Black Hawk Lake
Watershed Management Plan

Black Hawk Lake, in harmony with its watershed, will be a healthy, safe, economically sustainable and visually appealing resource for residents and visitors.

Prepared By: Sac County Soil & Water Conservation District
Plan Approved: October 26, 2011
Plan Timeframe: 2011-2041
Plan Revisions: 2016, 2021, 2026, 2031, 2036

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Preface

In 2007 a local group of citizens met several times to discuss the condition of Black Hawk Lake. These meetings eventually initiated the collection of $40,000 of local donations to be used to find ways to protect and improve this important asset of the community and the state.

This turned into a community-based watershed program. The local dollars were matched with Iowa Department of Natural Resources funding to do a diagnostic feasibility study (DFS) of the lake. Then a Total Maximum Daily Load study was completed. A comprehensive assessment of the entire watershed coincided with these studies.

The DFS study was done to see if the lake water quality could be improved. The others were completed to verify the resource concerns within the watershed and to identify the best management practices which would need to be implemented to get Black Hawk Lake off the federal 303(d) list of impaired waters.

A technical advisory team was formed to assist the public in plan development. This required the formation of partnerships between local, county and state agencies as well as interested and affected citizens.

Stakeholders, together with a technical advisory team, developed a vision statement, identified goals, management alternatives, action plans and projects that, when implemented, will protect the water quality of Black Hawk Lake.

This watershed management plan was developed based on combined efforts of watershed residents, businesses, lake and recreational users, farm owners, farm operators, the cities of Breda, Carnarvon, and Lake View, Sac County Soil and Water Conservation District (Sac SWCD), Carroll County Soil and Water Conservation District, Natural Resources Conservation Service, Sac and Carroll County Supervisors, Iowa Department of Agriculture and Land Stewardship - Division of Soil Conservation (IDALS-DSC), Iowa Department of Natural Resources (IDNR), Sac and Carroll County Iowa State University Extension Services, M & M Divide Resource Conservation & Development, Iowa Learning Farm, and Trees Forever.

The development of this watershed management plan was largely funded by two grants. The first was a Watershed Development and Planning Grant from IDALS-DSC and administered through the Sac SWCD. The second grant was a Watershed Improvement Planning Grant received from the IDNR. It was also administered through the Sac SWCD.

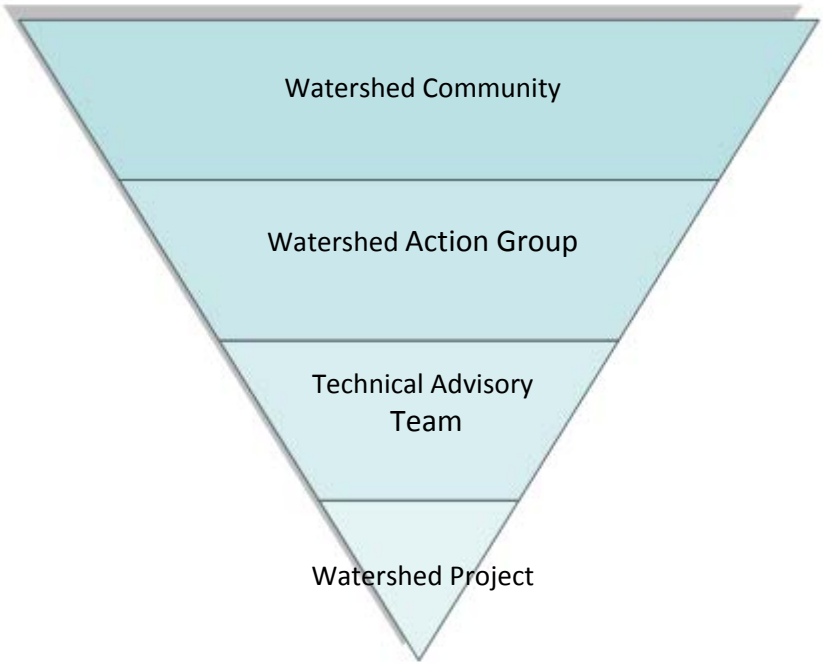
Excess phosphorus loading has been identified as the primary cause of water quality problems in Black Hawk Lake. Support for water quality improvements has been verified from rural and urban landowners and residents and local government agencies; all involved are ready to start implementation of this watershed management plan.

Watershed Planning Process

Public involvement is an important part of the watershed improvement process since it is the land owners, tenants, and citizens who directly manage land and live in the watershed that determine the water quality in Black Hawk Lake. Major efforts have been made to ensure that local stakeholders have been involved in the decision-making process that has set goals and actions for improving water quality in Black Hawk Lake.

Strong support for water quality has been shown for decades in and around Black Hawk Lake. A local action group was able to raise over $40,000 to provide local match dollars with the Iowa Department of Natural Resources (IDNR) to fund a Diagnostic Feasibility Study performed by Dr. Downing at Iowa State University. Two public meetings were held in 2009 and 2010 to present results of the study and both events had excellent community attendance.

In 2010 a Watershed Action Group was formed to gather public input regarding water quality improvement in Black Hawk Lake. The Watershed Action Group is made up of a cross section of watershed residents, landowners, and others interested in the lake and watershed. A main task of the Watershed Action Group was to develop recommendations for watershed conservation practices, education and outreach and potential project partners. The recommendations of this group have been incorporated into this plan.



In 2010 a smaller Technical Advisory Team was formed to help coordinate the watershed planning process and incorporate Watershed Action Group and public input into the planning process. Technical Advisory Team members were responsible for the development of this plan and will continue in an advisory role to any subsequent watershed improvement projects.

Watershed planning efforts have resulted in the City of Lake View and other partner groups pursing the formalization of a lake protection association. As of the publication date of this plan the formalization of such an association was still in development but both the Watershed Action Group and Technical Advisory Team are participating in the development of such a group.

Table 1. Black Hawk Lake Watershed Group Members

Name	**Affiliation/Title**	**Sub Category, *if applicable***
Tom Duncan	ISU Extension, watershed resident	Technical Advisory Team
Kenny Bentsen	Sac SWCD, farmer	Technical Advisory Team
Jim Frederick	Sac SWCD Chairman	Technical Advisory Team
Denis Schulte	Sac NRCS, District Conservationist	Technical Advisory Team
Jeremy Viles	Sac NRCS, Resource Conservationist	Technical Advisory Team
Konda Slagle	Sac SWCD Secretary	Technical Advisory Team
Ben Wallace	IDNR, Fisheries Management Biologist	Technical Advisory Team
Pete Hildreth	IDNR, Wildlife Biologist	Technical Advisory Team
Adam Kiel	IDNR, Upper Des Moines and Raccoon River Basin Coordinator	Technical Advisory Team
Mark Licht	ISU Extension Agronomist	Watershed Advisory Group
Dennis Berry	ISU Extension Council, lake resident	Watershed Advisory Group
Lannie Miller	Retired IDNR Fisheries Biologist	Watershed Advisory Group
Scott Peterson	Lake View City Administrator	Watershed Advisory Group
DG Partridge	Watershed resident, landowner	Watershed Advisory Group
Rosie Partridge	Watershed resident, landowner	Watershed Advisory Group
Jenny Easler	Lake resident	Watershed Advisory Group
Mark Easler	Lake resident	Watershed Advisory Group
Erin McCollough	Attorney, lake resident	Watershed Advisory Group
Graham Hoeg	Retired farmer, landowner	Watershed Advisory Group
Norma Hoeg	Resident, landowner	Watershed Advisory Group
Dorothy Lamphier	Landowner	Watershed Advisory Group
Clint Miller	Carroll NRCS, District Conservationist	Watershed Advisory Group
Dean Stock	Sac County Supervisor, farmer	Watershed Advisory Group
Diane Lucas	Breda City Clerk	Watershed Advisory Group
Mike Schwabe	Breda City Council	Watershed Advisory Group
Emily Busch	City of Lake View Marketing	Watershed Advisory Group
Alan Lemker	Carroll County Supervisor	Advisor
John Klein	M&M Divide RC&D Director	Advisor
Erick Haakenson	IDNR	Advisor
Alan Kruthoff	Lake resident	Advisor
Barb Grabner Kerns	Trees Forever Field Coordinator	Advisor
Jackie Comito	Iowa Learning Farm Director	Advisor
Jeff Pudenz	Farmer	Advisor
Sherri Wilson	Sac County Sanitarian	Advisor
Carey Kersey	Carroll County Sanitarian	Advisor
Bill Geake	Sac SWCD Assistant Commissioner	Advisor
Ray Willhoite	Sac SWCD Commissioner	Advisor
Collin Garrels	Farmer, landowner, resident	Advisor

Public Perceptions and Willingness to Participate

Success of watershed projects hinges on public participation. A survey of watershed residents (n=25) was conducted in 2011 to gauge their perceptions of water quality and willingness to participate in water quality improvement projects. The results are summarized below.

Survey respondents were first asked to describe themselves.

Landowner not farming land - 12
Landowner farming - 4
Tenant farming rented land - 6
Resident only within the watershed - 2
Business owner only within the watershed - 1

Survey respondents were then asked to indicate their level of agreement or disagreement with the following statements.

Table 2. Perceptions of water quality.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Water quality in Black Hawk Lake needs improvement				8	17
Agriculture fertilizers have impacted water quality in Black Hawk Lake		1	7	12	5
Eroded soil and sediments have impacted water quality in Black Hawk Lake				18	7
Improperly functioning septic systems have impacted water quality in Black Hawk Lake		1	12	10	2
Urban issues have impacted water quality in Black Hawk Lake		4	8	10	3
Other issues have impacted water quality in Black Hawk Lake		1	9	10	5
Poor water quality affects economic development in this area			2	6	17
I know what steps to take to better conserve soil and water on my land			6	16	3
I would be willing to work with others to develop and implement strategies that protect our watershed		3	8	11	3

Survey respondents were asked what sources of information they currently use or would use in the future to assist them in making decisions about their farming operation. Survey respondents were able to select multiple means of received information. They answered the following.

Information meetings – 16
Face-to-face contacts - 16
Field days - 14
Demonstration projects - 12
Newsletters - 7
Newspapers - 6
Internet - 5

Farm magazines – 2

The following conservation practices have been identified as being effective at improving the water quality in the Black Hawk Lake watershed. Survey respondents were asked how interested they were in adopting them to their farming operation if 75% cost share was provided.

Table 3. BMP Interest.

	Would not work on my land	Not at all interested	Somewhat interested	Very interested	Already adopted
No-Till/Strip Till	2	1	8	6	2
Mulch-Till	3	1	2	7	6
Stream Buffers/Filter Strips	7		3	6	3
Livestock Exclusion from Streams	15		2	2	1
Streambank Stabilization	10		3	7	
Cover Crops	1	4	13	2	
Grass Waterways			8	8	4
Terraces	1	1	8	6	4
Ponds	5	10	2	3	
Wetlands	2	10	5	3	
Pasture Management	16		1	3	
Variable Rate Fertilizer Application	2		2	16	
Livestock Waste Systems	16	1		3	
CRP		2	10	6	3

Public Meetings & Outreach *(as of publication)*

March 26, 2009

A public meeting was held on March 26, 2009. The meeting was facilitated by the Iowa Department of Natural Resources (IDNR) in cooperation with the Limnology Laboratory at Iowa State University (ISU). ISU conducted a diagnostic feasibility study for Black Hawk Lake concurrent with TMDL development. IDNR and ISU collaborated to share data and public participation efforts.

The March 26 meeting focused on the diagnostic feasibility study and IDNR staff informed attendees of the TMDL process (goals, requirements, and timeline). Attendees were invited to ask questions and provide insight, and IDNR contact information was provided to attendees for future use. Approximately 60 individuals attended the meeting. Both urban and rural landowners and residents were well represented.

Key agency attendees included:
IDNR – Black Hawk Lake State Park staff
IDNR – Fisheries Bureau staff
IDNR – Wildlife Bureau staff
IDNR – Lakes Restoration program staff
IDNR – Watershed Improvement Section (TMDL and 319 program staff)
ISU Extension Office
ISU Limnology Laboratory
IDALS – Division of Soil Conservation (Basin Coordinator)
Sac County Soil and Water Conservation District (SWCD)
USDA-NRCS

March 23, 2010

A preliminary draft of the ISU/IDNR diagnostic feasibility study was presented to local stakeholders on March 23, 2010. The focus of the meeting was on the ISU study and an update regarding the TMDL was provided by IDNR staff. Meeting attendance was similar to attendance for the March 26, 2009 meeting. Discussion topics included:

Results of diagnostic feasibility study (John Downing, ISU)
Potential fishery restoration (Don Herrig, IDNR)
Opportunities for landowner conservation measures (Kathy Koskovich, IDNR)
Community-based watershed planning process (Ben Wallace, IDNR)

June 19, 2010

As a follow up to Dr. Downing's presentation of the DFS findings, the Technical Advisory Team was asked to present those findings on a Saturday when more lake residents were present. Several of the Technical Advisory Team members presented the findings and gave updates on the process and the work in the watershed. It was the first opportunity many of the lake residents had to interact with and ask questions of the Technical Advisory Team. Many ideas were shared at this informal meeting.

July 1, 2010

The Iowa Learning Farm hosted an event at Black Hawk State Park on July 1, 2010. They displayed the Conservation Station and had a team to work various displays that help educate the public on conservation. Youth and adults were provided a meal, given a chance to interact with many of the displays, and then viewed the ILF video *Troubled Waters*.

August 11, 2010

A public meeting was held on August 11, 2010 for tenants and landowners in the watershed. The SWCD shared conservation program specifics and allowed the group to ask questions about the process and the funding. ISU Extension Field Specialists also shared information on the fall stalk nitrate testing, the p-index, the soil conditioning index, and various conservation practices. Finally they shared information on conservation tillage techniques.

January 27, 2011

A public meeting to present the results of the TMDL study and discuss the next steps for community-based watershed planning was held on January 27, 2011. Charles Ikenberry and Jeff Berkes shared the water quality improvement plan and the TMDL. The local Watershed Action Group also gave an update on the activities and the process. NRCS District Conservationist Denis Schulte discussed many of the best management practices that will be pursued.

February 17, 2011

A public meeting was held on February 17, 2011 in the Village of Carnarvon. Carnarvon is a small, unincorporated area with about 60 residents. The majority have septic systems that need to be upgraded with leach fields. Sac County Sanitarian and SWCD commissioners shared information on possible strategies to address the concerns and answer questions the residents had on the process and funding. The meeting was well attended by nearly 30 residents and the consensus was that they wished to be involved in the project and needed more technical and financial assistance to bring their systems up to code.

About Black Hawk Lake Watershed

Black Hawk Lake is a natural lake that borders the east edge of the City of Lake View, located in Sac County in northwest Iowa. The Iowa Department of Natural Resources (IDNR) maintains and operates Black Hawk State Park and Black Hawk Wildlife Management Area, both adjacent to the lake. Two parks owned and operated by the City of Lake View, Speaker Park and Crescent Beach Park, are also adjacent to the lake. The IDNR identified Black Hawk Lake as a major recreational area based on factors such as visitation rates, campground use, and population within a 50-mile radius of the lake. The Center for Agricultural and Rural Development (CARD) at Iowa State University estimates that between 2002 and 2005, Black Hawk Lake averaged over 146,000 annual visitors. Those visitors spent an average of $19 million per year, which supported 379 jobs and $5.1 million of labor income in the region.

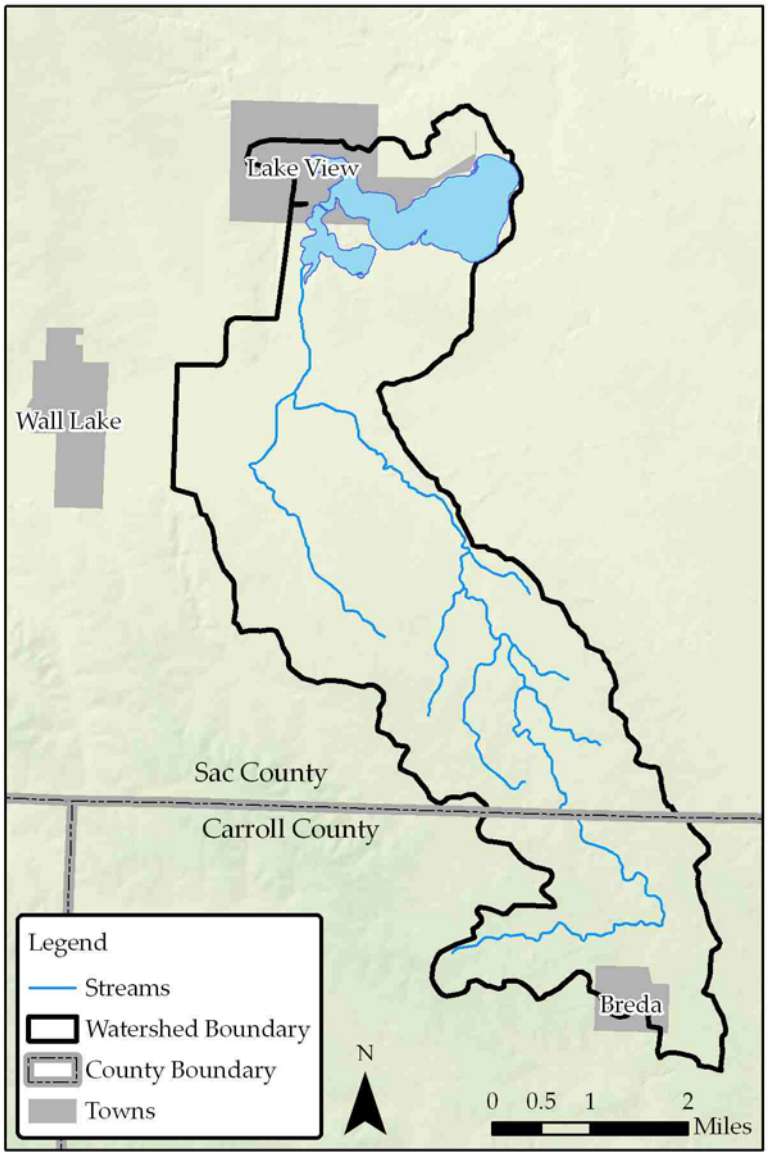


Figure 1. Black Hawk Lake watershed.

The drainage area to Black Hawk Lake is a 13,156-acre watershed, not including the surface area of the main body of the lake or the adjacent Provost Slough. The watershed to lake ratio of over 14 to 1 is higher than the average for natural lakes in Iowa, and indicates that watershed characteristics have a potentially large impact on water quality in Black Hawk Lake. However, the ratio is low enough that water quality improvement can be achieved with a comprehensive package of best management practices (BMPs) and restoration alternatives. The potential for successful lake restoration efforts is generally considered good in cases where the watershed to lake ratio is less than 20:1

Physical Characteristics

Table 4 presents general characteristics of Black Hawk Lake and its watershed as it exists today. Estimation of physical characteristics such as surface area, depth, and volume are based on the bathymetric survey conducted by IDNR in 2006.

Table 4. Watershed characteristics.

IDNR Waterbody ID	IA 04-RAC-00475-L_0
12-Digit Hydrologic Unit Code (HUC)	71000060401
12-Digit HUC Name	Wall Lake Inlet
Location	Sac County, S35, T87N, R36W
Latitude	42° 18′ N
Longitude	95° 1' W
Designated Uses	A1 – Primary contact recreation B(LW) – Aquatic life (lakes and wetlands) HH – Human health (fish consumption)
Tributaries	Carnarvon Creek, unnamed tributaries
Receiving Waterbody	Unnamed stream to Indian Creek to North Raccoon River
Lake Surface Area	922 acres (main lake = 760; inlet slough = 162)
Maximum Depth	15.1 feet (main lake)
Mean Depth	5.97 feet (main lake)
Lake Volume	4,487.7 acre-feet (main lake)
Length of Shoreline	11.4 miles (60,134 feet)
Watershed Area	13,156 acres (excludes lake and inlet slough)
Watershed : Lake Ratio	14.3:1
Lake Residence Time	86 days (2005-08 growing season average.) 133 days (2005-08 annual average)

Hydrology

Black Hawk Lake lies within the North Raccoon River HUC-8 and Indian Creek – North Raccoon River HUC-10. It is the southern-most glacial lake in the State of Iowa. The lake does have a man-made outlet structure, which was constructed to safely release water and eliminate low land flooding at the east end of the lake during high water. The date of construction of the current dam is unknown, but a historical narrative suggests that some type of dam existed prior to 1893. The original outlet structure was removed to protect Lake View from flooding, but a new dam was later rebuilt. Major surface water inflows include one major inflow stream,

Carnarvon Creek, and several small unnamed tributaries to Carnarvon Creek. Local overland flow also enters the lake through storm sewers and tile drains. The lake outlet discharges over a 38-foot long semi-circular concrete dam, with a spillway crest elevation of 1,220.50 feet. Outflows travel east and then north for approximately six miles in this unnamed stream before discharging to Indian Creek and eventually the North Raccoon River, which flows south toward Des Moines.

In addition to runoff and surface water inflow, direct precipitation and groundwater are part of the lake's hydrologic system. Like all natural lakes, groundwater plays an important role in the hydrology of Black Hawk Lake. In a study of the water budget of several Iowa lakes, Hanson (1983) estimated that on average, groundwater accounted for approximately 80 percent of the inflow to Black Hawk Lake from 1970 to 1982. The overall water balance during the 11-year study period was positive, meaning that inflows exceeded evaporation and seepage losses. Data for 1976 and 1977, two of the driest years on record, were not available for Hanson's study. This

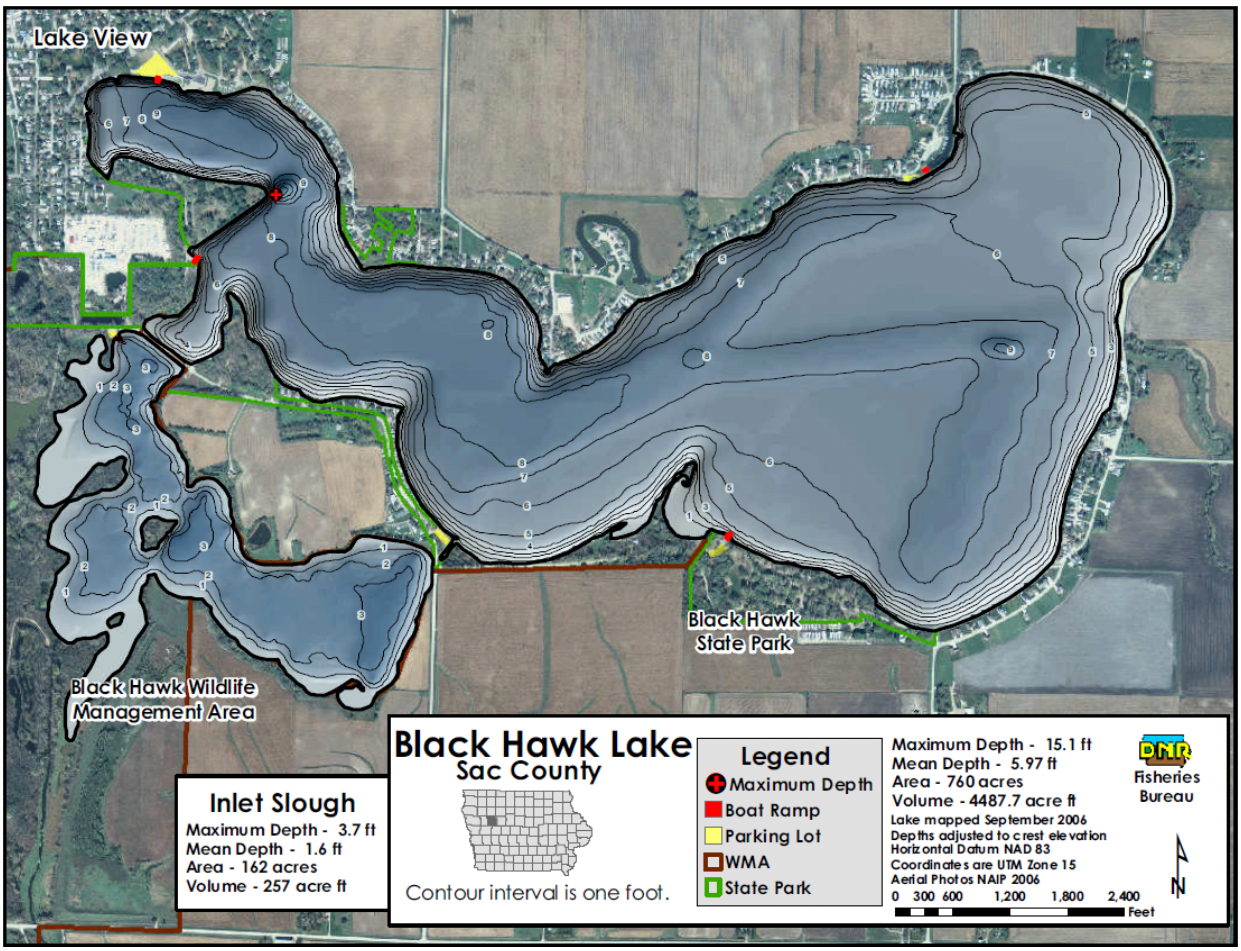


Figure 2. Black Hawk Lake.

certainly influenced the study findings, and it is likely that groundwater contributions were negligible, or even negative, during these two years. The overall water balance estimations would not have been as positive if data from 1976 and 1977 would have been available.

Analysis reveals several noteworthy trends. First, during most years the spillway is discharging a majority of the time, indicating that the water balance is normally positive (inflows exceeded losses.) Second, in nearly every year, lake stage is highest from April through June. Third, the lowest stage and frequent zero discharge periods typically occur between October and December. Lastly, particularly high lake levels (and corresponding flows) were observed in May 2001, May 2007, and June 2008.

Many of the natural wetlands that were common in the watershed pre-settlement have been lost. Based on soil characteristics, historic aerial photography, and topography, there was once approximately 1,140 acres of wetlands in the Black Hawk Lake watershed. Historical wetlands were a mix of depressional wetlands in upland areas and riparian wetlands adjacent to stream corridors. Today approximately 490 acres of wetland remain, most of which consist of the Ducks Unlimited (DU) Pond and State Marsh, located just upstream of the lake. The loss and transformation of wetland distribution in the watershed has affected both hydrology and water quality.

Soils, climate, and topography

Black Hawk Lake is situated in the terminal moraine of the Wisconsin Age Glacier, causing local geological conditions to be somewhat complex. Nearly two-thirds of the watershed is derived from glacial till within the Des Moines Lobe landform region. Glacial outwash, alluvium, and marsh areas compose the rest of the watershed. The fact that the lake is in an alluvial valley with an extensive area of glacial outwash near the lake suggests that there is a strong hydraulic connection between the lake and local groundwater supplies.

Table 5. Soils

Soil Name	Watershed Areas (%)	Description of Surface Soil Layer	Typical Slopes (%)
Clarion	35	loam, black, well drained,	2-9
Nicollet	13	loam, black, somewhat poorly to moderately well drained	1-3
Webster	11	silty clay loam, black, poorly drained	0-2
Coland	6	clay loam, black, poorly drained	0-2
Canisteo	3	silty clay loam, black, poorly drained	0-2

Three soil associations dominate the Black Hawk lake watershed: the Clarion-Nicollet-Canisteo, Clarion-Nicollet-Webster, and Marshall-Exira associations. Of these, the Clarion-Nicollet-Canisteo association comprises the largest portion of the watershed. The Clarion-Nicollet-Canisteo association is characterized by nearly level or gently undulating slopes; however, near larger streams, many soils are gently rolling to hilly and a few are steep or very steep. This

association is well to poorly drained and closed depressions or "potholes" are a common feature. The Clarion-Nicollet-Canisteo association is found primarily in upland areas. The Clarion-Nicollet-Webster association is also found in upland areas on nearly level to strongly slope areas, and includes well drained to poorly drained soils. The Marshall-Exira association is characterized by nearly level to moderately steep slopes, is well-drained, and includes silty soils formed in loess on upland areas. The following table describes the five most common soil types (comprising the largest area) in the watershed.

The climate is typical of the Midwest, with most of the annual rainfall occurring from late spring through early fall. Spring and summer rainfall can be intense, with large amounts of rain occurring in short time spans. High intensity rainfall increases the potential for localized flooding and soil erosion. From 1997 through 2009, average annual precipitation at NWS COOP stations located in Sac City and Carroll, Iowa was 31.7 and 32.4 inches, respectively.

Topography

Table 6. Topography

Slope (%)	Description	Watershed Area (%)
0-2	Level and nearly level	50.9
2-5	Gently sloping	42.9
5-9	Moderately sloping	5.9
>9	Strongly sloping to very steep	0.3

Land Use

IDNR staff and Sac SWCD staff involved in the development of this document conducted a windshield survey of land cover in the fall of 2008 and again in the fall of 2009. The 2008 and 2009 windshield survey data was collected the field scale. Land cover information reveals that row crop agriculture is the most dominant feature of the Black Hawk Lake watershed. Most of the agricultural land is in a corn-soybean rotation. Approximately 68 percent of the watershed is assumed to have tile drainage, based on row crop land use, slopes less than 5 percent, and soil types known to require tile drainage for row crop production. Other land uses include alfalfa, pasture, grasslands, timbered areas, and urban areas of residential and commercial/industrial uses. Table 7 reports the generalized land uses and percent of watershed according to the 2009 windshield assessment.

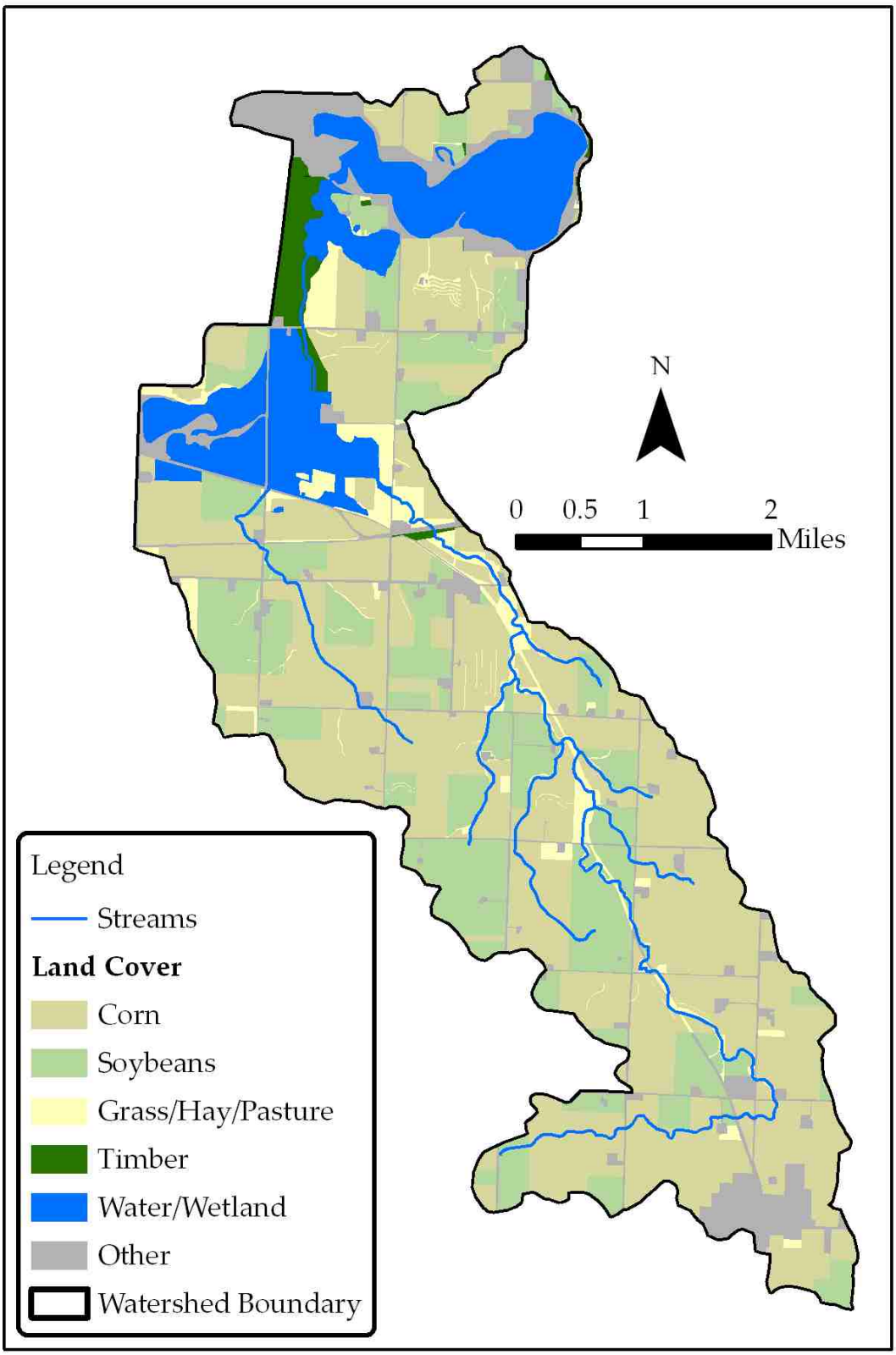


Figure 3. 2009 land use of the Black Hawk Lake watershed.

Table 7. 2009 land use.

2009 Land Use	Description	Area (Acres)	% of Watershed
Corn	--	6,936	52.7
Soybeans	--	2,878	21.9
Grass/Hay/Pasture	grassland, parks, alfalfa, pasture	888	6.7
Timber	Forest, vineyard	245	1.9
Water/Wetland	wetlands and ponds (excludes lake)	764	5.8
Other	urban uses, roads, farmsteads, etc.	1,445	11
Totals =		13,156	100

Population and Land Ownership

The watershed includes the towns of Breda, Carnarvon, and Lake View. The 2010 Census report showed 409 people live in Breda and 1,151 live in Lake View which includes the unincorporated town of Carnarvon.

There are 176 USDA tracts of farm ground within the watershed which are owned by 165 people/entities and operated by 78 individuals.

Water Quality Findings

A great deal of water quality monitoring has taken place in Black Hawk Lake and tributary streams over the past several years. Monitoring results will be summarized in this section by focusing on recent in-lake monitoring and watershed monitoring. For detailed results see Appendices D and E.

Watershed Monitoring

Monitoring was conducted at thirteen sites throughout the watershed as part of the 2010 Black Hawk Lake Diagnostic and Feasibility Study. Continuous monitoring of stream discharge and monthly nutrient sampling from July 2008 to September 2009 (excluding January and February 2009) were used to calculate nutrient export rates from subwatersheds. It should be noted the subwatersheds used in the Diagnostic and Feasibility Study were mimicked in the TMDL modeling discussed later in this document.

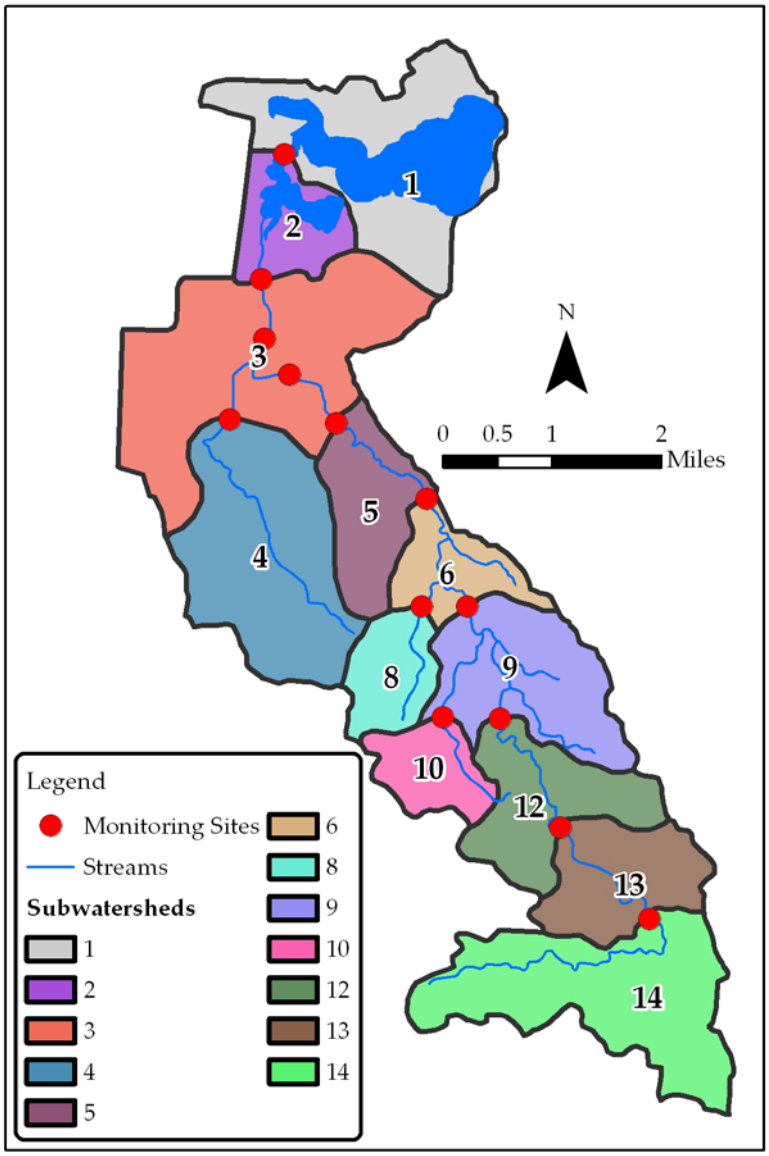


Figure 4. Diagnostic and Feasibility Study monitoring locations.

As expected, nutrient loading rates varied by subwatershed. Phosphorus loading, the focus of this plan, was determined to be the highest from subwatersheds in the southern 1/3 of the watershed. Subwatersheds 12 and 13 contributed greater than 50% of the total phosphorus load. Nitrogen loading patterns varied as well, but almost 75% of the load originated from the southern subwatersheds. See Figure 4, 5 and 6.

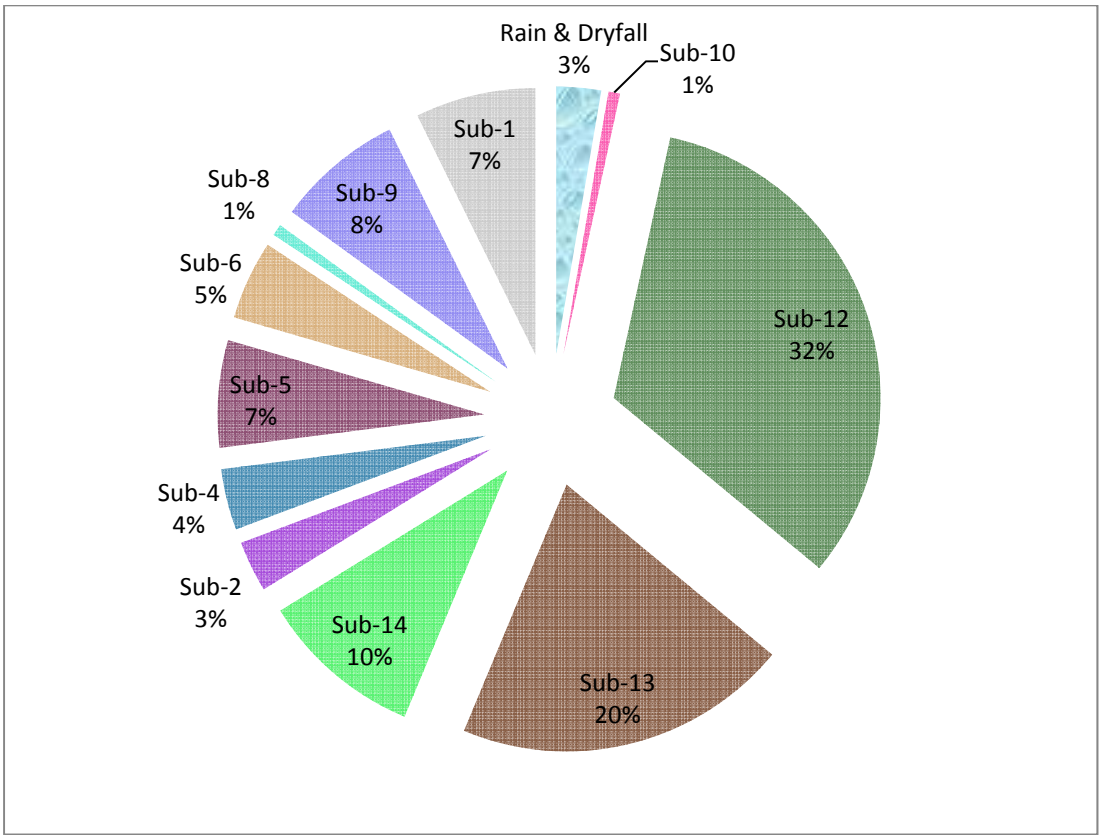


Figure 5. Phosphorus loading from subwatersheds

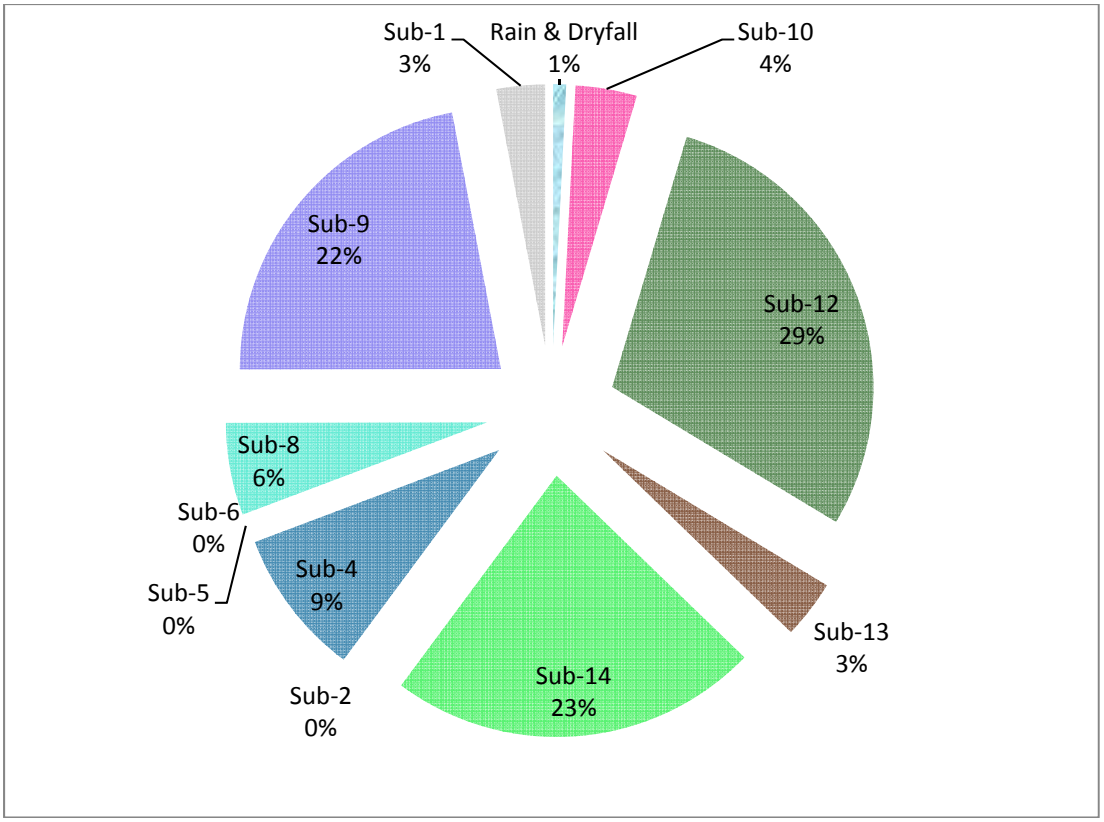


Figure 6. Nitrogen loading from subwatersheds

In-Lake Monitoring

In-lake monitoring has been conducted at one site in Black Hawk Lake since the year 2000. These data were used to determine that the Class A1 uses of Black Hawk Lake were not supported due to poor water transparency resulting in Black Hawk Lake being listed on the Iowa 303(d) Impaired Waters List. The cause of the poor water transparency is algal and non-algal turbidity. Using Carlson's Trophic State Index (TSI) for Secchi depth, chlorophyll-a and total phosphorus, Black Hawk Lake falls in the hypereutrophic category. Hypereutrophic lakes often exhibit extensive weeds, algal scums and low transparency that discourage swimming and boating, and the fish population tends to be dominated by common carp and other rough fish. Figures 7 and 8 illustrate the Secchi depth and total phosphorous levels in the lake since 2000.

Black Hawk Lake is also listed on the Iowa 303(d) Impaired Waters List due to high levels of indicator bacteria at the Black Hawk State Park beach. Black Hawk Lake was sampled as part of IDNR's Safe Lakes Program, which aimed to identify sources of bacteria to selected beaches where bacteria levels have consistently violated the state water quality criteria. The Safe Lakes Program found human contamination in a tile about 200 meters east of the beach. This tile had very high concentrations of detergents present and blood worms where the tile was discharging. The tile line was reported to the IDNR Field Office who could not find it when they went to investigate in the summer of 2006. During follow-up sampling in 2007 the IDNR Safe Lakes Program also could not find the tile. This tile was gone, capped off, or underwater as the lake water level was higher in 2007. This tile was a likely source of contamination to Blackhawk Lake beach. The Iowa DNR Field Office is working with the suspected owner of the

tile line to install a treatment system, as of 2011 the system has yet to be installed. It is anticipated bacteria levels at the beach will benefit from the additional tile line treatment and thus bacteria will not be a focus of this plan. Project staff will continue to monitor the bacteria levels at the beach.

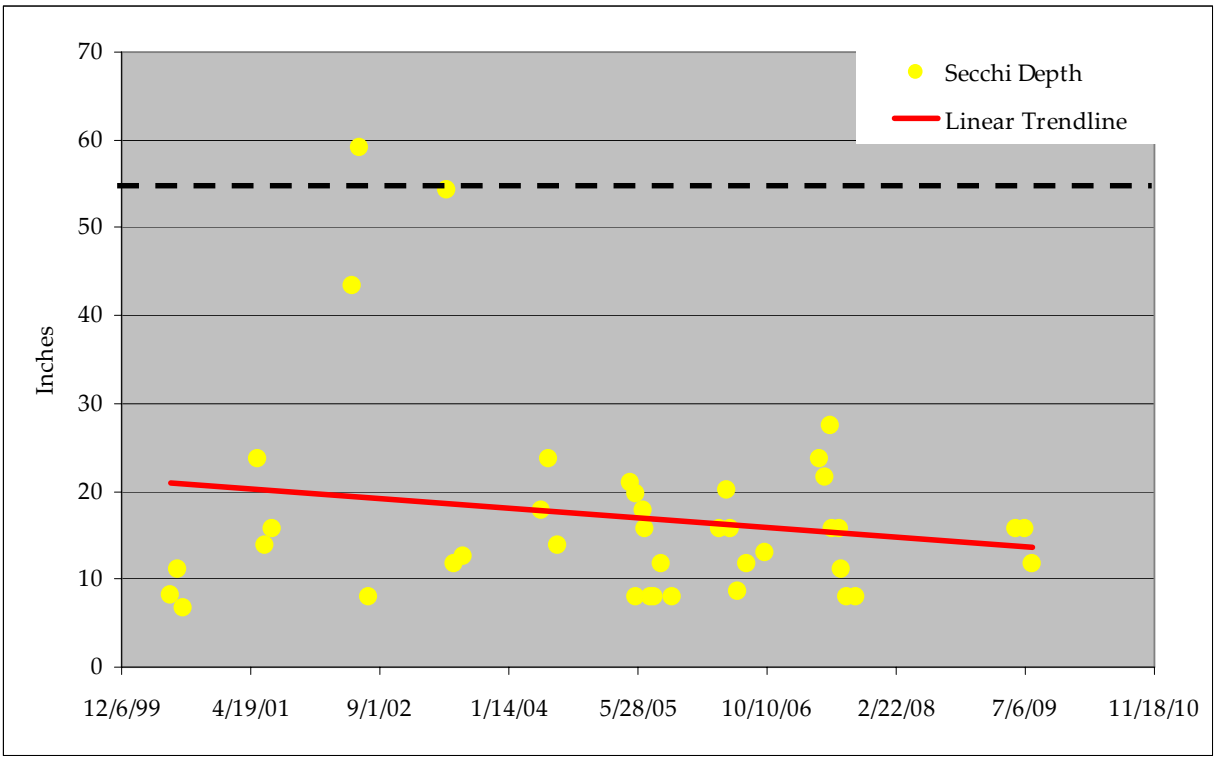


Figure 7. Secchi Depth at in-lake ambient monitoring site.

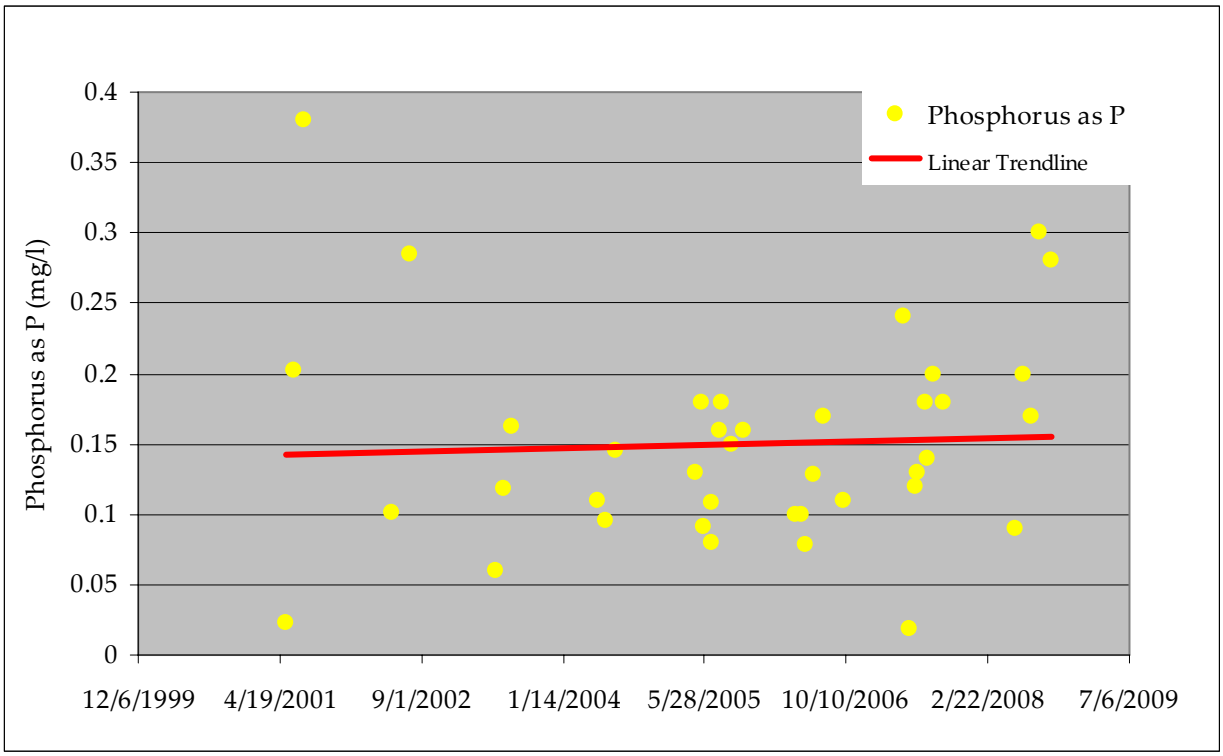


Figure 8. Phosphorus as P levels at in-lake ambient monitoring site.

As part of the TMDL process, monitoring was conducted by IDNR in 2007 and 2008. Water quality data was collected at three locations in Black Hawk Lake; the west arm, the middle segment at the ambient data location, and in the large bay on the east side of the lake. Figure 9 shows the locations of these monitoring sites. The goal of this monitoring was to assess spatial variability in water quality within Black Hawk Lake. Monitoring at these three sites revealed several noteworthy trends in water quality. First, total phosphorus concentrations were the highest in the west arm of Black Hawk Lake where water enters from Provost

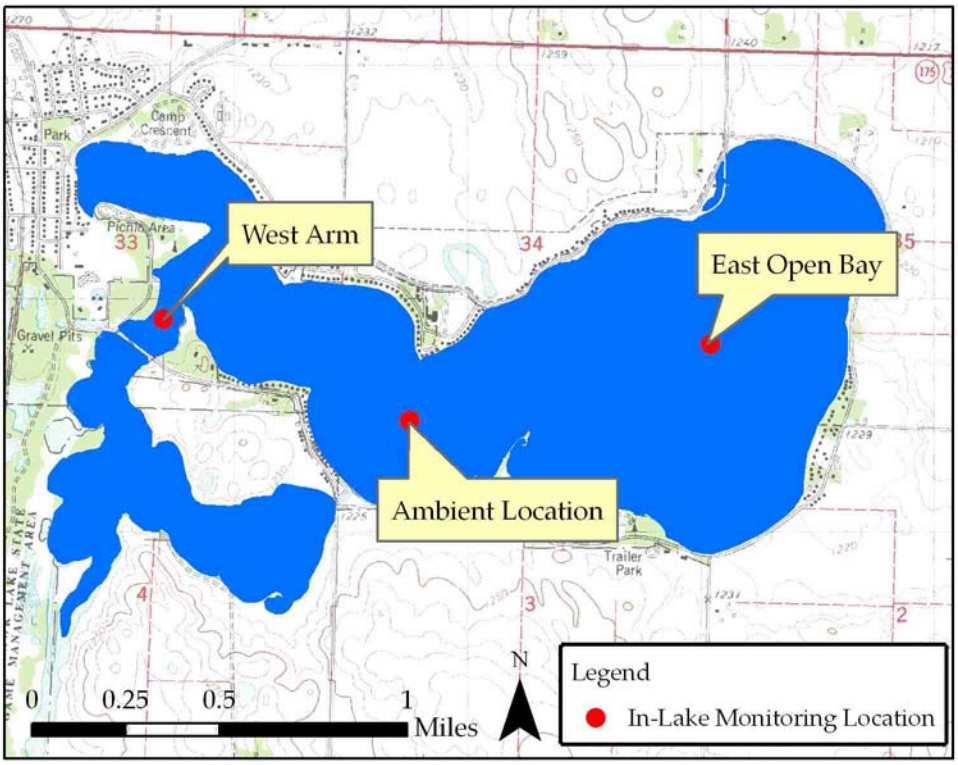


Figure 9. In-lake TMDL monitoring locations.

Slough. Total phosphorus levels decrease as water travels towards the outlet of the lake, likely due to the settling of fine sediment particles that contain phosphorus. Second, both chlorophyll-a and Secchi depth follow the same pattern as total phosphorus but the drop is slightly less pronounced. See Figure 10 for mean TSI scores at each lake monitoring point. For more information see Appendix D.

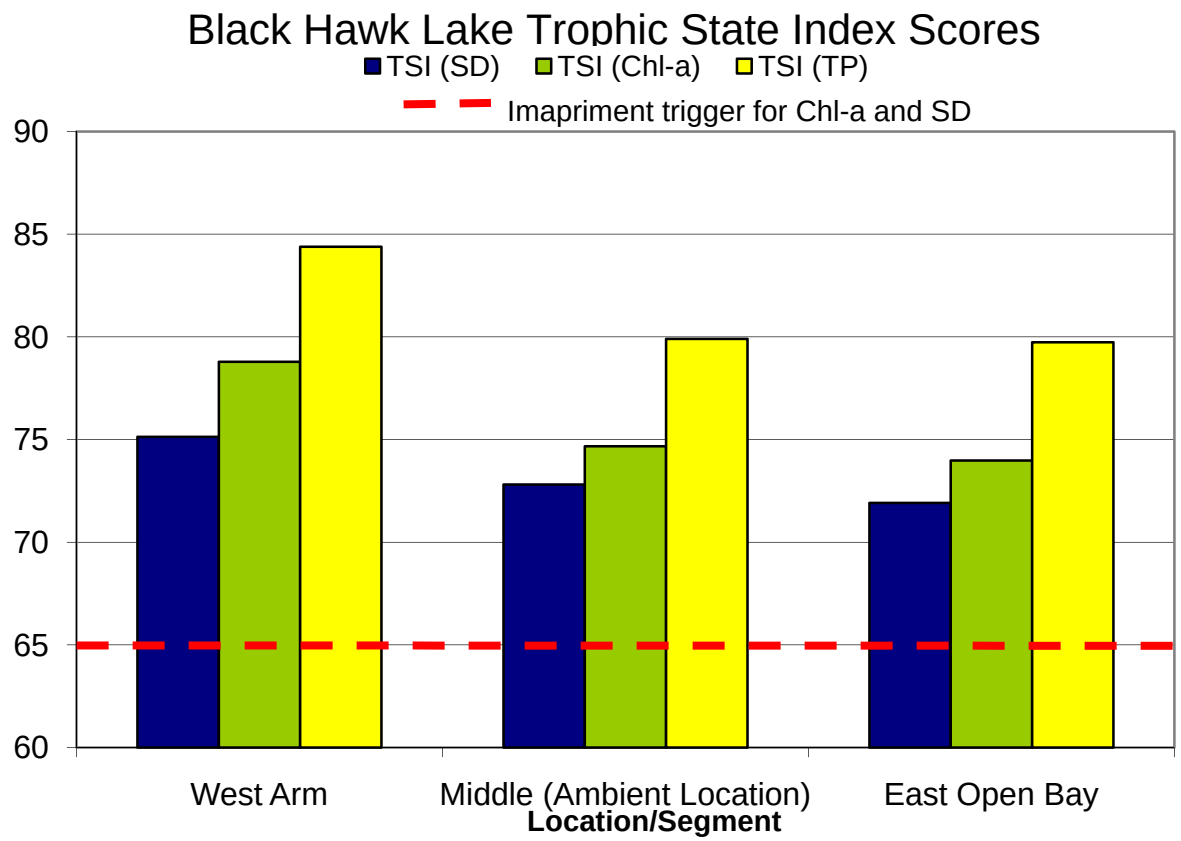


Figure 10. In-lake TSI values.

Pollutant Source Assessment

Designated Use & Impairment

Black Hawk Lake is not supporting its Class A1 (primary contact recreation) designated use causing the lake to be listed on Iowa's 303(d) Impaired Waters List. Primary contact recreation includes those activities which involve prolonged and direct human contact with the water such as swimming, wading, and water skiing. Poor water transparency caused by algae and turbidity, which violates the narrative water quality criterion for surface water to be free of "aesthetically objectionable conditions," is preventing the primary contact recreation use from being fully supported.

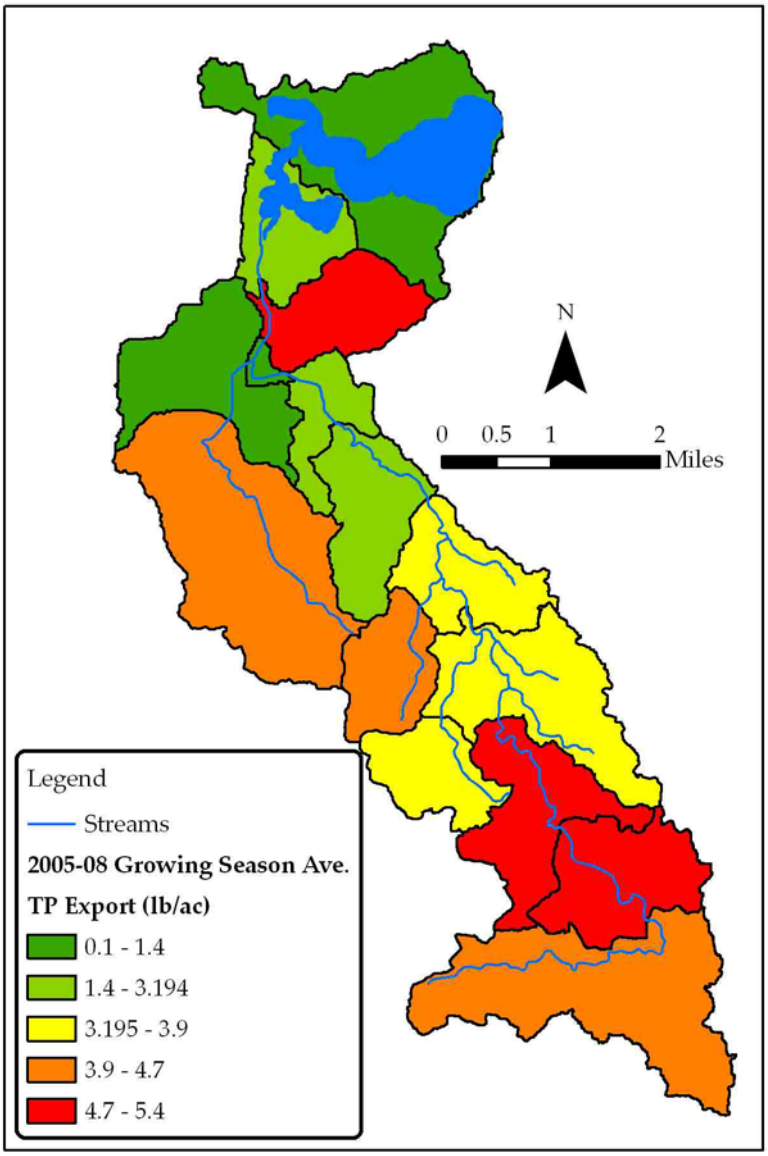


Figure 11. Total phosphorus loading from TMDL.

When nitrogen and phosphorus are abundant in surface water they speed the growth of algae to an unhealthy level in a process called eutrophication. The 2011 Black Hawk Lake TMDL found that excess phosphorus, mostly attached to sediment, is thought to be the critical factor causing hypereutrophic conditions in Black Hawk Lake.

Existing load

As part of the Black Hawk Lake TMDL long-term simulations (1997-2009) of hydrology and pollutant loading were developed using the Soil and Water Assessment Tool (SWAT) model. Using SWAT, the growing season (April through September) average total phosphorous (TP) load to Black Hawk Lake, including watershed, internal, and atmospheric loading was estimated to be 42,620 lbs per season, or an average of 234 lbs/day, from 2001 through 2008. This period was selected for several reasons: the growing season is the critical season for algal blooms and poor water clarity, water quality data were collected by ISU and University Hygienic Laboratory during the 2001-08 growing seasons, and best agreement between observed and simulated in-lake water quality were

achieved in this period. In addition, the impaired designated use, primary contact recreation, is most applicable to this period.

Departure from load capacity

The target TP load, also referred to as the load capacity, for Black Hawk Lake is 9,366 lbs/season or 219 lbs/day (maximum daily load). This is an aggressive goal, and will require implementation of a comprehensive package of BMPs in the watershed and in Black Hawk Lake itself to achieve this goal. It should be noted that the Black Hawk Lake Diagnostic Feasibility Study concluded that a similar reduction in nutrient and sediment loading reduction is needed to achieve water quality goals. See appendix E, Black Hawk Lake Diagnostic Feasibility Study

Identification of pollutant sources

The existing TP load to Black Hawk Lake is primarily from nonpoint sources of pollution, but includes one point source operating under a National Pollution Discharge Elimination System (NPDES) permit. Table 8 reports estimated TP loads to the lake from all known sources during the growing seasons (April to September) of 2001-2008.

Figure 12 illustrates the relative contributions of generalized phosphorus sources. The predominant source of phosphorus in the watershed is land in row crop production. Soil erosion results in phosphorus-laden sediment being washed into tributaries to Black Hawk Lake. Phosphorus levels in sediment and runoff are increased by the application of chemical and organic fertilizers, such as di-ammonium phosphate and swine manure. Runoff from row crops also carries soluble phosphorus into the stream network. Row crops comprise approximately 75 percent of the land use in the watershed and contribute an estimated 74 percent of the TP load. Approximately 20 percent of row crops in the watershed receive manure application, according to manure management plan (MMP) records. SWAT simulations revealed that the 20 percent of row crops receiving manure application account for over 28 percent of the total TP load from row crops.

Internal recycling of phosphorus in the lake, sometimes referred to as internal loading, comprised 14.8 percent of the average TP load in the 2001-2008 growing seasons. However, internal recycling may be more critical than this contribution suggests. In dry years, the internal load can drive algal blooms in the absence of significant phosphorus loads from watershed runoff. Precipitation data indicates that 2006 was the driest year on record between 2001 and 2009, and the estimated internal load in 2006 was two and one-half times greater than the simulated load from all watershed sources. The average chlorophyll-a TSI during the 2006 growing season was 70, lower than most other years but still classified as hypereutrophic. The relative magnitude of average internal loads is decreased due to extremely large external loads in wet years, but in-lake water quality will not improve significantly without reducing both internal and external sources of phosphorus.

Streambank erosion (also called channel erosion) is temporally and spatially variable and inherently difficult to quantify. The SWAT model simulates streambank erosion and deposition, but quantifies only sediment, not phosphorus associated with channel sediment. One problem arising from this limitation is that the effects of sediment deposition on phosphorus transport

are ignored. To calculate TP loads to Black Hawk Lake resulting from streambank erosion, SWAT-predicted channel erosion, in metric tons (mtons), was multiplied by the 2001-2008 watershed-wide growing season-average sediment phosphorus concentration of 1,074 mg TP per kg sediment (2.15 pounds per ton). This concentration was obtained from the simulated average sediment and phosphorus yields to the stream, and therefore considers phosphorus enrichment of sediment as it is delivered to the stream network. The inherent assumption is that streambank soil has the same phosphorus concentration as sediment that is washed from the land surface. The simulated 2001-2008 growing season average TP load to the lake (from streambank erosion) is 2,888 lb-TP/season, 6.8 percent of the TP load to Black Hawk Lake.

Table 8. Total phosphorus loads from identified sources.

Average growing season TP loads from each source (2001-08). Source	**Descriptions and Assumptions**	**TP Load (lb/season)**	**Percent (%)**
Row Crops	Corn and soybeans	31,459	73.8
Internal Recycling	Phosphorus recycled from lake bottom	6,299	14.8
Streambank Erosion	Phosphorus-bound sediment from unstable stream banks	2,888	6.8
Breda STP	Municipal sewage treatment plant	847	2
Feedlots	Runoff from open feedlots	418	1
Atmospheric Deposition	Wet and dry deposition from the atmosphere	204	0.5
Urban/Roads	Stormwater from Lake View, runoff from roads, etc.	192	0.4
Septic systems	Private on-site wastewater treatment systems	104	0.2
Cattle Grazing	Direct deposition of cattle manure in streams and pasture runoff	75	0.2
Wildlife/Background	Runoff from wildlife grass and timber areas; direct deposition by wildlife and geese	79	0.2
Other	All other minor sources	55	0.1
Total		42,620	100

Phosphorus discharged from the Breda Sewage Treatment Plant (STP) is estimated at two percent of the total load, the fourth largest TP source behind row crop agriculture, internal loading, and streambank erosion. Other relatively insignificant sources, each comprising less than one percent of the total load, include natural background sources such as wildlife and

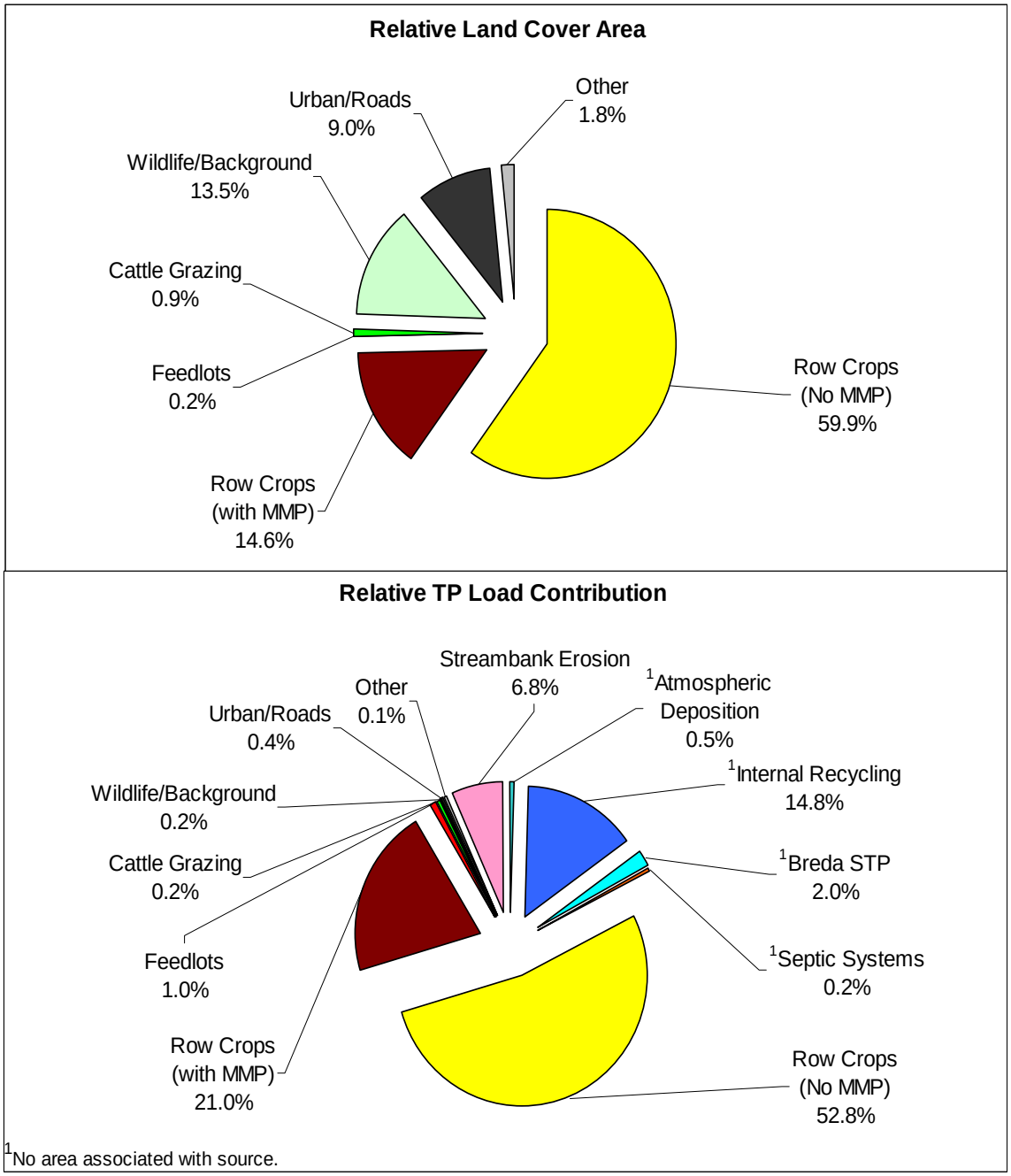


Figure 12. Land cover and relative total phosphorus loading.

atmospheric deposition, livestock grazing, privately owned on-site wastewater treatment systems (e.g., septic systems), and runoff from roads and urban land uses in the City of Lake View. Although overall loads from the urban area are relatively small due to the small urban area in the watershed, localized impacts on water quality (e.g., near outfalls) could be significant and should be considered when implementing watershed conservation practices.

Allowance for increases in pollutant loads

There is no allowance for increased TP loading included as part of the TMDL. A majority of the watershed is in agricultural row crop production, and is likely to remain in cropland in the future. Black Hawk State Park, which is adjacent to the lake, is unlikely to undergo significant land use changes. There are no incorporated unsewered communities in the watershed; therefore, it is unlikely that a future waste load allocation would be needed for a new point source discharge. There may be an increase in residential development in the watershed in the future, but areas of Lake View that drain to the lake are already developed. Any transition from agriculture to residential land use would change the nature and the source of loading, but not the total load allocation as set forth in the TMDL.

Pollutant Allocation - Wasteload allocation

The Breda STP is located approximately 7 miles south of Black Hawk Lake and is the only permitted point source discharger in the watershed. The treatment facility is a four-cell controlled-discharge lagoon that typically discharges for 2-3 week periods in the spring and fall of each year. Existing phosphorus loads from the Breda facility were estimated using daily discharge records and an assumed effluent concentration of 3.6 mg/L TP. This concentration is based on the findings of two independent studies of TP in wastewater effluent (IDNR, 2007 and MPCA, 2000). The MPCA study found that TP in lagoon effluent ranges from 1 to 3 mg/L, with mean and median TP concentrations both equal to 2.0 mg/L (MPCA, 2000). The median effluent concentration from mechanical plants in the MPCA study was 4.0 mg/L. IDNR sampled ortho-phosphorus concentrations (PO4) from 100 wastewater treatment facilities (WWTFs) across the State of Iowa, 16 of which were waste stabilization lagoons. The median outfall composite sample concentration (including all types of systems) was 3.6 mg/L PO4 (IDNR, 2007). The data indicated that concentrations in lagoon effluent were lower than most other types of systems. Due to a limited number of controlled discharge lagoons in the study, the statewide WWTF median concentration of 3.6 mg/L PO4 was assumed to represent the Breda STP effluent total phosphorus (TP) concentration. This is reasonable, and likely a conservative assumption, given the collective findings of the MPCA and IDNR studies.

The estimated load contributed by the Breda STP is two percent of the overall TP load to Black Hawk Lake. However, because no observed phosphorus data are available for the Breda facility, there is uncertainty associated with this allocation. The WLA is based on the best estimate of the existing effluent concentration of 3.6 mg/L and actual discharge (flow) records. Lagoon effluent concentrations above 3.6 mg/L may be indicative of conditions that require additional phosphorus reduction measures at the facility. The TMDL sets the WLA ceiling for the Breda STP at 936 lbs-TP/season, with a maximum daily WLA of 37 lb/day.

Black Hawk Lake Watershed Goals and Objectives

Statement of Goals and Objectives

The goals of this Watershed Management Plan and subsequent water quality improvement projects are to improve water quality in Black Hawk Lake to the point where the algae and turbidity impairment can be removed. This will be accomplished through a combination of watershed conservation practices and in-lake improvements. The following goals and objectives have been developed by the Black Hawk Lake Watershed Action Group with input from landowners and residents of the watershed. A 30-year time frame has been established to meet the following goals.

Goal 1: Increase public understanding of Black Hawk Lake water quality problems

Objective A: Inform landowners and operators of water quality issues by holding educational seminars, mailings, news releases, personal contacts, etc.

Objective B: Educate urban homeowners, businesses and municipalities by holding a "Day on the Lake" seminar, news releases, mailings, personal contacts, etc.

Objective C: Inform visitors with handouts, signage, and websites.

Objective D: Encourage adoption of BMP practices through demonstrations, field days, one-on-one contacts, third party influences, park days, public releases and social networking.

Objective E: Provide awareness to visitors of their role in protecting the water quality of the lake by signage, handouts, and posters.

Goal 2: Implement targeted best management practices in Black Hawk Lake and its watershed to improve water quality in Black Hawk Lake. The in-lake water quality target is to have TSI scores below the impairment trigger for chlorophyll-a and secchi depth.

Objective A: Implement conservation practices on priority agricultural lands within the watershed to reduce phosphorus delivery

Objective B: Implement practices on urban/developed lands within the watershed to reduce phosphorus delivery

Objective C: Implement practices on public owned land within the watershed to reduce phosphorus delivery

Objective D: Implement practices in Black Hawk Lake and Provost Slough to reduce internal recycling of nutrients

Water Quality Milestones

Numeric water quality targets and load reductions are important to measure the success of the watershed quality improvement efforts. The following milestones have been established for each phase of the Watershed Management Plan. Phase 1 is years one to five, Phase 2 is years six to ten, and Phase 3 is years eleven through thirty. As the plan is revised every five years the phases may be modified to better align with water quality improvement progress and funding sources and availability. Load reduction milestones have established using BMP implementation goals for each phase modeled within SWAT. In-lake water quality goals have been set using the BATHTUB model. Both models were used to develop the TMDL.

The goal of this plan is to improve in-lake water quality measures, specifically Trophic State Index (TSI) scores for chlorophyll-a and secchi depth to levels below the impairment trigger of 65. Tables 9 and 10 provide phosphorous load reductions and associated in-lake water quality target by phase.

Milestones and associated reductions are presented in phases, rather than individual BMPs. There are several practical reasons for this methodology. Many of the BMPs specified in this plan work in concert with each other to form comprehensive "treatment trains" of BMPs. The performance (i.e., the load reduction) achieved by each BMP is dependent on one or more other BMPs implemented as part of the same phase of improvements. This makes quantifying the load reduction of each individual BMP difficult. It is more realistic to utilize a watershed-scale modeling tool, such as the one used in the development of this plan, to simulate the potential reductions of each package or phase of BMPs. This approach also provides the planning group with a more realistic and accurate way of projecting and tracking water quality improvement throughout the implementation process.

Table 9. Phosphorus Load Reduction Goals

Scenarios	Phosphorus Loading					
	Watershed TP Load (lbs/season)	Internal TP Load (lbs/season)	Atmospheric (lbs/season)	Total TP Load (lbs/season)	Reduction (%)	Reduction (lbs)
Baseline Conditions	36,117	6,299	204	42,620	--	0
End of Phase 1	29,453	6,299	204	35,956	15.6	6,664
End of Phase 2	19,324	6,299	204	25,827	39.4	10,129
End of Phase 3	8,335	3,150	204	11,689	72.6	14,138

Table 10. In-Lake Water Quality Goals

Scenarios	TP (ppb)	Chl-a (ppb)	Secchi (m)	TSI TP	TSI Chl-a	TSI Secchi
Baseline Conditions	177	58	0.5	79	71	71
End of Phase 1	164	56	0.5	78	70	71
End of Phase 2	139	52	0.5	75	69	70
End of Phase 3	89	39	0.6	69	67	68
End of Phase 3 (3-m mean depth)	73	24	0.7	66	**62**	**64**

The watershed and in-lake models used to develop the TMDL were also utilized to develop this WMP. It should be noted that the projected load reduction in this plan is less than the target set forth in the TMDL. However, the in-lake water quality goals are still achieved because of in-lake dredging that will be performed during implementation. Dredging will increase the mean depth of Black Hawk Lake, which increases its assimilative capacity for phosphorus. At the time of TMDL development, Iowa DNR could not be certain, and therefore did not assume, that any dredging would be performed. Required phosphorus reduction decreases with increased depth, therefore, this plan will meet or exceed the in-lake water quality targets set forth in the TMDL.

Phase 3 includes in-lake measures such as dredging, but also other measures to reduce the cycling of phosphorus from the sediment to the water column of the lake (i.e., internal loading). Attainment of water quality goals is most efficiently achieved through reductions in both internal and external loads. There are many different ways to balance the external vs. internal load reductions to meet in-lake water quality goals. Figure 13 illustrates the range of external load reductions required if internal load reductions vary from zero to 100 percent. This plan calls for a 50 percent reduction of the internal load, which necessitates a 77 percent reduction of the external load. This point is illustrated by an "X" on Figure 13.

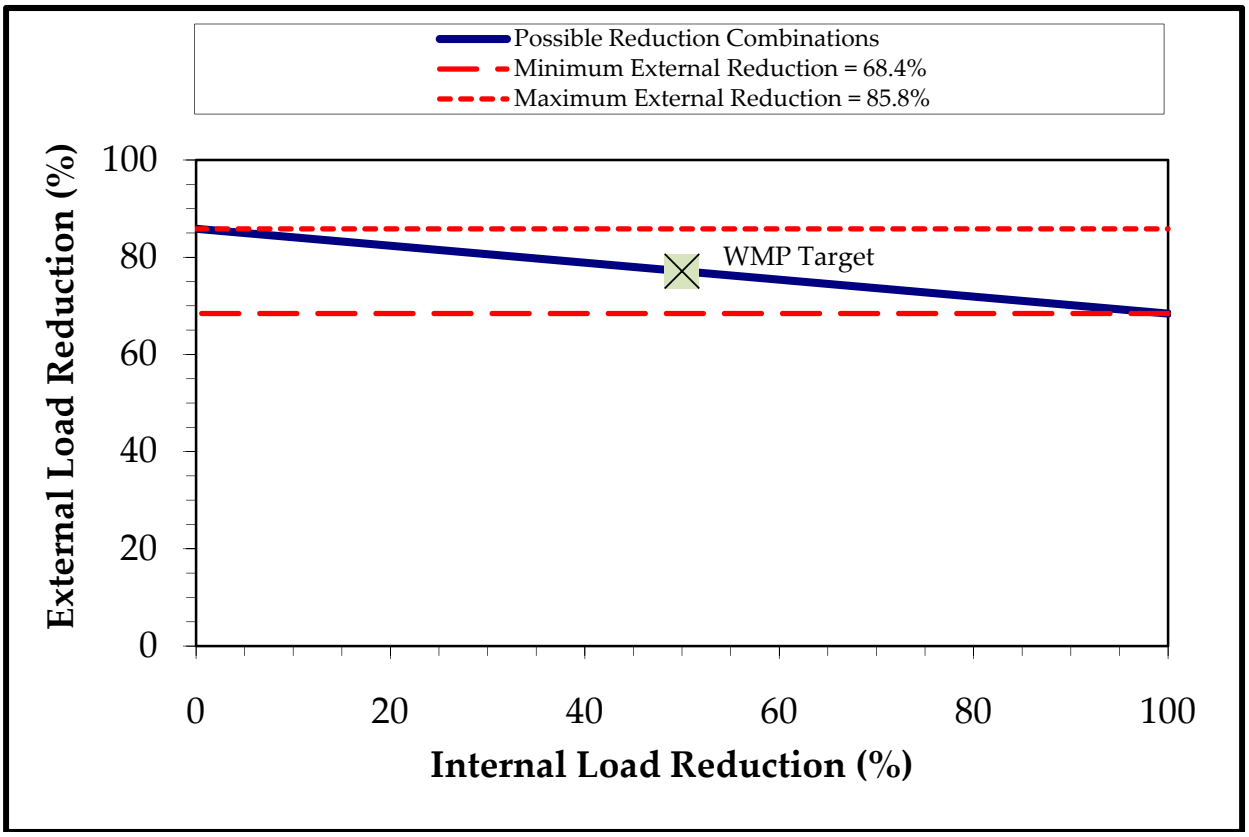


Figure 13. Possible combinations of internal and external load reductions to meet TMDL load allocation.

Phosphorus load reductions resulting from the implementation of best management practices will be calculated using the Iowa Sediment Delivery Calculator. A Sediment to phosphorus

ratio of 2.15 pounds of phosphorus per 1 ton of sediment delivery reduction will be used to estimate in-field reductions. This ratio was cited in the TMDL and will be utilized within the Black Hawk Lake watershed. In-stream water monitoring will also be utilized to track reductions but weather patterns and seasonal variations in flows may make change detection difficult.

Best Management Practices

To determine the benefits of BMP implementation on water quality in Black Hawk Lake the Soil Water Assessment Tool (SWAT) and the BATHTUB Model were used to model different scenarios and the water quality response. Modeling revealed that the following scenario of best management practices will achieve lake water quality TSI targets of 64 for secchi depth and 62 for chlorophyll-a, both levels are below the impairment threshold of 65. Implementation of best management practices has been divided into agricultural, urban, public land, inlet (Provost Slough) and main lake practices. BMPs will be targeted to the areas of greatest phosphorus loading, see Figure 11 for high phosphorus loading areas within the watershed. More details regarding proposed strategies and targeting can be found in Appendix A, B, C, and F.

Agricultural BMPs

See Appendix F for more information.

No-Till
Total Phosphorous potential reduction efficiency[1]: 70%
Goal: 3,925 acres (40% of row crop)
Target: Row crop land with highest slopes and erosion rates
Payment Rate/Incentive: EQIP payment plus $60 per acre one time signup incentive

Mulch-Till
Total Phosphorous potential reduction efficiency[1]: 50%
Goal: 5,888 acres (60% of row crop land)
Target: Remaining row crop land in watershed
Payment Rate/Incentive: EQIP payment plus $10 per acre one time signup incentive

Filter Strips
Total Phosphorous potential reduction efficiency[1]: 45%
Goal: 64 acres of filter strips along stream channels
Target: Areas currently void of adequate stream protection
Payment Rate/Incentive: CRP payment plus $100 per acre sign-up incentive

Livestock Exclusion/Pasture Management
Total Phosphorous potential reduction efficiency[1]: 75%
Goal: Total exclusion of livestock from streams on 106 acres
Target: All areas where livestock have direct access to streams
Payment Rate/Incentive: Up to 75% of total cost

Streambank Stabilization – Hard Armor
Total Phosphorous potential reduction efficiency[2]: Low to Medium
Goal: Address streambank erosion in Carnarvon Creek on 2,000′
Target: Most severely eroding stream banks
Payment Rate/Incentive: Up to 95% of total cost

Streambank Stabilization – Bio-engineering *(aka soft armor)*
Total Phosphorous potential reduction efficiency[2]: Low to Medium
Goal: Address streambank erosion in Carnarvon Creek on 4,000′
Target: Remaining eroding stream banks
Payment Rate/Incentive: Up to 95% of total cost

Streambank Stabilization – Two Stage Ditch and Rock Riffles
Total Phosphorous potential reduction efficiency[2]: Low to Medium
Goal: Address streambank erosion in Carnarvon Creek on 16,000′
Target: Unstable stream channels in southern 1/3 of watershed.
Payment Rate/Incentive: Up to 95% of total cost

Cover Crops
Total Phosphorous potential reduction efficiency[1]: 95-99%
Goal: 490 acres
Target: Areas of corn silage
Payment Rate/Incentive: EQIP payment plus $50 per acre sign-up incentive

Waterways
Total Phosphorous potential reduction efficiency: Varies
Goal: Establish an additional 105,000 feet of waterways in areas showing evidence of ephemeral gully erosion
Target: Areas identified as showing signs of gully erosion
Payment Rate/Incentive: CRP up to 90% of cost

Terraces
Total Phosphorous potential reduction efficiency[1]: 50%
Goal: Additional 70,000 feet of terraces where identified
Target: Cropland where terraces do not currently exist
Payment Rate/Incentive: Up to 75% of total cost

Water and Sediment Control Basin (WASCOB) and Ponds
Total Phosphorous potential reduction efficiency: Varies
Goal: 9 identified sites
Target: Identified feasible locations capturing runoff from priority lands
Payment Rate/Incentive: Up to 75% of total cost

CREP Wetlands
Total Phosphorous potential reduction efficiency[1]: 20%
Goal: 3 CREP Wetlands
Target: As identified by IDALS-DSC
Payment Rate/Incentive: 100% payment by IDALS-DSC CREP

Wetland Restoration (Oxbows or Potholes)
Total Phosphorous potential reduction efficiency[1]: 20%

Goal: 6 additional wetlands will be constructed in the watershed
Target: Eligible areas of watershed
Payment Rate/Incentive: CRP

Livestock Waste Total Containment
Total Phosphorous potential reduction efficiency: Varies
Goal: 4 total containment systems
Target: Livestock producers with open lots
Payment Rate/Incentive: Up to 75% of total cost

Variable Rate Fertilizer Application
Total Phosphorous potential reduction efficiency[1]: 40%
Goal: 100% of cropland
Target: All cropland
Payment Rate/Incentive:

Urban BMPs

See Appendix A for more information.

Carnarvon Septic Systems
Total Phosphorous potential reduction efficiency: Varies
Goal: 100% treatment
Target: Septic systems in Carnarvon
Payment Rate/Incentive: $600 one time incentive for septic upgrades

Phosphorus Free Fertilizer Program
Total Phosphorous potential reduction efficiency[2]: Medium to High
Goal: NA
Target: Residents of Lake View
Payment Rate/Incentive: $5 voucher toward purchase of P-free fertilizer

City Rain Gardens
Total Phosphorous potential reduction efficiency[2]: Varies
Goal: 2
Target: Lake View & Breda city offices
Payment Rate/Incentive:

Residential Rain Gardens
Total Phosphorous potential reduction efficiency[2]: Varies
Goal: 30 rain gardens
Target: Watershed residents
Payment Rate/Incentive: 50% of total cost

Storm Sewer Separation Systems within Lake View
Total Phosphorous potential reduction efficiency[2]:9%

Goal: 2
Target: Storm sewers discharging to Black Hawk Lake
Payment Rate/Incentive: Pending

Rain Barrels
Total Phosphorous potential reduction efficiency[2]: Varies
Goal: 100 rain barrels
Target: Watershed residents
Payment Rate/Incentive: $50 dollar voucher

Black Hawk Marsh Wildlife Area BMPs

See Appendix B for more information.

Water Level Control of Marshes
Total Phosphorous potential reduction efficiency: Varies
Goal: Manage water level of marches
Target: Ducks Unlimited and State Marsh
Payment Rate/Incentive: NA

Rough Fish Management
Total Phosphorous potential reduction efficiency[3]: Medium to High
Goal: Reduced population of rough fish
Target: Provost Slough and upstream areas
Payment Rate/Incentive: NA

Inlet Area (Provost Slough) BMPs

See Appendix C for more information.

Aquatic Vegetation Management
Total Phosphorous potential reduction efficiency: Varies
Goal: Manage aquatic vegetation
Target: Provost Slough
Payment Rate/Incentive: NA

Hydraulic Dredging & Dewatering Pump
Total Phosphorous potential reduction efficiency[3]: Medium to High
Goal: 381,958 cubic yards
Target: Provost Slough
Payment Rate/Incentive: NA

Fish Barrier Improvement
Total Phosphorous potential reduction efficiency[3]: Medium to High
Goal: Install fish barrier
Target: Fish barrier between Black Hawk Lake and Provost Slough

Payment Rate/Incentive: NA

East Culvert Fish Barrier
Total Phosphorous potential reduction efficiency[3]: Medium to High
Goal: Install fish barrier
Target: East culvert between Provost Slough and Black Hawk Lake
Payment Rate/Incentive: NA

Main Lake (Black Hawk Lake) BMPs

See Appendix B for more information.

Lake Shoreline Stabilization
Total Phosphorous potential reduction efficiency[2]: Low to Medium
Goal: Stabilize shoreline of BHL
Target: Highly eroding areas along lakeshore
Payment Rate/Incentive: NA

Hydraulic Dredging
Total Phosphorous potential reduction efficiency[3]: Medium
Goal: 3,234,017 cubic yards
Target: Main lake
Payment Rate/Incentive: NA

Rough Fish Management
Total Phosphorous potential reduction efficiency[3]: Medium to High
Goal: Reduced population of rough fish
Target: Provost Slough and upstream areas
Payment Rate/Incentive: NA

[1] Adopted from USDA-ARS (2004). Actual reduction percentages may vary widely across sites and runoff events.
[2]Percent reductions taken from EPA Region 5 STEPL model. Relative reductions from previous studies and various literature.
[3]Reductions are relative to each other and based on numerous research studies and previous IDNR projects.

Water Monitoring

Water monitoring is an important tool to assess progress in any watershed improvement project. This water monitoring plan has been developed to track water quality in the watershed and in Black Hawk Lake itself.

Site Locations

In-Lake: Two sites will be monitored in-lake; BHL-Ambient and BHL-West Arm. Figure 14 shows these locations. Beach sites will be monitored weekly through the IDNR Beach Monitoring Program, this site will track bacteria levels. BHL-Ambient will also be monitored 3 times by Iowa State University through the DNR's ambient lake monitoring program.

Tributary: Nine tributary sites will be monitored; BHL-02, BHL-03, BHL-04, BHL-05, BHL-06, BHL-13, BHL-14, BHL-18 and BHL- Carnarvon. Figure 13 shows these locations. Table 11 provides detailed location information.

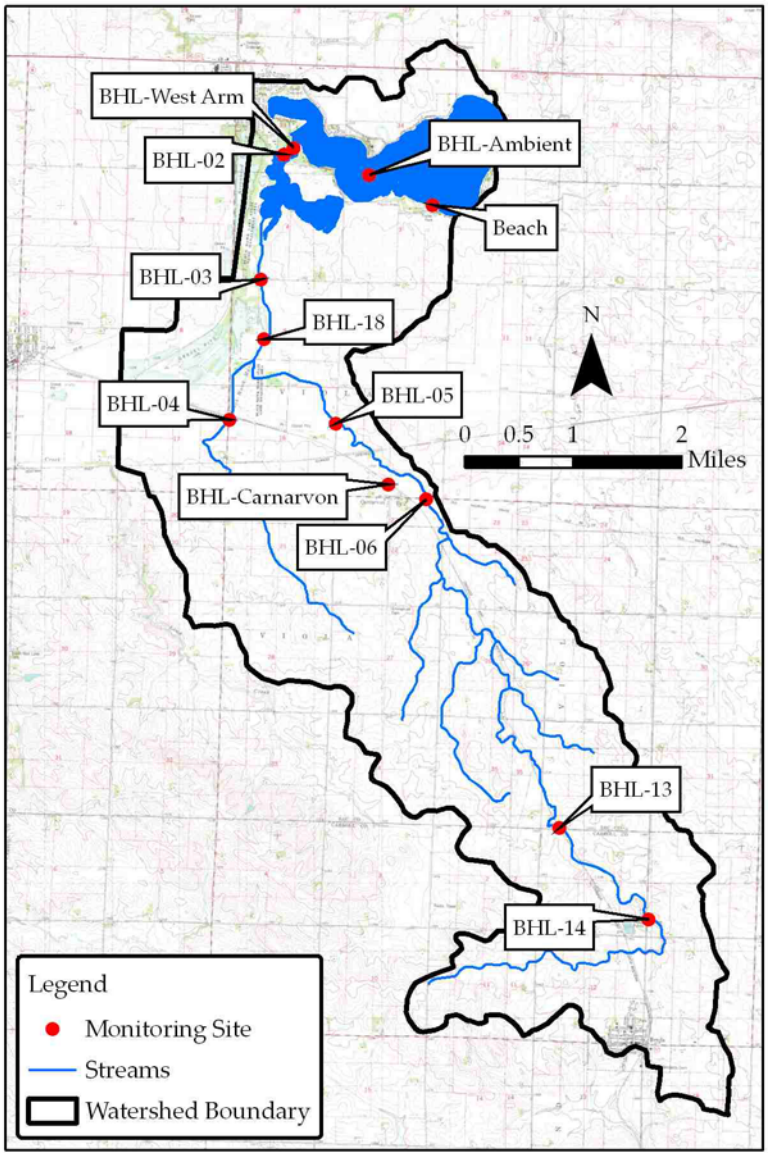


Figure 14. Proposed monitoring locations.

Frequency

In-Lake: Monthly (April through October)

Tributary: Twice per month (April through October) and grab samples during a maximum of 5 storm events (to be determined by the project coordinator with at least one occurring in October after harvest).

Parameters

In-Lake: chlorophyll a, chloride, total suspended solids, total fixed suspended solids, nitrate + nitrite nitrogen, total phosphate, orthophosphate, Secchi depth (field), dissolved oxygen (field), temperature (field), pH (field), turbidity (field)

Tributary: chloride, total suspended solids, nitrate + nitrite nitrogen, total phosphate, orthophosphate, dissolved oxygen (field), temperature (field), pH (field), turbidity (field), flow (field).

Lab Analysis Budget (one sampling season using 2011 dollars)

In-Lake:

Parameter	Cost per sample	# of sites	# of samples	Total cost
Chlorophyll a	$39	2	7	$546
Chloride	$13	2	7	$182
Total Suspended Solids	$13	2	7	$182
Total Fixed Suspended Solids	$26	2	7	$364
Nitrate + Nitrite	$13	2	7	$182
Total Phosphate Orthophosphate	$26	2	7	$364
			SHIPPING ESTIMATE	$140
			TOTAL	$1,820

Tributary:

Parameter	Cost per sample	# of sites	# of samples*	Total cost
Chloride	$13	9	19	$2,223
Total Suspended Solids	$13	9	19	$2,223
Nitrate + Nitrite	$13	9	19	$2,223
Total Phosphate Orthophosphate	$26	9	19	$4,446
			SHIPPING ESTIMATE	$570
			TOTAL	$11,685

*Assumes 5 storm event samples are collected.

Monitoring Site Details

Table 11. Monitoring locations

Site ID	Location	Site Type	STORET ID	UTM X	UTM Y
Beach	Campground Beach	Beach	21810002	333745.0	4684277.0
BHL-02	South State Road - Fish barrier	Stream	TBD	331540.4	4685027.8
BHL-03	350th Street	Stream	TBD	331195.7	4683170.4
BHL-04	Perkins Avenue	Stream	TBD	330736.5	4681094.1
BHL-05	Quincy Avenue	Stream	TBD	332313.7	4681034.2
BHL-06	370th Street	Stream	TBD	333651.3	4679916.2
BHL-13	100th Street - Below WWTP	Stream	TBD	335627.4	4675049.9
BHL-14	Granite Avenel - Above WWTP	Stream	TBD	336946.4	4673683.8
BHL-18	Outflow of wetland complex	Stream	TBD	331244.2	4682286.2
BHL-Ambient	Black Hawk Lake Ambient Site	Lake	22810002	332801.0	4684717.0
BHL-West Arm	Black Hawk Lake West Arm	Lake	22810003	331681.6	4685122.3
BHL-Carnarvon	Sauk Rail Trail - Carnarvon Outfall	Stream	TBD	333094.1	4680135.9

Public Outreach

Public involvement is important in the process since it is the land owners, tenants, and citizens who directly manage land and live in the watershed that determines the water quality in Black Hawk Lake. During the development of this plan, efforts were made to ensure that local stakeholders were involved in the decision-making process regarding goals and required actions for improving water quality in Black Hawk Lake. The following plan will guide public outreach activities in the Black Hawk Lake watershed. The plan has been organized in this manner to provide the greatest assistance to watershed project staff and partners.

1. Goals

-Increase public understanding of Black Hawk Lake water quality problems

-Implement targeted best management practices in Black Hawk Lake and its watershed to improve water quality in Black Hawk Lake. The in-lake water quality target is to have TSI scores below the impairment trigger for chlorophyll-a and secchi depth.

2. Target Audiences

Who will be needed in order to make changes to the land and water?

- Agricultural land owners
- Agricultural tenants
- Year round residents of Lake View
- Seasonal residents of Lake View
- Rural residents
- Managers of public owned land
- Businesses
- Municipalities of Lake View, Breda, and Carnarvon

Who do you depend on to advance this project?

- Sac and Carroll County Soil and Water Conservation Districts
- Cities of Lake View, Breda, and Carnarvon
- Iowa Department of Natural Resources
- NRCS
- Sac and Carroll County Conservation Boards
- Black Hawk Lake Protection Association

Who will be needed to communicate key messages to these people?

- Community leaders and spokespersons
    - SWCD Commissioners
    - Lake View/Breda City Councils
    - Sac and Carroll County Supervisors
    - Iowa Learning Farm and ISU Extension
    - Lake Protection Association
- Project partners and stakeholders

  - Iowa Department of Natural Resources
  - Farm Service Agency
  - Iowa Department of Agriculture and Land Stewardship
  - NRCS
  - Sac and Carroll SWCDs
  - Municipalities of Lake View, Breda, and Carnarvon
- Local agriculture and outdoor groups and clubs
  - Pheasants Forever
  - Ducks Unlimited
  - 4-H
  - Farm Bureau
  - Sac County Sportsmen's Club
  - FFA
  - IA Water Volunteers
  - Master Gardeners
  - Local Agricultural Suppliers
- Newspapers
  - The Sac Sun (Sac City)
  - The Lake View Resort (Lake View)
  - The Chronicle (Odebolt)
  - Tri-County
  - Daily Times Herald (Carroll)
  - Farm Bureau Spokesman
  - Iowa Farmer Today
- Radio stations
  - KAYL Storm Lake
  - KWMT Fort Dodge
  - Carroll Broadcasting Group

3. Target Audience Outreach Strategy & Tactics

The following section outlines how to best reach and speak to the primary target audiences, based upon input received from watershed residents, the watershed action group and others involved with the preparation of this document. The messaging and outreach strategy considers each target audience's barriers to participation, as well as potential solutions/motivators that could help overcome these barriers.

<u>Potential Barriers to Participation</u>

Agricultural land owners

- Loss of rental income from production land put into conservation
- Cost share of conservation practices
- Perception of yield loss when adopting new conservation crop production techniques
- Absentee land owner contact and education problems

Agricultural tenants

- Loss of crop production land
- Perception of yield loss when adopting new conservation crop production techniques
- Selling conservation practices to nonfarm background absentee landowners
- Cost share for conservation practices

Urban Property Owners

- Loss of Urban property to install conservation practices
- Cost share to install practices
- Seasonal or absentee property owners availability

Potential Solutions, Motivators, Incentives or Benefits to Encourage Participation

- Provide and/or increase cost share rates for conservation practices in the watershed
- Leverage multi-program/source funds
- Participation recognition/awards
- Education/demonstrations

With knowledge of the potential barriers and motivators, public outreach tactics are being developed around the target audiences' preferred means of receiving information, which include one-on-one contact, direct mail, email, and press (e.g. newspaper articles). In addition, general communication elements will be required to help advance the overall public outreach effort.

General Elements

- Project identity – Develop an identity for the project that can be used consistently in all public outreach efforts so it all can be recognized as coming from the same place and tied back to the project.
- Online presence – Create and maintain a basic website to provide information about watershed activities and explore other online communication tools that allow for an ongoing dialogue with all target audiences (e.g. Facebook, YouTube, Flickr, etc).
- Photography – Capture photos of project activities that can be used to educate target audiences and gain/maintain support by demonstrating project progress.
- Comprehensive communication schedule – Develop an annual outreach plan that takes key dates/seasons into account to ensure messaging is relevant and activities for the various audiences are complimentary.

One-on-One/Personal Contact

- Personal meetings/phone calls – Plan for private meetings or phone calls to educate individuals about the project and explain cost sharing options in detail.
- Field days – Arrange an annual field day to increase awareness of watershed

activities/practices and show project progress. Demonstrations and tours will be conducted in cooperation with all project partners to demonstrate the level of participation from all groups, including rural landowners/residents, urban residents, DNR staff, City officials, County officials, etc.

- Other educational events – Any opportunities that allow the technical advisory team and/or watershed advisory group to have direct exposure to members of the target audiences and/or the opportunity to have one-on-one conversations with individuals will also be pursued in partnership with other agencies (e.g. water testing workshop).

Direct Mail/Email

- Postcard campaign – Produce annual mailing to build relationships with key targets and use for education purposes (e.g. "Did you know?" campaign mailers).
- Email newsletter – Create a newsletter template and utilize for news, information and regular project updates.

Press/Publicity Efforts

- News/Photography releases – Send quarterly press releases annually to media outlets (e.g. newspapers and radio stations) with newsworthy project information and updates, including photographs to visually demonstrate information whenever possible.
- Public recognition/awards – Develop and present watershed urban and rural cooperator of the year awards to publicly acknowledge project participants/supporters.
- Publicity events – Stage events and educational activities that have a news or "feel good" angle, such as the field day mentioned previously or events that involve other key audiences (e.g. youth involved in the local FFA chapter, 4-H group, or local high school environmental science class).

Other

- Signage – Develop watershed/water quality signage at highly visible locations (Sauk Rail Trail, City Parks, highways, etc).
- Partnerships – Develop strong relationships with local organizations that have forums and tools to help communicate watershed messages to the public, such as the City of Lake View's newsletter, the Black Hawk Lake LPA's member materials, etc.
- Committee & Public Meetings
    - Hold quarterly watershed advisory committee meetings
    - Hold annual project review meeting
    - Hold annual public meeting

4. Evaluation/Measurement

- Meeting attendance and participation
- Follow-up surveys (distribution at annual meeting or mail/email)

- Follow-up phone calls
- Follow-up one-on-one interviews
- Conservation participation reports
- Press hits/media coverage

Implementation Schedule

To achieve in-lake water quality targets ambitious conservation practice implementation will be required. With this in mind, a 30-year timeline has been established to accomplish goals included in this plan. The 30 year timeline has been broken into three phases, years 1-5, 6-10 and 11-30.

Table 12. BMP implementation schedule.

Component	Units	Phase 1 (Years 1-5)	Phase 2 (Years 6-10)	Phase 3 (Years 11-30)	Total
Terraces - New (600)	FT	15,000	20,000	35,000	70,000
WASCOB (638)	NO	3	3		6
Pond (378)	NO	1	1	1	3
Pasture Management (528/512/382)	AC	106			106
Waterways -New (412)	FT	35,000	35,000	35,000	105,000
Streambank Stab. Hard armor (580)	FT	1,000	500	500	2,000
Streambank Stab. Soft armor (580)	FT	2,000	1,000	1,000	4,000
Filterstrips (393)	AC	32	32		64
Wetland Restoration (657 & 658)	NO	2	2	2	6
No till/strip till (329)	AC	1,000	1,000	1,925	3,925
Mulch-till (345)	AC	2,000	2,000	1,888	5,888
Nut mgt/VRT/grid sampling (590)	AC	3,000	3,000	3,814	9,814
Cover Crops (winter hardy) (340)	AC	250	240		490
CREP Wetlands	NO	1	1	1	3
Livestock Total Containment (313)	NO		2	2	4
Terraces - Rebuilt (600)	FT	15,000	30,000	75,000	120,000
Waterways - Rebuilt (412)	FT	10,000	15,000	10,000	35,000
2-Stage Ditch Stabilization	FT		5,000	11,000	16,000
Rock Riffles	NO		2	3	5
Pervious Paving	NO	1			1
Rain Gardens- City of Lake View and Breda	NO	2			2
Residential Rain Gardens	NO	10	15	5	30
Shoreline Stabilization (City)	FT	200			200
Storm sewer outlet treatment structures	NO		2		2
Storm water detention structures	NO	3			3
Urban Rain Barrels	NO	20	30	50	100
Provost Dewatering Pump	NO		1		1
Dredging Provost Bay	Yd^3		381,958		381,958

Dredge Spoil Site Cost (84ac)	NO		1		1
Rough Fish Management	YR	5			5
Fish Barrier Upgrades	NO	1			1
Component	**Units**	**Phase 1 (Years 1-5)**	**Phase 2 (Years 6-10)**	**Phase 3 (Years 11-30)**	**Total**
Main Lake Dredging	Yd^3			3,234,017	3,234,017
Dredge Spoil Site Cost (320ac)	NO			1	1
Main Lake Shoreline Stabilization	FT	4,096			4,096
Water Level Management (WMA)	Hours	3,075	3,075	12,300	18,450
Education and Outreach	YR	5	5	20	30
Water Monitoring	YR	5	5	20	30
Coordinator Salary and Benefits	YR	5	5	20	30

Resource Needs

The estimated cost, in 2011 dollars, to achieve in-lake water quality goals is $27,895,566. The following table outlines estimated costs by component and phase.

Table 13. Resource needs.

Component	Possible Funding Source(s)*	Phase 1 (Years 1-5)	Phase 2 (Years 6-10)	Phase 3 (Years 11-30)	Total
Terraces – New (600)	POL, WPF, WSPF	$52,500	$70,000	$122,500	$245,000
WASCOB (638)	POL, WPF, WSPF	$18,000	$18,000	$0	$36,000
Pond (378)	POL, WPF, WSPF	$30,000	$30,000	$30,000	$90,000
Pasture Management (528/512/382)	EQIP, 319	$31,164	$0	$0	$31,164
Waterways –New (412)	CRP	$210,000	$210,000	$210,000	$630,000
Streambank Stab. Hard armor (580)	319, LRP, WPF	$50,000	$25,000	$25,000	$100,000
Streambank Stab. Soft armor (580)	319, LRP, WPF	$32,000	$16,000	$16,000	$64,000
Filter strips (393)	CRP, LRP	$84,800	$84,800	$0	$169,600
Wetlands (657 & 658)	CRP	$27,000	$27,000	$27,000	$81,000
No till/strip till (329)	EQIP, 319	$200,000	$200,000	$385,000	$785,000
Mulch-till (345)	319	$100,000	$100,000	$94,400	$294,400
Nut mgt/VRT/grid sampling (590)	319	$30,000	$30,000	$38,140	$98,140
Cover Crops (winter hardy) (340)	EQIP, 319	$39,945	$38,347	$0	$78,292
CREP Wetlands	CREP	$370,000	$370,000	$370,000	$1,110,000
Livestock Total Containment (313)	EQIP, 319	$0	$260,000	$260,000	$520,000
Terraces – Rebuilt (600)	POL	$22,500	$45,000	$112,500	$180,000
Waterways – Rebuilt (412)	POL	$60,000	$90,000	$60,000	$210,000
2-Stage Ditch Stabilization	319	$0	$80,000	$176,000	$256,000
Rock Riffles	319	$0	$10,000	$15,000	$25,000
Pervious Paving	319, City	$60,000	$0	$0	$60,000
Rain Gardens- City of Lake View and Breda	319, City	$12,000	$0	$0	$12,000
Residential Rain Gardens	319, City	$20,000	$30,000	$10,000	$60,000
Shoreline Stabilization (City)	319, City	$11,000	$0	$0	$11,000
Storm sewer outlet treatment structures	319, City	$0	$150,000	$0	$150,000
Storm water detention structures	319, City	$12,000	$0	$0	$12,000
Urban Rain Barrels	319, City	$1,500	$2,250	$3,750	$7,500

Provost Dewatering Pump	LRP	$0	$137,000	$0	$137,000
Dredging Provost Bay (cubic yds)	LRP	$0	$1,527,832	$0	$1,527,832
Dredge Spoil Site Cost (84ac)	LRP	$0	$954,020	$0	$954,020
Rough Fish Management	LRP	$100,000	$0	$0	$100,000
Fish Barrier Upgrades	LRP	$353,000	$0	$0	$353,000
Main Lake Dredging(cubic yds)	LRP	$0	$0	$12,936,068	$12,936,068
Dredge Spoil Site Cost (320ac)	LRP	$0	$0	$2,479,600	$2,479,600
Main Lake Shoreline Stabilization	319	$225,280	$0	$0	$225,280
Water Level Management (WMA)	DNR	$123,000	$123,000	$492,000	$738,000
Education and Outreach	319	$25,000	$25,000	$100,000	$150,000
Water Monitoring	319	$67,525	$67,525	$270,100	$405,150
Coordinator Salary and Benefits	319, LRP, WSPF	$428,920	$428,920	$1,715,680	$2,573,520
TOTAL		$2,797,134	$5,149,694	$19,948,738	$27,895,566

*Funding sources will be determined based on available funds and grant cycles.
POL = Public Owned Lakes
WPF = Water Protection Fund
WSPF = Watershed Protection Fund
EQIP = Environmental Quality Incentive Program
319 = EPA Section 319 Funds via the IDNR
LRP = Lake Restoration Program
CREP = Conservation Reserve Enhancement Program
CRP = Conservation Reserve Program
City = Communities in Black Hawk Lake watershed