an effort with Charles City in 2014 specifically addressing water quality concerns for both nitrogen and phosphorus. The discussion was based on the idea of developing a water quality trading program between the City's wastewater treatment plant and surrounding rural landowners. The effort brought together stakeholders from both urban and rural environments to hear questions/concerns, prepare a model to identify priority locations for implementing rural BMPs, and consider the economic cost of different treatment approaches. A wide variety of other projects have already been completed in the watershed and the Technical Memo prepared on June 17, 2014 offers a summary of each project scope, and can be used as a launching point for identifying key partners and developing new initiatives (Appendix B).

It would also be worthwhile to talk with other Watershed Management Authorities to find out what educational materials/strategies worked well, or didn't work well in their communities. Establishing these relationships can facilitate the sharing of materials and prevent doubled efforts when creating solutions and/or outreach materials.

As practices are implemented, it will be important to continue the discussion and follow-up to see how activities are progressing and figure out if there are things that should be changed or modified that didn't work well. At the beginning of the outreach planning process, metrics should be established to measure the success of different activities and will provide feedback after implementation.

One final and important "lesson learned" from the USDA-NRCS study is that education and behavior change should not be confused. Education alone is rarely sufficient to promote behavior change (conservation practice adoption), and regulation must be used in some cases. That being said, behavior change will be more likely if the community is given a compelling reason to change (such as cost savings or protecting resources for future generations) and is involved in the creation of the solutions.

http://www.soil.ncsu.edu/publications/NIFACEAP/Factsheet_4.pdf

4-1.4 Monitoring Strategy

Many of the Upper Cedar Watershed goals and objectives relate to measurable water quality improvements and flood reductions. To gage the effectiveness of the watershed plan, it is imperative to have regular monitoring in place to track both short and long term improvements. It is important to remember the scale of the watershed when designing monitoring programs, and to have realistic expectations of when certain goals will be achieved. For example, a new water quality BMP might be installed in the headwaters of the watershed, with measurable improvements in water quality immediately downstream. However, those improvements might not be apparent within individual grab samples taken at the outlet of the entire watershed, since the BMP improvement is masked by the sheer size of the rest of the watershed. However, many small BMP implementations will have an additive effect, and after enough have been installed, the cumulative effective will be measurable at the watershed outlet. Therefore, it is necessary to have both a long-term monitoring regime in place (to capture changes at the entire watershed scale), and short-term monitoring regimes to track improvements for each new BMP and at the outlet of prioritized subwatersheds.

The outlet of the Upper Cedar Watershed is near the city of Janesville, and the Iowa DNR and the USGS collect water quality and quantity data, respectively, at this location. The UCWMIA can use this existing data source to track long term trends for the entire watershed. However, the UCWMIA should stay abreast of changes to this monitoring location, and be prepared to augment the monitoring regime if either organization changes the frequency or type of sampling. More information on existing sampling can be found in Section 2-11.

As BMPs are implemented throughout the watershed, the new plans should incorporate a monitoring strategy to determine each BMP's relative impact on water quality and flood control. Many projects might not have a physical monitoring component, but instead will rely on modeling to determine their effectiveness. Within priority subwatersheds, where many BMPs will be installed, it is recommended that a short-term physical sampling effort be considered. A pre- and post- BMP implementation sampling regime will both support any modeling of individual BMP effectiveness, and provide confidence that the BMPs are having a measurable effect downstream.

4-1.5 Priority Subwatersheds

The physical size of the Upper Cedar Watershed lends itself to targeting priority subwatersheds for more focused watershed planning, implementation of programs, and evaluation. The Upper Cedar is comprised of forty-seven (47) HUC-12 subwatersheds, with thirty-two (32) completely or partially within Iowa. It is recommended that the UCWMIA selects several priority HUC-12 subwatersheds, by reviewing those that contribute the most of water quality impairment and flooding.

Each subwatershed was ranked by its relative contribution to both flooding and nutrient loading. The Iowa Flood Center's hydrologic assessment of the Upper Cedar Watershed (Section 2-15.2) assigned an average SCS Curve Number (CN) to each of the HUC-12 subwatersheds (Figure 2-15-2). Those with higher curve numbers have a higher runoff potential and offer the greatest opportunity for flood mitigation. MSA Professional Services modeled the Upper Cedar Watershed using SWAT (Section 2-14) to determine relative nutrient loading from each subwatershed (Figures 2-14-1 and 2-14-2). Finally, previous watershed programs within the Upper Cedar found that the topography of the region (slope) significantly affected what types of projects can be implemented (personal

communication, Iowa Soybean Association). Regions with relatively higher slopes allowed for more structural BMPs (e.g. flood storage ponds, CREP wetlands); regions with relatively lower slopes were confined to more land-use/ management BMPs (e.g. cover crops). Figure 2-4-3 shows the average slope within each HUC-12 subwatershed.

Table 4-1-2 shows the relative ranking for flooding and nutrient loading for each of the HUC-12 subwatersheds to help identify those regions which should be targeted for future watershed programs. Flood storage BMPs are typically structural practices, which require higher slopes for installation; therefore, the flood-ranking component is based on both slope and curve number. Subwatersheds with relatively higher slopes (2.5% or greater) were ranked according to curve number. Subwatersheds with relatively lower slopes (less than 2.5%) were ranked equally for flood reduction potential. The nitrogen and phosphorus priority ranking are based on the annual loading on a per acre basis from the SWAT model. Note that the SWAT modeling necessitated broad-brush assumptions, specifically regarding land use practices (e.g. fertilizer application rates and timing, tillage practices, etc) since fine-detail information was not available for the entire subwatersheds (Appendix B). The N- and P-loading presented in Table 4-1-2 should therefore only be used for comparative ranking of subwatersheds. Once a priority watershed is selected, it is recommended that the UCWMIA completes more detailed modeling that incorporates fine-scale management parameters before formalizing baseline values that will be used in evaluating progress towards the watershed goals (e.g. 45% reduction of nitrogen of loading). Figure 4-1-2 shows the relative ranking of the subwatersheds based on the combination of flood reduction and nutrient loading potential.

4-2 Evaluation and Interim Milestones

The UCWMIA will need to regularly evaluate its progress toward meeting the overall watershed goals. For example, how many management practices within the Action Plan have been implemented? Have there been measurable improvements in water quality and reduced flooding? Is the public more engaged with watershed issues, resulting in increased adoption of land use conservation practices? A series of interim milestones can help track progress towards the watershed goals, and also assist in reevaluating the Action Plan over time. This adaptive approach can help to focus efforts on the most fruitful action items, and create momentum by highlighting success stories. The evaluation program can be thought of in two categories: qualitative and quantitative evaluation.

Qualitative evaluation is based on observations, rather than a numerical value. This type of evaluation is imperative in gaging progress towards the broad long-term goal of “Encouraging watershed stewardship at all levels” as it hinges on human behavior and perceptions about the watershed. The evaluation can determine the effectiveness of public outreach programs, gage public response to watershed projects, and provide crucial feedback to improving programs and increasing public participation. Although these techniques do not directly measure the environmental impact of specific practices, it does provide insight into the public’s perception of watershed-related activities.

Table 4-1-2: Prioritized Subwatersheds based on average SCS Curve Number (flooding potential), nitrogen and phosphorus loading (lbs/acre) and average slope (%). Flooding rank is based on slope (>2.5% slopes allowing for structural flood retention BMPs and SCS curve number. Any subwatersheds with an average slope less than 2.5% were ranked equally for flooding rank of 17). Nitrogen and phosphorus ranking are based on N-load and P-load from Upepr Cedar Watershed SWAT modeling, respectively. Subwatersheds entirely within Minnesota were not included within the rankings.

HUC 12 ID	HUC 12 Name	State(s)	Average Slope (%)	BMP Suitability (based on slope)	Curve Number	N Load	P Load	Flooding Rank	N Load Rank	P Load Rank	Combined Rank	Prioritized Subwatersheds
70802011201	Dry Run	IA	3.2	Structural Practices	75	40.4	5.0	4	8	1	13	1
70802010802	Beaver Creek-Little Cedar River	IA	2.5	Structural Practices	76	38.3	4.0	2	11	4	17	2
70802011202	Horton Creek	IA	3.2	Structural Practices	75	35.5	4.6	8	13	2	23	3
70802010901	Beaver Creek	IA	3.4	Structural Practices	75	32.9	3.3	7	16	6	29	4
70802010803	Uphams Slough Creek-Little Cedar River	IA	2.4	Land Use/Management Practices	77	39.8	4.4	17	9	3	29	4
70802010605	Sugar Creek-Cedar River	IA	2.7	Structural Practices	77	34.7	2.2	1	14	16	31	6
70802011001	Skunk Creek-Cedar River	IA	2.8	Structural Practices	75	30.4	2.4	5	19	10	34	7
70802010602	Spring Creek	IA	1.7	Land Use/Management Practices	78	43.6	2.3	17	3	14	34	7
70802010702	Village of Meyer-Little Cedar River	IA,MN	1.7	Land Use/Management Practices	75	38.3	2.8	17	10	8	35	9
70802010603	Headwaters Rock Creek	IA	1.1	Land Use/Management Practices	80	46.1	2.1	17	2	17	36	10
70802010604	Rock Creek	IA	1.8	Land Use/Management Practices	78	43.2	2.3	17	5	15	37	11
70802010902	Colwell County Park-Little Cedar River	IA	3.2	Structural Practices	74	26.2	3.4	11	23	5	39	12
70802010703	City of Stacyville-Little Cedar River	IA,MN	1.8	Land Use/Management Practices	76	36.0	2.4	17	12	12	41	13
70802011004	Gizzard Creek	IA	3.0	Structural Practices	74	28.7	2.4	9	21	11	41	13
70802010403	Deer Creek (IA)	IA	1.2	Land Use/Management Practices	79	49.0	1.8	17	1	24	42	15
70802011002	Drainage Ditch 3	IA	1.7	Land Use/Management Practices	77	42.9	2.1	17	6	19	42	15
70802010801	Burr Oak Creek	IA	1.5	Land Use/Management Practices	79	43.4	1.9	17	4	22	43	17
70802011005	Bloody Run-Cedar River	IA	3.3	Structural Practices	73	23.0	2.5	13	24	9	46	18
70802010601	Turtle Creek (IA)	IA	1.5	Land Use/Management Practices	79	40.6	1.8	17	7	23	47	19
70802011203	Village of Plainfield-Cedar River	IA	3.4	Structural Practices	74	18.5	2.3	12	25	13	50	20
70802010903	Little Cedar River	IA	4.0	Structural Practices	70	16.5	2.8	16	28	7	51	21
70802010504	Otter Creek	IA,MN	1.2	Land Use/Management Practices	75	30.4	2.1	17	18	18	53	22
70802010505	Town of Otranto-Cedar River	IA,MN	1.7	Land Use/Management Practices	77	34.0	2.0	17	15	21	53	22

70802011101	Headwaters Quarter Section Run	IA	2.5	Structural Practices	76	17.7	1.4	3	26	27	56	24
70802011003	Stewart Creek-Cedar River	IA	2.3	Land Use/Management Practices	75	30.0	2.0	17	20	20	57	25
70802011102	Baskins Run	IA	3.3	Structural Practices	75	15.4	1.5	6	30	26	62	26
70802010402	Headwaters Deer Creek	IA,MN	1.0	Land Use/Management Practices	75	30.9	1.3	17	17	28	62	26
70802011103	Quarter Section Run	IA	3.9	Structural Practices	73	15.9	1.6	14	29	25	68	28
70802010401	Drainage Ditch 11	IA	0.8	Land Use/Management Practices	78	27.9	0.8	17	22	32	71	29
70802011205	Village of Janesville-Cedar River	IA	2.7	Structural Practices	74	9.7	1.1	10	31	31	72	30
70802010503	Woodbury Creek	IA,MN	1.5	Land Use/Management Practices	75	17.5	1.1	17	27	30	74	31
70802011204	Cedar Bend County Park-Cedar River	IA	4.2	Structural Practices	72	7.6	1.2	15	32	29	76	32
70802010701	City of Adams	MN	2.0		76	35.8	2.7					
70802010206	City of Austin-Cedar River	MN	1.2		76	49.1	1.2					
70802010101	Deer Creek (MN)	MN	1.7		74	18.0	0.9					
70802010205	Dobbins Creek	MN	1.6		76	30.2	2.5					
70802010102	Geneva Lake	MN	1.8		75	16.7	1.5					
70802010204	Green Valley Ditch-Cedar River	MN	1.0		76	13.9	1.5					
70802010201	Headwaters Cedar River	MN	1.1		76	39.0	2.1					
70802010103	Judicial Ditch No 24	MN	1.6		74	16.1	1.4					
70802010502	Judicial Ditch No 77-Cedar River	MN	1.4		76	25.6	2.2					
70802010202	Little Cedar River-Cedar River	MN	0.7		76	19.6	0.6					
70802010302	Lower Rose Creek	MN	1.4		77	26.9	2.7					
70802010501	Orchard Creek	MN	1.0		76	19.7	1.0					
70802010203	Roberts Creek	MN	1.7		77	34.0	2.8					
70802010104	Turtle Creek (MN)	MN	2.3		74	8.5	0.7					
70802010301	Upper Rose Creek	MN	1.9		76	36.0	2.8					

Quantitative evaluation is based on numerical measurements and can help track watershed objectives that have specific numerical targets (e.g. 45% reduction in riverine nitrogen). This type of evaluation necessitates having a monitoring system already in place, specifically designed to track advancement towards the watershed's goals/objectives. The Upper Cedar can make use of existing/ongoing water quality and quantity sampling by the Iowa DNR and USGS in order to track progress towards these milestones. However, some milestones might require first developing an additional monitoring regime in order to gage progress. Therefore, some interim milestones start by developing a monitoring component first, and then gathering enough data to establish a baseline. Any measurements in the future are then compared to the baseline levels, in order to gage impact of new Best Management Practices.

Table 4-2-1 lists the evaluation methods and milestones for each of the UCWMIA's objectives. The evaluation plan is intended to be a live document that is regularly referenced and revised to reflect he UCWMIA's accomplishments and revised goals and objectives. Some objectives are combined to be evaluated in tandem. Each objective includes the following:

- **Evaluation Method:** A broad description of the type of evaluation
- **What is Measured:** Specific items that will be measured within the evaluation
- **Implementation:** How the evaluation will be conducted
- **Target Milestone:** The final milestone for the objective
- **Interim Milestones:** A set of three milestones (Short, Medium and Long-Term) to be completed within <2 years, < 5 years and 5+ years

Table 4-2-1: Evaluation Methods and Interim Milestones

Broad Long-Term Goal	Objective(s)	Evaluation Method	What is Measured	Implementation	Target Milestone	Interim Milestones		
						Short Term (<2 years)	Medium Term (<5 years)	Long Term (5+ years)
Encourage watershed stewardship at all levels	Develop and share education programs on water and land practices that impact surface water quality, ground water quality and drinking water supplies, and flooding	Public Surveys	Awareness, knowledge, behaviors, attitudes, concerns	Mail or telephone surveys to watershed stakeholders. Completed on a regular basis in order to identify trends.	Watershed wide awareness of issues/ concerns related to water quality and flooding	Growing awareness of watershed issues and UCWMIA activities	Growing adoption of land use changes and management practices that support watershed goals	Broad acceptance of land use changes & management practices and participation in watershed projects
	Prepare a public relations program that raises the public profile of the UCWMIA and its ongoing efforts							
	Develop model ordinances/policy statements related to water quality and flooding that can be readily adopted by local agencies	Participation Tracking	Number of communities adopting ordinances	Mail survey to local governments. Completed on a regular basis to track adoption rates.	100% adoption of ordinances/policy statements	Prepare and distribute model ordinances/policy statements	50% of communities adopt ordinances/policy statements	75% of communities adopt ordinances/policy statements
	Create an UCWMIA website to promote educational opportunities and track progress towards UCWMIA goals	Website monitoring	Website hits and updates to content	Track number of website hits and frequency of content updates. Completed annually to identify trends.	Website updated biannually; continuous growth in website hits	Develop website	1,000 website hits annually; website updated annually	2,000 website hits annually; website updated biannually
	Promote intergovernmental coordination in land use planning, natural resource protection, point and non-point source pollution control and stormwater management	Written Evaluations	Awareness, knowledge	Mail or telephone surveys to each local government agency and relevant departments in order to identify trends	Regular intergovernmental coordination on watershed programs	Select local government 'champion' to promote watershed-related programs	2+ new watershed projects/ programs that are supported by multiple government agencies	3+ new watershed projects/ programs that are supported by multiple government agencies
	Develop and maintain a legislative program that promotes watershed efforts and concerns to state legislators	Written Evaluations	Awareness, knowledge	Survey UCWMIA advisory committees on their efforts/ progress. Completed biennially.	Address state legislature biennially regarding watershed-related issues.	Establish legislative and funding advisory committees	Presented watershed goals/ objectives to state legislature at least once. Assist in the preparation of at least two grants for watershed projects.	Presented watershed goals/ objectives to state legislature at least twice more. Assist in the preparation of an additional two grants for watershed projects.
	Develop a long term strategy for funding Best Management Practices (BMPs) that address water quality and flooding issues and for long-term monitoring efforts							

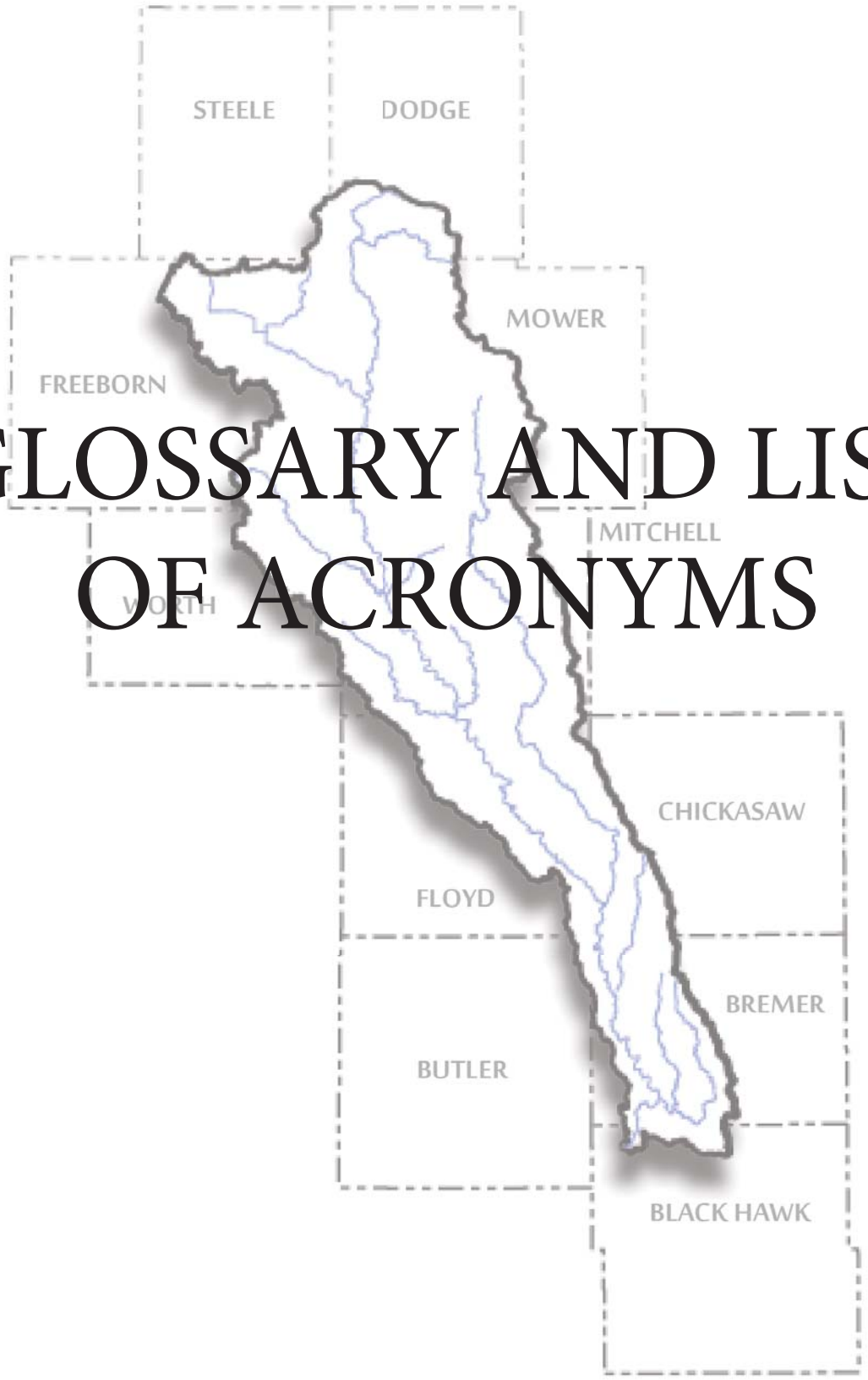
						Interim Milestones		
Broad Long-Term Goal	**Objective(s)**	**Evaluation Method**	**What is Measured**	**Implementation**	**Target Milestone**	**Short Term (<2 years)**	**Medium Term (<5 years)**	**Long Term (5+ years)**
Protect and improve surface water quality	Develop and maintain water quality programs in Nitrate Indicator Bacteria *E. Coli*	Water Quality Sampling	Total Nitrogen Geometric mean and Sample Maximum (organisms per 100 milliliters of water)	Develop water quality monitoring regime at the outlet of the Upper Cedar Watershed	35% reduction in nitrate load Reduce E.Coli concentrations to meet WQS for Class A1 waters (geometric mean: 126 org/100 ml; sample max: 235 org/100 ml) during the recreational season	Design a database system to store a copy of the IDNR monthly samling concentrations (nitrate and E. Coli) and along the Cedar River. Select 2+ priorty subwatersheds.	Isolate funding/ resources to implement monitoring/ modeling of priority subwatersheds	Establish baseline for nitrate in priority subwatersheds. Reduce nitrate by 5% in priority subwatersheds. Reduce E. Coli to geometric mean to 160 and sample maxium to 600
	Develop and maintain water quality programs in order to reduce total riverine nitrogen and phosphate loads by 45% as was stated in the Iowa Nutrient Reduction Strategy.	Water Quality Sampling	Total Nitrogen and Total Phosphorus	Develop water quality monitoring regime at the outlet of the Upper Cedar Watershed	45% reduction in baseline N and P	Select 2+ prioritized subwatersheds. Apply for funding to develop a subwatershed management plans that incorporates a monitoring/ modeling regime to establish baseline loads.	Isolate funding/ resources to implement monitoring/ modeling of priority subwatersheds	Establish baseline for total nitrogen and phosphorus for priority subwatersheds. Develop projects/ programs that reduce nitrogen and phosphorus by 5%.
	Review past Best Management Practices (BMPs) that were designed to improve surface water quality, and rank them according to effectiveness in reducing pollutant loads, acceptance by local stakeholders, and siting condition requirements.	Focus Groups	Awareness, knowledge, perceptions, behaviors	Focus groups with project developers, UCWMIA board members and local stakeholders. Completed on in different locations within the watershed to account for spatial variability.	Ranked BMP list specific to Upper Cedar Watershed prioritized subbasins.	Prepare list of viable BMPs for the Upper Cedar, specific to prioritized subwatersheds	Conduct one focus group within a prioritized subwatersheds to develop BMP ranking.	Conduct one focus group within another prioritized subwatersheds to develop BMP ranking.

						Interim Milestones		
Broad Long-Term Goal	**Objective(s)**	**Evaluation Method**	**What is Measured**	**Implementation**	**Target Milestone**	**Short Term (<2 years)**	**Medium Term (<5 years)**	**Long Term (5+ years)**
Protect and improve surface water quality	Plan, develop and implement Best Management Practices (BMPs) that improve surface water quality focusing efforts on targeted subwatersheds within the Upper Cedar	Focus Groups/ Participation Tracking	Awareness, planning and knowledge. Number, type, and effectiveness of BMPs	Focus groups with SWCDs, project developers, UCWMIA board members and local stakeholders. Count and effectiveness of new BMPs	*See milestones for E. Coli, nitrate, nitrogen and phosphorus*	Select 2+ prioritized subwatersheds. Apply for funding to develop a subwatershed management plans.	Develop subwatershed management plans.	Implement 3 pilot BMP projects and measure effectiveness with pre- and post-water quality sampling
	Minimize discharge of untreated stormwater to surface waters	Participation Tracking	Creation of illicit discharge ordinances and monitoring programs	Survey of local governments	Communities complete illicit discharge monitoring every 5 years	Prepare and distribute model ordinances/policy statements. Develop illicit discharge monitoring programs.	75% of communities adopt ordinances/policy statements. Begin illicit discharge monitoring program.	100% of communities adopt ordinances/policy statements. Complete first illicit discharge monitoring, and prepare for next round of inspections.
	Encourage the development of nutrient management plans for agricultural activities in accordance with the NRCS 590 Standard	Participation Tracking	Number of stakeholders developing plans	Mail survey to local SWCDs to determine number of new plans developed.	100% of landowers adopt a nutrient management plan	15% of landowners create/update nutrient management plans	25% of landowners create/update nutrient management plans	50% of landowners create/update nutrient management plans
	Adopt county and local stormwater management requirements	Participation Tracking	Number of communities adopting ordinances	Mail survey to local governments. Completed on a regular basis to track adoption rates.	100% adoption of ordinances/policy statements	Prepare and distribute model ordinances/policy statements	50% of communities adopt ordinances/policy statements	75% of communities adopt ordinances/policy statements
	Encourage local ordinances that minimize stormwater runoff from highways, encourage the development of native landscapes and reduce the use of chemical applications							
	Ensure application of soil erosion and sediment controls during construction activates							
	Identify and repair highly eroded and susceptible stream channels and banks	Focus Groups/ Survey	Awareness, planning and knowledge. Number of erosion repair sites.	Focus groups/ surveys with SWCDs, UCWMIA board members and local stakeholders.	Identify and repair all highly eroded and susceptible stream channels and banks	Begin mapping drainage systems in prioritized subwatersheds	Identify erosion locations in prioritized subwatersheds	Implement 5 erosion repair BMPs in priority subwatersheds

						Interim Milestones		
Broad Long-Term Goal	**Objective(s)**	**Evaluation Method**	**What is Measured**	**Implementation**	**Target Milestone**	**Short Term (<2 years)**	**Medium Term (<5 years)**	**Long Term (5+ years)**
Reduce flood damage	Understand where flooding occurs and the current water storage and conveyance functions of the watershed	Focus Groups/ Survey	Awareness, planning and knowledge.	Focus groups/ surveys UCWMIA board members and local government leaders.	Map all known problem flood locations and existing flood-related BMPs	Identify point-person for each community who will coordinate documentation of flooding locations	Gather locations/ extent of flooding from all communities. Compile flood-damage maps covering the entire watershed	Update flood damage maps annually. Include new flood reduction BMP locations
	Map existing floodplains	Map Count/ Extent	Number of revised floodplain maps and watershed coverage	Request updated floodplain maps from the Iowa Flood Center (IFC)	Updated floodplains makes for the entire watershed	Communicate with the IFC	Receive and distribute maps to local government officials	*not applicable*
	Identify any existing development within the floodplain and relocate to prevent structural damage from a 100-year precipitation event	Survey	Number of communities reviewing floodplain maps and relocating existing development	Survey local governments	All existing development removed from the floodplain	Communicate with the IFC about updated floodplain maps	Identify existing development within the floodplain and apply for relocation funding	Begin relocation process for 1+ existing development sites
	Modify regulations to reduce flood damage: Prevent construction of new development within the floodplain	Participation Tracking	Number of communities adopting ordinances	Mail survey to local governments. Completed on a regular basis to track adoption rates.	100% adoption of ordinances/policy statements	Prepare and distribute model ordinances/policy statements	50% of communities adopt ordinances/policy statements	75% of communities adopt ordinances/policy statements
	Modify regulations to reduce flood damage: Prevent filling of the floodplain which causes adverse impact to flood storage or conveyance							
	Reduce the risk of flooding by decreasing flow and volume by 20% at Janesville (the outlet of the Upper Cedar Watershed) based on a 100-year, 24- hour design storm	Survey/Water Quantity Sampling	Number and effectiveness of new flood-related BMPs. Water flow and volume measurements at Janesville USGS gage.	Survey of SWCDs, project developers, UCWMIA board members and local stakeholders. Count and effectiveness of new BMPs. Review USGS gage data.	20% reduction in peak flow at Janesville (65,220 cfs to 52,175 cfs)	Select prioritize subwatersheds for flood-related BMPs. Begin annual review of USGS gage data at Janesville.	Develop subwatershed management plans. Develop priority locations for flood-related BMPs and apply for funding.	Install 3+ flood-related BMPs in priority subwatersheds. Model peak flow at the outlet of the priority subwatershed for a 100-year, 24- hour design storm.

						Interim Milestones		
Broad Long-Term Goal	**Objective(s)**	**Evaluation Method**	**What is Measured**	**Implementation**	**Target Milestone**	**Short Term (<2 years)**	**Medium Term (<5 years)**	**Long Term (5+ years)**
Protect and improve groundwater quality	Develop an implementation plan for removal of existing agricultural drainage wells	Focus Groups/ Well Closure Count	Awareness, planning and knowledge. Number of active wells closed.	Survey of UCWMIA board members and local stakeholders. Count of well closures.	All agricultural drainage wells closed	Begin mapping active wells and contacting landowners. Begin developing prioritization of wells.	All wells located and prioritization complete. Apply for well-closure funding.	Close 1 active agricultural drainage well.
	Develop source water protection plans	Survey	Number of communities reviewing implementing plans	Survey local governments	All municipal water supplies have a source water protection plan	Prioritize communities for new plans. Review existing plans to ensure implementation.	1 community prepares a source water protection plan	1 additional community prepares a source water protection plan
	Promote agricultural practices that protect and maintain groundwater supplies	Public Surveys	Awareness, knowledge, behaviors, attitudes, concerns	Mail or telephone surveys to watershed stakeholders. Completed on a regular basis in order to identify trends.	Watershed wide awareness of ground water quality and best management practices	Growing awareness of groundwater quality, specifically in regions within source water areas	Growing adoption of best management practices that promote groundwater quality and recharge	Broad acceptance of best management practices that promote groundwater quality and recharge
	Educate local stakeholder and government agencies on practices that enhance high quality groundwater recharge							

						Interim Milestones		
Broad Long-Term Goal	**Objective(s)**	**Evaluation Method**	**What is Measured**	**Implementation**	**Target Milestone**	**Short Term (<2 years)**	**Medium Term (<5 years)**	**Long Term (5+ years)**
Monitor and collect data for water quality and quantity	Develop an adaptive monitoring strategy that provides adequate data to determine a baseline for existing conditions and impairments	Tracking Strategy Development	Extent of completion	Communicate with UCWMIA Board about status of the monitoring strategy	Complete monitoring strategy for the entire watershed that addresses the WMP goals/objectives	Develop a methodology for regularly extracting Iowa DNR water quality data and USGS water quantity data collected within the Upper Cedar	Develop a comprehensive repository for all water quality/ quantity data collected within the Upper Cedar to be posted on the UCWMIA's website	Maintain data repository incorporating measurements taken in priority subwatersheds. Begin to analyze data for short/long term trends.
	Adjust the adaptive monitoring strategy to monitor short and long term changes in water quality and flooding to track progress towards the UCWMIA's goals and objectives							
	Develop a comprehensive data repository for all monitoring results to be used by the UCWMIA and accessed freely by members of the public							
	Design monitoring programs on smaller scales to determine individual BMP effectiveness	Counts of New Monitoring Programs	Number of new monitoring activities associated with new BMPs	Survey of SWCDs, project developers, UCWMIA board members and local stakeholders.	Tracking all new BMP developments to determine the relative impact on water quality and flood reduction	Select 2+ prioritized subwatersheds. Apply for funding to develop a subwatershed management plans incorporating a monitoring component.	Develop subwatershed management plans incorporating a monitoring component.	Implement 3 pilot BMP projects and measure effectiveness with pre- and post-water quality sampling
	Partner with other governmental agencies, academic researchers, non-profits, and others to review BMP effectiveness within the watershed in order to prioritize future projects							
	Report short and long term measureable progress towards goals and objectives	Counts of UCWMIA Reports and Public Outreach Activities	Number of watershed reports prepared/ distributed documenting improvements. Number of public outreach activities explaining improvements.	Survey of SWCDs, project developers, UCWMIA board members and local stakeholders.	Biennial report on UCWMIA progress towards watershed goals/objectives. Annual watershed outreach events explaining improvements.	Prepare outline for future UCWMIA progress reports. Determine needed monitoring information.	Prepare first UCWMIA report, highlighting the potential improvements from proposed BMPs in prioritized subwatersheds.	Prepare biennial reporting documented improvements in water quality and reduced flooding due to completed BMPs. Conduct 2+ outreach activities that demonstrated completed BMP effectiveness.
	Raise awareness for new individual developments (e.g. BMPs, changed polices, etc.) and the state of overall progress towards goals and objectives to the general public							



GLOSSARY AND LIST OF ACRONYMS

GLOSSARY

100-year flood: A flood that has a 1% chance of occurring in any given year
Source: Federal Emergency Management Agency (FEMA)

agricultural drainage wells: Outlets for surface runoff and tile drainage water from cropland areas. Historically they discharged water directly to groundwater aquifers, but now ADWs are being closed and alternative drainage outlets to surface streams are being constructed.
Source: Iowa Department of Agriculture and Land Stewardship

allluvium: A deposit of sand, clay, silt or mud formed by flowing water.
Source: US Geological Survey (USGS)

annual exceedance probability: The chance of a natural hazard event such as a rainfall or flooding, occurring annually and is usually expressed as a percentage.
Source: Environment Canterbury Regional Council

aquifer: An underground layer of sand, gravel or rock that stores water below the surface of the soil.
Source: Minnesota Pollution Control Agency

basin: A tract of land that is tilted toward a common point.
Source: Minnesota Pollution Control Agency

bedrock: The solid rock found on the surface of the land or just below the soil.
Source: Minnesota Pollution Control Agency

BMPs: Best management practices are control methods or treatment techniques found to be the most effective and practical means in preventing or minimizing pollution.
Source: US Environmental Protection Agency (EPA)

confinement operation: Where animals are kept in totally roofed areas.

digital elevation model: A digital model of a terrain's surface created from terrain elevation data.
Source: USGS

drift: Deposits of boulders, gravel, sand or clay left by a glacier or the water from a melting glacier. groundwater.
Source: Minnesota Pollution Control Agency

groundwater: Underground water found below the level of the water table often used for drinking water.
Source: Minnesota Pollution Control Agency

headwater: The source of a stream.
Source: Merriam-Webster Dictionary

hydrogeological: A science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.
Source: Merriam-Webster Dictionary

Hydrologic unit code (HUC -8, -10, or -12):
infiltration: The United States is divided and sub-divided into successively smaller hydrologic units. The hydrologic units are nested within each other, and are identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system.
Source: USGS

infiltration: The flow of water from the land surface into the subsurface.
Source: USGS

non-point source: Nutrients and pollution sources not discharged form a single point: e.g., runoff from agricultural fields or feedlots.
Source: Minnesota Pollution Control Agency

NPDES: The federal Clean Water Act requires that all municipal, industrial, and commercial facilities that discharge wastewater or stormwater directly from a point source into a water of the United States (such as a lake, river, or ocean) must obtain a National Pollutant Discharge Elimination System (NPDES) permit. All permits are written to ensure the receiving waters will achieve their Water Quality Standards.
Source: EPA

ordinance: Legislation enacted by a municipal authority.

point source: An identifiable and stationary source of pollution, such as a wastewater treatment plant.

precipitation: Rain, snow, hail, sleet, dew and frost.
Source: USGS

prairie: A large, mostly flat area of land that has few trees and is covered in grasses.
Source: Merriam-Webster Dictionary

recurrance intervals: The estimate of an occurrence of a given precipitation event.
Source: USGS

runoff: That portion of precipitation or irrigation water that flows off a field or paved area and enters surface water.
Source: Minnesota Pollution Control Agency

sediment: Solid material that is in suspension, is being transported, or has been moved from its original location by air, water, gravity or ice.
Source: Minnesota Pollution Control Agency

sinkhole: A depression or cavity in the ground, especially in limestone bedrock, caused by water erosion and providing a route for surface water to be routed underground.
Source: Minnesota Pollution Control Agency

stormwater: Water that flows over land from rainfall or snowmelt, often causing flooding, erosion and pollution problems. It includes flows from storm drains and natural drainage courses serving industrial, commercial, residential, undeveloped, recreational and agricultural lands.
Source: Oxford Dictionaries

subwatershed: A smaller watershed within the boundary of a larger watershed, draining into a contributing waterbody.

surface water: Aboveground water, such as streams, rivers and lakes.
Source: Minnesota Pollution Control Agency

TMDL: The maximum amount of a particular pollutant that a water body can receive while still supporting its designated use(s).
Source: Minnesota Pollution Control Agency

topography: A detailed description or representation on a map of the surface shapes and features of any given area on Earth.
Source: Merriam-Webster Dictionary

wastewater: Water that has been used in homes, industries, and businesses that is not for reuse unless it is treated.
Source: USGS

water quality: A legally established state regulation consisting of three parts: (1) designated uses, (2) criteria, and (3) antidegradation policy.
Source: Minnesota Pollution Control Agency

water table: The level below which the ground is saturated with water.
Source: USGS

watershed: The land area that drains water to a particular stream, river or lake.
Source: USGS

wetland: A lowland area, such as a marsh or swamp, saturated with water.
Source: Minnesota Pollution Control Agency

Acronyms

AEP: Annual Exceedance Probability

AFO: Animal feeding operation

BMPs: Best management practices

CWA: Clean Water Act

DNR: Department of Natural Resources

HSG: Hydrologic soil group

IFC: Iowa Flood Center

ISA: Iowa Soybean Association

LA: Load allocation

NPDES: National Pollutant Discharge Elimination System

NRCS: Natural Resources Conservation Service

TMDL: Total maximum daily load

UCWMIA: Upper Cedar Watershed Management Improvement Authority

USGS: United States Geological Survey

WMA: Watershed Management Authority

WMP: Watershed Management Plan

WQS: Water quality standards

WWTP: Wastewater treatment plant

APPENDIX A: FIGURES

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APPENDIX B: MODEL ORDINANCES

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APPENDIX C: SWAT MODELING OF THE UPPER CEDAR WATERSHED

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APPENDIX D: SUMMARY OF PREVIOUS STUDIES/ PROJECTS