Watkins Creek Watershed Management Plan

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Revised Date:
September 24, 2012

Version Number: 2

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Acknowledgements

We would like to thank the following for their time and contributions in making this project possible and for participating in the writing, review and editing of the watershed management plan.

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The Confluence Partnership
East West Gateway Council of Governments

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Janet Wilding – Great Rivers Greenway District
Greg Poleski – Greenway Network, Inc.

This project has been funded by the US EPA Region 7 through the Missouri Department of Natural Resources under Section 319 of the Clean Water Act.

EXECUTIVE SUMMARY

The Watershed:

The Watkins Creek Watershed is located in northwestern St. Louis County in a suburban area of mixed residential, commercial, and light industrial land use. The creek is a tributary of the Mississippi River arising some 5.7 miles west of its confluence and covers approximately 4300 acres. As of the census of 2000, there were 21,337 people, 8,381 households, and 5,673 families residing in the watershed. The population density was 2,900.4 people per square mile. There were 8,852 housing units at an average density of 1,203.3/sq mi. Between 2000 and 2010 the area saw an estimated decrease in population of 19%.

From the 1950's to the 1970's, the watershed experienced rapid urbanization when few storm water management practices were in place. The changes in hydrology accompanying urbanization provoked systemic bank erosion and mass wasting observed throughout the Watkins Creek Watershed. Streams in the watershed are now severely degraded and in a condition of physical instability, and severe erosion continues to threaten infrastructure and property. The creek ultimately was placed on the DNR 303d list of impaired streams, having chronically unacceptable levels of both chloride and *E. coli* pollutants.

Past Studies:

Two previous studies have been conducted of the watershed. They are:

> *Watkins Creek Watershed Study—RegionWise 2006:* This report contains information on channel stability problems as well as the implementation of Water Quality Monitoring by Stream Team 3553.
>
> *Watershed Planning; a Scientific Methodology and Ramifications for Personal Property Rights The Watkins Creek Watershed Study – Andrew Lawrence Francis Struckhoff 2005:* This report was a capstone project completed by a student at St. Louis University on stream bank instability and the surrounding community.

The 2006 collaborative effort by St. Louis University's RegionWise program in conjunction with Hazelwood Schools, Intuition and Logic, and the Spanish Lake Community Association focused on Watkins Creek as an area of concern with the effort concentrated on physical stability, identification of existing problem areas affecting water quality, and organizing a partnership and planning committee. Unfortunately, due to the reorganization and redirection of the RegionWise program furtherance of any Watkins Creek planning effort languished. The Confluence Project and Greenway Network were contacted if the work could continue on Watkins Creek. After much discussion, an application for 319 grant funding was submitted in 2010 by Greenway Network, Inc., a 501-c-3 nonprofit and partner in the Confluence Project. The grant was awarded in June 2011 and an agreement signed in July 2011.

Building a New Partnership:

The majority of organizations and individuals that had formed the advisory committee for the Phase I

study agreed to continue the work on the Watkins Creek Watershed Management Plan. New members that had previous experience, interest in the watershed, and those who live in the watershed were also asked to serve on the Advisory Committee. The watershed management plan development is being lead by a "partnership" of four organizations: Greenway Network, Inc., The Confluence Partnership, East West Gateway Council of Governments (EWGCC), and the Metropolitan St. Louis Sewer District (MSD).

Identifying Impairments:

Watkins Creek has been placed on the 2011 proposed list as impaired for E. Coli and chloride with sources shown as unknown. The impaired area of Watkins Creek as identified by MDNR's TMDL report begins just as it crosses under Interstate 270 heading north till the mouth. However, testing throughout the watershed indicates the presence of excessive levels of E. Coli and high to excessive levels of chloride in all reaches of the stream and its tributaries.

Non-point stressors include pet and other animal waste, septic systems, and other sources from runoff. Point stressors include sewer system overflows and illicit discharges although MSD has found no evidence of these discharges to date.

Load Reduction and Management Measures:

Based on previous studies, reports, and citizen concerns expressed on the Watkins Creek watershed, there are a number of concerns and issues related to the physical and visual quality of the creek and its surrounding watershed. However, the purpose and focus of this management plan is to address the two impairments, E. Coli and chloride, which have lead to the stream being identified as an "impaired" waterway.

The long range goals for target pollutant loads, level, or value are listed below. The target loads are based upon the review of water quality data discussed in Chapter 2. Reduction in the E. Coli and chloride may prove to be incremental and take a number of years based on the methods used to correct the problems.

Impairment	Present Load (Chapter 2)	Target Level
E. Coli	3959.60	Not to exceed State of Missouri standard for whole body contact (mean of 206 cfu/dL) for a Class B stream during recreational season.
Chloride	942.02	Not to exceed one severe toxic occurrence (230 milligrams/liter) in 3 years during periods of steady, low flow conditions. No more than one occurrence in three years of the 860 mg/L chloride acute criterion under any flow conditions.

By comparing the water quality data collected since 2008 to the above Target Level criteria, it was found that the target level was exceeded numerous times for both E. Coli and chloride throughout the entire watershed. This information is very important in light of the fact that E. Coli testing only occurred in the months between April and October. This corresponds to, what most would consider, the recreational season.

Using the *Spreadsheet Tool for Estimating Pollutant Load (STEPL)* modeling system various Best Management Practices (BMPs) could be tested for their efficacy in reducing pollutant levels. The modeling indicated that the implementation of as few as five structural BMPs capturing storm water from just 25% of the watershed could reduce nutrient levels by more than 50% and sediment over 95%. With the addition of other Best Management Practices such as street sweeping, improved salt management programs, and public education further reductions can be achieved.

Priorities and Implementation:

Priorities related to implementing proposed BMPs were based on immediacy of impact, time needed to implement measures, and costs. Basically, those measures which resulted in the greatest reduction in pollutant levels in the shortest period of time, could be constructed or implemented quickly, and had lower costs would be at the top of the priority list. Using these criteria a matrix was developed listing the proposed measures, immediacy of impact, time to implementation, and relative costs. Implementation, time, and costs could be scored. Using the cumulative score for each measure priorities could then be established.

Management measures that were scored as having the highest priority included:

- Survey the watershed for septic systems and assist property owners in eliminating the systems and connecting to the sanitary system.
- Remediate the former highway maintenance salt storage site to reduce chloride infiltration.
- Assist property owners to construct bioretention systems in commercial, industrial, and institutional areas to capture and filter storm water runoff.
- Assist subdivisions in converting retention and dry detention areas to wetland detention basins.
- Assist property owners in installing or managing vegetated filter strips adjacent to streams.
- Develop and enforce pet waste management program and educate the public about its importance.

Implementation involves a consideration of economics and environmental impact. In order to obtain and maintain the widest level of support in the community for the proposed management measures they must not place an undue burden on the individual property owner or government agencies. Therefore, many of the structural and some of the non-structural measures will need to be supported, at least in the beginning, with financial incentives to cover a portion of the development costs. However, it should be understood that not all the costs can be offset by other support. Government agencies, the business community, and individual property owners will need to share some portion of the costs of implementing this plan. How much is dependent on the level of grant funding and other support.

The environmental impact of implementing the proposed management measures can only be positive. Each of the proposed management measures is intended to reduce the pollutant levels in Watkins Creek. Over time this should result in the stream being removed from the TMDL list.

While this plan is based on the concept that action should be taken to reduce the levels of E. Coli, chloride, and other pollutants in Watkins Creek, the community has the option of electing to take no action in regards to minimizing these pollutants. The likely result of a “Do Nothing” option will be for the levels of E. Coli and chloride to remain at the same relative levels as have been measured since

2008. This will result in Watkins Creek continuing to be listed as an impaired water way and on the TMDL list. With this listing the community and the state will continue to be in violation of Federal regulations.

Technical and Financial Assistance:

Sources of technical and financial resources were identified and listed as part of the study. There are limitations of trying to identify long-term funds sources due to the vagaries of the economy, government budgets, and other funding sources. Table 5-1 in Chapter 5 describes the suggested order of implementation of management measures, the time requirements for implementing the plan, the unit cost based on available information, estimated development cost, as well as a listing of technical and financial resources for each management measure.

The list of resources included:

Metropolitan St. Louis Sewer District

Metropolitan St. Louis Sewer District (MSD) provides various creek monitoring activities and data, planning leadership, engineering technical expertise, and appropriate educational programs. In addition, MSD provides leadership on implementation of NPDES strategies in the watershed.

Missouri Botanical Garden

The Missouri Botanical Garden (MBG) can provide technical expertise in the design of certain structural BMPs as well as selection of appropriate plant materials to be used.

Soil and Water Conservation District

The St. Louis Soil and Water Conservation District (SWCD) can provide technical assistance to help plan and apply the identified management measures. They can be used to consult with property owners regarding issues related to implementation of the watershed plan as well as provide assistance in relation to the educational programs. Finally, the SWCD is a resource for identifying potential sources of funding.

Greenway Network

Greenway Network (GN) is a regional conservation non-profit whose mission is, in part, to conserve natural resources and encourage sound management of the watersheds. Greenway provides technical assistance through its network of environmental education, water quality monitoring, and conservation planning volunteers. As a 501-c-3 non-profit Greenway can also act as a conduit for funding for some grants that cannot otherwise be obtained.

Missouri Stream Team

Missouri Stream Team is a working partnership of citizens who are concerned about Missouri Streams. Trained volunteer(s) from Stream Team 3553 have been an integral part of the watershed planning

process to date, providing water quality monitoring at no cost to the project. Additionally, Stream Team members can provide assistance in education, stewardship (such as clean ups and tree plantings), and advocacy for policy and ordinance support or changes.

East West Gateway Council of Governments

East West Gateway (EWGCC) is the metropolitan planning organization (MPO) for the area. EWGCC is involved in many planning projects throughout the region. EWGCC can provide technical expertise in planning related to the project, mapping services, and acts as a resource for identifying funding sources.

Spanish Lake Community Association

The Spanish Lake Community Association (SLCA) is a community non-profit organization formed to inform, motivate and organize the residents of Spanish Lake on issues that affect the quality of life in their unincorporated community. The SLCA can act as the overall umbrella organization for implementation of the watershed management plan.

Missouri Department of Natural Resources

The Missouri Department of Natural Resources (MDNR) provides technical expertise to assist in watershed planning and implementation efforts. MDNR is also a source of funding for implementation through the Department from the US EPA Region 7 under Section 319 of the Clean Water Act.

Missouri Department of Transportation

The Missouri Department of Transportation (MoDOT) is the main source of funding for transportation related projects within any highway right-of-way controlled by the department. Limited technical assistance may be available for implementation of management measures on or adjacent to these right-of-ways.

Municipalities and St. Louis County Government

The municipalities (Muni's) located in the watershed (Black Jack, Bellefontaine Neighbors) and St. Louis County government (St LC) can provide outreach, education, and administrative services related to the management measures. Some capital improvement funding and commitments for maintenance will be requested.

Other Funding and Assistance Source:

The following is a list of other potential sources of funding and assistance for the implementation of the watershed management plan and the proposed management measures.

Alternative Loan Program
Grow Native! Program

Missouri Wildlife Habitat Incentives Program (WHIP)
Missouri's Aquaculture Program
North Central Region(NCR)-SARE Professional Development Program Grant
North Central Region(NCR)-SARE Research and Education Grant Program
Conservation Contractor Training
Missouri Agroforestry Program
Missouri Watershed Management Assistance (MoWMA)
Missouri's Forest Keepers Network
Outdoor Classroom Grant, Missouri
United Sportsmen's League Wildlife Conservation Grant, Missouri
Community Development Block Grant (CDBG) Other Public Needs, Missouri
Community Development Block Grant Program (CDBG) Water and Wastewater, Missouri
Delta Regional Authority
Industrial Infrastructure Grant
Energy Revolving Fund
Land and Water Conservation Fund (LWCF) - Missouri
Living Lands and Waters-Educational Workshops
Missouri Brownfields Revolving Loan Fund
Missouri Energy Efficiency and Renewable Energy Set-Aside Program
Recreational Trails Program (RTP) - Missouri
Watershed Management Development Grant
Adopt-A-Highway Program, Missouri
Request An Expert Program
Scenic Byways Program
Transportation Enhancement Program, Missouri
Tools for Floodplain Management
Abandoned Well Plugging Program
Plant Diagnostic Clinic
University of Missouri Center for Agroforestry
Missouri Alternatives Center
Region 7 Pollution Prevention Regional Information Center

Long-term Monitoring and Maintenance

During the first five years of the implementation of the watershed management plan it is anticipated that the monitoring of the development and success of the management measures will be a shared responsibility and collaborative effort between various agencies and organizations involved in the implementation process. Once a significant portion of the implementation is completed (Year 5) it is expected that the municipalities and St. Louis County will assume responsibility for most monitoring and maintenance except for those functions now held by other agencies such as MSD.

Public Information and Education:

The Watkins Creek watershed holds many opportunities for education on an urban stream. Education outlets include outreach through schools, youth organizations, and local community associations, building awareness through media and signage, encouraging participation in Stream Team activities,

and reaching out to partners for further informational and educational opportunities. Partner involvement will play a key role.

The public information and education program will include the following steps:

- Finalize the I/E goals and objectives
- Target the audience for the I/E message – residents, businesses, schools
- Create individualized message for the audience
- Package and distribute the message
- Evaluate the results

Milestones, Schedule, and Performance:

Development of the plan milestones, schedules, and performance measurement were based on the following goals:

- Install new structural BMPs to capture and filter storm water from 25% of the watershed.

- Reduce E. Coli pollution load from septic systems and sanitary sewer overflows by 75%

- Reduce Chloride pollution load 60% by remediation of former salt storage facility.

- Reduce E. Coli pollution load 10% by improving monitoring and maintenance from non-point sources.

- Reduce Chloride pollution load 30% by monitoring and minimizing usage and loss of salts in winter time and/or during storage.

- Reduce pollution 25% by implementation of appropriate education programs

The projected schedule is for all goals and objectives to be completed by the end of year 5 of the project. The exception is the installation of the porous pavement BMPs which are projected to be completed by the end of year 10 of the project.

Monitoring:

Monitoring methods will be designed to measure progress in meeting load reduction goals and attaining water quality standards. Monitoring objectives will provide the information necessary to determine progress in meeting set milestones. Measurable progress is critical to ensuring continued support of watershed projects and/or the need to modify objectives to reach the stated goals.

Because of natural variability, some progress may not be linear and should be measured as trends toward the goals of lowering E. Coli and chloride to target levels. Therefore, results of some monitoring methods, such as water quality data, must be analyzed over time to identify trends. Other measurements, based on tangible objectives, such as construction of BMPs, can be measured in incremental time periods.

The methods for measurement will based on the goals, objectives, and tasks identified in the milestones and schedule.

CHAPTER 1: INTRODUCTION

Project Overview:

Watkins Creek Watershed is located in northeastern St. Louis County in a suburban area of mixed residential, commercial, and light industrial land use. The creek is a tributary of the Mississippi River arising some 5.7 miles west of its confluence with the Mississippi in a residential neighborhood. The watershed is somewhat degraded with its riparian buffer removed in the upper reaches and shows signs of stream incision in the lower reaches. However the lower reaches include riparian buffer including several areas of extensive wooded slopes. These riparian buffers provide habitat for a variety of wildlife including deer, turkey, raccoons, and others.

From the 1950's to the 1970's, the watershed experienced rapid urbanization when few storm water management practices were in place. The changes in hydrology accompanying urbanization provoked systemic bank erosion and mass wasting observed throughout the Watkins Creek Watershed. Streams in the watershed are now severely degraded and in a condition of physical instability, and severe erosion continues to threaten infrastructure and property. The creek ultimately was placed on the DNR 303d list of impaired streams, having chronically unacceptable levels of both chloride and *E. coli* pollutants. With the framework put in place by RegionWise, it became possible to use a citizen task force to identify possible sources of the pollution as a step toward improving the quality of the creek. Our goal is to identify potential nonpoint source pollution locations, continue testing and monitoring the quality of water, and create more citizen awareness of Watkins Creek.

In 2006, a collaborative effort by St. Louis University's RegionWise program in conjunction with Hazelwood Schools, Intuition and Logic, and the Spanish Lake Community Association was made focusing on Watkins Creek as an area of concern. The effort concentrated on physical stability, identification of existing problem areas affecting water quality, and organizing a partnership and planning committee. After concluding Watkins Creek Citizen Watershed Planning—Phase I, the project pieced together a framework for further use in the development of a Watershed Management Plan.

Unfortunately, due to reorganization and redirection of the RegionWise program furtherance of any Watkins Creek planning effort languished. The Confluence Project was contacted by Brenda Bobo-Fisher, former Phase I project manager, to see if The Confluence Project would continue the work on Watkins Creek. After much discussion, an application for 319 grant funding was submitted in 2010 by Greenway Network, Inc., a 501-c-3 nonprofit and partner in the Confluence Project. The grant was awarded in June 2011 and an agreement signed in July 2011.

Building the Partnerships:

Public outreach meetings were essential in the planning process. Meetings were conducted with community groups, such as the Spanish Lake Community Association, informing residents of the goals of the committee as well as educating them on Watkins Creek. Additionally, residents were invited to participate in regular water quality monitoring of Watkins Creek as well as other events. In the previous RegionWise lead project, the Metropolitan Sewer District working with the Hazelwood

School District was able to educate students on storm water issues as well as bring light to the current physical condition of Watkins Creek. With the Watershed Management Plan project MSD has focused more on extending the educational component to the general public through public meetings and other events as well as distribution of brochures and pamphlets regarding non-point source pollution of the stream.

Information related to the management plan project was disseminated through press releases and articles on websites of the organizations participating in the project. Four public meetings were held to provide residents, business owners, and other interested parties an opportunity to review and comment on the progress and direction of the project. One appearance on a local cable channel community service program was also used as an opportunity to share information about the watershed and the project's goals. Two stream clean ups were held during the project period and information was distributed at each. Surveys and questionnaires related to the watershed management plan and its goals were distributed at meetings and available on the organizations' websites.

Citizen watershed concerns that were communicated through participation in the public meetings and surveys can be categorized as follows:

- Establish Best Management Practices in impaired stream area in the Spanish Lake community
- Need for more Citizen Involvement in Watershed Studies
- Yard waste and trash and dumping tend to be a large problem along Watkins Creek.
- Identify the sources of *E. Coli.* Septic Tanks that have been abandoned or have not received proper care remain in a portion of Spanish Lake.
- Over use of salt being applied to Highway 270 runs off into Watkins Creek during the winter months. Some participants speculate there is contaminated soil where a salt pile once was located.
- Need for further education and public awareness outreach

The majority of organizations and individuals that had formed the advisory committee for the Phase I study agreed to continue the work on the Watkins Creek Watershed Management Plan. New members that had previous experience, interest in the watershed, and those who live in the watershed were also asked to serve on the Advisory Committee. (See Acknowledgements for a complete list of committee members.)

The watershed management plan development is being lead by a "partnership" of four organizations: Greenway Network, Inc., The Confluence Partnership, East West Gateway Council of Governments (EWGCC), and the Metropolitan St. Louis Sewer District (MSD). (For more information on the organizations and their role in the project see Appendix 1) The actual responsibility for leading and developing the management plan lies with the following individuals:

Ralph Rollins, Greenway Network, Project Manager – Responsible for overall management of the Watkins Creek Watershed Management Plan project including scheduling, advisory committee coordination, public contact, writing of plan, and supervision of personnel.

Laura Cohen, Confluence Project Director – Responsible for overall management of all Confluence Project related activities. Cohen has primary responsibility for the Watkins Creek Watershed Management Plan integration into the Confluence Project Master Plan.

Natalie Johnson, Field Coordinator – Responsible for coordination of watershed assessment and water quality monitoring as well as liaison with Stream Team 3553 which is actually conducting the stream monitoring efforts. She also attended public and advisory committee meetings and provided other assistance as needed.

Describing the Watershed:

Physical and Natural Features –

Location: The Watkins Creek watershed lies in the northwestern corner of St. Louis County on the eastern border of Missouri. It is a tributary of the Mississippi River several miles south of the Mississippi's confluence with the Missouri River. It is a small sub-watershed of 4,300 acres and is approximately 5.7 miles long.

Natural History: According to data from the Missouri Resource Assessment Partnership (MoRAP) (obtained from http://www.cares. missouri.edu/), land cover for the area of Watkins Creek Watershed inventoried from 2000-2004, comprised primarily low density urban developments. Small areas of deciduous forest, associated with parks and stream corridors, are scattered within the watershed. (Appendix 2) Limited areas of cropland and grassland are located within the watershed in the floodplain of the Mississippi River.

Historically, the area of Watkins Creek Watershed was glaciated and, as the glaciers retreated, would likely have been comprised of a mix of climax oak/hickory forest, tall grass prairie, perennial and intermittent stream corridors, and bottomland and wetland communities.

Endangered Species –

No specific studies of endangered species in the watershed has been conducted. However, The following list, obtained from the Missouri Department of Conservation - Natural Heritage Program *(http://mdc.mo.gov/landwater-care/heritage-program)*, identifies species of conservation concern in St. Louis County.

See chart beginning on next page.

Name	State Rank	Global Rank	State Status	Federal Status
A Blue Mud Dauber *Chalybion zimmermanni zimmermanni*	Unrankable Code: SU	Not Ranked Taxonomic Subdivision: Not Ranked Code: GNRTNR		
A Broomrape *Orobanche ludoviciana*	Critically Imperiled Code: S1	Secure Code: G5		
A Marsh Elder *Cyclachaena xanthifolia*	Critically Imperiled Code: S1	Secure Code: G5		
Alabama Shad *Alosa alabamae*	Imperiled Code: S2	Vulnerable Code: G3		
American Badger *Taxidea taxus*	Unrankable Code: SU	Secure Code: G5		
American Bittern *Botaurus lentiginosus*	Critically Imperiled Code: S1	Apparently Secure Code: G4	Endangered Code: E	
Bald Eagle *Haliaeetus leucocephalus*	Vulnerable Code: S3	Secure Code: G5		
Belted Crayfish *Orconectes harrisonii*	Vulnerable Code: S3	Vulnerable Code: G3		
Bergia *Bergia texana*	Imperiled Code: S2	Secure Code: G5		
Black Sandshell *Ligumia recta*	Imperiled Code: S2	Secure Code: G5		
Crystal Darter *Crystallaria asprella*	Critically Imperiled Code: S1	Vulnerable Code: G3	Endangered Code: E	
Decurrent False Aster *Boltonia decurrens*	Critically Imperiled Code: S1	Imperiled Code: G2	Endangered Code: E	Threatened Code: T
Dwarf Burhead *Echinodorus tenellus var. parvulus*	Critically Imperiled Code: S1	Vulnerable Taxonomic Subdivision: Vulnerable Code: G3T3		
Eastern Hellbender *Cryptobranchus alleganiensis alleganiens*	Critically Imperiled Code: S1	Vulnerable Apparently Secure Taxonomic Subdivision: Vulnerable Code: G3G4T3	Endangered Code: E	
Ebonyshell *Fusconaia ebena*	Critically Imperiled Code: S1	Apparently Secure Secure Code: G4G5	Endangered Code: E	
Elephantear *Elliptio crassidens*	Critically Imperiled Code: S1	Secure Code: G5	Endangered Code: E	
Elktoe *Alasmidonta marginata*	Imperiled Code: S2	Apparently Secure Code: G4		
Enigmatic Cavesnail *Fontigens antroecetes*	Imperiled Code: S2	Imperiled Code: G2		
Flathead Chub *Platygobio gracilis*	Critically Imperiled Code: S1	Secure Code: G5	Endangered Code: E	
Ghost Shiner *Notropis buchanani*	Imperiled Code: S2	Secure Code: G5		
Gray Bat *Myotis grisescens*	Vulnerable Code: S3	Vulnerable Code: G3	Endangered Code: E	Endangered Code: E
Hickorynut *Obovaria olivaria*	Vulnerable Code: S3	Apparently Secure Code: G4		

Name	State Rank	Global Rank	State Status	Federal Status
Highfin Carpsucker *Carpiodes velifer*	Imperiled Code: S2	Apparently Secure Secure Code: G4G5		
Indiana Bat *Myotis sodalis*	Critically Imperiled Code: S1	Imperiled Code: G2	Endangered Code: E	Endangered Code: E
Lake Sturgeon *Acipenser fulvescens*	Critically Imperiled Code: S1	Vulnerable Apparently Secure Code: G3G4	Endangered Code: E	
Large Seeded Mercury *Acalypha deamii*	Critically Imperiled Code: S1	Apparently Secure Inexact Numeric Rank Code: G4?		
Midland Clubtail *Gomphus fraternus*	Unrankable Code: SU	Secure Code: G5		
Mississippi Kite *Ictinia mississippiensis*	Vulnerable Code: S3	Secure Code: G5		
Mississippi Silvery Minnow *Hybognathus nuchalis*	Vulnerable Apparently secure Code: S3S4	Secure Code: G5		
Mooneye *Hiodon tergisus*	Vulnerable Code: S3	Secure Code: G5		
Pale Avens *Geum virginianum*	Critically Imperiled Code: S1	Secure Code: G5		
Pallid Sturgeon *Scaphirhynchus albus*	Critically Imperiled Code: S1	Imperiled Code: G2	Endangered Code: E	Endangered Code: E
Peregrine Falcon *Falco peregrinus*	Critically Imperiled Code: S1	Apparently Secure Code: G4	Endangered Code: E	
Pink Mucket *Lampsilis abrupta*	Imperiled Code: S2	Imperiled Code: G2	Endangered Code: E	Endangered Code: E
Plains Minnow *Hybognathus placitus*	Imperiled Code: S2	Apparently Secure Code: G4		
Ringed Salamander *Ambystoma annulatum*	Vulnerable Code: S3	Apparently Secure Code: G4		
River Darter *Percina shumardi*	Vulnerable Code: S3	Secure Code: G5		
Rock Pocketbook *Arcidens confragosus*	Vulnerable Code: S3	Apparently Secure Code: G4		
Running Buffalo Clover *Trifolium stoloniferum*	Critically Imperiled Code: S1	Vulnerable Code: G3	Endangered Code: E	Endangered Code: E
Salamander Mussel *Simpsonaias ambigua*	Critically Imperiled Code: S1	Vulnerable Code: G3		
Saltmarsh Aster *Symphyotrichum subulatum var. ligulatum*	Imperiled Code: S2	Secure Code: G5		
Scaleshell *Leptodea leptodon*	Critically Imperiled Code: S1	Critically Imperiled Imperiled Code: G1G2	Endangered Code: E	Endangered Code: E
Sheepnose *Plethobasus cyphyus*	Imperiled Code: S2	Vulnerable Code: G3	Endangered Code: E	Candidate Code: C
Short-tailed Groundwater Amphipod *Bactrurus brachycaudus*	Apparently secure Code: S4	Apparently Secure Code: G4		
Sicklefin Chub *Macrhybopsis meeki*	Vulnerable Code: S3	Vulnerable Code: G3		
Silver Chub *Macrhybopsis storeriana*	Vulnerable Code: S3	Secure Code: G5		

Name	State Rank	Global Rank	State Status	Federal Status
Slender Paspalum *Paspalum setaceum var. setaceum*	Critically Imperiled Code: S1	Secure Taxonomic Subdivision: Secure Code: G5T5		
Slender Pondweed *Potamogeton pusillus var. pusillus*	Critically Imperiled Code: S1	Secure Taxonomic Subdivision: Secure Code: G5T5		
Small Pocket Moss *Fissidens exilis*	Unrankable Code: SU	Vulnerable Apparently Secure Code: G3G4		
Snuffbox *Epioblasma triquetra*	Critically Imperiled Code: S1	Vulnerable Code: G3	Endangered Code: E	
Spectaclecase *Cumberlandia monodonta*	Vulnerable Code: S3	Vulnerable Code: G3		Candidate Code: C
Sturgeon Chub *Macrhybopsis gelida*	Vulnerable Code: S3	Vulnerable Code: G3		
Stygian Cave Isopod *Caecidotea stygia*	Critically Imperiled Code: S1	Secure Code: G5		
Sullivantia *Sullivantia sullivantii*	Imperiled Code: S2	Apparently Secure Code: G4		
Swamp Metalmark *Calephelis muticum*	Vulnerable Code: S3	Vulnerable Code: G3		
Tingupa Cave Millipede *Tingupa pallida*	Apparently secure Code: S4	Apparently Secure Code: G4		
Wartyback *Quadrula nodulata*	Vulnerable Code: S3	Apparently Secure Code: G4		
Western Sand Darter *Ammocrypta clara*	Imperiled Vulnerable Code: S2S3	Vulnerable Code: G3		
Western Silvery Minnow *Hybognathus argyritis*	Imperiled Code: S2	Apparently Secure Code: G4		
Wood Frog *Lithobates sylvaticus*	Vulnerable Code: S3	Secure Code: G5		

The following list, obtained from the U.S. Fish and Wildlife Service – Endangered Species Program *(http://www.fws.gov/endangered/)* contains threatened or endangered species that are known to or are believed to occur in St. Louis County.

Group	Name	Population	Status
Clams	Pink mucket (pearlymussel) (*Lampsilis abrupta*)		Endangered
	Scaleshell mussel (*Leptodea leptodon*)		Endangered
	Spectaclecase (mussel) (*Cumberlandia monodonta*)		Proposed Endangered
	Snuffbox mussel (*Epioblasma triquetra*)		Proposed Endangered
	Sheepnose Mussel (*Plethobasus cyphyus*)		Proposed Endangered
Fishes	Pallid sturgeon (*Scaphirhynchus albus*)		Endangered
Flowering Plants	Mead's milkweed (*Asclepias meadii*)		Threatened
	Decurrent false aster (*Boltonia decurrens*)		Threatened
	Running buffalo clover (*Trifolium stoloniferum*)		Endangered
Mammals	Indiana bat (*Myotis sodalis*)		Endangered
	Gray bat (*Myotis grisescens*)		Endangered

Soils - The following list, from the on-line *Soil Survey of St. Louis County, Missouri* published by the United States Department of Agriculture – Natural Resources Conservation Service (http://websoilsurvey.nrcs.usda.gov/), contains soils mapped across the Watkins Creek Watershed.

St. Louis County and St. Louis City, Missouri (MO189)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
13598	Booker silty clay, frequently ponded, 0 to 2 percent slopes, occasionally flooded	18.2	0.4%
60001	Menfro silt loam, 5 to 9 percent slopes	85.2	1.6%
60003	Menfro silt loam, 9 to 14 percent slopes, eroded	250.7	4.8%
60004	Menfro silt loam, 14 to 20 percent slopes, eroded	396.1	7.7%
60005	Menfro silt loam, 20 to 35 percent slopes	172.3	3.3%
60025	Urban land-Harvester complex, 2 to 9 percent slopes	2,625.8	50.8%
60030	Winfield silt loam, 5 to 9 percent slopes	149.3	2.9%
60031	Winfield silt loam, 9 to 14 percent slopes, eroded	15.6	0.3%
60055	Winfield silt loam, 2 to 5 percent slopes	53.5	1.0%
60165	Menfro silt loam, 2 to 5 percent slopes	362.7	7.0%
60171	Menfro silt loam, karst, 2 to 14 percent slopes	13.1	0.3%
60189	Menfro-Urban land complex, 2 to 5 percent slopes	7.0	0.1%
60190	Menfro-Urban land complex, 5 to 9 percent slopes	147.6	2.9%
60222	Urban land-Harvester complex, 0 to 2 percent slopes	9.3	0.2%
60223	Urban land-Harvester complex, 9 to 20 percent slopes	194.0	3.8%
60224	Urban land-Harvester complex, karst, 2 to 9 percent slopes	43.4	0.8%
60250	Winfield-Urban land complex, 2 to 5 percent slopes	63.3	1.2%
60251	Winfield-Urban land complex, 5 to 9 percent slopes	140.6	2.7%
66014	Haymond silt loam, 0 to 3 percent slopes, frequently flooded	82.1	1.6%
66047	Nevin-Urban land complex, 0 to 2 percent slopes	207.2	4.0%
66092	Fishpot-Urban land complex, 0 to 5 percent slopes, rarely flooded	94.6	1.8%
66126	Haynie-Treloar-Blake complex, 0 to 2 percent slopes, frequently flooded	0.4	0.0%
99001	Water	21.3	0.4%
99023	Urban land, upland, 0 to 5 percent slopes	17.2	0.3%
Totals for Area of Interest		**5,170.0**	**100.0%**

The survey classifies approximately 24 soil-mapping units underlying the Watkins Creek Watershed. According to the survey, urban land complexes occupy approximately 70 percent of the watershed area. The main natural soil-mapping units occupying the remainder of the watershed are:

Menfro silt loam – The Menfro soil is described as a well drained soil on hillslopes. The typical profile of the Menfro soil comprises silt loam and silty clay loam. Depth to the water table is more than 80 inches below the surface, and flooding or ponding is not experienced.

Winfield silt loam – The Winfield soil is described as a well-drained to moderately well-drained soil on hillslopes. The typical profile of the Winfield soil comprises silt loam and silty clay loam. Depth to the water table is 24 to 48 inches below the surface, and flooding or ponding is not experienced.

Haymond silt loam – The Haymond soil is described as a well-drained soil on floodplains. The typical profile of the Haymond soil comprises silt loam. Flooding is frequent, but with no ponding. Depth to the water table is more than 80 inches below the surface.

Topography - As depicted on the Columbia Bottoms, Missouri Quadrangle 7.5-Minute USGS Topographic Map, the elevation of Watkins Creek Watershed ranges from approximately 400 feet above the National Geodetic Vertical Datum (at the confluence of Watkins Creek with the Mississippi River) to approximately 620 feet (near the headwaters of Watkins Creek). The majority of the watershed comprises gentle sloping topography, modified by urban development. The east end of the watershed comprises steep bluff and floodplain along the Mississippi River.

Hydrology - Watkins Creek is a modified tributary to the Mississippi River emerging approximately 5.7 miles west of its confluence and located in a suburban area. Watkins Creek begins just south of Parker Road in the Black Jack area, continuing southeastwardly under Highway 367 and looping south and then north of I-270 before emptying into the Mississippi River. The Watkins Creek watershed includes approximately 4,300 acres of primarily residential and commercial land. Some undeveloped and agricultural land is located south of I-270 and near the Mississippi River.

Due to rapid growth in the Watkins Creek Watershed, the stream is severely degraded and unstable. The creek has adjusted to accommodate the increased storm water delivered to it. Watkins Creek is on the Missouri 2010 list of impaired waters for bacteria and chlorides caused by pollution from various sources. (Appendix 3)

According to the U.S. Fish and Wildlife Service - National Wetland Inventory (NWI) map (http://www.fws.gov/wetlands), NWI-classified wetlands are located within the watershed. "Forested/Shrub" wetlands are located at the confluence of Watkins Creek with the Mississippi River, and at other locations along the Mississippi River. The NWI map also identifies several small lakes or ponds associated with dammed tributaries to Watkins Creek, and near the headwaters of Watkins Creek.

Geology –

Based on USGS data the main geologic components of the Watkins Creek watershed are the following:

CHEROKEE GROUP - Cabaniss Subgroup - cyclic deposits, shale, sandstone, clay and several workable coal beds. Krebs Subgroup - cyclic deposits, sandstone, siltstone, shale, clay and some workable coal beds.

MARMATON GROUP - cyclic deposits, shale and limestone with sandstone, clay and several coal beds, some workable

Karst features are not known to exist within the watershed.

Precipitation - According to the weather data from the St. Louis International Airport the 30 year average precipitation from 19881 through 2010 is 40.92 inches. April through July have the highest average monthly rainfalls exceeding 4 inches and January, February, and December have the lowest average monthly precipitation being less than 3 inches.

Land Use and Land Cover –

Land ownership:

The Watkins Creek watershed consists of 4300 acres of land. Of this approximately sixty-five percent (65%) of the watershed (2,795 acres) is indicated on the land use map as "residential". This includes both single family and multi-family dwellings. (Appendix 4)

An additional sixteen point seven percent (16.7%) of land use is denoted as vacant/agriculture (718 acres). In reviewing an aerial photograph of the watershed most of the designated vacant/agricultural land is woodland with some small interspersed open fields. The largest concentration of vacant/agricultural land is along the bluff line of the Mississippi River in the eastern section of the watershed.

The next largest land use is designated institutional having six point seven percent (6.7%) of the total watershed (288 acres). The institutional land tends to be consolidated into larger tracts used for hospitals and schools concentrated in the western or upper reaches of the watershed.

Commercial accounts for four point five percent (4.5%) of the land use (194 acres) and is scattered throughout the watershed.

Recreational/Park land use is four point four percent (4.4%) of the watershed (189 acres). Of this, Veterans Memorial Park in the western portion of the watershed and a tract of land owned by Great Rivers Greenway (a local park and recreation district) are the majority of the total.

The smallest percentage of land use is that designated as industrial/utility land. This land use accounts for two point seven percent (2.7%) of the total watershed land use (116 acres)

History:

Prior to the late 1700's the Watkins Creek watershed would have been little affected by human habitation. While there are records of significant indigenous peoples inhabiting the area at the time of European's arrival, they are believed to have been mostly hunter/gatherer groups with, possibly, some agriculture. Because of their lifestyle one can speculate that they had minimal impact on the watershed.

Beginning in 1768 the Spanish moved a contingent of soldiers to the area to construct a fort. By 1806

the United States had completed the Louisiana Purchase and the construction of the original Fort Bella Fontaine completed. To improve access to the fort from St. Louis a plank road, Bellefontaine Road, which exists today and bisects the watershed from north to south was constructed. Construction of this road opened the area to further development and the agricultural community of Spanish Lake came into existence. Previous research indicates that north St. Louis County was a mix of prairie and woodlands. The introduction of extensive agriculture would have had an impact on the watershed due to clearing of the land. Clearing of the prairie and woodlands would have increased erosion and runoff to the stream. While immeasurable, one can surmise that this resulted in increased turbidity and some channel incision. Introduction of outhouses and domesticated farm animals would have increased the occurrence of bacteria in the runoff leading to contamination of the stream.

Spanish Lake remained largely a farming community until the end of World War II with a few stores and a blacksmith shop serving the community. After World War II St. Louis County, in general, saw a rapid increase in the development of single family subdivisions as people migrated from the City of St. Louis to the suburbs. Because Spanish Lake was an agricultural area with larger farm tracts developers were attracted to the area to build subdivisions. With the subdivisions came increased commercial, industrial, and institutional development. Because of this development there was a significant increase in impervious surfaces resulting in increased runoff. While exact numbers are not available, a number of homes built on larger lots had septic systems and smaller lot subdivisions were connected to private sewer systems. Not until the late 1960's were these systems consolidated into the Metropolitan St. Louis Sewer District. This further development exacerbated the problems started with the agricultural development of the area. Additional land clearing, mass grading, impervious surfaces, and minimal sewage treatment lead to further water quality problems. Compounding the problem was the increased use of salt to clear roads of snow and ice during winter months. This road salt was washed into Watkins Creek causing increased levels of chloride in the stream. (Anecdotal information indicated that a salt storage facility was formerly located in the watershed. This site has been verified as being near the Interstate 270 and Missouri Highway 367 interchange on the west side north of Christian Northwest Hospital.) The chloride continues to be one of the two issues causing Watkins Creek to be placed on the TMDL list.

With the establishment of Federal environmental regulations, the consolidation and improvement of the sewer system, and renewed public interest efforts began to clean up the watershed. In 2006 the Spanish Lake Community Association in collaboration with St. Louis University's RegionWise began an effort to educate the community regarding the importance of the watershed and efforts to improve the creek. Demonstration projects, signage, printed materials, and clean up efforts were undertaken to inform and involve the community in improving the watershed. Other efforts to reduce non-point sources of pollution were needed to stem the problem of E. Coli and chlorides, the two pollutants which have resulted in Watkins Creek being placed on the state's Total Maximum Daily Load (TMDL) list. This project, the development of a Watershed Management Plan, is an outgrowth of the 2006 effort.

Resource areas:

While there is open land available for commercial, industrial, or residential development there are no known plans for significant development. As stated previously, there is approximately 189 acres of park/recreational land in the watershed. Most of this is already developed as parks. Only a tract owned

by Great Rivers Greenway (the local regional park district) on the bluff overlooking the Mississippi River floodplain is undeveloped. There are no plans to develop this site in the near future.

Demographic Characteristics:

Population Changes - For the most part, the Watkins Creek watershed is what would be considered "built-out", that is completely developed. There are still a number of larger tracts of land that could, conceivably, be developed for residential dwellings. However, most of these are currently zoned commercial or industrial. Therefore, a considerable increase in population is not anticipated.

As of the census of 2000, there were 21,337 people, 8,381 households, and 5,673 families residing in0 the Spanish Lake community. The population density was 2,900.4 people per square mile. There were 8,852 housing units at an average density of 1,203.3/sq mi. Between 2000 and 2010 the area saw an estimated decrease in population of 19%. (Due to the size and location of the watershed which overlaps parts of several census blocks, details for the watershed cannot be provided. However due to the homogeneity of the community the population and housing density can be extrapolated to be approximately the same.)

Area economics - No significant influx of population is anticipated for the watershed in the future. However, due to the proximity to Interstate 270, development of the remaining commercial and industrial lands could occur because of the ease of access to transportation. However, it should be noted that several of the industrial sites have been for sale for a number of years with no sales having occurred. Therefore, it is difficult to predict the future interest in development of these vacant lands.

CHAPTER 2: ELEMENT A. - IDENTIFYING IMPAIRMENT

Watershed Inventory:

Watkins Creek, a sub watershed of the Mississippi River, remains on the list for 2012 impaired streams for chronic toxicity for both *E. coli* and chloride. Improvement to Watkins Creek may positively affect the Mississippi River from further contaminants entering its waters.

Stakeholder Concerns -

The following list includes some of the areas of concern that were expressed by the community of Spanish Lake and surrounding communities, as well as those who were part of the planning meetings. The following data reflects information collected through both formal and informal surveys.

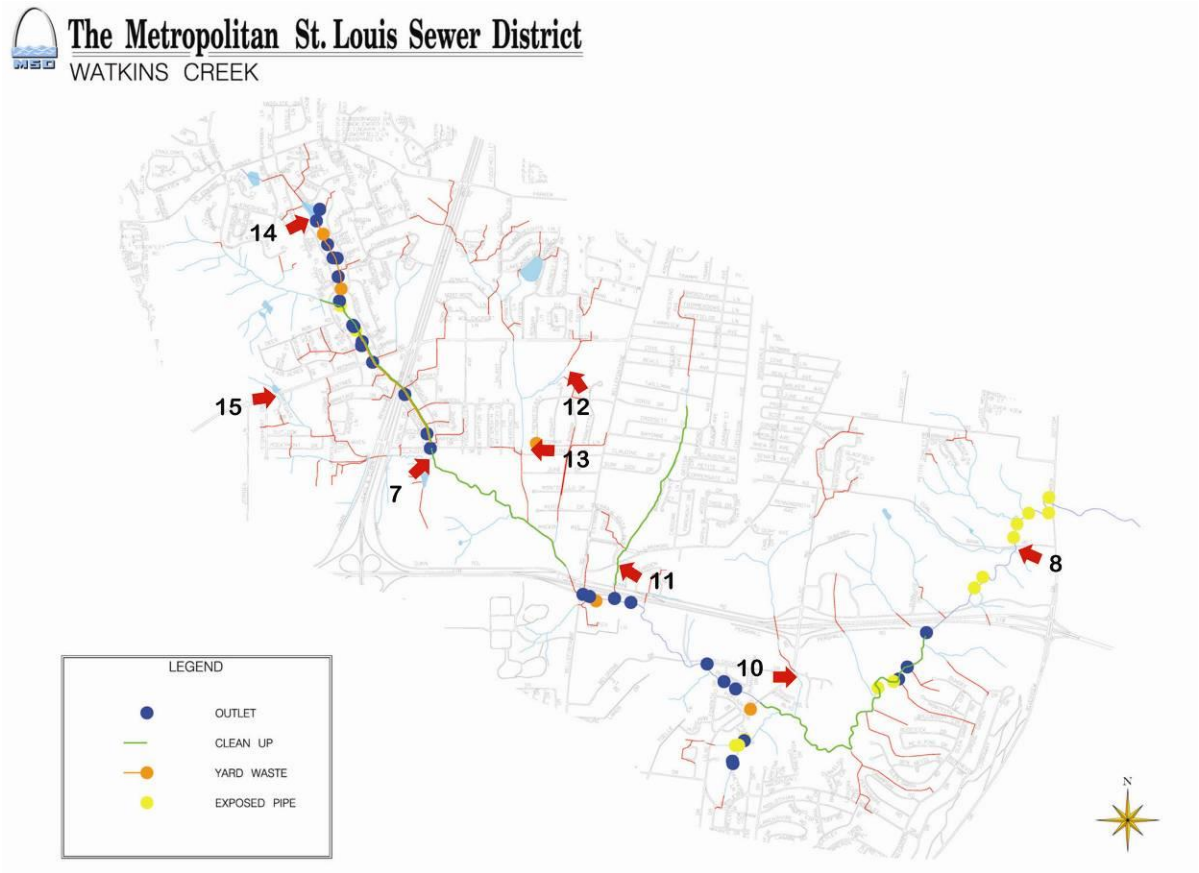
1. Storm water Best Management Practices (BMP) Issues
    a. Prioritize establishment of BMPs in impaired area in the Spanish Lake community
2. Need for more Citizen Involvement in Watershed Studies
    a. In order to create more awareness of Watkins Creek, reach out to the community to be more involved in the monthly data collection as preformed by Stream Team 3553. .
3. Yard Waste and Trash
    a. Trash and dumping tends to be a large problem along Watkins Creek. More community outreach is needed to inform citizens of the dangers of dumping as well as encouraging clean-ups.
4. Sources of *E. Coli*
    a. Septic Tanks that have been recently abandoned or have not received proper care remain in a portion of Spanish Lake.
5. Sources of Chloride
    a. Over use of salt being applied to Highway 270 runs off into Watkins Creek during the winter months.
    b. It is speculated there is contaminated soil where a salt pile once was located above the impaired section of the creek.
6. Further Education and Public Awareness
    a. The public must be informed and educated on impaired streams in order for a real difference to be made.

All of these concerns address issues with the watershed. Obviously, several of them are more directly aligned with the issues being addressed by this watershed management plan. However, all can lead to improved water quality and, indirectly, lowering of E. Coli and chloride levels in the stream.

Existing Watershed Data -

Watkins Creek is currently monitored by volunteers of the Missouri Stream Team Program. Stream Team 3553, led by Claire Schosser, has been actively testing, at some level, since 2008 on the impaired section of the creek.

The map below indicates by number where data collection has taken place.



Site Number	Latitude	Longitude
7	N 38.77788	W 90.23289
8	N 38.77207	W 90.1825
10	N 38.76383	W 90.20305
11	N 38.77130	W 90.21783
13	N 38.77857	W 90.22555
14	N 38.79317	W 90.24223

Table 2.1 - Location of Test Sites

According to the Stream Team's monitoring plan:

> "Monitoring at the sites include bacterial, chemical, and macroinvertebrate sampling. Chemical (water and air temperatures, pH, dissolved oxygen, chloride, conductivity, and turbidity) sampling will be conducted 7 times per year at all 6 sites in conjunction with

bacterial sampling (once per month from April through October) and at least once more between November and March, for a total of at least 8 chemical sampling events per year. Nitrates will be sampled in conjunction with macroinvertebrate sampling at sites 14 & 8, and in conjunction with winter sampling at all 6 sites.

Bacterial sampling will be conducted 7 times per year, once per month from April through October. Sampling protocol will follow the Missouri Dept. of Natural Resources Standard Operating Procedure, and samples will be delivered to the Missouri American Water laboratory at 901 Hog Hollow Rd, Chesterfield, 63017 within 6 hours of sample collection.
Bacterial sampling will be conducted by Claire Schosser trained in the Volunteer Water Quality Monitoring Cooperative Stream Investigation protocol (CSI). Chemical and macroinvertebrate sampling will be conducted by trained members of the Watkins Creek Stream Team.

Visual data has also been collected during the course of this sampling. Data includes the presence of fish and crayfish in some locations. A summary of visual data can be found in Appendix 5.

In addition to volunteer Stream Team involvement, USGS operates two gages on the main stem of Watkins Creek. The parameter measured is stream discharge. Their locations are the following:

USGS 07001910 Watkins Creek near Bellefontaine Neighbors, MO
Latitude 38°46'43.4", Longitude 90°13'59.0" NAD83

USGS 07001985 Watkins Creek at Bellefontaine Neighbors, MO
Latitude 38°45'44.2", Longitude 90°11'48.9" NAD83 ”

303 (D) Classification and Impairment -

Watkins Creek has been placed on the 2011 proposed list as impaired for E. Coli and chloride with sources shown as unknown.

Current 2010 303 (d) Impairment List

No.	Water Body Name	WBID	Class	MDNR Proposed Impairment Length (mi/acres)	Proposed Impaired Classified Segment* (mi/acres)	EPA Approved Classified Segment (mi/acres)	County	Pollutant
331	Watkins Creek	1708	C	1.4	1.4	3.5	St. Louis	Bacteria
332	Watkins Creek	1708	C	1.4	1.4	3.5	St. Louis	Chloride

According to the Code of State Regulations (CSR). The listing is in 10 CSR Division 20, Chapter 7 – Water Quality, Table H – Stream Classifications and Use Designations (available at http://www.sos.mo.gov/adrules/csr/current/10csr/ 10c20-7.pdf), Watkins Creek has been designated as

whole body contact, which is referred to as Category B. For most protection, this report will assess the designated use for whole body contact, or Category B. This category applies to those water bodies designated for whole body contact recreation not contained within Category A. While secondary contact recreation uses include fishing, wading, commercial and recreational boating, and limited contact incidental to shoreline activities, and activities in which users do not swim or float in the water.

Interpretation of Data -

The majority of the data collected since 2008 has been that of the Missouri Stream Team 3553. In Appendix 6, graphs display data collected for both E. Coli and chloride. The data clearly displays spikes in E. Coli greater than 9,500 MPN/100mL on several occasions and at multiple sites. Missouri's Water Quality Standards at 10 CSR 20-7.031(4)(C) state that the E. Coli bacteria count shall not exceed 126 colonies per 100 milliliters of water (126 col/100 mL) for Category A and 206 col/100 mL for Category B waters. For chloride, there have been multiple instances where spikes have been over 1,000 mg/L. The trend tends to be higher chloride in the Winter falling through the Fall. The criteria for chloride are found in 10 CSR 20-7.031 Table A. The chronic criterion is 230 milligrams per liter (mg/L or parts per million) and the acute criterion is 860 mg/L.

Summary Of Previous Studies -

Additional information collected on Watkins Creek includes:

> *Watkins Creek Watershed Study—RegionWise 2006:* This report contains information on channel stability problems as well as the implementation of Water Quality Monitoring by Stream Team 3553.
>
> *Watershed Planning; a Scientific Methodology and Ramifications for Personal Property Rights The Watkins Creek Watershed Study – Andrew Lawrence Francis Struckhoff 2005:* This report was a capstone project completed by a student at St. Louis University on stream bank instability and the surrounding community.

<u>Identifying Non-Point Source Stressors:</u>

In the areas surrounding Watkins Creek, there are many residential areas. Below, in Figure 2.2, yellow areas indicate residential properties over 1 acre. Traditionally, many of the residential parcels larger than one acre found in the developing areas of the county were developed using septic systems. Septic systems can be a source of E. Coli.

Records of which of these one acre parcels continue to use septic systems are unavailable due to the method of permitting used by St. Louis County. The U.S. Census included information on septic systems until 1990. However, this information is unreliable as many of the parcels may have converted to sanitary sewers since 1990.

Figure 2.2 – Watershed Limits With 1-acre Parcels Shown

Preliminary information from the Metropolitan St. Louis Sewer District, through a state program identified as HB661, indicated at least fifteen parcels with septic systems in the watershed. Updated information from MSD indicates that 600 parcels within the watershed are not served by the sewer district. Any of these parcels that are developed would likely have a septic system or other type of sewage treatment. (In discussions with residents it was mentioned that several knew of homes in their neighborhood that still used septic systems.) Since this is unclear what the type of service is, it would be prudent if further research was conducted in the future to ascertain the exact type and number treatment systems still in use as part of implementing the findings of this watershed management plan.

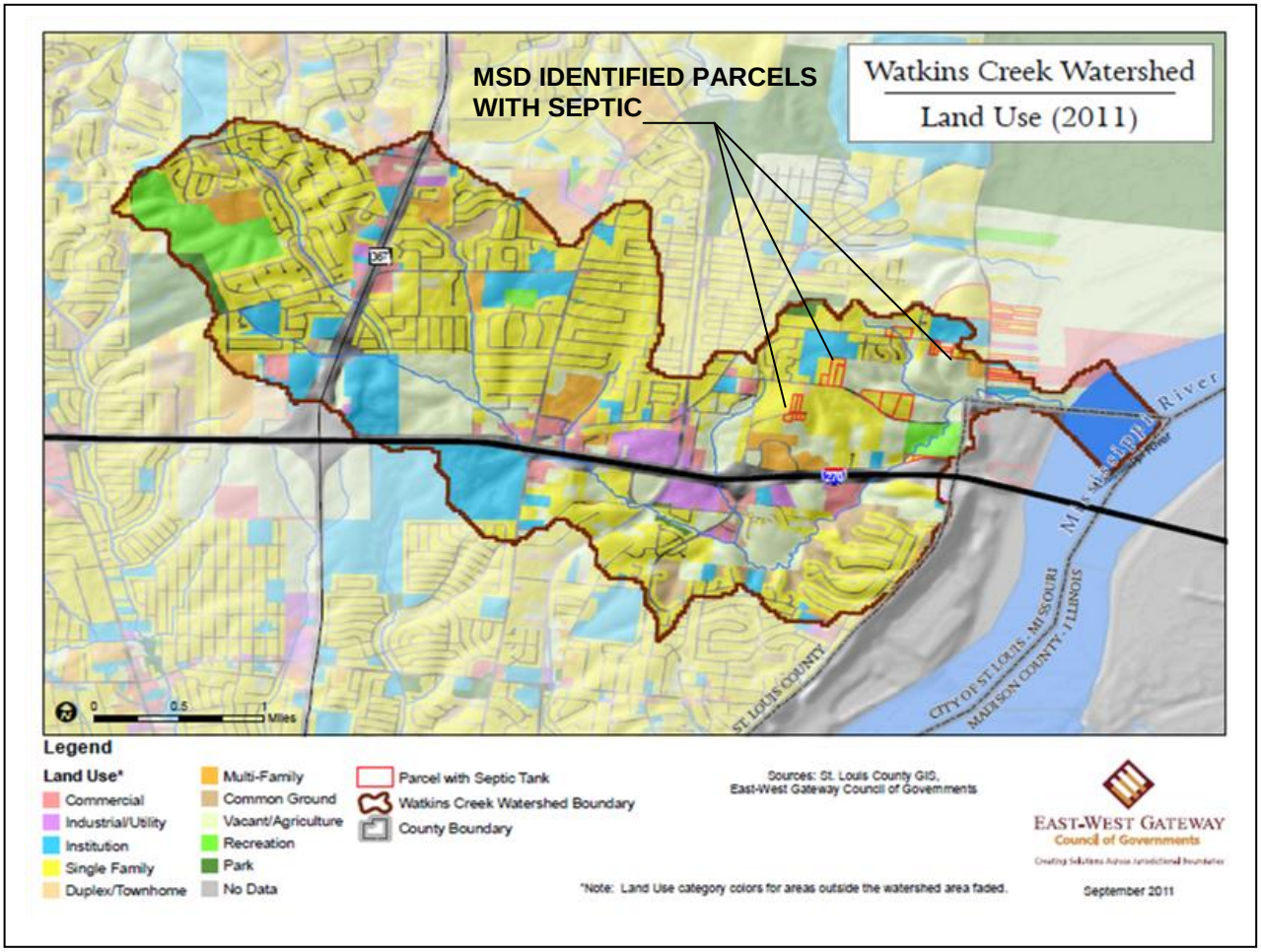
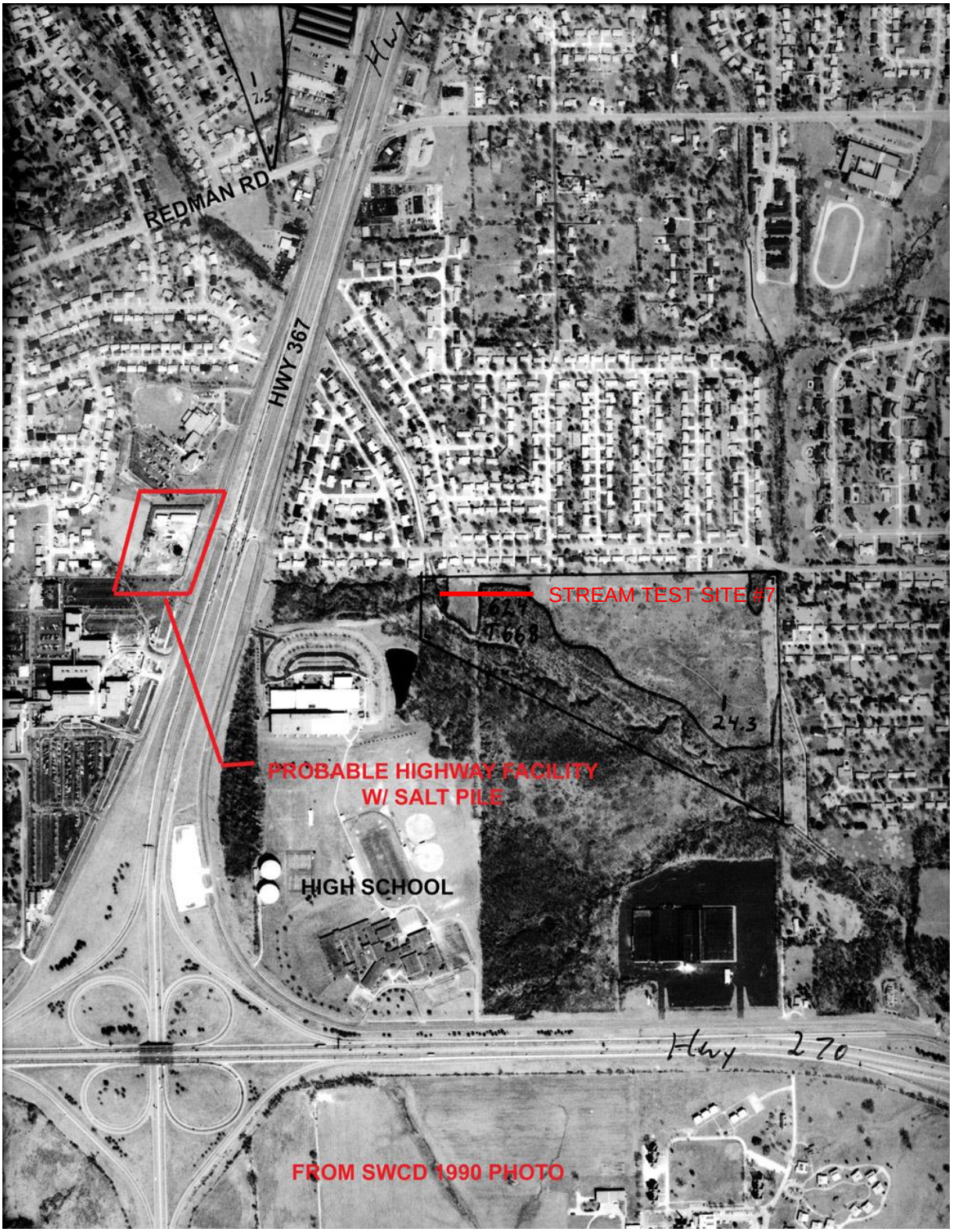


Figure 2.3 – Preliminary Map of Septic Systems

Other nonpoint sources have been considered such as agriculture. However, available data does not support livestock as a source. Other non-point stressors are more likely. With large open spaces wildlife of various types must exist. Also, since the area is largely residential, pet waste is also a probable factor. It should be noted, however, that neither wildlife nor pets would be a major factor in the high levels of E. Coli

Regarding chloride, Watkins Creek falls near Interstate 270 and Highway 367. There are many parking lots and neighborhood streets which are salted during the winter months to prevent ice formation. It is also known that a highway maintenance facility existed near the intersection of Interstate 270 and Highway 367 which probably had a salt pile (Figure 2.4). Both residents' memory, county records, and aerial photography support this. Although the maintenance facility was removed during Highway 367 reconstruction around 2000, it is theorized that contaminated soil is still present and chloride is being transported by groundwater to the creek. Results of soil tests from two locations at the former facility by Stream Team 3553, processed by the University of Missouri Extension Service, had readings of 474.1 ppm and 791.6 ppm exceeding the target levels by a factor of two or three. Control samples taken at two other locations had results of 50 ppm or less. (It should be noted that one of the soil test sites was a small wetland. While it is likely that the high chloride levels are a result of seepage from the former highway facility it cannot be discounted that this wetland is a natural salt seep. Further study would need to be done to determine this. However, due to the extensive landform modification in this area it is unlikely that the wetland has been there very long or that the seepage is from a natural spring.)

Figure 2.4 – Former Highway Facility Location



Identifying Point Source Stressors:

Sanitary Sewer Overflows -
One possible point source stressor is sanitary sewer overflows (SSOs). The Metropolitan St. Louis Sewer District (MSD) reports:

> "While there are no actual combined sewer-storm water systems in the Watkins Creek watershed precipitation does enter the sewer system by various methods which is the most significant reason for overflows. When a pipe's capacity is exceeded the SSO releases the overflow into the stream. The Watkins Creek watershed includes four SSO's numbered BP-210, BP-211, BP-213, BP-214. Information for the location of these SSO's was found in the draft TMDL report provided by MDNR. SSO's 210, 211, and 213 are on an unnamed tributary east of Bellefontaine Rd. and south of Redman Rd. SSO 214 is located near Talbott Ct Dr., south of Redman and near Trinity High School."

There have been several instances in which overflows have occurred. Table 2.2 describes the location of these overflow events as well as their duration. All of these sites fall within the Watkins Creek Watershed. Overflows will contribute directly to E. Coli found in Watkins Creek.

Table 2.2 – SSO Overflow Dates and Durations

SSO	Location	Event Date	Duration
BP-210	Bayonne Dr.	9/14/2008	130 minutes
		1/27/2010	345.0
		1/29/2010	67.5
BP-211	Crosset Dr.	9/14/2008	105.0 minutes
		7/6/2011	7.5
BP-214	Talbott Ct.	5/27/2008	20.0 minutes
		9/14/2008	220.0
		12/27/2008	45.0
		5/16/2010	57.5
		7/8/2010	10.0

Unidentified or Illicit Discharge –

MSD currently monitors Watkins Creek for issues or problems related to it sanitary sewer system. Sewer mains and manholes are found along, adjacent to, and crossing the creek. In monitoring the system MSD checks these lines and manholes and operation of the SSOs for malfunctions including leaks. Additionally, the monitoring program includes checking for unidentified or illicit discharges of sewage. Based on available information MSD has not identified any illicit discharges of sewage that would lead to an increase in E. Coli levels in the creek.

Identifying Critical Areas:

The impaired area of Watkins Creek as identified by MDNR's TMDL report begins just as it crosses under Interstate 270 heading north till the mouth. However, testing throughout the watershed indicates the presence of excessive levels of E. Coli and high to excessive levels of chloride in all reaches of the stream and its tributaries. While the location of possible septic tanks or other treatment systems will need further investigation before solutions can be initiated, recommendations for Best Management Practices (BMPs) should be developed and implemented to reduce pollutant levels for point source pollution (SSOs) and non-point source pollution (pet and other waste). These BMPs need to be dispersed throughout the watershed to minimize pollutants entering the stream before they can become a problem.

Current loads for E. Coli and chloride can be calculated based on available data. This in turn can serve as a basis for calculating load reductions and development of the BMPs necessary to begin the process of actually reducing pollutant levels.

Per MDNR recommendations loads are calculated as *Load = Concentraion x Flow (volume/time)*. For E. Coli the load calculation is thus:

Concentration = Average E. Coli measured over three year period in MPN/100 ml = 2848.633

Flow = Average Annual Flow for 2011 period in cubic feet per second = 1.39

Load = 2848.633 x 1.39 = 3959.60

For chloride the load calculations is thus:

Concentration = Average chloride measured over three year period in mg/l = 677.71

Flow = Average Annual Flow for 2011 period in cubic feet per second = 1.39

Load = 677.71 x 1.39 = 942.02

Concentrations for both E. Coli and chloride were based on measurements taken at test site #7 just east of Hwy. 367. This is the closest test site that corresponds to the site of the USGS stream gauge.

CHAPTER 3: ELEMENT B. – ESTIMATING LOAD REDUCTIONS

Background:

Based on previous studies, reports, and citizen interests expressed on the Watkins Creek watershed, there are a number of concerns and issues related to the physical and visual quality of the creek and its surrounding watershed. Loss of habitat, increased runoff from impervious surfaces, and dumping along the streambank have all contributed to the degradation of the stream. However, the purpose and focus of this management plan is to address the two pollutants, E. Coli and chloride, which have lead to the stream being identified as an "impaired" waterway.

The long range goals for target pollutant loads, level, or value are listed below. The target levels are based upon the review of water quality data discussed in Chapter 2. Reduction in the E. Coli and chloride may prove to be incremental and take a number of years based on the methods used to correct the problems. These methods, identified in Chapter 4, will include both structural and non-structural means. As additional data becomes available the targets values and methods will be adjusted as necessary.

Impairment	Present Load (Chapter 2)	Target Level
E. Coli	3959.60	Not to exceed State of Missouri standard for whole body contact (mean of 206 cfu/dL) for a Class B stream during recreational season.
Chloride	942.02	Not to exceed one severe toxic occurrence (230 milligrams/liter) in 3 years during periods of steady, low flow conditions. No more than one occurrence in three years of the 860 mg/L chloride acute criterion under any flow conditions.

By comparing the water quality data collected since 2008 to the above Target Level criteria, it was found that the target level was exceeded numerous times for both E. Coli and chloride throughout the entire watershed. For example, the E. Coli values at Test Site 8, located at a bridge crossing on Coal Bank Road, exceeded the Missouri State standard seven (7) out of fourteen (14) times tested. At the same site chloride exceeded the Target Level seven (7) out of twenty-two (22) tests. Similar E. Coli results were measured at Test Site 10, located downstream from the bridge at Bellefontaine Estates Ct. near Lilac Ave. Here the E. Coli exceeded the Target Level twenty-two out of twenty-two tests. However, chloride exceeded the Target Level only two out of twenty-two tests. This information is very important in light of the fact that E. Coli testing only occurred in the months between April and October. This corresponds to, what most would consider, the recreational season.

Calculating Load Reductions:

Selection of Method: A review of available watershed management plans, both local plans and those available on the internet, found that watershed modeling appears to be the most common way of calculating load reductions versus estimating land use loading rates based on monitoring data or literature values. Because of its commonality of use this method was selected for the project.

Information provided by the Missouri Department of Natural Resources suggests the use of one of the following watershed models for urban areas:

- STEPL (Spreadsheet Tool for Estimating Pollutant Load) is another spreadsheet tool that estimates load reduction resulting from the implementation of management practices.
- HSPF (Hydrologic Simulation Program-Fortran) is a comprehensive package for simulating watershed hydrology and water quality for a wide range of conventional and toxic pollutants.
- P8-UCM predicts the generation and transport of storm water runoff pollutants in small urban watersheds.
- SWMM is primarily used in urban areas with impervious surfaces to simulate rainfall-runoff.

Any modeling system used for the Watkins Creek project would, of necessity, have to be simple to set up, enter data, and produce results in an understandable format and minimum amount of time. This is due to both the technical expertise of the users and budget constraints. A review of the above modeling systems resulted in the following concerns: HSPF is a "complex model require[ing] extensive calibration and a high level of expertise for application"; P8-UCM needs a "moderate effort to set up, calibrate, and apply". (Additionally, several attempts to identify a source for downloading the model failed); SWMM requires that the watershed be divided "into a collection of smaller, homogeneous subcatchment areas, each containing its own fraction of pervious and impervious sub-areas." This was considered to be a time consuming process which was not cost effective.

Upon study, STEPL proved to be easy to learn and apply, required only minimal effort to enter data, and included an urban component to calculate load reductions. Therefore STEPL was selected as the model to use for calculating load reductions in the watershed. (One fault of STEPL is that it does not allow direct calculations of load reduction of pathogens such as E. Coli. Therefore, the probability of reduction is based on lowering nutrients, such as nitrogen, which contribute to or are linked to the presence of E. Coli and are affected by the correct BMP selection.)

STEPL requires the completion of worksheets in spreadsheet format. (For a complete understanding of the STEPL process refer to the Users Guide at http://it.tetratech-ffx.com/steplweb/). Worksheets require data entry on specific physical characteristics of the watershed and probable best management practices (BMPs) which can be applied. Some data are constants based on geographic location, soil types and other factors. Other sets of data can be varied. Particular attention was given the "affective area" of any given BMP. Affective area refers to the total acreage to which a selected BMP practice applies. Since the watershed is almost completely developed, no BMP practice could be retroactively and/or successfully applied to the entire watershed of 4300 acres. Therefore, a percentage was applied to each land use type to find the Affective area. (Example: Open space in the watershed equals 189.2 acres. If BMP's could be applied to affect 10% of the open space the "affective area" would be 19 acres with numbers rounded to the nearest whole.) Because of the uncertainty of the effectiveness of various BMP's on load reduction the percentage of affective area was adjusted to reflect a 10%, 25%, and 50% rate, calculations completed, and the results compared.

The other variable that could affect the outcome of the load calculations were the number of functioning septic systems or other treatment methods that could impact the stream. St. Louis County building codes require a minimum one acre parcel size for the installation of septic systems. In the Watkins Creek watershed there are one hundred thirty four (134) residential parcels one acre or larger. This excludes multi-family units. Updated information from MSD indicates that 600 parcels within the watershed are not served by the sewer district. Any of these parcels that are developed would likely have a septic system or other type of sewage treatment. Data on septic systems were previously compiled as part of the U.S. Census until 1990. However, current data is unavailable. A draft TMDL

document from the Missouri Department of Natural Resources states "The exact number of onsite wastewater treatment systems in the Watkins Creek watershed is unknown, however such systems are known to exist, especially in older developed areas of the county that were developed prior to the sewerage systems serviced by the Metropolitan St. Lewis Sewer District (Jack Fischer, St. Louis County Public Works, personal communication, June 6, 2011)." Anecdotal information from residents also indicates the existence of functioning and/or abandoned septic systems in the watershed beyond the fifteen accounted for by MSD. The MDNR report continues; "Much of the watershed is now serviced by the Metropolitan St. Louis Sewer District's Bissell Point wastewater treatment plant located about 5.5 miles south of Watkins Creek. Due to the availability of this sewer system and a St. Louis County ordinance requiring that a sewer connection to a building be made when a sanitary sewer line is within 200 feet of the property, many septic system eliminations have *likely* (emphasis added) been made. For this reason, the number of onsite wastewater treatment systems in the Watkins Creek watershed is expected to be low." However, with the continuing presence of high E. Coli test results within the watershed and the number of parcels not served by MSD it could be argued that without an in-depth study of the issue, septic systems could not be discounted as a source of E. Coli. Without further research, though, it is impossible to calculate the impact of septic systems on the model. Therefore, this variable was not adjusted in the model.

Results:

In running the STEPL model the nutrient values in runoff and groundwater set by the model (based on local soil hydrologic group, precipitation, and storm water runoff curves) were used in the calculation. This was due to the lack of adequate water quality data to independently calculate current nutrient loads.

The STEPL model also included a series of Best Management Practices (BMPs) which could be applied to the load reduction calculation. Six BMPs were selected from the series. These were:

- Bioretention
- Wetland Detention
- Sand Filter/Infiltration
- Vegetation Filter Strip
- Grass Swale
- Porous Pavement

Selection was based on several criteria. First, reducing loads (including E. Coli) has been correlated to the reduction of storm water runoff. Second, the six selected BMPs are included in the Metropolitan Sewer District's new requirements for storm water runoff reduction in new construction. Third, a number of studies indicate that Bioretention and Wetland Detention can reduce E. Coli levels. In at least one study Sand Filters/Infiltration Basins were included in this group. It should be noted that the literature also indicated that even in commercial areas where the amount of impervious surface was high and the number of sources low, significant levels of E. Coli were found in storm water runoff. The other BMPs (vegetation filter strip, grass swale, and porous pavement) reduced nutrient loads. Below is a table showing the results of the calculation for each BMP, the affective area covered, and each type of load:

LOAD REDUCTION TABLE
(Results given in percentage reduction & pounds or tons per year)

Pollutant BMP	Nitrogen	Phosphorus	BOD	Sediment
Bioretention				
10% affective area	5.0% 1429.5 lbs	7.5% 287.3 lbs	0.0% 0.0 lbs	0.0% 0.0 tons
25% " "	12.6 3570.1	18.7 717.3	0.0 0.0	0.0 0.0
50% " "	25.2 7132.5	37.4 1432.7	0.0 0.0	0.0 0.0
Wetland Detention				
10% affective area	1.6% 453.8 lbs	4.1% 158.0 lbs	6.3% 5367.3 lbs	7.8% 40.6 tons
25% " "	4.0 1133.4	10.3 394.5	15.7 399.8	19.4 101.4
50% " "	8.0 2264.3	20.6 788.0	31.4 26784.2	38.7 202.5
Sand Filter/Infiltration				
10% affective area	2.8% 794.2 lbs	4.7% 179.6 lbs	0.0% 0.0 lbs	8.0% 41.9 tons
25% " "	7.0 1983.4	11.7 448.3	0.0 0.0	20.0 104.7
50% " "	14.0 3962.5	23.4 895.4	0.0 0.0	40.0 209.1
Vegetation Filter Strip				
10% affective area	3.2% 907.6 lbs	4.2% 162.5 lbs	5.1% 4302.4 lbs	7.3% 38.2 tons
25% " "	8.0 2266.7	10.6 405.7	12.6 10741.1	18.3 95.5
50% " "	16.0 4526.6	21.1 810.4	25.2 21469.8	36.5 190.8
Grass Swale				
10% affective area	.8% 226.9 lbs	2.3% 89.8 lbs	3.0% 2555.9 lbs	6.5% 34.0 tons
25% " "	1.9 538.9	5.7 217.2	7.2 6158.8	15.5 80.8
50% " "	4.0 1132.1	11.7 447.7	15.0 12754.4	32.5 169.9
Porous Pavement				
10% affective area	6.8% 1928.7 lbs	6.1% 233.4 lbs	0.0% 0.0 lbs	9.0% 47.1 tons
25% " "	17.0 4816.7	15.2 582.8	0.0 0.0	22.5 117.7
50% " "	34.0 9623.3	30.4 1164.1	0.0 0.0	45.0 235.2
TOTAL REDUCTION				
10% affective area	20.2% 5740.7 lbs	28.9% 1110.6 lb	14.4% 12225.6 lbs	38.6% 201.8 tons
25% " "	50.5 10739.1	72.2 2765.8	35.5 17299.7	95.7 500.1
50% " "	101.2 28641.3	144.6 5538.3	71.6 61008.4	192.7 1007.5

Analysis:

Based on the STEPL model the six selected BMPs provide some level of load reduction for Nitrogen (N) and Phosphorus (P). These nutrients are a major cause of algae and other organism growth in streams. Reduction of the N and P loads will result in improvements in the stream over time. How much time would be based on how fast the nutrients are reduced. Biological Oxygen Demand (BOD) is improved when using only four of the six BMPs. Bioretention and porous pavement have no effect on BOD. Sediment, which contributes to turbidity (cloudiness) of the stream is affected by five of the six BMPs. Only Bioretention does not affect sediment loads.

When comparing the reduction rates based on affective area covered one observes a significant difference in results in the use of some BMPs. For example, if 10% of the land is serviced by Wetland Detention the Nitrogen load is reduced just 1.6%. Increasing the affective area to 50% results in just an

8% reduction in Nitrogen load. But if 10% of the land area within the watershed uses porous pavement instead of traditional pavement the result is a 6.8% reduction in Nitrogen loads. The reduction jumps to 34% if the affective area is increased to 50% coverage.

It may not be necessary, however, to implement BMPs using a 50% affective area coverage. When totaling the load reduction for all six BMPs for each level of affective area coverage, one observes that the total reduction for 50% affective area coverage for N, P, and Sediment exceed 100% and BOD is reduced by 71.6%. Therefore, it may be more practical and cost affective to implement BMPs at an affective area coverage in the range of 25%. To implement this level of coverage would require developing BMPs that would affect the following acreage for each land use:

Land Use Type	**Total Acreage in Watershed**	**Acreage Affected**
Commercial	193.5	48
Industrial	116.1	29
Institutional	288.1	72
Transportation	430.0	108
Multi-Family Housing	176.3	44
Single Family Housing	2188.7	547
Vacant/Agricultural	718.1	180
Open Space/Parks	189.2	47

It should be noted that “acreage affected” is not equal to acreage converted to BMPs. Instead it should be assessed as acreage from which storm water is drained to one or more of the BMPs.

The question also arises as to whether all six of the selected BMPs should be applied since some of the results indicate zero reduction levels. This is particularly true of Bioretention since it does not lower BOD or sediment. But Bioretention, along with Wetland Detention and Sand Filter/Infiltration Basin, are known to aid in the reduction of E. Coli. Therefore, it will be important to include Bioretention in the suite of BMPs recommended for use in the watershed management plan. Additionally, all of the selected BMPs provide some important level of load reduction which, when coupled with other non-structural BMPs, will allow the target levels, described above, to be achieved.

CHAPTER 4: ELEMENT C. - MANAGEMENT MEASURES

Need:

As described in earlier chapters, Watkins Creek has two significant problems that have led to the Creek's placement on the list of impaired waters. Those two problems were levels of E. Coli bacteria and chloride in excess of mandated safe amounts. It is believed that no single action will affect the changes necessary to achieve the required reduction in pollutant loads. Therefore, to reduce the levels of these pollutants a variety of changes will have to be undertaken within the watershed. The project team, in conjunction with the Watershed Advisory Committee and responding to public comments, is recommending a three pronged approach. First is the implementation of structural changes that will result in a reduction of storm water runoff thereby reducing the direct release of pollutants into the creek. Structural changes will allow the pollutants to be filtered from the storm water prior to its entry into the stream. Second are non-structural changes that will allow for improved monitoring and maintenance of pollution sources, new local policies or ordinances that strengthen monitoring and maintenance procedures, and code enforcement related to the same. Proper monitoring and maintenance coupled with code enforcement will reduce levels of pollutants entering the stream. Third is the improvement and/or implementation of efforts to inform and educate the public (including individuals, businesses, and organizations) as to the need and requirement of reducing pollution especially E. Coli and chloride. Education should encourage the public to reduce activities that result in pollution thereby lowering the levels of pollution entering Watkins Creek.

Proposed Management Measures:

Structural –

Significant impact on reducing pollutants can be had by reducing the amount of storm water runoff flowing directly to streams. By researching available sources of information regarding structural methods of reducing E. Coli and chloride as well as consulting with the Metropolitan Saint Louis Sewer District six Best Management Practices (BMPs) were identified and load reductions calculated for each using the STEPL watershed modeling method. The six methods as previously identified in Chapter 3 were:

- Bioretention
- Wetland Detention
- Sand Filter/Infiltration Basins
- Vegetation Filter Strip
- Porous Pavement
- Grass Swale

All six BMPs are known to reduce storm water runoff to streams, filter nutrients, sediments, and other pollutants. Additionally, research has shown that Bioretention, Wetland Detention, and Sand Filter/Infiltration Basins reduce E. Coli levels at a moderate to significant rate.

After further review it is recommended that the implementation of the management plan not include grass swales as a BMP because grass swales have become a standard construction practice in directing

storm water runoff in this region. As such, future efforts do not need to focus on implementing this practice. Instead, it is recommended that future efforts be focused on convincing property owners to implement the use of the other five BMPs for beginning the process of reducing pollutant levels in Watkins Creek.

It should be noted that the five BMPs (Bioretention, Wetland Detention, Sand Filter/Infiltration Basins, Vegetation Filter Strip, and Porous Pavement) are not universally applicable to all storm water runoff situations or to all properties. Instead it would be more cost effective to apply each BMP to the most appropriate property type and location. Below is a description of the appropriate type and location for each BMP.

In addition to the implementation of the proposed BMPs, structural changes need to be made in regard to septic systems and sanitary sewer overflows. Where practical septic systems need to be eliminated and properties connected to the existing sanitary sewer system. The four existing sanitary sewer system overflows, while they overflow infrequently, need to be modified to further reduce the frequency of overflows or eliminate the overflows if possible.

New BMPs

Bioretention:

Bioretention is probably the most versatile of the proposed BMPs. Bioretention utilizes soils and both woody and herbaceous plants to remove pollutants from storm water runoff. Current research indicates that Bioretention can remove 70% of bacteria, between 35 and 65% of nutrients, and 97% of sediments.

It is a shallow depression designed to retain or detain storm water before it is infiltrated or discharged downstream. Bioretention can be designed to various shapes and sizes. Therefore, it could be applied to all land use types found in the Watkins Creek watershed. However, its would most likely and practicably be applied to land uses which have large parking areas such as commercial, industrial, institutional, and multi-family housing complexes as well as along transportation corridors and, on a smaller scale, single family properties in the form of rain gardens.

As a practical matter, Bioretention should be used for new developments or retrofitted in areas with adequate space for an appropriately designed Bioretention system adequate to the drainage area being serviced.

Wetland Detention:

Wetland Detention Basins are artificial wetlands, marshes or swamps created as a new or restored habitat for human-generated discharge such as wastewater, storm water runoff, or sewage treatment, or other ecological disturbances. Wetlands act as filters, removing sediments and pollutants such as heavy metals from the water, and constructed wetlands can be designed to emulate these features. Current research indicates wetland detention can remove 78% of bacteria, as much as 55% of nutrients, and 80% of sediments.

Technically, Wetland Detention Basins can vary considerably in size and could be applied to even single family properties. However, they are most effective when applied to larger scale developments or areas and can act as replacements for the more traditional dry detention basins. Therefore, wetland detentions should be applied to any new commercial, industrial, institutional, multiple-family housing, and subdivision size single-family housing development that requires detention basins as part of the design development requirements as set forth by the local permitting agency.

It is also important to consider retrofitting existing dry detention basins. These dry detentions can be modified to wetland detentions through slight grading and drainage modifications as well as the addition of wetland plant materials. This could provide significant as well as cost effective, benefits in regards to reducing both E. Coli and chloride as well as other pollutants.

Sand Filter/Infiltration Basins:

This method is actually a combination of two separate BMPs (Sand Filter and Infiltration Basin) that combine the qualities of the two. Sand Filter/Infiltration Basins are detention ponds constructed to allow infiltration into the soil and groundwater of runoff to occur. Current research indicates sand filter/infiltration basins can remove around 76% of bacteria, as much as 33% of nutrients, and 70% of sediments.

The operating characteristics of Sand Filter/Infiltration Basins are essentially the same as for dry detention, with a few significant exceptions: A) Sand Filter/Infiltration Basins also remove dissolved solids, nutrients, BOD, and fecal coliform in the volume of infiltrated water; B) The settling velocities of the particles are increased by a value equal to the infiltration rate in the basin; C) Infiltration practices differ from typical dry basins because they have the ability to meet groundwater recharge needs; D) Because they can provide volume control, Sand Filter/Infiltration Basins can effectively address the issues of increased frequency and duration of peak flows providing downstream channel protection; E) Because they operate by infiltration of runoff into the subsurface soils, Sand Filter/Infiltration Basins are able to prevent the thermal impacts issues associated with extended detention and retention ponds.

Because Sand Filter/Infiltration Basins can vary considerably in size they can be applied to both large scale and small scale areas or properties. They are best suited to sites where runoff is concentrated such as developments with parking lots and transportation corridors. However, they can be applied, in some cases, to single family properties where runoff converges to a single or just a few points on the property. Therefore, this BMP can be used instead of Rain Garden bioretention systems.

Vegetated Filter Strips:

Filter Strips are vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and by providing some infiltration into underlying soils. The key to sediment and pollutant removal is the use of dense, usually native, plantings. Current research indicates

vegetated filter strips can remove as much as 75 to 85% of nutrients and 85% of sediments. Vegetated Filter Strips are most effective when the strip is a minimum of 50 feet wide and slopes are no more than 15%. Therefore, they are recommended for use in large commercial, industrial, institutional and residential development where adequate land can be dedicated to constructing the filter at the recommended minimum width. It should also be noted that Vegetated Filter Strips are not recommended for use adjacent to large impervious surfaces such as parking lots or transportation corridors to control runoff. Instead, they should be developed in conjunction with large lawn areas and/or roof top runoff.

Also, it should be noted that many streams have or had natural vegetated strips called riparian buffers. Communities and property owners should be encouraged to preserve, protect and/or restore the riparian buffers that occur with any tributary or the main channel of Watkins Creek.

Porous Pavement:

Porous or permeable paving is a range of materials and techniques for paving roads, cycle-paths, parking lots and sidewalks that allow the movement of water and air around and through the paving material. Its greatest impacts are in reducing the amount of storm water runoff being directed to streams and allowing for groundwater recharge. The actual pollutant removal occurs as a result of the exfiltration or percolation of runoff through the pavement into the subsoil where the pollutants are removed through adsorption or straining. Current research indicates porous pavement can remove as much as 75% of Phosphorus, 30% of nitrogen, and 100% of sediments. The key to continued and efficient pollutant removal is proper maintenance to prevent the porous surface becoming clogged.

The use of porous pavement has some limitations. First and foremost, porous pavement systems are not adequate for high volume and heavy loads such as those found in roadways or parking lot drive lanes. Second, porous pavements require regular maintenance to retain their porosity. This usually entails quarterly sweeping to remove sediments which will tend to fill the pores or openings that allow runoff percolation. Third, the actual and perceived cost of porous pavements can be considered high in comparison to traditional paving. However, when the cost of substituting other storm water BMPs that have no dual benefit is factored in, the cost comparison is much more favorable. Additionally, as advancements are made in technology and the use of porous pavements become more common the costs are expected to decrease.

Based on these factors, porous pavement is best applied to small parking areas or overflow parking areas in commercial, industrial, and institutional developments. Additionally, porous pavements are quite adequate for use in sidewalk, driveway, and traditional landscape applications found in residential development, both multi and single family.

Septic Systems

At this time inadequate data exists to accurately quantify the number of septic systems within the Watkins Creek watershed. Updated information from MSD indicates that 600 parcels within the watershed are not served by the sewer district. Any of these parcels that are developed would likely

have a septic system or other type of sewage treatment. St. Louis County stopped recording separate information on septic systems in the 1990's.

However, in brief discussions with a number of residents it has been clearly stated that they are aware of properties which have currently functioning septic systems which are not included in the inventory. It can also be argued that the levels of E. Coli monitored in Watkins Creek exceed the levels one would anticipate from infrequent sanitary sewer overflows, pet waste, or the few septic systems on record with MSD. Therefore, it seems prudent that the implementation of the management plan include an in-depth survey and documentation of the actual number of septic systems existing in the watershed. An accurate survey would allow adjustments in the plan to reflect the true nature of the problem and focus on eliminating septic systems as a source of E. Coli.

Sanitary Sewer Overflows

Over a three year monitoring period the existing Sanitary Sewer Overflows were active ten times in total. Although this may seem insignificant any discharge of raw sewage into the watershed is bound to have considerable impact on water quality. Therefore, it would seem sensible to make efforts to reduce or eliminate overflows. This will require a concerted effort to find sources of storm water runoff entering the sanitary sewer system. While implementation of the above mentioned BMPs may have some effect it should be noted that most of the sources are more likely unidentified connections of storm drains (downspouts, floor grates, and/or outdoor inlets) in older neighborhoods.

To deal with this issue will require a coordinated effort between MSD, local agencies, and property owners. Doing so will greatly reduce the mix of storm water with the sanitary sewer system and minimize or eliminate overflows which will reduce E. Coli levels.

Chloride

The question of whether soil at the site of the former highway maintenance facility at Hwy 367 and I-270 was contaminated with salt or not was similar to the septic tank issue. There was little data available. However, the data could readily be developed through soil testing. Two soil samples were taken of the site on May 15, 2012 from two test borings. Analysis of the soil samples indicated that chloride exceeded 474.1 and 791.6 ppm respectively. Using this information along with the aerial photography indicating the existence of the former Highway Maintenance facility, a report has been filed with MDNR to, hopefully, begin the process of remediation for the site. Appropriate organizations have been notified so that follow-up can be conducted to insure that the remediation occurs.

Non-structural –

Monitoring and Maintenance

Vegetated Filter Strips:

As noted in the Structural Section under Vegetated Filter Strips, existing riparian buffers along Watkins Creek and its tributaries are natural vegetative strips. Property owners should be

encouraged to preserve, protect, and in some cases enhance these riparian buffers. Municipalities and county government should be encouraged to improve or implement policies through ordinance and/or regulations that protect existing riparian buffers. If circumstance requires the removal of plant material, removal should be minimized. Replanting should be done using native plant species.

While maintenance is minimal, vegetated filter strips and riparian buffers are not maintenance free. Proper maintenance is required for maximum effectiveness of the filtering qualities of the strip. This is especially true when the strip has been recently installed. These steps are recommended for proper maintenance:

1. Inspect regularly and frequently, especially after heavy rainfall and runoff events of long duration or flooding. The filter strips should be checked for damage, particularly erosion, and debris.
2. Minimize the development of erosion channels within the filter. Even small channels may allow much of the runoff from the drainage area to bypass the filter. These areas should be repaired immediately to help ensure proper flow of runoff through the filter.
3. Reseed or interseed bare areas of the filter and replace trees or shrubs that have died. Since it may be difficult to re-establish vegetation in an established filter strip, the use of mulch can help to reduce some problems.
4. If the vegetated filter strip is a native plant grass/wildflower stand mow and remove hay as required to maintain moderate vegetation height. Mowing two to three times per year may be necessary. The vegetation should not be mowed closer than 6 inches. If haying is not desirable (or allowed), more frequent mowing may be needed to prevent thatch buildup and smothering of vegetation. To avoid destruction of wildlife nesting areas, delay mowing until after mid-July. Fall mowing of the filter no closer than 6 inches will provide adequate winter habitat for wildlife.
5. Control invasive trees, brush, and perennials in the filter using either mechanical means or herbicides. Contact their county Extension office for recommendations on the proper methods of controlling invasive species.

Septic Systems:

In order to operate efficiently septic systems need regular maintenance. Many homeowners may not know this. Maintenance must be conducted on the septic tank as well as the drainfield. Maintenance requirements should be well known by property owners. Municipalities and county government should be encouraged to improve or implement policies through ordinance and regulations that require proper maintenance. These policies should then be enforced. If necessary, agencies should consider providing incentives to property owners to properly maintain their systems. At a minimum, maintenance should include the following:

- Minimize amount of water flowing into the septic system; typical water use is about 50 gallons per day for each person in the family. Too much water can overload the system.
- Do not add materials (chemicals, sanitary napkins, applicators, and so on) other than domestic wastewater.
- Restrict the use of garbage disposal.

- Do not pour grease or cooking oils down the sink drains.
- Every property owner should make a diagram showing the location of their tank and drainfield and repair area.
- Each septic tank should have a watertight concrete riser installed over the septic tank to simplify access.
- Solids should be pumped out of the septic tank every 3 to 5 years.
- Adequate vegetative cover should be maintained over the drainfield. This will absorb water and acts as a filter.
- Keep surface waters away from the tank and drainfield. Redirect storm water away from drainfield. Never let storm water accumulate and pond over drainfield.
- Keep automobiles and heavy equipment off the system. Autos and equipment will compress the soil and reduce the ability of the drainfield to operate properly.
- Do not plan any building additions, pools, driveways, or other construction work near the septic system or the repair area.

Pet Waste Control:

When pet waste is left in place E. Coli is leached into the soil or directly into the stream through rainfall and runoff. (A USGS study of St. Louis streams indicates that approximately 10% of E. Coli comes from dog waste.) Steps should be taken to encourage pet owners to clean up their pet's waste regularly and frequently. Municipalities, neighborhood associations, and other agencies can coordinate and promote a "pet waste elimination program". Many park systems have implemented a program of providing bags in parks for waste clean up. This should be expanded for all parks, trails, and greenway systems. Pet owners should be encouraged to pick up their pet's waste and flush it down the toilet or added to the trash to go to the landfill. Composting and the use of advertised "pet waste digesters" should be discouraged. Composting has the same impact as leaving the waste in the yard. The E. Coli ends up in the soil and is leached into streams. Current design of pet waste digesters allow them to operate as an inefficient septic system with the drainage being loaded with E. Coli.

In addition to the traditional dog and cat households, homeowners that may have horses or other farm animals should be encouraged to graze and stable their animals away from Watkins Creek and its tributaries to minimize direct entry of E. Coli into the streams.

Illicit Discharge Monitoring:

The Metropolitan Saint Louis Sewer District (MSD) currently monitors the Watkins Creek watershed for illicit discharge. This practice should continue. In addition it is suggested that MSD promote the participation of property owners in the observation and reporting of any unusual events that may be resulting in sewage discharge into the stream.

Yard Waste:

Yard waste has an indirect impact on water quality in streams. As the yard waste decomposes nutrients are released that encourage bacteria growth. If yard waste is dumped or discarded on or near stream banks these nutrients quickly enter the stream. Some research has indicated that

high concentrations of nutrients prolong the presence of bacteria in a stream. Therefore, municipalities and county government should be encouraged to improve or implement policies through ordinance and/or regulations that discourage yard waste dumping on stream banks. These policies should then be enforced. As part of periodic volunteer stream clean up programs assistance could be provided in the removal and proper disposal of yard wastes.

Street Sweeping:

While regular and frequent street sweeping may be considered an extra expense for most communities, new research is indicating that it can be an effective non-structural method of significant pollution reduction. This research indicated that as little as 1 kilogram or 2.2 pounds of street dirt could contain millions of colony forming units (CFU) of fecal coliform, an indicator of animal or human waste. In addition, the street dirt contributes to sediment loads in the stream as well as significant levels of Phosphorus, one of the unwanted nutrients in streams, and other pollutants. Street sweeping may be one of the most cost effective methods of reducing pollutant loads as it removes the sources before they enter the storm water system reducing the need for construction of structural BMPs to remove the pollutants.

Governments should be encouraged and supported in efforts to implement or increase regular and frequent street sweeping on all streets not just major arteries. Street sweeping programs could also include a fall leaf pickup as leaves also contribute to nutrient loads as they decompose.

Chloride Reduction:

Realistically, the way to reduce chloride in Watkins Creek is to properly manage and control salt usage to reduce the amounts used during the winter on streets, parking lots, sidewalks, and driveways as well as to properly store salt. Steps to proper management and control included:

a. Plow and/or shovel early and often
b. Rock salt (sodium chloride) does not work below 15 degrees. Switch to calcium chloride (it does not take as much to work) or sand at low temperatures.
c. Use the right amount. Rock salt should not be applied at greater than 4 lbs per 1000 sf.
d. Clean up excess amounts from spills or over application.
e. Switch to other deicers such as one of the acetate based products which have fewer environmental impacts.

Government agencies are probably employing many of these steps. However, regular training and monitoring will reinforce these management tools. As for property owners and private contractors who plow and salt during the winter, it is important that agencies have proper policies in place to insure appropriate salt usage. In addition, dissemination of information and monitoring of usage is critical.

Code Enforcement:

The development of policies and the passage of ordinances by municipalities and county governments are only steps in insuring that actions are taken to reduce pollution of Watkins Creek. For policies and ordinances to be successful requires enforcement. This can be a costly, but necessary, undertaking. Organizations, business leaders, and property owners need to encourage and support government officials' efforts to enforce ordinances that reduce pollution of streams.

Also, efforts to develop and implement policies and ordinances that require the use of the BMPs that are listed in this document should be encouraged and supported by the entire Community.

Educational

Septic System:

In order to insure that remaining septic systems are properly maintained it will be important to. provide education to eligible homeowners regarding proper septic system maintenance. This can take the form of printed information, workshops, or personal contacts.

Pet Waste Control:

Many people do not see pet waste as a problem. To help them understand it will be critical for agencies and organizations to cooperate on developing and implementing an education program regarding benefits of pet waste management. As with septic systems this may take the form of printed information, workshops, or personal contacts. Because of the nature of the problem it may be necessary to provide repeated contact with the educational information as well as incentives to insure that the majority of pet owners comply.

Chloride reduction:

Along with monitoring the most important component of reducing chloride levels is the implementation of an education program regarding proper salt usage. This program can be divided into a government agency component and a property owner component. It may be that most agencies already have an education or training program. In this event, support for occasional refresher courses may be all that is required. For property owners printed materials, occasional news articles, and/or public service announcements may provide the required educational information.

Yard Waste:

As with pet waste, many people do not see a problem with dumping yard waste near or on a stream bank. Agencies and organizations need to cooperate on developing and implementing an education program regarding the negative impacts of yard waste disposal on stream banks.

Impacts:

Structural

Positive:

The addition of such as bioretention, vegetated filter strips, and porous pavements will provide positive results in the reduction of pollutants by capturing and filtering storm water. This will also result in increased time of concentration flows to the creek and its tributaries reducing rapid increases in flow rates decreasing channel erosion and the chance of flash floods. When designed properly most of the new BMPs can have a secondary benefit of being aesthetically pleasing and beautifying the area in which they are installed.

Reducing or eliminating septic systems and sanitary sewer overflows can rapidly reduce the E. Coli levels in the creek once the change is fully implemented. Other positive aspects may be secondary related to aesthetic appeal of the creek related to overall water quality

Remediation of the former salt storage facility will eliminate or greatly reduce the year-round levels of chloride measured in the creek. However, there will be continued seasonal increases in chloride levels.

Negative:

To design and construct the new BMPs will require funding and space. Much of the proposed work may occur during the current economic downturn when government revenues are lower than normal. Without incentives the community may resist or be reluctant to participate in the implementation of the new BMP measures. Additionally, the new BMPs require space to install which may reduce the amount of land available to property owners for future expansion or other use.

Non-structural

Positive:

Increased or improved monitoring and maintenance should actually reduce costs in some areas. While the cost of monitoring may increase, finding and correcting problems with BMPs, septic systems, or sanitary sewer systems when they first occur usually result in lower maintenance and/or repair costs. Finding and correcting violations in pet waste or yard waste disposal will minimize pollution from these sources.

Negative:

Implementation of the non-structural measures will result in increased costs unless a revenue source can be identified. This may result in resistance to implementing the non-structural recommendations.

Education:

Positive:

The most positive aspect of the recommended education measures is the ease of developing educational programs. The cost is relatively low on a per unit basis and when properly implemented can reach and influence a very broad audience. Additionally, assuming the educational programs are effective, they will have significant affect on pollutant levels in the creek.

Negative:

The only negative impact that could be identified for the educational management measures might be a reluctance of the target audience to accept some of the recommended changes they would have to make for the measures to be effective.

Priorities:

In some cases the implementation of proposed measures to reduce pollutant loads is based on land use type. However, Watkins Creek is a small watershed and data of pollutant loads by land use type was not available. Therefore, it was deemed more practical and effective to base priorities on immediacy of impact, time needed to implement measures, and costs. Basically, those measures which resulted in the greatest reduction in pollutant levels in the shortest period of time, could be constructed or implemented quickly, and had lower costs would be at the top of the priority list.

Using these criteria a matrix was developed listing the proposed measures, immediacy of impact, time to implementation, and relative costs. Implementation, time, and costs could be scored. Using the cumulative score for each measure priorities could then be established. The results are shown in Table 4-1 beginning on the next page.

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Table 4-1 – Proposed Management Measures Priorities

Management Measures	Management Objectives	Impact	Timeline	Cost	Total Score	Priority
Structural						
Bioretention	a. Retrofit parking areas with bioretention systems.	3	3	2	8	**1**
	b. Install bioretention systems at street or other drainage points on homeowner property.	1	2	3	6	**3**
Wetland Detention	a. Convert dry basins to wetland detention basins.	3	3	2	8	**1**
Sand Filter/ Infiltration basins	a. Retrofit commercial, industrial, institutional, and multi-family residential parking areas with sand filter/infiltration basins	2	2	2	6	**3**
	b. Install sand filter/infiltration basins on appropriate residential property.	1	1	3	5	**4**
	c. Retrofit sand filter/infiltration basins along major transportation corridors or new roadway construction.	3	2	2	7	**2**
Vegetative Strips	a. Install vegetative strips along existing streams and intermittent waterways.	3	2	3	8	**1**
Porous Pavement	a. Retrofit parking and driveway pavement with porous pavement materials	2	2	1	5	**4**
	b. Install porous pavement in appropriate new construction	2	1	1	4	**5**
Septic systems	a. Remove existing septic and connect to sanitary sewer line and eliminate septic system.	3	2	1	6	**3**
Sanitary Sewer Overflows	a. Modification of sanitary sewer overflows to reduce or eliminate overflows	3	2	1	6	**3**
Chloride reduction	a. Remediate former site of salt storage facility.	3	2	2	7	**2**

1 Point = Minor impact, long timeline, or high cost **2 Points – Average impact, moderate timeline, or medium cost** **3 Points = Major impact, short timeline, or low cost**

Management Measures	**Management Objectives**	**Impact**	**Timeline**	**Cost**	**Total Score**	**Priority**
Non-Structural						
Vegetative Strips	a. Managing and maintain existing riparian buffers along stream.	3	1	1	5	**4**
Septic systems	a. Properly maintain septic systems	3	2	3	8	**1**
Pet waste control	a. Develop and implement pet waste elimination program.	3	2	2	7	**2**
Illicit discharge monitoring	a. Monitor streams for illicit connections, failing septic systems, or problems with existing sewer line crossings/ manholes.	1	1	3	5	**4**
Yard waste disposal	a. Support periodic stream clean-ups.	1	3	3	7	**2**
	b. Monitor streams & identify sources of stream bank dumping. Provide assistance to landowners in removal of dumped material.	2	2	2	6	**3**
Street Sweeping	a. Promote effective street sweeping and leaf pickup to reduce pollutants washing into streams	3	1	1	5	**4**
Chloride reduction	a. Develop coordinated salt usage monitoring program with pertinent agencies.	3	1	3	7	**2**
Code enforcement	a. Support enforcement of existing codes regarding of Structural & Non-structural management measures	2	2	2	6	**3**
	b. Support development and implementation of regulations that require the use of the above listed BMP.	2	1	3	6	**3**

1 Point = Minor impact, long timeline, or high cost **2 Points – Average impact, moderate timeline, or medium cost** **3 Points = Major impact, short timeline, or low cost**

Management Measures	**Management Objectives**	**Impact**	**Timeline**	**Cost**	**Total Score**	**Priority**
Educational						
Septic systems	a. Provide education to eligible homeowners regarding proper septic system maintenance.	3	3	3	9	**1**
Pet waste control	a. Develop and implement education program regarding benefits of pet waste management.	3	3	3	9	**1**
Chloride reduction	a. Develop and implement education program to reduce salt usage by agencies.	2	2	3	7	**2**
	b. Develop and implement education program to reduce salt usage by public.	1	2	3	6	**3**
Yard waste disposal	a. Develop and implement education program regarding the negative impacts of yard waste disposal on stream banks.	1	3	3	7	**2**

1 Point = Minor impact, long timeline, or high cost **2 Points – Average impact, moderate timeline, or medium cost** **3 Points = Major impact, short timeline, or low cost**

Implementation:

Economics

In order to obtain and maintain the widest level of support in the community for the proposed management measures they must not place an undue burden on the individual property owner or government agencies. Therefore, many of the structural and some of the non-structural measures will need to be supported, at least in the beginning, with financial incentives to cover a portion of the development costs. Support could be in the form of grant funds, technical expertise, or project management from organizations. However, it should be understood that not all the costs can be offset by other support. Government agencies, the business community, and individual property owners will need to share some portion of the costs of implementing this plan. How much is dependent on the level of grant funding and other support. Certainly, the associated costs can be amortized over a period of time by phasing and scheduling the implementation of proposed measures over several years.

Environmental Impact

The environmental impact of implementing the proposed management measures can only be positive. Each of the proposed management measures is intended to reduce the pollutant levels in Watkins Creek. Over time this should result in the stream being removed from the TMDL list.

"Do Nothing" Option

While this plan is based on the concept that action should be taken to reduce the levels of E. Coli, chloride, and other pollutants in Watkins Creek, the community has the option of electing to take no action in regards to minimizing these pollutants. The likely result of the "Do Nothing" option will be for the levels of E. Coli and chloride to remain at the same relative levels as have been measured since 2008. This will result in Watkins Creek continuing to be listed as an impaired water way and on the TMDL list. With this listing the community and the state will continue to be in violation of Federal regulations. Failure to take action can result in civil and, in some cases, criminal penalties.

CHAPTER 5: ELEMENT 5. – TECHNICAL AND FINANCIAL ASSISTANCE

This chapter includes a description of anticipated technical and financial resources for the watershed plan implementation. It should be noted that there are limitations of trying to identify long-term funds sources due to the vagaries of the economy, government budgets, and other funding sources. It will be necessary to identify and apply for funding sources continually to assure funding of projects and programs. As new information is obtained it will be incorporated into future plan updates and modifications.

Additionally, Table 5-1 describes the suggested order of implementation of management measures, the time requirements for implementing the plan, the unit cost based on available information, estimated development cost, as well as a listing of technical and financial resources for each management measure. Management measures are listed in the order of priority per category as indicated in Chapter 4, Table 4-1.

Technical and Financial Resources:

Metropolitan St. Louis Sewer District

Metropolitan St. Louis Sewer District (MSD) provides various creek monitoring activities and data, planning leadership, engineering technical expertise, and appropriate educational programs. In addition, MSD provides leadership on implementation of NPDES strategies in the watershed. They have been instrumental in providing technical resources for the planning process and it is anticipated they will continue to do so. Recent passage (2012) of a bond issue to finance major improvements means MSD will be committing additional funds related to upgrades and/or modifications to the sewer system including, possibly, SSOs. The District will also be approached to assist with funding to implement portions of the plan related to constructing BMPs.

Missouri Botanical Garden

The Missouri Botanical Garden (MBG) can provide technical expertise in the design of certain structural BMPs as well as selection of appropriate plant materials to be used.

Soil and Water Conservation District

The St. Louis Soil and Water Conservation District (SWCD) can provide technical assistance to help plan and apply the identified management measures. They can be used to consult with property owners regarding issues related to implementation of the watershed plan as well as provide assistance in relation to the educational programs. Finally, the SWCD is a resource for identifying potential sources of funding.

Greenway Network

Greenway Network (GN) is a regional conservation non-profit whose mission is, in part, to conserve natural resources and encourage sound management of the watersheds. Greenway provides technical assistance through its network of environmental education, water quality monitoring, and conservation

planning volunteers. As a 501-c-3 non-profit Greenway can also act as a conduit for funding for some grants that cannot otherwise be obtained.

Missouri Stream Team

Missouri Stream Team is a working partnership of citizens who are concerned about Missouri Streams. Trained volunteer(s) from Stream Team 3553 have been an integral part of the watershed planning process to date, providing water quality monitoring at no cost to the project. This technical assistance may continue into the foreseeable future or other Stream Teams can provide such services. Additionally, Stream Team members can provide assistance in education, stewardship (such as clean ups and tree plantings), and advocacy for policy and ordinance support or changes.

East West Gateway Council of Governments

East West Gateway (EWGCC) is the metropolitan planning organization (MPO) for the area. EWGCC is involved in many planning projects throughout the region. One focus is on storm water and water quality issues. EWGCC can provide technical expertise in planning related to the project, mapping services, and acts as a resource for identifying funding sources.

Spanish Lake Community Association

The Spanish Lake Community Association (SLCA) is a community non-profit organization formed to inform, motivate and organize the residents of Spanish Lake on issues that affect the quality of life in their unincorporated community. The SLCA can act as the overall umbrella organization for implementation of the watershed management plan. They can provide assistance in planning, implementing, and facilitating the educational management measures and assistance in organizing efforts to support or advocate for policy and/or ordinance changes. Additionally, they can assist in implementing many of the non-structural management measures through their contacts in the community.

Missouri Department of Natural Resources

The Missouri Department of Natural Resources (MDNR) provides technical expertise to assist in watershed planning and implementation efforts. MDNR is also a source of funding for implementation through the Department from the US EPA Region 7 under Section 319 of the Clean Water Act.

Missouri Department of Transportation

The Missouri Department of Transportation (MoDOT) is the main source of funding for transportation related projects within any highway right-of-way controlled by the department. Limited technical assistance may be available for implementation of management measures on or adjacent to these right-of-ways.

Municipalities and St. Louis County Government

The municipalities (Muni's) located in the watershed (Black Jack, Bellefontaine Neighbors) and St. Louis County government (St LC) can provide outreach, education, and administrative services related to the management measures. Some capital improvement funding and commitments for maintenance will be requested.

Other Funding and Assistance Source:

The following is a list of other potential sources of funding and assistance for the implementation of the watershed management plan and the proposed management measures.

Alternative Loan Program
Grow Native! Program
Missouri Wildlife Habitat Incentives Program (WHIP)
Missouri's Aquaculture Program
North Central Region(NCR)-SARE Professional Development Program Grant
North Central Region(NCR)-SARE Research and Education Grant Program
Conservation Contractor Training
Missouri Agroforestry Program
Missouri Watershed Management Assistance (MoWMA)
Missouri's Forest Keepers Network
Outdoor Classroom Grant, Missouri
United Sportsmen's League Wildlife Conservation Grant, Missouri
Community Development Block Grant (CDBG) Other Public Needs, Missouri
Community Development Block Grant Program (CDBG) Water and Wastewater, Missouri
Delta Regional Authority
Industrial Infrastructure Grant
Energy Revolving Fund
Land and Water Conservation Fund (LWCF) - Missouri
Living Lands and Waters-Educational Workshops
Missouri Brownfields Revolving Loan Fund
Missouri Energy Efficiency and Renewable Energy Set-Aside Program
Recreational Trails Program (RTP) - Missouri
Watershed Management Development Grant
Adopt-A-Highway Program, Missouri
Request An Expert Program
Scenic Byways Program
Transportation Enhancement Program, Missouri
Tools for Floodplain Management
Abandoned Well Plugging Program
Plant Diagnostic Clinic
University of Missouri Center for Agroforestry
Missouri Alternatives Center
Region 7 Pollution Prevention Regional Information Center

Table 5-1 – BMP Implementation Technical and Financial Estimate

Management Measures	Management Objective	Timeline	Unit Cost	Est. Development Cost	Technical Resources	Financial Resources
Structural						
Bioretention – up to 14,800 sy surface area total	a. Provide incentives to retrofit commercial, industrial, institutional, and multi-family residential parking areas with bioretention systems.	5 years	$ 63/cy up to 30% of total cost per property	$140,000	MSD, Muni's, St. LC, SWCD	MDNR, MSD, MDC, property owners, others
Up to 1,620 sy surface area total	b. Provide incentives for homeowners to install bioretention systems at street or other drainage points on property.	5 years	$ 63/cy up to 50% of total cost per property	$25,500	Muni's, St LC, Show Me Raingardens, MBG	MDNR, MSD, Muni's, St LC, property owners
Wetland Detention – up to 9 acre ft of basin	a. Provide incentives for any properties or subdivisions with existing dry detention basins to convert said basins to wetland detention basins.	5 years	$30,000/acre ft not to exceed 50% of total cost per property	$135,000 max.	MSD, Muni's, St LC, MDC, SWCD	MDNR, MSD, MDC, property owners, others
up to 22 acre ft of basin	b. Provide incentives for any properties or subdivisions with existing retention ponds/lakes to modify them to wetland detention basins.	5 years	$15,000/acre ft. not to exceed 50% of cost per property	$168,900 max.	MSD, Muni's, St LC, MDC, SWCD	MDNR, MSD, MDC, property owners, others
Sand Fltr/Infil. basins up to 16,900 sy surface area	a. Provide incentives to retrofit commercial, industrial, institutional, and multi-family residential parking areas with sand filter/infiltration basins	5 years	$ 45/cy up to 30% of total cost per property	$152,000	MSD, Muni's, St. LC	MDNR, MSD, property owners, others
Vegetative Strips up to 8 acres of veg.	a. Provide incentives for property owners to install vegetative strips along existing streams and intermittent waterways.	5 years	$2,000/acre up to 30% of total cost per property	$5,000	Muni's, St LC, MDC, SWCD, MBG, SLCA	MDNR, MSD, MDC, property owners, others
Porous Pavement between to 500,000 sf (paver) and 1,250,000 sf (asphalt)	a. Provide incentives to commercial, industrial, institutional, and/or multi-family residential property owners to retrofit parking and driveway pavement with porous pavement materials	5-10 years	$ 4/sf asphalt $ 5/sf concrete $ 10/sf paver up to 30% of total cost per property	$1,500,000	MSD, Muni's, St. LC	MDNR, MSD, property owners, others
Septic systems Up to 120 systems	a. Provide incentives to eligible homeowners to connect to sanitary sewer line and eliminate septic system.	5 years	$10,000/system not to exceed 50% of total cost per property	$600,000 max.	MSD, Muni's, St. LC	MDNR, MSD, property owners, others
Sanitary Sewer Overflows	a. Coordinate modification of sanitary sewer overflows to reduce or eliminate overflows	TBD by MSD	TBD by MSD	TBD by MSD	MSD	MSD
Chloride reduction	a., Based on findings, work with appropriate agency to insure remediation of former site of salt storage facility.	TBD by MoDOT	TBD by MoDOT	TBD by MoDOT	MoDOT, SLCA	MoDOT

Abbreviations:

MSD – Metropolitan St. Louis Sewer District
Muni's – Municipalities
St. LC – St. Louis County
MBG – Missouri Botanical Garden
SWCD – Soil and Water Conservation District
Stream Teams – Missouri Stream Team(s)
EWGCC – East West Gateway Council of Governments
SLCA – Spanish Lake Community Association
MDNR – MO. Dept of Natural Resources
GN – Greenway Network
MoDOT – Missouri Dept. of Transportation
TBD – To Be Determined

Management Measures	Management Objective	Timeline	Unit Cost	Est. Development Cost	Technical Resources	Financial Resources
Non-Structural						
Vegetative Strips Up to 180 acres	b. Provide assistance to communities and property owners in managing and maintaining existing riparian buffers along stream.	1 year to initiate then ongoing	$750/acre up to 30% of total cost per property	$40,500 max. initial cost then support through stream clean ups	MDC, GN, Stream Teams, SLCA	MDC, others
Septic systems	a. Conduct survey for unidentified septic systems. Document and map information.	1 year	$10,000 one time cost	$10,000	MSD, EWGCC, SLCA, University	MDNR, MSD, others
	b. Provide incentive to eligible homeowners to properly maintain septic systems	1 year to initiate then ongoing	$50 reimbursed every 3 yrs after proof of pumping	$3,000 based on actual numbers found in survey	Munis, St LC	MDNR, MSD, MDC, property owners
Pet waste control	a. Develop and implement pet waste elimination program.	3 years to initiate then ongoing	$25,000 to initiate program	$25,000	MSD, SLCA	MSD, Muni's, St LC, others
Illicit discharge monitoring	a. Develop and maintain map of streams, storm sewers, and outfalls	TBD by MSD	TBD by MSD	TBD by MSD	MSD	MSD
	b. Monitor streams for illicit connections, failing septic systems, or problems with existing sewer line crossings/ manholes.	TBD by MSD	TBD by MSD	TBD by MSD	MSD, SLCA	MSD
	c. Pursue elimination of any illicit discharges into stream.	TBD by MSD	TBD by MSD	TBD by MSD	MSD	MSD
Yard waste disposal	a. Support periodic stream clean-ups.	Ongoing	$200 every year	N/A	MDC, GN, Stream Teams, SLCA	MSD, MDC, Muni's, St LC
	b. Monitor streams & identify sources of stream bank dumping. Provide assistance to landowners in removal of dumped material.	3 years to initiate then ongoing	$10,000/year	$30,000	Muni's, St LC, SLCA	Muni's, St LC, others
Street Sweeping 240 curb miles, 6 times per year	a. Promote affective street sweeping and leaf pickup to reduce pollutants washing into streams	5-10 years to full implementation	$45/curb mile/year/pass	$ 324,000 for 5 years	Muni's, St LC	MDNR, MSD, Muni's, St LC, others
Chloride reduction	a. Develop coordinated salt usage monitoring program with pertinent agencies.	2 years to initiate then ongoing	$ 0	$ 0	Muni's, St LC	MSD, Muni's, St LC
Code enforcement	a. Support enforcement of existing codes regarding use of above listed BMPs.	1 year to initiate then ongoing	$ 0	$ 0	Muni's, St LC, SLCA	Muni's, St LC
	b. Support development and implementation of regulations that require the use of the above listed BMP.	2 year to initiate then ongoing	$ 0	$ 0	Muni's, St LC, SLCA	Muni's, St LC

Abbreviations:

MSD – Metropolitan St. Louis Sewer District
Muni's – Municipalities
St. LC – St. Louis County
MBG – Missouri Botanical Garden
SWCD – Soil and Water Conservation District
Stream Teams – Missouri Stream Team 3553 or others
EWGCC – East West Gateway Council of Governments
SLCA – Spanish Lake Community Association
MDNR – MO. Dept of Natural Resources
GN – Greenway Network
MoDOT – Missouri Dept. of Transportation
TBD – To Be Determined

Management Measures	**Management Objective**	**Timeline**	**Unit Cost**	**Estimated Cost**	**Technical Resources**	**Financial Resources**
Educational						
Septic systems	a. Provide education to eligible homeowners regarding proper septic system maintenance.	1/2 year to initiate	$3,500 initial cost - $900/yr afterward	$3,500	MSD, Muni's, St LC, SLCA	MDNR, MSD, Muni's, St LC, others
Pet waste control	a. Develop and implement education program regarding benefits of pet waste management.	1/2 year to initiate	$3,500 initial cost - $1,500/yr afterward	$3,500	MSD, GN, SLCA	MDNR, MSD, Muni's, St LC, others
Chloride reduction	a. Develop and implement education program to reduce salt usage by agencies.	1/2 year to initiate	$500 initial cost - $200/yr afterward	$500	MSD, Muni's, St LC	MSD, Muni's, St LC
	b. Develop and implement education program to reduce salt usage by public.	1 year to initiate	$3,500 initial cost - $900/yr afterward	$3,500	MSD, Muni's, St LC, SLCA	MDNR, MSD, Muni's, St LC, others
Yard waste disposal	a. Develop and implement education program regarding the negative impacts of yard waste disposal on stream banks.	1 year to initiate	$3,500 initial cost - $900/yr afterward	$3,500	MDC, GN, Stream Teams, SLCA	MDNR, MSD, MDC, property owners, others
Associated tasks & expenses						
Project Management (First 5 years only)	Costs associated needed for selected project manager to plan, organize, secure, and manage resources to insure that progress is made in implementing management measures	5 years	$45,000/yr	$225,000		MDNR, others
Design development (20%)	Costs associated with development of necessary construction documents needed to proceed with construction of identified BMPs	5 to 10 years max.		TBD	MSD	MDNR, others
Implementation costs	Costs related to implementing watershed management plan including supplies, travel, equipment, and other expenses	5 years	$10,000	$50,000		MDNR, others
On-going water quality monitoring	Costs related to continued water quality testing to ascertain affect of management measure implementation.	ongoing		TBD	Stream Team	MDC, others

Abbreviations:

MSD – Metropolitan St. Louis Sewer District
Muni's – Municipalities
St. LC – St. Louis County
MBG – Missouri Botanical Garden
SWCD – Soil and Water Conservation District
Stream Teams – Missouri Stream Team 3553 or others
EWGCC – East West Gateway Council of Governments
SLCA – Spanish Lake Community Association
MDNR – MO. Dept of Natural Resources
GN – Greenway Network
MoDOT – Missouri Dept. of Transportation
TBD - To Be Determined

Cost Estimating Methodology

Unit prices for structural BMPs such as bioretention, sand filter/infiltration basins, etc. were provided by MSD. Unit prices for septic systems and street sweeping were based on internet research and averaging several sources. Costs for implementing other non-structural projects and educational programs were based on extensive experience of Greenway Network and Confluence staff which have planned and implemented such programs in the past.

Calculating total estimated costs for implementing structural BMPs proved to be difficult. While the results of calculating load reductions in Chapter 3 gave us the amount of affective area coverage by land use type it could not provide us the number of bioretention units, square footage of porous pavement, or number of sand filter/infiltration basins that needed to be installed to capture the storm water for the required affective area. Since these BMPs are tied to commercial, industrial, institutional, and multi-family properties and their parking areas, it would have been necessary to be able to calculate the drainage area for each property and then apply appropriate unit-to-drainage area ratios to ascertain the number of BMP units needed.

Enough information could be collected from aerial photography to develop approximate number of units to be implemented to meet the plan requirements. These units were used along with unit prices to calculate estimated development costs for those measures where it is indicated.

Long-term Monitoring and Maintenance

During the first five years of the implementation of the watershed management plan it is anticipated that the monitoring of the development and success of the management measures will be a shared responsibility and collaborative effort between various agencies and organizations involved in the implementation process. During the preparation of the WMP monitoring was conducted by Stream Team 3553. It is anticipated that future monitoring will be conducted by Stream Team personnel from other Stream Teams with support from the agencies and organizations involved in implementation of the WMP. Once a significant portion of the implementation is completed (Year 5) it is expected that the municipalities and St. Louis County will assume responsibility for most monitoring and maintenance except for those functions now held by other agencies such as MSD.

CHAPTER 6: ELEMENT E. - PUBLIC INFORMATION & EDUCATION

The Watkins Creek watershed holds many opportunities for education on an urban stream. Education outlets include outreach through schools, youth organizations, and local community associations, building awareness through media and signage, encouraging participation in Stream Team activities, and reaching out to partners for further informational and educational opportunities. Outreach has already begun through schools such as Christ Light of the Nation in Spanish Lake through litter pick-up events and presentations. The Spanish Lake Community Association has also served as a public forum to raise watershed issues and inform the public of current efforts. The media has also been targeted through several articles being written and an appearance on the Gateway Television News Network with City of Blackjack's Mayor, Norm McCourt. Discussion within the Watkins Creek watershed committee has yielded the idea of signage being placed near bridge crossings at Watkins Creek to create awareness. In addition, signage such as "Now Entering Watkins Creek Watershed" has also been discussed to add public visibility. The encouragement of Stream Team participation has also been posted in the Spanish Lake Community Association newsletter. Partner involvement will also play a key role. For example, the Metropolitan St. Louis Sewer District can provide an Enviroscape Watershed Model to help demonstrate storm water runoff. This can be used in schools and other forums. The Missouri Department of Conservation at Columbia Bottom Conservation Area also offers free public programming and is able to provide watershed education and curriculum for teachers. They have also offered to help promote upcoming events.

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Determining the I/E goals and objectives:

1) Recruit 3-5 new members to Stream Teams to participate in multiple sessions of monthly data collection through the Missouri Stream Team Program in the next five years.
2) Host 5-10 litter pick-up events in the Watkins Creek watershed in the next five years.
3) Educate and make aware of *E. Coli* and chloride in conjunction with storm water runoff to community groups and schools, resulting in ten public presentations in the next three years.
4) Implement educational programs such as yard waste removal, pet waste removal, and composting alternatives.
5) Produce signs that indicate the Watkins Creek watershed's boundaries.
6) Publish updates on continuing Watkins Creek watershed efforts in the Spanish Lake Community Association newsletter and other media outlets on a quarterly basis.
7) Maintain a public website or facebook page updating the community and other interested parties on current Watkins Creek efforts, data collected, and educational material.
8) Facilitate communication between municipalities on best management practices.

Targeting the audience:

Watershed Residents

With 65% or 2,795 acres of the land-use being residential, those owning or renting property in the watershed will be targeted.

Business Owners and Industry

11.2% or 482 acres of the land-use is commercial and industrial. A focus on best management practices for business and industry will also be necessary.

Schools and Community Organizations

Schools are a great way to provide information to youth which is then taken back home to the extended family. Working with interested schools will also be a key focal point. Community Organizations which can often host over 200 residents and business owners in the watershed will also be a priority.

Creating a message:

Clean Water for Everyone

By ensuring our waters are clean, we reap many rewards. Clean water promotes physical well-being as our source waters. It also enriches our lives by providing many recreational opportunities and memorable experiences. In addition, clean water helps plants and wildlife thrive for all to enjoy.

Volunteering is Fun

You can make a difference volunteering in your own community and have a lot of fun doing it. The satisfaction of knowing what good you have done makes it well worth it.

Good Citizens

Good citizens are models to those around them. By picking up your pet's waste, properly disposing of litter or yard waste, and using your own best management practices at home, you are doing your part as a good citizen.

We All Live Downstream

What we do in our own community will impact communities downstream. As responsible watershed communities, best management practices that can be implemented in an upstream community will help those downstream.

Packaging and distributing the message for various audiences:

A combination of methods will be used:

Mass Media- Articles written in the Spanish Lake Community Association and other local publications will be used to reach the community as whole. Maintaining a webpage or facebook page that holds current work, upcoming programs, and educational information can also be made available.

Printed Materials- For use in schools and at special events, printed fact sheets and brochures will be a great asset. These can also be passed out at association meetings and located on the designated Watkins Creek web page. Large signage indicating the Watkins Creek watershed should be located when entering the watershed. This will require MoDOT's cooperation and support.

Evaluating the I/E program:

- Track how many visits there are to Watkins Creek web page or followers on facebook
- Track increase in participation in stream team activities
- Track amount of litter pick-up events and amount of litter picked up in watershed
- Give informal post tests/surveys to community groups/schools

CHAPTER 7: ELEMENT F. - SCHEDULE

Chapter 4 identified management measures and objectives to address issues and concerns in the Watkins Creek Watershed. Chapter 5 further described technical and financial support for those management measures. The chart below provides more detail by outlining tasks associated with objectives, identifying potential responsible agencies, organizations, or individuals, and laying out a timeline for implementing those tasks on a quarterly basis. The timeline intentionally does not use a specific year since the actual start date of the project would be based on receipt of appropriate funding.

Management Measures	**Management Objective**	**Responsible Parties**	**Timeline**
Structural			
Bioretention	a. Provide incentives to retrofit commercial, industrial, institutional, and multi-family residential parking areas with bioretention systems.	SLCA, Muni's, St LC, SWCD, MSD	5 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 1
	2. Begin marketing incentive program & selecting initial participants		Yr. 1, Qrtr 2
	3. Begin design development for initial round of selected participants		Yr. 1, Qrtr 3
	4. Begin construction of bioretention		Yr. 1, Qrtr 4
	5. Continue program		Yrs 2-4
	6. End marketing of incentive program		Yr. 5, Qrtr 1
	7. Select final participants		Yr. 5, Qrtr 2
	8. Close out design development		Yr. 5, Qrtr 3
	9. Complete construction & close out program		Yr. 5, Qrtr 4
	b. Provide incentives for homeowners to install bioretention systems at street or other drainage points on property.	SLCA, Muni's, St LC, SWCD	5 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 1
	2. Begin marketing incentive program & selecting final participants		Yr. 1, Qrtr 2
	3. Begin design development for initial round of selected participants		Yr. 1, Qrtr 3
	4. Begin construction of bioretention		Yr. 1, Qrtr 4
	5. Continue program		Yrs 2-4
	6. End marketing of incentive program		Yr. 5, Qrtr 1
	7. Select final participants		Yr. 5, Qrtr 2
	8. Close out design development		Yr. 5, Qrtr 3
	9. Complete construction & close out program		Yr. 5, Qrtr 4
Wetland Detention	a. Provide incentives for any properties or subdivisions with existing dry detention basins to convert said basins to wetland detention basins.	SLCA, Muni's, St LC, MSD	5 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 2
	2. Begin contacting appropriate property owners		Yr. 1, Qrtr 3
	3. Begin design development for initial round of participants		Yr. 1, Qrtr 4
	4. Begin construction of wetland detention		Yr. 2, Qrtr 2
	5. Continue program		Yrs 2-4
	6. End contacting appropriate property owners		Yr. 5, Qrtr 1
	7. Close out design development		Yr. 5, Qrtr 2
	8. Complete construction & close out program		Yr. 5, Qrtr 4
	b. Provide incentives for any properties or subdivisions with existing retention ponds/lakes to modify them to wetland detention basins.		5 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 2
	2. Begin contacting appropriate property owners		Yr. 1, Qrtr 3
	3. Begin design development for initial round of participants		Yr. 1, Qrtr 4

	4. Begin modifications of retention to wetland		Yr. 2, Qrtr 2
	5. Continue program		Yrs 2-4
	6. End contacting appropriate property owners		Yr. 5, Qrtr 1
	7. Close out design development		Yr. 5, Qrtr 2
	8. Complete construction & close out program		Yr. 5, Qrtr 4
Sand Filter/ Infiltration basins	a. Provide incentives to retrofit commercial, industrial, institutional, and multi-family residential parking areas with sand filter/infiltration basins	SLCA, Muni's, St LC, SWCD, MSD	5 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 1
	2. Begin marketing incentive program & selecting initial participants		Yr. 1, Qrtr 2
	3. Begin design development for initial round of selected participants		Yr. 1, Qrtr 3
	4. Begin construction of sand filter/infiltration basin		Yr. 1, Qrtr 4
	5. Continue program		Yrs 2-4
	6. End marketing of incentive program		Yr. 5, Qrtr 1
	7. Select final participants		Yr. 5, Qrtr 2
	8. Close out design development		Yr. 5, Qrtr 3
	9. Complete construction & close out program		Yr. 5, Qrtr 4
Septic systems	a. Provide incentives to eligible homeowners to connect to sanitary sewer line and eliminate septic system.	SLCA, Muni's, St LC, MSD	5 years
	1. Develop agreements with appropriate property owners		Yr. 1, Qrtr 4
	2. Begin design development for initial round of participants		Yr. 2, Qrtr 1
	3. Begin replacing septic systems		Yr. 2, Qrtr 3
	4. Continue program		Yrs 2-4
	5. End contacting appropriate property owners		Yr. 4, Qrtr 4
	6. Close out design development		Yr. 5, Qrtr 1
	7. Complete construction & close out program		Yr. 5, Qrtr 4
Vegetative Strips	a. Provide incentives for property owners to install vegetative strips along existing streams and intermittent waterways.	SLCA, MDC, Muni's, St LC, SWCD	5 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 3
	2. Begin contacting appropriate property owners		Yr. 1, Qrtr 4
	3. Begin design development for initial round of participants		Yr. 2, Qrtr 1
	4. Begin construction/installation		Yr. 2, Qrtr 2
	5. Continue program		Yr. 2 - 3
	6. End contacting appropriate property owners		Yr. 4, Qrtr 1
	7. Close out design development		Yr. 4, Qrtr 2
	8. Complete construction & close out program		Yr. 5, Qrtr 1
Porous Pavement	a. Provide incentives to commercial, industrial, institutional, and/or multi-family residential property owners to retrofit parking and driveway pavement with porous pavement materials	SLCA, Muni's, St LC	5-10 years total
	1. Develop parameters of incentive program		Yr. 1, Qrtr 4
	2. Begin marketing incentive program & selecting initial participants		Yr. 2, Qrtr 1
	3. Begin design development for initial round of selected participants		Yr. 2, Qrtr 3
	4. Begin construction of porous pavement		Yr. 2, Qrtr 4
	5. Continue program		Yrs 3-8
	6. End marketing of incentive program		Yr. 9, Qrtr 1
	7. Select final participants		Yr. 9, Qrtr 2
	8. Close out design development		Yr. 9, Qrtr 3
	9. Complete construction & close out program		Yr. 10, Qrtr 2
Sanitary Sewer Overflows	a. Coordinate modification of sanitary sewer overflows to reduce or eliminate overflows	MSD	TBD by MSD
Chloride reduction	a., Based on findings, work with appropriate agency to insure remediation of former site of salt storage facility.	SLCA, MoDOT, Muni's, St LC, MDNR	TBD by MoDOT

Management Measures	**Management Objective**	**Responsible Parties**	**Timeline**
Non-Structural			
Vegetative Strips	b. Provide assistance to communities and property owners in managing and maintaining existing riparian buffers along stream.	SLCA, MDC, Muni's, St LC, SWCD	1 year to initiate then ongoing
	1. Develop parameters of assistance program		Yr. 2, Qrtr 1
	2. Begin marketing incentive program		Yr. 2, Qrtr 2
	3. Begin assessment of needs		Yr. 2, Qrtr 3
	4. Implement assistance to selected property owners		Yr. 2, Qrtr 4
	5. Continue assistance as demand requires		Ongoing thereafter
Septic systems	b. Conduct survey for unidentified septic systems. Document and map information.	SLCA, University	1 year to initiate then ongoing
	1. Develop MOU with local university to conduct survey		Yr. 1 Qrtr 2
	2. Develop criteria for survey		Yr. 1, Qrtr 2
	3. Conduct survey		Yr. 1, Qrtr 3
	c. Provide incentive to eligible homeowners to properly maintain septic systems	SLCA, Muni's, St LC	1 year to initiate then ongoing
	1. Develop parameters of incentive program		Yr. 2, Qrtr 2
	2. Begin marketing incentive program		Yr. 2, Qrtr 3
	3. Begin assessment of needs		Yr. 2, Qrtr 4
	4. Implement assistance to selected property owners		Yr. 3, Qrtr 1
	5. Continue incentives as demand requires		Ongoing thereafter
Pet waste control	a. Develop and implement pet waste elimination program.	SLCA, Stream Teams	3 years to initiate then ongoing
	1. Develop parameters of program		Yr. 2, Qrtr 3
	2. Begin marketing program		Yr. 2, Qrtr 4
	3. Begin assessment of needs		Yr. 3, Qrtr 1
	4. Implement and enforce program		Yr. 3, Qrtr 2
	5. Continue program		Ongoing thereafter
Illicit discharge monitoring	a. Develop and maintain map of streams, storm sewers, and outfalls	MSD	TBD by MSD
	b. Monitor streams for illicit connections, failing septic systems, or problems with existing sewer line crossings/ manholes.	MSD	TBD by MSD
	c. Pursue elimination of any illicit discharges into stream.	MSD	TBD by MSD
Yard waste disposal	a. Support periodic stream clean-ups. Program in place and operating. Continue support.	SLCA, Stream Teams, SWCD	Ongoing
	b. Monitor streams & identify sources of stream bank dumping. Provide assistance to landowners in removal of dumped material.	SLCA, Muni's, St LC	3 years to initiate then ongoing
	1. Develop parameters of program		Yr. 2, Qrtr 4
	2. Begin marketing program		Yr. 3, Qrtr 1
	3. Begin assessment of needs		Yr. 3, Qrtr 2
	4. Implement and enforce program		Yr. 3, Qrtr 3
	5. Continue program		Ongoing thereafter
Street Sweeping	a. Promote affective street sweeping and leaf pickup to reduce pollutants washing into streams	SLCA, Muni's, St LC	5-10 years to full implementation
	1. Meet and confer with municipalities & county to ascertain needs for establishing or implementing expanded street sweeping program		Yr. 1, Qrtr 4
	2. Define cost requirements and negotiate cooperative agreement		Yr. 2, Qrtr 2
	3. Assist municipalities & county in building support and acquiring additional funds for program		Yr. 2, Qrtr 4
	4. Support municipalities and county in adding needed staff and purchasing equipment		Yr. 3. Qrtr 4
	5. Begin expanded program by adding streets		Yr 4, Qrtr 4

	6. Expand program by increasing frequency of sweeping		Yr. 5, Qrtr 4
	7. Continue program		Ongoing thereafter
Chloride reduction	a. Develop coordinated salt usage monitoring program with pertinent agencies.	SLCA, MoDOT Muni's, St LC	2 years to initiate then ongoing
	1. Meet and confer with pertinent agencies to set parameters of monitoring program		Yr 1, Qrtr 4
	2. Begin collecting and tabulating composite salt usage data		Yr. 2, Qrtr 2
	3. Collect and share information on salt usage, alternatives, and removal of salt from runoff.		Yr. 2, Qrtr 4
	4. Support training programs		Yr. 3, Qrtr 1
	5. Monitor usage and water quality data. Share data with agencies.		Yr. 3, Qrtr 2
	6. Continue program		Ongoing thereafter
Code enforcement	a. Support enforcement of existing codes regarding use of above listed BMPs.	SLCA, Stream Teams, SWCD	1 year to initiate then ongoing
	1. Review existing codes related to BMP use		Yr. 1, Qrtr 1
	2. Contact agencies related to support for codes		Yr. 1, Qrtr 2
	3. Conduct campaign for support of BMP use		Yr. 1, Qrtr 3 & 4
	4. Continue support for code enforcement		Ongoing thereafter
	b. Support development and implementation of regulations that require the use of the above listed BMP.	SLCA, Stream Teams, SWCD	2 year to initiate then ongoing
	1. Identify what regulations are needed		Yr. 1, Qrtr 2
	2. Contact agencies and local officials and build support for new BMP regulations		Yr. 1, Qrtr 3
	3. Conduct public campaign for support of new BMP regulations		Yr. 2, Qrtr 1
	4. Support implementation and enforcement once regulations established		Yr. 2, Qrtr 3
Educational			
Septic systems	a. Provide education to eligible homeowners regarding proper septic system maintenance.	SLCA, Stream Teams	1/2 year to initiate
	1. Develop parameters of program		Yr. 1, Qrtr 1
	2. Begin marketing program		Yr. 1, Qrtr 2
	3. Initiate program		Yr. 1, Qrtr 3
	4. Continue program		Ongoing thereafter
Pet waste control	a. Develop and implement education program regarding benefits of pet waste management.	SLCA, Stream Teams	1/2 year to initiate
	1. Develop parameters of program		Yr. 1, Qrtr 1
	2. Begin marketing program		Yr. 1, Qrtr 2
	3. Initiate program		Yr. 1, Qrtr 3
	4. Continue program		Ongoing thereafter
Chloride reduction	a. Develop and implement education program to reduce salt usage by agencies.	SLCA, Stream Teams	1/2 year to initiate
	1. Develop parameters of program		Yr. 1, Qrtr 1
	2. Begin marketing program		Yr. 1, Qrtr 2
	3. Initiate and complete program		Yr. 1, Qrtr 3
	4. Switch to monitoring program with agencies		Ongoing thereafter
	b. Develop and implement education program to reduce salt usage by public.	SLCA, Stream Teams	1 year to initiate
	1. Develop parameters of program		Yr. 1, Qrtr 3
	2. Begin marketing program		Yr. 1, Qrtr 4
	3. Initiate program		Yr. 2, Qrtr 1
	4. Continue program		Ongoing thereafter
Yard waste disposal	a. Develop and implement education program regarding the negative impacts of yard waste disposal on stream banks.	SLCA, Stream Teams	1 year to initiate
	1. Develop parameters of program		Yr. 1, Qrtr 3
	2. Begin marketing program		Yr. 1, Qrtr 4
	3. Initiate program		Yr. 2, Qrtr 1
	4. Continue program		Ongoing thereafter

CHAPTER 8: ELEMENT G. - MILESTONES

Watkins Creek has two overriding problems – E. Coli and Chloride. It could be said that the goals of the watershed management plan are the minimization or elimination of these two pollutants. However, in terms of this watershed management plan it is better to identify the means of minimizing or eliminating the pollutants as the goals. The following provides prioritized goals for achieving the reduction of the overriding problems through structural, non-structural, and educational methods that were previously developed. These goals include specific targets for reducing pollutants or mitigating impacts, and identify timeframes for accomplishment. Below each goal is a list of interim milestones as well as expected dates of completion for each. These are, in general, short and medium-term milestones. Note that the listed dates for reaching the milestones for each goal are based on funding being in place for work to proceed.

Goal: Install new structural BMPs to capture and filter storm water from 25% of the watershed.

Milestones:	Date complete:
1. Develop parameters for incentive programs for bioretention and sand filter/infiltration basin BMPs	Yr. 1, Qrtr 1
2. Develop parameters for incentive program to convert detention/ Retention basins to wetland detention basin BMP	Yr. 1, Qrtr 2
3. Select initial incentive program participants for bioretention and Sand filter/infiltration basin BMPs	Yr. 1, Qrtr 2
4. Develop parameters for incentive program to install vegetated filter strip BMP	Yr. 1, Qrtr 3
5. Begin construction of initial bioretention and Sand filter/infiltration Basin BMPs	Yr. 1, Qrtr 4
6. Develop parameters for incentive program for converting nonpervious pavement to porous pavement BMP	Yr. 1, Qrtr 4
7. Select initial wetland detention basin incentive program participants	Yr. 1, Qrtr 4
8. Select initial vegetated filter strip incentive program participants	Yr. 2, Qrtr 1
9. Begin construction of wetland detention basin BMP	Yr. 2, Qrtr 2
10. Begin construction/installation of vegetated filter strip BMP	Yr. 2, Qrtr 2
11. Select initial porous pavement program participants	Yr. 2, Qrtr3
12. Begin installation of porous pavement BMP	Yr. 2, Qrtr 4
10. Complete construction/installation of vegetated filter strips	Yr. 5, Qrtr 1
11. Complete construction of bioretention and Sand filter/infiltration BMPs	Yr. 5, Qrtr 4
12. Complete construction of wetland detention basin BMPs	Yr. 5, Qrtr 4
13. Complete construction of 40% of porous pavement program projects	Yr. 5, Qrtr 4
14. Complete construction of porous pavement BMPs	Yr. 10, Qrtr 2

Goal: Reduce E. Coli pollution load from septic systems and sanitary sewer overflows by 75%.

Milestones:	Date complete:
1. Establish coordinate effort to support MSD's efforts to modify or eliminate sanitary sewer overflows (SSOs)	Yr. 1, Qrtr 1
2. Establish cooperative agreement with local university to conduct survey for septic systems	Yr. 1, Qrtr 2
3. Modify or eliminate SSOs	TBD by MSD
4. Develop criteria and conduct survey to identify septic systems	Yr. 1, Qrtr 3

5. Develop agreements with property owners to provide assistance to abandon septic and connect to sewer	Yr. 1, Qrtr 4
6. Develop parameters of incentive program for septic maintenance	Yr. 2, Qrtr 2
7. Begin sewer connection program to replace septic	Yr. 2, Qrtr 3
8. Implement septic maint. incentive program to selected participants	Yr. 3, Qrtr 1
9. Complete sewer connection program	Yr. 5, Qrtr 4
10. Continue septic maint. incentive program as demand requires	Ongoing after Yr. 2, Qrtr 4

Goal: Reduce Chloride pollution load 60% by remediation of former salt storage facility.

Milestones:	Date complete:
1. Support efforts to remediate site by responsible agency	Yr. 1, Qrtr 1
2. Coordinate with agency to insure remediation completed	TBD by MoDOT

Goal: Reduce E. Coli pollution load 10% by improving monitoring and maintenance from non-point sources.

Milestones:	Date complete:
1. Conduct campaign for enforcement of codes related to BMPs in plan	Yr. 1, Qrtr 4
2. Meet with municipalities & county to ascertain needs for establishing and/or expanding street sweeping program	Yr. 1, Qrtr 4
3. Conduct campaign for new BMP regulations and enforcement	Yr. 2, Qrtr 1
4. Support and assist municipalities & county in establishing and/or expanding street sweeping program	Yr. 2, Qrtr 2
5. Develop parameters of pet waste elimination program	Yr. 2, Qrtr 3
6. Implement and enforce pet waste elimination program	Yr. 3, Qrtr 2 and ongoing thereafter
7. Develop and maintain maps of watershed streams, storm drains, and outfalls	TBD by MSD
8. Monitor watershed and pursue elimination of any illicit discharges	TBD by MSD
9. Support periodic stream cleanups	Current & ongoing
10. Develop parameters of stream bank dumping program	Yr. 2, Qrtr 4
11. Implement and enforce stream bank dumping program	Yr. 3, Qrtr 3 and ongoing thereafter
12. Begin expanded street sweeping program	Yr. 4, Qrtr 4
13. Expand street sweeping program further by increasing frequency	Yr. 5, Qrtr 4 and ongoing thereafter

Goal: Reduce Chloride pollution load 30% by monitoring and minimizing usage and loss of salts in winter time and/or during storage.

Milestones:	Date completed:
1. Meet with pertinent agencies to set parameters of salt monitoring program	Yr. 1, Qrtr 4
2. Complete collection and sharing of salt usage data	Yr. 2, Qrtr 4
3. Complete training program on minimizing salt usage	Yr. 3, Qrtr 1
4. Monitor salt usage and water quality changes and share with agencies	Yr. 3, Qrtr 2 and ongoing thereafter

Goal: Reduce indicated sources of pollutants 25% by implementation of appropriate education programs.

Milestones:	Date completed:
1. Develop parameters of education program for septic system maint.	Yr. 1, Qrtr 1
2. Develop parameters of education program for pet waste management	Yr. 1, Qrtr 1
3. Develop parameters of education program for salt usage by agencies	Yr. 1, Qrtr 1
4. Develop parameters of education program for salt usage by public	Yr. 1, Qrtr 3
5. Develop parameters of education program for yard waste disposal	Yr. 1, Qrtr 3
6. Initiate septic system maintenance education program	Yr. 1, Qrtr 3
7. Initiate pet waste management education program	Yr. 1, Qrtr 3 and ongoing thereafter
8. Initiate salt usage education program for agencies then switch to monitoring program upon completion	Yr. 1, Qrtr 3 and ongoing thereafter
9. Initiate salt usage education program for public	Yr. 2, Qrtr 1 and ongoing thereafter
10. Initiate yard waste disposal education program	Yr. 2, Qrtr 1 and ongoing thereafter

CHAPTER 9: ELEMENT H. - PERFORMANCE

Due to the nature of urban streams, reaching state standards for chloride and E. Coli must of necessity be long range, and make take 20 or more years to achieve. However, as noted in Chapter 3 the overall goals are to reach target levels as noted here:

Impairment	Target Level
E. Coli	Not to exceed State of Missouri standard for whole body contact (mean of 206 cfu/dL) for a Class B stream during recreational season.
Chloride	Not to exceed one severe toxic occurrence (230 milligrams/liter) in 3 years during periods of steady, low flow conditions. No more than one occurrence in three years of the 860 mg/L chloride acute criterion under any flow conditions.

Therefore, the goals outlined in Chapter 8 are focused toward making changes within the watershed that will lead to achieving the target levels. Below are these same goals with specific, measurable performance criteria.

Goal: Install new structural BMPs to capture and filter storm water from 25% of the watershed.

Performance criteria:

1. Potential participants will respond to incentive program and be selected for bioretention and sand filter/infiltration program by end of Yr. 1, Qrtr 2
2. Potential participants will respond to incentive program and be selected for wetland detention and vegetated filter strip program by end of Yr. 2, Qrtr 1
3. Potential participants will respond to incentive program and be selected for porous pavement program by end of Yr. 2, Qrtr 3
4. Construction of vegetated filter strips is completed by end of Yr. 5, Qrtr 1
5. Complete construction of bioretention, sand filter/infiltration, and wetland detention BMPs by end of Yr. 5, Qrtr 4
6. Complete construction of 40% of porous pavement projects by end of Yr. 5, Qrtr 4
7. Capture and filter storm water through constructed BMPs from 20% of watershed by end of Yr. 5, Qrtr 2
8. Monitor water quality, assess results for improvements in E. Coli and chloride levels, and modify programs as needed by end of Yr. 6, Qrtr 4
8. Complete construction of remaining porous pavement projects by end of Yr. 10, Qrtr 2
9. Capture and filter storm water through all constructed BMPS from 25% of watershed by End of Yr. 10, Qrtr 2

Goal: Reduce E. Coli pollution load from septic systems and sanitary sewer overflows by 75%.

Performance criteria:

1. Complete survey of watershed and identify properties with septic systems by Yr. 1, Qrtr 3
2. Modify or eliminate sanitary sewer overflows by date to be determined by MSD
3. Implement incentive program for septic system maintenance program for those who cannot connect to sewer system by Yr. 3, Qrtr 1

4. Complete program to abandon septic systems and connect to sewer system where feasible by Yr. 5. Qrtr 4

Goal: Reduce Chloride pollution load 60% by remediation of former salt storage facility.

Performance criteria:

1. Take necessary steps to support and insure that remedial action will be undertaken to decontaminate soil from former salt storage site by end of Yr. 1, Qrtr 1
2. Complete remediation of salt storage site by date to be determined by MoDOT

Goal: Reduce E. Coli pollution load 10% by improving monitoring and maintenance from non-point sources.

Performance criteria:

1. Establish campaign to enforce current codes related to use of BMPs listed in plan by end of Yr. 1, Qrtr 4
2. Conduct at least 2 stream cleanups by end of Yr. 1, Qrtr 4 and continue thereafter
3. Establish campaign to pass new regulations for new BMPs to further reduce pollutants by end of Yr. 2, Qrtr 1
4. Support and assist municipalities & county in establishing and/or expanding street sweeping program by end of Yr. 2, Qrtr 2
5. Implement and enforce pet waste elimination program by end of Yr. 3, Qrtr 2
6. Map and monitor watershed to insure that illicit discharges are not occurring by date to be determined by MSD
7. Implement and enforce stream bank dumping program by end of Yr. 3, Qrtr 3
8. Monitor water quality, assess results for improvements in E. Coli chloride levels, and modify programs as needed by end of Yr. 4, Qrtr 4
9. Maximize street sweeping extent and frequency to limit that budgets will allow for interstate, arterial, collector and local streets in watershed by Yr. 5, Qrtr 4
10. Assess monitoring results since Yr. 4, Qrtr 4 for improvements in E. Coli levels, and modify programs as needed by end of Yr. 6, Qrtr 4

Goal: Reduce Chloride pollution load 30% by monitoring and minimizing usage and loss of salts in winter time and/or during storage.

Performance criteria:

1. Establish interagency salt monitoring program, collect, and share salt usage data by end of Yr. 2, Qrtr 4
2. Complete training, collect water quality data, and share changes in chloride content with agencies to indicate success level of usage monitoring program by end of Yr. 3, Qrtr 2

Goal: Reduce indicated sources of pollutants 25% by implementation of appropriate education programs. (septic systems, pet waste, gov't and public salt usage, yard waste)

Performance criteria:

1. Have all education programs in place and functioning by the end of Yr. 2, Qrtr 1

CHAPTER 10: ELEMENT I. - MONITORING

The Watkins Creek Watershed Management Plan reflects management measures intended to improve the water quality within the watershed. Monitoring methods will be designed to measure progress in meeting load reduction goals and attaining water quality standards. Monitoring objectives will provide the information necessary to determine progress in meeting set milestones. Measurable progress is critical to ensuring continued support of watershed projects and/or the need to modify objectives to reach the stated goals.

Because of natural variability, some progress may not be linear and should be measured as trends toward the goals of lowering E. Coli and chloride to target levels. Therefore, results of some monitoring methods, such as water quality data, must be analyzed over time to identify trends. Other measurements, based on tangible objectives, such as construction of BMPs, can be measured in incremental time periods.

Monitoring:
Below is a list of goals with the proposed monitoring plan:

Goal: Install new structural BMPs to capture and filter storm water from 25% of the watershed.

Measurement method:

1. Tally number of participants responding to incentive programs to construct BMPs. Responsible parties are SLCA, Muni's, and St LC. Timeline is to measure at Yr. 3, Qrtr 1 and Yr. 5, Qrtr 4
2. Quantify total number of BMPs constructed by end of Yr. 5, Qrtr 2. Responsible parties are SLCA, Muni's, and St LC.
3. Quantify that storm water from 20% of watershed has been captured and filtered by new BMPS. Responsible parties are MSD and SLCA. Timeline is to measure at end of Yr. 5, Qrtr 2

Goal: Reduce E. Coli pollution load from septic systems and sanitary sewer overflows by 75%.

Measurement method:

1. Complete survey and quantify total number of septic systems in watershed by end of Yr. 1, Qrtr 3. Responsible parties are SLCA, Muni's and St LC
2. Tally number of participants in septic system maintenance program. Responsible parties are SLCA, Muni's and St LC. Timeline is to measure at end of Yr. 3, control runoff from 1.
3. Quantify number of septic systems abandoned and properties connected to sewer system. Responsible parties are MSD and SLCA. Timeline is to quantify by end of Yr. 5, Qrtr 4.
4. Complete modification or elimination of sanitary sewer overflows. Responsible party is MSD. Timeline is to be determined by MSD but no later than Yr. 5, Qrtr 1.
5. Monitor Watkins Creek and tributaries for E. Coli. Track trends in levels to ascertain improvements. Responsible party is Stream Teams. Provide monthly data to SLCA and prepare reports on trends at Yr. 3, Qrtr 1 and Yr. 5, Qrtr 4

Goal: Reduce Chloride pollution load 60% by remediation of former salt storage facility.

Measurement method:

1. Insure that former salt storage facility site has had remedial action completed. Responsible parties MoDOT, St LC, MDNR. Timeline is to be determined by MoDOT but no later than Yr. 5, Qrtr 1
2. Monitor water quality, assess results for improvements in chloride, share results with agencies and modify programs as needed beginning in Yr. 3, Qrtr 2 and continuing to Yr. 5, Qrtr 4.

Goal: Reduce E. Coli pollution load 10% by improving monitoring and maintenance from non-point sources.

Measurement method:

1. Measure media contacts, public meetings attended, and number of contacts with public officials related to existing BMP code enforcement. Responsible party SLCA. Timeline is to begin measurement at end of Yr. 1, Qrtr 4 and continue to Yr. 5, Qrtr 4.
2. Quantify number of stream cleanups and amount of debris removed each time. Responsible parties SLCA and Stream Teams. Timeline is ongoing.
3. Measure media contacts, public meetings attended, and number of contacts with public officials related to establishment of new BMP regulations. Responsible party SLCA. Timeline is to begin measurement at end of Yr. 2, Qrtr 1 and continue to Yr. 5, Qrtr 4.
4. Quantify type, number of miles, and frequency of streets swept. Responsible parties SLCA, Muni's, and St. LC. Timeline is by end of Yr. 2, Qrtr 2.
5. Measure number of public contacts, in all forms, regarding pet waste elimination program. Responsible parties SLCA, Muni's, and St LC. Timeline is Yr. 3, Qrtr 2 and continue to Yr. 5, Qrtr 4.
6. Measure number of public contacts, in all forms, regarding stream bank dumping program. Responsible parties SLCA, Muni's, and St LC. Timeline is Yr. 3, Qrtr 3 and continue to Yr. 5, Qrtr 4.
7. Quantify increase in type, number of miles, and frequency of streets swept. Responsible parties SLCA, Muni's, and St. LC Timeline is the end of Yr. 5, Qrtr 4.
8. Monitor water quality, assess results for improvements in E. Coli levels, and modify programs as needed by end of Yr. 4, Qrtr 4
9. Assess monitoring results since Yr. 4, Qrtr 4 for improvements in E. Coli levels, and modify programs as needed by end of Yr. 6, Qrtr 4

Goal: Reduce Chloride pollution load 30% by monitoring and minimizing usage and loss of salts in winter time and/or during storage.

Measurement method:

1. Interagency salt usage monitoring program in place collecting and sharing salt usage data. Responsible parties are SLCA, MoDOT Muni's, St LC. Timeline is by end of Yr. 2, Qrtr 4.
2. Training completed on salt usage. Responsible parties are SLCA, MoDOT Muni's, St LC. Timeline is by end of Yr. 3, Qrtr 2.

3. Monitor water quality, assess results for improvements in chloride, share results with agencies and modify programs as needed beginning in Yr. 3, Qrtr 2 and continuing to Yr. 5, Qrtr 4.

Goal: Reduce indicated sources of pollutants 25% by implementation of appropriate education programs. (septic systems, pet waste, gov't and public salt usage, yard waste)

Management measures:

1. All education programs in place and functioning. Responsible parties SLCA and Stream Teams. Timeline by end of Yr. 2, Qrtr 1.
2. Quantify number of participants in education program by attendees at workshops, number of flyers distributed, number of hits on website(s), and other identified methods. Responsible parties SLCA and Stream Teams. Timeline by end of Yr. 2, Qrtr 1 and continuing to Yr. 5, Qrtr 4

Evaluating & Adapting the Plan:

The Watkins Creek Watershed Management Plan is based on data collected prior to and during the preparation of the plan in 2011 and 2012. As the plan is implemented additional information as well as changing conditions may come to light. Most of the goals, objectives, and tasks outlined in the document will be implemented by the end of the fifth year of the schedule. Data from monitoring the plan will be available by that time and, when coupled with new information or changing conditions, can guide the evaluation of progress. At that time the plan can be modified

Evaluation and modification of the plan should be undertaken by the parties responsible for its implementation and other interested parties. These will include, but are not limited to, the Spanish Lake Community Association (SLCA), watershed municipalities (Muni's), St. Louis County (St LC), the Missouri Department of Natural Resources (MDNR), Missouri Department of Conservation (MDC), Stream Teams, St. Louis Soil and Water Conservation District (SWCD), Missouri Department of Transportation (MoDOT), and Greenway Network (GN).

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Appendix 1

Description of organizations partnering or collaborating to complete the Watkins Creek Watershed Management Plan:

Greenway Network, Inc.:

Greenway Network's mission is to conserve natural resources, encourage sound management of the area's watersheds and protect the quality of life for all citizens. Greenway Network is not anti-development but does believe that development must proceed with sustainable plans and providing low impact considerations of our natural resources. We believe people can live in harmony with nature if we plan and make decisions wisely. The organization started in 1993 as a St. Charles County, MO based organization. We soon learned that the problems we face as a rapidly changing community are most efficiently dealt with by cooperative regional efforts and the realization that we all gain by helping one another. Problems do not stop and begin at county or corporate lines. Therefore, working in partnerships is critical to solving problems.

The Confluence Partnership:

Since 1997, the Project has been led by a working partnership of non-profit organizations, brought together with encouragement and seed support from The McKnight Foundation. The non-profits represent diverse missions and geographic parts of the bi-state region. They bring unique, complementary skills to the Project, while continuing their good works in the community as independent organizations.

By April 2001, an ambitious Master Plan for the Confluence region was developed that promoted environmental sensitivity, conservation and stewardship while reconnecting the people and communities of the region to the rivers. It encouraged tourism and economic development, protection of cultural and historic features and proposed means to improve the quality of life. The Plan delineated an overall shared vision of the Confluence region with specific projects and programs that could be implemented by a large

Since the development of the master plan the partners and collaborators working together on the Confluence Project has conserved over 13,000 additional acres, encouraged 93,000 volunteers to work on various clean-up and habitat restoration projects, and supported numerous program and events related to environmental and conservation issues.

East West Gateway Council of Governments:

East West Gateway (EWGCC) is the metropolitan planning organization (MPO) for the St. Louis metropolitan area. EWGCC is involved in many planning projects throughout the region. The East-West Gateway Council of Governments provides a forum for local governments of the bi-state St. Louis area to work together to solve problems that cross jurisdictional boundaries. The geographic region that East-West Gateway has served since 1965 is the 4,500 square miles encompassed by the City of St. Louis; Franklin, Jefferson, St. Charles, and St. Louis counties in Missouri; Madison, Monroe, and St. Clair counties in Illinois.

East West Gateway is involved in community level planning, such as the Watkins Creek Watershed Management Plan, through the Initiative for a Metropolitan Community program. "The Initiative for a

Metropolitan Community (IMC) is a community-based effort of the East-West Gateway designed to carefully identify those areas where local governments can act with common purpose and fact-based analysis in order to develop planning strategies which address the on-going issues of growth and development. An important and critical area of concern for all local governments was the proper management of natural resources. A key element which emerged from all the IMC focus groups was water resources. In particular, local governments and officials were concerned about storm water, water quality and drinking water issues with respect to their communities."

Metropolitan St. Louis Sewer District:

The Metropolitan St. Louis Sewer District (MSD) was formed on February 9, 1954, when voters approved the Plan of the District. MSD started operation and maintenance activities in January 1956 in an area roughly compromised of the City of St. Louis and the portion of St. Louis County east of Interstate 270. Most of the remainder of St. Louis County was annexed by MSD in 1977. MSD is a public agency and is the only special district in Missouri created under a provision of the State Constitution.

MSD's responsibilities include the interception, collection and treatment of wastewater, as well as storm water management. MSD's current boundaries cover 525 square miles and encompass all of St. Louis City and approximately 80 percent of St. Louis County.

MSD serves a population of approximately 1.4 million and has approximately 519,000 single-family residential, multi-family residential and commercial/industrial accounts. MSD currently operates seven wastewater treatment facilities, treating a combined average of 330 million gallons of sewage per day.

MSD assists communities and organizations as a result of the St. Louis County Phase II Storm water Management Plan. The purpose of the Plan is to improve area water quality by preventing harmful pollutants from being carried by storm water runoff into local water bodies. The plan includes six control measures. They are: Public Education; Public Involvement and Participation; Illicit Discharge Detection and Elimination; Construction Site Storm Water Runoff Control; Post-Construction Storm water Management; Pollution Prevention/Good Housekeeping for Municipal Operations.

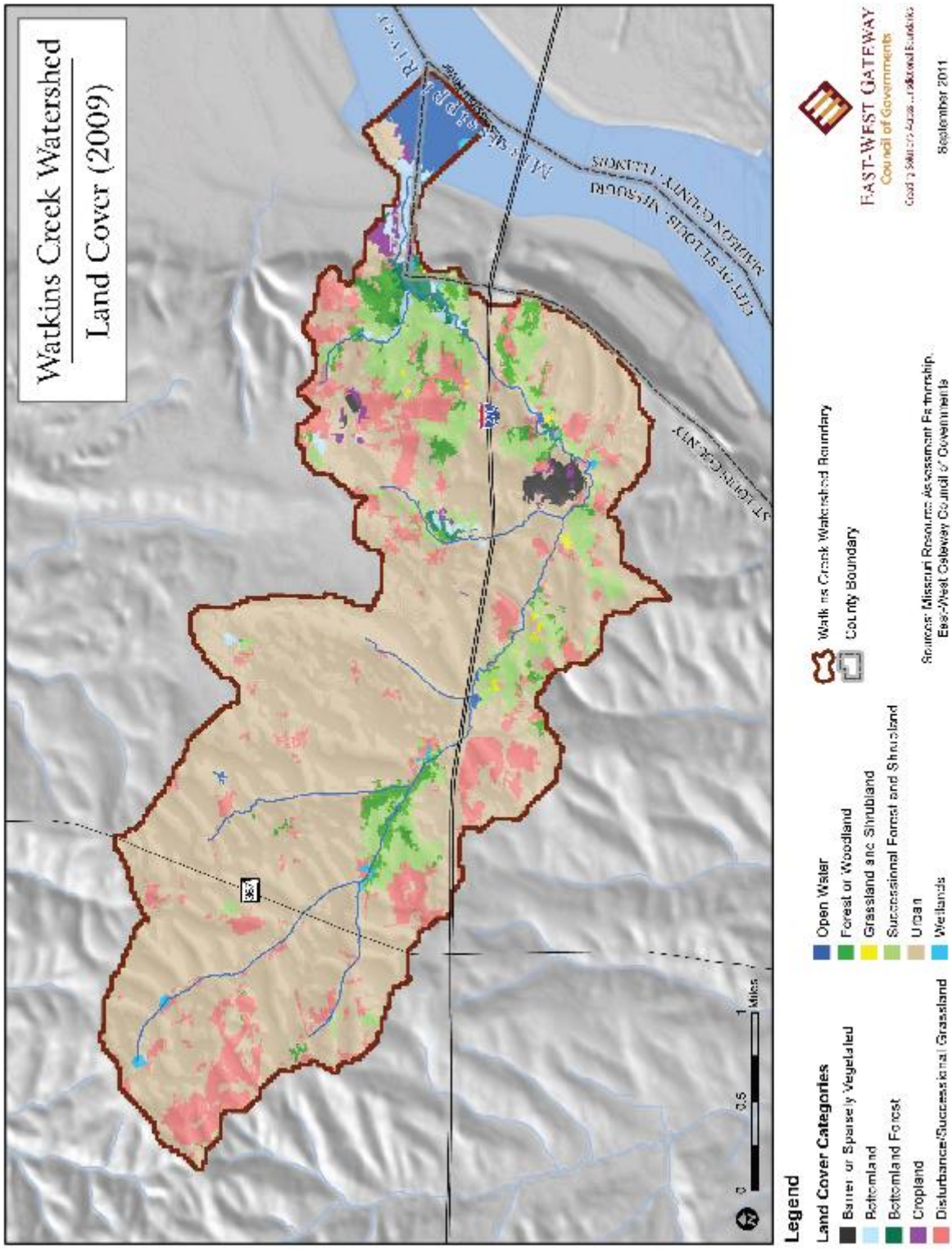
Spanish Lake Community Association:

The mission of the Spanish Lake Community Association is to inform, motivate and organize the residents of Spanish Lake on issues that affect the quality of life in their unincorporated community. The association sponsors projects and activities to encourage cooperative efforts that will develop a strong community identity among its residents.

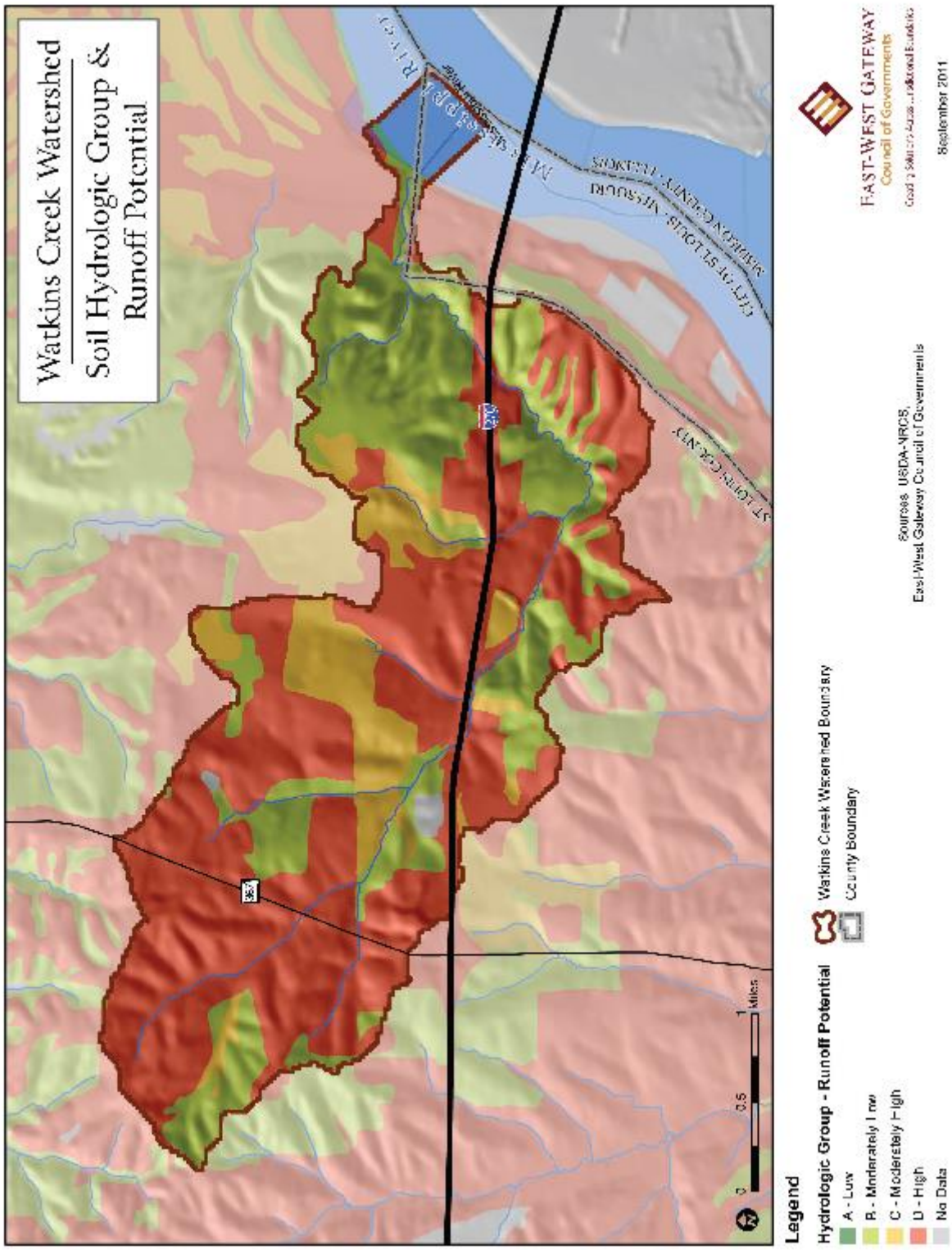
The goals of the association are:

- To promote the development of a strong community identity among the residents of Spanish Lake.
- To encourage cooperative efforts among churches, schools, businesses, subdivisions and other organizations with the goal of improving the quality of life for all residents of the Spanish Lake area.
- To improve communication between the Spanish Lake community and St. Louis County, neighboring municipalities and cities in order to further mutual goals and a shared sense of responsibility.
- To enhance a sense of pride among Spanish Lake residents by identifying and developing the assets of the community.
- To provide a forum whereby residents of the Spanish Lake community can share with each other their concerns and visions about the future of the area.

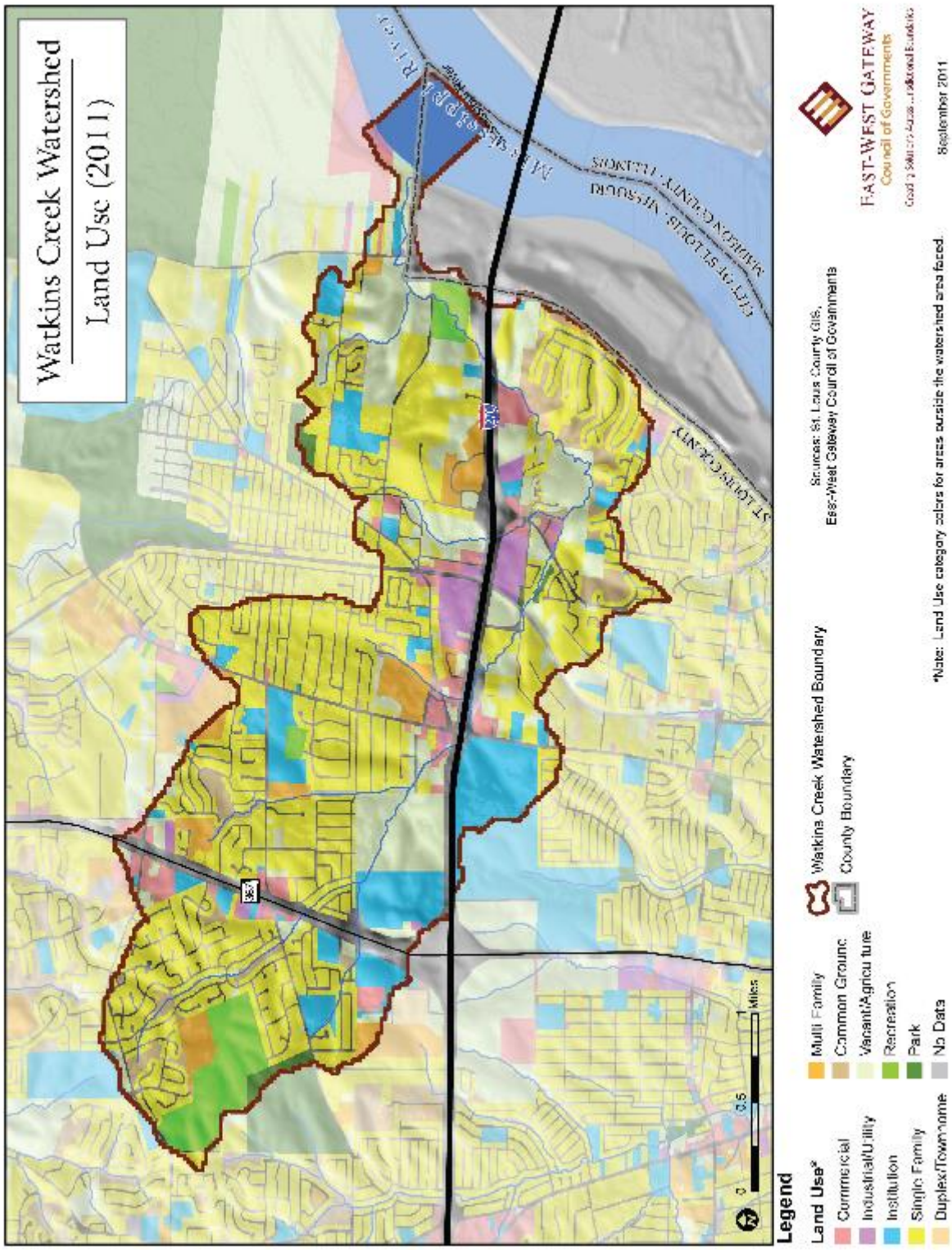
Appendix 2


Watkins Creek Watershed
Land Cover (2009)
Legend
Land Cover Categories
Barren or Sparsely Vegetated
Bottomland
Bottomland Forest
Cropland
Disturbance/Successional Grassland
Open Water
Forest or Woodland
Grassland and Shrubland
Successional Forest and Shrubland
Urban
Wetlands
Watkins Creek Watershed Boundary
County Boundary
Sources: Missouri Resource Assessment Partnership,
East-West Gateway Council of Governments
0
0.5
1
Miles
EAST-WEST GATEWAY
Council of Governments
September 2011

Appendix 3


Watkins Creek Watershed
Soil Hydrologic Group &
Runoff Potential
Legend
Hydrologic Group - Runoff Potential
A - Low
B - Moderately Low
C - Moderately High
D - High
No Data
Watkins Creek Watershed Boundary
County Boundary
0
0.5
1
Miles
Sources: USDA-NRCS,
East-West Gateway Council of Governments
EAST-WEST GATEWAY
Council of Governments
September 2011

Appendix 4


Watkins Creek Watershed
Land Use (2011)
Legend
Land Use*
Commercial
Industrial/Utility
Institution
Single Family
Duplex/Townhome
Multi Family
Common Ground
Vacant/Agriculture
Recreation
Park
No Data
Watkins Creek Watershed Boundary
County Boundary
0
0.5
1
Miles
Sources: St. Louis County GIS,
East-West Gateway Council of Governments
*Note: Land Use category colors for areas outside the watershed area faced.
EAST-WEST GATEWAY
Council of Governments
September 2011

Appendix 5

Visual Data Summaries

Visual Stream Survey, Site 7: Hazelwood East HS, Shadrack Nature Center

Date	Time	Floodplain Land Use	Riparian Cover	Streambank Conditions	Bed comp of riffle	% embd	Signs of human use	Algae %	Close %, filament %	Water color, odor	Weather
10/3/08	12:28	woods 100%	trees 75% grasses 5% bare 20%	trees 5% grasses 10% bare 80% pavement 5%	sand 40% gravel 30% cobble 20% boulders 10%	58%	none	25%	95%, 5%	colorless odorless	sunny (1 toad seen)

Visual Stream Survey, Site 8: eastern end of Coal Bank Rd., upstream of overpass
N lat +38.77207, W long -90.1825 +/-11'

Date	Time	Floodplain Land Use	Riparian Cover	Streambank Conditions	Bed comp of riffle	% embd	Signs of human use	Algae %	Close %, filament %	Water color, odor	Weather
10/2/08	10:45	woods 100%	trees 70% grasses 25% bare 5%	trees 10% grasses 20% bare 60% bedrock 5% concrete 5%	silt 5% gravel 60% cobble 30% bould 5%	35%	trail w/ human & dog footprints	33%	95%, 5%	colorless odorless	sunny
3/20/09	9:52	woods 100%	trees 75% bare 25%	trees 10% bare 85% bedrock 5%	silt 5% sand 20% gravel 30% cobble 40% bould 5%	20%	4-wheelers use trail in floodplain	50%	90%, 10%	colorless odorless	sunny
10/15/10	9:58	woods 100%	trees 70% grasses 20% bare 10%	trees 5% grasses 10% bare 85%	sand 25% gravel 40% cobble 30%	34%	trail, high school kids party	75%	25%, 75%	colorless odorless	clear

					bould 5%		at site				
3/19/11	11:23	woods 100%	trees 75% grasses 20% bare 5%	trees 10% grasses 10% bare 80%	sand 20% gravel 35% cobble 40% bould 5%	21%	4 wheel tracks, beer cans	25%	80%, 20%	colorless odorless	partly sunny

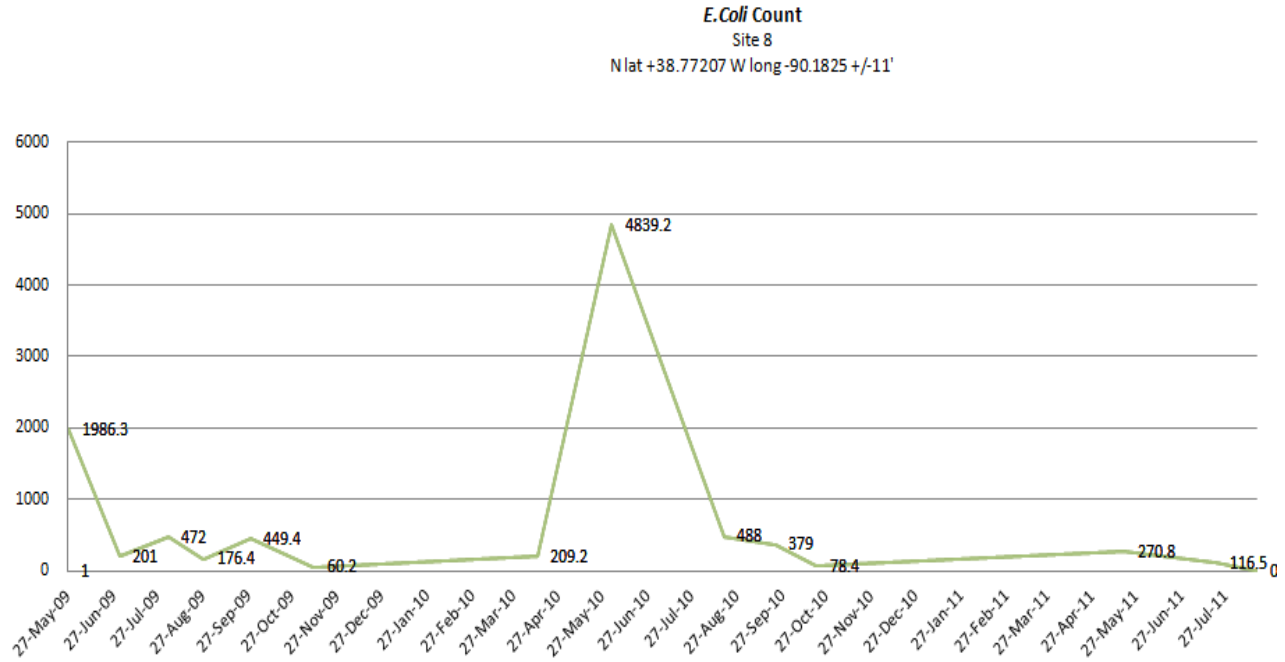
Visual Stream Survey, Site 14: just below pond on main stem at El Camaro and Red Barn

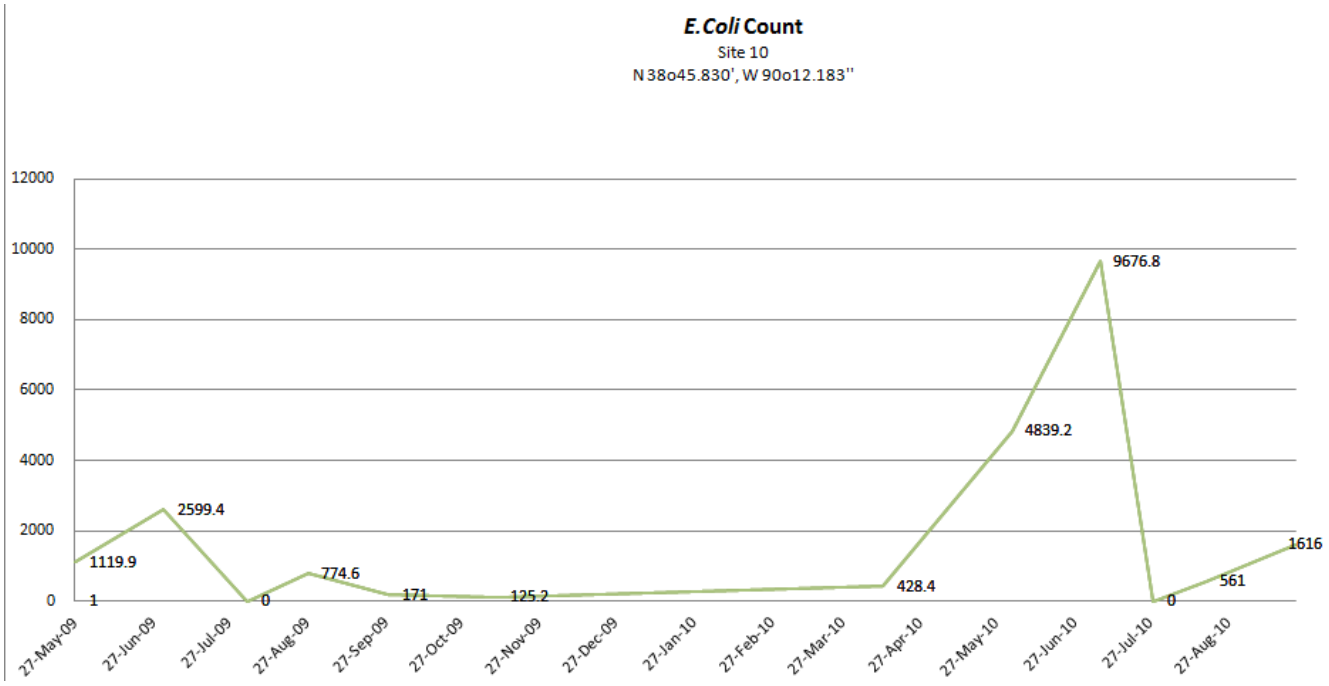
Date	Time	Floodplain Land Use	Riparian Cover	Streambank Conditions	Bed comp of riffle	% embd	Signs of human use	Algae %	Close %, filament %	Water color, odor	Weather
3/20/09	12:01	residential 100%	trees 45% grasses 25% bare 10% bldgs 20%	trees 20% grasses 20% bare 10% pavement 50%	gravel 20% cobble 75% bould 5%	39%	maybe a trail next to culvert	70%	30%, 70%	colorless odorless	sunny
10/15/10	12:52	residential 100%	trees 50% grasses 20% bare 10% bldgs 20%	trees 30% grasses 10% bare 30% pavement 30%	silt 40% gravel 20% cobble 20% bould 20%	34%	trail, condom wrappers	0%		colorless odorless	clear

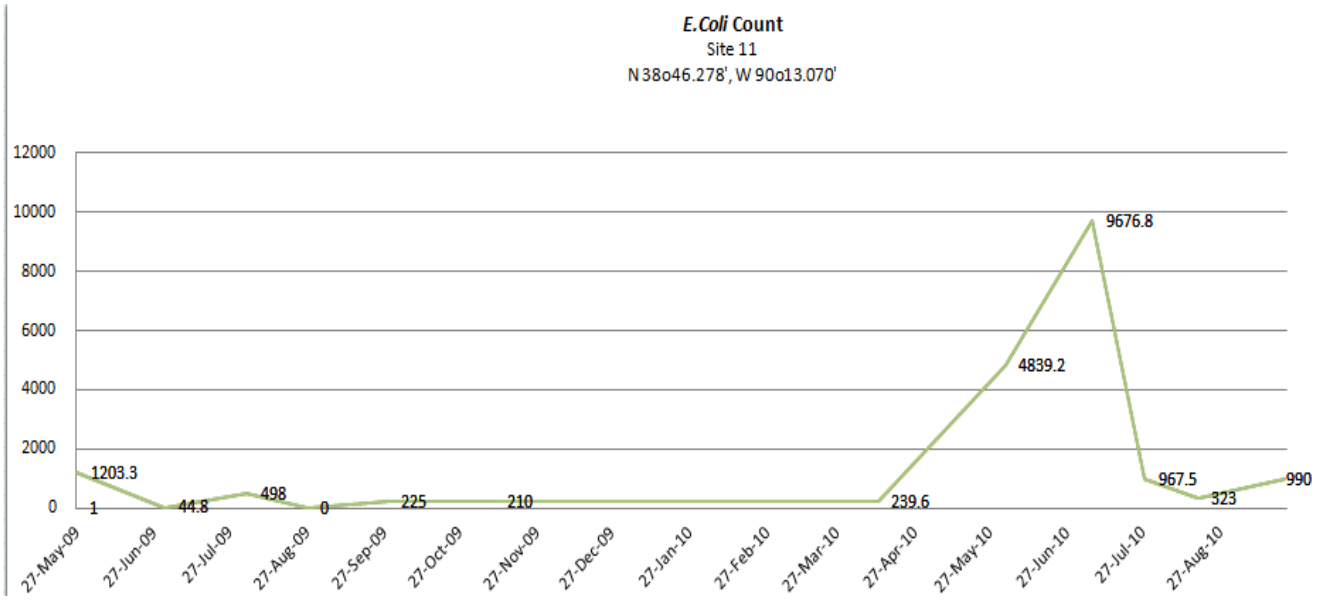
Appendix 6

Graphs of E. Coli and Chloride test results by Stream Team 3553

**E.coli measured in MPN/100mL*






E.Coli Count
Site 11
N 38o46.278', W 90o13.070'
12000
10000
8000
6000
4000
2000
0
1203.3
1
44.8
498
0
225
210
239.6
4839.2
9676.8
967.5
323
990
27-May-09
27-Jun-09
27-Jul-09
27-Aug-09
27-Sep-09
27-Oct-09
27-Nov-09
27-Dec-09
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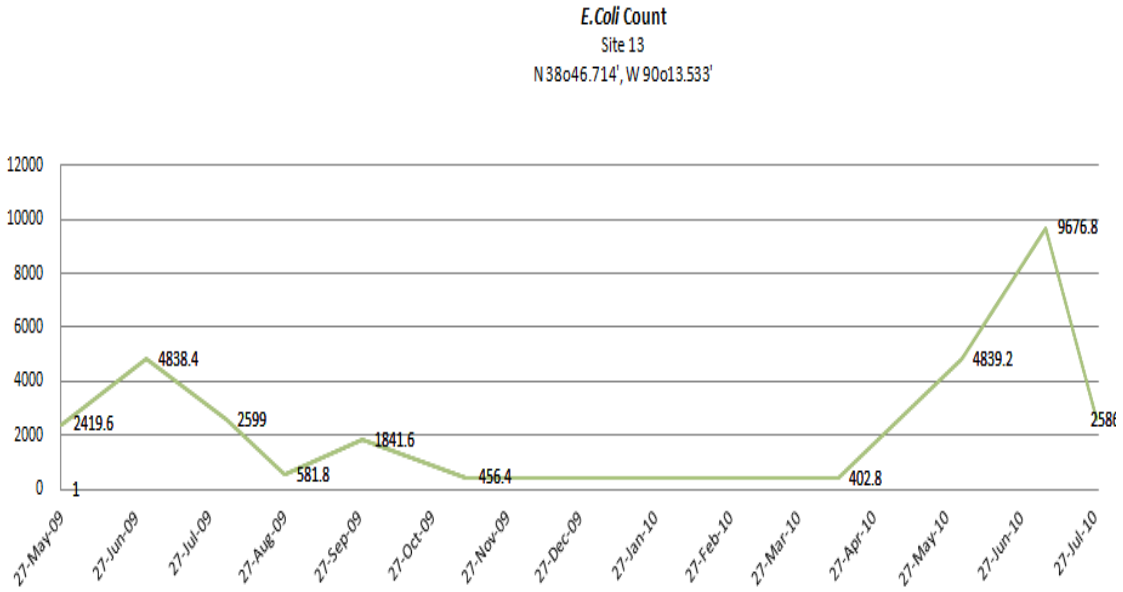
27-May-10
27-Jun-10
27-Jul-10
27-Aug-10


E.Coli Count
Site 13
N 38o46.714', W 90o13.533'
12000
10000
8000
6000
4000
2000
0
2419.6
1
4838.4
2599
581.8
1841.6
456.4
402.8
4839.2
9676.8
27-May-09
27-Jun-09
27-Jul-09
27-Aug-09
27-Sep-09
27-Oct-09
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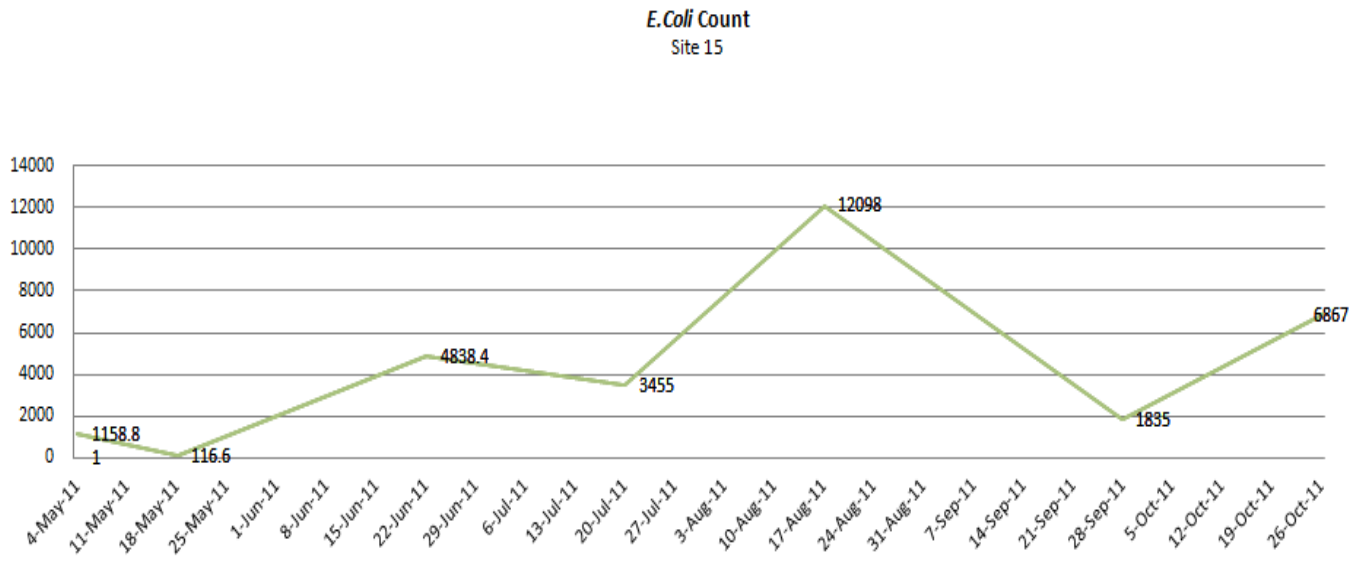
27-Apr-10
27-May-10
27-Jun-10
27-Jul-10


E.Coli Count
Site 15
14000
12000
10000
8000
6000
4000
2000
0
1158.8
1
116.6
4838.4
3455
12098
1835
6867
4-May-11
11-May-11
18-May-11
25-May-11
1-Jun-11
8-Jun-11
15-Jun-11
22-Jun-11
29-Jun-11
6-Jul-11
13-Jul-11
20-Jul-11
27-Jul-11
3-Aug-11
10-Aug-11
17-Aug-11
24-Aug-11
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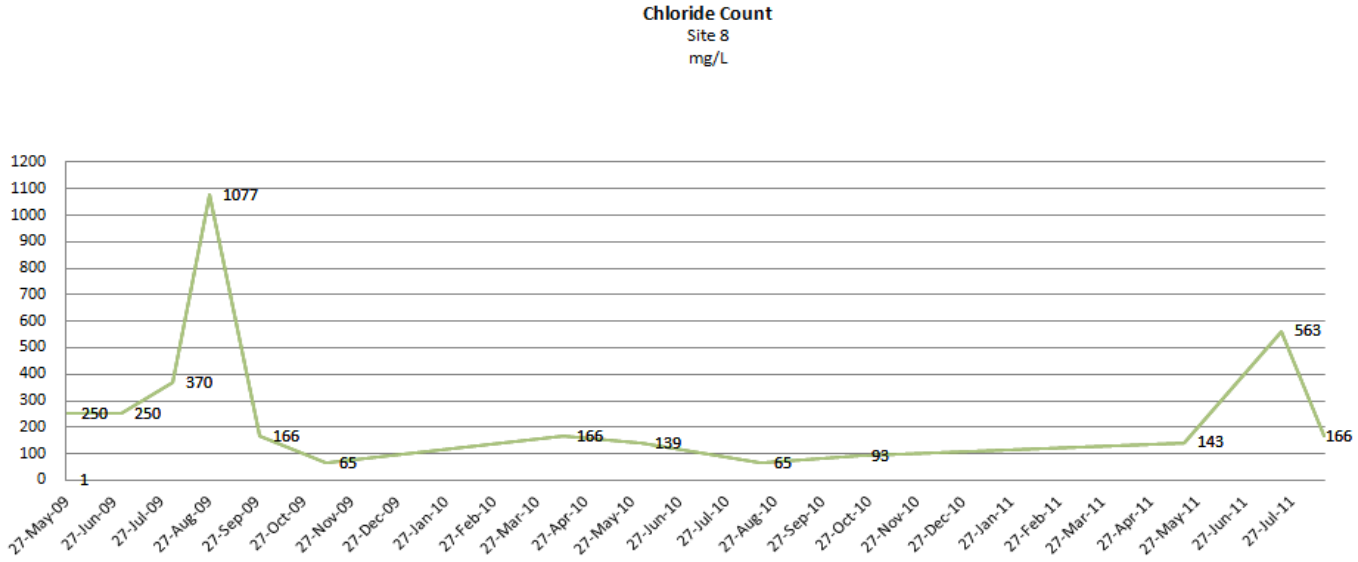
5-Oct-11
12-Oct-11
19-Oct-11
26-Oct-11


Chloride Count
Site 8
mg/L
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
250
250
370
1077
166
65
166
139
65
93
143
563
166
1
27-May-09
27-Jun-09
27-Jul-09
27-Aug-09
27-Sep-09
27-Oct-09
27-Nov-09
27-Dec-09
27-Jan-10
27-Feb-10
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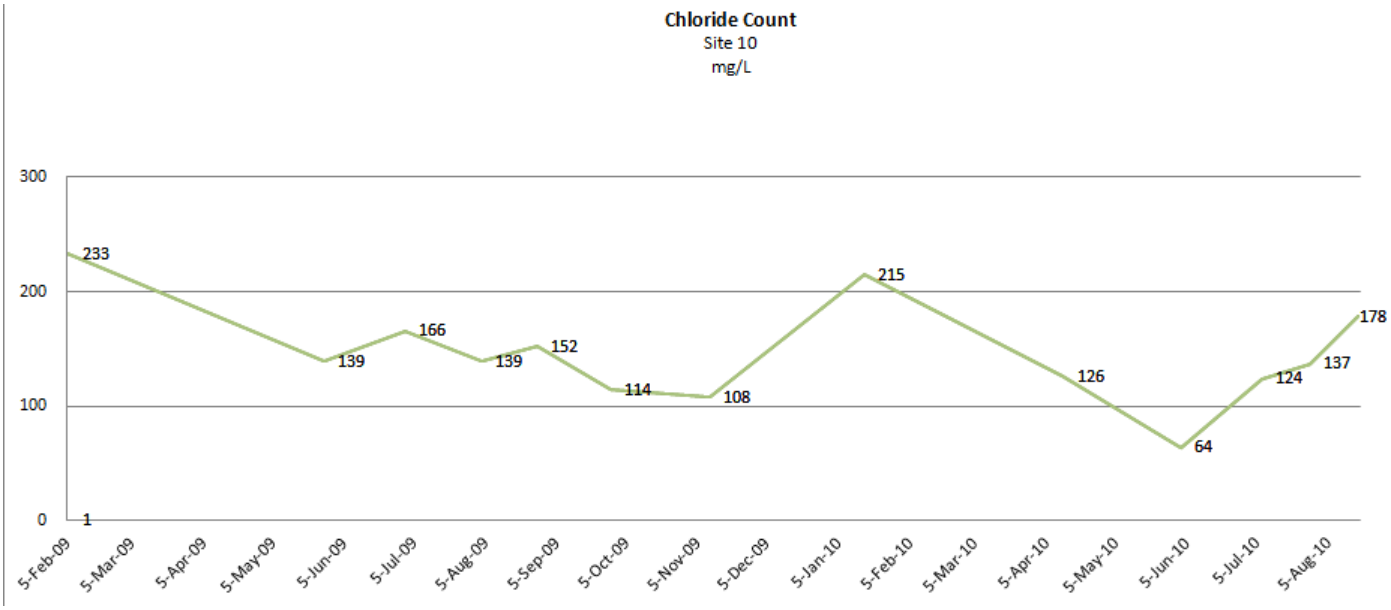
27-Jun-11
27-Jul-11


Chloride Count
Site 10
mg/L
300
200
100
0
233
1
139
166
139
152
114
108
215
126
64
124
137
178
5-Feb-09
5-Mar-09
5-Apr-09
5-May-09
5-Jun-09
5-Jul-09
5-Aug-09
5-Sep-09
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5-Nov-09
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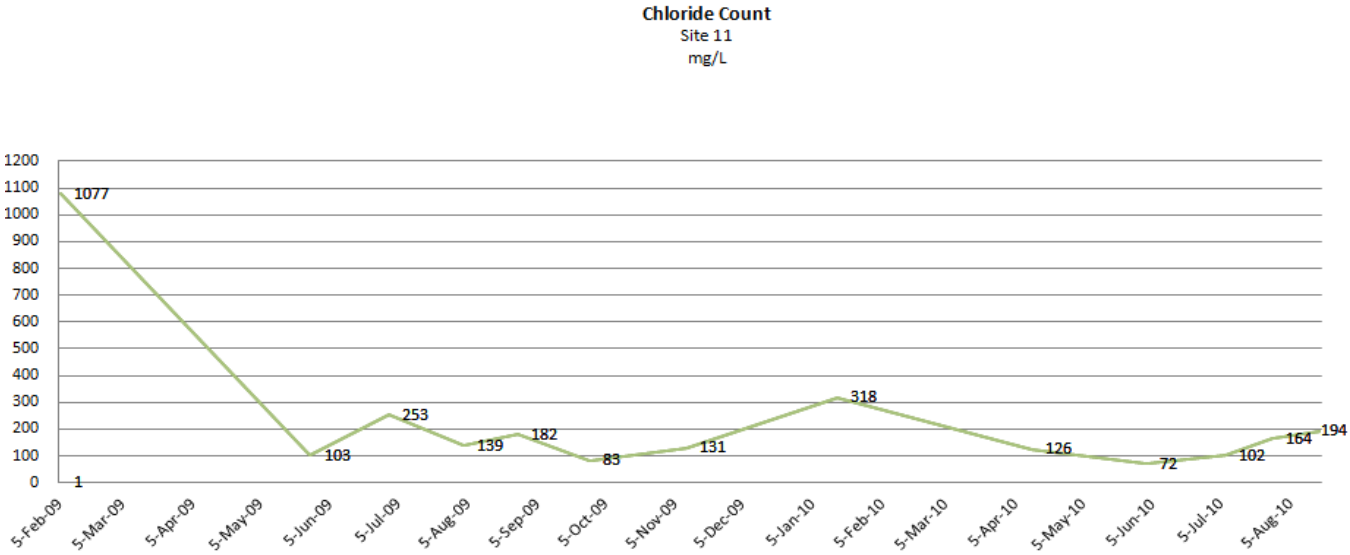
Chloride Count
Site 11
mg/L
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1077
1
103
253
139
182
83
131
318
126
72
102
164
194
5-Feb-09
5-Mar-09
5-Apr-09
5-May-09
5-Jun-09
5-Jul-09
5-Aug-09
5-Sep-09
5-Oct-09
5-Nov-09
5-Dec-09
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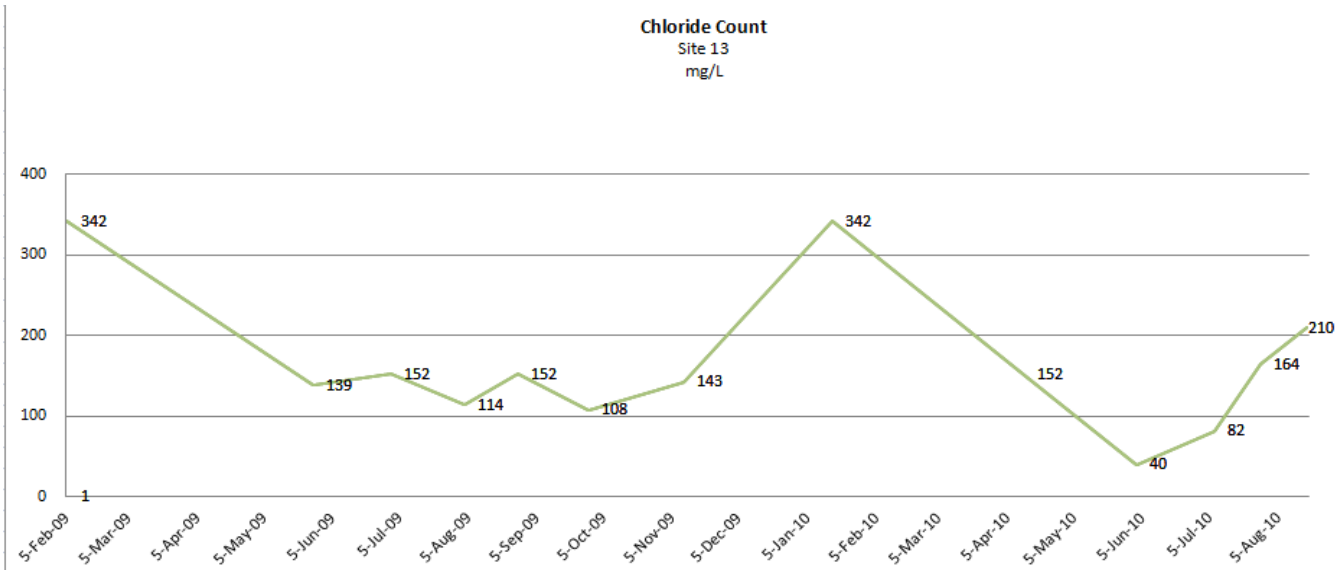
Chloride Count
Site 13
mg/L
400
300
200
100
0
342
1
139
152
114
152
108
143
342
152
40
82
164
210
5-Feb-09
5-Mar-09
5-Apr-09
5-May-09
5-Jun-09
5-Jul-09
5-Aug-09
5-Sep-09
5-Oct-09
5-Nov-09
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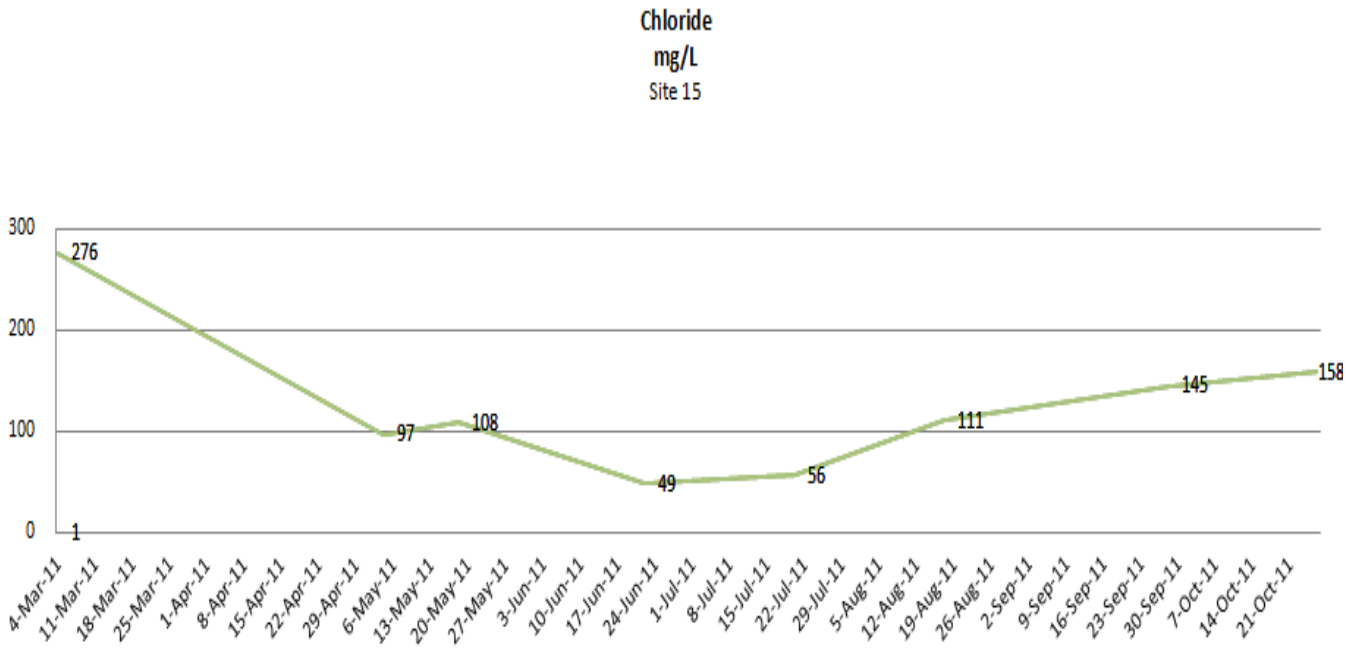
Chloride
mg/L
Site 15
300
200
100
0
276
1
97
108
49
56
111
145
158
4-Mar-11
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18-Mar-11
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26-Aug-11
2-Sep-11
9-Sep-11
16-Sep-11
23-Sep-11
30-Sep-11
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14-Oct-11
21-Oct-11