# Watershed Management Plan

# Silver Creek

# Clayton County, IA

# June 2010

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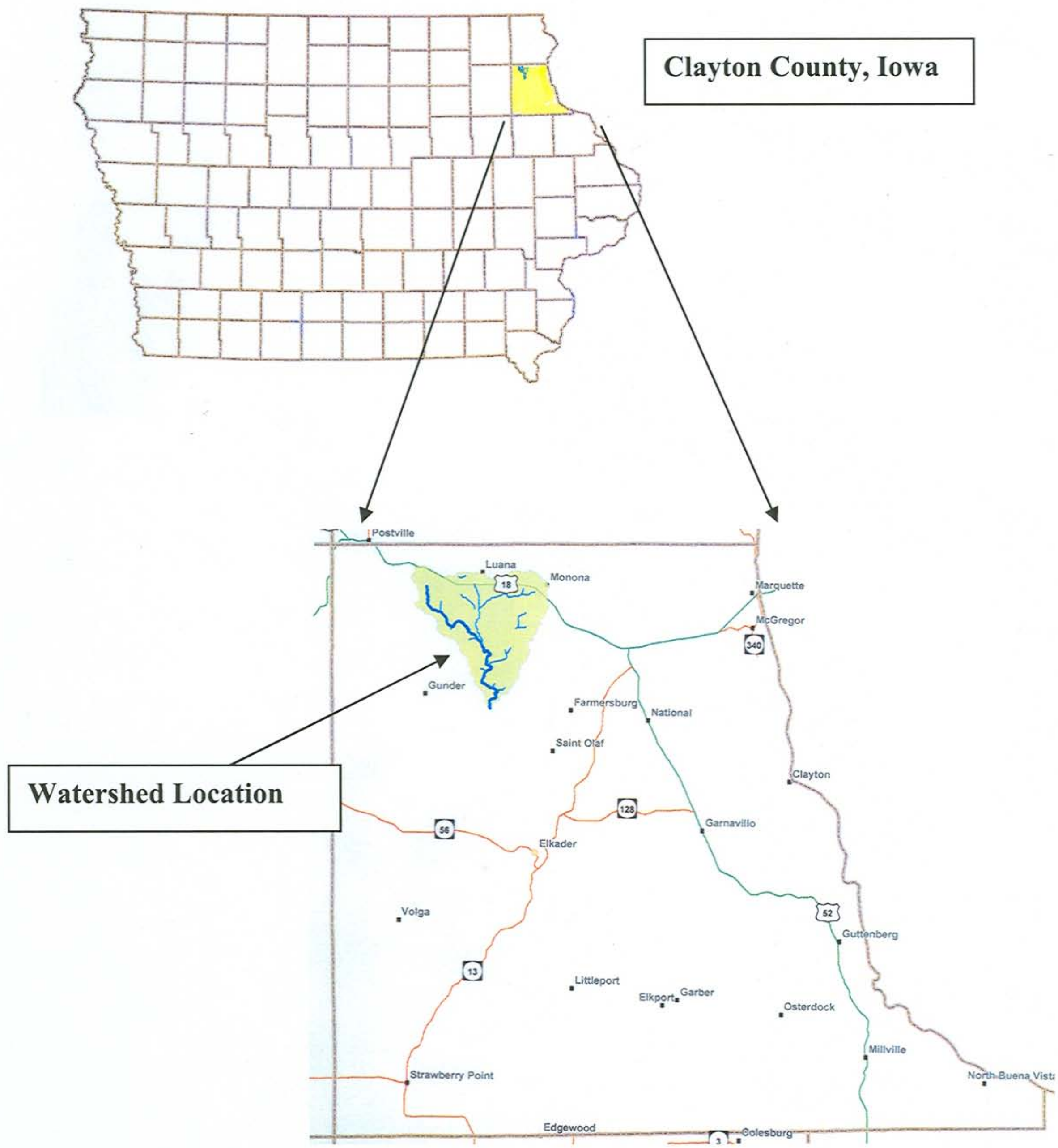
# Silver Creek Watershed Location



**Silver Creek – Hydrologic Unit Code 070600040502**

**Purpose Statement:**

> **Accelerate the adoption of conservation practices that will remove Silver Creek from Iowa's list of impaired waters.**

## A. Identification of Causes and Sources of Impairment

Silver Creek is a warm water stream resource located in northwest Clayton County, Iowa. The watershed includes a total of 17,991 acres (28.1 square miles), extending east from Luana to the outskirts of Monona to a point where Silver Creek empties into Roberts Creek about three miles northwest of St. Olaf. Roberts Creek continues southeast to where it joins the Turkey River near Elkader.

Silver Creek is within the Paleozoic Plateau landform region, which is characterized by deep valleys, abundant rock outcrops, and high bluffs. A distinct feature of the area is the presence of karst topography, evident from the numerous springs and sinkholes found throughout the region. Silver Creek's geological composition (fractured limestone bedrock covered by a thin layer of soil) increases the threat of pollutants directly entering groundwater. The unique geology of the area provides some of the most fragile surface waters in the state, and highlights the connection between surface and groundwater resources.

Silver Creek is considered a "losing" stream. The soil survey report for Clayton County documents over 60 sinkholes in the Silver Creek watershed. Sinkholes in the stream channel have been identified during low flow periods. At these points, surface water flow from Silver Creek enters the groundwater system and resurfaces at Big Spring.

***Left: Silver Creek roughly ½ mile upstream of its confluence with Robert's Creek***
***Right: A sinkhole that developed near Silver Creek following heavy rains in 2008.***

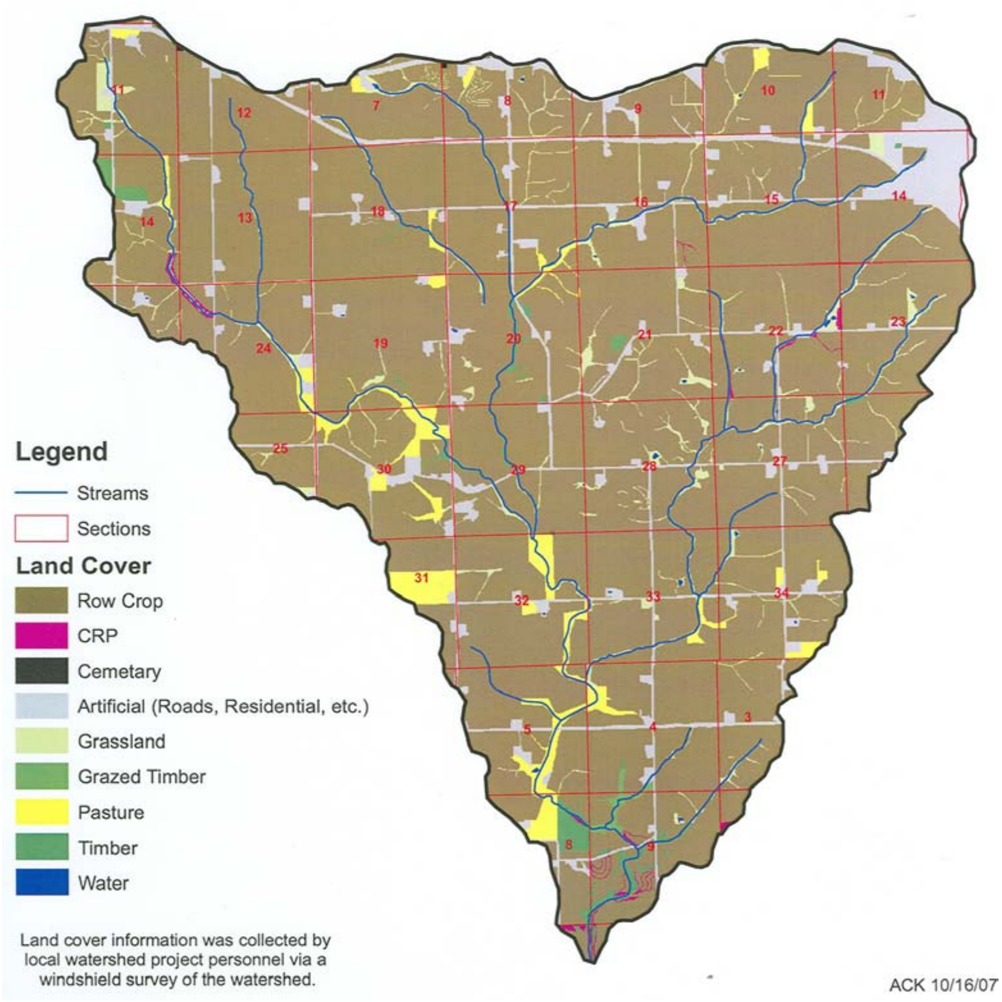
The climate of the watershed is typical of Iowa and the Midwest. The Soil Survey of Clayton County reports that the total annual precipitation is normally about 32 inches, with 70% of this amount occurring during the growing season of April through September.

The Silver Creek Watershed represents one of the most intensely cropped portions of Clayton County. Scattered areas of timber and small pastures flank the stream corridor. Estimated land use for the watershed is shown in Table 1, and on Map 1 below:

**Table 1: Watershed Land Use as of April 2006**

| Landuse Class | Acres | Percent of Total |
|---|---|---|
| Cropland | 15,692 | 87.2% |
| Farmsteads, Roads, and Buildings | 960 | 5.3% |
| Grassland & Existing Waterways | 455 | 2.5% |
| Pasture and/or Grazed Timber | 419 | 2.3% |
| Monona & Luana City Areas | 281 | 1.6% |
| Timber | 110 | 0.6% |
| Conservation Reserve Program | 74 | 0.4% |
| **Total** | 17,991 | |

## Map 1: Silver Creek Land Cover (2005 Assessment)



One hundred and twenty-two landowners hold a total of 160 tracts that are either entirely or partially within the boundaries of the watershed. Of these land units, 153 contain at least a small amount of cropland. There are only three tracts with more than 15 acres of adjoining timber. Given that many of the small farmland tracts are leased, there are approximately 85 landowners/operators that can be considered "decision makers" for the cropland acres.

More than 2/3 of the watershed (about 12,800 acres) is composed of "highly erodible" soils. Downs and Fayette soil types with slope ranges of 5-14% are predominant, and encompass more than 56% of the total acres. Up to 5,140 acres in the watershed are classified as "Not Highly Erodible" (NHEL). The majority of the NHEL acres are comprised of the ridges of upland crop fields (which are flanked by steeper soils) or narrow drainages at the base of upland slopes.

The Silver Creek watershed can be divided into two distinct regions based upon typical crop rotations and cropping practices. The northeast portion of the watershed near Monona is intensively row cropped. Normally, soybeans are rotated with one or two years of corn. Contouring and conservation tillage are widely utilized throughout the watershed. Prior to 2007, terraces had been implemented on portions of 30 tracts to address sheet and rill erosion.

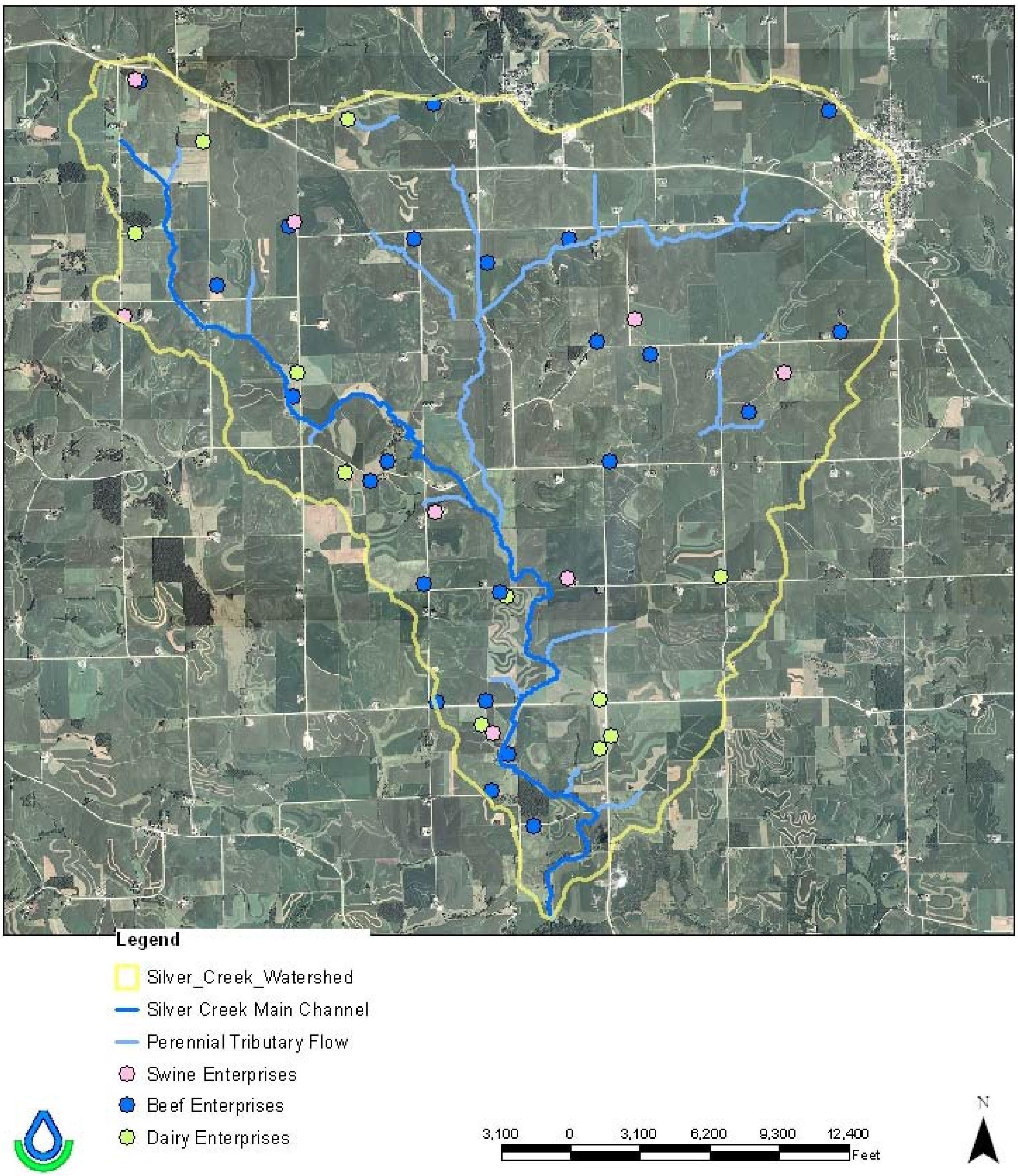
Hay and livestock production are more common in the southwest portion of the watershed. In this region, a typical crop rotation includes three years of corn in rotation with oats and alfalfa, and an occasional year of soybeans. While the popularity of contour stripcropping has faded with the decline in cattle enterprises, the system is currently practiced on nine different tracts. Contour buffer strip systems are utilized on three tracts, and hay is included in a rotation on eleven additional farms.

***Left: No-till planting has gained popularity where soybeans are included in crop rotations.***
***Right: Stripcropping systems common in the 1980's have declined as cattle numbers have dropped.***

Livestock is important in the area. In 2006, there were at least 12 dairy, 11 beef, 3 swine and 2 sheep operations within the watershed. Approximate livestock numbers include 800 dairy cows, 250 beef cow/calf pairs, 500 feeder cattle, 50 sheep, and 4,500 hogs. Most operations are open feedlots that contain small to moderate numbers of cattle or hogs when livestock and feed prices are favorable. Confinement buildings are limited to 5 sites, two of which are less than ten years old. Few of the older operations have existing storage structures, and manure is commonly hauled and spread on crop fields throughout the year.

Map 2 details a concentration of livestock operations near the western edge of the watershed along the main channel of Silver Creek. The aerial imagery used as a backdrop also provides an additional indication of farms where hay is grown in rotation with corn, soybeans, and small grains to support cattle enterprises. The GIS maps, however, do not document the continuing loss of livestock in the watershed. During the watershed assessment, it was noted that nearly all of the Silver Creek farmsteads included livestock enterprises within the last twenty years. Based upon the number of empty cattle feedlots, hog buildings, and dairy barns, it is estimated that more than 50% of the livestock operations, and a corresponding number of farms with alfalfa based rotations, have left the watershed.

## Map 2: Location of Silver Creek Livestock Enterprises (2006)



The “Rapid Assessment of Stream Conditions Along Length” (RASCAL) was completed on Silver Creek in December of 2006. The bulk of the RASCAL data was collected in late November and early December. By that time, crop harvest was complete, soils were frozen, and vegetation near the stream had died back so that the points of interest were visible. Significant snowfalls had not yet occurred, but low temperatures meant that some segments of the stream were frozen. Seventy photos showing stream conditions were collected during the assessment. In retrospect, data from the major unnamed tributary of Silver Creek and from additional tracts near the headwaters of the stream would have also been valuable.

The RASCAL assessment expanded the database of information available for Silver Creek and its watershed. In addition to providing a benchmark of stream conditions, RASCAL revealed a series of conditions that influence water quality:

- More than 90% of the stream showed silt as the dominant stream substrate.
- Vegetation provided 25% canopy cover or less on more than 66% of the stream length.
- Less than 11% of the stream channel had a riparian zone width of more than 60 feet.
- During the assessment, 7% of Silver Creek was dry due to the loss of surface water flow to sinkholes.
- Pasture or row crops flanked more than 70% of Silver Creek.
- Livestock grazed more than 41% of the stream length.
- More than 20% of Silver Creek’s streambanks were assessed as being “moderately unstable”.

After reviewing the RASCAL data, the stream was divided into ten segments according to four parameters. Two stream segments that included each of these four parameters were identified as priority locations for future water quality improvement actions:

1. Losing stream segments that flowed into sinkholes.
2. Areas where livestock had direct access to the stream.
3. The width of the buffer zone.
4. The stability of streambanks.

There are two National Pollution Discharge Elimination System (NPDES) permitted point sources within the watershed. The city of Monona’s wastewater treatment plant and the Swiss Valley Farms creamery discharge into the major unnamed tributary of Silver Creek. Previous water quality assessments note the creamery as a potential point source of pollution. The 305(b) Water Quality Report for Silver Creek cites a 1998 UHL report entitled ‘A Survey of the Benthic Macroinvertebrates and Fishes of the Big Spring Basin’. That particular study indicated that aquatic life uses in the stream were partially supported due to: *(1) indications of problems with fish kills due to a creamery near Monona and (2) results of fish sampling that showed very low fish community diversity and the presence of very few of the expected fish taxa for streams in this region”*. The ‘Unnamed tributary to Silver Creek’ impacted by the creamery was added to Iowa’s 2008 Draft List of Impaired Waters, noting “Ammonia” and “Bacteria” as the causes for the listing, and citing overwhelming evidence of impairment. This issue may impact permitted discharges from the creamery.

Silver Creek is classified as a Class A1 – Class B(WW-2) water body, and is grouped with streams that support fish composed primarily of minnows and other nongame species. Based on poor or fair “Fish Index of Biotic Integrity (FIBI)” and “Benthic Macroinvertebrate Index (BMIBI)” scores, it has been shown as either “not supporting” or “partially supporting” its beneficial uses in each 305(b) Water Quality report since 2000. Silver Creek has appeared on Iowa’s 303(d) list of “Impaired Waters” since 2002. “Aquatic Life” was the original designated use impairment.

A Stressor Identification (SI) was completed for Silver Creek in December 2007. The goal of the SI was to determine the primary causes of biological impairment, including any pollutant for which a TMDL is required. Despite some data limitations, the evidence was sufficient to identify the following primary stressors, any of which is capable of causing biological impairment in the Silver Creek Watershed:

- **Elevated and potentially lethal concentrations of un-ionized ammonia.** Un-ionized ammonia is directly toxic to aquatic invertebrates and fish. Based on a comparison of Silver Creek sampling results, elevated pH and water temperature may be factors contributing to the occurrence of toxic unionized ammonia levels in the watershed.

- **Elevated levels of silt accumulation and sedimentation of rock substrates.** Several sediment related indicators provide evidence of sedimentation as a primary stressor in the Silver Creek biological impairment. The average embeddedness range for three biocriteria sampling sites was 60-80 percent. Additionally, both rapid bioassessment sites were evaluated as having silt covering much of the stream bottom including rock substrates. Potential sources of suspended solids and turbidity include sheet and rill erosion from agricultural fields, gully erosion, stream bed and bank erosion, and re-suspension of fine sediment by watering livestock.

- **Low and potentially lethal levels of dissolved oxygen.** Reduced levels of dissolved oxygen can cause impacts to aquatic life ranging from acute mortality to chronic stressed behavior and diminished biological functions. Available monitoring data for Silver Creek indicate dissolved oxygen levels are mostly suitable for aquatic life, but that levels occasionally fall below water quality standards. Ammonia exerts an oxygen demand through nitrification, depleting dissolved oxygen. There is often an additional oxygen demand from heterotrophic bacteria growth and metabolism of organic components in manure. The dissolved oxygen saturation level decreases with increasing water temperature. Groundwater inputs from springs have a cooling effect on stream temperatures; however, effluents from the identified point sources may increase stream temperature. Riparian canopy coverage in the watershed varies widely. The establishment of riparian vegetation to provide shade to cool stream reaches could help maintain acceptable dissolved oxygen levels.

- **Dewatering due to in-stream sinkholes.** During low flow periods, there is evidence that much of the surface water flow of Silver Creek is diverted by in-stream sinkholes. This is likely to worsen the effects of low flow on temperature and dissolved oxygen. Additionally, the sinkholes may be a barrier to fish migration upstream.

The stressors are influenced by the stream conditions that were documented during the Silver Creek assessment. In order to reduce ammonia levels:

- Cattle should be removed from 4.3 miles of the stream channel at 9 different sites.
- Riparian canopy cover must be increased above 50% on 8.1 miles of Silver Creek.
- The riparian zone width should be increased to at least 60 feet on 9.1 miles of the stream.
- The threat of manure runoff must be controlled from livestock enterprises, especially those within ½ mile of Silver Creek that pose the greatest threat of manure runoff.

While land treatment practices are widespread and obvious on surrounding cropland, silt has accumulated in the stream:

- Soil losses must be minimized throughout the watershed on over 15,000 acres of cropland.
- Structural practices should be targeted to at least 3,355 acres of critical cropland slopes in order to reduce sediment delivery from sheet, rill, and gully sources.
- 2.1 miles of Silver Creek's banks were rated as "moderately unstable" and in need of improvement.

***Left: One of at least 3 sinkholes in the Silver Creek stream corridor.***
***Right: A dry segment of stream, downstream of the sinkholes.***

## B. Expected Load Reductions

Total Maximum Daily Loads for sediment and ammonia have been drafted for Silver Creek. The Stressor Identification recognized excessive siltation and sedimentation of the streambed as a cause of impairment to the benthic and fish communities. The major sources of sediment include sheet, rill, and gully erosion from cropland, and streambank erosion. Point source sediment inputs are considered minor.

The goal for Silver Creek is to reduce the average siltation/sedimentation rate of the streambed from its current level of approximately 80 percent silt substrates to that of comparable reference streams (18 percent silt). When expressed as a maximum annual average for planning purposes, this translates to approximately 2,745 tons of sediment per year. To achieve this goal, sediment inputs to the stream must be reduced by over eighty percent from their current levels. The estimated annual load from the identified sources is as follows:

**Table 2: Estimated Sediment Load Sources**

| Sediment Source | Estimated Load |
|---|---|
| Sheet and Rill Erosion from Cropland | 12,202.0 Tons/Year |
| Stream Bank Erosion | 2,664.0 Tons/Year |
| Creamery Inputs | 50.2 Tons/Year |
| Monona Waste Water Treatment | 14.2 Tons/Year |
| **Total** | **14,930.4 Tons/Year** |

High levels of ammonia have also periodically depleted dissolved oxygen levels within Silver Creek, causing stress to the benthic and fish communities. Ammonia toxicity is dependent on temperature and pH. Controlling the chronic ammonia toxicity in Silver Creek requires controlling episodic releases, as opposed to reducing an existing load. Therefore, an existing load would consist of episodic events at given temperature and pH conditions. Ammonia also depletes dissolved oxygen.

The primary nonpoint sources have been identified as cattle with direct access to the stream, and manure runoff from feedlots. Given that ammonia toxicity is dependent on pH and temperature, the negative impact of these sources is magnified during low flow conditions during the summer.

The TMDL was based on violating numeric water quality standards of either ammonia toxicity at an average pH and temperature for Silver Creek in a summer month, or the dissolved oxygen criteria by inputting ammonia into the stream model. Based on stream modeling utilized for the TMDL, the goal is to reduce ammonia inputs to Silver Creek to 12.33 lbs/day. To reach this level, livestock access to the stream must be controlled, manure runoff from production sites must be managed, and buffers need to be established near critical areas where manure is applied.

**Development of the Sediment Delivery Model**

A sheet and rill erosion model for Silver Creek was created in 2005 as a component of a watershed project development grant secured by the Clayton SWCD. Land use and tillage practices were recorded on printed infrared maps shortly after planting in June. In September, the data was transferred to a tablet computer utilizing “Watershed Assessment Tool” software provided by DNR. Numerical ‘Cover Management’ and ‘Support Practice’ values were assigned to each unit of the GIS to complete a soil loss model of the watershed based on the “Revised Universal Soil Loss Equation”.

Land Cover, Potential Sheet and Rill Erosion, and Sediment Delivery Maps were created. The Land Cover map reveals the large concentration of cropland acres in the watershed. Crop acres are broken only by roads and scattered areas of timber and small pastures that flank the stream corridor. The percentage of cropland in the watershed represents a sizable increase when compared to other watersheds previously targeted for improvement by the Clayton SWCD. For comparison, the Sny Magill and Bloody Run Watersheds are approximately 24,000 acres in size, but represent cropland land uses of 57% or less.

The locations of more than 527,000 feet of existing terrace systems and 16 functioning grade stabilization structures were identified in the GIS model. Due to the widespread use of contouring and reduced tillage, nearly all of the farms in the watershed are in compliance with USDA soil loss standards. Based on RUSLE soil loss calculations, the pre-project average soil loss per acre for the watershed from sheet and rill sources was estimated to be 3.4 tons/acre/year (a total of 61,130 tons annually). Areas showing soil losses of 4 tons/acre/year or greater were typically identified as steep slopes (>9%) farmed with corn and soybean rotations. According to GIS sediment delivery model, it was estimated that 12,202 tons of sediment was delivered to Silver Creek each year from sheet and rill erosion sources. These estimates are shown as Maps 3 and 4, which follow.

The original use of the sediment delivery model was to generate a visual baseline reference of fields where soil loss and sediment delivery was the highest, and to select priority locations for future treatment. The model loses accuracy as slope lengths utilized in the RUSLE soil loss equation are generalized, and as tillage operations and crop rotations change from the year in which they were initially recorded. A site specific sediment delivery model would improve the sheet and rill erosion estimates that were generated for the TMDL, and give a more accurate representation of the reductions that must be achieved in order to improve aquatic life in the stream.

Sediment contributions from gully sources were estimated by using the direct volume method. A series of aerial photos from crop years 2002 through 2009 were utilized to locate ephemeral gullies. The identified gullies typically formed where water concentrated from significant rain events and ground cover and control practices were lacking. Infrared photos from 2002 proved useful for identifying adequate existing grassed waterways and grade control structures. Aerial photos from 2008, when combined with LIDAR coverage available for the watershed, were utilized to identify potential gully sites. Gully lengths were estimated via the GIS model for the watershed, and sediment contributions were determined using the “Sediment Delivery Calculator” developed by IDALS-DSC.

Streambank erosion was identified as a sediment source during RASCAL. During the assessment, bank heights were recorded and each stream segment was evaluated for its stability. The location of ten severely eroding banks was recorded. Streambank sloughing was more evident on nine tracts where cattle have direct access to the stream. Additionally, where livestock enterprises have ended, landowners have converted pastures to row crops and have removed existing grass and tree cover in the riparian zone. For the TMDL, bank recession rates were assigned according to adjacent land uses and sediment delivery was estimated based upon the Direct Volume Method.

***Left: Severe gully erosion in cropland.***
***Right: One of the eroding streambanks identified during the RASCAL assessment.***

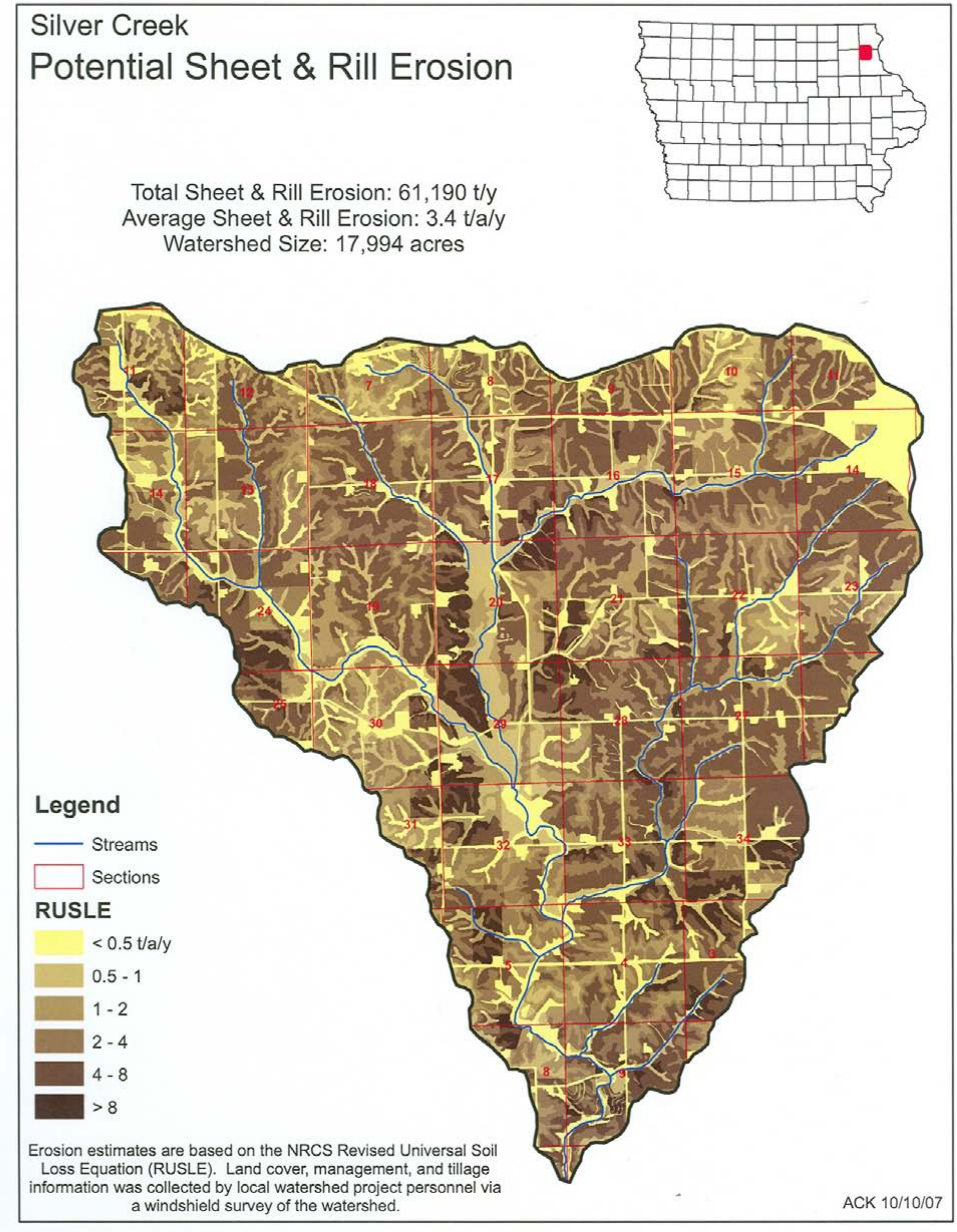
Table 3 indicates the cumulative estimated impact of the upland treatment, streambank and buffer practices on the sediment load sources, as described in Section C, “Proposed Management Measures”:

**Table 3: Estimated Post Implementation Sediment Load Sources**

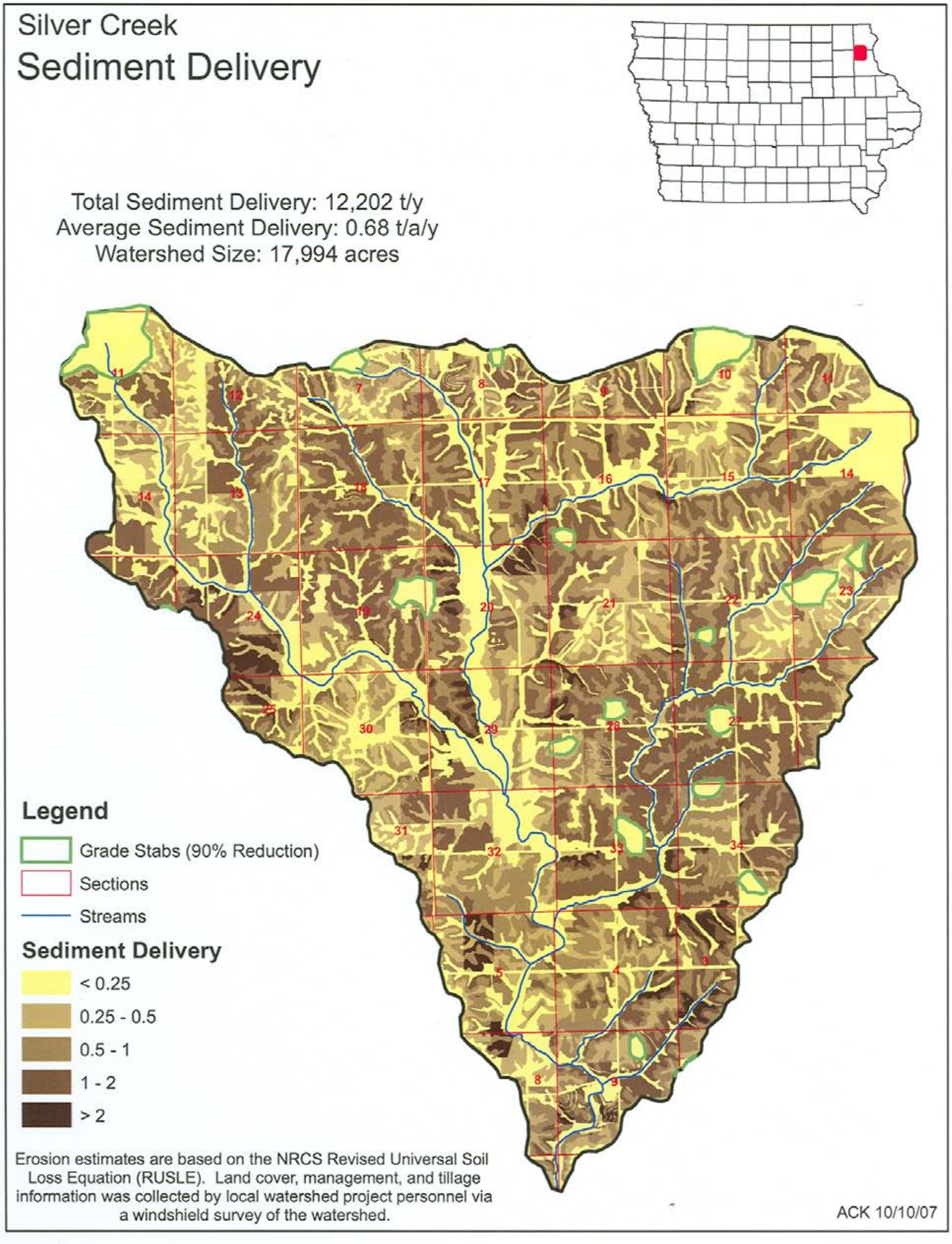
| Sediment Source | Estimated Load | Post Implementation |
|---|---|---|
| Sheet and Rill Erosion from Cropland | 12,202.0 Tons/Year | 4,567.0 Tons/Year |
| Stream Bank Erosion | 2,664.0 Tons/Year | 423.0 Tons/Year |
| Trapping Efficiency from Buffers | | (453.0) Tons/Year |
| Creamery Inputs | 50.2 Tons/Year | 50.2 Tons/Year |
| Monona Waste Water Treatment | 14.2 Tons/Year | 14.2 Tons/Year |
| **Total** | **14,930.4 Tons/Year** | **4,472.6 Tons/Year** |

The proposed practices aggressively target sediment and ammonia sources. Achieving the outlined practice goals should create a measurable improvement in the Fish Index of Biotic Integrity (FIBI) and Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) scores, which would allow Silver Creek to be removed from Iowa’s 303(d) list of Impaired Waters.

**Map 3: Silver Creek Potential Sheet & Rill Erosion (2005 Assessment)**



**Map 4: Silver Creek Sediment Delivery Estimates (2005 Assessment)**



## C. Proposed Management Measures

As stated in the Implementation Plan in the draft TMDL, the two major pollutants causing the aquatic life impairment of Silver Creek are excess sediment and episodic ammonia toxicity. While both are the by-product of land management, different approaches are required to reduce their impacts. Sediment delivery is best controlled with upland management and in-stream stabilization practices. Controlling episodic ammonia toxicity is more complicated, since it is influenced by water temperature and pH. Controlling the amount of ammonia that reaches the stream via runoff from animal feeding operations and limiting livestock access would limit ammonia inputs. As documented in the TMDL, potential Best Management Practices and their perceived impact on sediment and ammonia are shown in Table 4:

**Table 4: Impairment Reduction Potential for Potential BMP's**

| Management Practice | Sediment Reduction Potential | Ammonia Reduction Potential |
|---|---|---|
| Conservation Tillage | | |
| Moderate vs. Intensive Tillage | Moderate | N/A |
| No-Till vs. Intensive Tillage | High | N/A |
| No-Till vs. Moderate Tillage | High | N/A |
| Cover Crops | High | N/A |
| Diversified Cropping Systems | Moderate | N/A |
| In-Field Vegetative Buffers | High | N/A |
| Terraces | High | N/A |
| Pasture/Grassland Management | | |
| Livestock Exclusion | Moderate | High |
| Rotational vs. Constant Intensive Grazing | Moderate | Moderate |
| Seasonal vs. Constant Intensive Grazing | Moderate | Moderate |
| Riparian Buffers | Moderate | Moderate |
| Wetlands | High | High |
| Streambank Protection | High | N/A |

No single practice will be able to sufficiently reduce pollutant loads to Silver Creek. A comprehensive package of practices will be required to address the issues that have led to the poor biological community in the stream. In order to reduce the impact of the identified impairments, the Clayton Soil and Water Conservation District has established the following objectives for water quality improvement activities targeted to Silver Creek:

1. Promote stream corridor and sinkhole protection along critical areas of the watershed, and install buffer practices to protect Silver Creek and its tributaries and reduce ammonia inputs.
2. Target the installation of conservation practices that will reduce sediment delivery to the stream.
3. Develop a series of news articles, newsletters, field days, and demonstrations that will increase public understanding of water quality issues and encourage greater involvement and participation in water quality programs.
4. Continually evaluate progress and renew priorities for water quality improvements.

The basis of this approach is to replace the impact of livestock access to the stream with new buffers, and to keep soil in place before it becomes a pollutant. In order to address the identified water quality problems, a variety of conservation practices are proposed. The major focus is the installation of filter strips and pasture improvement practices along the stream corridor, and structural practices targeted to reduce sediment delivery from critical upland slopes.

Given the large percentage of cropland in the watershed, the amount of practices needed to reach the identified load reductions will take several years to implement. Since nearly all of the Silver Creek

Watershed is privately owned, the proposed improvements are dependent on the voluntary actions of landowners, farm operators, and watershed residents.

The District has identified a need to increase public awareness of the conservation opportunities available through the Continuous Conservation Reserve Program. Historically, most watershed landowners have been reluctant to give up productive cropland and pasture adjacent to the stream. Additionally, while landowners are aware of the water quality problems associated with sinkholes, there are few established buffers around the 60 or more sinkholes that are present in the watershed. In most locations, fertilizer, manure, and pesticides are applied next to these critical areas.

Incentives for pasture management and streambank protection have proven useful for treating priority segments of the stream identified during the RASCAL assessment. When used in combination with the conservation opportunities that are available through Continuous CRP, there are a variety of options for landowners. Improved animal waste management systems are also needed. The limited number of existing manure storage facilities in the watershed results in a potential for manure runoff.

Conservation tillage and contouring are commonly used in the watershed. Further reductions in rill, sheet, and ephemeral gully erosion in the Silver Creek Watershed can be achieved by promoting no-till planting systems, tile outlet terraces, contour strip cropping, contour buffer strips, and grassed waterways. Water and sediment control basins and grade stabilization structures are needed to reduce classic gully erosion. These structures also serve as effective sediment traps, and have the added benefit of reducing peak discharge rates after storm events.

Based on the assessment of the Silver Creek Watershed, it is estimated that the following practices would be needed in order to reduce the impact of the identified impairments. The following practices have been selected to reduce episodic ammonia levels:

- **Promote the Conservation Reserve Program**, targeting critical locations of the Silver Creek Watershed. At a minimum, an estimated 240 acres of filter strips, riparian buffers, wetlands and other improvement practices are needed to restore a 60’ buffer zone along the length of Silver Creek and its tributaries.

- **Complete 200 acres of improved pasture management practices, and/or install 14,000 feet of resource protection fencing to remove livestock from Silver Creek and its tributaries**. Cattle are allowed direct access to the main channel of Silver Creek on nine farms, and to the major unnamed tributary at two sites. Experience in other watersheds has shown that one of the simplest ways to achieve water quality benefits is to remove cattle. Due to a long history of concerns regarding flood events, however; permanent fence may not be viewed as a viable option by landowners. Pasture management programs which include incentives for low cost electric fence lines and alternate water sources, are currently a more acceptable practice.

- **Install six improved animal waste management systems**. Livestock is produced on over 25 farms in the watershed. The six livestock operations located within ½ mile of Silver Creek have been identified as potential threats for manure runoff.

These practices have been selected to target the sources of sediment delivery to the stream:

- **Treat all cropland acres with a combination of no-till planting practices, terraces, contour strip cropping, and contour buffer strips.** When considered individually, each of these practices is at least partially accepted in the watershed. It is rare, however; that a combination of these practices is utilized to create a resource management system that fully reduces sediment delivery to the stream. Based on the tillage assessment conducted in 2005, a majority of Silver

Creek farm operators utilize no-till when planting soybeans, or when planting corn into soybean stubble. These same producers have experienced yield losses when attempting no-till planting in a continuous corn system, and will utilize tillage for corn following corn. Additionally, buffer strips, strip cropping, and terraces have historically been implemented by landowners that wish to reduce soil losses, while maintaining their option to utilize tillage operations prior to planting.

- **Build 560,000 feet of terraces to reduce soil loss and sediment delivery from 3,355 acres of highly erodible cropland.** Cost share incentives for terraces have accelerated the adoption of this practice in Clayton County. Cropland slopes >9% farmed with corn/soybean rotations have been designated as a significant source of sediment through the use of the GIS model. Sloping fields that lack support practices within ½ mile of the stream, its tributaries and major known sinkholes have been selected as a high priority for terrace systems.

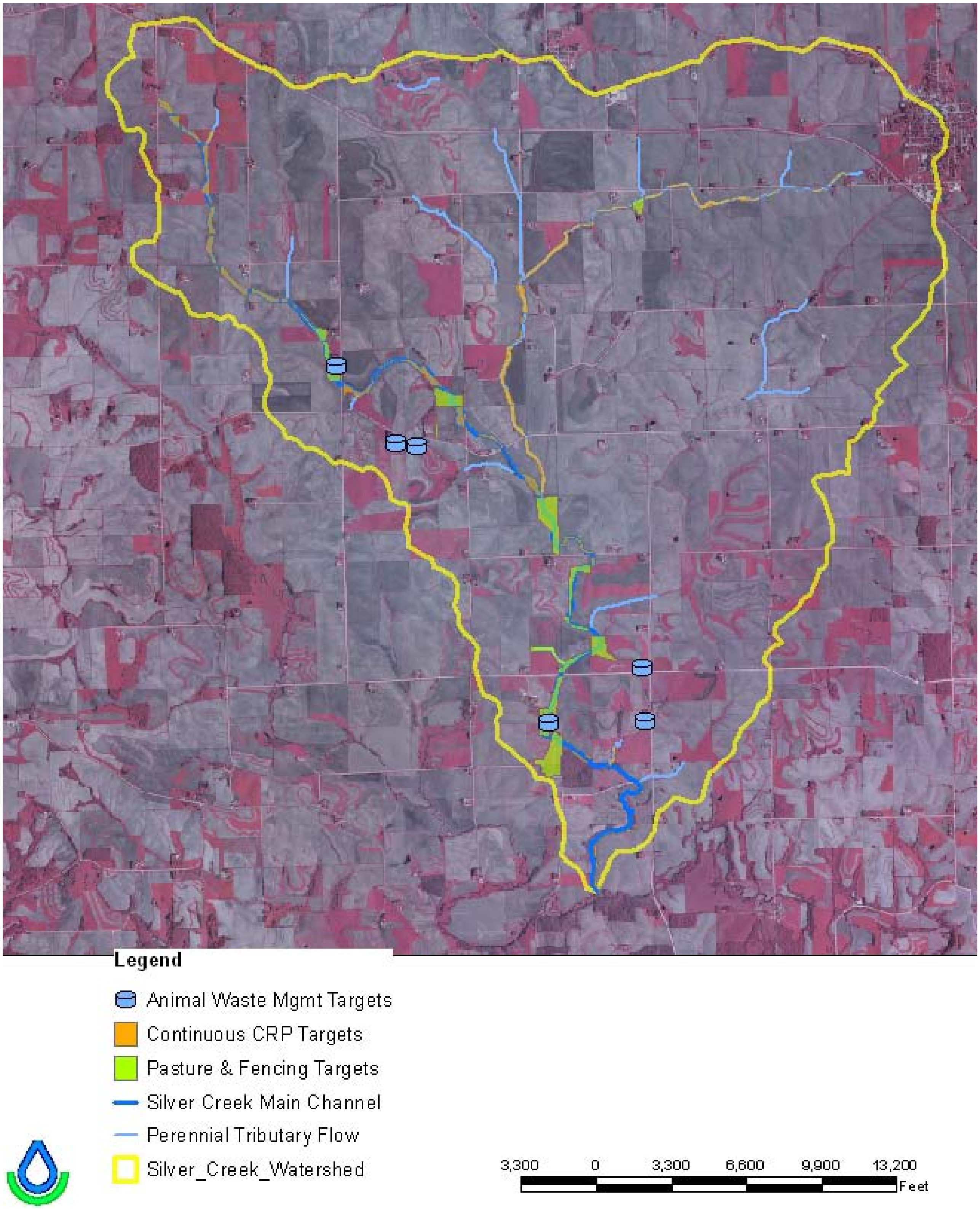
- **Install water and sediment control basins, grade stabilization structures, and grassed waterways for gully control.** Based on an assessment of LIDAR data and updated annual photos, there are at least 95,000 lineal feet of active and ephemeral gullies within the Silver Creek Watershed. This estimate will likely increase as LIDAR data is made available for the southern half of the watershed. Using the Direct Volume Method, an additional 1,012 tons of gross erosion occurs each year from the identified gully sources. The impact of the identified gullies can be reduced with the establishment of at least 65 acres of grassed waterways, or the installation of sediment basins and grade stabilization structures, where feasible.

- **Stabilize 2,000 feet of severely eroding stream banks**. The location of severely eroding streambanks was recorded during the RASCAL assessment of Silver Creek. Landowners typically place a priority on treating eroding banks that directly threaten crop land.

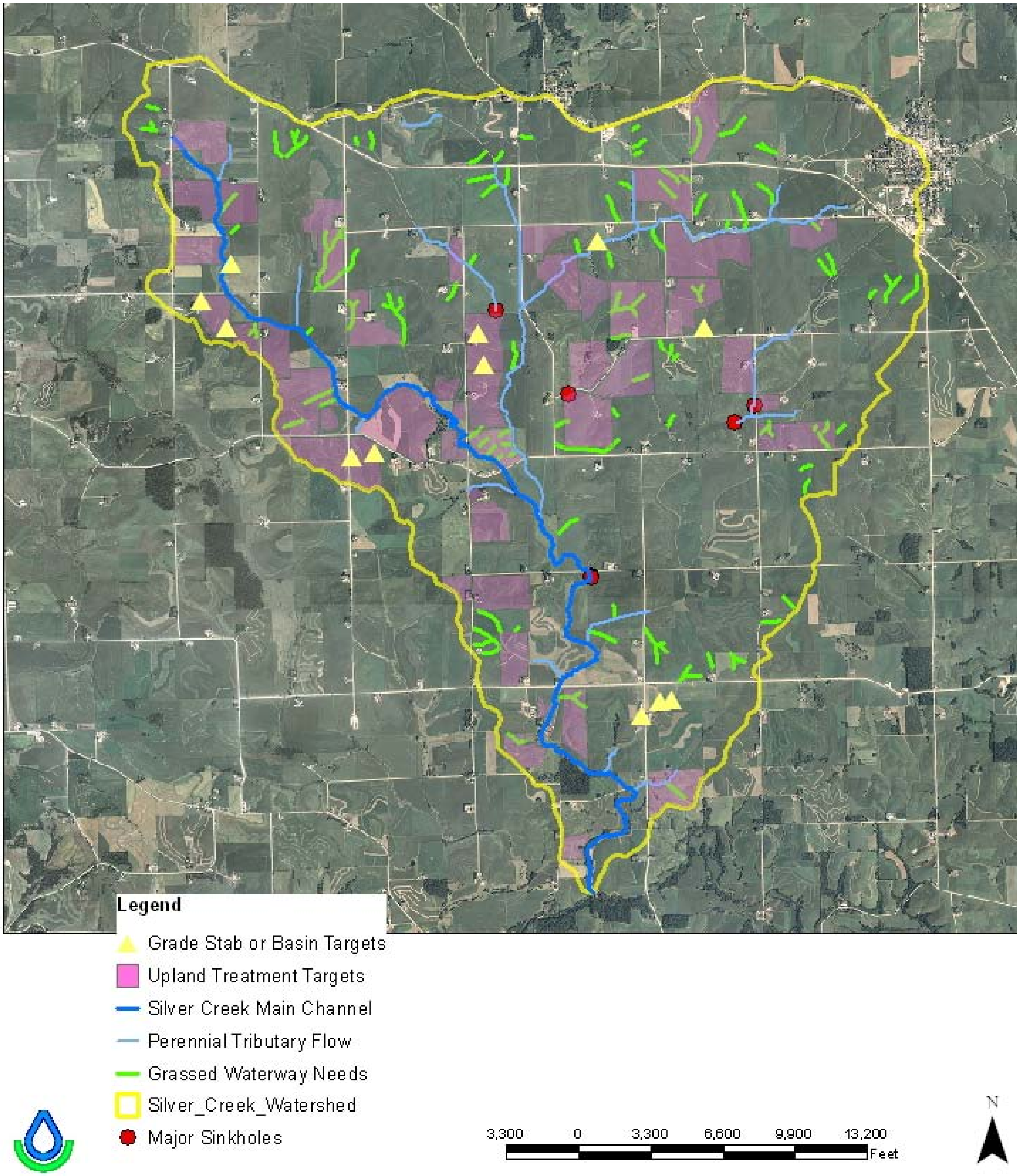
Areas targeted for buffer, animal waste management, and pasture improvement practices are highlighted on Map 5. The highest priority targets include tracts where cattle are allowed access to the main channel of Silver Creek and livestock enterprises within ½ mile of the stream. Secondary targets include the grazed portion of the unnamed tributary, and portions of Silver Creek and its tributaries with a riparian width of 60 feet or less.

Map 6 shows farms having the highest priority for upland treatment, as identified by the soil loss and sediment delivery model for the watershed. These tracts typically include a combination of critical slopes, row crops, and a lack of support practices. Highest priority slopes are those within a half mile of the main channel of Silver Creek. Secondary priorities are the areas flanking the unnamed tributary, and fields that drain to major sinkholes. Sites targeted for grade stabilization structures, water and sediment control basins, and grassed waterways are also indicated on the map.

## Map 5: Areas Targeted for Livestock Exclusion, Buffers and Animal Waste Management Systems



**Map 6: Priority Watershed Targets for Upland Treatment**



## Expected Impact of the Proposed Management Measures

The RUSLE model was utilized to evaluate the impact of land management and conservation practices on sheet and rill erosion, and sediment delivery for the preparation of the TMDL. For this purpose, "Cover/Management (C)" and "Support Practice (P)" factors utilized in RUSLE were manipulated. Four scenarios were created to compare with the baseline conditions documented in 2005. The scenarios predict the reduction of soil loss and sediment delivery in the watershed if the management measures described in this plan are implemented. The modeled impacts are shown in Table 5:

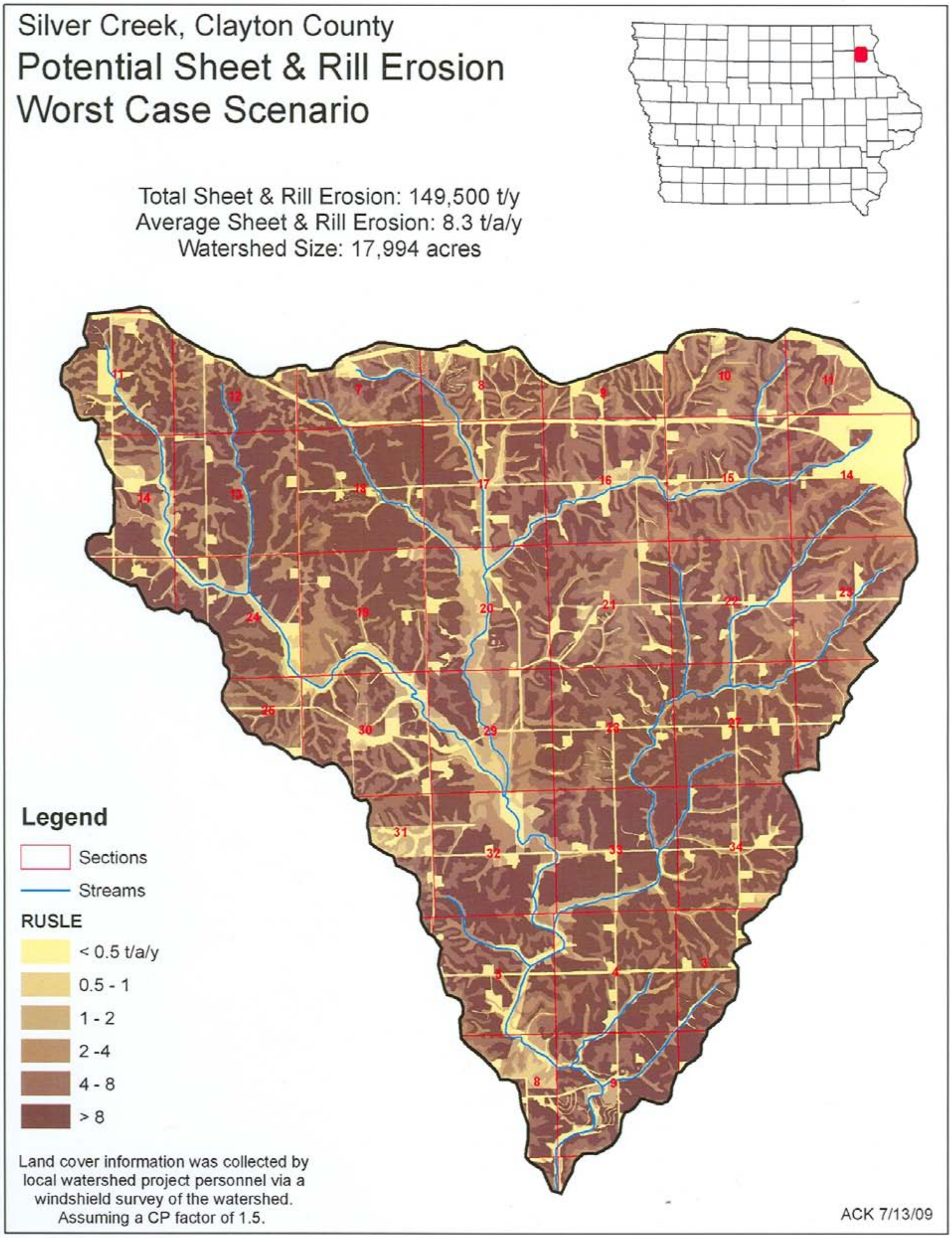
- **Scenario 1:** Cover/Management and Support Practice factors were raised in order to reflect a "Worst Case" scenario where aggressive tillage operations are combined with erosive crop rotations and limited support practices.
- **Scenario 2:** (C) and (P) factors were altered to show the potential impact of the use of Terraces, Contour Buffer Strips, and/or Strip Cropping on all cropland with slopes of 5% or greater.
- **Scenario 3:** (C) and (P) factors were changed to reflect the use of no-till planting practices on all Silver Creek Watershed cropland.
- **Scenario 4:** (C) and (P) factors were modified to reflect the use of no-till on all cropland; combined with terraces and/or buffer strips and strip cropping on all slopes >5%.

**Table 5: Modeled Soil Loss and Sediment Delivery Impacts for Proposed Practices (Cropland)**

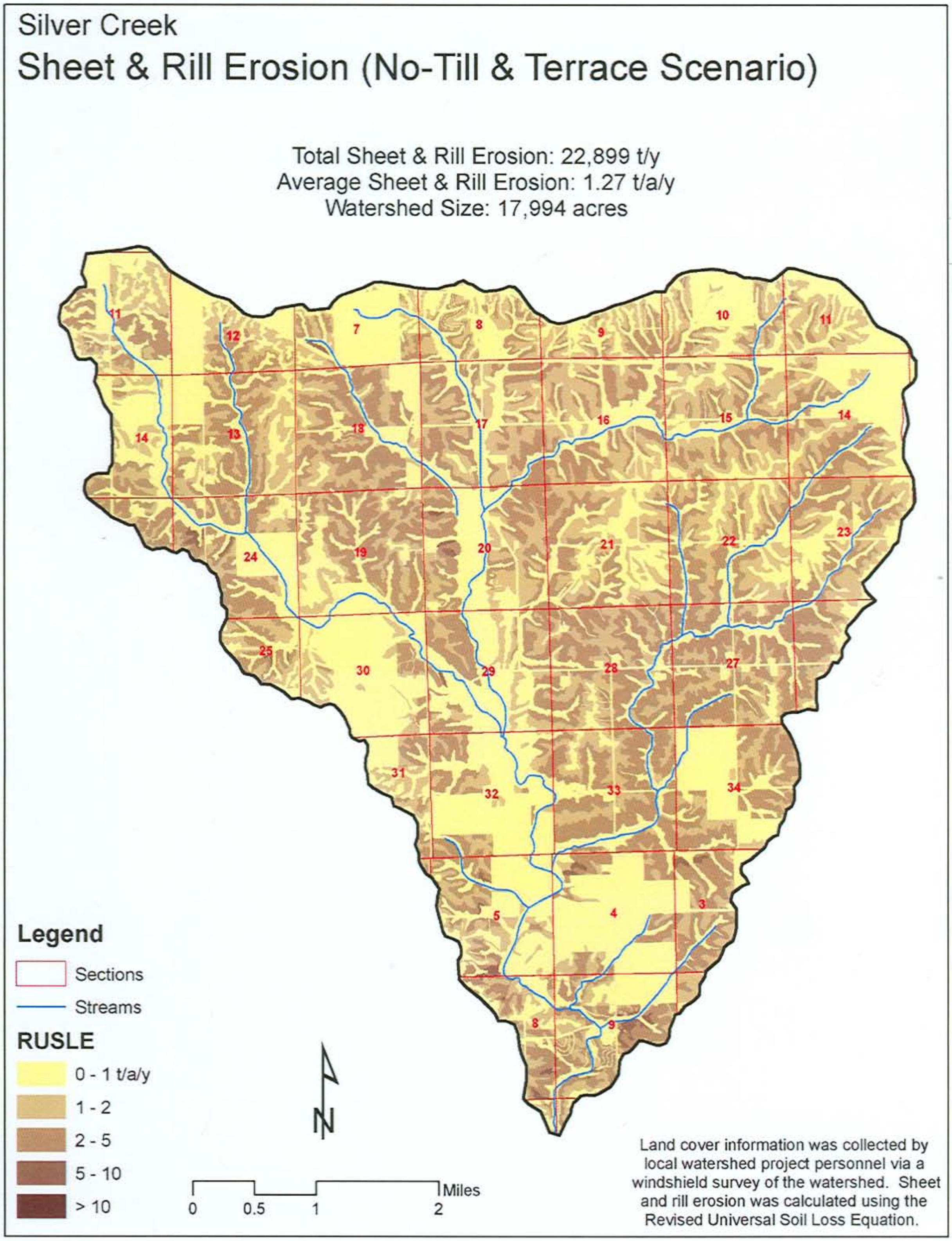
| | Sheet & Rill Erosion (Tons/Year) | Average Erosion (Tons/Acre/Year) | Sediment Delivery (Tons/Year) | Average Delivery (Tons/Acre/Year) |
|---|---|---|---|---|
| **Scenario 1:** Worst Case Conditions | 149,500 | 8.30 | 29,600 | 1.60 |
| **Baseline** Assessed Conditions 2005 | 61,190 | 3.40 | 12,202 | 0.68 |
| **Scenario 2:** Install Support Practices on All Slopes >5% | 50,832 | 2.82 | 10,126 | 0.56 |
| **Scenario 3:** No-Till Planting on All Cropland | 27,514 | 1.53 | 5,496 | 0.31 |
| **Scenario 4:** Support Practices on All Slopes >5% and No-Till Planting on All Cropland | 22,899 | 1.27 | 4,567 | 0.25 |
| **TMDL Goal** | 13,742 | 0.76 | 2,745 | 0.15 |

The scenarios demonstrate the need for the widespread use of a combination of structural and reduced tillage systems throughout the watershed. The "Worst Case Scenario 1" reveals the considerable impact of the conservation systems that landowners and farm operators had put in place prior to 2005. While the individual impacts of support practices and no-till planting are significant (as shown in Scenarios 2 and 3) only the widespread combination of those practices will result in sediment delivery reductions that will impact aquatic life in Silver Creek. Scenario 4 not only reflects the practices described within the watershed management action plan, but also the systems that have been proven to be acceptable and successful by Silver Creek landowners and farm operators.

**Scenario 1: Silver Creek Worst Case Potential Sheet & Rill Erosion**



**Scenario 4: Sheet & Rill Erosion Estimate in which Support Practices are Utilized on all Slopes >5% in Combination with No-Till Planting for Cropland**



The expected impact of the proposed buffer and streambank protection practices on sediment delivery sources can also be evaluated by manipulating the factors used to calculate bank sediment loss. During the RASCAL assessment, "Bank Stability" was characterized as "Moderately Unstable" for 2.1 miles of Silver Creek (more than 10.3 miles of the stream were assessed). Bank heights and adjacent land uses were recorded. Bank sediment losses for the TMDL were completed by assigning a lateral recession rate for each 'moderately unstable' stream segment according to its adjacent land use (crop or pasture). Calculations were prepared by using the Direct Volume Method.

The proposed management measures have the objective of removing cattle from the stream and its tributaries, establishing a buffer of at least 60 feet adjacent to perennial water sources, and stabilizing severely eroding banks that were identified during the RASCAL assessment. The theoretical result of these management measures has a significant impact on estimated streambank erosion, as per Table 6:

**Table 6: Estimate of Bank Sediment Loss**

| | Eroding Bank Length | Weighted Average Bank Height | Lateral Recession Rate | Soil Density | Gross Streambank Erosion |
|---|---|---|---|---|---|
| Units | Feet | Feet | Feet/Year | Lbs/Ton | Tons/Year |
| Assessed Conditions | 11,088 | 6.9 | 0.9 | 85 | 2,926 |
| Stabilized Conditions | 11,088 | 6.9 | 0.13 | 85 | 423 |
| Potential Reduction | | | | | 2,503 |

For the TMDL, recession rates of 295 mm/year and 253 mm/year were assigned to pasture and row crop land uses, respectively. When units are converted, an equivalent recession rate of 0.97 feet/year is assigned to the pasture land use, and 0.83 feet/year to crop land. In Table 6, a rate of 0.13 feet/year was chosen to describe "Stabilized Conditions" as it signifies a major improvement when compared to the assessed streambank erosion rates.

Further sediment reductions are possible as a result of the pasture management, livestock exclusion and buffer practices that are targeted to remove cattle from the stream and address the ammonia impairment. The goaled 240 acres of Continuous CRP buffers would convert existing cropland and pasture to permanent vegetation. Based on the use of the IDALS-DSC Sediment Delivery Calculator, a 75% trapping efficiency for sediment generated in fields adjacent to the buffers is allowed. For slopes >2% typical of Silver Creek, trapping credit is assumed for the buffer itself and an adjacent area 100 feet wide.

***Left: An electric fence protects a portion of Silver Creek from cattle.***
***Right: No-till planting and a grassed filter strip along the headwaters of the stream.***

Buffers are targeted for the combined 88,000 foot length of Silver Creek and its major unnamed tributary. By using a 160 foot wide sediment trapping credit and a conservative soil loss reduction of 2 tons/acre (before) to 1 ton/acre (after), the Sediment Delivery Calculator determines a reduction of 453 tons delivered (from 517 to 64 tons/year).

Table 7 details the estimated impact of the upland treatment, streambank and buffer practices on the identified pollutant load sources:

**Table 7: Estimated Impact on Pollutant Load Sources**

| Management Practice | Sediment Reduction Potential | Ammonia Reduction Potential |
|---|---|---|
| Conservation Tillage<br>No-Till vs. Moderate Tillage | **High**<br>Modeled Load Reduction = 6,706 tons/year | **N/A** |
| Terraces, Grassed Waterways, Sediment Basins, and Grade Stabilization Structures | **High**<br>Modeled Load Reduction = 3,005 tons/year | **N/A** |
| Pasture/Grassland Management<br>Livestock Exclusion | **Moderate**<br>Impacts on Bank Stability are Reflected within the Estimates for "Streambank Protection" | **High**<br>Restricting cattle from the stream removes the ammonia source identified in the TMDL. |
| Riparian Buffers (Continuous CRP) | **Moderate**<br>Estimated Load Reduction = 453 tons/year | **Moderate**<br>Episodic events reduced due to increased stream canopy and improved riparian zone. |
| Streambank Protection | **High**<br>Estimated Load Reduction = 2,503 tons/year | **N/A** |

The reduction estimates shown in Table 7 reveal the challenge that lies ahead in the Silver Creek Watershed. The proposed practices aggressively target sediment and ammonia sources. Achieving the practice goals should create a measurable long term improvement in the Fish Index of Biotic Integrity (FIBI) and Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) scores.

Given that the watershed is almost entirely privately owned, improvements are totally dependent on the voluntary actions of landowners, farm operators, and watershed residents. The proposed practices were chosen based upon a historical level of acceptance experienced by previous water quality initiatives within Clayton County. The Watershed Management Action Plan will be updated annually, and evaluated for effectiveness at the close of each of three implementation phases. Over the long term, Silver Creek ultimately becomes a test bed for the use of conservation systems with crop and livestock production, and the ability of those systems to protect the natural resources that agriculture impacts.

## D. Implementation Schedule

Watershed improvement activities are outlined in three implementation phases defined as follows:

- Phase 1: January 1, 2007 through December 31, 2012.
- Phase 2: January 1, 2013 through December 31, 2017.
- Phase 3: January 1, 2018 through December 31, 2022

**Goal:** Accelerate the adoption of conservation practices that will remove Silver Creek from Iowa's 303(d) list of impaired waters.

**Implementation Phase 1: January 1, 2007 – December 31, 2012**

**Objective:** Promote stream corridor and sinkhole protection along critical areas of the watershed, and install buffer practices to protect Silver Creek and its tributaries and reduce ammonia inputs.

**Baseline**: Less than 11% of the length of Silver Creek and its tributaries (133,000' total) had a buffered riparian zone of 60 feet or more during the December 2006 RASCAL assessment.
**Milestone:** At least 40% of the length of Silver Creek and its tributaries is buffered and protected from livestock.

| Task | Metric | Phase Total | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| Continuous CRP Practices | Acres | 60 | 10.5 | 3.3 | 15.5 | 10 | 10 | 10.7 |
| Resource Protection Fencing | Feet | 3,000 | | | | | 1,500 | 1,500 |
| Pasture Improvement | Acres | 100 | 40 | | 20 | | 20 | 20 |
| Streambank Protection | Feet | 700 | | | 300 | 150 | 125 | 125 |
| Animal Waste Mgmt. Systems | Number | 1 | | | | | | 1 |

**Objective:** Target the installation of conservation practices that will reduce sediment delivery to the stream.

**Milestone:** Reduce sediment delivery to Silver Creek by at least 700 tons annually.

| Task | Metric | Phase Total | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| Terraces | Feet | 165,000 | 8,830 | 26,475 | 48,020 | 21,245 | 30,000 | 30,430 |
| Grade Stab. Structures | Number | 2 | | | 1 | 1 | | |
| Sediment Basins | Number | 2 | | | | 1 | 1 | |
| Grassed Waterways | Feet | 10,000 | | | 6,650 | 1,000 | 1,000 | 1,350 |

**Objective:** Develop a series of new articles, newsletters, field days, and demonstrations that will increase public understanding of water quality issues and encourage greater involvement and participation in water quality programs.

**Milestone:** > 20 Silver Creek landowners complete water quality improvement projects each year.

| Task | Metric | 2007 – 2012 Phase Total |
|---|---|---|
| On-Farm Planning Visits | # Conducted | 120 |
| Project Newsletters & News Articles | # Circulated | 12 |
| Field Days & Demonstrations | # Conducted | 6 |
| Public Meetings & Direct Mailings | # Completed | 6 |

**Objective:** Evaluate progress in the watershed, and renew priorities for water quality improvement activities.

**Milestone:** Improved FIBI and BMIBI scores.

Tasks

- Annually Update the Watershed Management Plan
- Annually Evaluate Progress and Financial Need, and Prepare a Funding Proposal for Phase 2
- Prepare a Quality Assurance Project Plan for Water Monitoring during Phases 2 and 3
- Repeat the RASCAL Assessment (2012)
- Determine FIBI and BMIBI Scores (2012)

**Implementation Phase 2: January 1, 2013 – December 31, 2017**

**Objective:** Promote stream corridor and sinkhole protection along critical areas of the watershed, and install buffer practices to protect Silver Creek and its tributaries and reduce ammonia inputs.

**Baseline**: Less than 11% of the length of Silver Creek and its tributaries (133,000' total) had a buffered riparian zone of 60 feet or more during the December 2006 RASCAL assessment.
**Milestone:** At least 70% of the length of Silver Creek and its tributaries is buffered and protected from livestock.

| Task | Metric | Phase Total | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| Continuous CRP Practices | Acres | 120 | 24 | 24 | 24 | 24 | 24 |
| Pasture Improvement | Acres | 100 | 20 | 20 | 20 | 20 | 20 |
| Streambank Protection | Feet | 600 | 200 | | 200 | | 200 |
| Animal Waste Management Systems | Number | 2 | | | 1 | | 1 |

**Objective:** Target the installation of conservation practices that will reduce sediment delivery to the stream.

**Milestone:** Reduce sediment delivery to Silver Creek by at least 700 tons annually.

| Task | Metric | Phase Total | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|
| Terraces | Feet | 200,000 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Grade Stab. Structures | Number | 2 | | 1 | | 1 | |
| Sediment Basins | Number | 2 | | 1 | | 1 | |
| Grassed Waterways | Feet | 20,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |

**Objective:** Develop a series of new articles, newsletters, field days, and demonstrations that will increase public understanding of water quality issues and encourage greater involvement and participation in water quality programs.

**Milestone:** >20 Silver Creek landowners complete water quality improvement projects each year.

| Task | Metric | 2013 – 2017 Phase Total |
|---|---|---|
| On-Farm Planning Visits | # Conducted | 100 |
| Project Newsletters & News Articles | # Circulated | 10 |
| Field Days & Demonstrations | # Conducted | 5 |
| Public Meetings & Direct Mailings | # Completed | 5 |

**Objective:** Evaluate progress in the watershed, and renew priorities for water quality improvement activities.

**Milestone:** Improved FIBI and BMIBI scores.

Tasks

- Annually Update the Watershed Management Plan
- Annually Evaluate Progress and Financial Need, and Prepare a Funding Proposal for Phase 3
- Execute the Water Quality Monitoring Plan
- Repeat the RASCAL Assessment (2017)
- Evaluate FIBI and BMIBI scores (2017)

| Implementation Phase 3: January 1, 2018 – December 31, 2022 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Objective:** Promote stream corridor and sinkhole protection along critical areas of the watershed, and install buffer practices to protect Silver Creek and its tributaries and reduce ammonia inputs. | | | | | | | |
| **Baseline**: Less than 11% of the length of Silver Creek and its tributaries (133,000' total) had a buffered riparian zone of 60 feet or more during the December 2006 RASCAL assessment. **Milestone:** Silver Creek and its tributaries are buffered and protected from livestock. | | | | | | | |
| Task | Metric | Phase Total | 2018 | 2019 | 2020 | 2021 | 2022 |
| Continuous CRP Practices | Acres | 60 | 12 | 12 | 12 | 12 | 12 |
| Streambank Protection | Feet | 700 | 200 | | 300 | | 200 |
| Animal Waste Management Systems | Number | 3 | 1 | | 1 | | 1 |
| **Objective:** Target the installation of conservation practices that will reduce sediment delivery to the stream. | | | | | | | |
| **Milestone:** Reduce sediment delivery to Silver Creek by at least 700 tons annually. | | | | | | | |
| Task | Metric | Phase Total | 2018 | 2019 | 2020 | 2021 | 2022 |
| Terraces | Feet | 200,000 | 40,000 | 40,000 | 40,000 | 40,000 | 40,000 |
| Grade Stabilization Structures | Number | 2 | | 1 | | 1 | |
| Sediment Basins | Number | 2 | | | 1 | | 1 |
| Grassed Waterways | Feet | 20,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |

| **Objective:** Develop a series of new articles, newsletters, field days, and demonstrations that will increase public understanding of water quality issues and encourage greater involvement and participation in water quality programs. | | |
|---|---|---|
| **Milestone:** >20 Silver Creek landowners complete water quality improvement projects each year. | | |
| Task | Metric | 2018 – 2022 Phase Total |
| On-Farm Planning Visits | # Conducted | 100 |
| Project Newsletters & News Articles | # Circulated | 10 |
| Field Days & Demonstrations | # Conducted | 5 |
| Public Meetings & Direct Mailings | # Completed | 5 |

| |
|---|
| **Objective:** Evaluate progress in the watershed, and renew priorities for water quality improvement activities. |
| **Milestone:** Improved FIBI and BMIBI scores. |
| Tasks<br>• Annually Update the Watershed Management Plan<br>• Annually Evaluate Progress and Financial Need<br>• Execute the Water Quality and Biological Monitoring Plan<br>• Repeat the RASCAL Assessment (2022)<br>• Evaluate FIBI and BMIBI scores (2022) |

## E. Technical and Financial Assistance Needs

Cost estimates for the proposed practices were determined based on an analysis of annual average costs for similar projects completed in Clayton County. Estimates reflect current costs, and 75% cost share for most practices. As shown in Table 8, landowner investment is estimated to be $832,500.00 over the course of three implementation phases.

**Table 8: Estimated Unit Costs for the Proposed Conservation Practices**

| Practice | Amount Needed | Cost/Unit | Cost Share | Landowner Cost |
|---|---|---|---|---|
| Continuous CRP | 240 Acres | $200/Acre | $24,000 | $24,000 |
| Pasture Improvement | 200 Acres | $60/Acre | $12,000 | $0 |
| Resource Protection Fencing | 3,000 Feet | $2/Foot | $4,500 | $1,500 |
| Streambank Protection | 2,000 Feet | $40/Foot | $60,000 | $20,000 |
| Animal Waste Management | 6 Systems | $100,000/system | $450,000 | $150,000 |
| Terraces | 565,000 Feet | $4/Foot | $1,695,000 | $565,000 |
| Grade Stabilization Structures | 6 Structures | $20,000/structure | $90,000 | $30,000 |
| Water & Sediment Basins | 6 Basins | $3,000/basin | $13,500 | $4,500 |
| Grassed Waterways | 50,000 Feet | $3/Foot | $112,500 | $37,500 |
| **Total** | | | **$2,461,500** | **$832,500** |

A breakdown of estimated costs, including planning and technical assistance for a full time project coordinator is shown in Table 9. It is assumed that the Natural Resources Conservation Service, IDALS-DSC, and the Clayton SWCD will provide office space and materials, vehicles, equipment, and technical support. Watershed Improvement Review Board funding has been secured for calendar years 2010 through 2013. Wherever possible, the District will utilize alternate funding sources. The Iowa Financial Incentives Program (IFIP) and the Environmental Quality Incentives Program (EQIP) have traditionally been utilized in conjunction with watershed project sources to support terrace and animal waste management installations.

***Construction and checkout of a new grade stabilization structure.***

**Table 9: Technical and Financial Assistance Needs**

| Goal: Accelerate the adoption of conservation practices that will remove Silver Creek from Iowa's 303(d) list of impaired waters. | | | | | |
|---|---|---|---|---|---|
| **Objective:** Promote stream corridor and sinkhole protection along critical areas of the watershed, and install buffer practices to protect Silver Creek and its tributaries and reduce ammonia inputs. | | | | | |
| | **Estimated Cost** | **Potential Funding Sources** | **Phase 1** | **Phase 2** | **Phase 3** |
| Conservation Reserve Program Buffers | $48,000 | USDA | $12,000 | $24,000 | $12,000 |
| Pasture Management and/or Fencing | $18,000 | 319, WSPF, WIRB | $12,000 | $6,000 | |
| Streambank Protection | $80,000 | 319, WSPF, WIRB | $28,000 | $24,000 | $28,000 |
| Animal Waste Management Systems | $600,000 | 319, WSPF, EQIP | $100,000 | $200,000 | $300,000 |
| **Objective:** Target the installation of conservation practices that will reduce sediment delivery to the stream. | | | | | |
| Terraces | $2,260,000 | 319, WSPF, WIRB, IFIP, EQIP | $660,000 | $800,000 | $800,000 |
| Grade Stabilization Structures | $120,000 | 319, WSPF, WIRB | $40,000 | $40,000 | $40,000 |
| Water & Sediment Control Basins | $18,000 | 319, WSPF, WIRB | $6,000 | $6,000 | $6,000 |
| Grassed Waterways | $150,000 | USDA, 319, WSPF | $30,000 | $60,000 | $60,000 |
| **Objective:** Develop a series of news articles, newsletters, field days, and demonstrations that will increase public understanding of water quality issues and encourage greater involvement and participation in water quality programs. | | | | | |
| 1 FTE Coordinator | $1,646,765 | 319, WPF, WIRB | $511,765 | $545,000 | $590,000 |
| Travel, Training, Supplies, I&E | $32,000 | 319, WPF, WIRB | $12,000 | $10,000 | $10,000 |
| **Objective:** Evaluate progress in the watershed, and renew priorities for water quality improvement activities. | | | | | |
| Annually update the Watershed Management Plan | Staff Time | 319, WPF, WIRB | X | X | X |
| Annually Evaluate Progress and Financial Need, and Prepare Funding Proposals. | Staff Time | 319, WPF, WIRB | X | X | X |
| Water Quality and Biological Monitoring | To Be Determined | 319 | Plan Monitoring | Begin Monitoring | Continue Monitoring |
| TOTALS | $4,972,765 | | $1,411,765 | $1,715,000 | $1,846,000 |

## F. Information and Education

The experience of past and ongoing water quality initiatives has provided a basis for increased landowner participation in efforts to improve Silver Creek. The watershed was included in one of Iowa's initial water quality improvement projects, the Big Spring Demonstration Project. Big Spring provided one of the first project models for individual management assistance, on farm demonstrations, and intensive information marketing. Structural and management practices that resulted from the project remain evident in the 1,100 acre Bugenhagen sub-basin. In addition to reducing soil losses by an estimated 64%, the practices that were implemented in the sub-basin have provided an important example of improved management for neighboring landowners.

In 1991, the example of Big Spring was expanded to the Northeast Iowa River Basins Water Quality Demonstration Project. Thirteen Silver Creek farmers cooperated in the project's nutrient management assistance and on-farm nitrogen, manure, and tillage demonstration programs. A bimonthly "Water Watch" newsletter provided local information on water quality issues to Silver Creek residents throughout the tenure of the Big Spring and NEIA Demo. Projects (1988-1999).

The experience of the earlier projects has increased landowner familiarity with sustainable management, and has proved that most watershed farmers are willing to take action to address water quality concerns. A variety of information and education methods will be renewed in Silver Creek, including:

- On-farm Planning Visits: At least twenty on-farm planning visits will be conducted each year with watershed landowners and farm operators. The planning visits allow project staff to learn the needs of watershed landowners and farm operators, and respond to their personal conservation objectives.
- Project Newsletters: Newsletter articles will detail Silver Creek water quality issues, improvement objectives, and innovative conservation practices.
- News Articles: In conjunction with the newsletter series, news articles on watershed initiatives will be circulated in the *Monona Outlook*, the *Clayton County Register*, and the *Farm Bureau Spokesman*.
- Field Days: Annual No-Till field days organized in conjunction with Iowa State University Extension and the Fayette SWCD have been promoted through direct mailings to watershed residents. Follow-up newsletter articles allow the experience of the field days to be expanded to a larger audience.
- Project Photo Log: Landowners can easily identify the benefits of practices when they are associated with familiar locations on neighboring farms. A log of color photos of "before and after" practice installations will be maintained for use in other media.
- Targeted Direct Mailings: A flyer detailing Continuous CRP practices, photos of local buffer installations, and specific rental rates will be utilized to promote C-CRP practices. The Northeast Iowa pasture walk series schedule will also be directed to landowners that graze portions of Silver Creek.
- Public Meetings: The public meeting to discuss the results of the Stressor Identification study drew seventeen Silver Creek landowners. Following the meeting, three landowners that were unable to attend called District staff to review the information that was presented.

Highest priority information and education topics include no-till planting systems, buffer and riparian improvement practices, and pasture management. While there are a limited number of existing buffer practices within the watershed, several sites are in highly visible locations, and can serve as a basis for promotional efforts.

***A photographic log of a completed grassed waterway project. In this picture, severe storms had cut an uncrossable gully in a crop field immediately west of the stream.***

***A grassed waterway was surveyed, designed, and shaped.***

***The grassed waterway after the project was seeded. Eliminating the gully significantly reduced sediment delivery to the stream.***

## G. Measurable Milestones and Project Outcomes

The practices described in the Implementation Schedule and the inherent changes on the watershed landscape provide an important visible reference for measuring progress, especially among landowners. Goals for the type and amounts of practices are specified in each of the three phases, and provide a short term method for determining annual progress. As described in the Implementation Schedule, execution of water quality improvement efforts in the Silver Creek Watershed is centered on three measurable milestones:

1. **The length of Silver Creek and its tributaries protected by buffers.**

   Silver Creek was evaluated according to RASCAL in 2006. Data from the assessment was utilized to expand the database of available water quality information, and to prioritize specific reaches of the stream for improvement. The process has also created a benchmark of assessment data. Given an update of RASCAL data during the last year of each implementation phase, comparisons are attainable for riparian zone width, livestock access, and bank stability. As described in the implementation phases, interim milestones are based upon the progression of the length of Silver Creek and its tributaries that are free from livestock access and protected with buffer practices.

2. **The estimated annual reduction of sediment delivery to Silver Creek.**

   The GIS soil loss and sediment delivery model provides a useful tool for targeting water quality improvement activities. Load reductions achieved from the installed practices can be evaluated individually through the use of the "Sediment Delivery Calculator". By continually updating the GIS model, management impacts can also be measured. In this way, annual sediment delivery reductions in Silver Creek can be compared to baseline levels established in 2005, and to the load reductions identified in the TMDL. As described in the implementation phases, an annual milestone for Silver Creek is to reduce sediment delivery to the stream by at least 700 tons/year.

3. **The number of project landowners, farm operators, and residents that participate in project initiatives.**

   Promotional efforts can be ultimately judged by the number of landowners that participate in project activities, install practices on their farms, or talk to their neighbors. Having staff assigned to specific watersheds has allowed the District to seek out non-traditional participants. Through watershed projects, farm operators that did not traditionally participate in District programs have become regular cooperators, and have continued their involvement in conservation work beyond the tenure of their watershed projects. As described in the implementation phases, the initial milestone is to involve at least 20 landowners in project activities that result in the application of new practices each year.

## H. Load Reduction Evaluation

There is a record of impairments in Silver Creek. In 1998, aquatic life use was assessed as "partially supporting" based on a stream use assessment conducted in 1991. Another assessment conducted in 2000 confirmed that the biological community did not meet expectations, and the stream was added to the 2002 303(d) list of impaired waters. Silver Creek has since appeared on each subsequent 303(d) list.

Support of biological life is determined according to a calculation of biological metrics that reflect water quality and habitat integrity. Metrics are based on the numbers and types of biota and fish present, and are combined to create Fish Community Index of Biotic Integrity (FIBI) and Benthic Macroinvertebrate Index (BMIBI) scores. The indexes rank stream sampling reaches on a rising scale from 0 (minimum) to 100 (maximum). Table 10 indicates the general scoring guidelines for these metrics:

**Table 10: Guidelines for BMIBI and FIBI Scores**

| *Condition Rating* | *BMIBI Score Range* | *FIBI Score Range* |
|---|---|---|
| Poor | 0 – 30 | 0 – 25 |
| Fair | 31 – 55 | 26 – 50 |
| Good | 56 – 75 | 51 – 70 |
| Excellent | 76 - 100 | 71 - 100 |

Biological sampling from Iowa ecoregion reference streams has been utilized to compare and categorize BMIBI and FIBI scores. The scores for reference streams are considered a minimum. Below these values, a stream is considered to either "partially" or "not support" its designated uses. Based on available sampling data, BMIBI and FIBI scores are below the Ecoregion 52(b) Driftless Area (Paleozoic Plateau) impairment conditions, and provide evidence that the biological impairment is consistent over time. Scores for Silver Creek from 2000 and 2005 samples are compared to the Ecoregion reference scores in Table 11:

**Table 11: BMIBI and FIBI Scores for Silver Creek versus Reference Sites**

| *Silver Creek Site* | *Year Sampled* | *Silver Creek BMIBI Score* | *Ecoregion Reference BMIBI Score* | *Silver Creek FIBI Score* | *Ecoregion Reference FIBI Score* |
|---|---|---|---|---|---|
| Site 1A | 2000 | 46 | 61 | 41 | 52 |
| Site 2A | 2005 | 26 | 61 | 19 | 52 |
| Site 2E | 2005 | 41 | 61 | 30 | 52 |

While these indicators have caused Silver Creek to be included on the impaired waters list, they potentially serve as a measure of the ultimate success of the project. BMIBI and FIBI scores will be determined during the final year of each implementation phase (2012, 2017, and 2022). This process will allow improvements in the biological community to be documented. If improvement is lacking, the watershed management plan will be evaluated and modified prior to the execution of the subsequent implementation phase.

The Silver Creek Watershed represents an initiative to demonstrate how landowners and farm operators can work together to create water quality improvements. Successful completion of the activities described in each implementation phase will result in noticeable and measureable improvement in the water quality of Silver Creek. While progress is totally dependent on the voluntary actions of landowners, farm operators, and watershed residents, an improvement in BMIBI and FIBI scores will provide a measure of the ultimate success of the project, and will determine if Silver Creek should be removed from Iowa's list of impaired waters.

## I. Monitoring

Since “Aquatic Life” is the identified impairment for Silver Creek, water quality monitoring will be necessary to document the improvement in the biological community that results from efforts to protect the stream. A proposed monitoring plan for Silver Creek includes four components as shown in Table 12:

**Table 12: An Idealized Monitoring Plan for Silver Creek**

| MONITORING COMPONENTS |
|---|
| **A. Water Chemistry Sampling**<br><br>Sample Frequency: Bi-Weekly from March to October; Monthly from November to February<br><br><u>Parameters</u><br>All common parameters listed in Appendix A of the Iowa Water Monitoring Plan 2000. |
| **B. Benthic Macroinvertebrate and Fish Sampling**<br><br>Sample Frequency: Every five years at the conclusion of each implementation phase.<br><br><u>Parameters</u><br>Benthic Macroinvertebrate and Fish Sampling should be completed to evaluate species susceptible to ammonia toxicity and low dissolved oxygen, and to track improvement. |
| **C. Habitat Sampling**<br><br>Sampling Frequency: Every five years at the conclusion of each implementation phase.<br><br><u>Parameters</u><br>Habitat sampling should be completed concurrently with the biological sampling according to IDNR protocols. The sampling is intended to track habitat conditions that indicate and contribute to the impairment (sedimentation and substrate embeddedness), and improvements that occur. |
| **D. Dissolved Oxygen and Temperature Sampling**<br><br>Sampling Frequency: Continuously from June to October<br><br><u>Parameters</u><br>Deployment of dissolved oxygen auto samplers according to UHL protocols. |

The RASCAL assessment and Stressor Identification process has already greatly expanded the database of information available for the stream and its watershed. In effect, the RASCAL and SI data will serve as the baseline monitoring information for Silver Creek. The additional monitoring activities proposed for Silver Creek build upon that work, and move efforts toward the completion of a series of objectives:

- To establish baseline stream data for the comparison of historical trends.
- To evaluate the effectiveness of ongoing efforts to improve water quality.
- To document the status of the stream in order to track progress toward the reductions identified in the TMDL.

- To document improvements in the biological community (as evidenced by FIBI and BMIBI scores) that could potentially lead to de-listing of Silver Creek.

Given the proposed volume of improvements that must be completed in the watershed, the next question that arises is the point at which the monitoring activities should be continued. The draft implementation schedule describes preparation of a Quality Assurance Project Plan for Water Monitoring during the first implementation phase. Monitoring would be continued during the second implementation phase, following achievement of the measurable milestones that serve as a reference of landowner "buy-in" to the watershed management action plan. Unless these initial milestones are achieved, it is doubtful that measureable impacts will be witnessed through the water quality monitoring activities:

- Removal of cattle from the stream and its tributaries.
- Greater than 40% of the stream channel has a riparian zone width of more than 60 feet, as compared to that documented during the 2006 RASCAL assessment.
- Sediment delivery to Silver Creek has been reduced by at least 4,000 tons/year.

## J. Progress During Implementation Phase 1

Grant development for the Silver Creek Watershed Project began in 2005 as an initiative of the Clayton Soil & Water Conservation District. The effort was supported, in part, by a Project Development Grant from the Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation (IDALS-DSC).

On April 14, 2006, the original "Silver Creek Watershed Project" proposal was submitted for consideration under the joint DNR/IDALS-DSC FY2006 Water Quality Project Grant Application. On June 30, 2006, the District received notice that the project was selected for Section 319, Water Protection Fund (WPF) and Watershed Protection Fund (WSPF) support. DNR included the project in its FY2006 Section 319 application to EPA.

Landowners have demonstrated considerable interest in conservation improvements during the tenure of the Silver Creek Watershed Project. The first practices approved for cost share assistance were completed immediately after the initiation of the project in the spring of 2007. A wide variety of practices have been installed in the last three and one half years.

At times, progress has been limited by adverse weather conditions and the short timeframe available for construction in northeast Iowa. Construction of most conservation practices is limited to the month of April just prior to planting in the spring, and approximately 6 weeks in the fall following harvest, but before soils freeze.

Based on the initial actions of landowners, on March 25, 2009, the District submitted a proposal for a project time extension according to the Category 1 guidance circulated by DNR and DSC. On June 22, 2009, the District received notice that the time extension was approved, and would be included as part of the FY2009 work plan submitted to EPA. A Contract Amendment was approved by the Environmental Protection Commission on March 16, 2010, which moves the duration of the Silver Creek Watershed Project to June 30, 2013.

In Table 13, the practices completed in the watershed are compared to the goals established for the first implementation phase of the project.

**Table 13: Practices Installed Compared to Implementation Phase Goals**

| Conservation Practice | Implementation Phase 1 Goal 2007 - 2012 | Total Complete January 1, 2007 to June 30, 2010 |
|---|---|---|
| Continuous CRP | 60 Acres | 31.5 Acres |
| Resource Protection Fencing | 3,000 Feet | |
| Pasture Management/Planting | 100 Acres | 60 Acres |
| Streambank Protection | 700 Feet | 450 Feet |
| Animal Waste Management Systems | 1 System | |
| Terraces | 165,000 Feet | 108,920 Feet |
| Grade Stabilization Structures | 2 Structures | 2 Structures |
| Water & Sediment Control Basins | 2 Basins | |
| Grassed Waterways | 10,000 Feet | 6,650 Feet |

An evaluation of progress for each of the objectives set forth during the development of the Silver Creek Watershed Project follows:

***Objective 1: Promote stream corridor and sinkhole protection along critical areas of the watershed, and install buffer practices to protect Silver Creek and its tributaries and reduce ammonia inputs.***

Landowners have begun the process of protecting critical areas of the stream. New filter strips have buffered approximately 1,460' of the main channel of Silver Creek, and 10,735' of its tributaries. Cattle have been removed from 4,900' of the main stream channel.

***Objective 2: Target the accelerated installation of conservation practices that will reduce sediment delivery to the stream.***

Based on estimates determined by the use of the "Sediment Delivery Calculator", the practices installed since FFY 2007 have reduced sediment delivery from sheet, rill, gully, and streambank erosion sources by 4,471 tons.

***Objective 3: Develop a series of news articles, newsletters, field days, and demonstrations that will increase public understanding of water quality issues and encourage involvement and participation in water quality programs.***

The project has attempted a variety of information and education methods. Most have proven successful when targeted to specific issues and audiences.

***Objective 4: Evaluate progress in the watershed, and renew priorities for water quality improvement activities.***

The interest demonstrated by Silver Creek landowners and farm operators has been outstanding. Continued support will build upon the initial success of the project, will accelerate the voluntary efforts of Silver Creek landowners and farm operators, and will move the project toward completion of its objectives.