Upper Iowa River Watershed

Assessment & Management Strategies

Prepared by:
The Upper Iowa River Watershed Project
through Northeast Iowa RC&D, Inc.
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Appendices

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- Upper Explorerland Regional Planning Commission
- Upper Iowa Marine, Decorah
- Upper Iowa Resort & Rental, Dorchester
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- Upper Mississippi Audubon Society
- US Department of Agriculture
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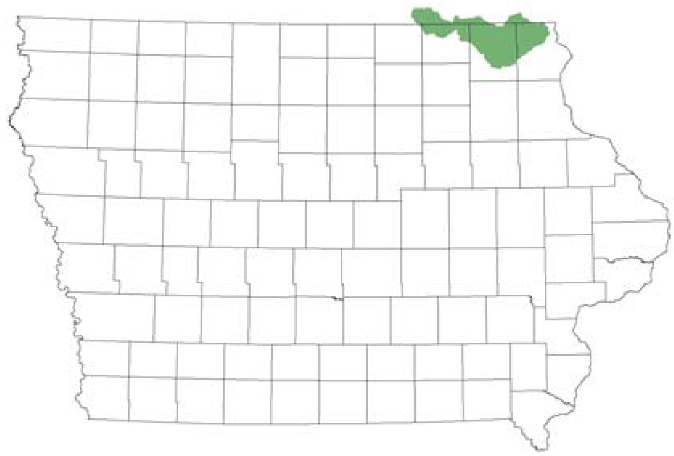
- US Fish and Wildlife Service
- Wal-Mart Store, Decorah
- Wings Restaurant, Dorchester
- Winneshiek County
- Winneshiek County Convention & Visitors Bureau
- Winneshiek County Farm Bureau
- Winneshiek County Pheasants Forever
- Winneshiek, Allamakee, and Howard County, Iowa Soil & Water Conservation Districts

Introduction

The Upper Iowa River and its Watershed



Located in extreme Northeast Iowa and Southeast Minnesota, the Upper Iowa River (UIR) and its watershed are valuable natural and economic resources. The Upper Iowa River watershed (UIRW) is a 1,001 square mile (640,901 acre) watershed recognized by the EPA and the State of Iowa in the Unified Watershed Assessment as a Priority 1 Watershed, "watershed is in need of restoration." This is the highest priority designation recognized by EPA.

Although it was ultimately withdrawn, the UIR was designated by the 90th U.S. Congress as among the initial rivers to be included in the National Wild and Scenic River System. The Bureau of Outdoor Recreation completed an intensive study of the Upper Iowa River in 1970 and recommended that it be added to the nine streams or rivers in the nation now in the National System of Wild and Scenic Rivers. In addition to being relatively wild and unpolluted at that time, the river was considered outstanding with respect to several features. *Chimney Rocks,* isolated columns of Galena limestone rising 150 feet above the river, *Cliffs and Palisades,* or high vertical walls of limestone on the outside edge of meanders rising as much as 250 feet above the river valley in the Bluffton area and 450 feet above the valley near the mouth and *Mural Escarpments,* sloping bluffs capped with limestone walls towering high above the river, were all noted. *Rapids,* caused by the steep gradient of 7 feet per mile and *Springs* that create 15 foot waterfalls falling directly into the river were also listed. *Abundant Wildlife and Unique Vegetation,* including the only native balsam fir trees in Iowa and *Fishing*, which included one of the best small-mouth bass fisheries and abundant trout were noted. *Geology,* including unique geologic features and abundant fossils, as well as the *Historic sites,* were considered significant. The historic sites included numerous prehistoric Indian villages, one of which may have been continuously inhabited longer than any other place in Iowa (Knudson.)

The UIR watershed is an area of rugged hills and steep topography with diverse land use. The surface water system in this watershed includes a complex network of spring fed coldwater trout streams. The last known native population of brook trout in Iowa is found in the watershed and 11 of the streams in the watershed have shown natural reproduction of trout. The UIRW has more designated coldwater streams than any other watershed in Iowa, and holds nearly a third of all coldwater streams in the State.

The majority of the UIRW is characterized by karst topography, where fractures in the bedrock and sinkholes allow for mixing of surface and groundwater and creates a fragile and complex hydrological system. The Karst topography has intricate cave networks, including Coldwater Cave, located in Winneshiek County. Coldwater cave is Iowa's longest cave and is designated as a National Natural Landmark by the U.S. Department of the Interior, a status only given to geologic and ecologic features considered to be of national significance.

The UIRW is a unique resource, different from other Iowa watersheds in many regards. The unique attributes of the watershed are discussed in-depth in this text. This document outlines the history of the watershed, from glaciation to present, gives an in-depth description of the watershed, outlines the subwatersheds that feed the UIR, discusses the assessment of the watershed, the concerns facing the watershed, identifies potential pollution sources and their risk to the watershed, and lastly, highlights management strategies aimed at improving the water quality in the watershed as well as the overall health of the watershed.

Section I
History of the UIRW

Glaciation

Bluffs along the Upper Iowa River

The UIRW is characterized by a unique geologic landform called the Paleozoic Plateau or Driftless Area. This landform encompasses portions of Northeast Iowa, Southwest Wisconsin, Southeast Minnesota and Northwest Illinois. It escaped the glaciers of the Pleistocene period, the last era of glaciers to pass over the Midwest. The topography in the Driftless Area differs markedly from that of the surrounding areas. Instead of low, gently rolling hills woven together with integrated systems of streams found in much of Iowa, the Paleozoic Plateau region is characterized by deeply cut meandering streams, bedrock riverbeds and very steep slopes.

The sedimentary rocks exposed along the Upper Iowa River were laid down about 500 million years ago during Ordovician and Cambrian times. The Cambrian system is the oldest of the eleven main systems of sedimentary rocks recognized worldwide by geologists and is observed in Iowa only along the deep cut valleys of the Upper Iowa and the Mississippi Rivers. At one time the Upper Iowa meandered in shallow loops across a flat surface. The sedimentary rock layers were later tilted slowly to their present position, tilting of three to four feet per mile toward the southwest. The river cut down through these layers as they were elevated, forming the rather unusual feature known as "entrenched meanders." Ordinarily a river in a deep valley would follow a much straighter path. As one descends the river, from west to east, the successive layers of rock are exposed. (Knudson)

The UIRW, like the rest of the Driftless Area, is an environmental mosaic, including fingers of the eastern wood lands extending westward. Its freedom from ice cover during the last glaciation left the area botanically unique. The Driftless Area is the only place in the state of Iowa where stands of northern deciduous forest, more commonly found at or near the Canadian border, exist. The deep ravines and precipitous bluffs furnish micro—environments for entirely different plants, including several threatened and endangered species. The northern slopes include niches that support plant communities normally found near the Arctic, while some south-facing slopes provide habitats for the growth of species usually found in drier regions.

Algific Talus Slope

Early Residents – European Settlement

Primitive hunters followed the retreating ice sheets into what would later become Northeast Iowa; they were the area's first known human occupants. Projectile points of the Folsom and Clovis fluted types, elsewhere dated to well over 10,000 years of age, have been found in Allamakee County and at other locations in eastern Iowa. These first inhabitants probably lived in small groups of closely allied families, depending for their subsistence on hunting mammoth and other prehistoric elephantine animals as well as extinct forms of horses and large bison. (O'Bright)

By 6—7000 years ago, Archaic Hunter—Gatherers occupied the area. The people of this culture usually inhabited areas at least partly covered by forests, and their tools reflect this change in environment. While they still hunted with atlatl-thrown darts, their prey was the more familiar deer, elk, bear, bison, and the smaller animals of the region. They also relied to a greater extent on other forest and riverine products for subsistence, gathering the fresh—water mussels and probably fish from the rivers, and berries, fruits, and nuts from the forests. (O'Bright)

The next period, called the Early Woodland, began roughly 3000 years ago. There is a question as to when the cultivation of crops began in the area, or whether any sort of farming at all was practiced, but it seems certain the Early Woodland people gathered and stored the wild rice that is abundant in the locality. The availability of wild rice may have precluded the need to practice the horticulture that was beginning in the southwest. The Woodland people may have also widened or intensified their exploitation of other forest, riparian, and wildlife resources. (O'Bright)

Aerial view of Northeast Iowa. (NRCS Photo)

The first white men to explore the watershed were sent by the French. An expedition was sent to the Iowa Indians to trade for beaver pelts. The first white settlers arrived along the banks of the Upper Iowa soon after the Winnebago Indians were removed in 1849. The area was surveyed by Nathan Boone, who recorded much of the watershed's historic vegetation (Knudson). His documents are used today to evaluate changes in natural resources over the past 150 years.

Section II
About the Upper Iowa River Watershed

Physical Location
The UIRW encompasses over 640,900 acres, spanning portions of seven counties across Northeast Iowa and Southeast Minnesota. It includes parts of Allamakee, Howard, Mitchell, and Winneshiek Counties in Iowa and Mower, Fillmore, and Houston Counties in Minnesota. Overall, 78.3% of the watershed is in Iowa and 21.7% is in Minnesota. Although the Iowa DNR has targeted the UIRW as a Priority Watershed for acquisition, 96.4% of the watershed remains in private land ownership. (*See* ***Public Lands Map****, Appendix A, Page G-7*)

County	Acres	% of Watershed
Winneshiek, IA	279,661.5	43.6%
Allamakee, IA	130,838.0	20.4%
Howard, IA	90,360.0	14.1%
Fillmore, MN	59,228.0	9.2%
Mower, MN	51,061.4	8.0%
Houston, MN	28,799.5	4.5%
Mitchell, IA	952.6	0.1%

Location breakdown of the UIRW.

Population
According to the 2000 US Census, approximately 27,000 people reside in the UIRW. This includes 12 incorporated cities and towns. The majority or 54% of residents reside in these incorporated areas. The largest incorporated city in the watershed, Decorah, has a population of 8,172. The 2000 Census also reported that 6,807 families reside in the watershed. (*See* ***Population Density 2000 Map,*** *Appendix A, Page G-8*)

Transportation
The UIRW is crossed by nearly 2000 miles of roads, hard surface or gravel. Roads meander more than they do in other parts of the state, due to the terrain, the high number of road miles creates a great number of intersections with streams and rivers in the UIRW. GIS analysis revealed 1,233 road intersections with rivers and streams in the UIRW. The UIRW contains no currently used railways. There is one airport located in the UIRW; an airport with a 4,000 runway is located 2 miles southeast of Decorah. The airport serves small jets and planes and is the only known jet fuel provider in the UIRW. There are currently plans for expansion of this airport. The Iowa DNR regulates 87 underground storage tanks in the UIRW, 31 of these are currently active. The DNR also has recorded 38 leaking underground storage tanks in the watershed, 9 of which are of high risk. (*See* ***Transportation Infrastructure Map,*** *Appendix A, Page G-9*)

Climate
The annual mean temperature at Decorah, the approximate center of the watershed, is 46.7° F. Decorah has recorded an all-time extreme high of 104° F and extreme low of -43° F. Precipitation records reveal an average of 33.4 inches of rain and an average of 39.8 inches of snowfall annually. The average number of days with greater than 1.0" of precipitation was 7.3, the average number of days with greater than 0.5" of precipitation was 21.9, and the average number of days with greater than 0.1" of precipitation was 65.6. The growing season (constant temperatures above 32° F) averages 152 days. (Midwestern Regional Climate Center)

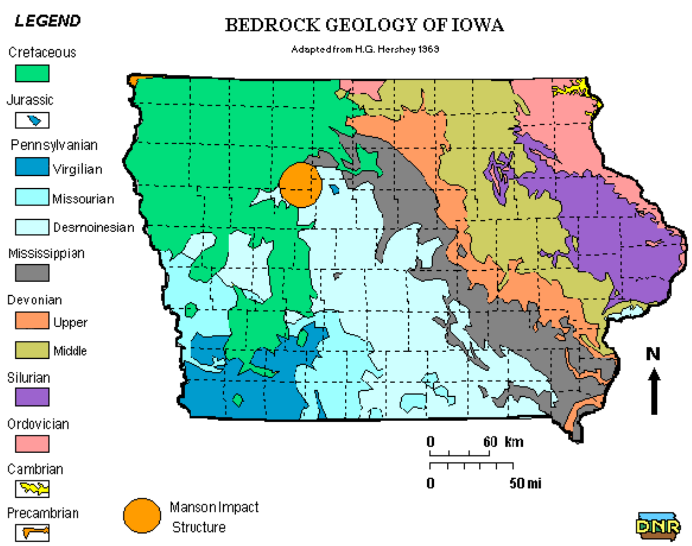
Agriculture/Farming
Analysis conducted by the UIRW Project identified 1,606 possible livestock producers in the watershed, as of publication; 28% have been ground truthed and confirmed. (*See* ***Livestock Producers Map****, Appendix A, Page G-18*) The 2002 NASS survey and GIS analysis also estimated that farms in the UIRW house approximately 97,000 cattle, 180,000 hogs and 3,100 sheep. The majority of livestock producers in the UIRW have head numbers below 300 animal units and therefore do not meet the definition or requirements of a Confined Animal Feeding Operation (CAFO).

The average value of an acre of land in the UIRW was estimated to be $2,629, which is in line with the State of Iowa average (2004 Iowa Land Value Survey). According to ISU Extension, farmers in the UIRW average a net cash return that is $13,000 les that the State of Iowa Average.

Geology/Karst

The Upper Iowa River flows through an area of topography and vegetation unlike any other region of Iowa. Much of the watershed is in the "Driftless Area" or Paleozoic Plateau landform. This area was bypassed by the last continental glacier. The area is characterized by differential weathering and erosion that results in a steep, rugged landscape referred to as "karst" topography. Karst topography is defined by land that is underlain by soluble bedrock, such as limestone, and characterized by depressions in the ground, or sinkholes, caves, and underground drainage. Because water can enter the subsurface easily through conduits and fractures in the soluble limestone bedrock, karst aquifers are highly susceptible to contamination. Karst topography features in the watershed include; springs, streams that disappear into bedrock fissures, sinkholes, caves, and steep, highly erodible hillsides. These features facilitate direct mixing of surface and ground water. Karst experts typically measure the development of karst by the number of sinkholes, springs and known caves. The UIRW has thousands of sinkholes, hundreds of springs and dozens of known caves. *(See **Karst Features Map**, Appendix A, Page G-10, **Coldwater Cave Map**, Appendix A, Page G-11 & **Geologic Mapping of Impaired Watersheds in Northeast Iowa,** Appendix I)*

The Paleozoic Plateau portion of the watershed also has shallow, near-surface bedrock with karst development in Paleozoic carbonate strata (Prior, 1991). The water quality impacts of non-point source contamination of shallow groundwaters in the karsted Ordovician carbonates of the Galena Group have long been the subject of continuing hydrogeologic investigations by the Iowa Geological Survey (Hoyer et al., 1986; Hallberg et al., 1989; Libra et al., 1991; Libra et al., 1992; Rowden et al., 1993; Rowden et al., 1995; Liuet al., 1997; Liu et al., 2000) The University of Minnesota and the Minnesota DNR consider surface and groundwater interchangeable in Southeast Minnesota, including the Minnesota portion of the UIRW.



The far western portion of the watershed, in Howard and Mower Counties, lies on the edge of a landform known as the Iowan Surface. This is a gently rolling to flat landscape. This portion of the watershed also has different soils, vegetation and topography. Historically the Iowan Surface, an area of high clay content soils, was dominated by wetlands that filtered the surface runoff before it drained to the karst areas further downstream in the watershed. The wetlands on the Iowan Surface provided a natural filtration system for the Upper Iowa River. After European settlement the wetlands were tiled and converted to row crop production. The majority of the surface water is now transported quickly off the Iowan Surface to the karst areas of the watershed without the benefit of filtration. Several disappearing streams are documented at the transition of the Paleozoic Plateau and the Iowan Surface. (*See **Karst Features Map**, Appendix A, Page G-10*)

Sinkholes

A common karst feature of the watershed is sinkholes, which form when the land surface collapses into subsurface voids formed in the slowly dissolving rock. According to historic inventories conducted by the Iowa Geologic Survey Bureau (IGSB) and the State of

The IGSB estimates 2,596 sinkholes in the Upper Iowa River Watershed but ground truthing suggests over two times as many actually exist.

Minnesota there are an estimated 2,596 sinkholes in the Upper Iowa River Watershed. However, according to recent ground truthing conducted through NE Iowa RC&D in a twelve square mile study area of the UIRW, this estimate may be low. The ground truthing documented 269 sinkholes in the same twelve square mile area that the IGSB estimated to include 118 sinkholes. Most of the sinkholes occur in rural areas where their main impact is rendering land unsuitable for row-crop agriculture. Sinkholes have also resulted in the failure of farm and other types of ponds, roads, and sewage-treatment lagoons. Sinkholes act as a conduit for surface runoff to directly enter bedrock aquifers. Both the Minnesota DNR and the Iowa Geologic Survey Bureau recognize that sinkholes have implications for groundwater quality in the Upper Iowa River Watershed. (*See **Karst Features Map**, Appendix A, Page G-10*)

One of thousands of sinkholes in the UIRW.

Sinkholes (and disappearing streams) carry surface water to underground rivers and aquifers used for drinking water. Water moving through underground rivers has been documented by UIRW Alliance Partners using dye tracing in the UIRW. These studies have demonstrated the ability to move very rapidly, sometimes resurfacing many miles away in springs, waterfalls and wells within hours. (*See **Dye Tracing Map**, Appendix A, Page G-12 and **Coldwater Cave Groundwater Basin Study**, Appendix E*)

Disappearing Streams

Disappearing Streams, also referred to as losing streams, stream sinks or sieves, are a feature found in the UIRW that has great implications for groundwater quality. Disappearing streams are characterized by flowing water from streams or rivers being transported underground via cracks or fissures in bedrock at or near the streambed. Disappearing streams can act as direct conduits for surface water contaminates to infiltrate groundwater resources. Surveys conducted by UIRW Project personnel and the State of Minnesota have identified 68 disappearing stream locations in the UIRW, with a survey of additional disappearing stream locations ongoing. (*See **Karst Features Map**, Appendix A, Page G-10*) Dye tracing studies in the Coldwater Cave area of the UIRW and near the UIRW and Root River Watershed border have revealed groundwater basins that defy traditional surface watersheds. (*See **Dye Tracing Map**, Appendix A, Page G-12 and **Coldwater Cave Groundwater Basin Study**, Appendix E*) The studies revealed surface and groundwater systems that are not only interconnected but that fluctuate depending on rainfall and flow volume. Some disappearing streams reemerge further downstream in the same channel during low flow but contribute to springs in other watersheds during high flow.

Dye tracing in the Coldwater/ Pine Creek Area.

Decorah Shale or Edge

An out-cropping of the Decorah Shale geologic unit further complicates the geology of the UIRW. This geologic feature was named for the City of Decorah and the shale outcropping that surrounds Decorah. Water flows vertically through limestone bedrock until it hits the Decorah shale layer. When water hits the shale layer it moves laterally until the shale is exposed, typically on a side hill slope. At the point where the shale layer out-crops, the water flows above ground through surface vegetation until it bypasses the shale and re-enters the bedrock through cracks or fissures. Many of the well known springs surrounding Decorah, including Dunnings Spring, are the result of this formation. Many lesser know small springs and side hill wetlands also surround the town. Water from many of the lesser known features eventually flows underground into deeper limestone layers to recharge deeper aquifers.

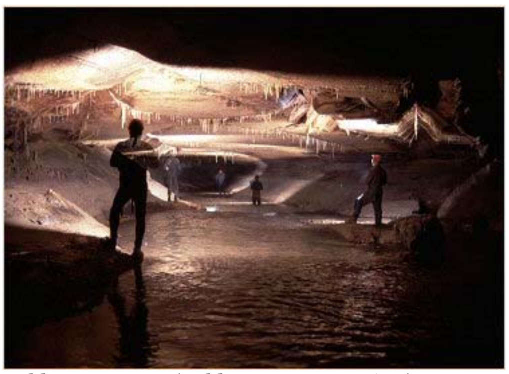
Vegetation on the Decorah Shale acts to filter contaminants in the water, much like wetlands act to remove contaminates. This phenomenon was found to be significant by the US Geologic Survey Bureau in the nearby City of Rochester, Minnesota, which is also located in a valley surrounded by outcroppings of the Decorah Shale. Building and infrastructure development of the Decorah Shale portions of hillsides pushed the City of Rochester to contract with the US Geologic Survey Bureau to conduct extensive analysis of the hydrologic characteristics and filtering abilities of vegetation along the Decorah Shale. The analysis found it would cost the city millions of dollars in water filtration each year to replace the action of the vegetation along the shale. The Decorah Shale has been documented in the Minnesota portion of the UIRW and an effort to locate and map the shale layer is underway in the Iowa portion of the UIRW.

Coldwater Cave

> ***"By far the most significant cave of the Upper Midwest karst region."***
> Coldwater Cave Project

Iowa's longest and most spectacular cave is located beneath the surface of the UIRW. By far the most significant cave of the Upper Midwest karst region, Coldwater Cave was designated a National Natural Landmark by the U.S. Department of the Interior in 1987. This status is accorded to geologic and ecologic features considered to be of national significance. (Coldwater Cave Project)

Since its discovery in the late 1960s, over 16 miles of passages have been documented. The cave is situated in the Iowa part of the UIRW below the topographic divide of the Coldwater and Pine subwatersheds of the UIRW. (*See* ***Coldwater Cave Map,*** *Appendix A, Page G-11*) The cave consists of over four miles of borehole and stream gallery, nearly a mile of parallel stream passage and another 11 miles of infeeders and their associated offshoots. The cave system, which is dendritic in its layout, is developed within a subtle carbonate ridge bounded by surface drainages; some of the side passages cross under these drainages. The entire area is mantled with loess and glacial till. (Coldwater Cave Project)


Coldwater Cave. (Coldwater Cave Project)

There is only one natural entrance to the cave and it is a water-filled spring that issues from the base of a 100 foot-tall bluff located within the Cold Water Creek Conservation Area. Access to the historic entrance requires SCUBA and the underwater entrance is currently gated. The system also consists of two other springs and two paleo springs which are not humanly enterable. Primary access to the cave is through a 94-foot shaft that was drilled by the State of Iowa for researcher access in the early 1970's. A second privately owned shaft entrance was drilled in 2003, and is located approximately 1 mile upstream from the primary entrance.

Soils

Soils in the UIRW are dominated by Fayette (28.9% of the UIRW) and Downs (16.6% of the UIRW) type soils. The remainder (54.5%) of the UIRW is composed of 14 different soil types, but no type accounts for more than 10%. (*See* ***Soil Type Map****, Appendix A, Page G-2*)

The Fayette series consists of very deep well drained soils formed in loess. Fayette type soils are found on convex crests, interfluves and side slopes, uplands and treads and risers on high stream terraces. Slopes range from 0 to 60 percent. Fayette soils are well drained and surface runoff potential is negligible to high. Nearly level to gently sloping areas of Fayette soils are cultivated, with the primary crops being corn, soybeans, small grains, and legume hays. Steeper slopes of Fayette soils are pastured, wooded or both wooded and pastured. The native vegetation of Fayette soils is deciduous trees, mainly oak and hickory. (NRCS)

The Downs series consists of very deep well drained soils formed in loess. These soils are on interfluves and side slopes of uplands and on treads and risers on stream terraces. Slopes range from 0 to 25 percent. Downs soil parent material is loess. Downs soils are well drained and surface runoff potential is negligible to high, depending on slope. Nearly level to gently sloping areas of Downs soils are cultivated. The principal crops are corn, soybeans, small grains, and legume hays. Steeper slopes are pastured, wooded or both wooded and pastured. The native vegetation is big bluestem, little bluestem, switchgrass, other grasses of the tall grass prairie and widely spaced oak and hickory trees. (NRCS)

Hydrology

According to Stralhers Stream Order survey of Iowa there are 1,419 miles of streams and rivers in the UIRW. The highest stream order in the UIRW is a 5th order stream; a 7th order stream is the highest classification and considered the most complex.

> ***"The real gem of Iowa's rivers is undoubtedly the Upper Iowa."***
> Des Moines Register, 6/12/03

The UIRW has been recognized by the State of Iowa as having some of the highest quality and priority waters in the state. 109.4 miles of the Upper Iowa River are designated as Class A, Human Contact. 152.2 miles of streams in the UIRW have been designated as BCW, coldwater resource. The UIRW has more miles of BCW streams than any other HUC 8 watershed in the State of Iowa. The UIRW also contains 183.9 miles of HQR, high quality resource waters, and 60.6 miles of HQ, high quality waters. In addition, there are 159.2 miles of streams designated as BWW, significant resource for warm water aquatic life, and 23.8 miles of stream designated as BLR, limited resource for warm water aquatic life. *(See **Water Classification Maps**, Appendix A, Pages G-13-17.)*

There are hundreds of springs in the UIR watershed of which 186 are currently mapped, including several well-known springs like Dunning's Spring, Twin Springs, and the second largest spring in Iowa, Siewers Spring. The largest spring in Minnesota, Odessa Spring, flows into the UIR just before the river enters Iowa. Odessa Spring has a discharge of 20,000 to 90,000 gallons per minute. Water disappearing underground at York Blind Valley, ten miles away in the Root River Watershed of Minnesota, resurges at Odessa Spring, as shown by groundwater dye-traces conducted by the Minnesota DNR. Water quality decline has been documented in many of the springs in the UIRW. (Tjostem) Springs in karst watersheds are often fed by sinkholes and losing streams, which are vulnerable to contaminates. The area of land that contributes to any spring is known as its springshed.

Malanaphy Springs, along the UIR.

Karst issues so greatly complicate the hydrology within watersheds that there has been national debate over the use of Hydrologic Unit Codes (HUC) that base watershed boundaries almost entirely on topographic ridgelines without taking actual hydrologic conditions into account. According to an Issues Paper released on June 5, 2001, the US Geological Survey's Hydrologic Unit Boundaries (For 10- and 12-Digit HUCs) delineation of the HUC boundaries, based almost entirely on topographic ridgelines not taking into account actual hydrologic conditions, is a concern in karst regions and has major implications for the following reasons:

- Safe Drinking Water Act reauthorization of 1996, Source Water Assessment and Planning: The State of Iowa is required to delineate water supply areas for drinking water systems and to inventory potential contaminant sources. Using HUC boundaries in karst watersheds like the Upper Iowa River watershed could incorrectly identify potential contaminant sources in their supply area or, more significantly, discount sources as being in one watershed, when in fact it contributes to another's drinking water supply.
- Total Maximum Daily Loads (TMDLs): Water quality data could be factored into the modeling of a TMDL for the wrong watershed based on incorrect watershed delineations. That is, a sampling site, and all the data associated with it, could be adding to the load of one watershed, when in fact, the water goes into a different watershed.
- Watershed Planning: Following inventories, assessments, and TMDL calculations, targeting of best management practices, or other pollutant control strategies could be incorrectly sited and resources misplaced if the source of the problem is placed in the wrong watershed.

Fisheries

The Upper Iowa River and its tributaries are home to both warm and coldwater species of fish. The UIRW has more coldwater stream miles, 152, than any other large watershed in Iowa and has sixteen designated public trout fishing streams and seven streams designated as "put-and-grow." Fourteen of these streams are stocked by the Iowa DNR with catchable size rainbow, brown, and brook trout. There are nine streams stocked with fingerling trout that grow to catchable size in the wild. The last known native population of brook trout in Iowa was found in the watershed by the Iowa DNR. It is now used as a native population source for re-introduction of Brook Trout to other streams segments. Although eleven of the streams in the watershed have shown natural reproduction of trout, Pine Creek near Satre and French Creek are home to the only known natural reproducing populations of Brook Trout in the state. *(See **Coldwater Streams Map**, Appendix A, Pages G-14.)*

The UIRW has more designated coldwater streams than any other large watershed in Iowa.

Trout fisherman in one of many coldwater trout streams in the UIRW.

The Northeast Iowa River Basin Study (NIRBS) of Iowa and Minnesota, conducted by the US Dept. of Agriculture in 1986, identified 25 Highest Priority Coldwater Streams. More of these priority streams (9 of 25) are in the UIR watershed than in any other system included in the study. The land area that drains into these 9 priority streams covers more than half of the area included in the total. The study also noted all of these streams have all-season fishing and public access, which makes them important to the economic health of the region.

Fishing in the UIRW is both a popular recreation activity and an economic benefit to Northeast Iowa. The Iowa DNR estimates about 30,000 trout stamps are purchased by anglers each year. Trout stamp sales have increased an average of two percent each year over the last decade, mirroring the national rapid expansion of fishing interest. The Upper Iowa River watershed is well known as a premier fishing destination in the region. Anglers can find quality smallmouth bass in just about any section of the Upper Iowa River that they chose to float. Many tributary streams to the Upper Iowa River provide quality trout angling. An estimated 315,000 angler trips are taken annually in The Upper Iowa River watershed. Of this total, 71,000 are on the UIR and 244,000 trips are made to the coldwater tributaries. A diverse fish assemblage inhabits the UIRW. In the last 20 years, 64 different species of fish have been sampled from the watershed. This includes 13 different species of game fish. The most commonly found game fish in the Upper Iowa are the smallmouth bass and rock bass, and in the tributary streams the brown, rainbow and brook trout. Several of the non-game fish are very rare in Iowa. The mottled sculpin inhabits the downstream reaches of trout streams and is only found in Iowa in five tributaries to the Upper Iowa River. This little fish reaches a maximum size of about six inches. The black redhorse is a larger fish, reaching a maximum size of seventeen inches. The black redhorse has been found in only one location in the UIR and in one tributary stream.

Canoeists fish in the UIR. (INHF Photo)

The health of the watershed has a direct impact on the quality of the water in which all aquatic life lives. Several Soil and Water Conservation projects were implemented in the 1980's and 1990's within the UIRW to conserve soil in agricultural fields and keep nutrients on the fields and available to crops. These projects also reduced the amounts of soil and nutrients that entered the streams. Keeping soil and nutrients in the watershed and out of the streams greatly benefited the fish populations, resulting in a restoration or increase in natural reproduction in several coldwater streams. Less soil in streams resulted in cleaner gravel on the stream bottom, where a majority of fish spawn. The stream bottom is also the area where a majority of the small invertebrate animals live. A wide variety of invertebrates is the first step in the food chain that supports a diverse fish community in the UIRW. In-stream and near-stream techniques used to reduce erosion and improve in-stream habitat were equally important to the restoration of natural reproduction of trout in the watershed. These techniques varied according to the characteristics of the different landforms found in a watershed including techniques such as vegetative and structural bank stabilization, bank hides and in-stream habitat restoration as appropriate.

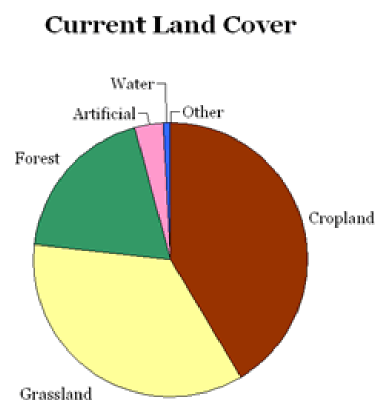
The Decorah Fish Hatchery, located along Trout Run just south of Decorah, is responsible for rearing and stocking Trout to many of the pristine streams of northeast Iowa. The hatchery was renovated in 1989 at a cost of 2.4 million dollars. The "new" hatchery went on line in 1989 as an extraordinary facility capable

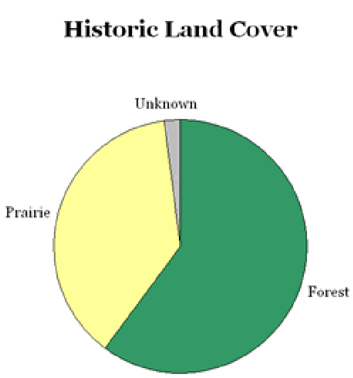
Decorah Fish Hatchery.

of compensating for the inferior water that at times emerges from Siewers Spring, Iowa's second largest spring and the sole water supply for the hatchery. A settling basin has been constructed to mitigate the increasingly heavy silt load before it reaches the raceways and ponds of the hatchery complex. Oxygen is added to the hatchery water as needed and excess levels of nitrogen gas are removed with a state of the art system.

Landuse/Landcover

The UIRW is characterized by diverse land cover consisting of a mix of cropland, grassland, forest, and residential/commercial development. Cropland is the principal land cover, accounting for 41.5% of the watershed, followed by grassland at 35.2% and forest at 19.1%. Corn and soybeans are the most commonly grown crops, representing 22.2% and 19.2% of the watershed respectively. Forests in the UIRW are primarily deciduous, at 16.9% of the watershed. Forestland is concentrated along waterways and on steep slopes in the eastern half of the watershed. Historic land cover in the UIRW was dominated by woodlands, accounting for 60% of the watershed, prairie accounted for 38%. *(See **Landcover Map**, Appendix A, Page G-3, **Pre-settlement Vegetation Map**, Appendix A, Page G-4 & **Cropland Map**, Appendix A, Page G-19)*





The farm program provides powerful incentives to raise "program" row crops throughout the watershed. These incentives, combined with major structural changes in the livestock sector, have led to a shift in land use from hay and pasture which supported dairy operation to row crops, especially soybeans. Between 1982 and 1997, according to USDA National Resource Inventory surveys, Major Land Resource Area 105, which encompasses the majority of the UIRW, has experienced several land use shifts including:

- A 20% reduction in acreage of hay and pasture. Hay and pasture favor reduced runoff, minimal leaching of nitrate-nitrogen and very little soil erosion.

- A 60% increase in acreage of soybeans. On steeper slopes, this rotation poses a threat of severe soil erosion and leads to greatly increased leaching of nitrate nitrogen.

- Enrollment of 820,000 acres of cropland in the Conservation Reserve Program (CRP) by 1997. This helped to offset the effects of increased soybean production. Much of the CRP acreage came out of corn production, which declined by 13% over the period. However, since 1997 the contracts on much of the CRP land have expired, and many acres have been returned to crop production.

- A 7% increase in forest land, an environmentally positive trend, although deforestation over the past 150 years has been dramatic in some areas.

Fueling the Trends:
Among the forces behind these land use trends are four that stand out as especially significant:

- Continuing Dairy Herd Decline: Milk cow numbers declined by an average of 31% between 1982 and 1997 in Iowa, Minnesota and Wisconsin. This trend is continuing in the UIRW. According to projections by the Food Policy Research Institute at the University of Missouri, dairy cattle, a strong component of the UIRW will decline by 11% in Iowa from 2000-2010. Local demand for hay and pasture has declined during that same time period resulting in hay and pasture conversion to annual crops on steep highly erodible lands.
- Beef cow reductions: In the period between 1982 and 1997, beef cow numbers, another major agricultural component in the UIRW, declined by 33% in Iowa, further reducing the demand for hay and pasture.
- Federal Farm Program Incentives: The federal farm program provides additional incentives to shift production from hay and pasture to corn and soybeans. In recent years of depressed market prices, up to 70% of net farm income from corn and soybean production has come from federal payments based on acreage and yields of these program crops. Because hay and pasture are not eligible for federal payments, the economic return to these land uses has fallen sharply relative to corn and soybeans. Inadvertently, the federal farm program is fueling the trend from hay and pasture to row crop farming by selectively supporting only the latter.
- Habitat Degradation: As grasslands, woodlands and wetlands have been gradually converted for suburban developments or row crop production over the past several decades, and as fields have been tiled or ditched and watercourses have been straightened, the destructive forces of floods, stream bank erosion, sedimentation and nutrient contamination have been unleashed on downstream communities and on fragile fish and wildlife habitats.

Forest Resources
Since European settlement, the loss of thousands of acres of timber has changed the hydrology of the area and increased soil erosion potential on steep deforested hillsides. Daniel Boone's son, Nathaniel Boone, conducted a land survey of the Upper Iowa River watershed for the US Government in the 1840's and 50's. He found the Upper Iowa River watershed had 324,000 acres of timber. Looking at recent data collected by ISU and USGS, we see that only 105,380 acres of forest remain in the watershed. The majority of the lost timber acres were converted in the 1800's to hay and pasture for dairy and meat production. The greatest forest loss in the watershed occurred in Winneshiek County. The timber was used by settlers for many of the same things timber is used for today; housing, furniture, firewood, fences,

and extra income. In the recent past those same acres were replaced with annually tilled crops such as corn and soybeans. Corn and soybeans now grow where oak, maple, walnut, aspen, white pine, red cedar, and other trees once stood. The loss of pasture and hay on highly erodible lands is a trend that has resulted in significant increases in soil erosion, sedimentation, and run-off.
A GIS analysis was conducted to identify areas of high forest loss. The Canoe Creek subwatershed of the UIRW, for example, has 72.6% of the forest that once covered the watershed. The UIRW as a whole has lost roughly 40%, or 250,000 acres, of forest land that once covered the watershed. The Trout Run subwatershed, the location of a special reforestation project has lost 84% of the forest lands that once covered the area. *(See **Trout Run Reforestation Project Summary**, Appendix O & **Forest Loss Map**, Appendix A, Page G-20)* The forested areas that remain are valuable resources to the UIRW. Many of the current forests stabilize steep slopes and lands adjacent to streams and rivers. An example of a unique forest area in the UIRW is the Bluffton Fir Stand. This 94-acre preserve features one of the largest populations of balsam fir in Iowa. Balsam fir, a boreal tree species, is typically found much farther north in Minnesota, Wisconsin, and Canada. (Iowa DNR Forestry)

Forested bluff in the UIRW.

Topography & Elevation

The Upper Iowa River Watershed has a high elevation of 1,438 feet above sea level and a low elevation of 612 feet above sea level, giving it a range of 826 feet. The mean elevation is 1,157 feet above sea level. The mean slope of land in the UIRW is 8.4%. The elevation of the Upper Iowa River Headwaters at Lake Louise is 1,261 feet above sea level, and the mouth at the Mississippi River is at 612 feet above sea. The river runs 133.6 miles from headwaters to mouth, giving the UIR an average drop, over its course, of 4.85 feet per mile. The topography of the watershed, by virtue of its size, varies from the west to the east. The western portions of the watershed have gradual slopes averaging 0%, in contrast slopes up to 104% can be found in eastern portions of the watershed. *(See **Elevation Map**, Appendix A, Page G-5 & **Slope Map**, Appendix A, Page G-6)*

Plants & Animals

The UIRW is home to many endangered plant and animal species that rely on the unique environment of the watershed. According to the Iowa DNR there have been 204 documented occurrences of threatened and endangered species and natural communities in the Iowa portion of the UIRW. Of that 204, 11 have been vertebrates, 59 invertebrates, 91 plants and 49 communities.

One of the more unique ecosystems in the UIRW are the Algific Talus Slopes. There are approximately 50 Algific Talus Slopes in the UIRW. They remain cool throughout the year and are home to rare species of plants and animals. The slopes remain cool by a system of sinkholes, cracked bedrock and vents located on steep slopes. In the summer, air is drawn down through sinkholes, flows over frozen groundwater and is released out vents on the slopes. Summer temperatures on the slopes range from just above freezing to 55 degrees Fahrenheit. In winter, the air is drawn into the vents, and the groundwater again freezes. (US Fish & Wildlife Service)

Because of the cool temperatures and moist conditions, unusual plants for this part of the country grow on the slopes. Typically growing in colder more northern climates, yews, balsam fir, showy lady's slipper and golden saxifrage can be found on the cool slopes. These cold microclimates of the slopes allow the rare plants and animals to survive. (US Fish & Wildlife Service)

A tiny land snail, the Iowa Pleistocene snail, is smaller than a shirt button, at about 5 millimeters (1/4 inch) in diameter. Considered a glacial relict species, it has survived only on these small areas where temperature, moisture and food are suitable. Thirty-six known colonies are currently found in Northeast Iowa. The snail was thought to be extinct until 1955, when a scientist discovered it alive in leaf litter in Northeast Iowa. (US Fish & Wildlife Service)


Northern Monkshood.

Several of the Algific Talus Slopes in the UIRW are included in the Driftless Area National Wildlife Refuge. The refuge, established in 1989, is helping to recover two federally listed species, the endangered Iowa Pleistocene snail and threatened Northern Monkshood, a purple hood-shaped flower belonging to the buttercup family. The US Fish & Wildlife Service manages the refuge as part of the National Wildlife Refuge System.

In the Upper Iowa River itself a freshwater mussel survey was conducted under contract with the Iowa DNR. The survey identified several high quality mussel beds remaining in the river. Studies conducted through Luther College confirmed the quality of the mussel beds. These studies identified 10 live species of mussels in the UIR, including one species considered threatened.

Tourism & Economic Impact of the Upper Iowa River Watershed

> ***Canoeing the Upper Iowa River is one of the top 100 adventures in the United States.***
> National Geographic Adventure Magazine

The Upper Iowa River and its tributaries contribute greatly to the economic health of the region, diversifying the opportunities for business and tourism development in the region. The waters of Northeast Iowa are a major attraction for anglers and other water recreationists. The Upper Iowa Watershed is noted nationally for its fine fisheries. In 1998 the Iowa DNR estimated over 314,000 angler trips per year are made to the Upper Iowa River Watershed, stimulating over $29 million dollars of economic activity each year. The Iowa DNR estimates canoeists enjoying the Upper Iowa River generate another $5 million yearly. Local DNR Fisheries Biologists consider these estimates, which are based on the area of the watershed, to be extremely low. Thousands of visitors each year tour the Iowa DNR Fish Hatchery in Decorah, Iowa, in the heart of the watershed. Iowa DNR Fisheries and Fish Hatchery Management in Decorah note, "the success of the operation of the hatchery and the success of the trout rearing and stocking program is directly tied to the water quality."


Canoeists enjoy the scenic bluffs of the UIR.

The Winneshiek County Tourism Director states that "if the quality of water declines, it will eventually have a negative impact on the recreation aspect of tourism in Winneshiek County." This statement is based on research and surveys conducted by the Winneshiek County Economic Development and Tourism Office. One survey found that the number one tourism draw in Winneshiek County is the Upper Iowa River. That survey also found the activities that bring visitors in direct contact with the water of the Upper Iowa River and its tributaries (i.e. canoeing, tubing, and fishing), were the primary outdoor recreational activities of visitors to Winneshiek County.

The Allamakee County tourism office responds to over 1,160 calls per year regarding tourism inquiries. The top three requests fall in the categories of fishing, canoeing, and general outdoor activities. The economic impact of the visitors generated by those calls is calculated at over $15 million dollars annually.

The largest city in the watershed, Decorah, is well known for its park system, which includes over 500 acres of parks, most of which are focused around springs, waterfalls, coldwater trout streams and/or the Upper Iowa River. The Decorah Park Director notes that the city has committed spending to highlight its water resources by strategically placing parks, trails, campgrounds and amenities near water resources.

A 2003 report from the Iowa Department of Economic Development estimated $7.65 million dollars in payroll was generated in the Iowa counties included in the UIRW. The same report revealed $45.92 million in total travel expenditures in Howard, Winneshiek and Allamakee counties. These numbers reflect a steady increase in tourism related expenditures and indirect water quality related economic benefits for the communities and rural areas in and around the UIRW. Dozens of small businesses related to the UIR and coldwater trout streams also depend directly on the water quality in the UIR and its watershed, including dozens of canoe, kayak and tubing rental businesses, campgrounds adjacent to the water resources and rural general stores located next to water features.

Fisherman along Twin Springs Creek, a coldwater stream.

Section III

Subwatersheds of the UIRW

The UIRW has been divided into 35 subwatersheds based on surface flow patterns. Subwatershed size ranges from 42,391 acres (Canoe Creek subwatershed) to the 969 acres (Dry Run Decorah subwatershed). There are two large corridor subwatersheds that encompass all land directly adjacent to the Upper Iowa River. (*See **Subwatershed Map**, Appendix A, Page G-1*)

The karst features of the UIRW complicate both surface and subsurface flow, defying traditional watershed boundaries. It is important to note that water and pollutants have been documented crossing watershed boundaries in the UIRW, therefore targeting subwatersheds for improvement requires additional preparation and research related to the karst features. This includes the research that has, and is scheduled to be, conducted to delineate spring-sheds and define the boundaries of subsurface flow, as well as the geologic studies currently being conducted by the Iowa Geologic Survey Bureau in cooperation with Luther College, the US Geologic Survey Bureau and NE IA RC&D.

The chart below is a listing of the subwatersheds in the UIRW, sorted in size from high to low. For more information on the subwatersheds of the UIRW please refer to detailed subwatershed maps and water quality data. *(**Subwatershed Maps**, Appendix A, Pages S-1 through S-33, **Water Quality Maps**, Appendix A, Pages W-1 through W-6, **Water Quality Monitoring Results 1999-2004**, Appendix B and **Weekly Water Quality Monitoring Results (2002-2003),** Appendix C)*

Name	Acres	Sq Miles
Upper Iowa River Corridor West	101271	158.2
Upper Iowa River Corridor East	55434.4	86.6
Canoe Creek	42391.2	66.2
Trout Run	32636.3	51
Waterloo Creek	30905.2	48.3
Trout River	25872.1	40.4
Pine Creek West	22976.7	35.9
Silver Creek West (Cresco)	22410.8	35
North Bear Creek	20521.5	32.1
Tenmile Creek	20229.7	31.6
Dry Run Creek	20171.8	31.5
N Branch Upper Iowa	20093.4	31.4
Little Iowa River	17554.9	27.4
Beaver Creek MN	17027.2	26.6
Beaver Creek IA	16960.3	26.5
Coldwater Creek	16097.4	25.2
French Creek	14979.1	23.4
Silver Creek East	13712.9	21.4
South Bear Creek	12989.5	20.3
Staff Creek	13018.1	20.3
Coon Creek	12537.2	19.6
Bigalk Creek	11498.3	18
Bear Creek	10165.2	15.9
Patterson Creek	10188.1	15.9
Clear Creek	9645.9	15.1
Unnamed Creek MN	8411.4	13.1
Casey Spring Creek	7923.2	12.4
Pine Creek E	7205.5	11.3
Irish Hollow Creek	5555.3	8.7

Silver Creek	5541.7	8.7
Mineral Creek	5200.3	8.1
Martha Creek	4633.5	7.2
No Name, MN	2190.3	3.4
No Name #2, MN	2160.9	3.4
Decorah Dry Run	969.3	1.5

Section IV
Partnerships, Research & Investigations in the UIRW

Partnerships
Recognizing the importance of water quality in the sensitive Upper Iowa River Watershed, local, state and federal agencies, organizations, businesses and landowners united to form the Upper Iowa River Watershed Alliance in 1999. The mission of the Upper Iowa River Watershed Alliance (UIRWA) is to improve the water quality in the Upper Iowa River and its tributaries, and improve the health of the Upper Iowa River Watershed.

An UIRWA Technical Committee was formed as a subgroup of the UIRW Alliance to provide guidance to the project. The Technical Committee includes local, state and federal agency and organization representatives. Information concerning watershed characteristics and health has been distributed at quarterly UIRW Alliance Technical Committee meetings, public meetings throughout the watershed, in regional press releases and in a quarterly newsletter to watershed residents. Information distribution has been multi-faceted and included historic data review, water quality monitoring, extensive GIS analysis, geologic studies, bacterial DNA analysis, forest resource analysis, livestock surveys, septic surveys, rainfall modeling, die tracing for springshed delineation and landowner surveys. Dozens of local, state, federal and private agencies, organizations and Universities have assisted with research and activities including NRCS, the US Forest Service, EPA, Iowa and Minnesota DNR (Fisheries, Forestry, Wildlife, Geologic Survey and Water Quality), IDALS, six SWCD's, personnel from six Counties, University of Iowa, Iowa State University, Luther College, University of Minnesota, University of Western Kentucky, the Hoffman Institute, Northeast Iowa Community College, the McKnight Foundation, the City of Decorah, local and state Iowa Farm Bureau, Izaac Walton League, Trout Unlimited, Pheasants Forever, Ducks Unlimited, IOWATER volunteers and other UIRW Alliance members.

Historic Water Quality Data Review
Through the UIRW Project, a historic water quality data review was completed by the UIRW Project Coordinator with analysis conducted by Luther College. The resulting report called attention to several concerns, including high sediment transport and increasing nitrates. (See **Project Report: The Upper Iowa River Watershed**, Appendix G)

An average annual flow and suspended sediment study of Minnesota, Iowa and Wisconsin rivers by the US Geological Survey Bureau entitled: *Tributaries Discharge and Sediment Transport from Upper Mississippi River and Illinois Waterway Cumulative Effects Study,* put the Upper Iowa River in perspective within its region**.** The study reported that the Upper Iowa River carried an annual total sediment load of 390,000 tons/year at Dorchester, Iowa. The same study ranked the Upper Iowa River 2nd out of the 13 rivers in the report for sediment load per acre of drainage area. The Upper Mississippi Fish and Wildlife Refuge reported backwater habitats, where the Upper Iowa River empties into the Mississippi River, have declined due to a sediment load.

Water sampling in the UIRW.

Periodic sampling was conducted by the USGS near the mouth of the Upper Iowa River between 1995 and 1998 (before it empties into Pool 9 of the Upper Mississippi River). When the data was compared to a 1972 study conducted by L.D. McMullen, of the University of Iowa College of Engineering, it suggests a 38% increase in the mean Nitrate+Nitrite, N over the 25-year period. Similar increases were noted in the nitrogen levels in the Upper Iowa River, several springs, and local shallow wells in the Upper Iowa Watershed in a 25-year study conducted by microbiologist Dr. Tjostem of Luther College. Dr. Tjostem noted in a presentation at Luther College that nitrates should be considered a sentinel indicator that warn of other problems. The same trend of increase in nitrate levels had been seen in the wells of the largest city on the watershed. Decorah had seen a significant increase in the past 15 to 20 years in nitrates detected in its municipal wells.

Water Quality Monitoring & DNA Analysis

Because no water quality monitoring had been conducted in the UIRW on a watershed wide basis before the project began in 1999, water quality monitoring was immediately recognized as a high priority. There was increasing pressure from the Iowa DNR 319 program and NRCS for Soil and Water Conservation Districts to target funding and technical assistance to subwatersheds based on documented water quality problems. Land Resource Managers felt that the best way to target was to compare the subwatersheds of the UIRW to each other. This method had been successfully modeled in the Maquoketa Watershed Project. The RC&D helped the team secure funding from local private and public sources to pay for limited monitoring, beginning in 1999. The initial monitoring was conducted four times each year during a spring snowmelt event, during an early summer rainfall before crops were leafed out, during a late summer rainfall event before crops were removed from the fields, and during low flow in the winter months. Thirteen samples were taken between 1999 and 2002 at 39 sites across the watershed. Parameters included Membrane Fecal Coliform, Total Phosphorus, Atrazine, Ammonia Nitrogen, and Nitrate+Nitrite N. In addition, Iowa DNR Fisheries in Decorah analyzes the samples for turbidity. Resource professions felt the event comparison monitoring enabled them to compare sub-watersheds adequately. *(See **Water Quality Monitoring Results 1999-2004**, Appendix B)*

DNA analysis of bacteria from the UIRW. (UHL Photo)

After monitoring revealed extremely high levels of bacteria and nutrients, members of the UIRWA Technical Committee began developing a plan that would provide more detailed water quality information. The members from the Iowa DNR also wanted the data to meet standards for use in the states new impaired waters and TMDL evaluations. Because local Sanitarians estimated 60 to 90% of Individual Sewage Treatment Systems in the area were outdated or not properly functioning and that many septic systems were plumbed to tile lines, ditches, or streams, bacteria in the UIR was of particular concern to the Iowa DNR. The DNR assisted with more detailed weekly monitoring in the UIR and the six tributaries with the highest fecal coliform bacteria from July of 2002 through June of 2003. *(See **Weekly Water Quality Monitoring Results (2002-2003)**, Appendix C)* This monitoring tested for Chloride, E-coli, Enterococci and Fecal Bacteria. Three of the six tributaries were chosen for a more detailed DNA analysis, including Silver Creek (near Cresco), Coldwater Creek, and Silver Creek (near Waukon). Samples were collected through the UIRW Project in 2002 and 2003 and analyzed by the University of Iowa Hygienic Laboratory. The bacterial DNA studies were conducted to pinpoint the sources of fecal contamination, as a joint project between the Iowa DNR, Iowa Geological Survey Bureau, the University of Iowa Hygienic Lab, and the Upper Iowa River Watershed Alliance, through Northeast Iowa RC&D. *(See **Microbial Source Tracking in the Upper Iowa River Watershed using E. coli Ribotyping**, Appendix D)*

The studies recognized that the ability to distinguish between human and animal sources of fecal contamination is an important assessment tool as different health risks are associated with human verses animal sources. During the studies the partners not only completed DNA testing of water born bacteria but also developed a bacteria database from the UIRW. From a water quality perspective, the ability to narrow the source of fecal contamination among the many potential sources was expected to help facilitate more tailored and cost effective pollution abatement efforts. The aim of the research was to improve the understanding of non-point source disease vectors and the methods of tracking bacteria through the environment. With the initiation of this research the UIRW Alliance began documenting levels of Escherichia coli (E. coli) bacteria, the predominant fecal bacterium and the common inhabitant of human and animal intestines. E. coli is widely used to assess the quality of surface water as an indicator of fecal pollution. The presence of fecal coliform bacteria or E. coli indicates that disease-producing organisms may be present. However their presence does not differentiate between human and animal sources of pollution and the potential pathways that exist for pathogens to reach surface water sources. To understand and control fecal contamination problems and to assess human health risks, the partners felt it was necessary to identify the contamination sources. DNA identification of sources in the watershed with high levels of fecal indicator bacteria was beneficial to all those agencies charged with protecting water quality and public health.

The project applied new source-tracking tools to a specific watershed problem in the UIRW. Isolates of E. coli were obtained directly from the animal feces of cattle, deer, swine, raccoon, sheep, geese and humans within the UIRW. E. coli from water isolates were also collected from the UIRW. The findings of the research indicated the fecal bacteria in the tributaries and in the Upper Iowa River come from a variety of sources, including humans, livestock, and other wildlife such as deer, raccoons, and geese. This information was used to educate the public. It proved a useful tool in preventing watershed stakeholders from blaming other entities and accepting responsibility for their contribution to the problem.

Starting in April 2004 monitoring was expanded from four to ten times per year and concentrated to areas of concern (*See **Water Sampling Locations 2004 Map**, Appendix A, Page W-1*). Monitoring included Atrazine at sixteen sites upstream of Decorah, E-coli bacteria at 28 sites, nitrate-nitrogen as N at 28 sites, ammonia nitrogen as N at 28, and total phosphate as P at 28 sites. The monitoring regime was also altered to be conducted on the last Tuesday of every month, regardless of stage or rainfall. Throughout the project, all samples were drawn by UIRWA Technical Committee professionals from the Iowa and Minnesota DNRs, the City of Decorah Water Department and IDALS. The samples were sent to the Iowa Hygienic Laboratory for analysis. The effort was coordinated by the UIRW Project Coordinator at the RC&D. Funding for the continued monitoring was once again paid for through local fund raising conducted by the UIRW Project Coordinator.

The geometric mean for membrane fecal coliform bacteria in the UIR at Decorah during the sampling period from 1999 through 2004 totaled 2,213 colonies/100mL for all samples. During events this geometric mean was 11,476 colonies/100mL. The highest membrane fecal coliform bacteria count recorded in the UIR at Decorah was 290,000 colonies/100mL. The geometric mean for membrane fecal bacteria at the mouth during events equaled 3,145 colonies/100mL and geometric mean equaled 816 colonies/100mL for all samples. The maximum membrane fecal bacteria level at the mouth was 92,000 colonies/100mL. The UIR is heavily utilized for swimming, tubing, and canoeing and has 109 river miles designated by the State of Iowa for Primary Body Contact use (Class A). The monitoring also identified tributaries with spikes of membrane fecal coliform as high as 1.1 million colonies per 100mL during an event on May 18, 2000 in Coldwater Creek. E-coli levels as high as 13,000 colonies/100mL during an event sample on May 25, 2004 in Trout Run and 11,000 during a non-event sample on October 27, 2004 in French Creek were also documented (French Creek is classified as High Quality and Coldwater). Many of the streams are documented losing streams, with documented in-stream sinks that contribute water either to ground water, coldwater trout streams or springs. Potential sources include runoff from feedlots and manure-amended agricultural lands, inadequate septic systems, and wildlife. (See **Water Quality Monitoring Results 1999-2004**, Appendix B and **Water Quality Maps**, Appendix A, Pages W3-4)

High nitrates were also documented in the Upper Iowa River and several tributaries throughout the sampling period. Throughout the surface water monitoring period, the highest nitrate and atrazine levels in surface waters were found in the western portion of the UIRW. These high levels were also found in rural drinking water supplies in the same areas. A survey of Staff and Beaver Creek residents conducted by the Howard County SWCD indicated that of the 73 resident surveyed 51 respondents treated their drinking water. Water quality data from throughout the UIRW was correlated to landuse through GIS analysis. The analysis found the subwatersheds with the greatest nitrate levels in surface water had the most intense agricultural production in the UIR watershed with 88.7% of the acres in cropland. In the Iowa portion of the UIRW these subwatersheds were found to have the least percentage of native vegetation remaining. The native prairie was negligible and CRP acres in the Staff and Beaver subwatersheds were found to be lower than any other portion of the Iowa portion of the UIR watershed. Although the area had hydric soils covering 25.2% of the area, the majority of the wetlands have been tiled for increased drainage and agricultural production. In addition, several negative trends related to livestock and manure application could be contributing to the high nitrogen levels. (See **Water Quality**

Monitoring Results 1999-2004, Appendix B and **Nitrate Levels Water Quality Maps**, Appendix A, Pages W5)

The UIR Watershed Project has also recorded high nitrate levels in Silver Creek Cresco, a 22,200-acre sub-watershed divided in half by the Howard/Winneshiek County line. The City of Cresco, in Howard County, discharges its treated waste into Silver Creek. Silver Creek drops underground downstream of the discharge through multiple in-stream sinkholes. Although this stream drains a large surface area, the extensive streambed karstification takes all surface water underground during low flow conditions. The destination of the surface water, after it drops underground, has not yet been determined. Work in the Silver Creek watershed is not yet proposed by any agency.

The high nitrate levels are of particular concern to the largest city in the watershed, Decorah, Iowa, with a population of 8,600. Decorah lies in the heart of the watershed with the river running through the center of town. Decorah's wells are shallow (*Appendix J, page 19*) and drilled into unconsolidated material. They are also located in close proximity to the river. Decorah has documented increasing levels of nitrogen in their wells. Concern over significant increases in nitrate levels prompted the city to install one of the first real-time nitrate monitors in the state and to partner with NE Iowa RC&D and others to form the Upper Iowa River Watershed Alliance. The City of Decorah contributes funding for water analysis and pays for real-time nitrate monitoring in the UIR at Decorah. A recent letter from Bob Libra of the Iowa Geologic Survey Bureau to the City of Decorah stated *"Given the proximity of the wells to the river, some portion of the water the city wells produce originated in the river. This relationship is shown in the Source Water Protection report you (Decorah) received from our office last fall, which shows the well capture zones extending to the river. Therefore improvements to the water quality of the river will have a positive impact on the quality of the city's water, particularly with respect to dissolved chemicals such as nitrate and atrazine."*

Water monitoring indicated increasingly high levels of sediment and nutrients being carried by the Upper Iowa River and its tributaries between 1999 and 2004. The UIRW Alliance Technical Committee paired the parameters to evaluate the water quality relationships to land-use. Sediment and phosphorous were paired to determine sub-watershed with the greatest erosion. These water quality extrapolations were then confirmed using GIS analysis that included application of the RUSLE. Critical erosion on Highly Erodible Lands was identified as in clusters that correlated with poor water quality. (See **Water Quality Monitoring Results 1999-2004**, Appendix B and **Phosphate Levels Water Quality Maps**, Appendix A, Pages W6)

Several projects were proposed and funded to address specific concerns in the UIRW, including the Trout Run Reforestation Project, which targeted highly erodible lands for reforestation to decrease sediment and phosphorus loading in the Trout Run Watershed. The Staff and Beaver subwatersheds were targeted for nutrient management and wetland restoration to reduce nitrate loading. The UIRW Corridor Protection Project was implemented to improve in-stream and near-stream erosion and direct sediment and nutrient loading on the Upper Iowa River.

Flow Monitoring & Modeling

Monitoring surface water flow in the UIRW was established as a goal early on in the project. Two gauging stations were installed on the UIR through a partnership with the City of Decorah and the US Geologic Survey Bureau, with facilitation through the UIRW Project. These stations measure real-time gauge height and stream flow, gathering information that is utilized to determine nutrient loads. Their addition brings the total to three USGS gauging stations on the UIR. (*See **Water Sampling Locations Map**, Appendix A, Page W-1)* These stations are located at Bluffton, Decorah, and near Dorchester. Limited, crude stream flow data was collected by hand during 2002, but no permanent research sites have been established on any of the river's tributaries. A rainfall and runoff analysis conducted by Professor Richard Bernatz of Luther College is currently underway to using landscape characteristics and rainfall data to predict flow regimes in the UIRW. According to Professor Bernatz, a mathematical model could possibly be used to predict hourly volume rate of flow of water in the Upper Iowa River and its subwatersheds. Such a model is useful for studying flood frequency and severity resulting from various rainfall events. An additional goal is to model pollution and sediment transport in the river channel. This would allow computer model studies of land use practices within the Upper Iowa River Watershed as a whole, or individual subwatersheds in particular. *(See **Rainfall-Runoff Modeling of the Upper Iowa River Catchment**, Appendix F)*

GIS Analysis

A comprehensive GIS analysis of the UIRW has been completed through the UIRW Project. The analysis has examined landuse changes and trends, examined water quality data, identified critical areas for conservation and more. The UIRW believes it is crucial to have an up-to-date library of GIS data and resources that can assist in targeting critical areas for best management practices and other conservation efforts in the UIRW.

GIS was specifically used to target areas for reforestation in the Trout Run Subwatershed of the Upper Iowa River. Trout Run was identified through water quality monitoring to have some of the poorest water quality in the UIRW. GIS analysis pinpointed land that was found to have excessive soil loss. Funding sources were secured and a 90% cost-share program was established for landowners in the Trout Run subwatershed. GIS helped target specific landowners and assisted in identifying on-the-ground areas for reforestation. Maps printed for the program assisted project personnel and landowners in planning best placement locations for reforestation practices.

GIS has also supported wetland restoration projects western portions of the UIRW, in Howard County, Iowa. This area of the watershed has been documented to have some of the highest nitrate levels in surface water in the entire UIRW. Studies conducted through Iowa State University have found that wetland creation can reduce nitrate levels in surface waters (IDALS). GIS analysis has identified areas that are at risk of high nitrate loss and areas that would be suitable for wetland creation/restoration. Landowners have these areas on their property, identified through GIS, are being contacted by field staff to implement best management practices or to install wetlands, both of which will have a positive impact on nitrate levels.

It is important to continue development of GIS as a tool for water quality analysis and conservation efforts in the UIRW. The UIRW Project and associated GIS Specialist act as a hub for GIS data and analysis in the watershed. Watershed-wide GIS analysis would not be possible without the efforts of the UIRW Project. Personnel from numerous agencies use GIS in the watershed and the UIRW Project strives to conduct advance GIS analysis and to assist local agencies as needed. *(See **GIS Analysis of the Upper Iowa River Watershed**, Appendix J)*

Forestry Resource Analysis

The US Forest Service paid for an analysis of the UIRW to include information concerning forest loss and its potential impact on water quality in the watershed between 1850 and 2000. This analysis indicated that over 250,000 acres of forest had been lost in the watershed. Historic surveys, soil types and landowner accounts were all used to validate the findings. Degradation of much of the remaining forest acres was reported by local resource personnel and confirmed through Iowa DNR Forester accounts.

Some of the functions and values of remaining forests that remain are not obvious to landowners. The massive root systems of the remaining trees stabilize soil on the steep slopes in the watershed. Much of the watershed is classified by the NRCS as Highly Erodible Land, HEL, because the soil types in the watershed are such that they are prone to high erosion. The classification is based on factors of soil type, the percentage of slope – how steep it is, and the length of slope. The average slope of the remaining forests in the Upper Iowa River watershed is approximately 30%.

The timber in the watershed not only stabilizes fragile soil but also works to move and clean both surface and ground water in ways that other vegetation does not. Trees intercept and slow down water as it flows over ground, reducing the amount of soil and nutrients that reach the streams and the river. The roots of trees provide pores for water to soak into the soil, increasing its water holding capacity by up to three times that of cropped or grazed land. Trees take up and store large amounts of nutrients and chemicals and absorb and purify several thousand gallons of water, per acre, per day, in their natural transpiration process. Scientists have documented the evapotransporation process of trees reversing ground water flow to lakes and decreasing the volume of water coming out of springs on hot days.

Understanding the significance of the forest loss in the UIRW, the NE IA RC&D partnered with the US Forest Service to evaluate the effects of forest loss on water quality. Through this partnership the UIRW Project found the sub-watersheds in the Upper Iowa River watershed with the greatest forest loss had some of the worst water quality in the watershed.

In an effort to determine if reforestation of the steepest slopes in the watershed would improve water quality, the Trout Run Reforestation Project was implemented through a partnership with the US Forest Service, Winneshiek and Iowa Farm Bureau, the McKnight Foundation and NE IA RC&D. A GIS analysis of Trout Run watershed, a sub-watershed of the Upper Iowa River with some of the worst water quality, provided some insight.

The Trout Run Reforestation Project targeted outreach and funding to landowners in Trout Run to plant trees on slopes greater than 12% and that were currently cropped. Water monitoring continues today to determine the impact of this outreach. The economic impact of the project was promoted to landowners. Timber can yield a rate of return of 15% and it's not taxed. The trees in Upper Iowa River watershed are important in the short term and in the long term. They not only provide wildlife habitat, and economic diversity; they are also an important piece of the water quality puzzle. *(See **Trout Run Reforestation Project Map**, Appendix A, Page G-21 & **Trout Run Reforestation Project Summary**, Appendix O)*

Example of hillside eligible for the Trout Run Reforestation Program.

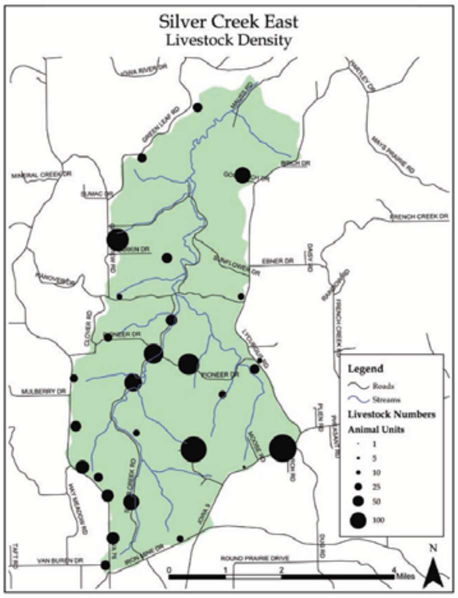
The Trout Run Watershed Project, pilot reforestation program, provided valuable information about landowner perceptions and attitudes. TSI cost share needs to be between 75% and 90% for participation. Landowners will only participate in CRP reforestation if incentive rates are equal to rental rates rather than $40 to $50 dollars below rental rates, as they are when based on soil type. Unless the rate of return on an annual basis is equal to or greater than the landowner's perceived return for cropping then revegetation of highly erodible lands will not occur. Reforestation, under these conditions will be prioritized to steep slopes (14% or greater) and the surrounding fields currently in row crop.

Pollution Source Inventory & Analysis

A detailed inventory of potential pollution sources was completed by the GIS Specialist at NE IA RC&D. This inventory included septic systems, municipal systems that contribute to surface waters, farm cooperatives, large feedlots and other features.

UIRW Project personnel worked with County Sanitarians, who estimated 60-90 percent of individual sewage septic systems were not functioning properly. GIS analysis indicates there are an estimated 6,500 Individual Sewage Treatment Systems (ISTS) in the UIRW. Additional analysis of the six worst subwatersheds pinpointed the systems but did not identify any specific trends related to septic systems and water quality. Sanitarians continue to partner with the UIRW Project by sharing private well water quality data and promotion of septic system replacement.

A livestock survey was completed by the Northeast Iowa RC&D GIS Specialist in 2004. This survey documented locations and characteristics of feedlots in the watershed, detailed data such as head number and manure storage type was collected in six subwatershed of the UIRW. A paired watershed study completed in that same year compared characteristics of a "poor water quality" subwatershed with characteristics of a "good water quality" subwatershed. The paired watershed study found that total number of animal units did not play as much of a role in determining fecal coliform levels in surface waters as livestock density in spatial relation streams and management practices. (See Paired Watershed Study of Silver and Ten Mile Creek Subwatersheds of the Upper Iowa River, Appendix H)



Example map of a livestock survey in portions of the UIRW.

Project water monitoring and outreach also provided information about point source pollutants. During one instance RC&D personnel were notified by concerned citizens familiar with the project when a local contractor buried tons of pollutants in the riverbank near Chester. During water monitoring unusual spikes in bacteria and nutrients were reported to the Iowa EPD who identified point source violations causing the spikes.

Since sinkholes have the potential to be contaminant dumps as well, sinkholes near roads have been identified for the entire UIRW. Studies conducted by the Minnesota DNR in the Minnesota portion of the watershed also delineated springsheds in a process intended to mitigate environmental damage inflicted by intentional contaminant dumping in near-road sinks. The studies not only identified springsheds but also documented travel times for liquids dumped in sinkholes.

Karst and Geologic Studies

Recognizing that karst features in the UIRW blur the subwatershed boundaries and make it difficult for land resource managers to address water quality issues, the UIRW Alliance Technical Committee advised that increased attention be devoted to analysis of the karst and geologic features. NE IA RC&D responded by partnering with the Hoffman Institute of Western Kentucky, the Minnesota DNR, the University of Minnesota, the Iowa Geologic Survey, US Geologic Survey Bureau and Olmstead and Fillmore County Water Resource Managers to conduct research and education projects. The UIRW Project began the process of GPS'ing springs and losing segments of streams in the karst portions of the watershed. *(See **Karst Feature Map**, Appendix A, Page G-10)* This information was utilized by project partners for dye tracing studies, with particular emphasis place on the karst watersheds that had demonstrated the poorest overall water quality, Coldwater and Pine subwatersheds.


Dye tracing in portions of the UIRW. (Coldwater Cave Project)

Delineation of springsheds was identified by natural resource managers as an important step in trying to change landuse for improved water quality. Springshed delineation provides a greater understanding of potential water pollutant sources as well as hydrologic travel time. Partners worked to determine subsurface karst flow in the Coldwater and Pine sub-watersheds of Iowa and in Minnesota portions of the watershed. They found it was rapid and documented subsurface flow carrying surface water through underground passages quickly. Floodwaters were documented to traverse basins of the UIRW in less than a day. Surface water was documented crossing defined topographic watershed boundaries and re-emerging from its underground travel in different watersheds, miles away from the source, within minutes or hours in Northeast Iowa and Southeast Minnesota, including in the UIRW, by the Iowa Dept. of Ag and Land Stewardship and the University of Minnesota. A limited number of springsheds in the UIRW were delineated; the majority has yet to be determined. *(See **Dye Tracing Map,** Appendix A, Page G-12 and **Coldwater Cave Groundwater Basin Study,** Appendix E)*

Project personnel also worked with the IGSB to submit an application for funding to USGS for extensive geologic studies that would define the location of the Decorah Edge feature in the UIRW and provide more detailed information concerning geologic formations in the watershed. This project was approved and is currently ongoing. *(See **Geologic Mapping of Impaired Watersheds in Northeast Iowa**, Appendix I)*

The Nature Conservancy, US Fish and Wildlife Service, the RJ McElroy Foundation and NE IA RC&D partnered in 2004 to study the accuracy of existing sinkhole maps and look for ways to develop more accurate methods of sinkhole identification and inventory. The current sinkhole maps were produced as long ago as 1968. The study, combined with additional ground truthing research completed through the UIRW Project, documented 269 sinkholes in the same twelve mile area that the IGSB estimated to include 118 sinkholes.

Water Quality Education and Public Participation

An important goal of the Upper Iowa River Watershed Project is to educate residents of the Upper Iowa River Watershed about water quality concerns and improvement efforts. It is also a high priority to involve them in the assessment process and the development of management strategies. Education and outreach was varied. Quarterly newsletters were distributed to UIRW residents during the majority of the project period. Periodic press releases were conducted throughout the project period. The UIRW Project Coordinator wrote a column for the largest paper in the watershed, the Decorah Journal, for several months during the project period. The column included information on all aspects of the watershed.

Students participating in the Upper Iowa River Valley Quest.

Hundreds of volunteers participated for thousands of hours in the Upper Iowa River Valley Quest, an educational sub-project of the UIRW Project. The volunteers ranged in age from pre-school through college. The volunteers worked through the UIRW Project to develop dozens of treasure hunts that engaged visitors and residents in educational scavenger hunts to natural areas in the UIRW. Field days were held for adults in the watershed including forestry field days, Conservation Tillage field days and karst education field days. During the project period from 1999 through 2002 over 200 presentations were delivered concerning the UIRW.

Dozens of these presentations were open to the public but the majority were given to interested groups or stakeholders including UIRW Alliance partnering organizations. The presentations provided a vehicle for clear, up-to-date communication concerning research and water monitoring results as well as a forum to gather input from landowners and watershed residents. To increase awareness of the resources in the UIRW, an UIR Canoe Guide was developed and distributed throughout Iowa with assistance from dozens of local sponsors and The Iowa Natural Heritage Foundation.

Sampling streams in the UIRW.

Northeast Iowa RC&D partnered with the IOWATER Program to bring Level I and Level II training sessions to the UIRW in Decorah. Over 80 IOWATER UIRW volunteers participated in IOWATER training during the first few years of the IOWATER program. Volunteers began independent monitoring, collective monitoring and were also paired with professionals to conduct side-by-side tests at select monitoring points. These volunteers continue to provide IOWATER data do date.

A series of public karst workshops were held in 2004. Through these workshops the UIRW Project brought in karst experts to educate hundreds of UIRW residents. The workshops included information on the karst features of the UIRW, the Decorah Shale, the Coldwater/Pine Study, and the Minnesota spring shed delineation studies that revealed information about issues in the UIRW.


Terry Lee, of Rochester, Minnesota presents on the Decorah Edge.

Twelve public meetings were held across the UIRW between 2000 and 2004. The meetings provided forums for communication between landowners and researchers. They also served to gather information and opinions from landowners and build interest in the watershed for improved water quality and watershed health. In 2002 a survey was sent to approximately 1,000 households in the UIRW, the survey was sent to nearly 10% of the households in the watershed. One household in each section of the watershed was selected randomly to receive the survey. Twenty-three percent of the surveys were returned and landowners citied soil erosion and agricultural chemical runoff were the largest problems in the UIRW, and 94% stating that "we should maintain or improve our surface water quality." Close to 90% of responses indicated that more incentives were needed for private landowners to adopt practices that benefit the environment. *(See **2002 Survey of Landowners in the Upper Iowa River Watershed**, Appendix K and **Farmer Feedback: Farmers' Views on Agricultural Conservation Issues in the Upper Iowa River Watershed**, Appendix L)*

An UIR canoe clean-up was held in partnerships with over 25 local and state businesses and organizations in September of 2004. Over 75 volunteers floated a 17-mile stretch of the UIR from Kendallville to Bluffton in canoes and kayaks removing over 1300 pounds of trash and recyclable materials from the river. The clean-up provided an opportunity for citizen-agency interaction and also documented pollutants in the UIR.

Environmentally Sensitive Area Surveys

Several sensitive ecosystems in the UIRW were identified by Natural Resource Managers serving on the UIRW Technical Alliance Committee as a high priority for assessment and protection. These ecosystems included Algific Talus Slopes and Mussel beds, which were home to threatened and endangered species.

Kayaker on the Upper Iowa River holds a large freshwater mussel.

Iowa State University, under contract by the Iowa DNR, conducted a mussel survey in rivers across the state. The UIRW Project assisted Luther College in a study that complimented that work. The Luther study provided a more detailed survey including locations, densities and species of mussels and mussel beds on the UIR. The studies identified 10 live species of mussels in the River, including one Iowa threatened, one Iowa listed, and three species under review. This is a dramatic decline from a previous study conducted fifteen year earlier by the Iowa DNR. The earlier study had estimated 20-24 live species. Sedimentation, cattle trampling of mussel beds and water pollution were indicated as potential causes of the decline in diversity and loss of water quality sensitive species. The decline in both fish species and movement of fish through the system were also noted as possible factors in the species richness and quantity reductions since mussels utilize walleyes as carriers during a portion of their life cycle.

According to the Iowa DNR, US Fish and Wildlife Service and The Nature Conservancy there are approximately 50 Algific Talus Slopes in the UIRW. They are considered some of the most fragile ecosystems in the region. Research revealed that although many of these slopes had been protected by public or non-profit organizations there are other contributing factors that are influencing their decline or destruction. These factors included the degradation of the sinkholes that provided water to the Algific Talus Slope system, livestock access to the slopes, and invasive species. The US Fish and Wildlife Service worked with project personnel to identify and notify landowners that had the potential to improve conditions on slopes. This included landowners with sinkholes above slopes in the Driftless Area National Wildlife Refuge. Landowners with potential private slopes were also identified. These landowners were provided monetary incentives to exclude cattle from the slopes. They were also notified of an existing program (continuous CRP) that pays landowners to put filter strips around the sinkholes. The Nature Conservancy, US Fish and Wildlife Service and the RJ McElroy Foundation also worked in partnership with NE IA RC&D to identify sinkholes that contribute to some of the most extensive Algific Talus Slopes. Filling of sinkholes, dumping in sinkholes and agricultural runoff into sinkholes that influence Algific continue to threaten their existence. *(See **R. J. McElroy Conservancy Planning Internship Final Report**, Appendix M)*

Section V

Assessment of Contamination Risks to the UIRW

Non-Point Sources

Livestock & Livestock Feeding Operations

The UIRW is home to an estimated 1,606 livestock producers. An inventory indicates the majority are small family operations with fewer than 300 animal units that do not meet the definition of a Confined Animal Feeding Operation (CAFO) under the current Clean Water Act. A DNA tracing study of bacteria in selected portions of the UIRW documented more fecal coliform bacteria from cattle in surface waters of the UIRW than any other warm blooded animal. In-stream pasturing and near stream feedlots are common. Typical feedlot runoff solutions are not required by law and are too expensive for the majority of the producers. Traditional methods of restricting livestock from surface waters are complicated by the flash flooding that occurs in the valley pastures. Engineering and funding is limited or unavailable for high or low cost fixes. (*See* ***Livestock Producer Map****, Appendix A, Page G-18*)

Cattle drink in an in-stream feedlot.

Erosion & Sedimentation

GIS and water quality analysis in the UIR Watershed has identified land-use trends and clusters of land-use trends on highly erodible land that are negatively impacting water quality in the UIR watershed. These areas require immediate attention. Land use in critical areas is impacting surface and ground water quality.

Example of sediment loss in the UIRW.

Erosion was identified as the number one concern for UIRW residents in a survey conducted through the UIRW Project (See Appendix K).

Average annual flow and suspended sediment reported in a study of Minnesota, Iowa and Wisconsin rivers by the US Geological Survey Bureau's: Tributaries Discharge and Sediment Transport from Upper Mississippi River and Illinois Waterway Cumulative Effects Study, puts the Upper Iowa River in perspective within its region. The study shows that the Upper Iowa River carries an annual total sediment load of 390,000 tons/year at Dorchester, Iowa. The same study ranked the Upper Iowa River 2nd out of the 13 rivers in the report for sediment load per acre of drainage area. The Upper Mississippi Fish and Wildlife Refuge reports backwater habitats, where the Upper Iowa River empties into the Mississippi River, have declined due to a sediment. The NE IA Rivers Basin study noted that excessive sediment in runoff adversely affects the quality of cold water for fish in several ways; physically harming the fish, reducing spawning, resting, and escape areas, decreasing invertebrate populations that serve as important fish foods, lowering water temperatures, and decreasing growth and survival rates. Sediment is also listed as a cause for failure of fish to produce in cold water trout streams.

The UIR Watershed Project has tied clusters of land use change to high soil erosion and high turbidity levels in the UIR watershed. The UIR Watershed Project estimates, based on the US Soil Survey and historic surveys, that the watershed has lost 230,000 acres of timber in the watershed since 1850. The US Forest Service estimates that when 50% of the timber in a watershed is removed, the hydrology of that watershed is dramatically altered.

Although reforestation is expensive, economic analysis of input cost to crop yield indicates landowners are losing money on these acres by cropping them. Farmers in the UIR Watershed average a net cash return that is $13,000 less than the Iowa average. The UIR Watershed Alliance feels that reforestation of the identified critical areas must be a priority if water quality is to be improved, the alliance also feels that landowners must understand the economic and environmental losses associated with farming steep hillsides

The Northeast Iowa River Basin Study reported land use from 1949 to 1974 intensified dramatically with a 530% increase in corn acreage and a 46% increase in soybean acreage. Data for the past 25 years indicates the trend toward row cropping of steep highly erodible pasture has continued. If the trend toward row cropping steep highly erodible land continues to accelerate without check, the erosion problems are predicted to accelerate throughout the UIR watershed.

The NRCS attributes high percentages of sedimentation to stream bank erosion. Stream bank erosion in the UIR watershed has been related to livestock overgrazing stream and river banks. The UIR Watershed Project helped coordinate development of the Upper Iowa River Corridor Protection EQIP to address stream bank erosion. This successful watershed wide EQIP program was developed with input from the Winneshiek County Cattlemen's Association. Ranking for the program was developed using water quality information collected by the UIR Watershed Project; targeting the areas with the worst water quality first. Local Soil and Water Conservation Districts documented waiting lists of producers beyond available funding.

Nutrient Loading

Data from the US Geological Survey Bureau, the University of Iowa, Luther College and the City of Decorah indicate a 38% increase in nitrogen in the UIR, several springs, and shallow uncased wells over the past 25 years. The increase in nitrates in the UIRW parallels the rest of Iowa. Unfortunately, nitrates in the City of Decorah's wells, which are shallow alluvial wells, next to the UIR, have also increased dramatically from 2 to 3 mg/L to as high as 8.5 mg/L. *(See **Atrazine Levels Map,** Appendix A, Page W-2**, Bacteria Levels Map,** Appendix A, Page W3-4**, Nitrates Levels Map,** Appendix A, Page W-5 **& Phosphate Levels Map,** Appendix A, Page W-6)*

Water quality monitoring conducted by the Upper Iowa River Watershed Alliance indicates that the subwatersheds in the western portion of the UIRW are contributing some of the most consistently high average concentrations of nitrogen to the UIR. This portion of the watershed also has the greatest wetland loss and most intensive agriculture. Analysis indicates the loss of wetlands not only increased flows in the UIR; creating an environment that promotes siltation, erosion, and channelization and thus stream degradation, but also combined with subsurface drainage networks to increase the ability of nitrates to enter the surface water.

Spring runoff of farm fields in the UIRW.

A survey of Staff and Beaver (Iowa) subwatershed residents indicates that of the 73% surveyed or 51 respondents treated their drinking water. The area has some most intense agricultural usage in the UIRW with 78.8% of the area in cropland.

The UIR Watershed Project has also recorded high nitrate levels in Silver Creek Cresco, a 22,200-acre sub-watershed divided in half by the Howard/Winneshiek County line. Statistical analysis of all six parameters tested for in the UIR Watershed Project ranks Silver Creek Cresco number one for worst water quality in the UIRW. The City of Cresco in Howard County discharges its wastewater into Silver Creek. Silver Creek drops underground downstream of the discharge through multiple in-stream sinkholes. Although this stream drains a large surface area, the extensive streambed karstification takes all surface water underground during low flow conditions.

Nutrient runoff from agricultural land represents one of the greatest non-point sources of pollution in Iowa. Excess nitrogen and phosphorus runoff leads to increased plant growth in streams and rivers and can lead to a condition referred to as hypoxia, which many believe is the cause for the “Dead Zone” in the Gulf of Mexico. Since agricultural land use in Iowa is near 90%, controlling nutrient runoff is of great concern. In the UIRW, row crop agriculture accounts for 41.5% of the landuse. The intensive agricultural practices, combined with the regions steep slopes, make controlling runoff of nutrients a high priority.

Urban Growth & Development of Sensitive Lands

Although only 3.3% of the UIRW is considered to have an urban landuse, the impacts of an urban environment are known to have a drastic impact on water quality. The UIRW Alliance has been testing water quality in an urban watershed of the UIRW; Dry Run Decorah. This small watershed's landuse is nearly 60% urban, with the remainder consisting mostly of forest and grasslands. According to the EPA, nonporous urban landscapes impede runoff from slowly percolating into the ground, therefore water remains above the surface, accumulates, and runs off in large amounts. Cities install storm sewer systems that quickly channel this runoff from roads and other impervious surfaces. When water leaves the storm water system and empties into a stream or river, large volumes of quickly flowing runoff erode stream banks and damage streamside vegetation. Also, discharged storm water tends to have higher temperatures resulting from heating on impervious surfaces. Native fish and other aquatic life cannot survive in urban streams severely impacted by urban runoff. Urban runoff also increases the variety and amount of pollutants transported to receiving waters. Sediment from development and new construction, oil, grease, toxic chemicals from automobiles, nutrients and pesticides from turf management and gardening, viruses and bacteria from failing septic systems, road salts, and heavy metals are examples of pollutants generated in urban areas. Urban development of sensitive lands in the UIRW is a concern, especially sensitive areas such as floodplains and blufflands. *(**See Landcover Map**, Appendix A, Page G-3)*

Sinkhole in the UIRW.

Sinkholes & Disappearing Streams

The UIRW is estimated to have over 2,500 sinkholes and 67 disappearing streams. Sinkholes and losing streams have been identified as critical areas that have a great impact on water quality. Sinkholes act much like agricultural drainage wells, transporting unfiltered surface water quickly to aquifers and underground rivers to reemerge in drinking water wells, springs, or on Algific Talus Slopes. The Iowa DNR has identified sinkholes as a threat to groundwater. *(See **Karst Features Map,** Appendix A, Page G-10)*

Deforestation

Deforestation has altered the hydrology in the watershed and current land use in critical deforested areas has been linked to surface and ground water quality impairment. Over 40% of the UIRW has been deforested based on GIS analysis of historical and current land cover data. The US Forest Service estimates that when 50% of the timber in a watershed is removed, the hydrology of that watershed is dramatically altered. *(See **Forest Loss Map**, Appendix A, Page G-20)*

There are over 30,000 acres of steep slopes, greater than 12%, with fragile forest formed soils currently being cropped in the UIRW. They are estimated to be eroding at 76 – 160 tons/acre/year or greater. Although these acres are only small portions of fields, averaging 3 to 5 acres in size, together they have a tremendous impact on water quality. GIS analysis shows 45% of the watershed has slopes greater than 10% and high potential for erosion. Land use in these areas results in thousands of tons of sediment eroding each year.

Artificial Drainage Systems & Hydrologic Modification

There are three dams in the Upper Iowa River. Although the Minnesota and Iowa DNR have considered removing these dams, landowner opposition and habitat concerns have prevented or delayed this action.

The hydrologic modifications caused by the dams is considered minimal compared to the loss of wetlands in the western portion of the UIRW.


One of three dams on the UIR.

Most of the UIRW is characterized by steep topography but western portions of the watershed become increasing flat and begin to resemble the "Prairie Pothole" region of Iowa where wetlands become increasingly important. Tiling is this portion of the watershed has become a common solution to convert poorly drained soils into highly productive cropland. Tile drained lands are characterized by reduced surface flow and increased subsurface flow which can lead to increased losses of nitrates. Higher nitrates in the western portions of the UIRW have been documented by water testing; this is the portion of the watershed where tile installation is common practice.

Thousands of wetland acres in Iowa have been drained and tiled for increased agricultural production. Studies indicate that 89% of Iowa's original wetlands have vanished, Iowa ranks near the top in state rankings of wetland loss. Wetland loss limits hydrologic holding time and water filtration. Nitrate and atrazine levels are highest in the areas with the greatest wetland loss. GIS analysis has identified 7056 acres suitable for wetland restoration in the UIRW. The majority of those acres are in the western portion of the watershed where over 70% of residents report treating their drinking water. High nitrate water is sent down the Upper Iowa River to the City of Decorah, which has documented nitrate levels approaching 10 ppm in their wells.


Tile installation in the UIRW.

Wetland loss has also decreased surface and groundwater static levels. Howard County Supervisors report that private landowners in the western portion of the watershed are reporting wells drying up. Rainfall moves through tiles and off the land quickly to cause flash flooding downstream. This flash flooding has increased in frequency and intensity, destroying stream banks and riparian areas and making vegetative bank stabilization very difficult.

Roads, Highways and Bridges

Roads, highways, and bridges can be a source of significant contributions of pollutants to surface waters. The UIRW contains 1,944 miles of roads, hard surface or gravel. Contaminants from vehicles and activities associated with road and highway construction and maintenance are washed from roads and roadsides when it rains or when snow melts. A large amount of this runoff pollution is carried directly to streams and rivers. (*See* ***Transportation Infrastructure Map,*** *Appendix A, Page G-9)*

Atmospheric Deposition

Atmospheric deposition throughout the United States is also a source of pollution in the nation's waters. Iowa currently has two monitoring sites as part of the National Atmospheric Deposition Program/National Trends Network (NAPD/NTN). Through the NAPD/NTN research so far, it has been determined that higher ammonium ion concentrations are associated with agricultural lands in the Midwest and central plains which likely result from fertilizer applications and livestock. Nitrate ion concentrations at both Iowa sites are also higher than at many of the other sites in the southern and western regions of the United States. Excess nitrate or ammonia in rainfall on lakes and streams can stimulate algae growth, eventually depleting oxygen levels which can affect fish and other aquatic organisms. (State of Iowa Nonpoint Source Management Program 9-2000)

Point Source Inventory

The following inventory is by no means a complete listing of possible point source pollutants. The inventory does touch on some of the prevalent point sources in the UIRW.

Shoreline Erosion

Severe soil erosion caused by flash flows occurs throughout the UIRW. This erosion is exacerbated by de-vegetation of riparian areas. Plantings adjacent to the river are limited by the severe erosion, which has been documented to cut away several feet of soil from stream banks each year.

Outdated Individual Sewage Treatment Systems

There are an estimated 4,311 households outside city or town boundaries that have some sort of waste treatment system. Sanitarians in the watershed estimate that 70 to 90 percent of the individual sewage treatment systems in the watershed do not function properly, or are discharged directly into streams, ditches or tile lines. Human waste, most likely from outdated sewage treatment systems, has been found through DNA bacteria tracing to be impacting water quality. The DNA study found that during winter months up to 100% of the fecal coliform bacteria in some surface waters is from humans.

Wastewater Treatment Facilities

Effluent that leaks, or is discharged, from incorporated or unincorporated towns may impair water quality in the UIRW. There are still towns in the watershed with outdated sewage treatments systems, some of which have been cited for illegal discharge into the UIR or its tributaries. There are 12 incorporated towns in the watershed that have no organized waste water treatment system. In the Iowa portion of the watershed, there are 10 municipal treatment plants, 21 industrial wastewater treatment facilities, and four semi-public wastewater treatment facilities.

Quarry Sites

Quarry sites in karst watersheds, such as the UIRW, have been documented in the Minnesota portion of the watershed to have tremendous impacts on both surface and ground water quality and quantity. Iowa DNR has documented surface water quality impairment due to improper dewatering of quarries. There are 67 quarries in the UIRW in Iowa, of which 13 are closed, 50 are open, and three have a release request. Products mined in the quarries include aglime (17 quarries), limestone or dolomite (53 quarries), sand (17 quarries), and/or gravel (8 quarries).

Recreational facilities

The UIRW is a destination location for recreational visitors from throughout the U.S. Visitor activities in the watershed may be sources of human and animal contamination. There are many campgrounds that lie in close proximity to the UIR and its tributaries, these campgrounds could possibly impact water quality in the watershed.

Industrial Facilities

Industrial spills and disposal of hazardous materials have been a source of contamination in the UIRW. Since the Iowa DNR began documenting fish kills there have been four known kills in the Upper Iowa River Watershed, at least two of the kills were a result of industry.

Leaking Storage Tanks

Leaking from underground and above ground storage tanks is a possible pollution source in the Upper Iowa River Watershed. The Iowa DNR has documented 87 underground storage tank locations in the Upper Iowa River Watershed. The Iowa DNR has also documented 38 leaking underground petroleum storage tank sites in the Upper Iowa River Watershed. Of the 38 sites, 9 have been defined as high risk. Of the high risk sites, 6 are within one mile of the Upper Iowa River, and all 9 are within 1 mile of a stream or river in the watershed.

Landfills

There are seven landfills or dumps contained in the UIRW.

Cooperatives

Farm chemical dealerships can be a source of contamination in the watershed when vandalism or accidents occur. There are 22 cooperatives or farm supply companies in the UIRW.

Section VI

Targeted Solutions & Management Strategies

Goals

The assessment and inventory of the UIRW helped the UIRW Alliance identify landuse changes and trends contributing to poor water quality and impairing the ability of the watershed to function efficiently and effectively. It also created the opportunity for improved management that targets funding and technical assistance to subwatersheds according to existing water quality. However, the assessment was more detailed than simple water quality monitoring. The many faucets and details of the assessment allow it to be used to target technical assistance and funding according to the: water quality of subwatersheds, the clusters of poor land use, landscape position within sub-watersheds, water quality in relation to designated water use, water quality in relation to karst feature contribution, surface water travel time, springsheds, potential protection of threatened and endangered species, potential for improved watershed capacity, and many other factors as described in the assessment.

Management strategies are best applied when as many targeting justifications overlap with water quality improvement as is strategically possible. This maximizes funding, partnerships and landowner participation. The potential ratio of outreach to participation in the UIRW has also been increased with the development of a landowner data base that allows all targeting to occur to the landowner level. The UIRW Alliance is currently implementing several targeted solutions and continues to work together to implement funded management strategies throughout the UIRW. These solutions and strategies will all improve surface and ground water quality and improve watershed health.

The UIRW Alliance Technical Committee has always agreed they must maximize existing programs. The assessment has always been tailored to that end. In keeping with that philosophy, they have agreed to review the Conservation Security Program, CSP, to determine if that program's management strategies are successful. They would like to structure future outreach to recognize healthy agricultural operations, complementing and promoting CSP in the UIRW, as well as preparing landowner for future CSP opportunities. They will utilize the assessment to prepare the landowners, fill the gaps for qualifications and bring everyone up to the expectations of the CSP. The UIRW Assessment has prepared natural resource managers and stakeholders to maximize the CSP program.

Solutions and strategies for water quality and watershed health have multiple benefits including economic benefits to landowners and increased long term sustainability of farming in the watershed, which are listed. They also have other benefits that will not be discussed in this section, such as increases of and improvements to terrestrial wildlife habitat.

Strategies

1) **Improve the hydrologic functioning of the UIRW, i.e. increase the watersheds holding and filtering capacity**
   - Reduce transport of nutrients and nutrient loading
   - Reduce flash flooding
   - Increase strategic placement of native vegetation throughout the watershed including wetlands, forests and prairie vegetation
   - Increase the function and values of existing vegetative communities
   - Improve the water management capacity for landowners
   - Protect sensitive karst features, including sinkholes and losing streams, from direct runoff

2) **Improve management and use of nutrients and pesticides**
   - Increase nutrient uptake and utilization
   - Reduce nutrient loading of the UIR

- Decrease nitrogen in Decorah's municipal drinking water and rural wells
- Improve the water quality of waters flowing to or on Algific Talus Slopes
- Reduce nutrient and pesticide levels in private wells

3) Improve management and disposal of animal and human waste

- Reduce bacterial levels in Class A sections of the UIR and protect the public health of river users
- Reduce bacteria levels in private wells
- Increase the functions and values of pasture in desirable locations
- Increase livestock management in relation to water resources and water access
- Improve the viability of small farms in relation to the economics of water quality
- Increase utilization of animal waste as a resource

4) Decrease soil erosion

- Increase the utilization of BMP's in sub-watersheds that are contributing the greatest quantities of sediment to the UIR
- Reduce sediment loss from the steepest slopes (greater than 14 %.)
- Improve the sustainability of land use in the UIRW or the potential of the land to be used for food and wood production and individual and community economic stability over a longer period of time
- Reduce the sedimentation of the highest quality resource waters
- Improve survival and reproduction of trout in cold water streams
- Increase the size and viability of mussel communities in the UIR

a. Utilize the least erodible ground for row crop agricultural production and the most highly erodible land for livestock and timber production

5) Increase Perennial Vegetation in the Upper Iowa River Corridor

- Provide a final defense or vegetative barrier that will decrease nutrient and pesticide loading of the UIR
- Reduce immediate degradation of the UIR

Methods

Increase Nutrient & Pesticide Management

Recap: The high levels of nutrients and pesticides found in rural surface waters of the UIRW indicate over application of nitrogen, phosphorous and Atrazine on row crops. Surveys of landowners in the specific subwatersheds demonstrating high levels of nutrients in surface waters, indicates landowners may be over applying (this statement is based on ISU and Minnesota Extension recommended rates in relation to actual application rates.) The landowner surveys also indicate that only one out of 35 landowners surveyed counted the manure they applied as a nitrogen source. The high nutrients and pesticides in the UIRW, particularly nitrates and Atrazine, are a concern for the City of Decorah as well as rural residents. Surveys also indicate a high percentage of rural landowners must remove nitrates from their well water. The majority of rural residents in the UIRW pull their drinking water from shallow aquifers. Karst areas of the watershed move nutrients and pesticides at abnormally high rates, without filtration or breakdown time that usually occurs in non-karst landscapes and surface waters.

Increased nutrient and pesticide management on agricultural lands is needed to reduce the excess loss of nutrients from the source. This will not only reduce nutrient loading, it will also improve profitability of farms. These efforts should be prioritized by water quality, with priority given to subwatersheds upstream of Decorah. The UIRW Alliance is supportive of the efforts in the Staff/Beaver Proposal to address this issue, giving this project priority for additional funding targeted at nutrient and pesticide reduction in the

Iowa portion of the watershed. The proposal includes BMP's to reduce the impact of agricultural production on the UIR. Goals of the project include enrolling 5,000 acres of cropland into a nutrient and pesticide management program, working with landowners to implement the plans and following up with record keeping. It also includes development of a phosphorous index on land receiving manure applications, completion of manure management plans for farms that do not current have them, updating existing plans, and completing manure/nutrient management plans on farms not required to have DNR plans. Several partners are conducting demonstrations and on-farm research. The UIRW Alliance feels this broad approach is important to the successful reduction of nutrient and pesticides.

The Minnesota portion of the watershed in Mower County documents higher levels of nutrients and pesticides than in any subwatersheds in Iowa. The best strategy for nutrient and pesticide management includes targeting Mower County portions of the watershed for the same type of outreach scheduled in Howard County – Staff/Beaver Creek Project. *(See **Atrazine Levels Map**, Appendix A, Page W-2, **Nitrate Levels Map**, Appendix A, Page W-5 & **Staff/Beaver Creeks Water Quality Project Application**, Appendix N)*

Wetland Restoration & Tile Management

Recap: Conversion of wetlands to cropland combined with tiling has limited hydrologic holding time and thereby limited water filtration in the UIRW. According to surveys conducted by the Howard County SWCD 70% of residents in the western portion of the UIRW treat their drinking water. The nitrate-laden water is sent down the UIR to the City of Decorah where it impacts municipal drinking water supplies. Wetland loss has also been blamed for reducing surface and groundwater static levels and drying up private wells in Howard County, causing flash flooding downstream, increasing the frequency and intensity of flooding, destroying stream banks and riparian areas and making vegetative bank stabilization nearly impossible. Recognizing that the draining and tiling of thousands of wetland acres has impacted water quality and watersheds health, wetland restoration is a management strategy that will provide multiple benefits.

Although the dramatic reduction of wetlands calls for wetland restoration or development throughout the watershed, there are limited areas that are more conducive to wetland establishment. The two areas of the watershed that have the greatest potential for wetland establishment are the UIR bottomlands and the sections of the UIRW in Howard and Mower Counties.

Wetlands established in the UIR bottomlands could be a last defense mechanism for nutrient and pesticide removal, particularly nitrate removal. The UIR Corridor is a high priority area for several agencies and organizations trying to protect the river. This strategy calls for those organizations to consider partnering for private lands wetland restoration in the UIR bottomlands. Limited wetland establishment has begun through private partnerships and funding. These efforts will create a buffer for the river from both nutrient loading and urban expansion and development. They also provide valuable wildlife habitat and help ensure the wild and scenic attributes of the river.

The UIRW Alliance Technical Committee agrees that reductions of nitrates in the UIR at Decorah is a critical need and therefore puts greater importance for wetland development upstream of Decorah. They supported the development and implementation of a project in 41,328 acre area of Howard County, in the Staff and Beaver Creek subwatersheds, and the adjacent drainage areas of the UIR. The area was found to have the greatest level of nitrates of any in the Iowa portion of the UIRW, they have appropriate soils for wetland development and wetlands historically dominated the landscape. The project includes GIS targeting to identify landscape positions within the subwatershed that allow for the least conversion of crop acres to wetland for the greatest potential nitrate removal. The targeting has identified the specific landowners within these critical acres, but is flexible enough to account for non-participation. The Staff & Beaver Water Quality Project requests 75% cost share for wetland restoration. The project also utilizes tile management techniques to regulate nutrient loss from tiled fields.

The Alliance also feels the Staff/Beaver Project area should be targeted for additional landowner funding and technical assistance for targeted wetland restoration, much in the same way North Central Iowa was targeted through the Conservation Reserve Enhancement Program or CREP. The Alliance feels that the eligible CREP area in Iowa should be expanded to include this area. State administers of the CREP program should work closely with the NE IA Regional Watershed GIS Specialist to identify eligible acres and landowners.

The UIRW Alliance also recommends targeted wetland restoration in three Minnesota subwatersheds including the North Branch of the Upper Iowa, the Little Iowa River, and Beaver Creek (Minnesota) for the same reasons. The Alliance recommends that wetland restoration in these areas be targeted by the same methods used in the Staff/Beaver Project, allowing for the least number of crop acres to be converted to wetlands for the greatest potential nitrate removal. *(See **Targeted Areas for Wetland Restoration Map**, Appendix A, Page T-8)*

BMP's, Reforestation and TSI to Reduce Sediment Loss from HEL

Recap: GIS analysis indicates over 230,000 acres of land have been deforested in the UIRW since 1850. Thousands of acres of steep slopes, greater than 12%, with fragile forest formed soils, are currently being cropped. They are estimated to be eroding at 50 – 160 tons/acre/year. Erosion from these HEL croplands corresponds with turbidity levels in tributaries. The remaining forest acres in the UIRW have been degraded by livestock, logging, and urban sprawl. Studies show that landowners that participate in Timber Stand Improvement place a higher value on timber and are less likely to remove or degrade their timber in the future, preventing future sediment loss. The demand for reforestation and timber stand improvement has outpaced available funding and technical assistance. Approximately 70% of the residents in the subwatershed of greatest deforestation treat their drinking water.

Highly erodible land, with greater than 14% slopes, is a priority for reforestation. Modeling predicts that reforestation will conserve thousands of tons of soil each year, improve water quality and restore hydrology. Promotion of BMPs including Timber Stand Improvement, TSI, will continue. Previous incentive sign-ups for these practices have documented high landowner interest. A pilot project targeted Trout Run Subwatershed for a pilot reforestation program between 2002 and 2004. The Trout Run Reforestation Project was the first of its kind in the nation. It targeted HEL slopes for reforestation to improve water quality in an agricultural watershed.

The Trout Run Watershed Project, pilot reforestation program, provided valuable information about landowner perceptions and attitudes. TSI cost share needs to be between 75% and 90% for participation. Landowners will only participate in CRP reforestation if incentive rates are equal to rental rates rather than $40 to $50 dollars below rental rates, as they are when based on soil type. Unless the rate of return on an annual basis is equal to or greater than the landowner's perceived return for cropping then revegetation of highly erodible lands will not occur. Reforestation, under these conditions will be prioritized to steep slopes (14% or greater) and the surrounding fields currently in row crop. This reforestation will be prioritized to the sub-watersheds with the highest turbidity and phosphorous levels. TSI will be prioritized to the remaining forested acres on slopes greater than 12%. NRCS should target funding for Reforestation & Timber Stand Improvement, Livestock exclusion. *(See **Targeted Areas for Reforestation** Map & **Targeted Areas for TSI** Map)*

Pasture Management and Rotational Grazing

Recap: Over the past 25 years NRCS has documented an increase in soybean production on HEL and a decrease in pasture and hay. This is a concern in the UIRW where 45% of the watershed has slopes greater than 10%. The loss of pasture and hay on HEL has resulted in sedimentation in high priority waters. The remaining pasture and hay in the watershed are located in critical areas and must be maintained as healthy perennial vegetation. Thousands of acres in the UIRW have been enrolled in the Conservation Security Program over the past ten years. These acres are scheduled to come out of the program and go back into production within the next few years.

Incentives for establishment, enhancement and maintenance of hay and pasture encourage perennial vegetation on highly erodible lands. The incentives must be substantially increased or the conversion of HEL land from pasture or hay to soybeans is likely to continue. The hay market is volatile and simple solutions are not feasible. The weather is also a factor. These risks must be reduced. Farmers must be feeding their hay rather than storing it. Programs that utilize non-traditional options must be explored including custom feeding heifers, etc. Assistance must be provided with new business establishment and management as well agronomic assistance to maximize pasture and hay land rate of return.

UIRW Alliance members supported an effort to introduce Hay as a Commodity as a pilot program in the Driftless Area, including the HEL portions of the UIRW. Although this effort was not successful, they feel some measures must be taken to address this alarming trend or land use shift. They recommend agency cooperation and collaboration for development of a plan to reverse the trend.

Filter Surface Water Entering Karst Features

Recap: The UIRW is a karst watershed with complex surface and ground water connections. It is estimated to have as many as 6000 sinkholes and 10 streams that flow over fractured bedrock. The water entering sinkholes and losing streams carries surface water rapidly underground without the benefit of photo-synthesis, in stream biotic activity, or filtration that occurs in surface waters. Waters resurface within hours many miles away in springs, Algific Talus Slopes, wells, cold water trout streams & the UIR. Sinkholes and losing streams are critical ground water recharge areas, acting much like natural agricultural drainage wells, except they provide water to recharge shallow drinking water aquifers that are still used by thousands of landowners in the watershed and also send water to sensitive high quality resource surface waters.

USDA currently provides limited incentives for sinkhole protection through the Continuous Conservation Reserve Program, CCRP. Unfortunately the incentives provided through this program are not perceived by landowners to be worth the effort it takes to participate in the program. Fields with sinkholes typically have more than one sinkhole, yet the CCRP does not provide for connection of filters between sinkholes. This restriction cuts up fields into unusable portions. Some segments of losing streams that do not frequently hold surface water are excluded from the CCRP program. These segments are perhaps some of the most crucial to ground water quality as well as transport of surface waters to high priority waters and springs, rapidly and without the benefit of filtration. Education and additional financial incentives to place native grasses or other perennial vegetation around sinkholes and next to losing streams is needed to even engage landowners in discussion. Technical assistance and additional funding will be prioritized to subwatersheds that have high densities of sinkholes combined with poor overall water quality, including the Upper Iowa River above Decorah. This protection must also include additional NRCS incentives for filter strip around and between sinkholes, filter-practice. Funding for structures such as sediment retention basins that filter water but allow it to pass through the system, grade stabilization-practice, & water and sediment control basins practice. *(See **Targeted Areas for Karst Protection Map**, Appendix A, Page T-3)*

Provide Low-cost Feedlot Fixes for Small Livestock Operators, Ag Waste Storage & Settling Basins

Recap: An inventory of livestock in the UIRW locates over 1600 producers. A DNA study documented more fecal coliform bacteria from cattle in the UIRW than any other warm-blooded animal. Typical feedlot runoff solutions are not required by law for the small operators and are too expensive for the majority. Traditional methods of restricting livestock from surface waters are complicated by the flash flooding that occurs in valley pastures and by the limited land available for pastures in the watershed. Pasture management is needed to maximize the pastured areas away from surface waters and karst features. According to the Livestock Survey hundreds of pastures are located on streams and on the UIR. In-stream pasturing and near stream feedlots are common. The paired watershed study indicates that livestock location within a watershed is one of the top factors in determining water quality. The Upper Iowa River Corridor Protection EQIP included incentives for landowners to remove livestock from the UIR in concert with increased pasture productivity away from the river. The EQIP funding addressed the concerns of the Cattlemen's Association and allowed landowners to flash graze river and stream corridors. All funding was utilized and there was a waiting list for additional funding, demonstrating strong landowner support. Feedlot runoff travels more quickly through karst systems, with less filtration.

The methods and incentives used in the UIR Corridor Protection EQIP proved successful and should continue to be used. Livestock and Pasture Management will be targeted toward riparian zones and environmentally sensitive areas. Permanent fixes such as clean water diversions, riparian exclusions, filter channels, settling basins and other BMPs will be promoted. *(See **Targeted Areas for Ag Waste Storage** Map, Appendix A, Page T-1)*

Pasture management that improves the productivity of pastures located away from streams is a strategy the UIRW Alliance agrees will make it more economically feasible for landowners to restrict livestock access to flowing surface waters. Rotational grazing funds will be prioritized to livestock operations that spend the majority of their time within 1000 feet of streams or of the Upper Iowa River. Cost share rates must be evaluated based on previous cost share success, 75% may not be high enough for large scale adoption. Once cost share rates are adjusted to provide sufficient incentive, specific practices in these targeted areas that should be funded include; prescribed grazing-practice, heavy use area protection – practice, fencing-practice, livestock exclusion-practice, pasture seeding-practice, off stream watering facilities. Stabilization is needed to repair and restore severely impacted stream banks so that plantings adjacent to them can be successful. Low-cost Feedlot Fixes, Pasture Management, and Streambank Stabilization and Animal Waste Funding will be prioritized to subwatersheds with combined high fecal coliform and phosphorous levels, with priority in those areas to feedlots in the Upper Iowa River Corridor and in close proximity to streams. NRCS should contribute funding for incentives and practices that keep clean water from washing through feedlots including clean water diversions- a structure built to divert water around a feedlot. Rain gutters and roof runoff management that collect control and transport precipitation from roofs should also be used. Funding will be used for practices that remove waste from feedlot runoff or prevent waste from entering the stream– filter strips, fences that allow landowners to shorten-up feedlots to get them further away from streams and remove livestock from streams, and other animal waste system management.

In-stream and Near Stream Restoration

Recap: Severe soil erosion, caused by flash flows, occurs throughout the UIRW. Plantings adjacent to the river and streams are limited by the severe erosion, which has been documented to cut away several feet of soil from stream banks each year. In-stream habitat in cold-water trout streams and in the UIR is being degraded by the shoreline erosion. Rock and riprap is geologically, hydrologically and historically appropriate in the UIRW, where rock bottoms and banks are common. The riprap is quarried locally and provides a natural looking stabilization. Vegetative stabilization merges well with the riprap.

The Alliance supports streambank stabilization, riparian zone protection and instream habitat restoration as long as every effort has been made upstream of the site to restore the hydrology of the system. Stream bank stabilization with be prioritized to streams classified by the DNR as high quality resource or high quality streams that lie in the watersheds with turbidity levels above average for watersheds in the UIRW. Targeted funding for practices include streambank and shoreline protection, which will be used in conjunction with in-stream habitat restoration, including fish habitat. Any disturbed areas will be seeded with native grasses including stream filter strips. Grade stabilization structures, will be used in near stream areas where active gullies are present. (*See **Targeted Areas for Streambank Stabilization**, Appendix A, Page T-6)*

Riparian Zone Protection

Riparian Zone Protection must continue to be a high priority, particularly in the UIR Corridor. The Corridor was evaluated as a sub-watershed and as such was targeted for improved water quality through wetland restoration, native grass restoration reforestation, cattle exclusion or limitation to the river, and other specific outreach. The UIR Corridor is recognized as a High Priority and should not be neglected due to targeting of the sub-watersheds. The UIRW Alliance feels that the paired watershed research as well as the DNA study indicates feedlots within the UIR Corridor should be a high priority. The UIR Corridor EQIP previously targeted this zone for increased incentive and very successfully engaged landowners.

Programs including EQIP, Continuous and General CRP, the Wetlands Reserve Program, REAP; the Floodplain Management Reforestation Program and WHIP are all in use in the watershed. Unfortunately, these programs have not been funded at a high enough level to impact the system. If these programs were used to complement additional targeting funds they may provide enough incentive for adoption throughout the riparian zone. They could then have an impact on water quality as well as protect and enhance the riparian zone. Planting and managing timber, filter strips, livestock exclusion or restriction, stream crossings and other BMPs should be priorities in the riparian zone. Bank stabilization and in-stream habitat restoration will at times be necessary for successful riparian restoration. Livestock and feedlot management must also occur for successful reduction of bacteria in the UIR Corridor. *(See **Targeted Areas for Riparian Zone Protection Map**, Appendix A, Page T-5)*

Individual Sewage Treatment System, ISTS Replacement

Water quality sampling and DNA analysis indicates ISTSs in the UIRW are contributing to bacteria levels in ground and surface waters. Sanitarians in the watershed estimate that 70 to 90 percent of the individual sewage treatment systems in the watershed do not function properly, or are discharged directly into streams, ditches or tile lines. Efforts should continue to be made to inform watershed residents of problems posed by outdated or non-functioning septic systems and resources available to them for repairs or replacement. The Onsite Wastewater Systems Assistance Program (OWSAP), available though the State of Iowa, offers low interest loans to individuals wishing to make improvements or replace their septic system. Additional measures should be taken not only to enforce existing laws but also to provide grants to low-income individuals. Counties in Minnesota are considering enforcement of existing laws on a rotational basis, notifying landowners of the rotational schedule prior to enforcement. *(See **Targeted Areas for Septic System Improvement Map**, Appendix A, Page T-2)*

GIS Development

It is crucial to have an up-to-date library of GIS data and resources that can assist in targeting critical areas for best management strategies and conservation efforts in the UIRW. Currently GIS is used in all aspects of the NE IA Regional Watershed Project including, analysis of water quality data to identify areas for reforestation, buffer strip installation, wetland restoration, feedlot management and more. It is important to continue to using GIS as a tool for water quality analysis, to track land use changes and document conservation efforts in the UIRW. The Northeast Iowa Regional Watershed Project will also serve as a central GIS contact in the watershed that can serve to provide up to date information and assistance. Personnel from numerous agencies are using GIS in the watershed and the NE IA Regional Watershed Project strives to assist local agencies as needed.

Point Source Pollution Awareness & Interagency Communication

Point source pollution sources have been proven to cause immediate water quality degradation in the UIRW. Several point source pollution sources were identified through the project via water monitoring and outreach. The UIRW Project Personnel and Alliance members must continue to work with local Sanitarians, the Iowa Environmental Protection Agency and other point source enforcement personnel to exchange information, increase awareness, compliance and to find alternative financing for organizations or individuals that need assistance.

Alliance Building

The Mission of the Upper Iowa River Watershed Alliance (UIRWA) is to improve the water quality in the Upper Iowa River and its tributaries, and improve the health of the Upper Iowa River Watershed. Through the NE IA Regional Watershed Project, and Northeast Iowa RC&D, the Alliance must continue to hold meetings, conduct water quality testing, share ideas, and discuss solutions to water quality concerns in the Upper Iowa River Watershed. The resolute of landowners must be increased as they become increasingly aware of the assessment results. Although landowners were involved in all phases of the project, they now must agree to take action. Any projects implemented in targeted areas must include outreach and education concentrated to that area. The outreach must help new and old stakeholders understand the assessment as well as the development of management strategies.

Water Quality Education

An important goal of the Upper Iowa River Watershed Project is to educate residents of the Upper Iowa River Watershed about water quality concerns and improvement efforts. Through the Northeast Iowa Regional Watershed Project at NE IA RC&D, recently funded by EPA, regional water quality education will continue. Now that the assessment has been completed and management strategies have been developed, there is a need for increased targeted education that corresponds to the targeted technical assistance and funding. This outreach to landowners will engage them in application of management strategies and to build support for projects. This is expected to occur over the next few years through the Staff/Beaver Creek Watershed Project, the Trout Run Project and other targeted efforts.

Water Quality Monitoring

Through the UIRW Project at NE IA RC&D the UIRW Alliance continues monitoring efforts to determine the effectiveness of their efforts. They feel the monitoring is important to their success. NE IA RC&D received funding from the Environmental Protection Agency to develop a Quality Assurance Project Plan, QAPP, procedure for water quality collection in the UIRW in 2005. Continued monitoring will help determine the effectiveness of solutions, document improved water quality, and ensure the collected water quality data is utilized by the Iowa DNR to determine impairment or development of TMDL's in the future. The UIRW Alliance current and proposed targeted efforts, as well as their overall water quality improvement strategies, are described in this section. *(See **Water Monitoring Sites Map**, Appendix A, Page W-1)*

Stream Flow Monitoring and Modeling

Monitoring surface water flow in the UIRW continues to be important. This monitoring is imperative to determine the increasing in hydrologic holding time as well as necessary to development of TMDLs. The three existing gauging stations in the UIR, measuring real-time gauge height and stream flow, must be maintained in Bluffton, Decorah, and near Dorchester. Additional gauging stations should be installed in critical sub-watersheds to determine and document the effectiveness of efforts. This information should also be used in concert with Dr. Bernatz's rainfall modeling and flow studies to maximize management strategies. (See Appendix F)

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