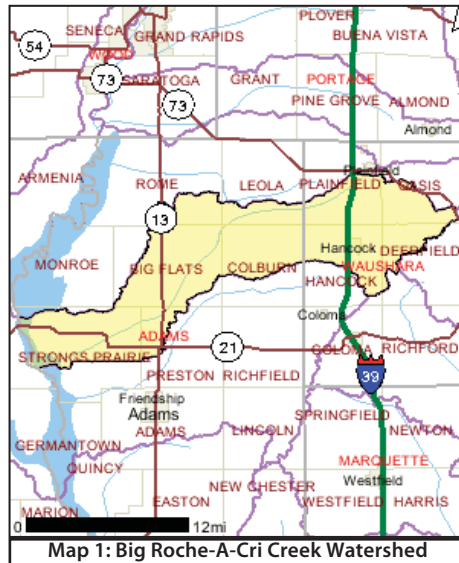


2011 Water Quality Management Plan Update

Central Wisconsin Basin, Wisconsin

December 2011

The Big Roche-A-Cri Creek Watershed is located in Adams and Waushara counties covering 113,277 acres. The Big Roche-A-Cri Creek Watershed is known for pivot irrigation and vegetable crop production consisting primarily of corn and potatoes. Most of the surface waters have been altered by ditching, especially on the eastern edge where agricultural land use predominates. Most lakes are artificial impoundments, however some small kettle lakes and wetlands are found in the pitted outwash areas in the central to eastern portions of the watershed. Big Roche-A-Cri Creek Watershed was ranked using the Nonpoint Source Priority Watershed Selection Criteria. Based on surface and ground water data, the overall ranking is high. This overall ranking establishes the watershed as a high priority for grant eligibility through the Nonpoint Source Program.



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Watershed Details

Population and Land Use

Forest cover and agriculture are the predominant land uses in the Big Roche-A-Cri Creek Watershed, with 39 % and 38% of the total area, respectively. Open water and space and wetlands are the next most common land uses in the watershed with ten percent and seven percent of the total area, respectively. Grasslands and suburban environments account for the remaining sizeable area percentages in the watershed with six percent and one percent, respectively. Urban landscapes amount to less than one tenth of a percent of the total area. The chart below indicates the percent area for each category of land use.

Table 1: Big Roche-A-Cri Creek Watershed Land Use		
Land Use	Acres	% Area
Forest	43,699.03	38.58%
Agriculture	42,962.68	37.93%
Wetland	11,293.65	9.97%
Open Water & Open Space	7,718.66	6.81%
Grassland	6,303.11	5.56%
Suburban	1,147.78	1.01%
Urban	103.64	0.09%
Barren	48.04	0.04%
Total Acres in Watershed	113,276.59	

Hydrology

Streams originate at the base of the lateral moraine in a pitted glacial outwash plain in the eastern area of the watershed. There have been significant hydraulic modifications in the watershed. Most of the headwaters and small streams in the watershed have been ditching by the Colburn Drainage District. The shallow water table with sandy aquifer material, results in sufficient drainage of the land to allow agriculture to be possible. Sandy soils require extensive irrigation for growing vegetable crops. Irrigation is continually expanding and is having an impact on local water table elevations. Some of the drainage ditches support cool to cold water fish species due to adequate flow of groundwater. Along the moraine in the east lie several natural glacial kettle lakes that have good water quality and support strong fisheries. Impoundments on the Big Roche-A-Cri also have good water quality.

Ecological Landscapes

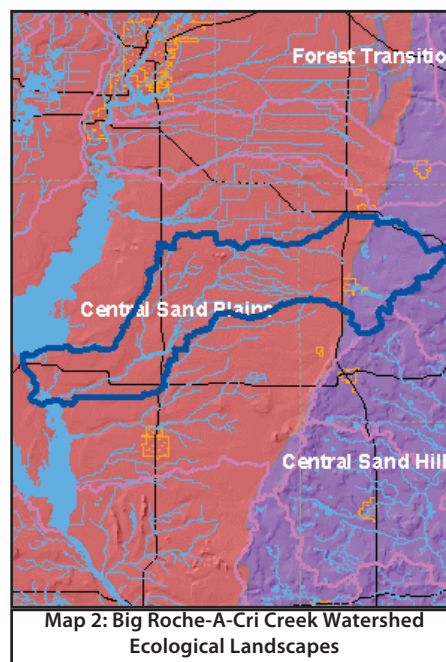
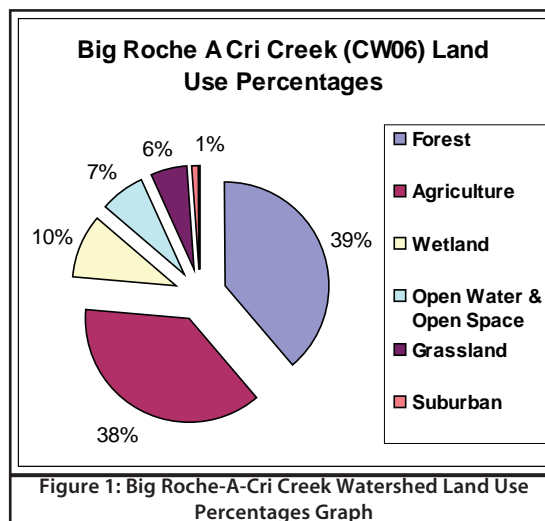
The Big Roche-A-Cri Creek Watershed is located primarily in the Central Sand Plains Ecological Landscape which is located in central Wisconsin, occurs on a flat, sandy lake plain, and supports agriculture, forestry, recreation, and wildlife management. The Ecological Landscape formed in and around what was once Glacial Lake Wisconsin, which contained glacial meltwater extending over 1.1 million acres at its highest stage. Soils are primarily sandy lake deposits, some with silt-loam loess caps. Sandstone buttes carved by rapid drainage of the glacial lake, or by wave action when they existed as islands in the lake, are distinctive features of this landscape.

The historic vegetation of the area included extensive wetlands of many types, including open bogs, shrub swamps, and sedge meadows. Prairies, oak forests, savannas, and barrens also occurred in the Ecological Landscape. An area of more mesic forest with white pine and hemlock was found in the northwest portion, including a significant pinery in eastern Jackson County. Today, nearly half of the Ecological Landscape is non-forested, in agriculture and grassland. Most of the historic wetlands were drained early in the 1900's and are now used for vegetable cropping. The forested portion is mostly oak-dominated forest, followed by aspen and pines. A minor portion is maple-basswood forest and lowland hardwoods.

Historical Note

Located within the Big Roche-A-Cri Creek Watershed in Waushara County is the Hancock Research Station. The University of Wisconsin College of Agricultural and Life Sciences began research here in 1916 on land belonging to the Hancock Development Company. The intent of the research was to aid general livestock farmers in their attempt to make a living on the droughty sands of central Wisconsin. It was six years later when the Board of Regents purchased 95 acres from this private company, and by 1934 they had acquired two more adjacent parcels to bring the farm to 223 acres. Research efforts for the next 20 years were directed towards dairy feeding, pasture utilization, soil fertility management, and studies with coniferous and deciduous shelterbelt plantings for wind erosion control.

Irrigation possibilities came to the forefront in the late 1940's with aluminum pipe becoming available and the discovery of an ample, easily accessible water supply underfoot. Irrigation brought renewed hope to the people of the area



and redirected the college’s research efforts. Studies began to reveal two-, three-, and sometimes four-fold increases in crop productivity when irrigation was used. Seventy acres were added to the station in 1962 to aid in irrigation research, provide low fertility land, and help offset acreage lost by the Highway 51 relocation.

The College of Agricultural and Life Sciences had the foresight to acquire an adjacent 120 acres in 1971 to add to the station’s land resource. This modestly priced purchase came with an irrigation well and was soon equipped with center pivot irrigation. The research data generated at the Hancock Research Station by the college faculty has had a major impact on the development of the Central Sands of Wisconsin.

Watershed Condition

Overall Condition

Big Roche-A-Cri Creek contributes over 29 miles of Class I and II trout streams, as well as nine miles of Exceptional or Outstanding Resources Waters, to the watershed. The Castle Rock and Petenwell Flowages on the Wisconsin River suffers from low Dissolved Oxygen (DO) levels and contaminated fish tissue due to PCBs, dioxin, and mercury. The Wisconsin River is also impaired by high Total Phosphorus (TP) levels at Castle Rock Flowage.

There are no specific waterbodies with Nonpoint Source (NPS) Watershed Rankings for this watershed; however, streams and groundwater rank high for NPS while the rank for lakes is low.

The watershed includes the towns of Leola and Colburn. The Adams County soil erosion plan ranks these towns first and fifth priority out of 17 for needing conservation work to control wind and water erosion, respectively. The Golden Sands Resource Conservation and Development Planning Agency studied the impact of wind erosion on water quality. The DNR partially funded this program. The study concluded that properly irrigated corn crops reduce the most erosion compared to the dominant potato farming. Adverse water quality impacts were detected on all the ditches throughout the Big Roche-A-Cri Creek Watershed through biotic index sampling and review of water quality data.

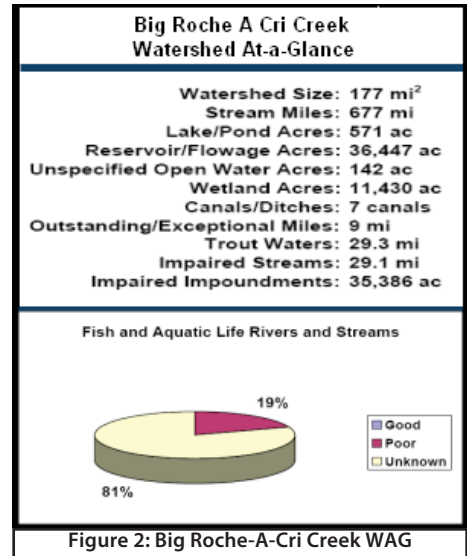


Figure 2: Big Roche-A-Cri Creek WAG

River and Stream Condition

Table 2: Designated Use Support Summary for Big Roche-A-Cri Creek Watershed Rivers and Streams (all values in miles)

Use	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption		29.13	120.71	149.84
Fish and Aquatic Life		29.13	120.71	149.84
General			149.84	149.84
Public Health and Welfare			149.84	149.84
Recreation			149.84	149.84

According to the WDNR’s Register of Waterbodies (ROW) database, there are over 677 miles of streams and rivers in the Big Roche-A-Cri Creek Watershed; 150 miles of which have been entered into the WDNR’s assessment database. Of these 150 miles, about 19% are considered to be in “poor” condition and are listed as impaired. The condition of the remaining stream miles is not known or documented.

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Additional uses for which the waters are evaluated include Fish Consumption, General Uses, Public Health and Welfare, and Recreation. As Table 2 shows, these uses have not been directly assessed for the watershed. However, a general fish advisory for potential presence of mercury is in place for all waters of the state.

Water quality in the Big Roche-A-Cri Creek Watershed is generally good. Monthly total phosphorus samples, for the water year of 2008, were collected near the lower reaches of Big Roche-A-Cri Creek. Of the 12 samples taken, none showed levels above the phosphorus standard of 0.75 mg/L. Additional sampling of the Big Roche-A-Cri Lake obtained from the Wisconsin River Total Maximum Daily Load (TMDL) project shows that the conditions in the water year of 2008 were not an anomaly.

Other methods of evaluating stream health use indicators, such as aquatic macroinvertebrates (insects), to give a picture of long term water quality and ultimately stream health. For instance, if water quality is generally good we expect certain species of insects to occupy the stream that are intolerant to pollution. The major advantage of using indicator species is that they inhabit the ecosystem on a continual basis. If a stream were subject to short pollution event(s) that were missed by traditional water chemistry sampling, the insects would be affected, resulting in a change to the aquatic macroinvertebrate population. Therefore, obtaining a representative macroinvertebrate sample can provide an overall picture of stream health by evaluating the biota. For general assessment purposes we used two macroinvertebrate matrices, a macroinvertebrate Index of Biological Integrity (mIBI), developed specifically for Wisconsin, and the Hilsenhoff Biotic Index (HBI). These matrices consider numerous aspects of the macroinvertebrate community composition and the pollution tolerance of individual species and assemblages when deriving an overall water quality score that can range from very poor to excellent.

The DNR has been sampling streams throughout the state of Wisconsin for over two decades. The results from this monitoring can provide insight into water quality instead of relying on intensive water chemistry monitoring. Seven sites in the Big Roche-A-Cri Creek Watershed have been sampled for macroinvertebrates and the results tend to agree with the water chemistry data.

HBI and mIBI results indicate that streams in the watershed appear to be in fair to excellent condition. Continual monitoring can show if conditions are remaining the same, are getting better, or getting worse over time. For example, macroinvertebrate sampling can be used to indicate if future changes in land use such as increase in irrigation are having long-term impacts on streams and ultimately stream health.

Big Roche-A-Cri Creek

Big Roche-A-Cri Creek is a hard water stream having clear water that flows in a southwesterly direction into Castle Rock Lake. Sand is the dominant substrate type. The portion of the stream above Big Roche-A-Cri Lake (21.5 miles) is considered a trout water, but most of the natural reproduction is found within the upper two miles of the stream in Adams County. The fishery consists of northern pike, smallmouth bass, brook trout, brown trout, rainbow trout, bluegill, pumpkinseed, bullhead, and carp. Numerous fish and macroinvertebrate samples have been collected in the segment above Big Roche-A-Cri Lake since 2002 and they indicate good water quality. The aerial groundwater survey conducted February 1963 found open water in two stretches of stream above County Highway C. There is a little less than one mile of public frontage. Access is also possible from several road crossings as well as from Castle Rock Lake and Big Roche-A-Cri Lake. There are several dwellings along the stream and land has been subdivided into lots at several locations (Source: Klick, Thomas A. and C.W. Threinen. 1966. Surface Water Resources of Adams County: Lake and Stream Classification Project. Wisconsin Conservation Department, Madison, WI).

The Upper Big Roche-A-Cri Creek is classified as a Class I and II trout stream. Brook trout populations doubled, resulting in heavy fishing pressure after approximately 2,400 feet of in-stream habitat improvements (boom covers) were completed. Intense irrigation occurs in the headwaters, possibly reducing the base flow. The creek also carries a large

bed load of sediment.

Biotic index values generated by DNR indicated poor and fair water quality in 1978 and 1979. Nitrate values also approached 4.0 PPM. Wind erosion is severe and this may be the source of sediment entering the stream. Irrigation cropping occurs in the upper portion of the watershed and ditches emptying into the Big Roche-A-Cri carrying nutrients, pesticides, and wetland drainage (Schultz, 2002).

Buckner Creek

This is a clear, hard water, sand bottom stream that flows in a general westward direction and is a tributary of Big Roche-A-Cri Creek. More than half Buckner creek is ditched as are most of its tributaries. Small forage fish inhabit the stream and it has been reported that on occasion northern pike are seasonal residents. Two macroinvertebrate samples have been collected from Buckner Creek since 2002. A sample from 2002 had an mIBI score of 5.79, indicating good water quality, a sample collected in 2007 had an mIBI score of 3.88 indicating fair water quality.

Dead Horse Creek

This clear, medium hard water stream flows over a predominantly sand bottom. It flows in a southerly direction and joins Big Roche-A-Cri Creek a short distance below Big Roche-A-Cri Lake. Forage fish species are the primary residents, but northern pike are seasonal inhabitants. Beaver and other furbearers are present and the upper end of the stream flows through land licensed as a fur farm. Wood duck nesting has been reported. A macroinvertebrate sample collected near the mouth of Dead Horse Creek had an mIBI score of 5.06 which indicates good water quality. Approximately the upper half of the stream has been ditched. There is no public land along the stream. Access is possible from several road crossings (Source: Klick, Thomas A. and C.W. Threinen. 1966. Surface Water Resources of Adams County: Lake and Stream Classification Project. Wisconsin Conservation Department, Madison, WI).

Biotic index values of samples collected by DNR in 1979 showed fair water quality conditions in Dead Horse Creek. Minimal information is known about this stream.

Dry Creek

This is a clear, hard water, sand bottom stream that flows in a general westward direction and is a tributary of Big Roche-A-Cri Creek. A portion of the creek is ditched. Small forage fish inhabit the stream and it has been reported that on occasion northern pike are seasonal residents. A macroinvertebrate sample collected in 2002 had an excellent mIBI score (8.97) indicating good water quality. There is no adjoining public land. Access is possible from three road crossings (Source: Klick, Thomas A. and C.W. Threinen. 1966. Surface Water Resources of Adams County: Lake and Stream Classification Project. Wisconsin Conservation Department, Madison, WI).

Dry Creek is classified as a valuable warm water forage fishery. It is affected by wind erosion. However, little information is known about this stream, as well.

Lake Health

Use	Supporting	Not Assessed	Total Size
Fish Consumption		856.75	856.75
Fish and Aquatic Life	637.03	219.72	856.75
General		856.75	856.75
Public Health and Welfare		856.75	856.75
Recreation		856.75	856.75

Table 4: Designated Use Support Summary for Big Roche-A-Cri Creek Watershed Impoundments (all values in acres)				
Use	Supporting	Not Supporting	Not Assessed	Total Size
Fish Consumption		35,386.44	69.49	35,455.93
Fish and Aquatic Life	60.98	35,386.44	8.51	35,455.93
General			35,455.93	35,455.93
Public Health and Welfare			35,455.93	35,455.93
Recreation			35,455.93	35,455.93

The WDNR’s ROW database shows that there are over 36,447 acres of reservoirs and flowages and over 713 acres of lakes, ponds, and other unspecified open water in the Big Roche-A-Cri Creek Watershed. Of these, approximately 35,456 acres of impoundments and 857 acres of lakes and are entered into the state’s assessment database. Almost three quarters (74%) of these lake acres are indicated as supporting Fish and Aquatic Life (FAL) uses. A couple hundred lake acres have not been assessed for FAL use, yet. About 61 acres of impoundments are indicated as supporting FAL uses, but the vast majority (99.8%) of impounded acreage within the watershed is indicated as not supporting FAL uses or Fish Consumption uses due in large part to the conditions of Castle Rock Flowage and Petenwell Flowage.

The Big Roche-A-Cri Creek Watershed has a diverse suite of lakes that range from natural glacial lakes to artificial impoundments. Lakes along the eastern side of the watershed were formed in glacial pitted outwash plains. These natural lakes are generally less than 100 acres in size and are of good water quality. They support healthy fisheries and are popular destinations for anglers. Water levels fluctuate considerably here due to the proximity to a large basin divide, the amount of annual precipitation, and the use of intense irrigation wells. The natural fluctuation of lakes is a critical function to these natural lakes. When water levels decline, shoreline vegetation expands lakeward and when water levels return, the water loving plants remain providing habitat for fish and wildlife. These plants also attenuate nutrients like phosphorus and nitrogen which aids in increased water quality. In a few lakes, the water level fluctuation is so great the lake actually disappears altering the landscape in a dramatic way. The plant/water level fluctuation relationship is a natural phenomenon; however it is extraordinary in the eastern side of this watershed.



Figure 3: Big Roche-A-Cri Creek leading into Castle Rock Lake (photo courtesy of Virtual Reality)

To the west, these natural lakes start to fade out. Some small natural wetland lakes can be found but are usually very small. Nonetheless, they provide essential habitat for wildlife and provide a source of groundwater recharge and serve as flood control. There are two impoundments on the Big Roche-A-Cri. The first is Big Roche-A-Cri Lake. It is a 205-acre impoundment that provides recreation and hydro power for a small energy producer. The other impoundment is Arkdale Lake found several miles downstream. Arkdale is 55-acre impoundment which is strictly maintained for recreational purposes. Despite being found lower in the watershed, they exhibit good water quality. Sporadic water quality data over the last 15 years shows Arkdale Millpond and Big Roche-A-Cri Lake average total phosphorus (TP) concentrations to be 0.040 mg/L and 0.022 mg/L, respectively. These values are considered low for impoundments. Both of these lakes have DNR approved aquatic plant management plans and have official Critical Habitat Areas (CHA) designations. The following water narratives summarize the most recent information available for lakes and flowages in the watershed.

Big Roche-A-Cri Lake

Big Roche-A-Cri Lake is a hard water drainage impoundment located on Big Roche-A-Cri Creek. The dam has a 17-foot head and it was recently sold by the Wisconsin Power and Light Company to Adams County. The clear water is alkaline and has a high transparency. Northern pike, largemouth bass, bluegills, black crappies, yellow perch, black and brown bullheads and white suckers comprise the fishery. Brown trout are caught occasionally near the upper end of the flowage. Carp are also present but have not caused a management problem. Aquatic vegetation is a problem during the summer months. There is public access from State Highway 13 and from a boat launching site immediately east of the highway crossing. Commercial resort facilities are available and there are 99 dwellings around the flowage. Muskrat are present. Mallard and blue-winged teal broods may be observed during the summer (Source: 1966, Surface Water Resources of Adams County Big Roche-A-Cri Lake).

Castle Rock Flowage

Castle Rock Flowage is a soft water, drainage impoundment located on the Wisconsin River that is the fourth largest lake within the state. The water level is controlled by a hydroelectric power dam having a 30-foot head owned by Wisconsin River Power Company. The water has a light brown color, is alkaline, and has a low transparency. Northern pike, walleye, largemouth bass, black crappie, bluegill, pumpkinseed, yellow perch, black bullhead, and brown bullhead are the significant game fish species. Carp, redhorse, buffalo, white sucker, bowfin, and burbot are also present. Partial winterkill and summerkill conditions occasionally occur. Commercial fishing for rough fish and bullhead has been carried out in the past. Industrial pollution is a problem. There is public access from county-owned parks in Adams and Juneau counties and numerous road ends; there are commercial facilities; there is one organizational camp; and there are over a hundred dwellings on the flowage. Much of the frontage is owned by the Power Company and expanded developments, including a state park, are now under consideration. Muskrat are significant and beaver are present in backwater areas. Several species of puddle ducks use the flowage for nesting and during their spring and fall migrations (Source: 1969, Surface Water Resources of Juneau County Castle Rock Flowage).

Jim Kreitlow (NOR) documented dissolved oxygen standards violations while sampling the lake in the mid 1990s. Dissolved oxygen concentrations below 5 mg/L were generally found during the early morning hours, probably a result of algae respiration. Values for pH above 9.0 were documented in 1994, 1995, 1996, and 1997 (9 of 107 samples). The cause of this impairment is likely a result of excessive nutrient loading (phosphorus) from point and nonpoint sources in the watershed. As a result, the flowage is very eutrophic with abundant algae growth.

Fish Lake

Fish Lake is a moderate-sized lake with an irregular basin located near Hancock. About 75% of the lake is greater than 20 feet in depth. The limited littoral zone is characterized by bottom types consisting primarily of sand, gravel and silt. The lake is landlocked and has no inlet or outlet, with the primary water source being seepage. The lake exhibits good water quality and clarity. It is interesting to note that comparative water analyses between 1949 and 1964 showed almost a twofold increase in overall fertility of the lake. Midsummer thermocline developed between 15 and 21 feet. The major fish species in the lake include northern pike, walleye, perch, largemouth bass, bluegill, black crappie, rock bass, pumpkinseed, green sunfish, bullheads, and white suckers. The lake is primarily managed for northern pike, largemouth bass, and panfish. The walleye population present is the result of stocking fingerling and adult walleyes when these species are available. Most walleyes that are caught on hook and line in the lake are caught incidental to fishing for other species. Adjoining habitat provides opportunities for nesting of blue-wing teal. The area also serves as a resting area for puddle ducks, diving ducks, coot and geese during the fall of the year. A portion of the shoreline is included in the Greenwood State Wildlife Refuge. There are 92 cottages or dwellings, five resorts, five boat rentals, two campgrounds and one private camp on the shoreline. Access is available from two town roads. The access provided by the township has adequate frontage of about 0.4 miles (Source: 1970, Surface Water Resources of Waushara County Fish Lake [Near Hancock]).

Petenwell Flowage

Petenwell Flowage is a soft water, drainage impoundment on the Wisconsin River that is the second largest lake within the state. Its water level is controlled by a hydroelectric power dam having a 42-foot head and it is owned by the Wisconsin River Power Company. The water has a light brown color, is alkaline, and has a low transparency. Northern pike,

walleye, largemouth bass, bluegill, pumpkinseed, crappie, perch, and bullhead are the significant game fish species present. Commercial fishing for rough fish species and bullhead has taken place. Industrial pollution is a problem. Partial winterkill conditions exist. Public parks (multiple-use areas) are present in Adams and Juneau counties. Commercial facilities are available and a few dwellings are present. Several species of puddle ducks nest at the flowage and there is also a heron rookery. Canada geese, coot, puddle ducks and divers use the area during their spring and fall migrations. Beaver are present and muskrat are significant (Source: 1969, Surface Water Resources of Juneau County Petenwell Flowage).

Jim Kreitlow (NOR) documented dissolved oxygen standards violations while sampling the lake in the mid 1990s. Dissolved oxygen concentrations below 5 mg/L were generally found during the early morning hours, probably a result of algae respiration. Values for pH above 9.0 were documented in 1996, 1997, and 1998.

The cause of these impairments is likely the result of excessive nutrient loading (phosphorus) from point and nonpoint sources in the watershed. As a result, the flowage is very eutrophic with abundant algae growth. The University of Wisconsin Stevens Point completed a nutrient and water budget modeling study in 1999 on Petenwell Flowage. Water chemistry data collected in 1996 indicates chlorophyll a concentrations ranged from 8.4 to 66.6 ug/L and total phosphorus concentrations ranged from 85 to 171 ug/L.

The Petenwell and Castle Rock Flowages Comprehensive Management Plan was completed in 1996. The report indicates severe algal blooms cause periodic shifts in dissolved oxygen. During photosynthesis, dissolved oxygen values are high (11-12 mg/L), but during respiration they can drop below 5.0 mg/L (STORET 1992 was referenced). The report also indicates blue-green algae are the dominant phytoplankton in the Petenwell and Castle Rock Flowages. The report also references sediment sampling has been completed in both flowages. However, additional sampling is recommended. Previous sampling has found high levels of 2,3,7,8-TCDD and 2,3,7,8-TCDF in sediments. PCBs and mercury have also been detected at limited sampling sites. Currently, a fish consumption advisory exists on the flowage for PCBs, dioxin and mercury.

Monitoring conducted in 2003 found frequent pH exceedances during the summer.

Pine (Hancock) Lake

Pine (Hancock) Lake is a large, moderately fertile lake located partially within the village limits of Hancock. The lake is landlocked, and its basin is somewhat elongated. The littoral bottom materials consist primarily of sand and muck. The lake is quite shallow, with approximately 40% of its area having depths less than three feet. Dense beds of aquatic vegetation choke nearly one half of the lake during the summer months. Following severe winterkills (winters of 1958-59; 1962-63; 1964-65), the lake was stocked and managed for northern pike, largemouth bass, and panfish. The most abundant panfish species are bluegills; perch and pumpkinseed are present in fewer numbers. Northern pike dominate the fishery. The lake was chemically treated in 1959. Walleye fry and fingerling stocking has been tried in the past, but without success in establishing the species. Future management will be primarily reintroduction of fish following severe winterkills. Pine Lake is a popular ice fishing lake for pike and bluegill. Water level fluctuations (up to five feet), winterkills, abundant aquatic vegetation, and periodic algae blooms discourage recreational use of the lake



Figure 4: Big Roche-A-Cri Creek Watershed Wetlands

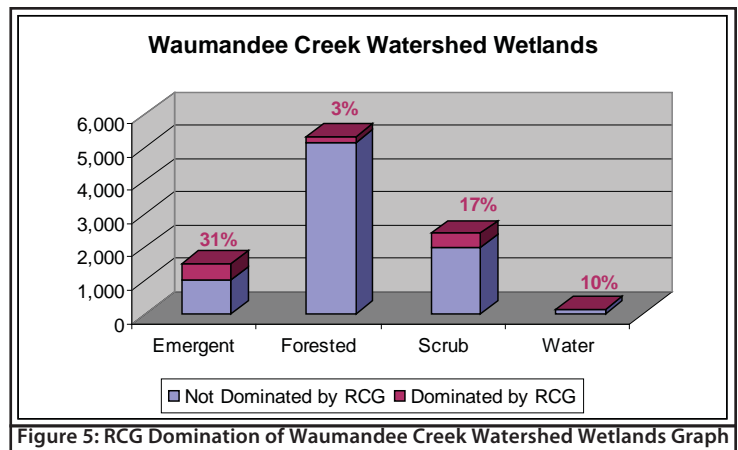


Figure 5: RCG Domination of Waumandee Creek Watershed Wetlands Graph

and create management problems. There are 24 cottages or dwellings on the lake. Approximately 25 acres of shallow marsh adjoin the lake, providing habitat for nesting blue-wing teal and wood ducks. Puddle ducks, diving ducks, coots, and swans use the area during seasonal migrations. Hunting is not permitted because half of the lake is within the village limits of Hancock. Public access on the east end is reached by a county road where parking and boat launching can be found (Source: 1970, Surface Water Resources of Waushara County Pine (Hancock) Lake).

Wetland Health

Wetland Status:

The Big Roche-A-Cri Creek Watershed is located in Adams and Waushara counties. An estimated eight percent of the current land uses in the watershed are wetlands. Currently, about 65% of the original wetlands in the watershed are estimated to exist. Of these wetlands, the majority include forested wetlands (57%), scrub (26%), and emergent wetlands (16%), which include marshes and wet meadows.

Wetland Condition:

Little is known about the condition of the remaining wetlands but estimates of reed canary grass (RCG) infestations, an opportunistic aquatic invasive wetland plant, into different wetland types has been estimated based on satellite imagery. This information shows that reed canary grass dominates 31% of the existing emergent wetlands, 17% of the existing scrub wetlands, and 3% of the remaining forested wetlands. Reed Canary Grass domination inhibits successful establishment of native wetland species.

Wetland Restorability:

Of the 5,081 acres of estimated lost wetlands in the watershed, approximately 96% are considered potentially restorable based on modeled data, including soil types, land use, and land cover (Chris Smith, DNR, 2009).

Groundwater

The watershed is rich with groundwater resources. Big Roche-A-Cri Creek supports nearly 30 miles of trout stream which is reliant on an ample groundwater supply. However studies have shown a loss of groundwater baseflow to streams due to intensive irrigation of agricultural lands. Low order headwater streams appear to be affected the most; while larger order streams are less impacted. The low order streams, especially those of Big Roche-A-Cri Creek, are major spawning areas for trout. The effect of baseflow loss is most significant because pumping exacerbates the reduced flow from natural drought cycles. Weeks et al., first predicted this in 1971 via modeling. Then, during the drought of the '00 years, Weeks predictions appeared to be correct. More research with modern modeling techniques by Kraft and Mechenich (2010), also predicted comparable results. Their results showed that up to 30-44% decrease in stream flow is possible in one of the unnamed tributaries to Big Roche-A-Cri Creek. This is not unique to the Big Roche-A-Cri Creek Watershed; other watersheds in the Central Sand Plains with intensive irrigation show similar scenarios. The issue of groundwater use and streamflow quantity is currently being addressed by voluntary partnership efforts between irrigators, state agencies, and legislators.

The following groundwater information is for Adams and Waushara counties (from Protecting Wisconsin's Groundwater through Comprehensive Planning website, <http://wi.water.usgs.gov/gwcomp/>), which roughly approximates to the Big Roche-A-Cri Creek Watershed.

No municipal water systems within the watershed have adopted wellhead protection plans or ordinances. Adams and Waushara counties have both adopted animal waste management ordinances, though.

Groundwater Use

From 1979 to 2005, total water use in Adams County has increased from about 12.5 million gallons per day to 46.0 million gallons per day. The increase in total water use over this period is due primarily to an increase in irrigation. Notably, commercial usage has doubled and domestic usage has increased by 50% in this time. The proportion of county water use supplied by groundwater has been consistently above 99% from 1979 to 2005

During the same time period, total water use in Waushara County has increased from about 18.3 million gallons per day to about 52.3 million gallons per day. The increase in total water use over this period is due to primarily to an increase in irrigation use. The proportion of county water use supplied by groundwater has ranged from about 86% to almost 100% during the period 1979 to 2005.

Private Wells

Ninety-one percent of 1,007 private well samples collected in Adams County and 83% of 259 private well samples collected in Waushara County from 1990 through 2006 met the health-based drinking water limit for nitrate-nitrogen. Land use affects nitrate concentrations in groundwater. An analysis of over 35,000 Wisconsin drinking water samples found that drinking water from private wells was three times more likely to be unsafe to drink due to high nitrate in agricultural areas than in forested areas. High nitrate levels were also more common in sandy areas where the soil is more permeable. In Wisconsin’s groundwater, 80% of nitrate inputs originate from manure spreading, agricultural fertilizers, and legume cropping systems.

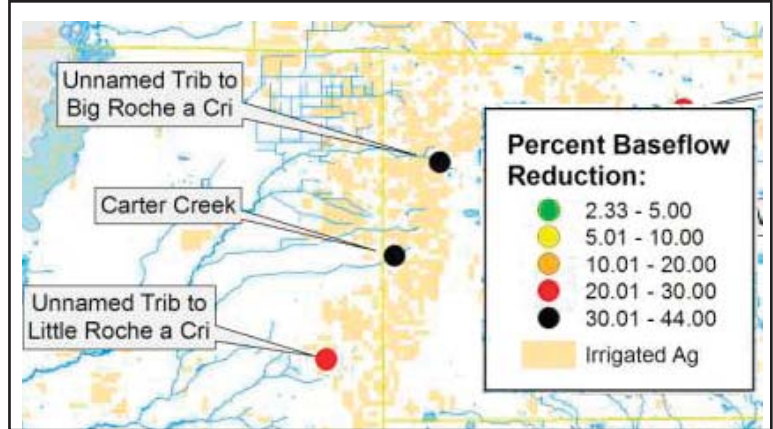


Figure 6: Predicted percent baseflow reduction to streams due to irrigation (Kraft and Mechenich, 2010)

A 2002 study estimated that 36% of private drinking water wells in the region of Wisconsin that includes Adams and Waushara counties contained a detectable level of an herbicide or herbicide metabolite. Pesticides occur in groundwater more commonly in agricultural regions, but can occur anywhere pesticides are stored or applied. A total of 28,817 acres of land in Adams County and 14,567 acres of land in Waushara County are in atrazine prohibition areas. One hundred percent of 12 private well samples collected in Waushara County met the health standard for arsenic. No arsenic data were found for private wells in Adams County.

Potential Sources of Contamination

WDNR’s Remediation and Redevelopment (RR) Program oversees the investigation and cleanup of environmental contamination and the redevelopment of contaminated properties. The RR Program provides information about contaminated properties and other activities related to the investigation and cleanup of contaminated soil or groundwater in Wisconsin through its Bureau for Remediation and Redevelopment Tracking System (BRRTS) database (WDNR 2010e).

The database shows that there are two sites in the Big Roche-A-Cri Creek Watershed that are classified as “open”, meaning “contamination has affected soil, groundwater, or more and the environmental investigation and cleanup need to begin or are underway.” These sites include one Leaking Underground Storage Tank (LUST) site and one Environmental Repair (ERP) site. A summary of these sites is included in the table below. Another open-status LUST site and open-status ERP site are located in Plainfield, just outside of the watershed boundary.

Table 5: Open-status Bureau for Remediation and Redevelopment Tracking System (BRRTS) sites in the Big Roche-A-Cri Creek Watershed						
WDNR BRRTS #	Site Name, Location	Start Date	Activity Type	Remediation Activities	Waste Activities	Substance
0270552965	Crop Production Services Inc. UAP Distribution - Bulk Liquid Plant, Plainfield	07/23/2008	ERP	1	2	Pesticides, Herbicides and Insecticides (Agricultural Chemicals) (Conditionally Closed, Transferred to DATCP)
0301000861	Country Deli, Preston	11/16/1992	LUST	1	0	Unspecified soil contamination

Point and Nonpoint Sources

This watershed was ranked using the Nonpoint Source Priority Watershed Selection Criteria. Based on stream and ground water data, the overall ranking is high. Lakes in the watershed have yet to be ranked. This overall ranking establishes the watershed as a high priority for grant eligibility through the Nonpoint Source Program. There are no WPDES-permitted discharges in this watershed, though there are a number of unincorporated communities along Highway 13, including Big Flats, Cottonville, and Arkdale. The Village of Hancock is located towards the east along I-39. All but Hancock rely on Privately Owned Wastewater Treatment Systems (POWTS), formerly known as septic systems, for waste treatment. The Village of Hancock relies on a Waste Water Treatment Facility (WWTF) to treat wastewater. The WWTF is an Orbal® oxidation ditch treatment system and a land application system consisting of three seepage cells. The Hancock WWTF was constructed in 1988 with a design flow of 66,800 gallons per day. The Discharge to Land Treatment/Disposal System facility is operated with a continuous discharge to the seepage cells. In 2006, there were three violations for exceeding nitrogen limits in the discharge to the seepage cells; limits were not exceeded in groundwater, however. There have been no violations reported since then.

There are seven permitted salvage yards in the watershed. Several citations have been written to the owners of the salvage yards. Violations mainly were administrative violations to their permits. Salvage yards may need considerable remediation efforts in the future.

There are no Concentrated Animal Feeding Operations (CAFOs) permitted in the basin. However, above background nitrogen concentrations are commonly found in groundwater. The shallow aquifer and sandy soils in the watershed are susceptible to leaching of surface applied fertilizers to groundwater, which ultimately discharge to surface water sources. Nitrogen concentrations, in the form of nitrite+nitrate, are well above background levels in Big Roche-A-Cri Creek.

Nitrogen is a very mobile and stable in groundwater. Thus, once translocated to groundwater it will remain until discharged to surface water or reduced in an anoxic environment. The high levels of nitrogen in the stream during baseflow periods suggest that concentrations in groundwater are also above natural levels.

Waters of Note

Trout Waters

Big Roche-A-Cri Creek is the only trout water in the watershed. The chart below indicates the different trout class rankings for the trout water segments within the river.

Class I trout streams are high quality trout waters that have sufficient natural reproduction to sustain populations of wild trout, at or near carry capacity. Consequently, streams in this category require no stocking of hatchery trout. These streams or stream sections are often small and may contain small or slow-growing trout, especially in the headwaters. Class II trout streams may have some natural reproduction, but not enough to utilize available food and space. Therefore, stocking is required to maintain a desirable sport fishery. These streams have good survival and carryover of adult trout, often producing some fish larger than average size.

Table 6: Big Roche-A-Cri Creek Watershed Trout Waters

Official Waterbody Name	Local Waterbody Name	WBIC	Start Mile	End Mile	Trout Class	Counties
Big Roche-A-Cri Creek	Big Roche-A-Cri Creek	1374100	16.56	36.83	CLASS II	Adams
Big Roche-A-Cri Creek	Big Roche-A-Cri Creek	1374100	36.83	41.66	CLASS I	Adams
Big Roche-A-Cri Creek	Big Roche-A-Cri Creek	1374100	41.66	45.86	CLASS I	Waushara

Outstanding and Exceptional Resource Waters

Wisconsin has designated many of the state's highest quality waters as Outstanding Resource Waters (ORWs) or Exceptional Resource Waters (ERWs). Waters designated as ORW or ERW are surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities. ORW and ERW status identifies waters that the State of Wisconsin has determined warrant additional protection from the effects of pollution. These designations are intended to meet federal Clean Water Act obligations requiring Wisconsin to adopt an "antidegradation" policy that is designed to prevent any lowering of water quality, especially in those waters having significant ecological or cultural value.

Outstanding Resource Waters (ORWs) typically do not have any point sources discharging pollutants directly to the water (for instance, no industrial sources or municipal sewage treatment plants), though they may receive runoff from nonpoint sources. New discharges may be permitted only if their effluent quality is equal to or better than the background water quality of that waterway at all times. No increases of pollutant levels are allowed. If a waterbody has existing point sources at the time of designation, it is more likely to be designated as an Exceptional Resource Water (ERW). Like ORWs, dischargers to ERW waters are required to maintain background water quality levels; however, exceptions can be made for certain situations when an increase of pollutant loading to an ERW is warranted because human health would otherwise be compromised (<http://dnr.wi.gov/org/water/wm/wqs/orwerw/>).

There are two segments of Big Roche-A-Cri Creek that are noted as Outstanding or Exceptional Resource Waters. The chart below indicates where the two segments are located and what classification they are given.

Official Waterbody Name	WBIC	ORW/ERW	Start Mile	End Mile	Counties
Big Roche-A-Cri Creek	1374100	ERW	41.66	45.86	Waushara
Big Roche-A-Cri Creek	1374100	ORW	36.83	41.66	Adams

Impaired Waters

At Castle Rock Flowage and Petenwell Flowage, the Wisconsin River suffers from low Dissolved Oxygen (DO) levels and contaminated fish tissue due to PCBs, dioxin, total phosphorus (TP), and mercury. The Wisconsin River is also impaired by high total nitrogen (TN) levels at Castle Rock Flowage.

Stream Name	Local Waterbody Name	Start Mile	End Mile	Pollutants	Impairments	Counties
Castle Rock Lake	Castle Rock Flowage	0	12,385.63	PCBs, Dioxin, Total Phosphorus, Mercury	Contaminated Fish Tissue, Eutrophication	Adams, Juneau
Petenwell Lake	Petenwell Flowage	0	23,000.81	PCBs, Dioxin, Total Phosphorus, Mercury	Contaminated Fish Tissue, Low DO	Adams, Juneau
Wisconsin River	Wisconsin River (At Castle Rock Lake)	158.68	173.27	Total Nitrogen, PCBs, Dioxin, Mercury	Contaminated Fish Tissue, Elevated pH	Adams, Juneau
Wisconsin River	Wisconsin River (At Petenwell Lake)	173.27	187.81	PCBs, Dioxin, Total Phosphorus, Mercury	Contaminated Fish Tissue, Low DO	Adams, Juneau

Fish Consumption

No specific fish consumption advisories are issued for waterbodies within the Big Roche-A-Cri Creek Watershed at this time. However, a general fish consumption advisory for potential presence of mercury is in place for all waters of the state.

Aquatic Invasive Species

Aquatic invasive species have been verified and vouchered in multiple waterbodies throughout the Big Roche-A-Cri Creek Watershed. Identified species include the zebra mussel, Eurasian water-milfoil, curly-leaf pondweed, rusty crayfish, banded mystery snail and the Chinese banded mystery snail. The chart below indicates the waterbody where each type of invasive species was found and the date of verification.



Figure 7: Greenwood Wildlife Area

WBIC	Name	Bio. Common Name	Status	Start Date
1179900	Wisconsin River - From Petenwell Lake to Castle Rock Lake	Zebra Mussel	Verified and Vouchered	01/01/2004
1345700	Castle Rock Lake	Zebra Mussel	Verified and Vouchered	01/01/2004
1377100	Petenwell Lake	Zebra Mussel	Verified and Vouchered	01/01/2004
1345700	Castle Rock Lake	Eurasian Water-milfoil	Verified and Vouchered	09/01/1992
1374300	Arkdale Lake (Millpond)	Eurasian Water-milfoil	Verified and Vouchered	11/01/1994
1377100	Petenwell Lake	Eurasian Water-milfoil	Verified and Vouchered	09/01/1992
1012000	Pine Lake	Eurasian Water-milfoil	Verified and Vouchered	08/01/2003
1374800	Big Roche-A-Cri Lake	Eurasian Water-milfoil	Verified and Vouchered	07/01/2003
1374800	Big Roche-A-Cri Lake	Curly-leaf Pondweed	Verified and Vouchered	-
1374100	Big Roche-A-Cri Creek	Rusty Crayfish	Verified and Vouchered	-
1374300	Arkdale Lake	Rusty Crayfish	Verified and Vouchered	-
1374300	Arkdale Lake	Curly-leaf Pondweed	Observed	06/06/2008
985000	Fish Lake (Town of Hancock)	Curly-leaf Pondweed	Verified and Vouchered	06/09/2009
985000	Fish Lake (Town of Hancock)	Eurasian Water-milfoil	Verified and Vouchered	06/09/2009
985000	Fish Lake (Town of Hancock)	Banded Mystery Snail	Verified and Vouchered	06/09/2009
1374800	Big Roche-A-Cri Lake	Chinese Mystery Snail	Observed	09/04/2009
1374300	Arkdale Lake	Chinese Mystery Snail	Verified and Vouchered	05/15/2009
980300	Deer Lake	Banded Mystery Snail	Verified and Vouchered	10/02/2008

Species of Special Concern

The following species are federally-listed Threatened, Endangered, Proposed, and Candidate species that have been observed in Adams and Waushara counties, in which the Big Roche-A-Cri Creek Watershed is located. A full list of special concern plants and animals for this watershed can be found on the state's Natural Heritage Inventory (NHI).

Table 10: Federally-Listed Threatened, Endangered, Proposed, and Candidate Species in Adams and Waushara Counties

Species	Status	Habitat	Taxa
Gray wolf (<i>Canis lupus</i>)	Endangered	Northern forested areas	Mammal
Kirtland's warbler (<i>Dendroica kirtlandii</i>)	Endangered	Young jack pine stands (5 to 25 years old). Confirmed breeding in Adams county, potential breeding in the other counties.	Bird
Whooping crane (<i>Grus americanus</i>)	*Non-essential experimental population	Open wetlands and lakeshores; Nests found in Adams County	Bird
Snuffbox (<i>Epioblasma triquetra</i>)	Proposed as Endangered	St. Croix, Wolf, Embarrass, and Little Wolf Rivers and Willow Creek	Mussel
Karner blue butterfly (<i>Lycæides melissa samuelis</i>)	Endangered	Prairie, oak savanna, and jack pine areas with wild lupine	Insect
Fassett's locoweed (<i>Oxytropis campestris</i> var. <i>chartaceae</i>)	Threatened	Open sandy lakeshores	Plant

*Whooping Crane - On June 26, 2001, a nonessential experimental population of the whooping crane was designated in a 20-state area of the eastern United States. The first release of birds occurred in Wisconsin in 2001. It is unknown at this time which counties the species will occupy in the future, as the birds mature and begin to exhibit territorial behavior. For purposes of section 7 consultation, this species is considered as a proposed species, except where it occurs within the National Wildlife Refuge System or the National Park System, where it is treated as a threatened species (<http://www.fws.gov/midwest/endangered/lists/wisc-spp.html>).

State Wildlife Areas

Big Roche-A-Cri Fishery Area

Big Roche-A-Cri Fishery Area is located four miles northwest of Hancock in Waushara County and is managed for trout habitat and upland best forest management practices. The Big Roche-A-Cri Creek is a Class I trout stream, upstream of County Highway W in Adams County to its headwaters in Waushara County. The same section of stream is classified as an Outstanding Resource Water (ORW). The land cover is primarily low lying hardwoods (oak) and jack pine with sandy soils. The area surrounding the fishery property is mainly in agricultural use with potatoes and corn being the predominant crops. Brook trout are the predominant trout species in the creek within the fishery area with a few brown trout. Some fly fishing opportunities are available especially in the areas where habitat improvements were made.

Colburn Wildlife Area

Colburn Wildlife Area is a 4,965-acre property located in north-central Adams County not far from the Waushara County border. It is about 13 miles northeast of Friendship and 22 miles southeast of Wisconsin Rapids. Access points are off County Highway C, Highway G, and Chicago Avenue. The property consists of mainly lowland brush and sedge marsh with areas of aspen and oak forest scattered throughout. Carter Creek passes through the middle of the property. The majority of the wildlife area was purchased in 1947 for its value to forest wildlife. Management on the property has been geared to maintaining the forested oak areas and providing different age classes of aspen.

Greenwood Wildlife Area (Figure 7, Page 13)

Located in west central Waushara County, three miles northeast of Coloma and one mile southeast of Hancock, the Greenwood Wildlife Area lies on the edge of a pitted outwash plain with a flat sandy topography and a wooded hilly moraine comprised mostly of oak.

Historically, the plains area was in agricultural practices and an important wintering area for a local population of giant Canada geese. In 1938, it was closed to goose hunting for the next ten years by a designation as a state refuge. During this time the flock increased dramatically from several hundred geese to several thousand, hunting pressure adjacent increased accordingly. Acquisition of the area began in 1949 and was completed by 1955. Presently the state owns 1,438 acres.

From 1949 to 1953, several hundred acres of state land were cropped by the UW Experimental Station at Hancock. The Department of Natural Resources took over the entire farming operation in 1954 and initiated an SCS farm plan to control wind erosion and increase soil fertility. Farm operations had been conducted by area farmers since 1960 under sharecrop agreements directed by the property manager. As the giant Canada goose population increased statewide, it became apparent the refuge was no longer needed. In 1994, with financial support from the "Wisconsin Chapter of the National Wild Turkey Federation" and Turkey Stamp Funding, an effort to restore the area to native prairie and savanna began. To date, approximately 100 acres remain in crops, while the remaining 500 acres have been restored to prairie. This provides important habitat for grassland dependant species. The refuge status has been eliminated and hunting is open during the appropriate seasons.

Timber management has always occurred on the moraine portion and continues to this day. About half of Greenwood's vegetative cover is forested. Within the properties heavily forested areas there has been an ongoing study of oak regeneration. Another portion surrounded by the prairie has been slowly converted into savanna type habitat to coincide with the grassland management.

Recognition of the diversity of glacial formations within the wildlife area led to the designation of an alternate route of the Wisconsin Ice Age Trail. The trail traverses along the southern and eastern borders, with a new segment through the grasslands. Additionally, a snowmobile trail exists through a portion of the southern property. There is ample parking on all sides of the wildlife area.

Watershed Actions

Grants and Projects

Lake Protection Grant – Adams County: Castle Rock Restoration - 09/01/2006 - Complete

- Adams County proposed to provide up to 75% of the cost of shoreland restoration practices to lake front property owners on the Wisconsin River, Castle Rock Lake, Klein Creek, Little Yellow River, Little Roche-A-Cri Creek, Big Roche-A-Cri Creek, and an unnamed stream. Grant funds were distributed to fund removal of sea walls, minor bank re-shaping, placement of rip-rap, establishment of vegetative buffers, and implementation of individual stormwater management plans. Special Conditions: 1) Space between rip-rap was filled with soil and vegetated to facilitate successful access of turtle hatchlings to water. Lupine seed was of a wild variety compatible with Karner blue butterflies. 2) Permits were secured by individual property owners prior to construction.

Lake Protection Grant – Petenwell Restoration - 09/01/2006 - Complete

- Adams County proposed to provide up to 75% of the cost of shoreland restoration practices to lake front property owners on the Petenwell Flowage, including the Wisconsin River, Petenwell Lake, Chester Creek, and Fourteenmile Creek. Grant funds were distributed to fund removal of sea walls, minor bank re-shaping, placement of rip-rap, establishment of vegetative buffers, and implementation of individual stormwater management plans. Special Conditions: 1) Lupine seed was wild for compatibility with Karner blue butterflies. 2) Soil was filled in between rip-rap to facilitate turtle hatchlings access to water. 3) Permits were secured by individual property owners prior to construction.

Aquatic Invasive Species Education Grant - Big Roche-A-Cri - 04/01/2006 - Complete

- Big Roche-A-Cri Lake District: Roche-A-Cri Invasive Species Signs: The Big Roche-A-Cri Lake Protection and Rehabilitation District proposed to install signs promoting safeguards against the spread of aquatic invasive species at the two public boat launches on Big Roche-A-Cri Lake in Adams County. Major project elements included: 1) Sign construction and installation, 2) Articles in newsletter and on web site, 3) Presentation at annual meeting, 4) Survey of District membership, and 5) Final report.

Aquatic Invasive Species Control Grant - Big Roche-A-Cri Creek 10/01/2005 - Complete

- Big Roche-A-Cri Lake District: Big Roche-A-Cri Drawdown: The Big Roche-A-Cri Lake Protection and Rehabilitation District proposed to use a winter drawdown of the lake to freeze out and remove Eurasian water-milfoil from shallow portions of this Adams County lake. Major project elements included: 1) Reimbursement of lost hydroelectric

generation revenues, 2) Volunteer labor to remove weeds, 3) DNR permit fees, and 4) Printing and mailing costs.

Lake Protection Grant - Adams County Lakes Class Phase 3 - 09/01/2005 - Complete

- Adams County proposed to wrap up its county-wide lake classification effort for: Silver Lake, Crooked Lake, Deep Lake, Little Lake, Fenner Lake, Goose Lake, Jordan Lake, Parker Lake, Patrick Lake, Rollers Lake, Wolf Lake, Fawn Lake, Easton Lake, Risk Creek Pond, Castle Rock Lake, Friendship Lake, Arsdale Lake, Dorro Couche Lake, Big Roche-A-Cri, Petenwell Lake, Twin Lakes, Lake Arrowhead, Lake Sherwood, Camelot Lake, Mason Lake, McCall Lake, Amey Pond, Big Spring Pond, Hill Lake, McDougall Lake, Peppermill Lake, McGinnis Lake, and many unnamed lakes. Major project elements included: 1) Completion of water sampling, 2) Development of lakes classification report and individual lake summaries, 3) Development of a PowerPoint presentation, 4) Four public meetings, and 5) Expansion of shoreline restoration packet.

Lake Protection Grant – Big Roche-A-Cri Creek - 09/01/2005 - Complete

- Adams County: Big Roche-A-Cri Restoration: Adams County proposed to install shoreline protection and stormwater management BMPs on 15 properties bordering Big Roche-A-Cri Lake. Major project elements included: 1) Installation of riprap and biologs, 2) Establishment of shoreline buffers, and 3) Informational signs.

Lake Protection Grant - Adams County Lakes Class Phase 2 - 09/01/2004 - Complete

- Adams County Lakes Class Phase 2: Adams County proposed to continue its lake classification efforts through collecting and assessing chemical and biological data on all lakes within the county that afford public access, including Silver Lake, Crooked Lake, Deep Lake, Little Lake, Fenner Lake, Goose Lake, Jordan Lake, Parker Lake, Patrick Lake, Rollers Lake, Wolf Lake, Fawn Lake, Easton Lake, Risk Creek Pond, Castle Rock Lake, Friendship Lake, Arsdale Lake, Dorro Couche Lake, Big Roche-A-Cri, Petenwell Lake, Twin Lakes, Lake Arrowhead, Lake Sherwood, Camelot Lake, Mason Lake, McCall Lake, Amey Pond, Big Spring Pond, Hill Lake, McDougall Lake, Peppermill Lake, McGinnis Lake, and many unnamed lakes. Major project components included: 1) Collection and assessment of chemical and biological data, 2) Development of a “library” of information for public use, 3) Development of management recommendations, and 4) I&E for riparians and lake users.

Aquatic Invasive Species Control Grant - Pine Lake 05/01/2004 - Complete

- Town of Hancock: Hancock Lake Eurasian Water-milfoil Control Project: The Town of Hancock proposed to conduct a large-scale Eurasian water-milfoil control project on 48.9 acres of affected area. Granular 2-4 D chemical was applied directly on the plant beds using a motorized blower/spreader. On dense milfoil beds totaling 18.7 acres 2-4-D were applied at high labeled rates or 150 pounds per surface, because milfoil plants in Hancock Lake are mature, dense, and support thick robust stems. GPS will be used for application accuracy. See application for further details. A final written report was submitted to the department detailing their accomplishments.

Lake Protection Grant – Adams County Lakes Classification - Phase 1 - 09/01/2003 - Complete

- Adams County Lakes Classification - Phase 1: Adams County proposed to initiate a Lakes Classification effort to assist in comprehensive plan development for communities surrounding its lakes with public access for: Silver Lake, Crooked Lake, Deep Lake, Little Lake, Fenner Lake, Goose Lake, Jordan Lake, Parker Lake, Patrick Lake, Rollers Lake, , Wolf Lake, Fawn Lake, Easton Lake, Risk Creek Pond, Castle Rock Lake, Friendship Lake, Arsdale Lake, Dorro Couche Lake, Big Roche-A-Cri, Petenwell Lake, Twin Lakes, Lake Arrowhead, Lake Sherwood, Camelot Lake, Mason Lake, McCall Lake, Amey Pond, Big Spring Pond, Hill Lake, McDougall Lake, Peppermill Lake, McGinnis Lake, and many unnamed lakes. Phase 1 elements, funded with this grant, included: 1) Delineation of surface watersheds and flow patterns, 2) Delineation of ground watersheds, 3) Identification and mapping of land uses, 4) Inventory and mapping of shoreline erosion and development problems, 5) Identification and mapping of sensitive/critical areas and natural heritage habitats, 6) Verification of wetland delineations, 7) Delineations of lake watersheds, and 8) Development of lake maps. DNR was provided with both hard copy and electronic versions of a final report on this project. Results were shared with partner agencies, town boards, lake districts and associations and members of the public through public meetings, individual lake summaries, a PowerPoint presentation, and development of a Lakes Protection Plan. Copies of the final report were also made available to local libraries.

Small Scale Lake Planning Grant - Adams County Shoreline Restoration Workshop for Professionals - 10/01/2001 - Complete

- The Adams County Land Conservation Department proposed to work with local lake associations, UWEX and other interest groups on producing a workshop for local professionals. This workshop was designed to: 1) Establish an informed network of professionals who are qualified to share information, 2) To educate others, and 3) Assist lakefront property owners with their lakeshore restoration efforts so that water quality of the major watersheds of Adams County are protected and improved. The Department of Natural Resources was provided with both a paper and electronic copy of the final report. Project results were disseminated to the public through local newspapers, radio stations and local newsletters. Project included: Amey Pond, Arkdale Lake, Big Roche-A-Cri, Big Spring Pond, Camelot Lake, Castle Rock Lake, Crooked Lake, Deep Lake, Dorro Couche Lake, Easton Lake, Fawn Lake, Fenner Lake, Friendship Lake, Goose Lake, Hill Lake, Jordan Lake, Lake Arrowhead, Lake Sherwood, Little Lake, Mason Lake, McCall Lake, McDougall Lake, and McGinnis Lake.

Large Scale Lake Planning – Big Roche-A-Cri Lake - 04/01/2000 - Complete

- Big Roche-A-Cri Lake District: Big Roche-A-Cri Lake Map: The Big Roche-A-Cri Protection and Rehabilitation District (PRD) proposed to analyze the effects of sedimentation and vegetation growth on the bottom of Big Roche-A-Cri Lake. Project activities included: 1) Development of Bathymetric map, 2) Mapping of sedimentation since 1965 survey, and 3) Distribution of maps to Adams County Departments of Conservation, Planning and Zoning, and to Preston Township and Lake District Residents. The Department of Natural Resources was provided with both a paper copy and an electronic copy of a final report on the project. Project results were disseminated to the public through the lake district annual meeting and through the lake district newsletter.

Large Scale Lake Planning – Big Roche-A-Cri Lake - 04/01/1999 - Complete

- Big Roche-A-Cri Lake District: Big Roche-A-Cri Lake Ecosystem Assessment: The Big Roche-A-Cri Lake District, through its contract with Foth and Van Dyke, proposed to study nutrient loading on Big Roche-A-Cri. Major project elements included: 1) Water sampling and analysis, 2) Sanitary survey, 3) Land use mapping, and 4) Development of a final report. The Department of Natural Resources was provided with both a paper and electronic copy of the final report. The results of the study were shared at the district's annual meeting and were published in the lake district newsletter.

Lake Protection Grant – Petenwell Lake - 09/10/1997 - Complete

- Golden Sands: Petenwell Flowage Water Quality Monitoring: Golden Sands Resource Conservation and Development Council, Inc. proposed to complete the second year of funding for water quality modeling of the Petenwell Flowage. The models used in applying the methodology on Petenwell Flowage included: 1) The Flux Reservoir loading Model, 2) Profile Model, and 3) Bathtub Model. Implementation of this plan provided information on the following: 1) Water/nutrient budget for the Petenwell Flowage, 2) Sources of nutrients, 3) Effects of nutrient reduction, and 4) Prediction of the total maximum daily loads necessary to reach desired target nutrient levels. A working model was provided as well. A final report was also made available for interested parties.

Large Scale Lake Planning - Adams County 05/05/1995 - Complete

- Adams County Lakes Shoreline Development Audit: 1) Conducted a shoreland audit for the balance of Adams County. 2) Mapped locations of non-compliant structures. 3) Video taped audit sites. Researched and determined permit issuance histories. 5) Processed permits and site plans for new construction of shoreland structures. 6) Field-checked new construction specifications. 7) Prepared a final report which included the tasks listed above. 8) The grantee disseminated information to the public by public meetings, summary report mailings, and local newspaper articles. The grantee provided the Department of Natural Resources with a paper copy and an electronic copy of the final report. Project results were repositied the City of Adams Library.

Large Scale Lake Planning – Big Roche-A-Cri Lake - 03/31/1995 - Complete

- Big Roche-A-Cri Lake Management Planning: Assessed the lake district's demographic profile. Determined the long range and short term goals of the Lake District. Obtained a basic contour map of the lake showing water depth and bottom or weed conditions. Mapped the watershed. Developed a lakefront property owner's guidebook which included building recommendations and landscaping recommendations. The grantee disseminated information to the public by fact sheet, public meetings, local newspaper articles, and land use recommendations. Project results were

reposited at the Adams County Library and the Town of Preston Town Hall.

Monitoring

Monitoring work in this watershed consists of lake monitoring and surveys for water quality, aquatic plants, aquatic invasive species, and ice observations.

Lakes Baseline and Trends Monitoring

River monitoring is conducted to comply with Clean Water Act implementation - water quality standards: use designations, criterion, permit issuance and compliance, assessments, and impaired waters management.

In close cooperation with UW Extension and Wisconsin Sea Grant, education efforts focus on working with resource professionals and citizens statewide to teach boaters, anglers, and other water users how to prevent transporting aquatic invasive species when moving their boats. Additional initiatives include monitoring and control programs.

The Citizen Lake Monitoring Network, the core of the Wisconsin Lakes Partnership, involves over 1,000 citizen volunteers statewide. The goals are to collect high quality data, to educate and empower volunteers, and to share this data and knowledge. Volunteers measure water clarity, using the Secchi Disk method, as an indicator of water quality. This information is then used to determine the lakes trophic state. Volunteers may also collect chemistry, temperature, and dissolved oxygen data, as well as identify and map plants, watch for the first appearance of Eurasian water-milfoil near boat landings, or alert officials about zebra mussel invasions on Wisconsin lakes.

Fisheries Monitoring:

Fisheries projects include a wide variety of "baseline" monitoring and targeted fieldwork to gain specific knowledge related to Wisconsin's fish communities.

Citizen Stream Volunteer Monitoring

There have been fifteen stations monitored by at least eighteen volunteer stream monitors in the CW06-Big Roche A Cri watershed from 2008 through 2010. Fourteen of the stations are monitored for dissolved oxygen, pH, instantaneous and continuous temperature and transparency using Level 2 procedures, and entered into the SWIMS database (<http://prodoasjava.dnr.wi.gov/swims/welcome.do>). Eight stations are monitored for biotic index, flow, dissolved oxygen, instantaneous temperature and transparency using Level 1 procedures, and entered in the WAV database (<http://www.uwex.edu/erc/wavdb/>). On average, a station was visited five times throughout a season (monthly from May through September).

Volunteers collect macroinvertebrates twice a year to determine a biotic index for each stream monitored for Level 1 procedures. Streams are considered in poor quality if biotic index is between 1.0-2.0, fair quality if between 2.1-2.5, and in good quality if the index is between 2.6-3.5. Generally, biotic index values indicated streams in the watershed to be in fair to good quality with 84% ranging from 2.0-3.5. The remaining 16% rated streams to be in poor quality ranging from 1-1.8. Most of the streams that were said to be in poor quality were recorded in the spring and were considered to be in fair to good quality by the fall, except one. This may have been due to sampling after spring emergence of the insects, and thus not having all taxa available to collect at that time of year. Biotic index analysis was only conducted once at Dead Horse Creek at Beaver Ave west of 10th Ave, CBSM-10007743 (DHC at Beaver Ave) on 9/05/2010 and was considered to be in poor quality with a biotic index of 1.5.

Generally, volunteers recorded dissolved oxygen levels in the watershed ranging from 5.6-12mg/l, which are sufficient to sustain aquatic life. Only two stations, DHC at Beaver Ave and Dry Creek at CTH G, CBSM-10030204 (DC at CTH G), recorded dissolved oxygen below acceptable levels. Throughout the four times DHC at Beaver Ave was monitored in 2010, dissolved oxygen remained at low levels, ranging from 0.1-4.98 mg/l. DC at CTH G was only monitored in 2009 and dipped below sustainable levels once on 9/16/2009 out of the four monitoring events, with a measurement of 2.5 mg/l.

Throughout the 2008-2010 monitoring seasons, volunteers collected pH measurements primarily within state standards (which range from 6 to 9) ranging from 6.26 to 8.33.

Temperature measurements, used to classify streams as cold, cool or warm water habitats, and which are indicative of the ability of a habitat to sustain aquatic species, were manually recorded at all 13 stations and continuously recorded at five of the 14 Level 2 stations throughout a season. Maximum instantaneous temperatures were below 25°C for all streams; suggesting they may be cold water streams. Continuously measured temperatures confirmed instantaneous measurements and classification of cold water streams in all streams where both methods were used. Continuous temperature monitoring at Big Roche A Cri at CTH Z, CBSM-10030248 indicated maximum daily mean temperatures were greater than 24°C, classifying it as a warm water stream.

Stream transparency measurements primarily indicated good water quality with 95% of measurements less than 10 NTU. The remaining 5% of field measurements were from two stations, Dead Horse Creek at Beaver Ave West (3 of the 4 field measurements were greater than 10 NTU) and Dead Horse Creek at Cottonville Ave, CBSM-10009454 (2 of the 5 field measurements were greater than 10 NTU); however none of the results were greater than 240 NTU.

Total Maximum Daily Load Reports (TMDLs)

Currently there are no TMDLs on the Big Roche-A-Cri Creek Watershed proper. However, the watershed is being intensively monitored as a tributary to the larger Wisconsin River TMDL. The WDNR has a sampling location below the Arkdale Dam that is sampled semi-monthly for nutrients, solids and flow. These data will be used in the Wisconsin River TMDL to help decrease the occurrences of large blue-green algal blooms on flowages of the Wisconsin River.

Basin/Watershed Partners

This basin is fortunate to have local organizations aimed at protecting water quality and watershed health. The Arkdale Lake Association, Castle Rock Lake District, Pine Lake Association, Hancock Lake Association, Roche-A-Cri Watershed Association, Petenwell and Castle Rock Stewards, the University of Wisconsin – Stevens Point, Adams County Land and Water Resources Conservation Department, and Wisconsin Department of Natural Resources should maintain the partnerships that have delivered comprehensive planning and implementation of projects that benefit water quality. These partnership efforts should continue and aggressively pursue grant opportunities to bolster their membership and activities and to increase the awareness and prevention of AIS, which will enhance the overall health of the watershed.

Recommendations

Overall Recommendations

Big Roche-A-Cri Creek Watershed should be considered a high priority for grant eligibility under the State Nonpoint Source Pollution Abatement Program (proposed 01/01/2010).

Watershed staff, in cooperation with Adams County Land Conservation Department and Central Wisconsin Watershed Partnership, should continue to work with local farmers to encourage wind erosion best management practices (proposed 01/01/2010).

Fish Monitoring or Management Recommendations

Fish and Water Resource Management Staff should continue baseline monitoring for watershed streams and lakes (proposed 01/01/2010).

Contributors

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Appendices



Big Roche a Cri River , Courtesy of Virtual Realty
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Wisconsin DNR's mission involves preserving, protecting, and restoring natural resources. Watershed Planning provides a strategic review of water condition to enhance awareness, partnership outreach, and the quality of natural resource management.

Big Roche-A-Cri Creek Watershed