Iowa

Sny Magill
Section 319
National Monitoring Program Project

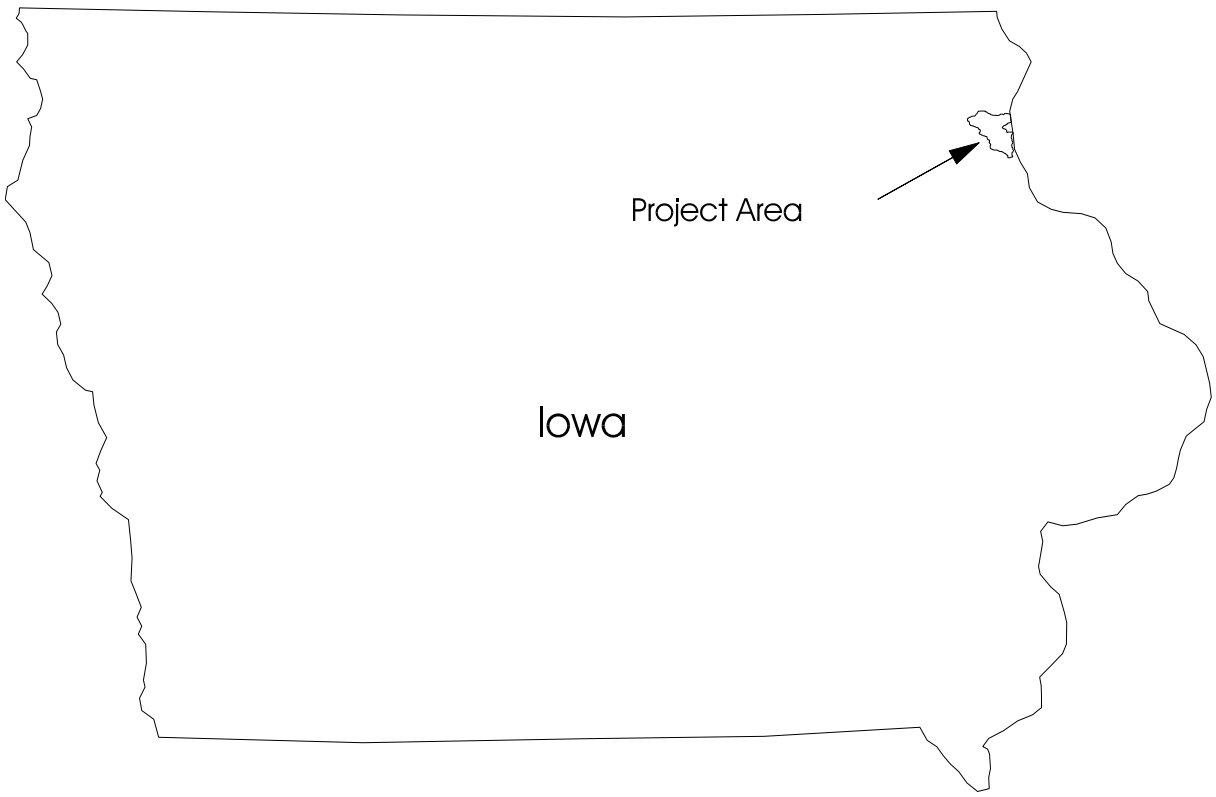

Figure 15: Sny Magill and Bloody Run (Iowa) Watershed Project Locations

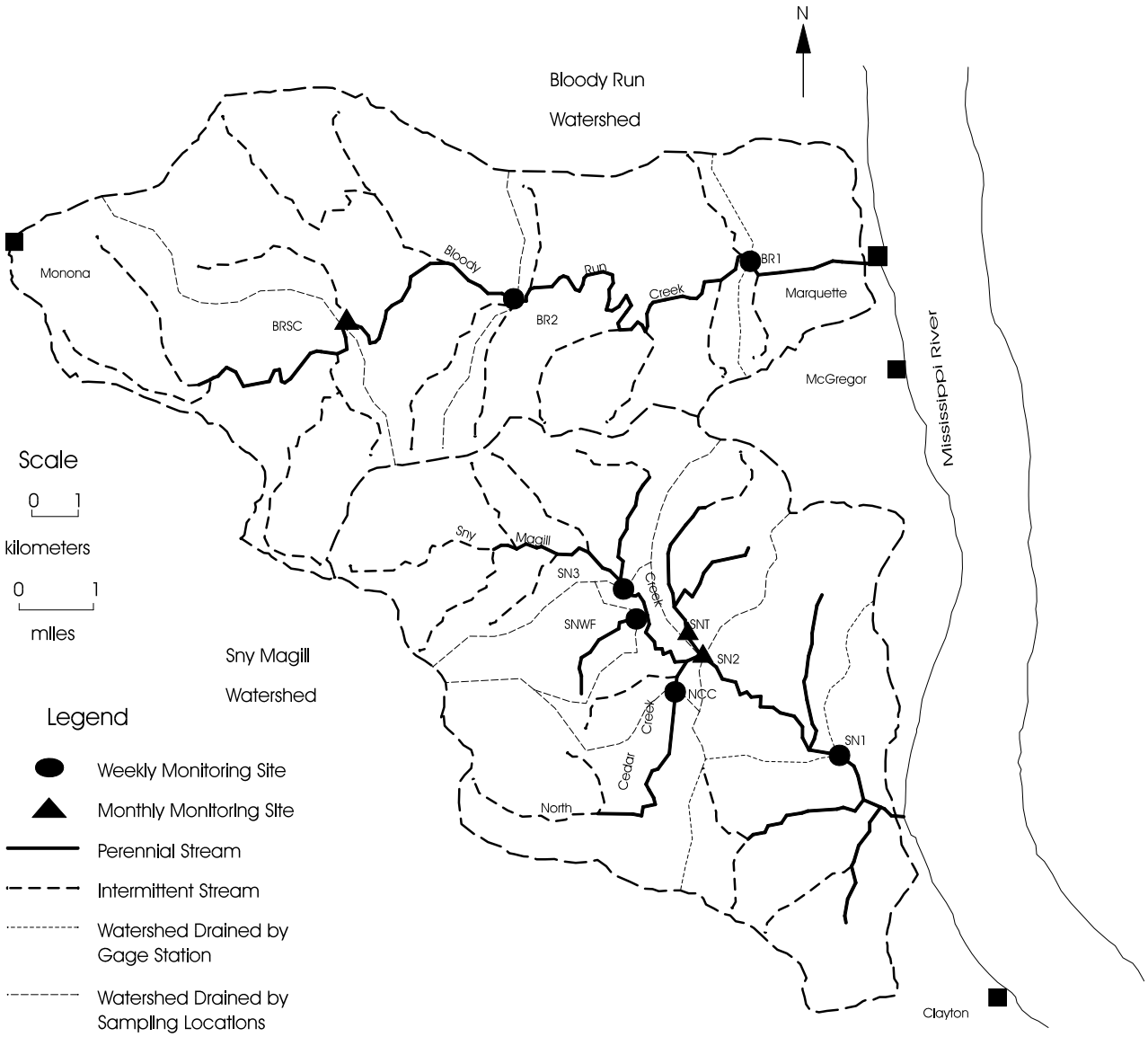

Figure 16: Water Quality Monitoring Stations for Sny Magill and Bloody Run (Iowa) Watersheds

PROJECT OVERVIEW

The Sny Magill Watershed Section 319 National Monitoring Program project was an interagency effort designed to monitor and assess improvements in water quality (reductions in sedimentation) resulting from the implementation of two U.S. Department of Agriculture (USDA) land treatment projects in the watershed: the Sny Magill Hydrologic Unit Area (HUA) and the North Cedar Creek Water Quality Special Project (WQSP). Project areas included Sny Magill Creek and North Cedar Creek basins (henceforth referred to as the Sny Magill watershed) (Figure 16). Sny Magill and North Cedar creeks are Class "B" cold water streams located in northeastern Iowa (Figure 15). North Cedar Creek is a tributary of Sny Magill Creek. The creeks, managed for "put and take" trout fishing by the Iowa Department of Natural Resources (IDNR), are two of the more widely used recreational fishing streams in the state.

The entire Sny Magill watershed is agricultural, with no industrial or urban areas. No significant point sources of pollution exist in the watershed. Land use consists primarily of row crop, cover crop, pasture, and forest. There are about 95 producers in the watershed, with farms averaging 250 acres in size.

Water quality problems in the stream result primarily from agricultural nonpoint source pollution; sediment is the primary pollutant. Nutrients, pesticides, and animal waste are also of concern.

Two USDA land treatment projects implemented in the watershed supported voluntary changes in farm management practices, resulting in improved water quality. The State of Iowa, through the Iowa Department of Agriculture and Land Stewardship (IDALS) and the IDNR, agreed to work through the local Clayton County Soil and Water Conservation District (SWCD) to provide funds for the best management practice (BMP) implementation. Sediment control measures, water and sediment control basins, animal waste management systems, stream corridor management improvements, and bank stabilization demonstrations were implemented to reduce agricultural nonpoint source pollution. A long-term goal of 50% reduction in sediment delivery to Sny Magill Creek was established.

A paired watershed approach was used with the Bloody Run Creek watershed serving as the comparison watershed (Figure 16). Subbasins within the Sny Magill watershed were compared using upstream/downstream stations.

Primary monitoring sites were equipped with U.S. Geological Survey (USGS) stream gauges to measure discharge and suspended sediment in both Sny Magill and Bloody Run creeks. Primary sites, and several other sites, were sampled for chemical and physical water quality parameters on a weekly to monthly basis. Annual habitat assessments were conducted along stretches of both stream corridors. Biomonitoring of macroinvertebrates occured on a bimonthly basis, and annual fisheries survey were conducted.

The project completed post-BMP monitoring on September 30, 2001. The final report was completed in May, 2005.

PROJECT DESCRIPTION

Project Area

The watershed drains an area of 22,780 acres directly into the Upper Mississippi River Wildlife and Fish Refuge and part of Effigy Mounds National Monument. Sny Magill Creek is the sixth most

widely used recreational trout fishing stream in Iowa.

Relevant Hydrologic, Geologic, and Meteorologic Factors

Average yearly rainfall in the area is 30.6 inches.

The watershed is characterized by narrow, gently sloping uplands that break into steep slopes with abundant rock outcrops. Up to 550 feet of relief occurs across the watershed. The landscape is mantled with approximately 10-20 feet of loess, overlying thin remnants of glacial till on upland interfluves, which in turn overlie Paleozoic-age bedrock formations. The bedrock over much of the area is Ordovician Galena Group rock, which composes the Galena aquifer, an important source of ground water and also drinking water in the area. Some sinkholes and small springs have developed in the Ordovician-age limestone and dolomite.

About 80% of discharge for both Sny Magill and Bloody Run is composed of ground water, which provides the cold water characteristic of the creeks. Hence, ground water quality is also important in the overall water resource management considerations for area streams.

The stream bottom of Sny Magill and its tributaries is primarily rock and gravel with frequent riffle areas. Along the lower reach of the creek where the gradient is less steep, the stream bottom is generally silty. The upstream areas have been degraded by sediment deposition.

Land use information for the Sny Magill watershed was compiled from 1:24,000 scale color infrared aerial photographs taken September 20, 1991. The land treatment is being tracked using the USDA Natural Resources Conservation Service's CAMPS and GRASS data management systems. The information is also summarized in annual reports as required by the Sny Magill Hydrologic Unit Area project. The land treatment information has been successfully transferred and linked by tract number to other available Geographic Information System coverages for the Sny Magill watershed.

Land Use

The entire watershed is agricultural, with no industrial or urban areas. No significant point sources exist in the watershed. Sixty-five percent of the cropland is corn, with the rest primarily in oats and alfalfa in rotation with corn. There are about 95 producers in the watershed, with farm sizes averaging 250 acres.

Land use is variable on the alluvial plain of Sny Magill Creek, ranging from row cropped areas, to pasture and forest, to areas with an improved riparian right-of-way where the IDNR owns and manages the land in the immediate stream corridor. The IDNR owns approximately 1,800 acres of stream corridor along approximately eight miles of the length of Sny Magill and North Cedar creeks. Some of the land within the corridor is used for pasture and cropping through management contracts with the IDNR.

Row crop acreage planted to corn has increased substantially over the past 20 years. Land use changes in the watershed have paralleled the changes elsewhere in Clayton County, with increases in row crop acreage and fertilizer and chemical use, and attendant increases in erosion, runoff, and nutrient concentrations. U.S. Forest Service data show a 4% decline in woodland between 1974 and 1982. Much of this conversion to more erosive row crop acreage occurred without adequate installation of soil conservation practices.

Land Use	Sny Magill		Bloody Run	
	Acres	%	Acres	%
Row crop	5,842	25.9	9,344	38.6
Cover crop, pasture	5,400	23.9	6,909	28.5
Forest, forested pasture	11,034	48.9	7,171	29.6
Farmstead	263	1.2	415	1.7
Other	28	0.1	376	1.6

TOTALS	22,567	100	24,215	100

Source: Bettis et al., 1994

Water Resource Type and Size

Sny Magill and North Cedar creeks are Class "B" cold water streams located in northeastern Iowa.

Water Uses and Impairments

Sny Magill and North Cedar creeks are managed for "put and take" trout fishing by the IDNR and are two of the more widely used streams for recreational fishing in Iowa. Sny Magill Creek ranks sixth in the state for angler usage. The creek drains into backwaters and wetlands of the Mississippi River. These backwaters are heavily used for fishing and also serve as an important nursery area for juvenile and young largemouth bass.

The creeks are designated by the state as "high quality waters" to be protected against degradation of water quality. Only 17 streams in the state have received this special designation. The state's Nonpoint Source Assessment Report indicates that the present classifications of the creeks as protected for wildlife, fish, and semiaquatic life and secondary aquatic usage are only partially supported. The report cites impairment of water quality primarily by nonpoint agricultural pollutants, particularly sediment, animal wastes, nutrients, and pesticides. No significant point sources of pollution exist within the Sny Magill watershed.

Pollutant Sources

Sediment — cropland erosion, streambank erosion, gully erosion, animal grazing
Nutrients — animal waste from livestock facilities (cattle), pasture, and grazed woodland; commercial fertilizers; crop rotations
Pesticides — cropland, brush cleaning

Pre-Project Water Quality

Water quality evaluations conducted by the University Hygienic Laboratory (UHL) in 1976 and 1978 during summer low-flow periods in Sny Magill and Bloody Run creeks showed elevated water temperatures and fecal coliform levels (from animal wastes) in Sny Magill Creek. Downstream declines in nutrients were related to algal growth and in-stream consumption. An inventory of macroinvertebrate communities was conducted in several reaches of the streams (Geary, 1977; Prill and Meierhoff, 1979).

Assessments of North Cedar Creek during the 1980s by IDNR and the USDA Natural Resources Conservation Service (NRCS) located areas where sediment covered the gravel and bedrock substrata of the streams, decreasing the depth of existing pools, increasing turbidity, and degrading aquatic habitat. Animal waste decomposition increases biochemical oxygen demand (BOD) in the streams to levels that are unsuitable for trout survival at times of high water temperature and low stream flows. The IDNR has identified these as the most important factors contributing to the failure of brook trout to establish a viable population (Seigley et al., 1992).

Several reports summarize pre-project water quality studies conducted in the two watersheds (i.e., water quality, including available data from STORET – Seigley and Hallberg, 1994; habitat assessment – Wilton, 1994; benthic biomonitoring – Schueller et al., 1994, and Birmingham and Kennedy, 1994; fish assessment – Wunder and Stahl, 1994; and Hallberg and others, 1994) and provide perspectives on water quality monitoring in northeast Iowa.

Water Quality Objectives

Primary objectives of the Sny Magill Watershed Project were:

- Reduce sediment delivery to Sny Magill Creek by 50%;
- Reduce manure runoff to Sny Magill Creek by helping producers implement 30 animal manure management sytems;
- Accelerate adoption of refined crop and manure management practices that reduce agricultural pollution potential in the watershed; and
- Develop a series of demonstrations to educatethe watershed's producers and the public at large about water quality issues and provide additional data and learning experience for the participating agencies.

Additional objectives of the broader HUA and WQSP projects included:

- To quantitatively document the significance of water quality improvements resulting from the implementation of the Sny Magill HUA Project and North Cedar Creek WQSP;
- To develop the protocols and procedures for a collaborative interagency program to fulfill the U.S. Environmental Protection Agency (USEPA) standards for Nonpoint Source Monitoring and Reporting Requirements for Watershed Implementation Projects;
- To refine monitoring protocols to define water quality impacts and the effectiveness of particular management practices;
- To develop Iowa's capacity for utilization of rapid habitat and biologic monitoring;
- To use water quality and habitat monitoring data interactively with implementation programs to aid targeting of BMPs, and for public education to expand awareness of the need for nonpoint source pollution prevention by farmers; and
- To provide Iowa and the USEPA with needed documentation for measures of success of nonpoint source control implementation (Seigley et al., 1992).

Project Time Frame

1991 to 2001

PROJECT DESIGN

Nonpoint Source Control Strategy

From 1988 through 1999, three separate projects installed many different BMPs in the Sny Magill Watershed. The first project was the North Cedar Creek Agricultural Conservation Program. This USDA program ran from 1988 to 1994 and focused only on the 3,220 acres of the North Cedar Creek Watershed. Most of the BMPs applied in the watershed under this program were structural, including terraces, tile outlets, grade stabilization structures, and animal waste structures. When the project ended in 1994, the Sny Magill Creek Watershed project continued the effort to install BMPs in the North Cedar Creek Watershed and work with landowners.

A large project – the Sny Magill Hydrologic Unit Area (HUA) project – began in 1991 and continued to 1999, covering 19,560 acres (86%) of the Sny Magill watershed. The remainder of the watershed is included in the WQST, which began in 1988 and was completed in 1994. These projects provided technical advice, cost sharing assistance, and educational programs to assist farmers in the watershed in implementing voluntary changes in farm management practices that would result in improved water quality in Sny Magill Creek.

Over the course of the HUA project, conservation plans were developed for all highly erodible (HEL) acres in the watershed and conservation plans were fully implemented on 4,174 acres, or 40% of the HEL acres in the project area. Structural practices, such as terracing and a few animal waste systems were implemented, as well as a variety of management practices such as crop residue

management and contour stripcropping. Extension staff assisted farmers with farmstead assessment

Site Name	Pre-BMP Monitoring Dates	BMPs Installed	Date Installed/ Established	Post-BMP Monitoring Dates
Sny Magill Treatment Watershed	October 1991– September 1992	Waste storage facility, conserv. cover, conserv. crop rotation, conserv. tillage, contour farming, critical area planting, residue mngmt., sediment basin, windbreak, field border, grade stabil., grass waterway, use exclusion, pasture and hayland mngmt., planned grazing systems, proper grazing use, streambank protect., stripcropping, nutrient mngmt., pesticide mngmt., terraces, subsurface drainage, tree and shrub establish., underground outlet, wildlife habitat mngmt., forest stand improv.	Various from 1991 through 1998	October 19 September 2
Bloody Run Control Watershed	October 1991 - September 1992	None to date	N/A	October 1999 - September 2001

(Source: Bettis et al., 1994)

and with ICM, in the hope of reducing fertilizer and pesticide inputs by at least 25% while maintaining production levels. Over 80% of the 98 landowners in the Sny Magill Watershed participated in the HUA project.

Project Schedule

Water Quality Monitoring

The Sny Magill watershed was amenable to documentation of water quality responses to land treatment. The cold water stream has a high baseflow element that provides year-round discharge, minimizing potential missing data problems. These conditions also make possible analysis of both runoff and ground water contributions to the water quality conditions. Because of the intimate linkage of ground and surface water in the region, the watershed has a very responsive hydrologic system and should be relatively sensitive to the changes induced through the land treatment implementation programs.

A paired watershed study compares Sny Magill watershed to the (control) Bloody Run Creek watershed (adjacent to the north and draining 24,064 acres). Watershed size, ground water hydrogeology, and surface hydrology are similar; both watersheds receive baseflow from the Ordovician Galena aquifer. The watersheds share surface and ground water divides, and their proximity to one another minimizes rainfall variation. However, the large size of the two watersheds creates significant challenges in conducting a true paired watershed study. Land

treatment and land use changes were kept to a minimum in the Bloody Run Creek watershed throughout the project period and for the first two years of water quality monitoring in the Sny Magill watershed.

Within the Sny Magill watershed, subbasins are compared using upstream/downstream stations.

Variables Measured

Biological

Fecal coliform (FC)
Habitat assessment
Fisheries survey
Benthic macroinvertebrates

Chemical and Other

Suspended sediment (SS)
Nitrogen (N)-series (NO3+NO2-N, NH4-N, Organic-N)
Chloride
Total phosphorus (TP)
Immunoassay for triazine herbicides
Water temperature
Conductivity
Dissolved oxygen (DO)
Turbidity

Covariates

Stream discharge
Precipitation

Sampling Scheme

Primary monitoring sites (SN1, BR1) (Figure 16) were established on both Sny Magill and Bloody Run creeks. The sites were equipped with USGS stream gauges to provide continuous stage measurements and daily discharge measurements. Suspended sediment samples were collected daily by local observers and weekly by water quality monitoring personnel when significant rainfall events occurred.

Monthly measurements of stream discharge were made at seven supplemental sites (NCC, SN2, SNT, SNWF, SN3, BRSC, and BR2) (Figure 16).

Baseline data were collected during the summer of 1991. A report documenting these data was published (Seigley and Hallberg, 1994). The monitoring program, as described below, began in October of 1991.

Weekly grab sampling was conducted at the primary surface water sites (SN1, BR1) for fecal coliform bacteria, N-series (NO3 +NO2-N, NH4-N, Organic-N), chloride, TP, BOD, and immunoassay for triazine herbicides.

Four secondary sites were monitored weekly (three on Sny Magill: SN3, SNWF, and NCC; and one on Bloody Run: BR2). Grab sampling was conducted for fecal coliform, partial N-series (NO3 + NO2-N, NH4-N), and chloride.

Three additional sites were monitored on a monthly basis (two on Sny Magill: SN2, SNT; and one

on Bloody Run: BRSC). These were grab sampled for FC, partial N-series, and chloride.

Temperature, conductivity, DO, and turbidity were measured at all sites when sampling occured.

An annual fish assessment was conducted at six sites in Sny Magill and Bloody Run watersheds during the fall of each year. The sample date was selected to minimize stocked trout numbers, to minimize angler interference with fish sampling personnel, and to sample the streams under baseflow conditions. Two backpack-mounted stream electrofishing units were used to sample a 300-foot stream reach of mixed pool-riffle habitat at each site.

An annual habitat assessment, designed to characterize stream habitat conditions, occured in the fall under low-flow, baseflow conditions at eight water-quality sites. Instream and streamside habitat variables were measured and observed at ten regularly spaced, cross-sectional stream transects within a 100-foot stream reach. Each stream reach included two or three sets of pools and riffles.

Modifications Since Project Started

Originally, site BRSC was monitored weekly and site BR2 was monitored monthly. However, after one water-year of sampling, the invertebrate biomonitoring group requested (in March of 1992) that the sites be switched. Thus, since October 1, 1992, BRSC was monitored monthly and BR2 was monitored weekly.

Statistical analysis required an extension of the pre-BMP period from the initial one-year (WY 1992) to three (WY 1992-94). This was due to an insufficient time to develop a significant relationship between parameters in the two streams. In addition to the pre/post model, a gradual change model was also used to define changes in water quality. Continual BMP implementation in the watershed throughout all ten years of the project made it impossible to strictly define distinct

Monitoring Scheme for the Sny Magill and Bloody Run Watershed Section 319 National Monitoring Program Project

Design	Sites	Primary Parameters	Covariates	Frequency of WQ Sampling	Frequency of Habitat/Biological Assessment	Duration
Paired watershed with upstream/ downstream stations (for each creek)	Sny Magill[T] and Bloody Run[C]	Habitat assessment Fishery survey Benthic macro-invertebrates SS Nitrogen series Chloride TP* BOD* Triazine herbicides* Water temperature Conductivity DO Turbidity FC	Stream discharge (daily at sites SN1 & BR1; monthly at sites NCC, SN2, SNT, SNWF, SN3, BRSC, BR2) Stage (continuous at SN1, BR1) Precipitation	Weekly (for SN1, BR1, SN3, SNWF, NCC, BR2) Monthly (for SN2, SNT, BRSC)	Habitat and fisheries data collected annually. Macroinvertebrate data collected every two months.	1 yr pre-BMP 7 yrs BMP 2 yrs post-BMP

[T]Treatment watershed
[C]Control watershed
* These parameters are only sampled at sites SN1 and BR1

calibration and treatment periods. Therefore, the monitoring design was amended to include a gradual change multiple regression analysis.

Analysis for nitrate-N was discontinued after WY 1996; analysis for anion fluoride, bromide, and sulfate was discontinued after WY 1997.

Progress to Date

Following the completion of all the land treatment projects, the following nonpoint source pollution controls were completed in North Cedar Creek and Sny Magill Creek watersheds:

- 392,765 feet of terraces
- 97 grade stabilization structures
- 62 water and sediment control basins
- 1,140 feet of streambank protection
- 1,907 acres of contouring
- 26,700 feet of field borders
- 2 agricultural waste structures
- The more effective use of nitrogen, phosphorus, and pesticides on 6,723 acres in the Sny Magill watershed

Five streambank stabilization demonstrations that utilize soil bioengineering technologies were constructed. One site took into account angler accessibility issues. A pool and riffle sequence was installed in 1999.

In 1998, a total of four cooperators enrolled 1,393 acres in the Nutrient and Pest Management Incentive Education Program. This program, developed in the fall of 1994, promotes nutrient and pest management through participant education and implementation, rather than relying on the private sector for crop management services.

Based on USLE estimates, sediment delivery has been reduced by 50.7% (Tisl and Palas, 1998).

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

Data was stored and maintained by the Iowa Department of Natural Resources-Geological Survey. The U.S. Geological Survey data were entered into the WATSTORE database and all other water quality data were entered into STORET. In addition, data were added to Iowa's STORET water quality database (http://wqm.igsb.uiowa.edu/storet/), and also entered into the USEPA's Nonpoint Source Management System (NPSMS) software.

The USEPA nonpoint source monitoring and reporting requirements for watershed implementation grants have been completed for the data from Water Years 1992, 1993, and 1994. Technical reports on data from water years 1992 and 1993 (Seigley et al., 1994), water year 1994 (Seigley et al., 1996), and water years 1995 through 1998 (Langel et al., 2001), and 1999 through 2001 (Liu et al., 2003) have been completed.

NPSMS Data Summary

Monitoring Station Parameters Report (WY92)

STATION TYPE: BR1 (Control Station)

CHEMICAL PARAMETERS

Parameter Name	Parm Type	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		275	85	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	28	24	20
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.4	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.2	0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.05	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		14	10	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		5.8	4.8	4.3

STATION TYPE: SN1 (Treatment Station)

Parameter Name	Parm Type	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		300	110	20
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	18	15	13
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.2	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.03	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		15	10	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		2.3	1.9	1.5

Monitoring Station Parameters Report (WY93)

STATION TYPE: BR1 (Control Station)

Parameter Name	Parm Type	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		1025	85	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	45	35	20
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.4	0.3	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.3	0.2	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.07	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		13	8	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		6.4	5.6	5.2

STATION TYPE: SN1 (Treatment Station)

Parameter Name	Parm Type	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		530	80	20
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	47	31	13
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.4	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.3	0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.07	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		13	8	4
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		3.0	2.4	2.2

Monitoring Station Parameters Report (WY94)

STATION TYPE: BR1 (Control Station)

Parameter Name	Parm Type	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		215	60	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	26	20	13
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		0.2	0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.2	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.01	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	11	6
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		6.5	5.8	5.1

STATION TYPE: SN1 (Treatment Station)

Parameter Name	Parm Type	Reporting Units	QUARTILE VALUES

Parameter Name	Type	Units	-75-	-50-	-25-
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		210	43	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	21	14	10
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		0.2	0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.2	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.01	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		17	11	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		3.3	3.0	2.5

Monitoring Station Parameters Report (WY95)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		218	65	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	26	23	19
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.02	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	11	4
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		5.9	5.5	5.1

STATION TYPE: SN1 (Treatment Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		220	115	18
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	24	16	12
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.2	0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.01	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		17	11	3
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		2.7	2.4	2.1

Monitoring Station Parameters Report (WY96)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		70	21	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	22	18	16
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.01	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		14	10	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		5.7	5.3	5.0

STATION TYPE: SN1 (Treatment Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		158	48	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	19	14	11
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.01	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		15	9	3
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		2.6	2.4	2.2

Monitoring Station Parameters Report (WY97)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**

FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		100	30	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	17	15	13
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.2	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.02	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		14	10	4
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		5.5	4.9	4.5

STATION TYPE: SN1 (Treatment Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		200	20	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	15	13	11
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.1	0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.02	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		15	10	2
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		2.6	2.4	2.2

Monitoring Station Parameters Report (WY98)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		320	32	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	13	12	11
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.03	0.01	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	11	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		6.7	5.6	5.2

STATION TYPE: SN1 (Treatment Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		340	55	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	21	17	11
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.03	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	10	4
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		3.1	2.7	2.6

Monitoring Station Parameters Report (WY99)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		500	82	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	33	25	21
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.02	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		15	11	6
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		9.6	8.6	7.6

STATION TYPE: SN1 (Treatment Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		305	100	15
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	32	21	18
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1

NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S	0.3	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S	<0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S	0.03	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S	15	10	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S	3.8	3.5	3.4

Monitoring Station Parameters Report (WY00)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		255	30	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	23	20	17
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.02	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		15	10	7
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		7.0	6.6	6.2

STATION TYPE: SN1 (Treatment Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		343	30	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	19	16	14
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.01	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	10	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		3.5	3.3	3.1

Monitoring Station Parameters Report (WY01)

STATION TYPE: BR1 (Control Station)

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		255	60	<10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	26	20	13
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.5	0.2	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.02	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	11	5
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		7.2	6.8	6.5

STATION TYPE: SN1 (Treatment Station)

CHEMICAL PARAMETERS

	Parm	Reporting	QUARTILE VALUES		
Parameter Name	**Type**	**Units**	**-75-**	**-50-**	**-25-**
FECAL COLIFORM, MEMBR FILTER, M-FC BROTH, 44.5 C	S		240	100	10
FLOW, STREAM, MEAN DAILY, CFS	S	CFS	21	14	10
NITROGEN, AMMONIA, TOTAL (MG/L AS N)	S		<0.1	<0.1	<0.1
NITROGEN, ORGANIC, TOTAL (MG/L AS N)	S		0.3	0.1	<0.1
PHOSPHORUS, TOTAL (MG/L AS P)	S		0.1	<0.1	<0.1
PRECIPITATION, TOTAL (INCHES PER DAY)	S		0.03	0	0
TEMPERATURE, WATER (DEGREES CENTIGRADE)	S		16	10	2
NITROGEN, NITRITE + NITRATE, TOTAL (MG/L as N)	S		3.5	3.3	3.1

Final Results

Water Quality Changes

Overall, a large decrease in turbidity and slight decrease in suspended sediment were observed in Sny Magill Creek, suggesting that BMP implementation can measurably improve water quality, even in a relatively healthy trout stream. Temperature in Sny Magill decreased slightly, likely due to improved riparian cover. Dissolved oxygen levels increased significantly and are close to saturation. The significant increase in discharge and nitrate-nitrite-N, however, indicates that there were other effects associated with BMP implementation that are not fully understood.

Table 4. Overall changes in water quality for Sny Magill sites when compared to their Bloody Run monitoring site.

Location	Discharge		Sediment		Turbidity		NOx		Fecal Coliform		Temperature		DO	
	P/P	Grad.	P/P	Grad.	P/P	Grad.	P/P	Grad.	P/P	Grad.	P/P	Grad.	P/P	Grad.
SN1	↑ 8%	↑ 12%	↓ 7%	NS	↓ 41%	↓ 46%	↑ 15%	↑ 39%	↓ 12%	NS	↓ 4%	↓ 5%	↑ 11%	↑ 16%
SN2	-	-	-	-	↓ 34%	↓ 24%	↑ 26%	↑ 43%	NS	NS	↑ 10%	↑ 17%	↑ 2%	↑ 26%
SN3	-	-	-	-	NS	NS	↑ 39%	↑ 37%	↑ 192%	↑ 464%	↓ 1%	NS	↑ 28%	↑ 36%

P/P = Pre/Post model; Grad. = Gradual Change model; NS = Not Significant

Benthic Macroinvertebrates

Based on results of biomonitoring, no dramatic changes were observed in the benthic communities of either watershed during the monitoring period. Though some metrics show statistically significant trends toward improving water quality, they are weak and other results indicate a significant trend toward declining water quality. Therefore, water quality changes in the study area based on benthic macroinvertebrate monitoring cannot be directly linked to land treatment changes.

Fish Assessment

Habitat assessments indicated monitoring sites with similar drainage areas had similar habitat characteristics for most years and that BMP implementation had little or no significant influence on stream habitat in Sny Magill. Sampled fish communities remained relatively constant through the project and were typical of Iowa coldwater streams. Although not conclusive, the results of the fish assessment and fish Index of Biotic Integrity (IBI) studies have shown that the environmental quality of. Sny Magill Creek has slowly improved during recent years. A return of the slimy sculpin to Sny Magill Creek may have ndicated an improvement in stream quality.

Source: Fields, et al. 2005. Sny Magill Nonpoint Source Pollution Monitoring Project: Final Report. Iowa Geological Survey, Technical Information Series 48, http://www.igsb.uiowa.edu/gsbpubs/pdf/TIS-48.pdf

Lessons Learned

Installed BMP's such as tiled terraces and sediment catchment basins significantly decreased turbidity levels and sediment concentrations in the stream. However, these same practices might have lead to increased discharge and nitrate+nitrite-N concentrations. Tiles and tiled terraces transfer surface water and shallow groundwater directly to the stream channel before evaporation and transpiration. Water flowing in the tiles also mobilizes water soluble nutrients such as NOx, which could lead to increased concentrations in the stream.

Having an adequate (2+ yrs) pre-BMP monitoring period is essential to properly establish a calibration relationship between the treatment and control streams.

The lag time between initial BMP installation and measured changes in stream water quality might take many years, perhaps even decades. This is especially true of watersheds that are highly groundwater dependent, or that have significant pre-existing sediment deposits in the stream system.

Results from the Sny Magill Watershed Section 319 National Monitoring Program project have influenced and aided subsequent projects: including the Walnut Creek Watershed Restoration and Water Quality Monitoring Project in Iowa, and the Sny Magill Watershed Monitoring Project, which used both data and results in its modeling and final report.

INFORMATION, EDUCATION, AND PUBLICITY

Information was disseminated through newsletters, field days, special meetings, press/media releases, surveys of watershed project participants, and at meetings at the local, state, and national level. Information about the project is also available via the internet (www.igsb.uiowa.edu/inforsch/sny/sny.htm).

Media outreach was conducted primarily by the communications specialist for the Sny Magill project. Various other personnel involved in the land treatment and water quality monitoring components also assist in these efforts.

- The media outreach program has included preparation of demonstration plot brochures, press releases, booklets for the "self-guided" tours of the watershed, and articles for local newspapers. Water Watch, a bimonthly newsletter published by the Extension Service, is disseminated to over 1,665 subscribers. Article topics have included upcoming field days, field demonstration results, water quality monitoring results, riparian buffer activities, and streambank stabilization efforts.
- Numerous field days were held at plot sites in and around the watershed.
- Efforts and activities in the Sny Magill watershed were the focus of a field trip that was held in conjunction with the Sixth National Nonpoint-Source Monitoring Workshop (September 1998, Cedar Rapids, IA).

TOTAL PROJECT BUDGET

Estimated budget for the Sny Magill Watershed Section 319 National Monitoring Program project for the period FY91-01:

Project Element	**Funding Source ($)**			
	Federal	**State**	**Local**	**Sum**
I&E	445,000	233,550	NA	678,550
LT (cost share)	374,000	333,634	NA	707,634
LT (technical assist.)	874,000	NA	NA	874,000
WQ Monit	1,133,910	NA	NA	994,958
TOTALS	2,826,910	567,184	NA	3,394,094

* from Section 319 National Monitoring Program funds

Funding restrictions in the Sny Magill HUA for FY94 affected cost-share funding to assist cooperating producers in installing BMPs. The HUA was able to operate in FY94 on limited funding that remained from previous years. The project applied for alternate funding to meet the unmet needs of producers to install BMPs. Funding for BMP implementation for 1995 through 1998 was provided by the Iowa Department of Agriculture and Land Stewardship – Division of Soil Conservation and the Iowa Department of Natural Resources.

Federal funding from the Agricultural Conservation Program to encourage BMP implementation was lost in 1993; however, applications for alternative funding sources were filed in 1994. Funding for sediment reducing practices, such as terraces, was secured through the Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation, for Fiscal Years 1995-1998. An application for funding was filed through the USEPA Section 319(h) Program for animal manure structures, Integrated Crop Management (ICM), and streambank stabilization practices. The USEPA Section 319(h) funding became available in 1995, and continued through 1998. Extended funding for the Sny Magill Hydrologic Unit Area was requested and received through 1999.

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

Please refer to the section entitled Nonpoint Source Control Strategy.

OTHER PERTINENT INFORMATION

Agencies participating in the Sny Magill Section 319 National Monitoring Program project are listed below:

- Clayton County USDA Farm Service Agency Committee
- Iowa State University Extension
- Iowa Department of Agriculture and Land Stewardship
- Iowa Department of Natural Resources
- Natural Resources Conservation Service
- University Hygienic Laboratory
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. National Park Service
- U.S. Environmental Protection Agency

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