Revised October 2014

Deer Creek Watershed

Management Plan Summary

Deer Creek Watershed Alliance

a project of Missouri Botanical Garden

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Watershed Planning Partners & Sponsors

Missouri Botanical Garden

ASCE American Society of Civil Engineers® St. Louis Section

East-West Gateway Council of Governments
Creating Solutions Across Jurisdictional Boundaries

Washington University in St. Louis®

Missouri Department of Natural Resources

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Conservation Department Missouri™

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City of Clayton
City of Creve Coeur
City of Crystal Lake Park
City of Des Peres
City of Frontenac
City of Glendale
City of Huntleigh
City of Kirkwood
City of Ladue
City of Maplewood
City of Olivette
City of Richmond Heights
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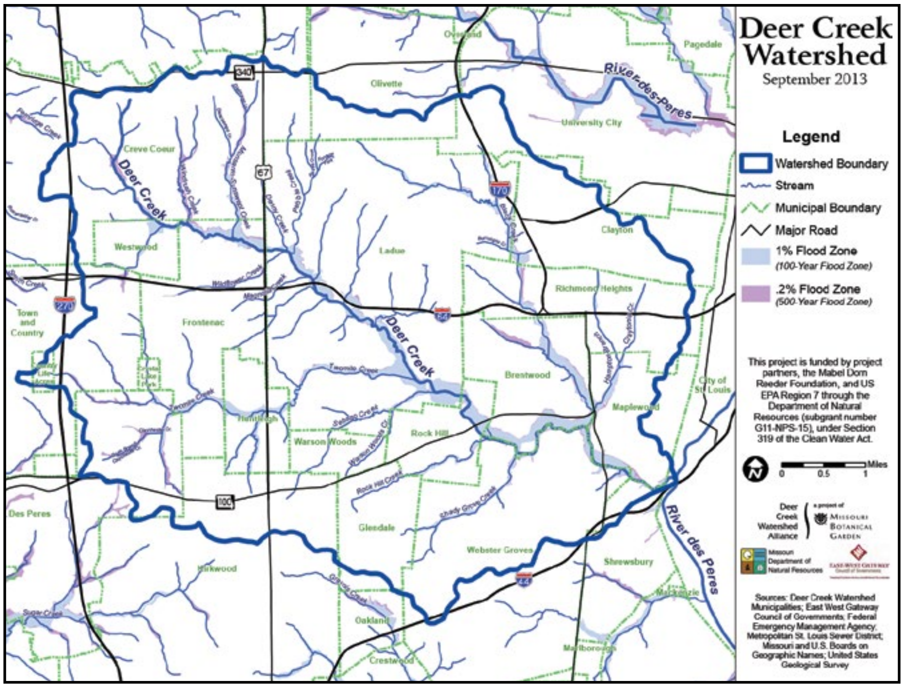
City of Town and Country
City of University City
City of Warson Woods
City of Webster Groves
City of Westwood
EcoWorks Unlimited
Missouri Stream Teams
River des Peres Watershed Coalition
St. Louis County
U.S. Army Corps of Engineers
U.S. Geological Survey

This project is partially funded by The Mabel Dorn Reeder Foundation and US EPA Region 7 through the Missouri Department of Natural Resources (subgrant numbers G09-NPS-13 & G11-NPS-15), under Section 319 of the Clean Water Act.

The Deer Creek Watershed Management Plan is a voluntary, educational guidance document designed to encourage the adoption of better stormwater management practices in the Deer Creek Watershed. The Deer Creek Watershed Management Plan's purpose is to minimize adverse impacts from rain events with a focus on plant-based solutions and community engagement. Implementing the recommendations in this plan can improve water quality and reduce the need to build stormwater drainage facilities. It is a broad ranging plan with a framework that encourages cooperation and collaboration. Plan components may be selectively applied as appropriate to individual municipalities. Please consider using this plan as a guidance document for your community on the path to better stormwater management.



Map 1: Deer Creek Watershed
Source: East West Gateway Council of Governments

What is a watershed?

A watershed is an area of land that drains to a body of water. The Deer Creek Watershed includes the land and tributaries draining into Deer Creek. We all live in a watershed, and the landscaping and building practices of all landowners directly affect the health of the streams into which the watershed drains.

What is stormwater?

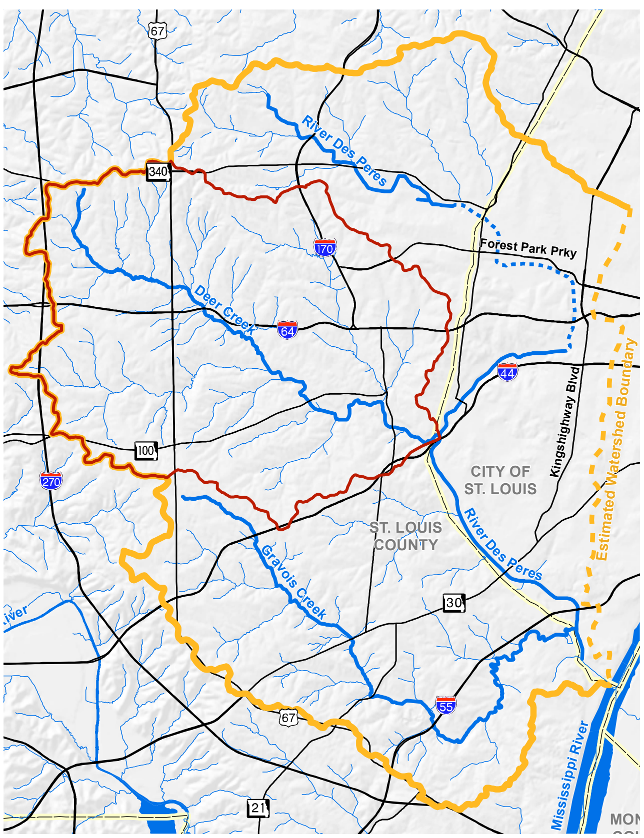
Stormwater is the runoff from rainwater and snowmelt. Rooftops, parking lots, streets and compacted soils are types of impervious surfaces that prevent stormwater from soaking into the ground as it does in vegetated and wooded areas. Impervious surfaces have replaced soils that would otherwise readily absorb rainwater allowing it to soak in and replenish both groundwater and stream base flow during dry periods. As water flows over impervious surfaces, it picks up pollutants such as oil, fertilizers, trash, and animal waste. Stormwater moves quickly into storm drains that carry it untreated into nearby waterways where it can negatively affect water quality, human health, wildlife, and property values. Left unaddressed, stormwater increases water pollution, erodes stream banks, causes flooding, and contributes to property loss.

How was this document developed?

The Deer Creek Watershed is a sub-watershed of the River des Peres Watershed. Due to the size and complexity of the River des Peres Watershed, watershed planning efforts need to begin at the sub-watershed level.

The Deer Creek Watershed is a good candidate for planning efforts due to the amount of citizen involvement, previous studies conducted, and historical water data available. Numerous studies have been carried out for the purpose of improving the management of Deer Creek. In April of 2008 a group of citizens concerned about Deer Creek approached Missouri Botanical Garden to sponsor their work.

To help facilitate cleaner, safer water in the Deer Creek Watershed, Missouri Botanical Garden established a Deer Creek Watershed Alliance in partnership with Metropolitan St. Louis Sewer District, Washington University, East-West Gateway Council of Governments, American Society of Civil Engineers, Great Rivers Greenway, Missouri Department of Conservation, Missouri Department of Natural Resources, Missouri Stream Teams, River des Peres Watershed Coalition, U.S. Army Corps of Engineers, St. Louis County, local garden clubs, local municipalities, and the citizen-led Deer Creek Watershed Steering Committee.



Map 2: River Des Peres Watershed
Source: East West Gateway Council of Governments

The purpose of the Deer Creek Watershed Alliance is to assess and improve the Deer Creek Watershed, with a focus on plant-based solutions.

Three key groups were formed in order to drive the watershed planning process:

1. Deer Creek Watershed Community Leaders Task Force, representing entities with jurisdictional or planning authority in the watershed.
2. Deer Creek Technical Advisory Group with expert representatives from government agencies, consulting firms, & non-profits.
3. A citizen-led Deer Creek Watershed Steering Committee, operating with the guidance and support of Missouri Botanical Garden.

This document would not be possible without the extensive contributions of many organizations, committees, and individuals who wrote, edited, discussed, shaped, reviewed, commented on and otherwise contributed to this watershed planning endeavor. See p. 26 for a list of plan contributors.

To view the complete watershed plan document, go to www.deercreekalliance.org/plan.aspx.

What do we know about the watershed?

Watershed Description

Deer Creek Watershed (HUC 071401010504) drains approximately 37 square miles (23,500 acres) of St. Louis County.

Deer Creek originates in the northwest in Creve Coeur near Interstate 270 and Olive, and flows in a southeasterly direction approximately 10.76 miles before it enters the River des Peres at Maplewood, near Interstate 44 and McCausland.

The major contributing streams within the watershed are Deer Creek, Twomile Creek, Sebago Creek, Shady Grove Creek, and Black Creek.

Geology

Deer Creek contains Mississippian limestone which includes chert (or flint). Because chert is much harder and more resistant to weathering than limestone, erosion of the softer limestone has left a thick blanket of chert gravel on the hilltops and ridges. Due to the presence of limestone the region has an extensive karst features including caves, springs, sink holes and losing streams that are created as groundwater dissolves soluble rock. Karst aquifers are also susceptible to surface contamination. Approximately 166 sinks holes have been identified. A majority of the sink holes are concentrated in the central area of the watershed and tend to follow the creek drainages.

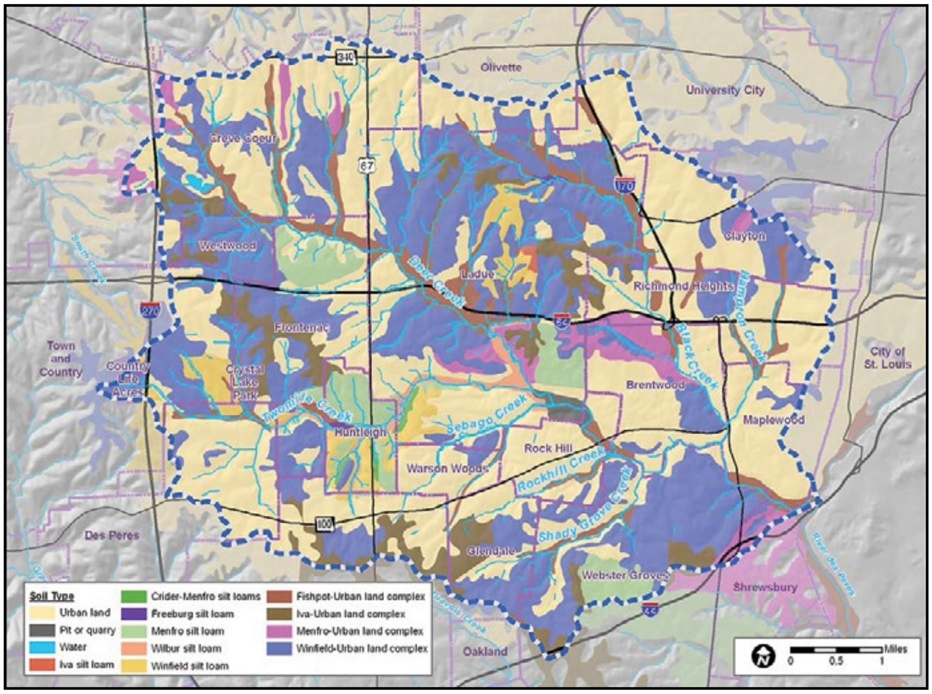
Soils

The majority of soils in Deer Creek are classified as Hydrologic Group C soils. Group C soils have moderately slow infiltration rates. Within the Deer Creek Watershed, 79% of the area is characterized by Group C soils, and 14% by Group C/D soils, with 7% not rated.

Soils with slow infiltration rates can limit stormwater volume reduction through ground infiltration. Low infiltration also reduces the bioremediation of organic and inorganic contaminants and pollutants in stormwater. The ability of these soils to support plant material can also be degraded due to soil compaction, or the removal of topsoil, or the addition of basement excavation fill during construction. As a result, some soils in the watershed may need to be amended or restored in order to achieve the intents of the stormwater best management practices.

Topography & Land Cover

The land cover is 82.21% urban with just 8.42% forest, 8.38% grassland, 0.47% crop land, 0.40% water, and 0.12% wetland. Consideration of slope will influence the location and selection of stormwater BMP methods and their effectiveness. Steep slopes can convert 90% of rainfall to runoff.

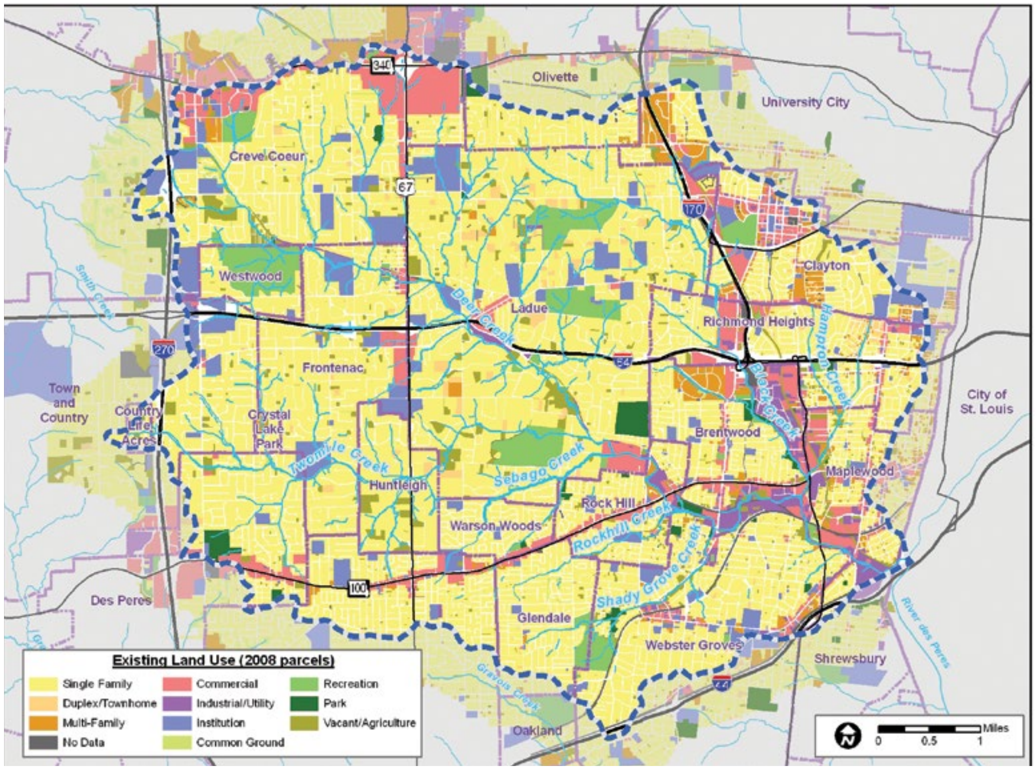


Map 3: Deer Creek Soil Types

Source: East West Gateway Council of Governments

What do we know about the watershed?

Flora & Fauna



Map 4: Existing Land Use Data Deer Creek

Source: East West Gateway Council of Governments

The Deer Creek Watershed is in the middle of a major metropolitan area yet the creek and riparian corridor provides important habitat and functions as a travel corridor for an assortment of wildlife species such as deer, coyotes, fox, raccoon, mink, great blue herons, kingfishers, various ducks, turtles, fish, frogs, and macroinvertebrates. Although large lots in the central portion of the watershed provide minimally disturbed habitat for wildlife, many parts of the stream bank, backyards, and other natural areas throughout the watershed have been overtaken by invasive species of plants, notably bush honeysuckle, which drives out other plants, increases erosion, and reduces the quality of the habitat for birds and mammals.

Riparian Corridor

Prior to 1953, much of Deer Creek from the center north to Highway 40/64 was undeveloped forest. Over time, hardening of the stream banks and straightening of the channel has increased the velocity of water and disconnected the stream channel from its floodplain. Similar changes have occurred in smaller tributary streams, all of which serve to increase volume and time of concentration in flood events. Many parts of the stream bank along Deer Creek are highly eroded and the stream has become incised and wider in places. Remarkably, Deer Creek still maintains its more natural flow in certain areas where it has room to move. These meanders also create in-stream habitat such as riffles, runs, and pools.

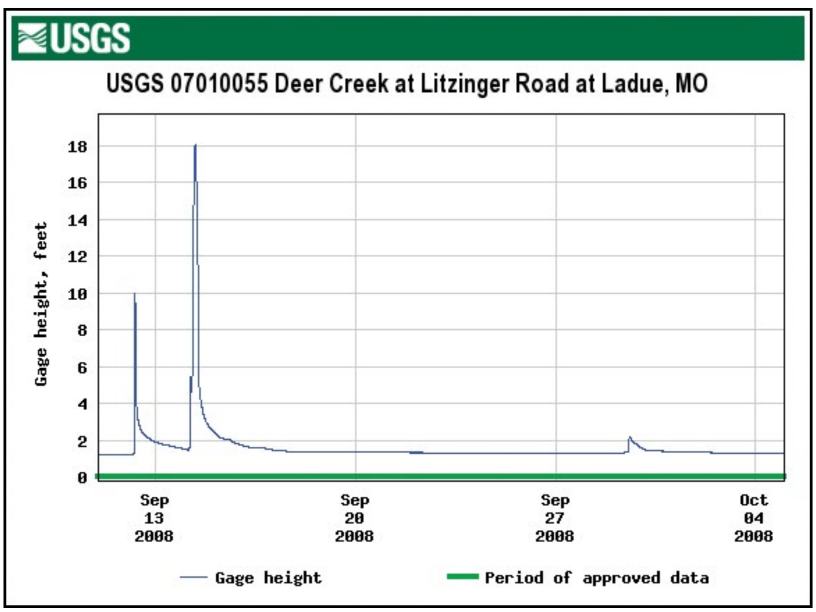
Precipitation & Hydrology

Precipitation in the St. Louis region has ranged from thirty-nine to forty-two inches annually. This rate is among the higher precipitation rates in the nation. Largely due to impervious surface areas that include infrastructure designed to convey flow to the stream as quickly as possible during rain events, tributary streams within the Deer Creek watershed experience a rapid rise after a rainfall, and tend to be flashy. (See Graph 1 on opposite page.) In large storms, the creek and its tributaries flood beyond its banks. Major floods have occurred in Deer Creek on five occasions in the last half-century: June 1957, April 1973, April 1979, July 1991, and September 2008.

FEMA Floodplain

Significant development has been permitted in the flood plain of Deer Creek and its tributaries. This development occurred before the adoption of the FEMA Flood Insurance Rate Maps (FIRMs) and the National Floodplain Insurance Program (NFIP). Mostly commercial and industrial structures are affected by floodwaters. A few residences are also in the floodplain. In September 2008, flash flooding on interior streams did significant damage in St. Louis County impacting 302 commercial properties. The City of Brentwood, which is entirely in the Deer Creek Watershed, experienced 45% of the commercial property damage of the county as a whole.

> "The quality of our waters is everyone's responsibility. A healthy creek leads to better human health, pet health, wildlife habitat and property values. The most effective path to clean creeks and streams is when everyone does their part."
>
> *— Jeff Theerman, P.E., Executive Director, Metropolitan St. Louis Sewer District*



Graph 1: Steep spikes indicating stream flashiness.
Source: USGS Monitoring Data

Demographic Characteristics

The Deer Creek watershed lies in central St. Louis County and includes all or parts of 21 municipalities. Although one sewer district, the Metropolitan St. Louis Sewer District (MSD), is responsible for stormwater planning and preparation of the Phase II stormwater permit for the larger communities, each community is responsible for development and enforcement of its own practices on publicly owned land and for management of development within its borders. In addition, Missouri Department of Natural Resources, U.S. Army Corps of Engineers, Great Rivers Greenway District, East West Gateway Council of Governments, St. Louis County and St. Louis County Municipal League each have jurisdictional or regional planning roles in the watershed. The number of municipalities and other agencies involved in land management decisions in the watershed greatly complicates any concerted effort at watershed planning.

The St. Louis county population as a whole grew rapidly from 1960-1990 but since that time it has flattened out and even declined slightly. The population in the watershed was approximately 91,000 in 2010. The highest population density is located along the east and southeast portions of the watershed. The Deer Creek area is predominantly residential; however the floodplain areas of Deer Creek and Black Creek have a variety of small businesses and light industry.

Watershed Inventory

A watershed inventory documents what previous studies have been conducted in the Deer Creek Watershed, stakeholder concerns, 303(d) classification and impairment identification, and baseline water quality data. 303(d) listed streams are streams that have been classified as impaired by the State of Missouri.

Previous Studies

Numerous studies have been conducted in the Deer Creek watershed, dating back as far as 1963. For a complete listing of studies, see Chapter 2 of the watershed plan document, online at www.deercreekalliance.org/documents/plan/Chapter_2.pdf.

Stakeholder Concerns

Areas of concern that were expressed during the citizen, community and technical meetings conducted, included issues related to:

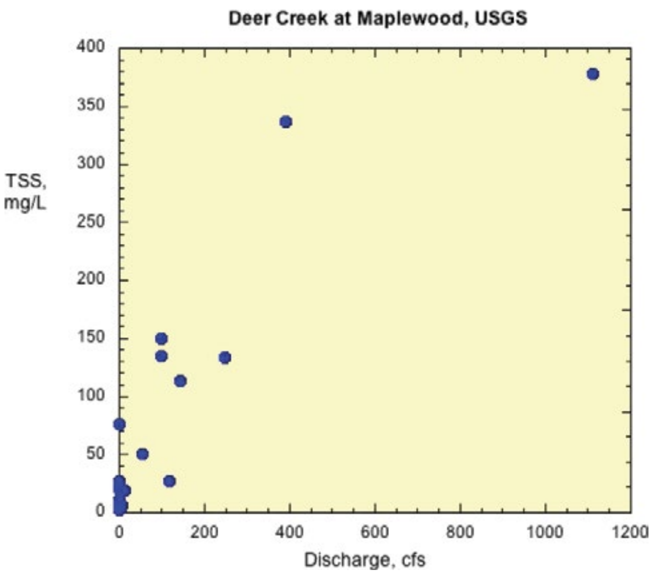
- stormwater best management practices
- the need for watershed studies
- industrial contamination
- flooding
- infrastructure damage
- yard waste, trash & construction debris
- stream bank erosion & sedimentation
- downspout disconnection concerns
- fertilizer & salt pollution
- sink hole issues
- tree loss
- riparian corridor development
- invasive species
- animal waste
- education and public awareness

303(D) Impairments

The Deer Creek Watershed is a major sub-watershed of the River des Peres Watershed. Sections of River des Peres, Deer Creek, and Black Creek are listed on the Missouri 303(d) list of impaired waters for E. coli and chloride due to non-point source urban runoff and storm sewer overflow. The beneficial uses impaired are wildlife watering, secondary contact recreation, whole body contact recreation (level b), and aquatic life protection. Water quality improvements in the Deer Creek Watershed will also have a positive effect on River des Peres.

Establishing Baseline Water Quality

A Water Quality Analysis Report was conducted by Washington University in 2010. Four sources of water quality data were reviewed and analyzed in the report, including 1) USGS monitoring data 2) MSD monitoring data 3) Washington University Stable Isotope Lab data, and 4) Litzsinger Road Ecology Center Stream Team data. Pollutant parameters assessed include specific conductivity, temperature, pH, dissolved oxygen, turbidity (suspended solids), total coliform, E. coli, ammonia, nitrate, phosphorus, chloride. The analysis found that Deer Creek failed to meet water quality standards established by State of Missouri for dissolved oxygen, chloride, and E. coli. Furthermore, there was a clear demonstrated correlation between volume of discharge into the stream and increase of total suspended solids (see Graph 2 below).



Graph 2: Volume of Discharge & Total Suspended Solids
Source: USGS Monitoring Data

A separate analysis of Litzsinger Road Ecology Center Stream Team data can additionally be found at www.deercreekalliance.org/documents/plan/Appendix_2-E.pdf.

Stream Team database and visual inspections have been recorded in the Deer Creek watershed since 1998. This data can be obtained from the stream team website at www.mostreamteam.org/mapwelcome.asp.

Identifying Point Source Stressors

Permitted Activities

Point source stressors in the Deer Creek Watershed include land disturbance associated with construction. Permitted activities are handled by the appropriate regulatory entity (e.g. MSD, Municipality, County, MoDNR, Corps of Engineers, etc.). Missouri Department of Natural Resources issues land disturbance permits when an acre or more of land is disturbed.

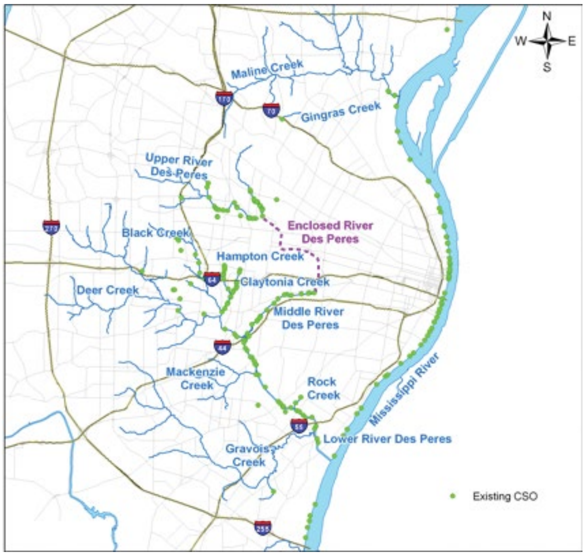
Industrial Corridor

Petrolite is a former industrial site with a history of contaminated soils. EPA has established a Superfund to address contaminated soils. MSD tracks industrial users that discharge into MSD's sanitary sewer and combined systems in a PIMS (Pretreatment Information Management System) database. MSD received two approvals for stormwater discharges in soil remediation excavations associated with the removal of contaminated soil from property. The impact on stormwater meets the regulatory requirements of EPA and MDNR. MSD has also been given special approval for discharges to their sanitary sewer system for tests and to purge water from their onsite monitoring wells used for site investigations to evaluate contamination.

Following the Hurricane Ike flood in 2008, Stream Teams from the River des Peres Watershed Coalition were mobilized to accomplish cleanups and assessment. In this process, forty-two 55 gallon drums were found; initial examinations identified drums containing toxic waste. Stream Team AmeriCorps assisted with locational identification of the drums. Several EPA contractors performed recovery, characterization, and disposal.

Sanitary Sewers

An additional point source stressor contributing to the degradation of stream quality is pollution from combined sewer overflows and from constructed separate sewer discharges into the creek. In the eastern areas of the watershed, the combined sewer system contributes to overflows (CSOs) to the stream. In the rest of the watershed, stormwater mixed with raw sewage is released into the stream from constructed sanitary sewer overflows (SSOs) during wet weather conditions. The constructed sewer overflow mechanisms protect homeowners from having sewage back up in their basements, but these systems leave the stream to carry pollutants such as bacteria, viruses and microbes from the sewage. As of April 2010 there were 51 constructed SSOs in the Deer Creek Watershed, and as of December 31, 2013 there were 46 constructed SSO's in the Deer Creek Watershed. Metropolitan St. Louis Sewer District is working on a plan to eliminate all SSOs in the watershed.



Map 5: Combined Sewer Overflows
Source: Metropolitan St. Louis Sewer District

Identifying Nonpoint Source Stressors

The following summary outlines nonpoint source watershed impairments, pollutants, and indicators.

Cause of Problem/ Concern	Watershed Problem/Concern	Pollutant Loads	Problem/Concern Indicator
Increased impervious surface area	Increased creek widening, property loss, bridge damage, gabion wall damage, erosion, flash flooding; reduced habitat & species diversity	Low dissolved oxygen, High TSS, E. coli	Geomorphologic assessment, resident reports
Channel straightening and loss of riparian corridor			
Soil compaction from construction	Low soil infiltration, erosion/ sedimentation, stormwater runoff	Low DO, High TSS, E. coli	GIS soil analysis chart, Onsite soil samples
Increased storm intensity from global climate change	Flooding, erosion, sedimentation, creek widening and property loss, sewer overflows	High TSS, E. coli	Climate change prediction models, scientific papers
Commercial/industrial properties clustered in lower floodplain	Economic damage from flooding causing property damage/loss	Industrial pollutants in stream	GIS land use mapping, list of potential industrial point-source polluters
Home construction practices of the 1950s	Potential erosion/ sedimentation, basement flooding from increases in overland flow stress	High TSS, E. coli, Low DO, Habitat loss	identify location & number of homes with inappropriate downspout connections
Human waste from CSOs & SSOs, waste from pets & wildlife in stream	Human health hazard	High E. coli count, Low DO	Homeowner surveys
Municipal winter road salting operations, landowner salt use	Human/pet health impact, reduced species diversity	High chloride count, high specific conductivity	Survey road salt operations
Lawn monoculture and pervasive invasive species with shallow root structure	Erosion/sedimentation	High TSS, Low DO	Visual plant location assessments
Landowner yard maintenance patterns, yard waste, organic debris, trash, lawn fertilizers in stream	Increase in eutrophication, channel obstruction, reduction in scenic beauty	Low DO, high phosphorus	Visual assessments, landowner reports
Tree loss from construction & disease	Erosion, sedimentation and flooding	Low DO, High TSS	Tree inventory
Presence of karst topography/sinkholes	Potential groundwater pollution	Depends on source	GIS mapping of karst/ sinkhole locations
Building in floodplain & floodplain infill	Residential flooding	High TSS, Habitat loss	Citizen reports/MSD database

What do we want to accomplish?

Estimating Load Reductions

Below is a table of long range goals for target pollutant loads, level, or value for 5 identified indicators or pollutants in the Deer Creek Watershed. Due to the nature of urban streams, reaching targeted standards for dissolved oxygen, chloride, E. Coli and other pollutants must, out of necessity, be long range, and may take 20 or more years to achieve.

Watershed & BMP Modeling

Once a load has been estimated using models, then various types of BMP implementation simulations can be run through the model to determine the location and the number of BMPs needed to obtain pollutant load reductions. Though there are many computation methods for calculating annual pollutant loading, the methods generally fall into either simple or complex with respect to level of effort. Simple models are defined as those models that make assumptions about hydrology that allow the user to bypass the effort required to model the complex relationship between land use, soil, topography, and detention facilities. STEP-L and L-THIA are examples of simple models. Though the accuracy of pollutant load estimates are compromised by this simplification, the accuracy may be sufficient to provide valuable feedback. In contrast, typical "complex" computer models used to estimate loading include EPA's SWMM, SUSTAIN, and MoHAT. Data obtained from the simple models may also be used as a check on the complex model results.

Indicator	Baseline Pollutant Load or Benchmark Value	Target Load, Level or Value
Dissolved Oxygen	Avg. mean D.O 7.1 milligrams/ liter Deer Creek @ Maplewood (23 samples, 2001–2004)	No more than 10% of all samples exceed criterion (5 mg/L for AQL) – State of Missouri standard for the protection of aquatic life
Chloride	Avg. mean chloride 407 milligrams/ liter Deer Creek @ Maplewood	No more than one acute toxic event (230 milligrams/liter) in 3 years during periods of stable, low flow conditions. No more than one exceedence in three years of the 860 mg/L chloride acute criterion under any flow conditions
E.Coli	Avg. geometric mean E. coli 1860 colony forming units/100 mililiters Deer Creek @ Maplewood	During the recreational season not to exceed geometric mean of 206 cfu/dL – State of Missouri standard for whole body contact
Volume as a surrogate for TSS	TSS increases with flow rates, and at first flush	Capture first 1.14 in rainfall onsite (90% of storms) – MSD standard
Phosporous	Avg. mean of .63 milligrams/liter Deer Creek @ Maplewood	60% reduction of load in targeted subwatersheds as per STEP-L model indications = .25 milligrams/liter

What do we want to accomplish?

Parallel Watershed Planning Efforts

NPDES Permit Discharge & Compliance

Metropolitan Sewer District's Saint Louis County NPDES Phase II Permit requires compliance with six MCMs (Minimum Control Measures). Their strategy for implementation addresses each of the six required minimum management measures:

- public education and outreach
- public involvement and participation
- illicit discharge detection and elimination
- construction site stormwater runoff control
- post-construction stormwater management
- pollution prevention/good housekeeping for municipal operations

Local Municipality Stormwater Management Plans

The Cities of Frontenac, Clayton, and Richmond Heights have completed stormwater management master plans. The Cities of Webster Groves and Brentwood have developed lists of priority areas for water quality improvements. Where municipalities have prioritized their water quality needs will be a key factor in guiding the location of water quality improvement projects.

Moving forward, critical areas will be identified at the municipal level in accordance with each municipality's planning priorities.

Watershed Goals

Deer Creek is an urban stream, located across several municipalities. The water quality issues cannot and will not be resolved/corrected overnight. It will take time, resources, and local buy-in. Each municipality has its own schedule and geographical priorities.

The intent of the Watershed Management Plan (WMP) is to incorporate their priorities over time as funding/resources allow. Funding sources will be continually sought and based upon political leadership. Milestones, priority areas, and funding resources will be re-evaluated and updated with each scheduled WMP revision.

The Community Leader Task Force and the Deer Creek Technical Advisory Group established goals for the Deer Creek watershed based on the issues and concerns developed during their meetings and those expressed by citizens in the watershed.

A. Maintain and improve water quality and quantity in watershed related to a one-year storm event or less.

B. Reduce the risk of stream bank erosion, sedimentation, and flooding from a one year or greater storm event.

C. Facilitate outreach to target audiences as it impacts water quality and water quantity.

D. Analyze/assess both existing conditions and effectiveness of management measures.

The goals established consist of the following:

Management Objectives

After defining and outlining goals to be accomplished in the watershed, the planning committees and subcommittees collaborated to identify a detailed list of management measures associated with each goal. The following lists detail the implementation plan for those management measures that should be completed within five years.

Goal A. Maintain and improve water quality and quantity in watershed related to a one-year storm event or less.

A1. Retain stormwater onsite through the following identified green infrastructure efforts.

Raingardens, bioswales and bioretention

- Provide incentives to encourage the design and installation of at least 20 demonstration bioretention/raingarden/bioswale projects at residences, churches, schools, parks or places of business in the watershed.
- Support the development and implementation of stormwater master plans in each municipality. Implement at least one demonstration project in each municipality.
- Develop a long term rainscaping maintenance strategy that provides technical assistance and includes training and educational opportunities for groundskeepers, landscapers, installers, and utility and transportation contractors.
- Develop and distribute educational material such as field guides/maintenance plans or schedules to landowners and/or schedule onsite work-days where trained professionals/volunteers will provide one-on-one assistance to landowners on predetermined dates.

Resources:

MBG, Show Me Raingardens, MSD, Municipalities, 319 funds, MDC, private donors, SNR

"Rain gardens, trees, healthy soils and native plant gardens are plant-based solutions that improve water quality. Successful projects have visual appeal, are easy to maintain, and meet water quality goals over the long term."

— Deborah Frank, Sustainability Vice President, Missouri Botanical Garden

Photo 1: This rain garden with surrounding lawn alternatives was installed in Kirkwood as part of a rainscaping cost-share program.
Credit: Stacy Arnold, Deer Creek Watershed Alliance

What do we want to accomplish?

Stormwater harvesting

- Document the relative effectiveness of different rain barrel designs.
- Make rain barrels available to landowners in the watershed through a public participation program 1 to 2 times/year.

Urban tree protection and urban forest management

- Engage citizens in tree inventory, tree maintenance, and tree planting efforts with emphasis on native trees.
- Identify and share local and model urban forest management programs.
- Ensure that trees do not compromise buried utility lines or traffic sight distance.
- Assist/encourage municipalities in the watershed to obtain Tree City USA designation.

Porous pavement

- Identify potential porous pavement demonstration projects.

Green roofs

- Identify potential green roof demonstration projects.

A2. Reduce identified pollutants and other impairments

Trash, yard waste and organic debris removal

- Identify and prioritize parcels in the watershed needing yard waste and organic debris removal as recommended by watershed municipalities.
- Support annual volunteer trash clean ups in the watershed. (Local as well as larger)
- Change yard maintenance patterns (including fertilizer reduction, trash, yard waste, and organic debris removal).

Reduce pet waste through education

- Distribute brochures on pet waste management.
- Promote horse manure recycling.

Reduce road salt in runoff

- Collect salt usage data.
- Research alternatives to road salt or the removal of road salt from runoff, with the recognition that once road salt becomes dissolved, it is very difficult to remove.
- Collect and share data on the effectiveness of pervious pavement in reducing the need for road salt applications.
- Conduct trainings for road salt and maintenance contractors on private developments.

Resources:

RdPWC, 319 funds, private landowners

Forest Releaf, MBG, Webster Grove Nature Study Society, MSD

MSD, Municipalities, Missouri Stream Team, RdPWC, 319 funds

MSD, River des Peres Watershed Coalition

MSD & co-permittees, St. Louis Earth Day

Symposium, Deer Creek Friends

- Educate the public on the hazards of excessive salt use.

Illicit discharge detection and elimination (see MSD Phase II NPDES)

- Develop and maintain a map of the area streams, storm sewers and storm sewer outfalls.
- Survey the creeks for illicit connections to storm sewers, Illegal dumping, and failing septic systems.
- Develop and implement a program to detect and eliminate illicit discharges into area streams.

Eliminate SSOs & address CSOs

- Plan for eliminating SSOs and addressing CSOs currently underway.

Resources:

MSD

Goal B. Reduce the risk of stream bank erosion, sedimentation, and flooding from a one year or greater storm event.

B1. Maintain and improve the natural stream physical stability and reduce stream widening and bank erosion.

Assess, implement, and maintain regional detention systems to manage channel protection

- Assess technical and cost feasibility of regional detention systems.

MSD, Municipalities

Utilize best available technology to improve channel protection and function

- Conduct a fluvial geomorphic assessment of Deer Creek and tributaries. Identify current conditions and/or current morphological trends. Use the assessment to identify areas that can be stabilized easily before the morphological trends compound issues on Deer Creek or its tributaries.
- Conduct seminars on the mechanics of stream dynamics related to flow. For planners, public works staff, developers.
- Partner with MSD and subcontractor(s) to identify at least three potential bio-engineering creek stabilization projects.
- Implement at least one bio-engineering creek stabilization project in partnership with MSD and subcontractor(s) in the Deer Creek Watershed.

Local engineering firms, local universities, St. Louis Earth Day Symposium, MDC

Promote invasive species removal and native plant establishment

- Assess invasive species and types and extents along the riparian corridor.
- Implement at least 5–10 model invasive species removal projects with a focus on bush honeysuckle removal and replacement.
- Replant native species
- Engage citizens in invasive species removal efforts.
- Provide invasive species education for planning, public works, and parks and recreation departments, landscape architects, and the general public.
- Partner with local nurseries to promote native plants.

Photo 2: Invasive bush honeysuckle was removed from this woodland in Ladue as part of a rainscaping cost-share program, and the woodland is being restored with a mix of native plant species.
Credit: Stacy Arnold, Deer Creek Watershed Alliance

B2. Provide adequate stream buffer zones (or stream riparian corridor) to reduce erosion and sedimentation to enable streams to carry large volumes of water associated with heavy rains without damage to property.

Greenway/trail development along riparian corridors

- Trail construction along sections of creek provide additional public access to the creek, serve to heighten awareness and interest in the creek and its condition, and highlight water quality management strategies to the public.
- Develop riparian corridor demonstration restoration projects.

Vegetated Buffers

- Encourage vegetated buffers along creeks.

Identify willing landowners located in the floodplain for voluntary purchase/sale and permanent removal from development

- Identify and prioritize parcels for purchase in the riparian corridor and set aside development rights in perpetuity as recommended by watershed municipalities.
- Facilitate the purchase and set-aside of development rights of these properties.

Resources:

GRG, Municipalities

Municipalities, FEMA, MDC Cost Share Program, RdPWC

- Use FEMA buy out opportunities to buy back floodplains.
- Educate FEMA Administrators at municipalities on floodplain development/ redevelopment restrictions (as a tool for opening floodplains).
- Solicit FEMA and others for additional floodplain buyout funding.

Research appropriateness of wetland restoration

- Identify and prioritize appropriate areas in the watershed for wetland restoration.

Resources:

U.S. Fish & Wildlife Service, FEMA

B3. Protect groundwater supplies in sensitive high karst areas.

Prevent sinkhole contamination

- Assess if any sinkholes are currently employed for stormwater drainage.

Prevent groundwater contamination

- Assess the effectiveness of the incorporation of forebays/underdrains in bioretention systems to prevent groundwater contamination in high karst areas.

Goal C. Facilitate outreach to target audiences as it impacts water quality and water quantity.

C1. Engage residential property owners in managing stormwater (71% of land is privately owned).

Provide technical support

East-West Gateway, MSD

- Consider creative strategies to disseminate information (i.e. Competition).
- Educate landowners how to ID and maintain native plants on their property.

Provide financial incentives

- Possible strategies include cost-share reimbursement program, reverse auction approach.

Encourage redirected downspouts

- Target appropriate properties, i.e. some lawns too steep, no lawn, nuisance to neighbor).

Develop demonstration green stormwater infrastructure projects

MBG, Municipalities, MSD, 319 funds, private donors

- Develop and implement a voluntary demonstration green stormwater infrastructure project that provides financial incentives to homeowners that manage stormwater on site. Over a five year period, target at least 20 key forward-thinking citizens throughout the watershed who will serve as agents of social change in their respective neighborhoods.

What do we want to accomplish?

Support annual citizen engagement projects in the watershed

- Trash clean up.
- Invasive species removal.
- Tree planting.
- Celebrate food yards, “Best Use of Natives”, “Best Rain Garden”, etc.

Educate homeowners to reduce leaf litter and other yard waste entering streams

- Provide positive reinforcement to residents who prevent leaf litter from entering streams (e.g. Signs for front yard “I’ve done My Part to Protect Water Quality”).

Engage residents in tree inventory, tree maintenance, and tree planting efforts

- Work with Forest Relief, MBG, Webster Groves Nature Study Society (WGNSS), and other organizations.
- Assist citizens in proper tree maintenance.
- Suggest quality native, disease-resistant varieties.
- Conduct tree identification (tree blitz) activities in local parks.
- Engage citizens in municipal tree inventory efforts.

C2. Support the development of municipal planning efforts that may include a combination of incentives, removal of barriers and/or case studies.

Identify appropriate conditions for porous pavement installation

Assist municipalities in managing parks and existing public lands for stormwater management

Identify certain plants as undesirable for appropriate stormwater management

C3. Develop strategies to assist commercial property owners to engage as responsible watershed stakeholders.

Encourage retail to stock/sell LID products; rain barrels & attachments, rain garden kits/instructions, rain garden plants, soil amendments, etc.

Encourage use of pervious pavement and bioretention in parking lots

Goal D. Analyze/assess both existing conditions and effectiveness of management measures.

D1. Expand and improve watershed modeling efforts.

Model the existing conditions of the watershed as a basis to compare and evaluate proposed improvements or proposed policies

- Take into account high cost of modeling efforts in a large watershed. Use L-THIA and/or STEP-L as a screening tool. Use SWMM, SUSTAIN and/or MoHAT for more detailed analysis.

Add BMPs to model to be implemented during 5 year period

- Run model for the projected 5 years. Repeat with subsequent addition of increased BMP implementation. Run model for subsequent 2 years, etc.

D2. Continue and refine watershed monitoring efforts.

Monitor the effectiveness of at least three demonstration BMPs over a 5-year period to inform future efforts

Recalibrate models based upon empirical data collected.

In order to better measure the effectiveness of identified management measures, establish a focus area to prioritize the locations of implemented Best Management Practices.

Initially this focus area will include the sub-watersheds of Denny, Pebble, and Monsanto-Sunswept Creeks.

Monitor base flow in creeks.

Survey creek cross-sections to study historical and future cross-sections.

Track and make available information on size, scope, location and effectiveness of area BMPs.

Continue ongoing water quality monitoring efforts in Deer Creek.

Resources:

Missouri Stream Team, MDC, MSD, USGS, WU, 319 funding, Show Me Rain Gardens, RdPWC, LREC

How do we engage the community?

Education Outreach & Public Engagement Objectives

Support municipalities in conducting outreach to their citizens to take positive voluntary action in their own yards, resulting in at least 20 landowners with demonstration projects over a five-year period.

1. Identify key schools to implement demonstration projects that can be a source of ongoing education for students, parents, and the local community, resulting in at least 8 schools in the watershed with implemented demonstration projects over a five-year period.
2. Conduct workshops for area professionals as identified in the plan to improve project implementation success rates, resulting in at least one professional training workshop per year for a five-year period.
3. Plan and develop citizen-led annual public engagement projects as prioritized by citizens in the watershed.
4. Grow a watershed citizen contact list to at least 1–2% of the watershed in five years (1,000–2,000 names) by tabling at festivals; encouraging peer-to-peer networking, making PowerPoint presentations, and conducting media outreach campaigns.

Photo 3: Visitors at the Deer Creek Watershed Alliance booth take a closer look at the Deer Creek Watershed Map on display during the 23rd Annual St. Louis Earth Day Festival.
Credit: David A. Wilson

5. Educate, grow the interest of, and motivate to action this core group, resulting in the publication of monthly email newsletters, website updates, and semi-annual educational public meeting.
6. Facilitate communication between municipalities regarding incentives, pilot projects, and barrier removal mechanisms.

"Motivated individuals can make a difference through voluntary efforts in their own yards and neighborhoods. Good neighbors pick up after their pets, manage stormwater on site, make sure their downspouts are not inappropriately connected to sanitary sewers and don't put trash or yard waste in the creek."

— Rick Holton, Chairman, Deer Creek Watershed Steering Committee

How will we measure our success?

Milestones, Schedule & Performance Criteria

The plan identifies interim measurable milestones and performance criteria for the following water quality improvement or protection objectives, as well as a schedule for completing them.

1. Demonstrate the effectiveness of bioretention systems to improve water quality (increase D.O.; reduce E. coli, TSS, phosphorus) by retaining the first 1.14 inches (90% of rainfall) at 3 demonstration sites by **March 2015**.
2. Remove barriers to bioretention installation through training and incentives resulting in at least 20 demonstration sites at area schools, churches, and residences by **March 2015**.
3. Establish metrics on impact of trees on stormwater management and implement model urban forestry management program in the watershed by **December 2017**.
4. At least 5000 pounds of trash, leaf litter, and/or organic debris removed or prevented from entering Deer Creek annually.
5. At least 2 linear miles of riparian corridor permanently removed from development and appropriately landscaped to reduce impacts on erosion, sedimentation and creek widening by **March 2014**.
6. Reach state standard for chloride levels in Deer Creek by **December 2020**.
7. Remove barriers to rain barrel effectiveness related to cost, capacity, and maintenance by **December 2014**.
8. Establish pilot models of effective rainscaping maintenance systems by **December 2017**.

Monitoring

Monitoring programs will be designed to track the progress in meeting load reduction goals and attaining water quality standards. It is important to specify monitoring objectives that, if achieved, will provide the data necessary to satisfy relevant management objectives. The selection of monitoring designs, sites, parameters, and sampling frequencies will be driven by agreed-upon objectives and will include factors such as site accessibility, sample preservation concerns, staffing, logistics, and costs.

Measurable progress is critical to ensuring continued support of watershed projects, and progress is best demonstrated with the use of monitoring data that accurately reflect water quality conditions relevant to the identified problems. Frequently watershed managers rely on modeling projections or other indirect measures of success (e.g., implementation of management measures) to document achievement; in some cases this approach can result in a backlash later when monitoring data shows that actual progress does not match the projections based on surrogate information.

Photo 4: One of five demonstration residential rain gardens in Creve Coeur working together in the same sub-watershed to reduce water pollution and water overflows downhill.
Credit: Stacy Arnold, Deer Creek Watershed Alliance

How will we measure our success?

Because of natural variability, one of the challenges in water quality monitoring is to be able to demonstrate a link between the implementation of management measures and water quality improvements.

Photo 5: One of seven demonstration residential rain gardens in University City monitored for effectiveness at improving water quality.
Credit: Stacy Arnold, Deer Creek Watershed Alliance

Monitoring Indicators for Best Management Practices

A monitoring program will assess the effectiveness of pollutant removal by three Best Management Practices.

Monitoring results will guide Metropolitan St. Louis Sewer District and municipalities regarding the degree to which bioretention methods should be implemented in the watershed. Monitoring will be conducted for following: flow, nutrients (phosphorus), chloride, bacteria, DO, BOD, total nitrogen, temperature, pH, and ammonia.

Activities associated with the monitoring will include: reviewing past data, journal articles, field monitoring, laboratory work, analysis, and reporting.

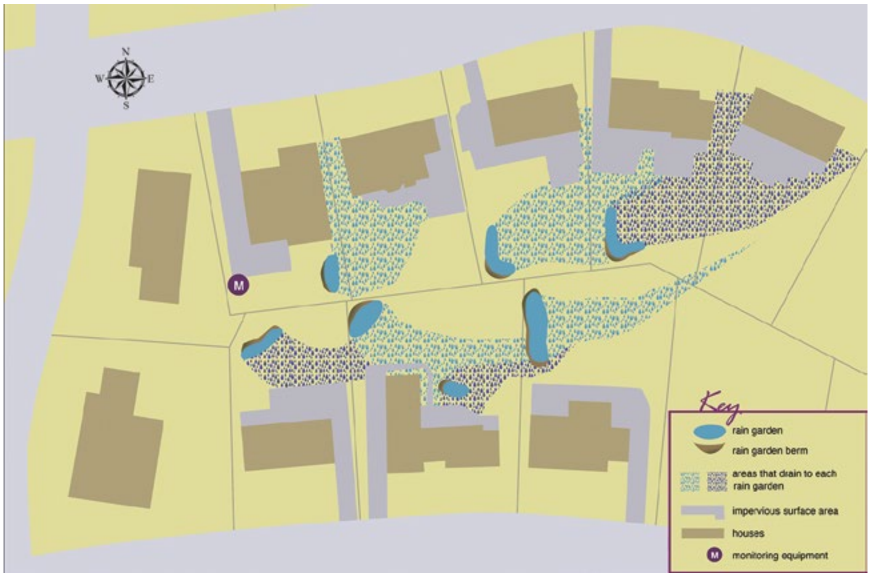
Monitoring Overall Goals & Progress

Litzsinger Road Ecology Center and Metropolitan St. Louis Sewer District currently plan to continue water quality monitoring in the Deer Creek Watershed. USGS/MSD monitoring is high quality data that can be used to document water quality trends at 4 stations within the Deer Creek Watershed, which can also be used to model water quality pollutant loads. Stream Team data can be used to document long-term trends documenting gross changes in water quality, while the Stream Team aquatic macroinvertebrate data can be used to document gross changes in aquatic life.

Evaluating, Adapting & Adopting the Plan

This Deer Creek Watershed Management Plan reflects the conditions in the watershed as of 2011. This plan is intended to be working document and updated on a periodic basis. This watershed plan reflects issues and concerns expressed by citizens, municipal organizations and technical participants. Therefore joint ownership of this plan should be considered by all three entities and their continued involvement to evaluate its effectiveness and modify the plan as needed. The municipalities within the watershed and St. Louis County should consider adopting this plan through either an ordinance or resolution.

Deer Creek Demonstration Projects



Map 6: Aerial view of seven residential rain gardens that were installed in a neighborhood in University City to address an erosion concern
Source: Deer Creek Watershed Alliance

MSD has designed and implemented three demonstration projects in the cities of Brentwood, University City, and Creve Coeur to assess effectiveness of raingarden and bioretention BMPs in reducing pollutant loads. These demonstration projects will be monitored over a 5 year period by Washington University and Litzsinger Road Ecology Center staff.

In a recent review of this data by Dr. Robert Criss at Washington University, statistical and theoretical means were applied to detailed pre-BMP and post-BMP monitoring data on three rain gardens in the Deer Creek basin, in order to evaluate there performance. Available data suggest that lag times between rainfall and runoff increased at two sites, and that peak stages in the culverts were reduced at all sites, for a given amount of antecedent rainfall. Significant change occurred in lag time at the Brentwood Mt. Calvary Rain Garden and probably at the University City Rain Gardens (see Map 6) where peaks have become later and broader or more diffusive (Criss report, pg. 7). A comparison of peak stages with antecedent rainfall suggested that runoff volumes were lower in the post-BMP period than in the pre-BMP period for all sites (Criss report, pg. 9). Robert Criss's full report can be viewed at www.deercreekalliance.org/documents/Criss.pdf.

The STEP-L model has been employed to estimate projected nutrient and sediment load reductions, and BMP effectiveness. In addition, raw data from pre- and post-BMP implementation will be evaluated using statistical comparisons such as the mean, minimum, and maximum nutrient, sediment, and coliform loads for similar storms before and after implementation. This raw data will be compared against STEP-L predictions to weigh the accuracy of the STEP-L model under local conditions.

The primary performance goal of all three demonstration projects is capturing, treating, and detaining stormwater runoff from 90% of the recorded daily rainfall events, which is based on a rainfall amount of 1.14 inches, with the understanding that in an urban environment, the most effective way to remove pollutants from stormwater is to remove the stormwater. Opportunities to design for larger events and incorporate enhanced infiltration techniques will be taken as downstream conditions warrant and with recognition that retrofitting in urban settings is challenging.

> "Quality professionals regularly educate themselves regarding new information in a rapidly changing field."
>
> *— Gene Rovak, Co-Chairman, American Society of Civil Engineers - St. Louis Section*

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"Responsible municipalities take into consideration the impact of their procedures on other municipalities. We all live downstream."

— David A. Wilson, Senior Manager, Environment and Community Planning, East-West Gateway COG

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Deer Creek Watershed Alliance

a project of Missouri Botanical Garden

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