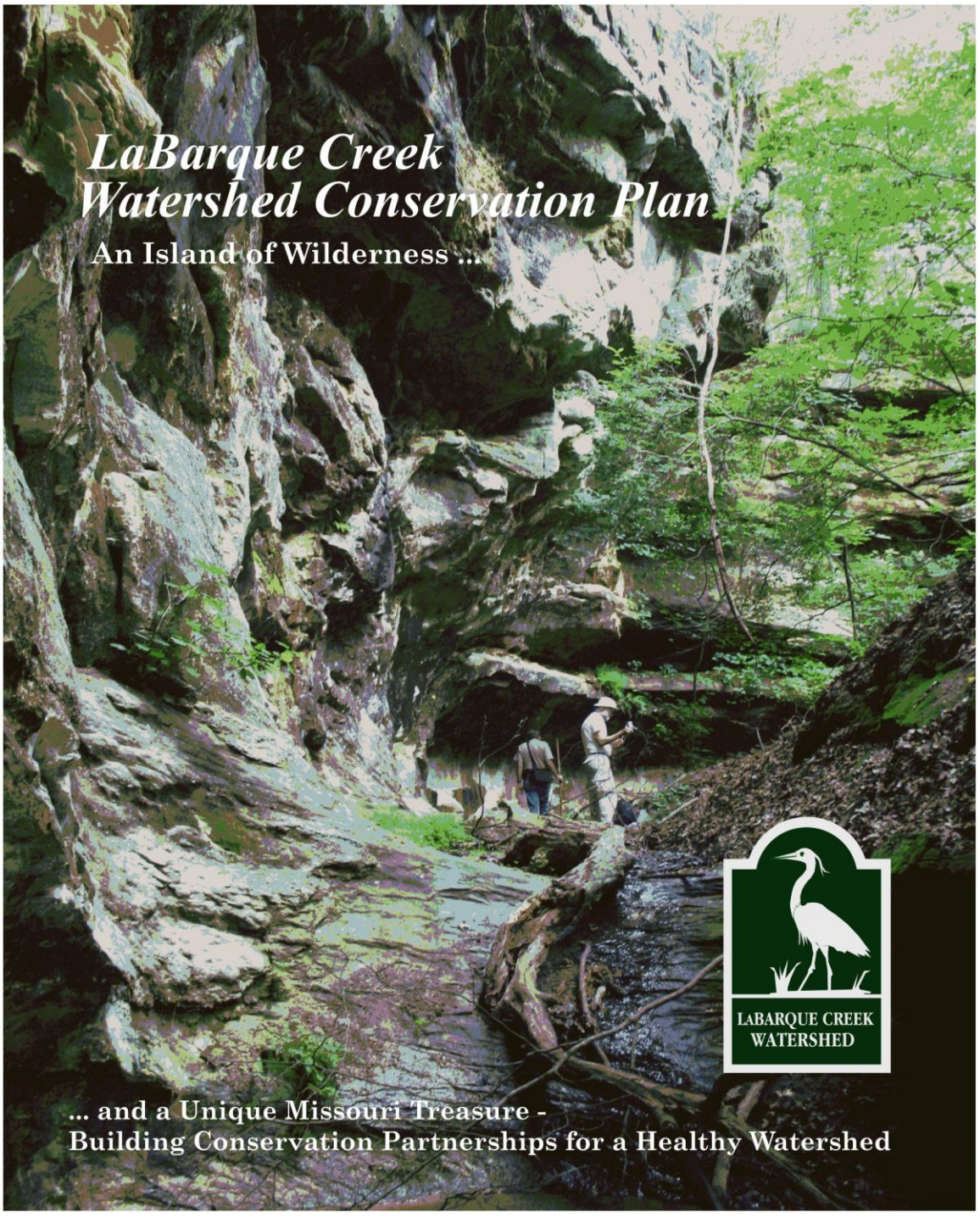
LaBarque Creek
Watershed Conservation Plan
An Island of Wilderness ...
LABARQUE CREEK
WATERSHED
... and a Unique Missouri Treasure -
Building Conservation Partnerships for a Healthy Watershed

We, the undersigned, contributed to the creation of this LaBarque Creek Watershed Conservation Plan and pledge our support for its contents and implementation:

Friends of LaBarque Creek Watershed:

_____	_____
Board member	Board member
_____	_____
Board member	Board member
_____	
Board member	
_____	
Stream Team #2991	
_____	_____
Jefferson County Government, County Executive	Missouri Department of Conservation
_____	_____
Missouri Department of Natural Resources	East-West Gateway Council of Governments
_____	_____
Missouri Native Plant Society	Ozark Regional Land Trust
_____	_____
The Nature Conservancy	The Open Space Council
_____	
Webster Groves Nature Study Society	

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EXECUTIVE SUMMARY

A. Background

The LaBarque Creek Watershed's primarily sandstone geology and rugged terrain produces a uniquely diverse and intact landscape and stream surprisingly close to the center of the St. Louis Region population. A combination of the ecological values and ownership and development patterns make the watershed an excellent candidate for conservation efforts.

The watershed lies in northwest Jefferson County and consists of 8,365 acres, or 13 square miles. LaBarque, a 6.4 mile long fourth order stream, enters the Meramec River approximately 42 miles upstream from its mouth at the Mississippi. The topography is rugged with nearly two-thirds of the land area having 15% or greater slopes. Over 86% of the watershed is forested.

The watershed includes 2,466 acres (29%) of public open space and 11 large undeveloped tracts totaling 2,043 acres (24%), the smallest of which is 102 acres. The LaBarque Creek watershed contained approximately 1,300 residents in 2000, a density of roughly 100 people per square mile. However, the population is concentrated on only 20% of the watershed land with impervious surfaces estimated at four percent of the watershed.

The low level of disturbance in the watershed yields a high quality aquatic system. LaBarque Creek provides over six miles of permanent flowing Ozark border stream which supports 44 species of fish, including black bass and sunfish. This level of aquatic biodiversity and richness can be found nowhere closer to the St. Louis area.

The watershed contains a variety of natural communities including those developed largely on St. Peter Sandstone, which produces a dramatic and unique landscape. Flowing water in intermittent and perennial streams carves cliffs, waterfalls, bowls, and overhangs into the soft sandstone. The resulting deep-sheltered moist canyons and ravines contain high-quality natural communities, some including state-listed plants considered to be glacial relicts. On the higher knobs and ridges a layer of dolomite caps the sandstone, yielding small isolated dolomite glades and sections of dry-mesic dolomite forest and woodland.

Appreciating these significant natural features and recognizing threats associated with poor developmental and land management practices, a group of watershed landowners partnered with agency and non-profit groups to begin a watershed conservation plan in 2004. In 2005, the partners organized and hosted a watershed festival, met with interested landowners, and held two visioning workshops to educate residents about the watershed, encourage further landowner interest, and gain landowner input regarding watershed problems and opportunities.

This process formalized landowner interests and concerns, generated the watershed vision statement and goals, and identified volunteers to form the LaBarque Creek Landowners Committee (which has evolved into The Friends of LaBarque Creek Watershed). Agency and non-profit partners formed a technical committee and together the two committees collaborated to produce this plan. Subsequent newsletters and committee meetings helped encourage open communication and information exchange while keeping all parties informed of plan progress. In 2007, a listening session was held to present the action portion of the plan and reaffirm support for plan elements. During 2008, partners provided additional comments to refine the plan further.

B. Plan Purpose and Role of Partners

The purpose of the LaBarque Creek Watershed Conservation Plan is to maintain and enhance the ecological, educational, and recreational values of and the quality of life in the LaBarque Creek Watershed. In order to achieve this, the plan:

- Establishes a common understanding of watershed assets
- Outlines common goals and action items to conserve and enhance watershed assets
- Defines entities responsible to lead implementation of priority action items
- Provides measureable indicators to determine if goals are being met

Implementation of action items are led by individual partners, in close cooperation with or independent of other partners. The partners may wish to form an implementation body, such as a watershed coordinator to help implement high priority actions. Partners should continue to keep one another informed on watershed conservation efforts through continuation of existing communications (newsletters, meetings). This partnership approach has served LaBarque Creek Watershed conservation efforts well and will support the accomplishment of Plan goals.

Although leadership and land ownership will change, this plan exists to help emphasize the importance of wise land use and management in concert with the natural environment. The tradition of conservation and preservation needs to continue if the LaBarque Creek Watershed is to remain healthy within an urbanizing landscape.

C. Summary

LaBarque Creek Watershed is currently healthy, but is also fragile. The Plan includes permanent land protection, guidance on placement and intensity of development, assistance to promote landowner watershed stewardship, education regarding watershed conservation needs, and support for stormwater management that mimics the natural hydrograph of watershed streams. These elements are critical to maintaining LaBarque Creek Watershed's healthy and diverse suite of plants, animals, and landforms, water quality, and high-quality of life for watershed residents.

The Plan is organized according to the vision statement and goals developed from the 2005 visioning workshops, which include:

> The Vision Statement: **In 2025, healthy forests and glades blanket the hillsides, diverse native plants and wildlife thrive, clear streams spill over rock formations and flow through valleys, and countless bright stars touch the horizon at night over homes nestled in the natural contours of the watershed.**
>
> Goals:
>
> I. Conserve the unique natural resources of the watershed by maintaining aquatic and terrestrial health and diversity, water quality and quantity, and habitat connectivity.
>
> II. Where development occurs, promote design that conserves watershed natural resources, community character, and a sense of place.

III. Preserve a high level of quality public and semi-public infrastructure and services.

IV. Foster a partnership among citizens, local governments, state government, non-governmental organizations, regional initiatives, and agencies.

The LaBarque Creek Watershed Conservation Plan includes a significant and complex action plan. Implementation of its action plan, through coordinated action from various partners, is the best chance watershed natural resources have at remaining healthy. Key watershed issues and opportunities identified in the planning process and addressed in the Action Plan include:

1. LaBarque Creek Soils and Geology. LaBarque Creek Watershed geology and soils are diverse and in many cases challenging for urban development. Shallow, highly-erodible soils, fragile sandstone bedrock, and very steep slopes present in much of the watershed are significant challenges to maintaining watershed health when altered. In addition, LaBarque Creek's low flow characteristics, steep slopes, shallow bedrock, and relatively porous soils and geology suggest caution is required when considering disposition of sewage treatment effluent into basin streams. Steep slopes and shallow bedrock suggest significant potential for serious impacts to stream health from stormwater runoff. Due to the numerous limitations found within these general soil types, fragility of sandstone bedrock, and steep slopes extra precautions and investigations will be needed to avoid potential problems related to soils and geology. Understanding the interactions between the two will help to frame proper management and development to minimize damage to the watershed's natural communities.

2. Human Interaction and Natural Community Conservation.
From a natural community and stream aspect, the entire LaBarque Creek Watershed is a gem and worthy of conservation. Unique geology, steep slopes, high quality Ozark streams, and minimal human impacts provide a rich mosaic of habitat types which host a large and diverse suite of plants and animals within a relatively small place. This level of diversity and quality within a single watershed so close to St. Louis is considered unique to Missouri, as evidenced by its designation as a Conservation Opportunity Area.

Human interaction with the watershed's natural communities and streams will determine their future quality, and in turn, help define the quality of life for watershed residents. Existing and future residents' stewardship and rules for development or use of watershed lands and streams will be critical. Lessons learned from the destruction of natural communities in adjacent watersheds should help guide future decisions within the watershed. Natural community and LaBarque Creek quality can remain high, if land use and management practices recognize the unique features of the watershed by avoiding some features, designing changes around other features, and significantly minimizing impacts of changes on still others.

3. Green Development.
Given the existing high-quality natural communities and streams, topography which is challenging to develop, and desire of watershed residents to retain natural community and stream quality, a unique opportunity for non-traditional (green) development practices exists, where

environmentally appropriate. Development designs which conserve watershed natural resources, community character, and provide a sense of place should be provided and promoted.

4. Livestock Interaction.

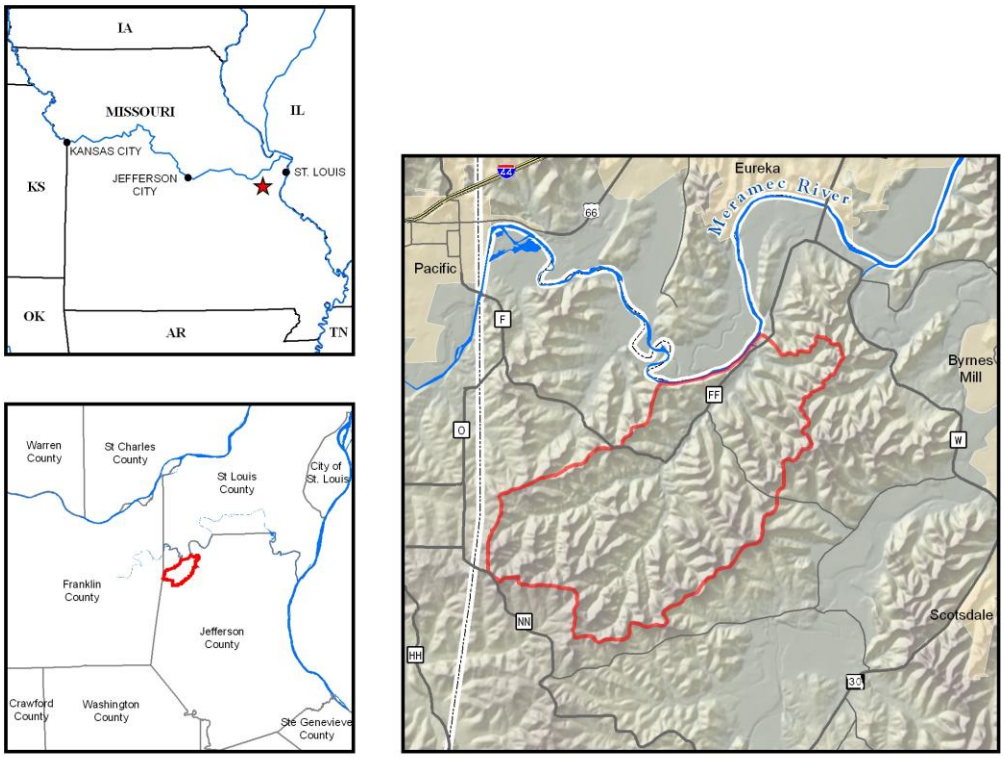
Livestock use of watershed streams and riparian areas negatively impact water quality through direct introduction of animal waste and disturbance of aquatic habitats and indirectly through increased soil erosion associated with disturbances in riparian corridors. These impacts harm stream health, limit aquatic species biodiversity, and quality of stream edge and wetland natural communities. However, these impacts can easily be remediated through use of alternative watering, fencing, rotational grazing, and protection/establishment of wooded riparian corridors, as part of livestock management.

By their nature, watershed plans are somewhat dynamic. As circumstances change or issues are resolved, new problems or opportunities may develop and could be incorporated into updated versions of the Plan.

WATERSHED LOCATION

The LaBarque Creek watershed is located in east-central Missouri, entirely-contained in northwestern Jefferson County. It drains 8,365 acres or 13 square miles of land as part of the lower Meramec River basin. LaBarque Creek flows 6.4 miles northeastward to its confluence with the Meramec River at river mile 42, south of Eureka, Missouri (Figure 1).

Figure 1. Location of LaBarque Creek Watershed, Jefferson County, Missouri



WATERSHED COVER

As LaBarque Creeks flows northeastward, it cuts through fragile sandstone in the upper watershed and relatively young limestone in the lower watershed. A pronounced southwest to northeast "down dip" of this rock across the watershed causes different rock strata to be exposed at the same elevations, in the different parts of the watershed. For example, the St. Peter Sandstone is most exposed in the southwestern half of the watershed, where it forms extensive cliffs, canyons, waterfalls, chutes, shelter caves, overlooks, talus (and other collapse structures), and floors in many valleys, tributaries of LaBarque Creek, and LaBarque Creek itself. The resistant dolomite cap to the St. Peter in this part of the watershed, conspicuous on higher ridges, increases topographic, soil and natural community diversity, making the SW portion of the LaBarque Creek watershed the most diverse and topographically spectacular of any in the entire St. Louis region. The northeastern half of the watershed has little exposed St. Peter Sandstone except at low elevations (550 feet or less), but extensive dolomite outcroppings at nearly all elevations. The elevation and relief here is similar to that of the southwestern portion of the watershed (e.g., as much as a 200 foot drop from ridge top to valley floor in a very short distance), but without the associated sandstone features and natural communities.

A. Ecoregion

The LaBarque Creek Watershed lies within the Ozark Highland Ecoregion which includes most of southern Missouri and northern Arkansas, and smaller portions of southwestern Illinois, southeastern Kansas, and Northwestern Oklahoma (Nigh and Schroeder 2002). The Ozark Highland Ecoregion is a large geographic area having distinctive Ozarkian physical and biological attributes, which have been undergoing erosion and weathering for a quarter billion years, creating numerous unique ecosystems with over 200 endemic species. Historically, this ecoregion was composed of oak and mixed-hardwood woodland and forest, savanna with scattered glades, and high-quality Ozark and Ozark border streams.

Within the LaBarque Creek Watershed, the ecoregion consists of very rugged hills with narrow ridges containing isolated knobs, steep slopes, and narrow valleys carved into late Ordovician sandstones and dolomites. LaBarque's valleys are quite steep with over 60% of the watershed having a slope of 15% slope or greater. Only 309 acres (less than 4% of the watershed) demonstrate gentle slopes (0-5% gradients). Watershed features include steep slopes with bedrock outcroppings, cliffs, glades, savannas, open woodlands, oak forests, thin soils, Ozark border streams, and a suite of unique sandstone communities. Fens, seeps, and sinkhole ponds are fragile.

Portions of the Ozark Highland Ecoregion are adjacent to significant urban development (Nigh and Schroeder 2002), including the southern and southwestern portions of the St. Louis metropolitan area. There, the ecoregion is dissected by numerous roads and small towns, fragmenting and negatively-altering major ecosystems.

The LaBarque Creek Watershed is significantly less urbanized than adjacent lands of lower relief, but development is rapidly encroaching along highways. Much of this landscape is still timbered in second-growth forest. Unique sandstone communities occur (Nigh and Schroeder 2002). Many of the characteristic savannas, open woodlands, and glades have been altered or lost by urbanization or overgrown with invasive woody species and have diminished ground flora

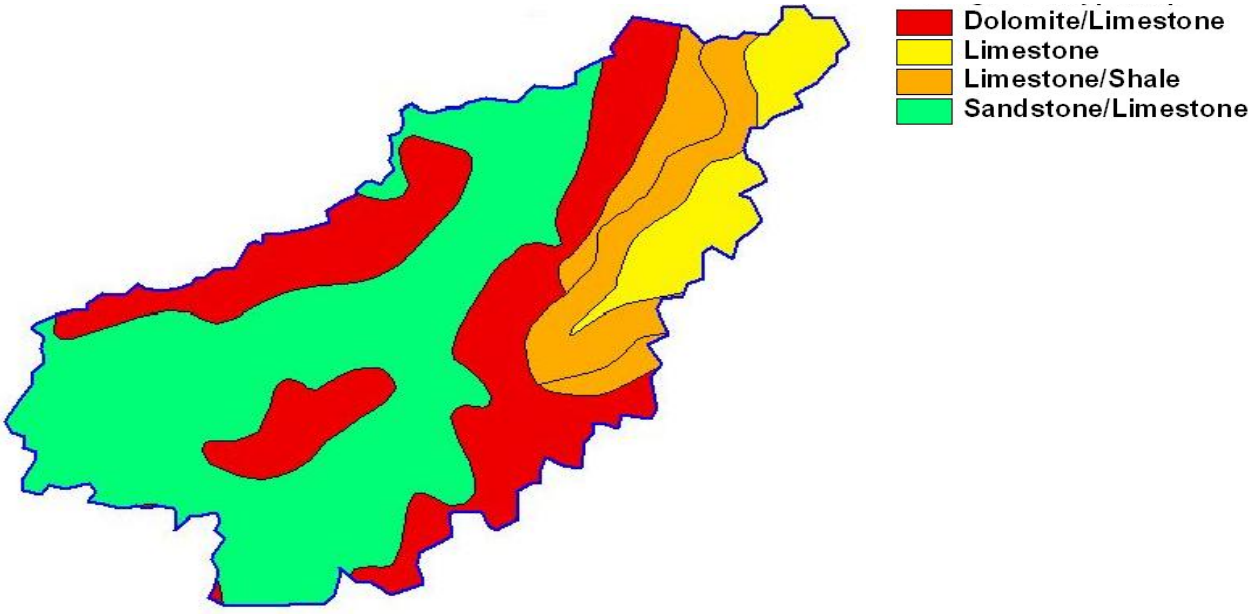
diversity. There are still exceptionally large blocks of forest associated with more rugged valleys and unique sandstone communities which could be focal areas for conservation efforts. LaBarque Creek and its tributaries contain outstanding aquatic assemblages which are sensitive to habitat changes from developmental impacts. The landscapes with deep loess soils or sandstones are highly erodible. By including natural resources in the long-term development strategy for the region, many of the qualities that make it special might be sustained and enhanced (Nigh and Schroeder 2002).

B. Geology

The LaBarque Creek watershed geology was formed during the Paleozoic Era, which covered more than 320 million years. Sea level variations and numerous unconformities resulted in the formations and natural communities present within the LaBarque watershed.

The majority of Paleozoic record within the LaBarque watershed produced limestone and dolomite, with inter-layered shales and sandstones (Figure 2). These formations are important since they serve as aquifers and provide the underlying base for many natural communities, springs, overhangs, ledges and caves representing millions of years of geologic development.

Figure 2. General locations of sandstone, limestone and/or dolomite rock within LaBarque Creek Watershed, Jefferson County, Missouri.



The LaBarque Creek Watershed contains two different systems within geologic history: Mississippian subsystem and Ordovician system (Figure 3). Each system played a significant role in the development of the unique characteristics of the watershed. However, both provide watershed slopes which are generally steep (Figure 4), with the majority consisting of slopes 15% and greater.

Figure 3. Location of Mississippian and Ordovician formations within LaBarque Creek Watershed, Jefferson County, Missouri.

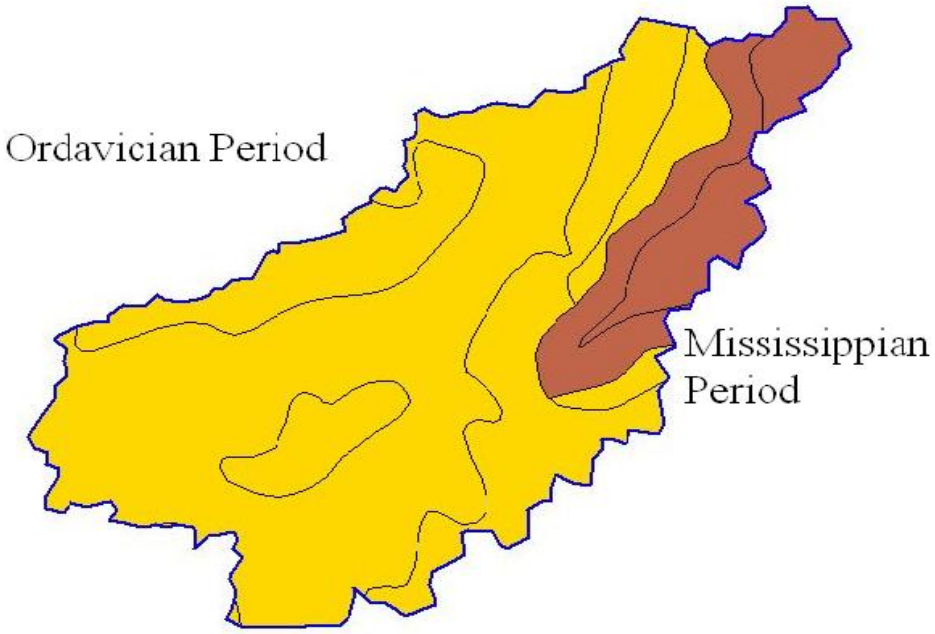
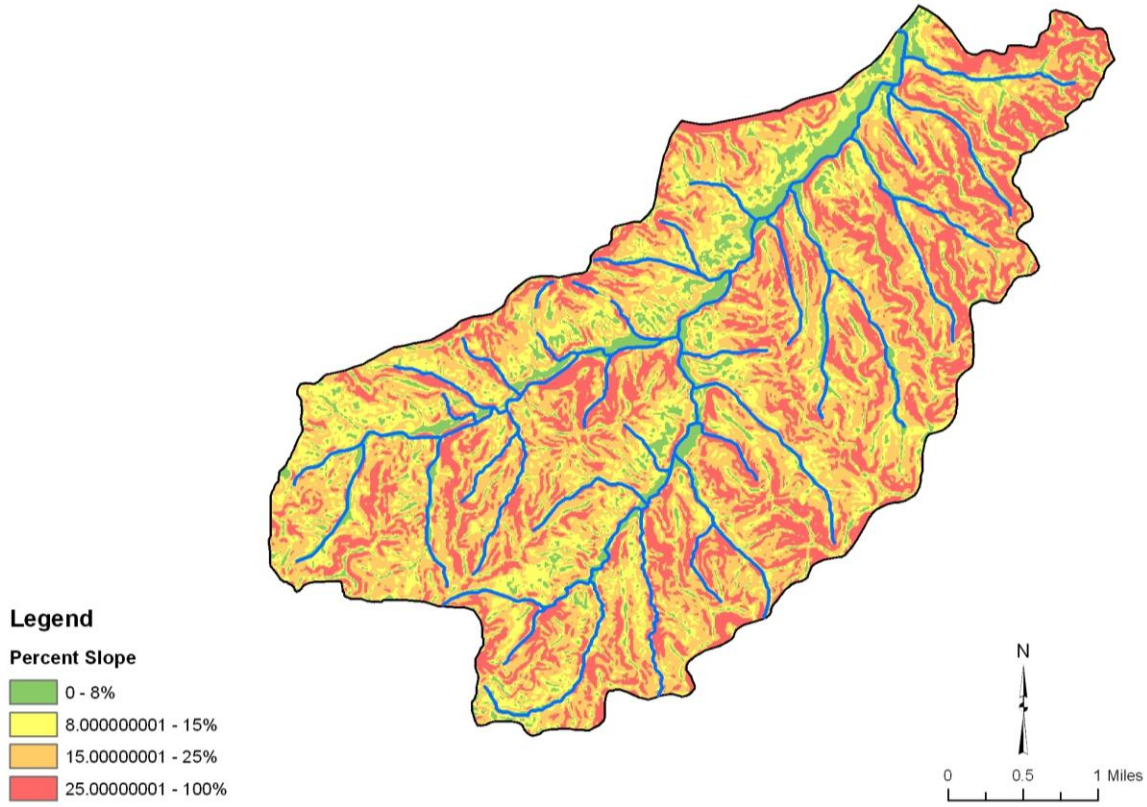


Figure 4. Slope of LaBarque Creek Watershed, Jefferson County, Missouri.



The Mississippian Subsystem is less dominant within the watershed and is primarily located in the northeast. Ordovician System geology dominates the remainder of the watershed. Its large sandstone formations found within the Ordovician System are very unique to the area. The natural communities derived from this unique combination of geology range from steep sandstone cliffs to glades with sandstone forests and dolomite woodlands.

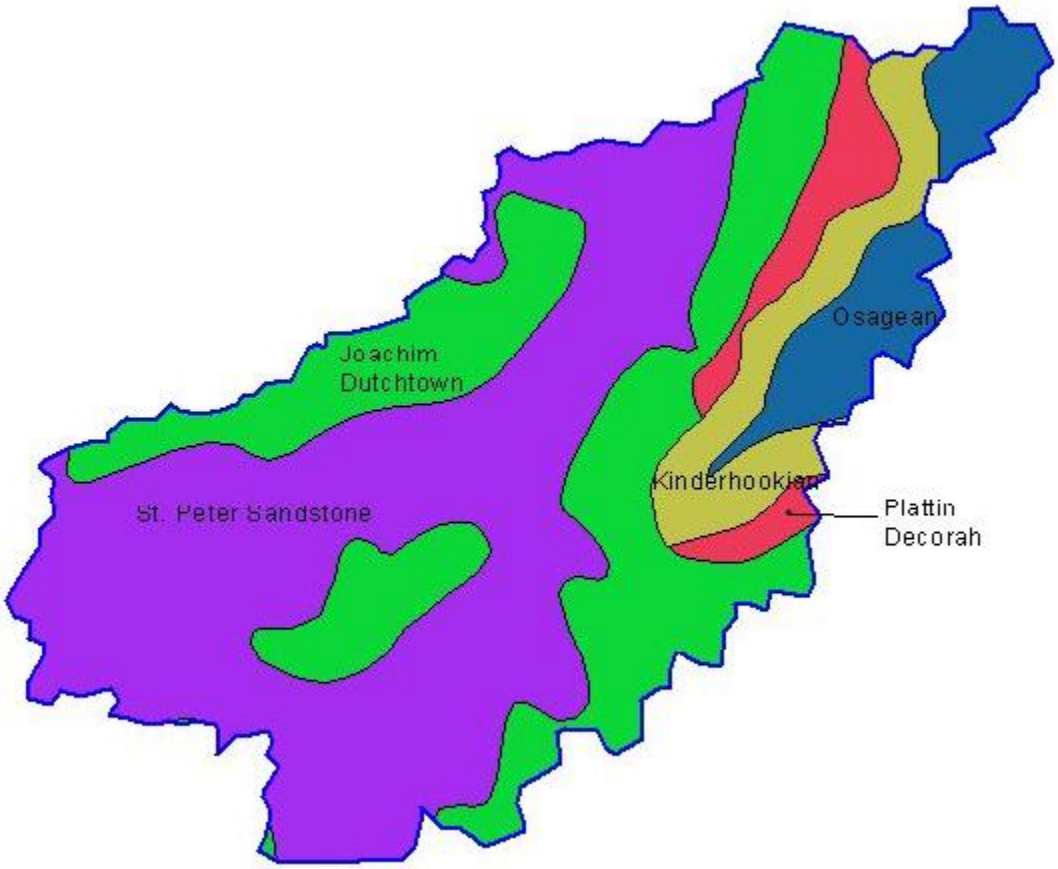
Mississippian Subsystem

During the Mississippian Subsystem, shifting seas and changing environments continued creating formations exhibiting great lateral and vertical variation resulting into four distinct series. Two of these series (Kinderhookian and Osagean) occur within the watershed (Figure 5) and possess natural communities of loess/glacial till forests, limestone/dolomite talus and sandstone woodlands.

Within portions of LaBarque Creek Watershed's Kinderhookian Series, the Bachelor Formation is present and is composed mainly of sandstone and can restrict construction of structures due to a higher potential of earthen slides. Mississippian limestone is quarried and used for agricultural stone and concrete aggregate; however, this activity is minimal or nonexistent in the watershed.

The Osagean Series contains two dominantly-limestone formations: the Fern Glen and Burlington. The Fern Glen formation is dominated by fossils of brachiopods, corals, and crinoids, where as the Burlington formation is medium to coarsely crystalline and crinoidal limestone.

Figure 5. General map of rock series and formations within the Mississippian Subsystem and Ordovician System



Ordovician System

The Ordovician System dominants watershed geology, encompassing three-fourths of the watershed (Figure 3). Important economic materials are found within the Ordovician strata; water, silica sand, and various limestone and dolomite products. However, they are not currently utilized within the watershed.

For several million years, conditions changed very little, remaining a shallow shelf or platform dominated by deposition of carbonate sediments. Periodic influx of clastic sediments allowed for the deposition of sandy beds, which may represent regression of sea margins resulting in about 2,000 feet of cherty dolomites with interbedded sandstones and limestone divided into four series. Only the Mohawkian series occurs in LaBarque and consists of distinct formations, including: St. Peter, Dutchtown, Joachim, Plattin, and Decorah (Figure 6).

During the early years of the Mohawkian Series, thin deposits of sandy carbonates occurred, but were slowly covered by a broad sheet of sand, known as the St. Peter Sandstone. It is a distinctive formation of fine-to-medium size, well rounded quartz grains with frosted surfaces which may have been originated in a wind-blown environment. This formation's silica content is as high as 99%. St. Peter Sandstone allows for the formations of sandstone communities such as sandstone cliffs, ledges, woodlands and forests as well as limestone/dolomite talus.

After the St. Peter deposition, a broad shallow shelf dominated along with carbonate and shale deposition which resulted in Dutchtown, Joachim, and Plattin formations. All of these formations have various thicknesses and carry traces of marine fossils.

The Dutchtown Formation is composed of sandy limestone and dolomite, containing asphalt-filled vugs. This formation contains pelecypod and gastropod fossils, but well-preserved fossils are scarce.

The Joachim Formation is predominantly dolomite with inter-bedded limestone and shale. Mud cracks are common in this formation. Chert is rare except in a nodular chert bed at the top. Though fossils can be found, they are very scarce within this formation.

The Joachim and Plattin formations will often contain dry mesic limestone/dolomite forest communities. Though both formations can contain similar natural communities, the Plattin differs from the others in that it is relatively pure limestone. The most common fossils found in abundance are dallmanellid, strophomenid, and orthid brachiopods.

After the Plattin deposition, there was another distinct change in the marine environment over much of the Mid-continent. Layers of green or brown shales, with many thin-bedded, silty, clay-rich limestones, were deposited and named the Decorah Formation. These shales can restrict construction of structures due to the higher potential of earthen slides. Limestone found within the formation contains thin fossiliferous shale partings. The brachiopods *Pionodema subaequata* and *Rafinesquina* are the most common fossils. Decorah can contain thin beds of bentonite, but the uppermost layers are relatively pure limestone.

C. Soils

Geology plays an important part in the soils that are present within this watershed. The general soils found in LaBarque are deposited from loess and formed over residuum, weathered from the dominant limestone and sandstone bedrock. The geologic formations present (Figure 5) produced the dominant soils in the watershed.

General soils descriptions and limitations taken from the Soil Survey of Jefferson County (Skaer 1996) are a guide to typical soil characteristics found in the area. The soil survey lists numerous limitations (many severe) which challenge the success of potential developmental practices within the watershed. Some of the soils units can have inclusions not listed within the map unit that may make the site more or less restrictive than stated in the general soil survey. On-site evaluations should be used to determine if these inclusions exist and how to direct development on these soil types.

Soils within the LaBarque watershed are generally thin and highly-erosive, with over half located on slopes 15% or greater. Depth to bedrock is shallow for many soils. This combination of soil conditions impact a variety of land uses.

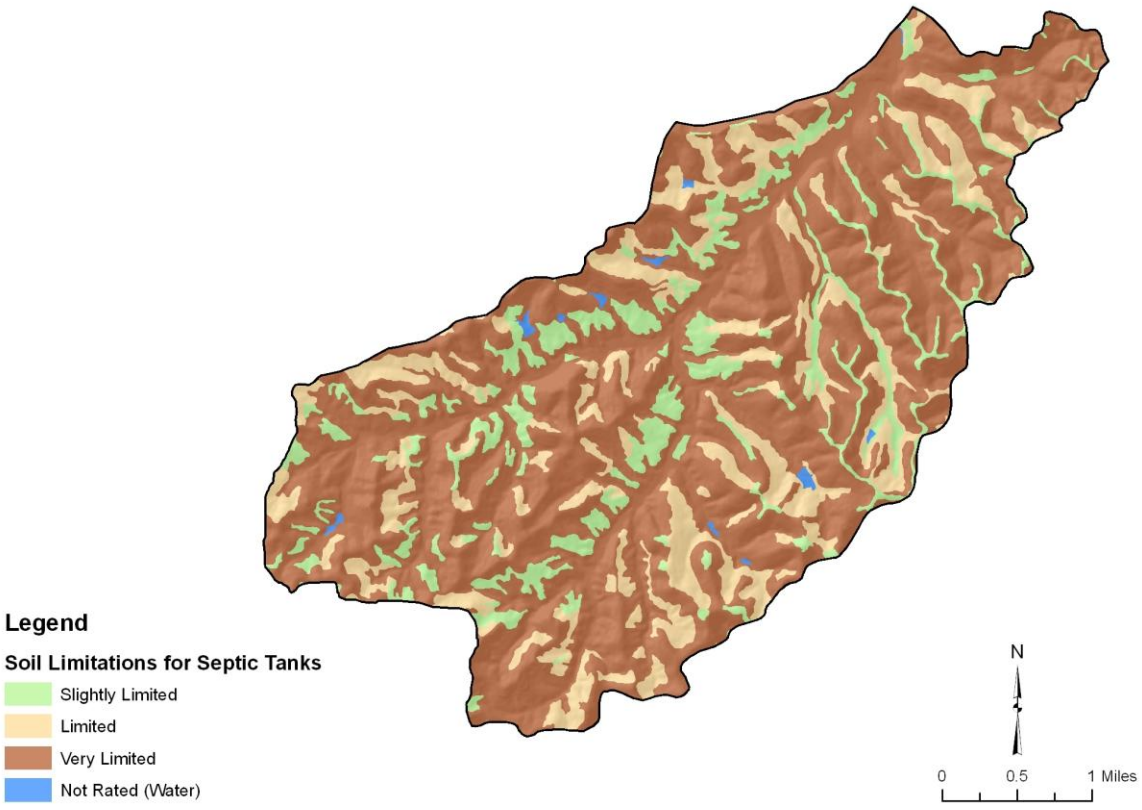
Stormwater runoff from developed lands has compromised aquatic habitat in similar watersheds, adjacent to LaBarque Creek, and has great potential for similar results here. Steep slopes and shallow bedrock would easily encourage stormwater damage from a landscape with increased impervious surface. Therefore, stormwater management which mimics the natural hydrograph of the receiving stream is required to maintain the health of LaBarque Creek and its tributaries. Erosion from land disturbances would be quickly magnified by the watershed's soils and slopes, contributing to stormwater impacts.

Use of septic tank absorption fields in watershed soils is considered to be very limited due to the shallow depth to bedrock and potential for seepage (Skaer 1996; Figure 6). Steep slopes, shallow soils, and shallow depth to bedrock contribute to poor potential performance. Septic systems in poor soils can fail, potentially polluting nearby streams and groundwater. Therefore, septic treatment alternatives to traditional absorption fields or basins should be used.

Skaer (1996) lists watershed soils limit construction of dwellings due to the shallow depth to bedrock and the steepness of slopes (Figure 4). A significant amount of costly blasting is required to remove bedrock to build sound foundations for homes with and without basements. Blasting or significance disturbance of fragile sandstone bedrock would significantly impact the unique communities it hosts. In addition, maintaining enough top soil for revegetation in disturbed areas is difficult.

There are many land uses such as roads, commercial buildings, top soil, road fill and others, that are restricted within LaBarque Creek Watershed soils (Skaer 1996). Similar limitations are found in recreation practices such as constructions of ponds, picnic areas, golf courses, and park paths/trails. These practices are somewhat-to-very limited due to bedrock, slope, and water features. Little agricultural opportunity exists, as on 7% of watershed soil is classified as prime farmland.

Figure 6. Soil limitations for septic tanks, LaBarque Creek, Jefferson County, Missouri, 1996.



Mississippian Subsystem formations lead to the dominant soil types of Goss and Wrengart (Figure 7). The Ordovician System contains St. Peter, Dutchtown, Joachim, Plattin, and Decorah formations which form the dominant soil types of Minnith, Pevely, Holstein, Ramsey, Sonsac, Gasconade and Useful (Figure 8).

These general soils found within the watershed create a unique natural landscape consisting of distinctive soil patterns, relief and drainage. Of these soils, there are two groups of soils geographically associated in a characteristic and repeating pattern which are typical of the LaBarque Creek Watershed. Though other soils types occur, the Sonsac-Useful-Moko and Minnith-Pevely associations are most common throughout the watershed. The general soils data associated with each soil type or association can be used to compare the suitability of a large area for general land uses as well as identify locations where those soils are not suitable for certain land uses.

Figure 7. The Mississippian period rock and dominate soils found in the LaBarque Creek Watershed, Jefferson County, Missouri.

System	Formation	Rock type	Thickness	Soil(s)
Mississippian	St. Louis	Limestone	0-50	Sonsac
	Salem	Limestone	20-40	Gasconade
	Warsaw	Shale	0-50	Menfro
	Burlington/ Keokuk	Cherty limestone	0-100	Goss Wrengart
	Fern Glen	Very cherty limestone	0-50	
	Bachelor	Sandstone	1-3	None

Figure 8. The Ordovician System rock and dominate soils found in the LaBarque Creek Watershed, Jefferson County, Missouri.

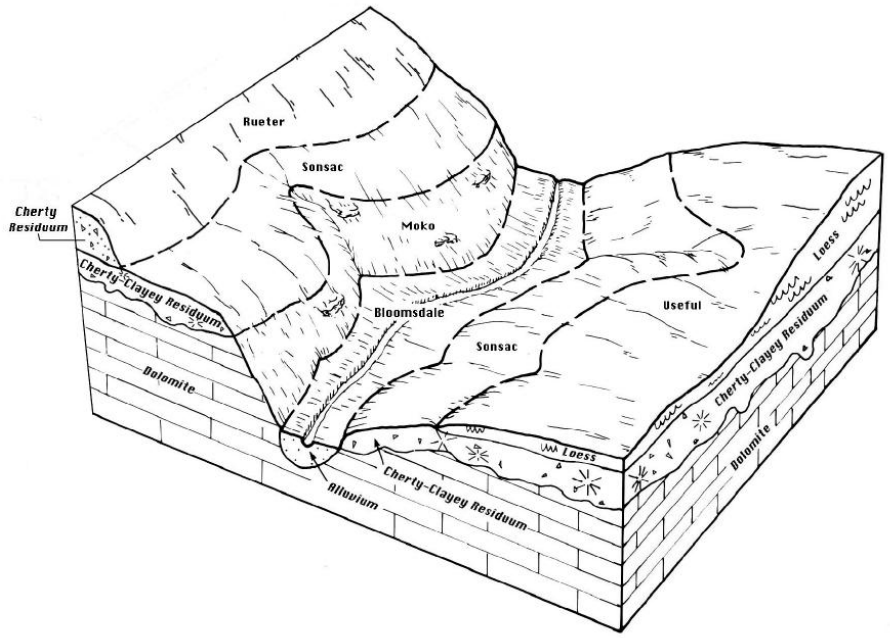
System	Formation	Rock type	Thickness	Soil(s)
			Ft	
Ordovician	Maquoketa	Shale	0-10	
	Kimmswick	Limestone	5-100	
	Decorah	Limestone, Shale	20-30	Sonsac Gasconade Useful
	Plattin	Limestone	140-180	
	Joachim	Dolostone	80-135	
	St. Peter	Sandstone	40-100	Minnith Pevely
	Everton	Limestone, Sandstone	0-70	Holstein Ramsey

Sonsac-Useful-Moko Association

The Sonsac-Useful-Moko Association is composed of three major soils (Sonsac, Useful, and Moko) and three minor soils (Goss, Rueter, and Wrengart). Sonsac and those soils similar are found on narrow ridge tops and backslopes, composing 44% of the association. Useful and those soils similar are found on summits composing 30% of the association. Moko and those soils similar are found along backslopes composing 15 % of the association. Minor soils of Goss, Reuter and Wrengart compose 11% of the association (Skaer 1996).

These soils have convex and complex slopes ranging from 3-55% (Figure 9). Sonsac has limitations due to shallow soils - less than 40 inches to bedrock. Moko has similar but more restrictive limitations due to less than 20 inches to bedrock and steep slopes. Generally on a 3-8 percent slope the limitations are minor. However, much of this association occurs on slopes greater eight percent, especially for Sonsac, Moko, and Rueter soils.

Figure 9. Typical Sonsac-Useful-Moko soil association pattern and parent material.

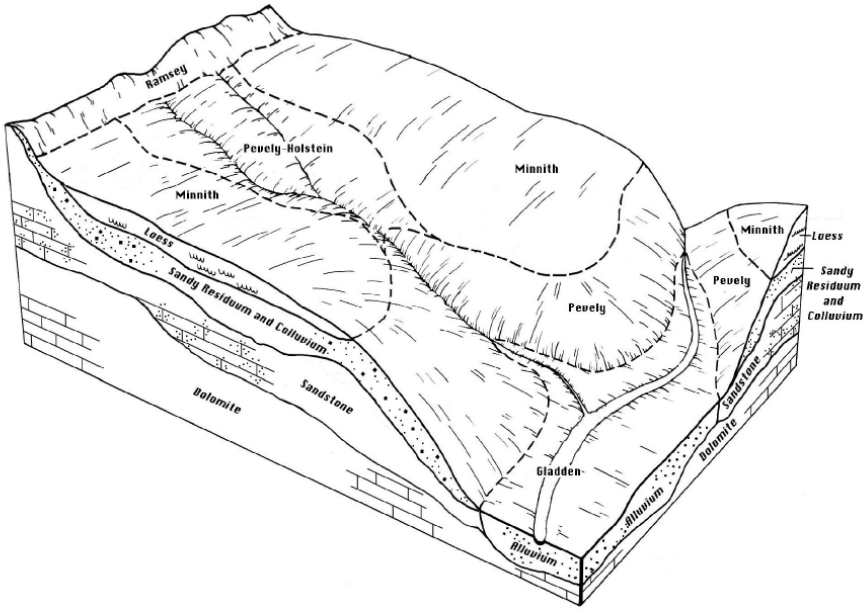


Minnith-Pevely Association

The Minnith-Pevely Association is composed of two major soils (Minnith and Pevely) and four minor soils (Freeburg, Ramsey, Sonsac, and Useful). Minnith and similar soils are found on ridge tops and backslopes, composing 51% of the association. Pevely and similar soils are found on narrow ridge tops and backslopes composing 32% of the association. Minor soils of Freeburg, Ramsey, Sonsac, and Useful compose 17% of the association (Skaer 1996).

These soils have convex and complex slopes, ranging from 3-50% (Figure 10). Pevely has limitations due to shallow soils, generally less than 40 inches to bedrock. Ramsey also has limitations due to less than 20 inches to bedrock. Sandy parent material and soil make these soils highly-erosive. Generally, on a 3-8 percent slope the limitations are minor. However, as the slopes increase above 8 percent the limitations and restrictions on land use increases. The majority of this association occurs with slopes greater than eight percent, especially within Pevely soils.

Figure 10. Typical pattern of soils and parent material in the Minnith-Pevely soil association.



D. Hydrology

LaBarque Creek's flows are not heavily-influenced by rapid stormwater runoff from average rainfalls or prolonged groundwater recharge. Annual precipitation is estimated to be 39" (Miller et al 1974). Precipitation usually peaks in May and is lowest in February. Mean annual runoff is average for St. Louis and northwest Jefferson counties and is estimated at 10.8" (Miller et al 1974). Currently, the LaBarque Creek Watershed generally isn't influenced by urbanization, as less than 5% of the watershed consists of impervious surfaces. So, the watershed's runoff rate may be lower than reported. The preponderance of porous soils within the watershed provide for a high soil infiltration index, which probably reduces severity of runoff further. However, urbanization has significantly aggravated flash flooding of neighboring streams which has extensively compromised their aquatic habitats and threaten infrastructure and property. With its steep slopes, the LaBarque Creek Watershed has great potential for similar harm, if impervious surfaces increase with inadequate stormwater management.

When coupled with porous sandstone bedrock and soils, basin streams receive relatively rapid stream recharge which can exhaust many contributions to base flows quickly and reduce spring influences. Nigh and Schroeder (2002) confirm small springs are present, but they are relatively insignificant contributors to total stream discharge.

The watershed contains no gauging stations to measure stream flow. However, LaBarque Creek's average discharge is estimated to be 10.3 cfs and the median low-flow value ranges from 0.06 to 0.10 cubic feet/square mile (Miller et al, 1974). Limited Stream Team flow measurements confirmed these estimates. So, weak base flows can be maintained during periods of little rainfall. Despite LaBarque Creek's somewhat low base flow, it is much more consistent and lacks the dramatic fluctuations of adjacent urbanized Meramec River tributary streams, which are seriously-impacted by impervious surfaces and poor stormwater management.

LaBarque Creek's flow characteristics suggest caution is required when considering disposition of sewage treatment effluent into basin streams. Its low flow value should be considered a primary limiting factor in effective waste disposal, as stream flows could be overwhelmed by effluent flows. In some locations, its relatively porous soils and shallow depth to bedrock may not be suitable for effluent storage in basins.

STREAMS

LaBarque Creek and its tributary streams are typical of the Ozark border stream classification. High gradient, intermittently-flowing, headwater streams give way to major tributaries with permanent pools, which flow into the riffle/glide/pool–dominated mainstem channel, which hosts permanent flow. Gravel, cobble, and bedrock are common channel substrates, while the majority of stream channels are lined with diverse stands of mixed-age softwood and hardwood riparian corridors which aid in cooling stream flows. In-stream habitat is provided by fallen trees and rootwads, bedrock shelves, boulders, rock bluffs, sandbars, gravel bars, and aquatic vegetation.

The combination of sandstone bedrock, steep stream channel gradients, and valley slopes create a dramatic, but fragile landscape. Though beautiful in its current state, steep slopes and stream gradients would aid in increasing intensity of stormwater flows during urban growth. Increasing impervious surface and inadequate management of stormwater runoff would increase intensity of stormwater flows and damage to natural resources, infrastructure, and property. Care should be taken to control stormwater runoff as close as possible to the source and slowly release it to watershed streams.

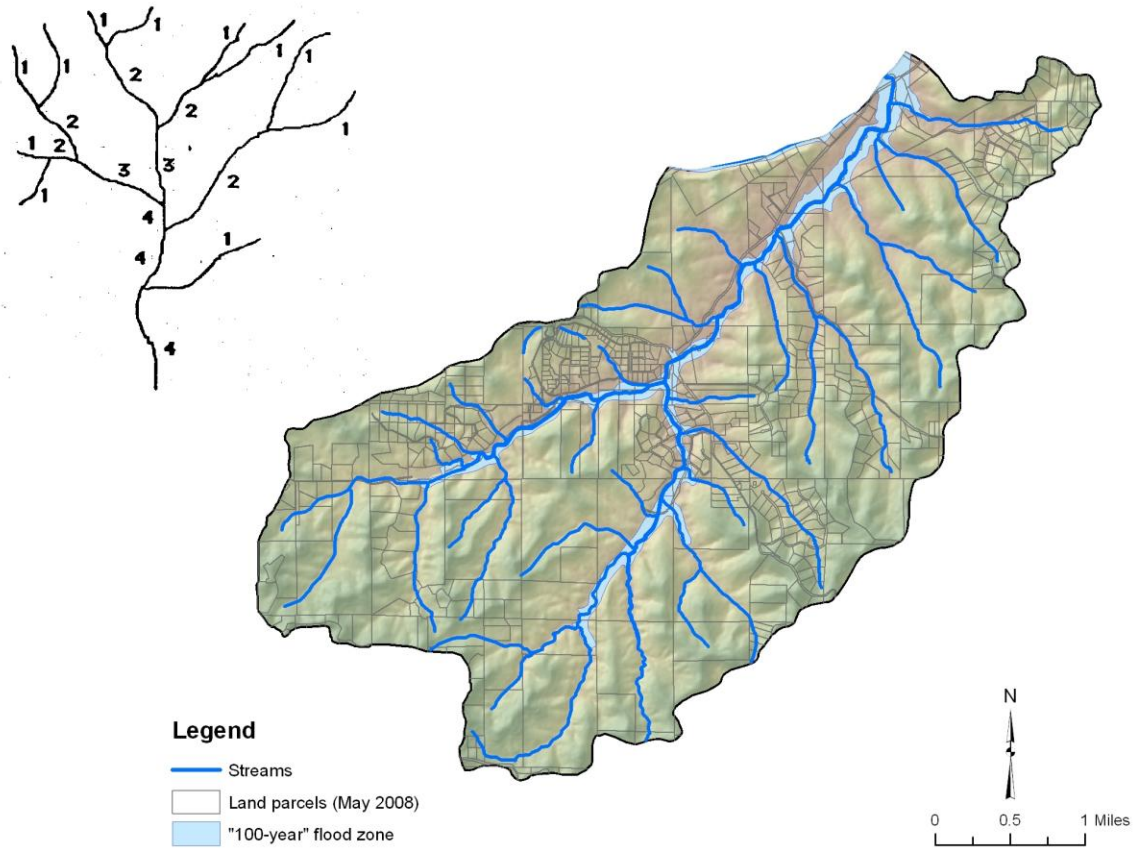
A. Stream Order and Gradient

LaBarque Creek's mainstem becomes an Order 4 stream 2.8 miles above its confluence with the Meramec River, which is just upstream of the Hwy F/FF intersection. Prior to that, the two main tributary streams (LaBarque Creek in the north and unnamed tributary in the south) progress to Order 3 size rapidly in the steep, upper watershed slopes. The watershed contains a total of 33 streams; direct tributaries to LaBarque Creek are all unnamed and include two Order 3, four Order 2, and three Order 1 streams (Figure 11). In addition, steep topography produces numerous ephemeral channels which drain into the watershed's established stream channels.

There are 6.5 miles of permanently-flowing and 58.2 miles of intermittent streams in the watershed. Most of the watershed's permanent flow is restricted to LaBarque Creek itself, from river mile 4.1 to the Meramec River or the main tributary stream adjacent to St. Joseph Hill Rd. and Highway F. However, 0.9 mile of an unnamed Order 1 tributary stream adjacent to LaBarque Trail Road (Don Robinson properties) also maintains flow, augmented by spring influences. Many intermittent streams maintain semi-permanent or permanent pools allowing for some aquatic life.

LaBarque Creek's gradient is relatively steep, with an average of 21 ft/mile. However, tributary gradients up to 350 ft/mile are common in headwater reaches. LaBarque Creek flows 6.4 miles northeastward to its confluence with the Meramec River at river mile 42, south of Eureka, Missouri.

Figure 11. Stream channels for LaBarque Creek Watershed, Jefferson County, Missouri and example of stream order system.



B. Stream Habitat

LaBarque Creek Watershed streams generally demonstrate very good habitat quality and diversity. LaBarque Creek's permanently-flowing reaches have channels which contain 71% pool, 10% glide, and 9% riffle habitats. Dry side channels were adjacent to 11% of permanently-flowing reaches. Occurrence of riffles increased with the increased gradient of upper watershed sections. During critical low flow periods, glides and pools maintain adequate depth and width for aquatic animals in LaBarque Creek (Table 1). Maximum low-flow depths increased adjacent to large woody debris, especially in pools. Average channel wetted width (i.e. stream channel with water present) is 16.7 ft. Widths and depths increase with rainfall.

Table 1. Minimum, maximum and average low-flow water depths, by channel type, in LaBarque Creek, Jefferson County, Missouri, 2001-2005.

Channel type	Minimum Depth (ft)	Maximum Depth (ft)	Average Depth (ft)
Riffle	0.19'	0.52'	0.33'
Glide	0.26'	1.28'	0.49'
Pool	0.36'	3.21'	1.38'

Brush or large woody debris were the most common mainstem habitat type (Table 2), while overhanging vegetation was present in 31% of channel segments. Filamentous algae was present in only 10% of mainstem channel segments, suggesting good overall water quality. However, algae distribution was limited to segments at and upstream of Lynch Road, suggesting some localized water quality concern.

Table 2. Percent presence of major habitat types in LaBarque Creek, Jefferson County, Missouri, 2001-2005.

Habitat type	% presence in stream sections
Filamentous algae	10%
Vascular plants	26%
Brush/Woody debris	50%
Overhanging Vegetation	31%
Undercut banks	16%
Boulders	10%

Gravels and cobbles are common throughout watershed streams (Table 3). They dominate the majority of mainstem riffle and glide habitat; however, sand is locally prevalent in channels between John McKeever and Lynch roads, adjacent to sandstone outcrops. Sand also made up the majority of substrate in mainstem pools. Bedrock appears throughout the LaBarque Creek mainstem; however, it becomes more prevalent upstream of Lynch Road and is common along with cobble and gravel in all tributaries.

Table 3. Presence of substrate type, by channel type, in LaBarque Creek, Jefferson County, Missouri, 2001-2005.

Substrate Type	Riffle	Glide	Pool
Fine	11%	-	5%
Sand	11%	24%	44%
Fine gravel	32%	12%	21%
Coarse gravel	40%	40%	15%
Cobble	-	20%	3%
Boulder	-	-	3%
Smooth Bedrock	6%	-	5%
Wood	-	4%	2%

Percent embeddedness of large substrates (large gravel, cobble, and boulders) provides estimates for accumulation of sediment within the stream channel, which relates to watershed stability. Mainstem embeddedness averaged 24.4%, but segments immediately downstream of tributaries which drain developing areas were higher. Sites near the Lynch Road/Hwy. FF intersection exhibited substrate buried with sediment for over half its diameter, suggesting elevated sediment inputs from channel and/or watershed disturbances. In contrast, measurements about ½-mile

below the intersection until John McKeever Road exhibit embeddedness under 10%, suggesting stable channels and influence from the watershed.

Despite LaBarque's typical in-channel Ozark features, it exhibits additional habitat features such as fine sand substrate. An average of 37% of stream segments contained sand substrates, primarily between John McKeever and Lynch roads. In this section, over half of all channel substrate is sand and correspond with sandstone outcrops, lesser gradients, and absence of bedrock channel substrate. This appears to be significant in that some fish species, such as silverjaw minnows, occur with these specialized habitats.

The riparian corridor is in good to very good condition throughout the majority of watershed streams, providing good stream channel stability. When not flanked by roadways, most streams have riparian corridors in excess of 100 feet. Tree canopy measurements over the mainstem show an average of 76% canopy coverage, but is somewhat lacking in the areas adjacent to Doc Sargent Road, portions of Valley Drive, and downstream of the Lynch Road/Hwy. FF intersection. Tributary streams exhibit well-wooded riparian corridors, but can be somewhat thin adjacent to housing developments, such as those along Wolf Creek and St. Joseph Hill roads.

Stream habitat is currently in very good shape; however, localized concerns exist. Substrate embeddedness suggests sedimentation has occurred in a few places directly below areas of disturbance. Sediment contributions by land disturbances can be minimized through rapid stabilization of disturbed ground and conservation of wooded riparian corridors.

The 100-year floodplain consists of 427 acres (5.1% of the watershed) and is primarily wooded with little development. Much of the watershed's grassland occurs within the floodplain, where human activity has replaced trees with grassland, old fields, or pasture. Only 59 acres of wetland exist, with the majority being stream side channels. However, small acids seeps are present in the upper watershed.

Changing land cover and poor management of stormwater runoff are potential concerns, due to their observed impacts on neighboring streams and watersheds. LaBarque Creek Watershed's combination of sandstone bedrock, steep stream channel gradients and valley slopes create a dramatic, but fragile landscape. Though beautiful in its current state, these existing conditions would exacerbate damage to watershed natural resources, property, and infrastructure if stormwater flow increases.

Care should be taken by homeowners and new developments to infiltrate or detain stormwater as close to its source (e.g. roof tops, turf lawns, and driveways) as possible through use of rain gardens, wetlands, and basins. It should then be slowly released to watershed streams to minimize erosion, flooding, and loss of base flows.

C. Water Quality

The permanently-flowing portion of the LaBarque Creek mainstem (4.5 miles) and the unnamed tributary along St. Joseph Hill Road (1.0 mile) have been designated the use standard of Whole Body Contact Recreation through a 2005 Use Attainability Analysis (UAA) performed by the Missouri Department of Natural Resources (DNR). The UAA demonstrates the water quality of

LaBarque Creek and protects it to accommodate recreational swimming and other beneficial uses where people can safely become fully immersed in water. In addition, these waters also receive water quality standard protections for aquatic life and livestock/wildlife watering by DNR. These designations are provided with water quality standards that need to be upheld (Appendix 1).

Additional water quality data from Missouri Stream Team (ST) volunteer water quality monitors and MDC demonstrates good water quality (Table 4). Maximum mainstem water temperature occurs in August and averages 75 degrees.

Seasonal presence of filamentous algae within localized sections of LaBarque Creek and some tributary streams indicates presence of excessive nutrients. These sections are likely impacted by under-performing sewage treatment facilities and animal waste.

Table 4. Summary of water quality data for LaBarque Creek watershed streams from MDC and Stream Team, 1996 - 2006.

Source	Conductivity (us/cm)	Dissolved Oxygen (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	pH	Phosphate (mg/l)
MDC	414 – 550 (455)	4.1-12.2 (7.1)	-	-	7.6 - 8.6 (8.0)	-
Stream Team (summer)	420 – 471 (447)	4.0 – 9.0 (6.7)	<0.01	0.125	7.6 – 8.3 (8.1)	.09 - .18 (0.14)
Stream Team (winter)	240 – 490 (380)	6.0 -16.0 (9.3)	0.26 – 1.0 (0.65)	0.125 - .25 (0.159)	7.5 – 9.7 (8.2)	0.23 – 0.5 (0.32)

Other water quality indicators include the biodiversity of fish and aquatic macroinvertebrate communities. Sensitive aquatic animals cannot survive in poor water quality, reducing the number of species (biodiversity) which can be present. So, when biodiversity is high, water quality is presumed to be good. Both fish and aquatic macroinvertebrate communities in LaBarque Creek exhibit a high degree of biodiversity (see Natural Communities Section), both in numbers of species present and presence of sensitive species.

Existing water quality is generally good, but some problems and potential problems exist. Livestock use of watershed streams and riparian areas negatively impact water quality through direct introduction of animal waste and indirectly through increased soil erosion. Riparian clearing and stream channel gravel moving increase erosion and channel instability. Improper construction of ponds can increase erosion and channel instability. Poorly constructed dams may fail, leading to stream channel damage and erosion. Though not currently chronic problems, addressing these issues now would be relatively easy and inexpensive, conserving long-term stream health.

D. Water Use

The watershed contains two groundwater aquifers. The deeper St. Francois aquifer is located up to 5,000 feet below the Earth's surface (MDNR, 2007). It travels in a northwestern direction in the LaBarque Watershed, but is not a significant source of groundwater. The St. Francois aquifer is overlaid by low-permeability carbonate rock and shale, which limits water exchange with the shallower, more prolific Ozark aquifer. Ozark aquifer flow generally follows the course of the main channel of LaBarque Creek (northeast). Its groundwater yields are non-uniform, but greater than 50 gallons/minute and of good drinking quality, though calcium, magnesium, and sulfate levels can be elevated (Miller et al, 1974). Lower yields (10-40 gallons/minute) are to be expected when St. Peters Sandstone is present (DNR, 2007). Despite extensive presence of Karst topography, few prominent springs are present.

Two permitted sewage treatment facilities are present in the watershed. St. Joseph's Hill Infirmary (owned by Franciscan Missionary Brothers) is permitted to operate a single cell, aerated lagoon on an unnamed, Order 3 tributary of LaBarque Creek until February, 2012. The facility design would accommodate 200 people with sludge production of 1.4 dry tons/year and daily effluent flow of 20,000 gallons. Its actual flow has been measured at 14,470 gallons/day and is used by 25 people. The other facility belongs to the owners of Winterwood Homeowners Association. The actual flow has not been measured, but the system is designed to support 222 people and flow of 20,000 gallons/day. The remainder of residential uses within the watershed utilizes individual septic tank/drain field systems.

Mainstem impoundments are not present, but twelve impoundments with dams on Order 1 tributary streams are located in the watershed. Though the total is unknown, additional small impoundments (less than 1 acre) have been constructed apart from stream channels. Several impoundments suffer from leaks due to porous soils or those which contain high amounts of rock and gravel. In general, soil quality unsuitable for dam/basin construction and steep slopes contribute to make the majority of the LaBarque Creek Watershed undesirable for impoundment construction.

Stewardship by volunteers is well represented in the LaBarque Creek Watershed since 1990. Nine Stream Teams (ST) have adopted watershed streams and 19 have performed work in the watershed. Through 2007, ST volunteers have conducted 65 water quality samplings, nine litter pick ups (11.47 tons removed), seven tree plantings (2615 trees planted), and one habitat project.

In 2006, the Friends of LaBarque Creek Watershed (primarily made up of watershed landowners) formed the Friends of LaBarque Creek (ST #2991) and have performed water quality sampling, tree planting, watershed conservation planning, watershed stream assessment, natural resource surveys, trash/tire clean ups, and watershed advocacy. In addition, the Friends of LaBarque Creek Watershed has embarked on a variety of public education projects including development of watershed protection highway signs, WEB site creation (http://www.labarque.org), and hosting a watershed festival.

Though recreational use of watershed streams is mostly confined to the mainstem reaches along Young and LaBarque Creek Conservation areas, private landowners access watershed streams, too. Fishing, swimming, wading, trash clean ups, and invertebrate collection are common spring

through fall activities. In addition, ST activities have led participants into most watershed stream channels during water quality monitoring and physical stream habitat surveys.

Though water use is not currently a major concern, some existing practices have potential to impact watershed streams. Under-performing sewage treatment facilities impact surface and ground water by replacing high-quality ground water with tainted surface water from aging facilities. New development could further pressure water use without investment into adequate treatment facilities. Pond construction can impact stream flows and improper construction can contribute habitat smothering sedimentation. All terrain vehicle (ATV) usage of tributary stream channels can be common, while usage of mainstem LaBarque occurs much less. Livestock watering and access to stream channels, primarily horses, is localized. Extensive mechanical and livestock access to riparian areas and stream channels can cause physical habitat and subsequent water quality impacts.

LAND USE

A. Historic/Cultural
LaBarque Creek derives its name from early French settlers in the area. LaBarque literally translates as “The Boat;” but some have used “Small Boat” or “Fishing Boat “ as interchangeable. Historically, Osage Indians (native Americans) used their canoes on the creek for fishing and to access the nearby Meramec River for fishing and travel.

Many roads in the watershed are named after families or individuals who lived and worked here. Doc Sargent Road is named after Dr. Jesse Sargent. Dr. Sargent was a typical country doctor who lived with his wife (Nora) in the old stone house near the entrance to The Pines of Lakewood Hills. Other roads such as John McKeever, Lynch and Wade are named after early watershed settlers.

St. Joseph's Hill Road is named after the St. Joseph’s nursing home operated by the Franciscan Missionary Brothers. Though existing buildings date to about 1948, the site was established in 1927. It was earlier used by the Sisters of Mercy as a convent established in 1884.

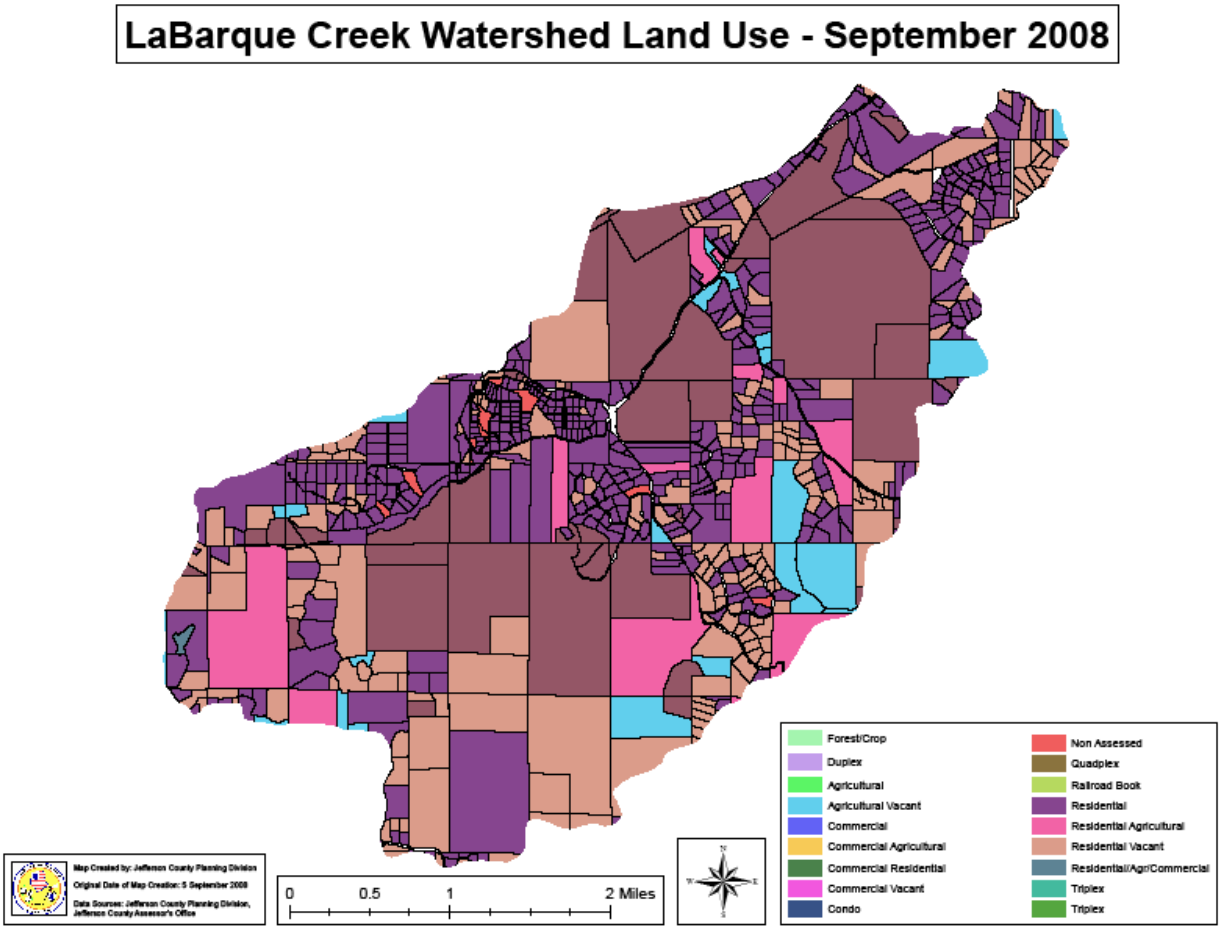
The LaBarque Schoolhouse is located on route "FF" near the Bob Heintz ranch. This one-room schoolhouse served area children from kindergarten through eighth grade until it closed in 1946. At that time, Rockwood School District included all of LaBarque in its service area, but has since relinquished about 40% to Northwest School District.

In this era of cell phones and globalization, it may be difficult to visualize this area as home to only a few farmers as recently as 50 years ago. However, distance from metropolitan St. Louis, limited accessibility, and steeply sloped, heavily wooded terrain has made typical suburban development uneconomical. Thus, the watershed continues to attract those whose interests lie in living with nature.

B. Current

Existing land cover shows the watershed is still primarily forested (over 7,500 acres or 90%), with minimal low intensity development and impervious surface (Figure 12). The current watershed population is estimated to be around 1,300 people, primarily residing in nine larger subdivisions or smaller large-lot developments on only 20% of watershed lands. Approximately 485 homes currently exist. Water features make up only 28 acres of the watershed, while impervious surface covers 336 acres (4%).

Figure 12. Current land use, by property tract, in LaBarque Creek Watershed, Jefferson County, Missouri.

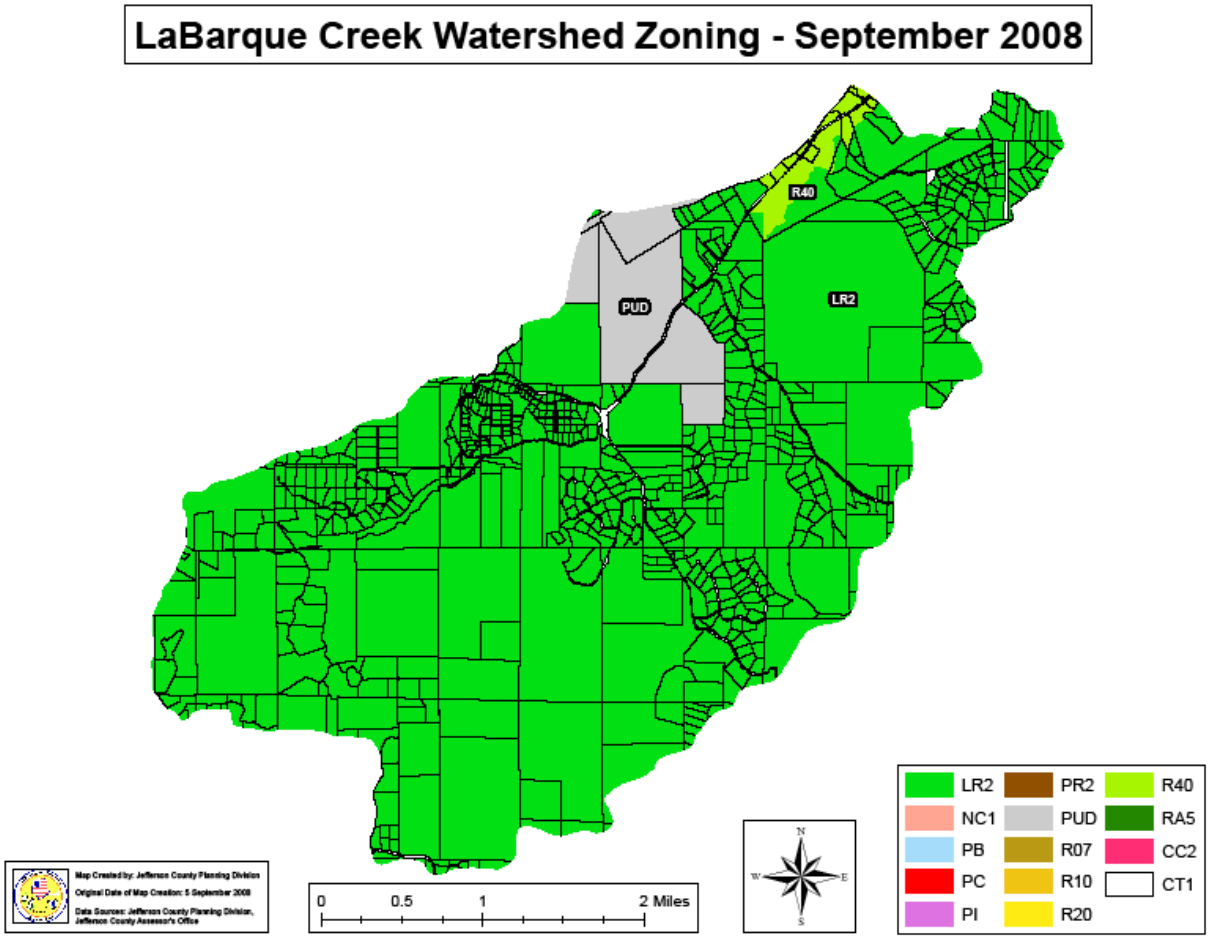


Of the watershed's 8,365 acres, 42% is set aside in public and semipublic ownership. Public ownership boasts two large conservation areas (Young CA and LaBarque Creek CA) totaling over 1,600 acres, managed by the Missouri Department of Conservation (MDC). Properties currently held by Don Robinson (815 acres) have been deeded to the Missouri Department of Natural Resources to be a future state park. Other holdings include The Wild Canid Survival Center (360 acres), Washington University (102 acres) and the Franciscan Missionary Brothers' St. Joseph's Infirmary (430 acres).

The remaining watershed lands are mostly single family residential use on one- to 273-acre tracts. A few landowners continue to raise cattle and horses and carry out other associated small farm uses, primarily along ridge tops and stream bottoms. In addition, all terrain vehicle (ATV) use is popular and in some cases a problem. Unauthorized ATV use and trespass have occurred on some MDC lands and larger private landowner tracts, damaging natural resources.

There are three zone districts in the LaBarque Creek Watershed: Planned Unit Development (PUD), LR2 – Large Lot Residential, and R40 – Single Family Residential (Figure 13). Over 90% of the land in the watershed is zoned LR2. Development in the LR2 district requires a minimum of two (2) acres. This district is established to provide rural density single-family detached residential development. Lot sizes may vary as long as the smallest lot is no less than two (2) acres in size. Open space conservation developments are allowed in the LR2 district, where minimum lot size may be reduced on a sliding scale based on the percentage of open space dedicated for preservation. For example, if 20% of the total land area is dedicated for open space, then the minimum lot size may be reduced to 60,000 square feet, while the total number of residential units allowed remains the same (one unit per every two acres). The absolute minimum lot size in the LR2 district is 20,000 square feet (50% open space dedicated).

Figure 13. Jefferson County zoning districts in LaBarque Creek Watershed, Jefferson County, Missouri.



A small area along Highway FF at the northeastern end of the watershed is zoned R40, extending a short distance north of where LaBarque Creek enters the Meramec River south along the north side of LaBarque Creek a distance of approximately 500 feet. Development in the R40 district requires a minimum of 40,000 square feet. This district is established to provide single-family residential development at a relatively low intensity but suburban in character, in areas that receive urban type services and consider the natural features of the land. Open space conservation developments are allowed in the R40 district. The minimum lot size in the R40 district is 18,000 square feet with 50% of the land area dedicated for open space.

The Wild Canid Survival and Research Center property is zoned as a Planned Unit Development (PUD). However, the southern 154 acres were purchased by the Missouri Department of Conservation in 2008.

C. Regulatory and assistance agencies
Agencies and not-for-profit conservation groups having regulatory responsibility or that can help provide technical advice for management of natural resources are listed in Appendix 2.

NATURAL COMMUNITIES
LaBarque Creek and its watershed contain a wide variety of high-quality terrestrial and aquatic communities rich in species diversity. They are a reflection of watershed health through the unique combination of geology and minimal human impacts despite being only a 30 minute drive from the Gateway Arch.

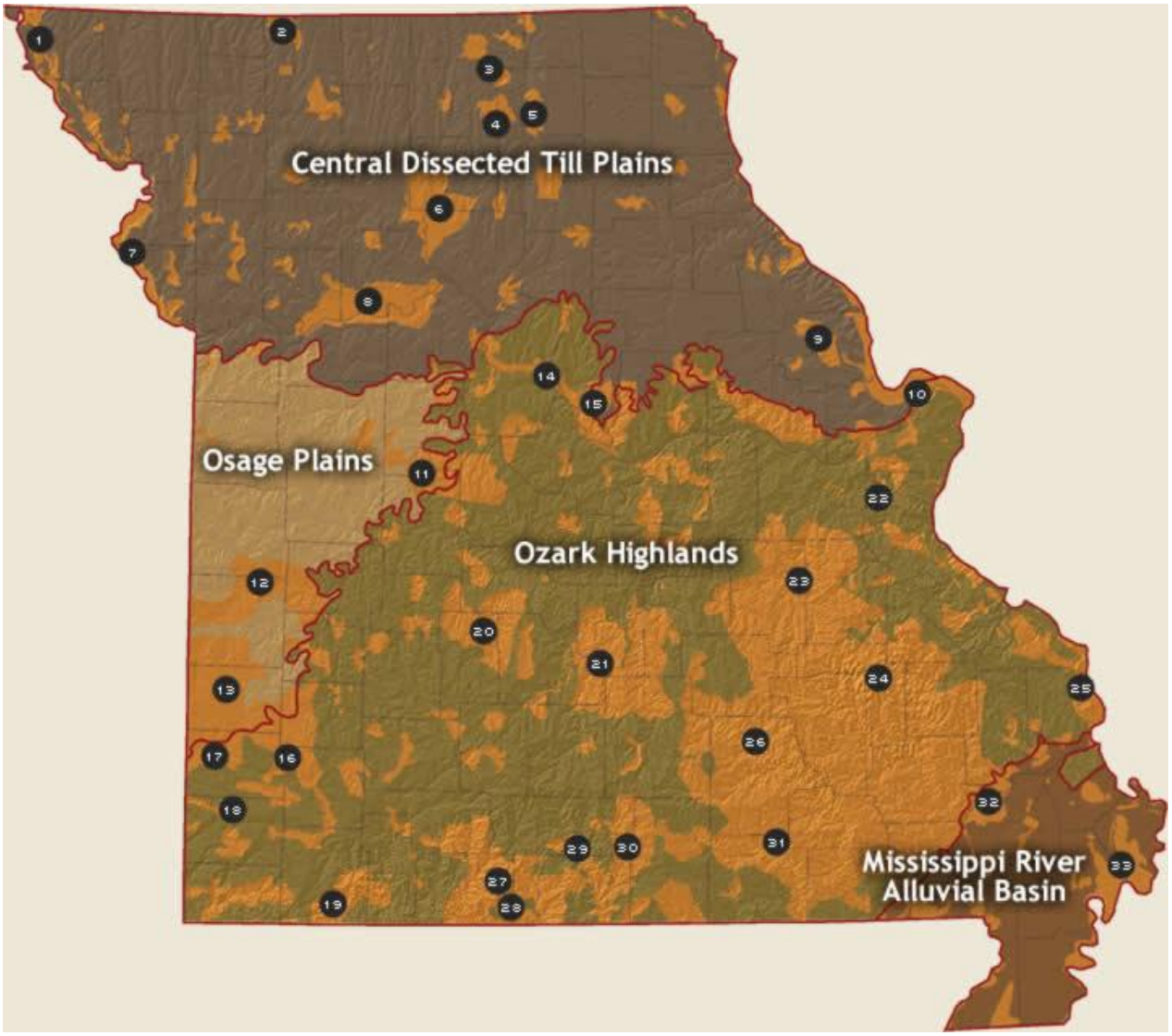
This unique combination of healthy natural resources has encouraged MDC and other conservation partners to designate the LaBarque Creek Watershed as a Conservation Opportunity Area (Figure 14, refer to #22) and LaBarque Creek as an Aquatic Opportunity Area. These designations identify LaBarque as one of the high priority places in Missouri where a variety of partners can combine technology, expertise and resources for fish, forest, and wildlife conservation. Focused efforts in these conservation opportunity areas will ensure that Missourians continue to enjoy a rich and diverse natural heritage.

A. Terrestrial
Six primary types of terrestrial natural communities occur in the LaBarque Creek watershed, including: forests, woodlands, glades, cliffs, wetlands and stream edge (Nelson, 2005). These communities were further identified (Nigh and Schroeder, 2002) to show the watershed is dominated by woodlands (mostly overgrown) and forests (Figure 15).

The sandstone communities in the upper half of the watershed (generally west of the Hwy. F/FF Bridge) and stream edge communities throughout the watershed are the most fragile. Most species of conservation concern present in the watershed reside in these natural communities.

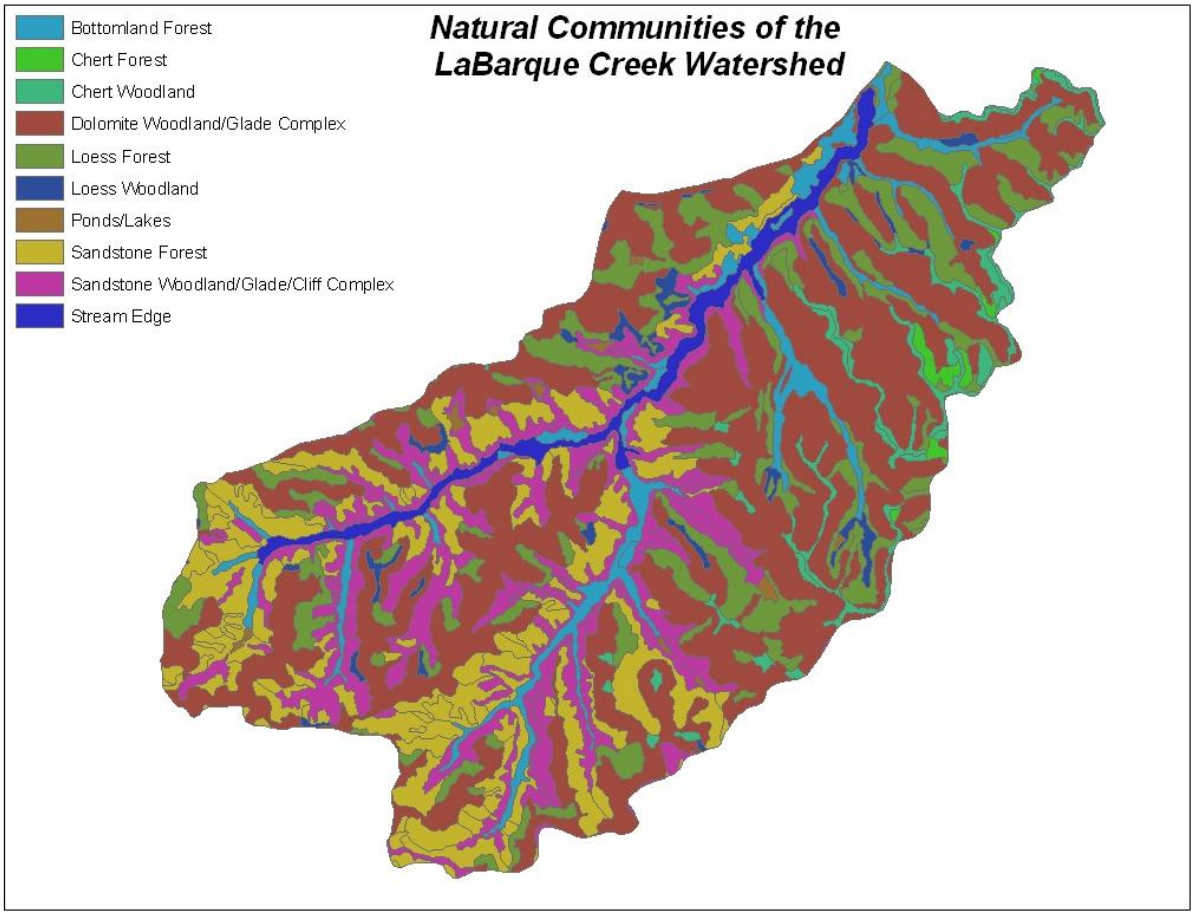
With the exception of some riparian corridor disturbances, these communities have remained relatively undisturbed which has allowed for establishment of entire suites of native plants and animals, many of which cannot tolerate disturbance or impacts from adjacent disturbance. Long term land stability within and near these communities is critical when considering their conservation.

Figure 14. Missouri's Profiled Conservation Opportunity Areas, 2008.



Forests: Dry-mesic and mesic limestone/dolomite and sandstone forests occur on lower slopes and tributary valley floors over much of the watershed (where not converted to pasture, etc.). They support a variety of neotropical migrant songbirds (e.g., ovenbird, Louisiana water thrush, and wood thrush), numerous herptile species (e.g., southern red backed salamander), butterflies (e.g., Zebra swallowtail), etc. A number of species of conservation concern are associated with these forests (e.g., four-toed salamander). Loess/glacial till forest occurs on deeper soils of upper backslopes and is of more limited extent. Limited acreage of mesic bottomland forest occurs along LaBarque Creek and its lower tributaries. A small amount of riverfront forest occurs near the Meramec River. Small acid seeps and forested fens are embedded in portions of mesic forest. Stream edge communities are largely bordered by mesic forest.

Figure 15. Natural Communities of the LaBarque Creek Watershed, Jefferson County, Missouri.



Woodlands: Dry-mesic to dry woodlands (limestone/dolomite, sandstone, chert and loess/glacial till) occur throughout the watershed on mid-to upper slopes and ridge tops. Nearly all of these woodlands (excluding some chert woodlands and dry sandstone woodlands) are degraded, overstocked, and in need of management (thinning, prescribed fire). Small glades (dolomite and sandstone) are associated with many of these woodlands, and are overgrown and in need of management also. No species of conservation concern have been associated with these woodlands.

Glades: Small (one acre or less) sandstone and dolomite glades and glade remnants occur over much of the watershed, associated with (usually dry) sandstone cliff or dolomite woodlands. Many of them occur on public land, and in a couple of instances, their proximity to one another (i.e., adjacent) is unique in the region. All of the sandstone glades are on St. Peter sandstone and occur in the southwestern half of the watershed where sandstone outcrops are common. Dolomite glades are scattered throughout the watershed. No species of conservation concern have been identified from any of the glades, with the exception of Fremont's leather flower on a few dolomite glades. Many small glades (dolomite and sandstone) are associated with the watershed's woodlands, are overgrown, and in need of management.

Cliffs: Dry and moist sandstone cliffs, and sandstone talus, occur commonly in the southwestern portion of the watershed, and to a lesser degree elsewhere. Several state-listed (or formerly state-listed) vascular and non-vascular plants are associated with these sandstone exposures (*Sullivantia, Huperzia spp*., etc.). These features can be quite fragile and benefit from long-term land stability and lack of impacts from adjacent lands.

Wetlands: Wetland natural communities in the watershed are limited to groundwater seepage types (acid seep and forested fen) embedded within mesic forests and along stream edge habitat, totaling only 59 acres. At least four seeps have been located. Adult *Tachopteryx thoreyi*, the state-listed gray petal-tail dragonfly, have been found in each of them. This dragonfly breeds only in seep-type habitats. Wetlands are critical habitat and in short supply within the watershed. Their protection and buffering from disturbance is very important for long-term health.

Stream edge: The vast majority of watershed streams, including LaBarque Creek and its tributaries, are bordered by stream edge habitat, including riverfront bottomland forest. Most streams boast a healthy and diverse wooded riparian corridor. Stream edge natural communities typically merge into mesic forest on the land side and with the stream on the water side. As such, stream edge communities are critical to stream health and as contributors to in-stream habitat.

A variety of surveys within the watershed have revealed extensive lists of non-aquatic and semi-aquatic plants and animals. Continuing plant surveys by the Webster Groves Nature Study Society, Missouri Native Plant Society, and Nels Holmberg have identified over 700 plants (partial list - Appendix 3) and 158 bryophytes (mosses, liverworts, and hornworts). Twenty-six of these are listed as species of conservation concern. This level of biodiversity underscores the watershed's stability and diversity of habitats.

A 2007 reptile and amphibian survey found 13 snake, two turtle, five lizard, seven salamander, one toad, and seven frog species (Appendix 4), including ringed and four-toed salamanders which are state listed species of conservation concern. Both species are secretive and prefer large expanses of heavily forested lands. The four-toed salamander also prefers undisturbed mosses along forested creeks.

The diversity of terrestrial habitats leads to a diverse bird community. In addition to migratory bird usage, the LaBarque Creek Watershed hosts at least 62 species of birds which successfully reproduce in the watershed (Appendix 5). Only casual observations of mammals have been made (Appendix 6). Though not a permanent watershed resident, it is interesting to note that black bear have occasionally wandered through the watershed.

B. Aquatic

The LaBarque Creek fish community is very diverse, containing nine families and 44 species (Appendix 6). Twenty-eight species are indicators of the Ozark Faunal Region (Pflieger 1989), which includes much of the southern half of Missouri. This number of species is significant, given the small size of LaBarque Creek. The entire Ozark Faunal Region contains a total of 67 species.

Of the remaining 16 species, 12 are widely distributed in Missouri (Appendix 7). These widely distributed species have broader environmental tolerances and are adapted to widespread habitats (Pflieger 1971). The remaining species: mosquitofish, spotted sucker, and warmouth and red shiner are Lowland and Prairie Faunal Region indicators, respectively (Appendix 7). These additional species contribute to LaBarque's uniqueness as an Ozark border stream, but occur in low numbers making up about 17% of the fish present.

Another indication of fish community quality is the use of Index of Biotic Integrity (IBI) scores. During 2001-2005 MDC fish surveys, LaBarque Creek's IBI scores average 81 and have remained consistent, demonstrating a high-quality, diverse, and stable fish community.

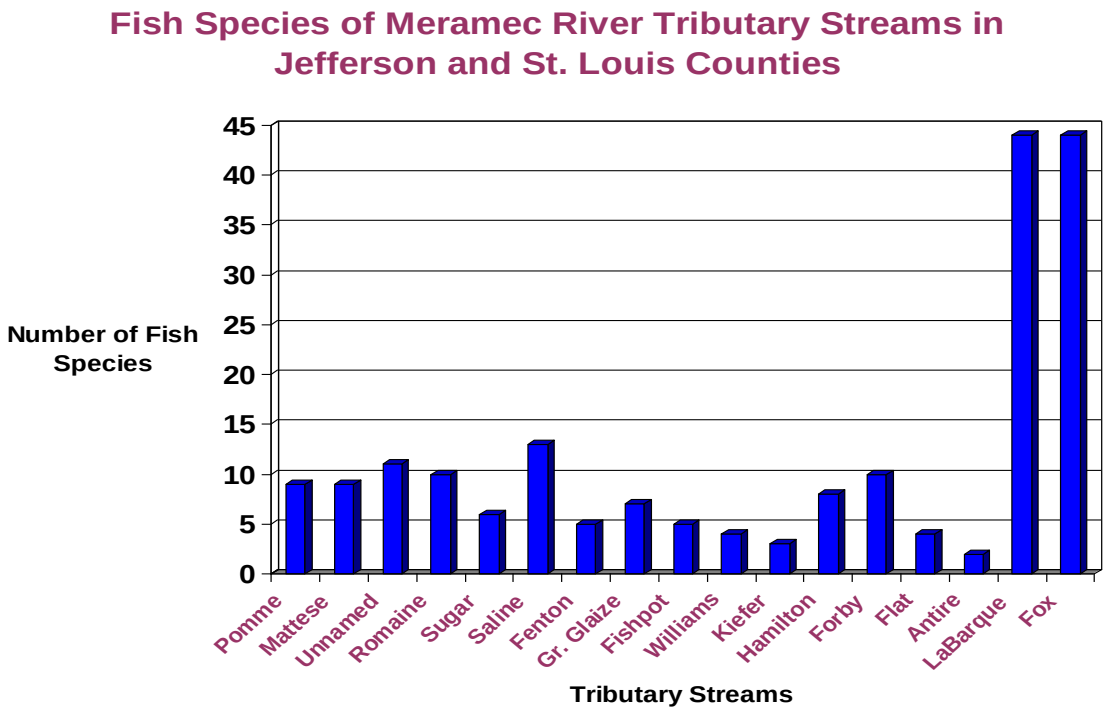
LaBarque's high number of species underscores its healthy habitat. Pflieger (1971) states, "Ozark species are quite intolerant of siltation and continuous high turbidity, and require streams having permanent flow and a predominance of coarse gravel or rock bottoms." LaBarque Creek's permanently-flowing sections have these habitats, plus sand and large woody cover to produce diverse and high-quality habitats for a variety of species which require specific conditions to thrive.

LaBarque Creek's level of species richness demonstrates very good stream health not present in most Meramec River tributary streams in Jefferson and St. Louis counties (Figure 16). Tributaries downstream of LaBarque contain communities lacking biodiversity and consisting almost entirely of widely distributed, pollution-tolerant species in response to impacts from extensive watershed development, primarily poor stormwater management. These impacts result in reduction/absence of base flows, increased flash flooding, channel and bank erosion, severe loss of in-stream habitat, and poor water quality. All impacts severely alter or eliminate habitat for fish. Fish species with specific habitat requirements must leave or die, allowing only the most tolerant of species to remain. In addition, these urbanized stream impacts negatively affect humans through various problems such as: loss of property to accelerated erosion, damage to roads and bridges, increased flooding frequencies and intensities, polluted water, and the increased property taxes enacted by communities to mitigate these problems (such as stormwater taxes).

The LaBarque Creek Watershed is stable, with intact natural communities and little impervious surface to damage aquatic habitats. As a result, the watershed handles stormwater quantity and quality much better than its more urbanized cousins to the east. Stream flows remain consistent with minimal flash flooding, erosion is not accelerated, and stream channels remain stable. Subsequently, high quality habitat exists for a wide variety of fish with specific habitat requirements.

A MDC contractor sampled aquatic macroinvertebrates from eight sites in Fall 2007 and Spring 2008. Sampling revealed a total of 132 species (Appendix 8), including 16 species from sensitive mayfly, stonefly, and caddisfly orders. Taxa richness index range was 20-57 species/site, demonstrating good biodiversity of insects. As expected, upstream sites hosted fewer species, due to smaller size and less consistent water conditions. Additional, cursory examinations from Stream Teams show pollution-intolerant mayflies and stoneflies are common – another indicator of good water quality.

Figure 16. Fish species richness in Meramec River tributary streams in Jefferson and St. Louis Counties, 2005.



In 2001 an MDC contractor found no native mussels in LaBarque Creek. This is expected, given its relatively small stream size. However, the 2007-08 macroinvertebrate sampling revealed two mussel species (including non-native *Corbicula*), four aquatic snail species (*Ferrissia, Gyraulus, Lymnaea, and Physella)*, and a crayfish (*Orconectes*). Little additional aquatic biotic sampling has been conducted.

WATERSHED ISSUES AND OPPORTUNITIES

LaBarque Creek Watershed is currently healthy, but is also fragile. As demonstrated by neighboring watersheds to LaBarque's east, developmental impacts severely-damage landforms, plant and animal communities, and stream health. Excessive grading, poor stormwater management, and clearing/damaging steep slopes severely-impact the environment's ability to support natural plant and animal communities. Subsequent loss of fish species, poor water quality, increased erosion, and altered stream flows have been demonstrated in Meramec River tributary stream watersheds downstream of LaBarque Creek. Therefore, a combination of permanent land protections, careful placement and intensity of development, good watershed stewardship by landowners, watershed conservation needs and awareness, and stormwater management that mimics the natural hydrograph of watershed streams, as outlined in the following action plan, is critical to maintaining diversity and health of the watershed's plants, animals, landforms and water, as well as maintaining a high quality of life for watershed residents and visitors.

Key watershed issues and opportunities identified in the planning process and addressed in the action plan include:

1. LaBarque Creek Soils and Geology. Within the LaBarque Creek Watershed, there are many different geologic formations and soil types with varying characteristics. Shallow, highly-erodible soils, fragile sandstone bedrock, and very steep slopes present in much of the watershed are significant challenges to maintaining watershed health when altered. The demand for dwellings with basements, local roads and septic tank absorption fields increases with urban growth. Yet, within the watershed, the dominant soils are somewhat-to-very limited for these uses due to the shallow depth to bedrock and steep slopes. In addition, LaBarque Creek's flow characteristics suggest caution is required when considering disposition of sewage treatment effluent into basin streams. Its low flow potential should be considered a principle limiting factor in effective waste disposal, as natural flow could easily be overwhelmed by effluent flows. And the watershed's relatively porous soils may not be suitable for effluent storage in basins. Steep slopes and shallow bedrock suggest significant potential for serious impacts to stream health from stormwater runoff.

Similar limitations are found in recreation practices such as the construction of ponds, picnic areas, golf courses and park paths and trails. These practices are somewhat-to-very limited due to bedrock, slope, and water features. Successful construction of recreational ponds is similarly limited; however, construction of stormwater basins, rain gardens, etc. should not be as limited because they do not require the pooling of water on a permanent basis. Water erosion may be a concern for construction of paths and trails on steep slopes. The shallow soils and steep slopes within the majority of the watershed are not suitable for production agriculture.

Due to the numerous limitations found within these general soil types, fragility of sandstone bedrock, and steep slopes, extra precautions and investigations will be needed to avoid potential problems related to soils and geology. Understanding the interactions between the two will help to frame proper management and development to minimize damage to the watershed's natural communities.

2. Human Interaction and Natural Community Conservation.
From a natural community and stream aspect, the entire LaBarque Creek Watershed is a gem and worthy of conservation. Unique geology, steep slopes, high quality Ozark streams, and minimal human impacts provide a rich mosaic of habitat types which host a large and diverse suite of plants and animals within a relatively small place. This level of diversity and quality within a single watershed so close to St. Louis is considered unique to Missouri, as evidenced by its designation as a Conservation Opportunity Area.

The sandstone communities in the upper half of the watershed (basically west of the Hwy. F/FF Bridge), wetland, and stream edge communities throughout the watershed are the most fragile. Most species of conservation concern present in the watershed reside in these natural communities. With the exception of some riparian corridor disturbances, these communities have remained relatively undisturbed which has allowed for establishment of entire suites of native plants and animals, many of which cannot tolerate disturbance or impacts from adjacent disturbance. Long-term land stability within and near these communities is critical when

considering their conservation. Watershed lands also contain significant slopes and severely-limited soil types which should influence land development decisions.

Human interaction with the watershed's natural communities and streams will determine their future quality, and in turn, help define the quality of life for watershed residents. Existing and future residents' stewardship and rules for development or use of watershed lands and streams will be critical. Natural community and LaBarque Creek quality can remain high, if land use and management practices recognize the unique features of the watershed by avoiding some features, designing changes around other features, and significantly minimizing impacts of changes on still others.

3. Green Development.
Given the existing high-quality natural communities and streams, topography which is challenging to develop, and desire of watershed residents to retain natural community and stream quality, a unique opportunity for non-traditional (green) development practices exists, where environmentally appropriate. Development designs which conserve watershed natural resources, community character, and provide a sense of place should be provided and promoted. Open space connectivity, cluster development, natural community and stream avoidance, careful stormwater management and providing incentives to minimize natural resource damage should be goals. Natural community and stream maps and/or databases should be provided to Jefferson County to aid in avoiding critical habitats and minimizing impacts to all natural resources.

4. Livestock Interaction.
Livestock use of watershed streams and riparian areas negatively impact water quality through direct introduction of animal waste and disturbance of aquatic habitats and indirectly through increased soil erosion associated with disturbances in riparian corridors. These impacts harm stream health, limit aquatic species biodiversity, and quality of stream edge and wetland natural communities. However, these impacts can easily be remediated through use of alternative watering, fencing, rotational grazing, and protection/establishment of wooded riparian corridors, as part of livestock management.

5. Plan Implementation.
Successful conservation of LaBarque Creek watershed requires a significant and potentially complex action plan including many partners. Coordination of these partners through a single group with selected leadership will be critical to implementing these actions. To date, MDC has often helped lead coordination of the partners, but intends to shift its role to agency partner and technical advisor as this group grows into its purpose. Therefore, it is suggested that the partners agree upon identification of that coordinating body, develop funding sources to compensate for it, and begin the process within six (6) months of the signing of this document. Completion of most action plan tasks (exclusive of most monitoring and analysis) is estimated to take 5 years (Year 2013). However, completion of several tasks is directly linked to successful allocation of funding, which could impede progress. Highest priority tasks are **bolded** within action plan text. If a coordinating body cannot be funded initially, the continued meeting of the Friends of LaBarque Creek Watershed can provide a structure to support collaborative implementation of this plan.

ACTION PLAN

Responsibility Key:
ALL – all groups/individuals involved in LaBarque Creek Watershed Conservation
EWG – East-West Gateway Council of Governments
JCG – Jefferson County Government (planning/zoning, commission, health, highway)
JCH – Jefferson County Health Department
MDC – Missouri Department of Conservation
DNR – Missouri Department of Natural Resources
MODOT – Missouri Department of Transportation
ORG – Friends of LaBarque Creek Watershed (landowner organization)
ORLT – Ozark Regional Land Trust
OSC – Open Space Council
ST – Stream Team #2991
TNC –The Nature Conservancy

Goal I. Conserve the unique natural resources of the watershed by maintaining aquatic and terrestrial health, diversity, water quality and quantity, and habitat connectivity

1. Improve wastewater treatment
   A. Provide information to homeowners on septic system management – **JCG/ORG**
   B. Encourage Jefferson County Government to enact an ordinance to require inspection and repair of septic systems upon sale of property – ORG/ST
   C. With appropriate funding, inventory existing waste treatment systems in the watershed to identify design, age, and functionality and provide assistance
      1. Prioritize failing systems for assistance based upon immediacy and extent of threat - JCG
      2. With appropriate funding, provide landowner assistance to failing systems - JCG
      3. Provide enforcement for failing septic systems if assistance is refused, as needed - JCG
      4. Monitor water quality above and below St. Joseph's Infirmary outfall using Level 3 water quality monitoring – DNR/JCH/JCG/ST
      5. Support implementation of habitat restoration of lands damaged by failing septic practices - MDC
   D. With appropriate funding, test all twenty watershed lakes for e-coli bacteria from humans or livestock - JCH
      1. If e-coli are found, identify source
      2. Develop and implement remediation plans for identified sources

E. Address animal waste

1. **Provide education and assistance to landowners with livestock to reduce or eliminate impacts on water quality – MDC/JCG**
2. Provide education to landowners about managing pet waste - **JCG**
3. **Sample water quality adjacent to livestock pastures to determine extent of animal waste impact on streams using Level 3 water quality monitoring – ST**

2. Improve stormwater management

A. Provide conservation-oriented design and construction training - **JCG**

1. **Plan and conduct annual Jefferson County staff training programs focusing on newly-adopted Jefferson County Unified Development Order (UDO) and conservation-oriented stormwater design and management, including:**
   - **Building Inspector training program**
   - **Planning Staff training program**
   - **Public Works training program**
2. **Plan and conduct an engineer/designer/contractor training program focusing on newly-adopted Jefferson County UDO and conservation-oriented stormwater design and construction per year**

B. Implement the new stormwater management regulations of the UDO approved in 2008 - JCG

C. Explore avenues to assess the effectiveness of the new Jefferson County Government stormwater regulations and design practices in sustaining natural hydrograph of receiving streams, channel integrity and water quality - MDC

1. **With appropriate funding complete a geomorphic analysis and hydrologic and hydraulic model of the watershed**
2. **Monitor water quality and aquatic biodiversity (see Objective 10)**

D. Implement Jefferson County Government's new design manual for sediment and erosion control practices and stormwater management practices - JCG

E. If analyses determine newly-adopted Jefferson County Government regulations are insufficient to protect LaBarque health, recommend and promote adoption of amended regulations – MDC/ORG/ST

3. Conserve stream channels

A. Improve stream crossings - **MDC/JCG/EWG**

1. **With appropriate funding, inventory and inspect existing crossings on all watershed streams for evidence of negative stream channel impacts**
2. **Prioritize replacement projects**

3. **With appropriate funding, develop stream crossing design standards and encourage incorporation into Jefferson County Stormwater Design Manual**
4. **With appropriate funding, retrofit up to three (3) existing substandard crossings using best management construction practices**
5. **With appropriate funding, inventory need for new crossings and construct up to three (3) demonstration crossings using best management construction practices**
6. Provide technical information on crossing construction to landowners

B. Discourage channel alteration and gravel dredging – **MDC/ST/ORG**

1. Conduct landowner outreach to educate them about stream processes and activities (such as ATVs, gravel pushing/removal and livestock use) which impact stream channels
2. Review and provide comments on 404 and 401 permit applications
3. Advocate DNR, EPA, and USCOE enforcement for violations of 404 or 401 permit regulations
4. Discourage channel alteration, levee construction, damming of watershed creek channels

C. Conserve streambanks - **MDC**

1. **Inventory cases of accelerated streambank instability/erosion**
2. Construct stabilization and restoration projects on public lands.
3. Work with landowners to construct stabilization and restoration projects on private lands, as requested
4. **Work with Ameren UE to remove unused power pole footings from LaBarque Creek on Young CA**

4. Conserve riparian corridors (land within 100' of streams)

A. Inventory riparian corridor condition and determine need for protection, improvement, and establishment projects – **MDC/ST**

B. Prioritize protection, improvement, and establishment projects

1. **Encourage streamside landowners to establish or conserve wooded riparian corridors, which are 100 feet wide on each side of streams – MDC/ST/ORG/ORLT**
2. **Implement riparian corridor protections outlined in Jefferson County's new UDO – JCG**
3. **Provide technical assistance for riparian management to riparian landowners through demonstrations, field days, or one-on-one visits – MDC/ST**
4. **Develop and help implement riparian conservation project plans on private lands – MDC/ST/ORG**
5. **Discourage pasture and agricultural uses within riparian corridors – MDC/ST**
6. **Discourage riparian corridor clearing – MDC/ST**

7. Establish or conserve 100-foot wide wooded riparian corridors on all streams within LaBarque Creek Conservation Area and Young Conservation Area – MDC/ST

5. Protect floodplains – **MDC/ST/ORG**
   A. Report unpermitted floodplain activity to appropriate authorities
   B. Review and provide comments on 404 and 401 permit applications
   C. Advocate DNR, EPA, and USCOE enforcement for violations of 404 or 401 permit regulations
   D. Discourage floodplain constriction and filling

6. Conserve and manage terrestrial habitats **– MDC/ORG/ST**
   A. Identify and protect high-quality natural communities and species of conservation concern (SOCC) on public and private lands
      1. Use maps, aerial photos, historical records, personal contacts, etc. to locate potential sites and species
      2. Verify sites on public lands
      3. Verify sites on private lands by contacting landowners to obtain permission to survey their lands
      4. Encourage landowners to appreciate, conserve and manage habitats through one-on-one contacts, literature, management plans and workshops, BMPS, cost share, easements, or voluntary land sale to conservation agency or NGO - ORLT
      5. Encourage landowners to utilize native plantings wherever possible
      6. Provide the highest level of cost share assistance available to landowners managing their lands to benefit natural communities and SOCC
      7. Encourage public agencies to increase public land ownership from willing landowners
      8. Encourage continuation of surveys of high-quality natural communities and SOCC through local nature groups, experts, and NGOs
      9. Discourage ATV trespass and use in sensitive areas
   B. Encourage land management and conservation practices that maintain watershed integrity – **MDC/ORG/ST**
      1. Provide technical assistance for land and habitat management to landowners through demonstrations, field days, one-on-one site visits, workshops, etc. emphasizing natural community management and land and water conservation
      2. Develop and produce a free "Living in the LaBarque Creek Watershed" guide targeting all landowners, focusing on land management practices for land tracts of all sizes
      3. Control invasive species
      a. Use existing manuals and expertise from management agencies

b. Identify, prioritize, and conduct removal projects
c. Coordinate removal projects with Stream Team #2991
d. Monitor removal sites for signs of re-infestation

4. Provide technical assistance to landowners on pond design, construction, and management
   a. Refer pond construction inquiries to Jefferson County Soil and Water Conservation District
   b. Refer pond management inquiries to MDC
   c. Include pond assistance information in newsletters, website, and other outreach
5. Encourage use of rain gardens to aid in stormwater management
6. Encourage use of pervious pavement for driveways and road shoulders

7. Improve permanent watershed land protection

A. Investigate opportunities to increase public lands through land purchase, easement, lease, or other device from willing landowners - MDC/DNR/ORLT/TNC/OSC

1. Prioritize lands adjacent to existing public lands which have significant natural resource or boundary consolidation values
2. Prioritize lands separated from existing public lands which have significant natural resource values
3. Contact selected landowners to determine interest in willingly pursuing permanent land protection
4. Encourage DNR and MDC partnerships to increase land management efficiency and consistency
5. Investigate utility of using conservation easements
6. Encourage involvement of additional public and semi-public entities (IE. Jefferson County, GRG)

B. Explore ownership and/or land management responsibilities and options with non-governmental partners

1. When appropriate, encourage conservation group land ownership - **MDC/DNR/ORLT/TNC**
2. Explore the option of contracting with an NGO to discuss permanent land protection options with selected landowners – **MDC**

8. Monitor results and analyze data

A. Analyze available data and aerial photos to quantify change in: - **MDC/DNR/JCG/EWG/ST**

- floodplain function
- stream channel condition
- riparian corridor width and condition
- road crossing and adjacent stream condition
- conservation target condition and management
- land cover

- land ownership

B. Monitor stream water quality – MDC/ST

1. Partner with Stream Team #2991 to develop and conduct a Level 3 water quality monitoring plan

2. Investigate the possibility of establishing up to three (3) USGS real-time monitoring stations in the watershed

3. Encourage Washington University to restore automated water quality monitoring on their property

4. Monitor aquatic biota (fish and aquatic macroinvertebrates) to determine water quality impacts on biodiversity

C. Monitor terrestrial condition – **MDC/ORG/ST**

1. Continue watershed biota inventories
2. Establish and conduct annual breeding bird survey
3. Monitor Heritage sites on a regular basis (approx. 5-year intervals)
4. Encourage continued participation of local nature groups and expertise in existing and new monitoring projects

9. Investigate funding opportunities

A. Explore funding options (including cost-share and grants) with MDC, SWCD, and DNR for habitat establishment, improvement, and restoration projects on public and private lands, including streambank stabilization, erosion control, riparian corridor establishment and protection, livestock watering, fencing, and stormwater management systems for livestock, invasive exotic plant control/removal, watershed conservation, aquatic or terrestrial species monitoring - ALL

B. Explore funding options with Jefferson County Government and Jefferson County Public Sewer District to help fund inspection of all watershed septic systems, design and repair of underperforming systems, design and construction of new conservation-oriented systems (ie., cluster systems), and restoration of land impacted by failing septic practices - ALL

C. Explore funding options to inspect all watershed stream crossings, design and repair underperforming crossings, and design and construct up to three (3) demonstration crossings – JCG/MDC/ST

D. Explore funding options for permanent land protections, including but not limited to easements, land purchase, or lease – ORLT/TNC/OSC/MDC/DNR

F. Explore funding options to establish up to three (3) USGS gauging and water quality stations – MDC/ST/ORG

Goal II. Where development occurs, promote design that conserves watershed natural resources, community character and a sense of place

1. Maintain community character and sense of place
    - **A. Identify, prioritize and promote protection of scenic viewsheds**
        1. **Identify important viewsheds and prioritize them – ORG/ST**
        2. **Provide incentives to protect viewsheds in new developments – ORLT/TNC/MDC**
        3. **Investigate conservation easements as tool to protect view sheds – ORLT/TNC/ORG/OSC**
        4. Investigate viewshed standards and provide to Jefferson County Government – **MDC/EWG/ORG**
        5. **Promote public acquisition of priority viewsheds – ORG**

2. Encourage environmentally sensitive practices at a landscape scale
    - A. Encourage open space connectivity
        1. Encourage linking new and existing development open space
        2. Maintain stepping stones of smaller open space areas between larger core open spaces
        3. Encourage establishment of and permanent protections for common grounds within new developments – **MDC/ORLT/TNC/TPL/JCG/OSC**
        4. Identify and target lands with high-quality natural communities as links
        5. Create, maintain, and promote connected trail system on public and semi-public lands – **MDC/DNR/ST/ORG**
    - B. Promote practices that support conservation goals and enhance a sense of place
        1. Develop workshop and materials demonstrating economic benefits of conservation development and present to larger (> 20 acres) landowners
        2. Discourage disturbance of land with slopes greater than 15%
        3. Minimize scope and duration of land disturbance
        4. Assemble "Green Practices" development library for Jefferson County. **– EWG/JCG/MDC/DNR**
    - **C. Develop a multifunctional database outlining watershed's high-quality natural communities and sensitive areas which would be accessible to developers and county government for use in site planning – EWG/JCG/MDC**

3. Encourage environmentally sensitive practices at a site scale
    - **A. Encourage use of Jefferson County's UDO provisions which provide the most appropriate conservation-oriented design practices to conserve open space and riparian buffer - JCG**
    - B. Promote visual buffers and prevention of light pollution – **ORG/EWG**

1. Encourage visual buffers adjacent to roadways utilizing native vegetation and natural materials
2. Encourage visual buffers between developments of like kinds
3. Encourage lighting standards that prevent light pollution

C. Utilize natural resource inventory maps to direct development away from rare, critical and sensitive areas and ensure open space connectivity

1. **Provide Jefferson County with natural resource inventory maps for watershed – MDC/ORG/ST**
2. **Utilize rare, critical and sensitive areas databases and GIS information in development planning process - JCG**

D. Encourage frequent site visits and inspections during construction

1. Support implementation of Jefferson County UDO stormwater provisions – **ORG/ST**
2. Encourage watershed residents to help Jefferson County with frequent inspection of building BMPs – **ORG/ST**

E. Encourage use of low impact development techniques in all new construction – **EWG/ORG**

1. Conduct workshops for developers and landowners
2. Provide information in new resident's welcome packet

4. Expand the economic benefits of conservation

A. Promote LaBarque Creek Watershed identity – ORG/ST/MDC

1. **Create and install watershed signage**
2. **Develop marketing tools (New Landowner Packet) to encourage new landowners to value LaBarque's assets**
3. Explore the possibility of creating a community name distinctive of the watershed

B. Promote conservation easements and landowner pacts – **ORG/ORLT/ST/TNC/OSC/MDC**

1. Identify entities involved in implementing conservation easement/landowner pact in LaBarque watershed
2. Identify, contact, and educate landowners about available land protection options
3. Develop and present workshop on conservation easements and other permanent protection measures
4. Develop a handbook on conservation easements and other land protection options

C. Provide incentives that reflect conservation goals for landowners developing their property

D. Assemble data and construct packet showing increased profitability of green development for developers and Jefferson County. **- EWG/ORLT/TNC/MDC**

5. Preserve historic resources – **ORG/ST**

A. Identify, prioritize and protect historic resources

1. Identify expertise to help identify watershed historic resources (DNR Historic Preservation staff, Carol Goggins, SIU Oral History classes)
2. Identify watershed historic places and determine significance
3. Prioritize historic resources for protection
4. Educate resident landowners about historic resources in watershed and prioritize them for preservation

6. Monitor results and analyze data, quantify changes in: **- ALL**
   - Acres of undeveloped land
   - Acres of cleared land
   - Amount of light pollution
   - Acres of permanent open space, placement and connectivity
   - Land use
   - Riparian corridor width and condition in new developments
   - Environmentally sensitive vs. traditional developments
   - Priority viewsheds
   - Historical/cultural resources
   - Property values

7. Investigate funding opportunities for: **- ALL**
   - conservation-oriented building practices
   - monitoring of land use changes
   - open space protection and connectivity
   - study and preservation of historic sites

Goal III. Encourage high quality public, semi-public, and private infrastructure and services, while maintaining the natural character of the LaBarque Creek Watershed

1. Provide cleaner, safer roadways
   A. Complete a transportation plan consistent with watershed character
      1. Encourage all new roads and improvements to existing roads capture stormwater runoff in a way that mimics the natural hydrology of the receiving stream by using a full range of low impact technologies, such as, micro-detention basins and swales and BMPs – **ORG/JCG/MODOT**
      2. Explore the possibility of lowering speed limits on Highways F and FF – **ORG/MODOT**
   B. Maintain condition of roadways and safety
      1. Encourage addition of rumble stripes on public road shoulders – **ORG/JCG**
      2. Encourage Jefferson County Sheriff's Department to conduct periodic speed limit checks – **ORG**

2. Control solid waste
    A. Support resident efforts to minimize litter and dumping
        1. Encourage Adopt-A-Highway participation by watershed residents – **ORG/ST**
        2. Investigate methods to improve enforcement of existing littering laws – **ORG/ST/JCG**
        3. Increase Stream Team trash clean up efforts along streams - ST
        4. Promote an annual watershed community clean-up day – ORG/ST
        5. Provide illegal dumping report information on watershed website **– ORG/ST**
        6. Develop a Keep LaBarque Beautiful campaign – **ORG/ST**
    B. Increase community awareness **– ORG/ST**
        1. Maintain Adopt-A-Highway and other watershed signage
        2. Utilize watershed website and newsletter to educate about trash collector options, impacts of trash
        3. Increase frequency and participation of highway litter pick up events

3. Encourage addition of updated communication and internet services – **ORG/ST**
    A. Consider petitioning cell phone and internet companies about upgrading watershed coverage/services
    B. Encourage subsurface transmission and communication line placement of utilities

4. Encourage timely police protection - **ORG**
    A. Explore the possibility of establishing a sheriff sub-station within 10 minutes of the watershed border

Goal IV. Foster a partnership among citizens, local governments, state government, non-governmental organizations, regional initiatives and agencies

1. Coordinate watershed conservation plan implementation – **ORG/ST**
    A. Evolve existing LaBarque Creek Watershed Landowner Committee into a watershed conservation organization which is representative of watershed landowners
        1. Elect organization officials and designate their terms
        2. Coordinate appointment of watershed conservation organization committees including those related to: federal and state agencies, Jefferson County government, public information (PR and outreach), events planning, finance development, and planning
        3. Enact governing rules and or by-laws
    B. Establish watershed coordinator position to manage implementation of the watershed plan

C. Organize and hold watershed plan review meetings

D. Organize and hold landowner-sponsored events (e.g. Watershed Festival, open house)

E. Organize and hold at least one annual partner meeting

F. Coordinate LaBarque Creek watershed conservation effort with other regional initiatives and partners focused on conservation

2. Support involvement of watershed landowners in watershed conservation plan implementation activities

A. Increase activities of the new landowner watershed conservation organization – ORG/ST

1. **Meet quarterly, distribute notes and post on website -- involve other partners, as needed**
2. **Produce quarterly newsletter**
3. **Maintain website (http://www.labarque.org)**
4. **Refine and maintain watershed awareness signage**
5. **Recruit additional watershed landowners for increased participation**
6. Encourage all watershed landowners to support watershed plan implementation
7. Explore establishing a community name to improve area identity and home values

B. Promote Stream Team #2991 and its activities – ST/ORG

1. **Provide information on Stream #2991 for new landowner packets**
2. **Maintain at least three lead members with water quality sampling Level 3 status**
3. **Generate and implement water quality monitoring plan and annual report**
4. **Coordinate invasive exotic species removal projects (≥ 1/yr)**
5. **Coordinate LaBarque Creek Stream Cleanup event (≥ 1/yr)**
6. **Coordinate stream water quality and/or physical habitat survey (≥ 1/yr)**

C. Expand outreach for watershed families and property owners to increase awareness of watershed natural resources and interest in stewardship **- ORG/ST**

1. **Develop and present workshop to watershed landowners demonstrating benefits of conservation easements and other land protections – ORLT/TNC/OSC**
2. **Develop and provide written information for landowners including: - ALL**
   - **new landowner watershed conservation and information packets**
   - **land management technical brochures (ie., controlling invasive exotics)**
   - **stream and lake management technical brochures**

- **lists of governmental regulatory and resource agencies**
- **watershed plan summary**

3. Develop and coordinate homeowner workshops/presentations and materials targeting landowners owning three (3) acres of less – ORG/ST/MDC/JCG/EWG

4 Host neighborhood gathering/celebration for educational outreach focused on conservation, including: rain gardens, landscaping, butterfly gardening, lawn management, and affiliate with local landscaper, forest management – ORG/ST

5. Provide landowners with updates of public land issues and actions, as needed – **MDC/DNR**
6. Investigate the possibility of creating color book of watershed features/flora/fauna, featuring color photography – **ORG/ST/MDC**

D. When requested, provide landowner conservation assistance – M**DC/DNR/JCG**

3. Identify and involve additional stakeholders – **ORG/ST**

A. Encourage additional watershed conservation involvement from conservation groups and universities, including: WGNSS, Audubon, Native Plant Society, Meramec Community College, Shaw Nature Reserve of Missouri Botanical Garden, and Washington University.

B. Encourage support and involvement of Jefferson County Commissioners and representative state legislators through mailings (new landowner packet and cover letter, news letters) and invitations to special events and meetings

C. Identify and involve watershed cultural and historic expertise and representation

D. Consider involvement in Northern Ozark Rivers Partnership (Meramec River Basin Stream Team association) and other Meramec River basin conservation efforts

4. Investigate funding opportunities - ALL

A. Explore funding options for landowner conservation organization to hire watershed coordinator, and help fund organization-driven efforts, including: newsletter, special events, mailings, monitoring, invasive exotic species control, neighborhood conservation projects, and other habitat improvement projects

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Appendix 1. Water quality standards assigned to LaBarque Creek and unnamed tributary by Missouri Department of Natural Resources, 2005.

Criteria for Designated Uses:
WBC = Whole Body Contact Recreation
AQL = Protection of Aquatic Life
LWW = Livestock and Wildlife Watering

Pollutant (µg/L)	**AQL**
Chlorine (total residual)	
warm-water chronic	10
acute	19
Cyanide (amenable to chlorination)	
Chronic	5
acute	22
Hydrogen sulfide (un-ionized)	2
Organics	
2,4-dichlorophenol	7
Ethylbenzene	320
Hexachlorocyclopentadiene	0.5
Phenol	100
2-chloronaphthalene	4,300
Pesticides	
Demeton	0.1
Endosulfan	
Chronic	0 .056
Acute	0.11
Guthion	0.01
Malathion	0.1
Parathion	0.04
Chlorpyrifos	0.04
Bioaccumulative, Anthropogenic Toxics (+)	
Heptachlor	0.0038
Methoxychlor	0.03
Mirex	0.001
Pentachlorophenol**	3.2–pH 6.5 8 1 1
Temperature (maximum)	90°F 32 2/9°C
Temperature (maximum change	5 2 7/9
Total Dissolved Gases	110%

Metals (Hardness Dependent)

Cadmium (µg/L)

Acute: $e^{(1.0166*\ln(\text{Hardness}) - 3.062490)} * (1.136672 - (\ln(\text{Hardness})*0.041838))$

Chronic: $e^{(0.7409*\ln(\text{Hardness}) - 4.719948)} * (1.101672 - (\ln(\text{Hardness})*0.041838))$

Chromium III (µg/L)

Acute: $e^{(0.8190*\ln(\text{Hardness}) + 3.725666)} * 0.316$

Chronic: $e^{(0.8190*\ln(\text{Hardness}) + 0.684960)} * 0.860$

Copper (µg/L)

Acute: $e^{(0.9422*\ln(\text{Hardness}) - 1.700300)} * 0.960$

Chronic: $e^{(0.8845*\ln(\text{Hardness}) - 2.044953)} * 0.960$

Lead (µg/L)

Acute: $e^{(1.273*\ln(\text{Hardness}) - 1.460448)} * (1.46203 - (\ln(\text{Hardness})*0.145712))$

Chronic: $e^{(1.273*\ln(\text{Hardness}) - 4.704797)} * (1.46203 - (\ln(\text{Hardness})*0.145712))$

Nickel (µg/L)

Acute: $e^{(0.8460*\ln(\text{Hardness}) + 2.255647)} * 0.998$

Chronic: $e^{(0.8460*\ln(\text{Hardness}) + 0.058978)} * 0.997$

Silver (µg/L)

Acute: $e^{(1.72*\ln(\text{Hardness}) - 6.588144)} * 0.850$

Zinc (µg/L)

Acute: $e^{(0.8473*\ln(\text{Hardness}) + 0.884211)} * 0.978$
Chronic: $e^{(0.8473*\ln(\text{Hardness}) + 0.785271)} * 0.986$

	Hardness								
	50–74	**75–99**	**100–124**	**125–149**	**150–174**	**175–199**	**200–224**	**225–249**	**250+**
Cadmium									
Acute:	2.4	3.6	4.8	5.9	7.1	8.2	9.4	10.5	11.6
Chronic:	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5
Chromium III									
Acute:	323	450	570	684	794	901	1,005	1,107	1,207
Chronic:	42	59	74	89	103	117	131	144	157
Copper									
Acute:	7	10	13	17	20	23	26	29	32
Chronic:	4	6	7	9	10	12	13	15	16
Lead									
Acute:	30	47	65	82	100	118	136	154	172
Chronic:	1	2	3	3	4	5	5	6	7
Nickel									
Acute:	261	367	469	566	660	752	842	930	1017
Chronic:	29	41	52	63	73	84	94	103	113
Silver									
Acute:	1.0	2.0	3.2	4.7	6.5	8.4	10.6	13.0	15.6
Zinc									
Acute:	65	92	117	142	165	188	211	233	255
Chronic:	59	84	107	129	151	172	193	213	233

Pollutant (mg/L)	**AQL**	**LWW**
Chloride		
chronic	230(+)	250
acute	860(+)	
Sulfate	(+)	250
Fluoride		4
Dissolved oxygen (minimum)		
warm-/cool-water fisheries	5	
Metals (µg/L)		
Aluminum (acute)	750	-
Arsenic	20	-
Beryllium	5	-
Cadmium	*	
Chromium III	*	
Chronmium VI		
chronic	10	-
acute	15	-
Cobalt	-	1000
Copper	-	500
Iron	1,000	-
Lead	*	-
Mercury		
chronic	0.5	-
acute	2.4	-
Nickel	*	-
Selenium	5	-
Silver	*	-
Zinc	*	-
* (Hardness Dependent)		
Oil and grease	10	

Pollutant (µg/L)	**AQL**	**LWW**
Metals (Nonhardness Dependant)		
Aluminum (acute)	750	-
Arsenic	20	-
Beryllium	5	-
Cadmium	*	
Chromium III	*	
Chronmium VI		
chronic	10	-
acute	15	-
Cobalt	-	1000
Copper	-	500
Iron	1,000	-
Lead	*	-
Mercury		
chronic	0.5	-
acute	2.4	-
Nickel	*	-
Selenium	5	-
Silver	*	-
Zinc	*	-

* (Hardness Dependent)

Pollutant (/100 mL)	**WBC**
E. coli Bacteria*	548

Appendix 2. Federal, State, and County agencies and natural resource organizations available to LaBarque Creek Watershed residents to help with natural resource management, 2009.

Federal Agencies

US Army Corps of Engineers (St. Louis District)

USCOE-St. Louis District is responsible for the navigation support and flood damage reduction on portions of the Missouri and Mississippi rivers, operating and maintaining five lakes and their associated recreational areas to serve a variety of purposes ranging from flood protection and recreation to potable water supply and hydroelectricity. In addition, other responsibilities include environmental restoration, environmental river engineering (created by the St. Louis District), water supply, emergency responses to natural disasters, and regulatory oversight (issuance of permits and wetland delineation). Learn more about USCOE-St. Louis District at: **http://www.mvs.usace.army.mil** View or apply for 404 permits applications for placing fill in wetlands and along streams at: **http://www.mvs.usace.army.mil/ConOps/permits/permits.html** or contact Danny McClendon (Branch Chief) @ (314)331-8574

US Environmental Protection Agency, Region 7 Office

The mission of the Environmental Protection Agency is to protect human health and the environment. Since 1970, EPA has been working for a cleaner, healthier environment for the American people. Contact US EPA at: Region 7, 901 N. 5th Street, Kansas City, KS 66101. 913-551-7003, Toll-Free: 1-800-223-0425. **To report a pollutant spill and/or release:** Call the 24-hour EPA Emergency Response line at: 913-281-0991

USDA Natural Resources Conservation Service (NRCS)

NRCS works with private landowners to help them protect their natural resources. NRCS conservationists focus on agricultural land-cropland, pasture, & rangeland—the predominant use of private lands in this country. They work in close cooperation with conservation districts through field offices that serve nearly every county in the nation, to address erosion reduction & control; water quality; wetland conservation; conservation plant testing & release program; grazing lands. Contact Jefferson County Field Office: (636) 789-2441 Ext. 3

State Agencies

Missouri Department of Conservation (www.mdc.mo.gov) – Private Land Services Division

Private Land Conservationists provide information, training, advice, technical & financial assistance to private landowners for sound land management. Landowners can obtain assistance for agriculture practices, forest management, pond creation/restoration, stream stabilization, fish habitat enhancement, wildlife habitat & damage control, & restoration of native communities like wetlands, prairies, glades & savannahs. Community Conservation Planners work with local governments, citizen groups & developers to promote & support comprehensive watershed & community-based planning, low-impact site design & complementary ordinances & codes. Specific elements include reducing habitat fragmentation, protecting or restoring forested stream buffers & prairies, & connecting conservation to the community. Contact: private land conservationist, (636) 789-2441; community conservationist (Tracy Boaz), 314-301-1506 ext. 2264

Missouri Department of Conservation – Forestry Division
Responsible for managing various Conservation Areas in the St. Louis area, including Young Conservation Area. Contact: resource forester (Paul Whitsell), 636-458-2236

Missouri Department of Conservation – Wildlife Division
Responsible for managing various Conservation Areas in the St. Louis area, including LaBarque Creek Conservation Area. Contact: wildlife management biologist (John Vogel), 314-441-4554, ext. 318

Missouri Department of Natural Resources (www.dnr.mo.gov) - Outreach & Assistance Center (OAC)
OAC provides information to Missouri citizens about services of the Missouri DNR and has specific information to share about conservation design practices for development and low impact development strategies. Contact: Ruth A. Wallace, (800) 361-4827 or (573) 526-6627

Missouri Department of Natural Resources - Division of Environmental Quality
The mission of the Division of Environmental Quality is to help Missourians prevent pollution, protect the public from harmful emissions, discharges and waste disposal practices. We are here to help Missourians improve the quality of the air, water and soil for the sustainable use by business, tourism and agriculture. Contact the **St. Louis Regional Office,** Mike Struckhoff, Director, 7545 S. Lindbergh, Suite 210, St. Louis, MO 63125, (314) 416-2960.

Missouri Department of Natural Resources - State Parks
Division of State Parks manages Missouri's state parks and provides natural history education. Contact MDNR State Parks at moparks@dnr.mo.gov, 1-800-334-6946, or Missouri Department of Natural Resources, Division of State Parks, P.O. Box 176, Jefferson City, MO 65102

County Agencies

Jefferson County Government (www.jeffcomo.org) - Department of Land Use Development and Code Enforcement
Organizing the divisions of Planning, Building, and Code Enforcement in a common department under a single director was a major step to improve accountability and upgrade the delivery of services to the citizens. By adopting a structure that encourages coordination among these divisions, County Government is better prepared to implement programs and policies that foster orderly development. The Department mission is to provide the citizens of Jefferson County with the means for future growth, educational opportunities, economic vitality & sound environmental compatibility, while enhancing and preserving the "quality of life" our citizens expect. Residents are encouraged to participate in watershed planning activities. Contact: Planning & Zoning – Kristi Bales (636) 797-5580; Solid Waste – Kara Dunnam (636) 797-5043; Stormwater - Bill Aho (636) 797-6225

Jefferson County Soil & Water Conservation District (SWCD)
The SWCD has a responsibility to conserve soil and water resources by working with landowners at a local level to decrease soil erosion and improve water quality. Assistance is provided to agricultural, urban and suburban landowners – providing information, technical assistance and financial assistance to qualifying landowners who implement practices which

improve or sustain the county's natural resources. Practices include improved livestock grazing systems, alternative watering methods, waterways, diversions, new ponds/grade stabilization structures, inter-seeding pastures, spring developments, and improved cropping methods. SWCD works with the US Natural Resource Conservation Service and the Missouri Department of Conservation to provide assistance programs that enhance natural resources while increasing land productivity. SWCD is a repository of data on soil and water resources related to land use patterns, flood plains and wetlands. SWCD provides educational outreach programs to landowners, schools and the general public about soil and water conservation issues through school programs, field days and newsletters and brochures. SWCD works with Jefferson County Department of Land Use Development and Code Enforcements division of planning to provide environmental reviews of preliminary plats based upon existing natural conditions with recommendations for improving the plat design to minimize the environmental impacts on the surrounding land and water bodies. Contact: Jefferson County SWCD at (636) 789-2441 Ext 3; Regional SWCD 636-922-2833. http://swcd.mo.gov/jefferson/index.html

Non-Profit Agencies

Audubon Missouri (www.mo.audubon.org)
Protecting habitat, educating citizens about resource conservation. Contact: Roger Still, (573) 447-2249; rstill@audubon.org

Genealogical and Historical Research
Researching local histories; cultural history; land title tracing in Jefferson County & the LaBarque Watershed. Contact: Carol Goggin 636-797-5622, gogginc@misouri.edu

East-West Gateway Council of Governments (www.ewgateway.org)
A regional planning agency focused on addressing transportation, sustainable development and planning in the eight county St. Louis metropolitan area. Contact Steve Nagle, David Wilson, or Mike Coulson, (314) 421-4220.

Open Space Council (OSC) (www.openspacestl.org)
OSC is dedicated to conserving public & private open space lands in the St. Louis Region. OSC organizes Operation Clean Stream on the Meramec River & its tributaries. Held the last Saturday and Sunday of August Clean Stream is the longest on-going river clean up in America. Contact: Ron Coleman, (636) 733-0088.

Ozark Regional Land Trust (ORLT) (www.orlt.org)
ORLT is dedicated to preserving the unique natural character and resources of the Ozarks Bioregion. ORLT works with willing and interested landowners and communities to evaluate, and implement many available land protection options/tools. ORLT has protected over 12,000 acres through conservation easements (purchased and donated), fee-simple donation of land, community land trusts, & best management practices. Contact: Abigail Lambert, P.O. Box 300 Gray Summit, Missouri 63039, aflambert@orlt.org, (636) 451-0404.

The Nature Conservancy (TNC) (www.nature.org)
The mission of TNC is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. The Missouri Chapter and its 14,000 members have protected more than 125,000 acres of critical lands across the state and currently manage 32 preserves totaling 18,000 acres. TNC accepts donations of land in priority projects areas, and in some cases, will acquire conservation easements. Contact: Jim Wildman, (314) 968-1105.

Trust for Public Land (TPL) (www.tpl.org)
TPL is a national, nonprofit, land conservation organization that conserves land for people to enjoy as parks, community gardens, historic sites, rural lands, and other natural places, ensuring livable communities for generations to come. Central Region Office, 2610 University Ave., Suite 300, St. Paul, MN 55114, (651) 917-2240.

Appendix 3. Plants found in LaBarque Creek Watershed, 2008.

Latin name		Common Name	Rank
Acalypha	gracilens	three-seeded mercury	
Acalypha	monococca	one-seeded mercury	
Acalyphaa	rhomboidea	rhombic copperleaf	
Acalypha	virginica	virginia copperleaf	
Acer	negundo	box elder	
Acer	rubrum	red maple	
Acer	saccharinum	silver maple	
Acer	saccharum	sugar maple	
Achillea	millefolium	yarrow	
Actaea	pachypoda	white baneberry	
Adiantum	pedatum v.pedatum	northern maidenhair fern	
Agalinis	gattingeri	rough-stemmed gerardia	
Agalinis	tenuifolia v. macrophylla	slender gerardia	
Agastache	nepetoides	yellow giant hyssop	
Ageratina	altissima v. altissima	white snakeroot	
Agrimonia	parviflora	swamp agrimony	
Agrimonia	pubescens	agrimony	
Agrimonia	rostellata	woodland agrimony	
Agrostis	elliottiana	awned bent grass	
Alisma	subcordatum	southern water plantain	
Allium	canadense	wild garlic	
Allium	canadense v. mobilense	wild garlic	
Allium	stellatum	wild onion	
Ambrosia	artemisiifolia	common ragweed	
Ambrosia	trifida	giant ragweed	
Amelanchier	arborea	serviceberry	
Ammannia	coccinea	toothcup	
Amorpha	canescens	lead plant	
Amphicarpaea	bracteata	hog peanut	
Andropogon	gerardii	big bluestem	
Andropogon	gyrans v. gyrans	Elliott's broomsedge	
Andropogon	virginicus v. virginicus	broomsedge	
Anemone	virginiana	thimbleweed	
Anemonella	thalictroides f.	rue anemone	
Antennaria	parlinii ssp.	pussytoes	
Antennaria	plantaginifolia	pussytoes	
Apios	americana	groundnut	
Aplectrum	hyemale	Adam-and-Eve orchid	
Apocynum	cannabinum	Indian hemp	
Apocynum	cannabinum v. cannabinum	Indian hemp	
Aquilegia	canadensis f. canadensis	columbine	
Arabidopsis	thaliana	mouse-ear cress	
Arabis	hirsuta	hairy rock cress	
Aralia	racemosa	spikenard	
Arisaema	dracontium	green dragon	
Arisaema	triphyllum ssp. triphyllum	Jack-in-the-pulpit	
Aristolochia	serpentaria v.	snakeroot	
Aristolochia	tomentosa	pipe-vine	
Arnoglossum	atriplicifolium	pale Indian plantain	
Arnoglossum	plantagineum	Indian plantain	
Arnoglossum	reniforme	great Indian plantain	
Artemisia	ludoviciana v.	white sage	
Aruncus	dioicus v. pubescens	goat's beard	
Asarum	canadense	wild ginger	
Asclepias	quadrifolia	whorled milkweed	
Asclepias	syriaca	common milkweed	

Asclepias	tuberosa ssp. interior	butterfly weed	
Asclepias	verticillata	horsetail milkweed	
Asclepias viridis		Green milkweed	
Asimina	triloba	pawpaw	
Asplenium	platyneuron	ebony spleenwort	
Asplenium	rhizophyllum	walking fern	
Asplenium	trichomanes ssp. trichomanes	maidenhair spleenwort	
Astragalus	canadensis v. canadensis	rattle weed	
Astragalus	crassicarpus v. trichocalyx	ground plum	
Astragalus	distortus v. distortus	bent milk vetch	
Athyrium	filix-femina ssp.	lady fern	
Aureolaria	grandiflora	big-flowered gerardia	
Aureolaria	grandiflora v. pulchra	big-flowered gerardia	
Baptisia	alba v. macrophylla	white wild indigo	
Baptisia	bracteata v. leucophaea	long-bracted wild indigo	
Barbarea	vulgaris	yellow rocket	
Betula	nigra	river birch	
Bidens	discoidea	beggar ticks	
Bidens	frondosa v. frondosa	beggar ticks	
Blephilia	ciliata f. ciliata	Ohio horse mint	
Blephilia	hirsuta v. hirsuta	wood mint	
Boechera	canadensis	sicklepod	
Boechera	laevigata	smooth rock cress	
Boehmeria	cylindrica	false nettle	
Botrychium	dissectum	cut leaf grape fern	
Botrychium	virginianum v. virginianum	rattlesnake fern	
Brachyelytrum	erectum	long-awned woodland grass	
Bromus	latiglumis	hairy woodbrome	S3
Bromus	pubescens	Canada brome	
Bromus racemosus		Chess	
Bulbostylis	capillaris	hair sedge	
Callitriche terrestris			
Calystegia	silvatica ssp. fraterniflora	bindweed	
Camassia	scilloides	wild hyacinth	
Campanula	americana	tall bellflower	
Campsis	radicans	trumpet creeper	
Capsella	bursa-pastoris	shepherd's purse	
Cardamine	bulbosa	spring cress	
Cardamine	concatenata	toothwort	
Cardamine	hirsuta	hoary bitter cress	
Cardamine	parviflora v. arenicola	small-flowered bitter cress	
Cardamine	pensylvanica	bitter cress	
Carex	albicans	spring sedge	
Carex	albursina	sedge	
Carex	amphibola	sedge	
Carex	blanda	sedge	
Carex	bushii	sedge	
Carex	cephalophora	woodbank sedge	
Carex	complanata	hirsute sedge	
Carex	crawei	sedge	
Carex	eburnea	sedge	
Carex	glaucodea	sedge	
Carex	granularis v. granularis	meadow sedge	
Carex	hirsutella	sedge	
Carex	hirtifolia	sedge	
Carex	jamesii	porcupine sedge	
Carex	laxiculmis	spreading sedge	S2
Carex	lupulina	hop sedge	
Carex	lurida	sedge	
Carex	muhlenbergii v. muehlenbergii	Muhlenberg's sedge	
Carex	normalis	sedge	
Carex	oligocarpa	sedge	

Carex	retroflexa	reflexed sedge	
Carex	rosea	convoluted sedge	
Carex	shortiana	sedge	
Carex	squarrosa	sedge	
Carex	torta	sedge	
Carex tribuloides		Awl-fruited oval sedge	
Carex	umbellata	umbel-like sedge	
Carex	virescens	sedge	
Carex	vulpinoidea	fox sedge	
Carex	willdenowii	Wildenow's sedge	S1
Carpinus	caroliniana ssp.	blue beech	
Carya	cordiformus	bitternut hickory	
Carya	ovata v. ovata	shagbark hickory	
Carya	texana	black hickory	
Carya	tomentosa	mockernut hickory	
Ceanothus	americanus v. pitcheri	New Jersey tea	
Celastrus	scandens	American bittersweet	
Celtis	occidentalis	northern hackberry	
Celtis	tenuifolia	dwarf hackberry	
Cephalanthus	occidentalis	buttonbush	
Cerastium	brachypodum	chickweed	
Cerastium	nutans	nodding chickweed	
Cerastium	pumilum ssp. pumilum f.	chickweed	
Cercis	canadensis v. canadensis	eastern redbud	
Chamaecrista	fasciculata	showy partridge pea	
Chamaecrista	nictitans v. nictitans	sensitive pea	
Chasmanthium	latifolium	river oats	
Cheilanthes	lanosa	hairy lip fern	
Chenopodium	ambrosioides.	Mexican tea	
Cichorium	intybus f. album	common chicory	
Cicuta	maculata v. maculata	common water hemlock	
Cinna	arundinacea	wood reed	
Circaea	canadensis ssp. quadrisulata	enchanter's nightshade	
Cirsium	altissimum f.	tall thistle	
Cirsium	discolor f.	field thistle	
Claytonia	virginica	spring beauty	
Clematis	fremontii	Fremont's leather flower	S3
Clematis	pitcheri v. pitcheri	leather flower	
Clematis virginiana		Virgin's bower	
Comandra	umbellata spp. umbellata	bastard toadflax	
Commelina	erecta	dayflower	
Conoclinium	coelestinum f. coelestinum	mist flower	
Conyza	canadensis v.	horse weed	
Corallorhiza	wisteriana	coral root	
Coreopsis	lanceolata	tickseed coreopsis	
Coreopsis	palmata	finger coreopsis	
Coreopsis	tripteris	tall tickseed	
Cornus	drummondi	rough-leaved dogwood	
Cornus	florida f. florida	flowering dogwood	
Corydalis	flavula	pale corydalis	
Corylus	americana	American hazelnut	
Crotalaria	sagittalis	rattlebox	
Croton	capitatus	wooly croton	
Croton	glandulosus v. septentrionalis	sand croton	
Croton	monanthogynus	one-seeded croton	
Croton	willdenowii	croton	
Cryptotaenia	canadensis	honewort	
Cunila	origanoides	dittany	
Cuphea	viscosissima	clammy cuphea	
Cuscuta	gronovii	commondodder	
Cynanchum laeve		Angle-pod	
Cynoglossum	virginianum	giant hound's tongue	

Cyperus	lupulinus ssp. lupulinus	umbrella sedge	
Cyperus echinatus		Hedgehog clubrush	
Cypripedium	calceolus v. pubescens	large yellow lady's slipper	
Cystopteris	bulbifera	bulblet fern	
Cystopteris	protrusa	lowland brittle fern	
Cystopteris	tennesseensis	Tennessee bladder fern	
Cystopteris	tenuis	Mackay's brittle fern	S1
Dalea candida		White prairie clover	
Dalea	purpurea v. purpurea	purple prairie clover	
Danthonia	spicata	poverty grass	
Daucus	carota ssp. carota	Queen Anne's lace	
Delphinium	carolinianum ssp carolinianum	Carolina larkspur	
Delphinium	tricorne	dwarf larkspur	
Dennstaedtia	punctilobula	hay-scented fern	S2
Deparia	acrostichoides	silvery spleenwort	
Desmodium	glabellum	tall tick clover	
Desmodium	glutinosum	arge-flowered tick clover	
Desmodium	nudiflorum f.	naked-stemmed tick clover	
Desmodium	paniculatum	tall tick clover	
Desmodium	perplexum	tall tick clover	
Desmodium	rotundifolium	dollarleaf	
Dianthus	armeria	deptford pink	
Diarrhena	obovata	American beakgrain	
Dicentra	cucullaria f. cucullaria	Dutchman's breeches	
Digitaria	ischaemum	smooth crab grass	
Diodia	teres	rough buttonweed	
Dioscorea	villosa	wild yam	
Diospyros	virginiana	persimmon	
Diplazium	pycnocarpon	narrow-leaved glade fern	
Dodecatheon	meadia v. meadia	shooting star	
Draba	brachycarpa	whitlow grass	
Draba	cuneifolia v. cuneifolia	whitlow grass	
Draba verna	Whitlow grass		
Dryopteris	marginalis	marginal shield fern	
Echinacea	pallida	pale-purple coneflower	
Echinacea	purpurea	purple coneflower	
Echinacea	simulata	palepurple coneflower	
Echinochloa	crusgalli	barnyard grass	
Elaeagnus umbellata		Autumn olive	
Eleocharis	compressa	flat-stemmed spike rush	
Eleocharis ovata		Spike rush	
Eleocharis	verrucosa	spike rush	
Elephantopus	carolinianus	elephant's foot	
Ellisia	nyctelea	Aunt Lucy	
Elymus	canadensis v. canadensis	Canada wild rye	
Elymus	hystrix	bottlebrush grass	
Elymus	villosus	downy wild rye	
Elymus	virginicus	Virginia wild rye	
Equisetum	arvense	common horsetail	
Equisetum	hyemale v. affine	winter scouring rush	
Equisetum	xferrissii	scouring rush	
Erechtites	hieracifolia v. hieracifolia	fireweed	
Erigenia	bulbosa	harbinger of spring	
Erigeron	annuus v. annuus	daisy fleabane	
Erigeron	philadelphicus	Philadelphia fleabane	
Erigeron	pulchellus v. pulchellus	robin's plantain	
Erigeron	strigosus	daisy fleabane	
Erythronium	albidum	white trout lily	
Euonymus	atropurpureus	wahoo	
Euonymus	*hederaceus (fortunei)*	wintercreeper	
Eupatorium	altissimum	tall thoroughwort	
Eupatorium	perfoliatum v. perfoliatum	boneset	

Eupatorium	serotinum	late boneset	
Euphorbia	commutata	wood spurge	
Euphorbia	corollata	flowering spurge	
Euphorbia	cyanthophora	wild poinsettia	
Euphorbia maculata		Nodding spurge	
Festuca	subverticillata	nodding fescue	
Fimbristylis	autumnalis	fimbristylis	
Fimbristylis	puberula v. puberula	hairy fimbristylis	
Fragaria	virginiana	wild strawberry	
Fraxinus	americana	white ash	
Fraxinus	quadrangulata	blue ash	
Galium	aparine f. aparine	cleavers	
Galium	circaezans	wild licorice	
Galium	circaezans v. circaezans	wild licorice	
Galium	concinnum	shining bedstraw	
Galium	obtusum	bluntleaf bedstraw	
Galium	pilosum v. puncticulosum	hairy bedstraw	
Galium	triflorum	sweet-scented bedstraw	
Gamochaeta	purpurea	purple cudweed	
Gamochaeta	sp.	cudweed	
Gaura	longiflora	large-flowered gaura	
Gentiana	puberulenta	downy gentian	
Geranium	carolinianum	cranesbill	
Geranium	maculatum f. maculatum	wild geranium	
Geum	canadense	white avens	
Geum	vernum	spring avens	
Gillenia	stipulata	indian physic	
Glandularia	canadensis	rose verbena	
Glechoma	hederacea	ground ivy	
Gleditsia	triacanthos	honey locust	
Glyceria	striata	fowl meadow grass	
Hedyotis	crassifolia	small bluets	
Hedyotis	longifolia	long-leaved bluets	
Hedyotis	nigricans	narrow-leaved bluets	
Hedyotis	purpurea	mountain houstonia	
Helenium	autumnale	sneezeweed	
Helianthus	hirsutus	bristly sunflower	
Helianthus	maximiliani	Maximilian sunflower	
Helianthus	mollis	ashy sunflower	
Helianthus	tuberosus	Jerusalem artichoke	
Heliopsis	helianthoides	ox-eye	
Hemerocallis flava		Orange day lily	
Hepatica	nobilis v. actua f. acuta	liverleaf	
Heuchera	americana	alum root	
Heuchera	richardsonii	alum root	
Heuchera	sp.	alum root	
Hieracium	gronovii	hawkweed	
Hieracium	longipilum	hawkweed	
Holosteum	umbellatum	jagged chickweed	
Huperzia	lucidula	shining clubmoss	
Huperzia	porophila	rock clubmoss	S2
Huperzia	xbartleyi	clubmoss	
Hybanthus	concolor	green violet	
Hydrangea	arborescens .	wild hydrangea	
Hydrastis	canadensis	golden seal	
Hypericum	drummondii	nits-and-lice	
Hypericum	gentianoides	pineweed	
Hypericum	hypericoides	St. Andrew's cross	
Hypericum	hypericoides v. multicaule	St. Andrew's cross	
Hypericum	mutilum	drawf St. John's-wort	
Hypericum	prolificum	shrubby St. John's-wort	
Hypericum	punctatum	spotted St. John's-wort	

Hypericum	sphaerocarpum	round-fruited St. John's-wort	
Hypoxis	hirsuta	yellow star grass	
Ilex	decidua	deciduous holly, possum haw	
Impatiens	capensis f. capensis	spotted touch-me-not	
Ipomoea	pandurata	wild potato vine	
Isoetes	butleri	Butler's quillwort	
Juglans	cinerea	butternut	
Juglans	nigra	black walnut	
Juncus	acuminatus	knotty-leaved rush	
Juncus	dudleyi	Dudley's rush	
Juncus	effusus ssp. solutus	soft rush	
Juncus marginatus		Grass-leaved rush	
Juncus secundus		A Juncus	
Juncus tenuuis v. anthelatus		Path rush	
Juncus tenuuis v. tenuis		A Juncus	
Juniperus	virginiana v. virginiana	red cedar	
Krigia	biflora v. biflora	false dandelion	
Krigia	dandelion	dwarf dandelion	
Krigia	virginica	dwarf dandelion	
Lactuca	canadensis	wild lettuce	
Lactuca	floridana	Florida lettuce	
Lactuca	serriola	prickly lettuce	
Lamium	amplexicaule v. amplexicaule	henbit	
Lamium	purpureum v. purpureum	dead nettle	
Laportea	canadensis	stinging nettle	
Lechea	tenuifolia v. tenuifolia	pinweed	
Leersia	oryzoides	rice cutgrass	
Leersia	virginica	white grass	
Lespedeza cuncata		Sericea lespedeza	
Lespedeza	hirta v. hirta	hairy bush clover	
Lespedeza	procumbens	trailing bush clover	
Lespedeza	violacea	bush clover	
Lespedeza	virginica	slender bush clover	
Leucospora	multifida	conobea	
Liatris	aspera f.	rough blazing star	
Liatris	ligulistylis ??????	blazing star	
Liatris	squarrolosa	blazing star	
Lilium	michiganense	Michigan lily	
Lindera	benzoin	spice bush	
Linum	medium v. texanum	sucker flax	
Lithospermum	canescens	puccoon	
Lobelia	inflata	Indian tobacco	
Lobelia	siphilitica	blue cardinal flower	
Lobelia	spicata	spiked lobelia	
Lonicera	maackii	Amur honeysuckle	
Lotus	corniculatus	bird's foot trefoil	
Ludwigia	alternifolia	seedbox	
Luzula	campestris v. bulbosa	wood rush	
Lycopodium	dendroideum	round-branched ground pine	S1
Lysimachia lanceolata			
Lysimachia	nummularia	moneywort	
Maianthemum	racemosum ssp. racemosum	false Solomon's seal	
Manfreda	virginica	false aloe	
Matelea	decipiens	climbing milkweed	
Medicago lupulina		Black medoc	
Melica nitens		Melica grass	
Melilotus albus		White sweet clover	
Melilotus officinalis		Yellow sweet clover	
Mertensia	virginica	bluebells	
Microthlaspi	perfoliatum	penny cress	
Mimosa	quadrivalvis v. nuttallii	sensitive brier	
Mimulus	alatus f. alatus	sharpwing monkey flower	

Mitchella	repens f. repens	partridge berry
Mollugo	verticillata	carpetweed
Monarda	bradburiana	beebalm
Monarda	fistulosa ssp. fistulosa	wild bergamot
Monotropa	uniflora	Indian pipe
Morus	rubra	red mulberry
Muhlenbergia	sobolifera f. sobolifera	rock muhly
Muhlenbergia frondosa		Nimblewill grass
Myosotis	stricta	small-flowered forget-me-not
Myosotis	verna	scorpion grass
Myosotis	verna v. macrosperma	scorpion grass
Nothoscordum	bivalve v. bivalve	false garlic
Nuttallanthus	canadensis	blue toadflax
Nyssa	sylvatica	black gum
Oenothera	biennis	common evening primrose
Oenothera laciniata		Cut-leaved evening primrose
Oenothera	linifolia	thread-leaved sundrops
Oenothera	macrocarpa ssp. macrocarpa	Missouri primrose
Onoclea	sensibilis	sensitive fern
Ophioglossum	engelmannii	Engelmann's adder's tongue
Ophioglossum	vulgatum	southern adder's tongue
Opuntia	humifusa v. humifusa	eastern prickly pear
Orbexilum	pedunculatum v. pedunculatum	Sampson's snakeroot
Orobanche	uniflora	one-flowered cancer-root
Osmorhiza	claytonii	wooly sweet cicely
Osmorhiza	longistylis	anise root
Osmunda	cinnamomea	cinnamon fern
Osmunda	regalis v. spectabilis	royal fern
Ostrya	virginiana	eastern hop hornbeam
Oxalis	florida ssp. florida	yellow wood sorrel
Oxalis	fontana	yellow wood sorrel
Oxalis	stricta	yellow wood sorrel
Oxalis	violacea	violet wood sorrel
Packera	aurea	golden ragwort
Packera	glabella	butterweed
Packera	obovata	squaw weed
Packera	plattensis	golden ragwort
Panax	quinquefolius	ginseng
Panicum	acuminatum	panic grass
Panicum	anceps v. anceps	beaked panic grass
Panicum	boscii	panic grass
Panicum	clandestinum	panic grass
Panicum	dichotomum	panic grass
Panicum	laxiflorum	panic grass
Panicum	linearifolium	panic grass
Panicum	oligosanthes v. scribnerianum	panic grass
Panicum	sphaerocarpon	panic grass
Panicum	virgatum	switch grass
Parietaria	pensylvanica	pellitory
Parthenium	integrifolium	American feverfew
Parthenium	sp.	American feverfew
Parthenocissus	quinquefolia v. quinquefolia f.	Virginia creeper
Paspalum	laeve	field paspalum
Paspalum	pubiflorum v. glabrum	smooth scaled paspalum
Passiflora	lutea v. glabriflora	yellow passion flower
Pedicularis	canadensis	wood betony
Pediomelum	esculentum	prairie turnip
Pellaea	atropurpurea	purple cliff brake
Pellaea	glabella	cliff brake
Penstemon	pallidus	pale beard-tongue
Penthorum	sedoides	ditch stonecrop
Perilla	frutescens	beefsteak plant

Phacelia	purshii	miami mist
Phegopteris	hexagonoptera	broad beech fern
Phleum	pratense	timothy
Phlox	divaricata ssp. laphamii	blue phlox
Phlox	paniculata	perennial phlox
Phlox	pilosa	phlox
Phryma	leptostachya v. leptostachya	lopseed
Phyla	lanceolata	northernfog fruit
Phyllanthus caroliniensis		Leaf-flower
Physalis heterophylla		Clammy ground cherry
Physalis	pubescens	downy ground cherry
Physalis	sp.	ground cherry
Phytolacca	americana	pokeweed
Pilea	pumila	clearweed
Pinus banksiana/vrginiana		A pine
Pinus echinata		Short-leaved pine
Planodes	virginica	sibara
Plantago	arenaria	Indian plantain
Plantago aristata		Bracted plantain
Plantago	cordata	heartleaf plantain
Plantago lanceolata		English plantain
Plantago	pusilla	plantain
Plantago	rugelii	rugel's plantain
Plantago	virginica v. virginica	hoary plantain
Polanisia	dodecandra ssp. trachysperma	clammy weed
Polemonium	reptans v. reptans	jacob's ladder
Polygala	sanguinea	milkwort
Polygonatum	biflorum v. commutatum	Solomon's seal
Polygonum	cespitosum v. longisetum	knotweed
Polygonum	hydropiperoides	wild water pepper
Polygonum	lapathifolium	pale smartweed
Polygonum	pensylvanicum	pinkweed
Polygonum	punctatum	water smartweed
Polygonum	sagittatum	arrow-leaved tear-thumb
Polygonum	scandens	crested buckwheat
Polygonum	tenue	knotweed
Polygonum	virginianum	Virginia knotweed
Polypodium	virginianum	common polypody
Polystichum	acrostichoides	Christmas fern
Populus	deltoides ssp.	eastern cottonwood
Potentilla	recta	rough-fruited cinquefoil
Potentilla	simplex v.	common cinquefoil
Prenanthes	alba	white lettuce
Prenanthes	altissima v. cinnamomea	rattlesnake root
Prunella	vulgaris	self-heal
Prunus	serotina ssp. serotina	black cherry
Pseudognaphalium	obtusifolium	sweet everlasting
Psoralidium	tenuiflorum	scurfy pea
Ptelea	trifoliata ssp. trifoliata	common hop tree
Pteridium	aquilinum	bracken
Pycnanthemum	tenuifolium	slender mountain mint
Pyrrhopappus	carolinianus	false dandelion
Quercus	alba	white oak
Quercus	imbricaria	shingle oak
Quercus	macrocarpa	bur oak
Quercus	marilandica	black jack oak
Quercus	muehlenbergii	chinquapin oak
Quercus	rubra	red oak
Quercus	stellata v. stellata	post oak
Quercus	velutina	black oak
Ranunculus	abortivus	small flowered crowfoot
Ranunculus	harveyi	Harvey's buttercup

Ranunculus	hispidus	hispid buttercup
Ranunculus	micranthus	rock crowfoot
Ranunculus	recurvatus f. recurvatus	hooked crowfoot
Ranunculus	sardous	crowfoot
Ratibida	pinnata	gray-head coneflower
Rhamnus	caroliniana	carolina buchthorn
Rhus	aromatica	fragrant sumac
Rhus	copallina v. latifolia	winged sumac
Rhus	glabra	smooth sumac
Rhynchospora	capillacea	beaked rush
Rhynchospora	capitellata	false bog rush
Ribes	missouriense	Missouri gooseberry
Rosa	carolina	pasture rose
Rosa	multiflora	multiflora rose
Rubus	occidentalis f. occidentalis	black raspberry
Rubus	pensilvanicus	highbush blackberry
Rubus flagellaris		Dewberry
Rudbeckia	hirta v. pulcherrima	black-eyed Susan
Rudbeckia	missouriensis	Missouri coneflower
Rudbeckia	triloba v. triloba	brown-eyed Susan
Ruellia	humilis	wild petunia
Ruellia	strepens f. strepens	wild petunia
Rumex	acetosella	sheep sorrel
Rumex	crispus	curly dock
Rumex	obtusifolius	bitter dock
Sabatia	angularis	rose pink
Sagittaria	sp.	arrowhead
Salix	caroliniana	Carolina willow
Salvia	azurea v. grandiflora	blue sage
Sambucus	canadensis v.	common elderberry
Samolus	parviflorus	water pimpernel
Sanguinaria	canadensis	bloodroot
Sanicula	canadensis v.	black snakeroot
Sanicula	odorata	black snakeroot
Saponaria	officinalis	bouncing bet
Sassafras	albidum	sassafras
Saxifraga	pensylvanica v. forbesii	swamp saxifrage
Saxifraga	virginiensis f. virginiensis	early saxifrage
Schizachyrium	scoparium v. scoparium	little bluestem
Scirpus	atrovirens	common bulrush
Scirpus	pendulus	reddish bulrush
Scirpus	sp.	bulrush
Scleria	triglomerata	tall nut grass
Scrophularia	marilandica	figwort
Scutellaria	incana	hoary skullcap
Scutellaria	lateriflora f.	mad-dog skullcap
Scutellaria leonardii		Leonard's skullcap
Scutellaria	ovata	heart-leaved skullcap
Scutellaria	parvula	small skullcap
Selaginella	rupestris	rock spikemoss
Senna	marilandica	wild senna
Sida	spinosa	prickly sida
Sideroxylon	lanuginosa ssp. oblongifolia	gum bumelia
Silene	antirrhina	sleepy catchfly
Silene	stellata	starry campion
Silphium	integrifolium	rosinweed
Silphium	perfoliatum	cup plant
Silphium	terebinthinaceum	prairie dock
Sisyrinchium	angustifolium	pointed blue-eyed grass
Sisyrinchium	campestre	blue-eyed grass
Smilax	hispida	bristly greenbrier
Solanum	carolinense v. carolinense	horse nettle

Solidago	altissima	tall goldenrod	
Solidago	flexicaulis	broadleaf goldenrod	
Solidago	gigantea	late goldenrod	
Solidago	hispida v. hispida	goldenrod	
Solidago	nemoralis v. longipetiolata	Gray goldenrod	
Solidago	petiolaris v.	goldenrod	
Solidago	ulmifolia	elm-leaved goldenrod	
Sorghastrum	nutans	Indian grass	
Sorghum halpense		Johnson grass	
Sphenopholis	obtusa v. obtusa	prairie wedgescale	
Spiranthes	cernua	nodding ladies' tresses	
Spiranthes	tuberosa	little ladies' tresses	
Sporobolus	clandestinus	sneaky dropseed	
Sporobolus	neglectus	poverty grass	
Stachys	pilosa v. arenicola	marsh betony	
Stachys	tenuifolia	hedge nettle	
Stellaria	media v. media	common chickweed	
Strophostyles	helvula	wild bean	
Stylosanthes	biflora	pencil flower	
Sullivantia	sullivantii	sullivantia	S2
Symphoricarpos	orbiculatus	coral berry	
Symphyotrichum	anomalum	many rayed aster	
Symphyotrichum	anomalus f. anomalus	many rayed aster	
Symphyotrichum	cordifolium	blue wood aster	
Symphyotrichum	drummondii ssp. drummondii	drummond aster	
Symphyotrichum	laeve	smooth aster	
Symphyotrichum	lateriflorum	white woodland aster	
Symphyotrichum	oblongifolium	aromatic aster	
Symphyotrichum	oolentangiense	azure aster	
Symphyotrichum	patens	spreading aster	
Symphyotrichum	pilosum	white heath aster	
Symphyotrichum	praealtum	willow-leaved aster	
Symphyotrichum	urophyllum	aster	
Taenidia	integerrima	yellow pimpernel	
Talinum	calycinum	fame flower	
Taraxacum	officinale	common dandelion	
Tephrosia	virginiana	goat's rue, hoary pea	
Teucrium	canadense	wood sage	
Thalictrum	revolutum	meadow rue	
Thaspium	trifoliatum	meadow parsnip	
Tilia	americana	basswood	
Toxicodendron	radicans	poison ivy	
Tradescantia	ohiensis	smooth spiderwort	
Tradescantia subaspera		Broad-leaved spiderwort	
Tradescantia	virginiana	Virginia spiderwort	
Trichostema	brachiatum	false pennyroyal	
Trichostema	dichotomum	blue curls	
Tridens	flavus	purpletop	
Trifolium dubium		Small hop clover	
Trillium	recurvatum	purple wake robin	
Trillium	sp.	trillium	
Trillium	viride	green trillium	
Triodanis	biflora	Venus' looking glass	
Triodanis	perfoliata	Venus' looking glass	
Triosteum	angustifolium	yellow-flwrd horse gentian	
Triosteum	perfoliatum	common horse gentian	
Typha	angustifolia	narrow-leaved cattail	
Ulmus	americana	American elm	
Ulmus	rubra	slippery elm	
Uvularia	grandiflora	large bellwort	
Vaccinium	pallidum	lowbush blueberry	
Valerianella	radiata	sweet sixteen	

Verbascum	blattaria f. blattaria	moth mullein
Verbena	urticifolia	white vervain
Verbesina	alternifolia	yellow ironweed
Verbesina	helianthoides	yellow crownbeard
Vernonia	baldwini	ironweed
Vernonia	gigantea ssp. gigantea	ironweed
Vernonia	missurica	ironweed
Veronica	serpyllifolia	
Veronica	polita	wayside speedwell
Veronicastrum	virginicum	culver's root
Viburnum	rufidulum	southern black haw
Vinca	minor	common periwinkle
Viola	bicolor	Johnny-jump-up
Viola	palmata	cleft violet
Viola	pedata	bird's foot violet
Viola	sororia v. sororia	common violet
Viola	striata f. striata	pale violet
Viola	tricolor	miniature pansy
Vitis	aestivalis	summer grape
Vitis	cinerea	grayback grape
Vulpia	octoflora	sixweeks fescue
Woodsia	obtusa	ncommon woodsia
Xanthium	strumarium v.	common cocklebur
Zanthoxylum	americanum f. americanum	common prickly ash
Zizia	aurea	golden Alexanders
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Conservation Concern Plants

Triosteum	angustifolium	Yellow-flowered horse gentian	
Sullivantia	sullivantii	sullivantia	S2
Lycopodium	dendroideum	round-branched ground pine	S1
Huperzia	porophila	rock clubmoss	S2
Dennstaedtia	punctilobula	hay-scented fern	S2
Cystopteris	tenuis	Mackay's brittle fern	S1
Cyperus	refractus	Teasel nutsedge	
Clematis	fremontii	Fremont’s leather flower	
Carex	laxiculmis	spreading sedge	S2
Carex	texenis	A sedge	
Bromus	latiglumis	hairy woodbrome	S3

Conservation Concern Bryophtes

Aneura	maxima	a thalloid liverwort
Aneura	pinquis	a thalloid liverwort
Bruchia	flexuosa	Pygmy moss
Dicranum	polysetum	Wavy broom moss
Ephemerum	Crassinervum var. crassinervum	An ephemeral moss
Hypnum	iponens	Hypnum moss
Mnium	thompsonii	Small-cell woodsy moss
Plagiomnium	ellipticum	Elliptic woodsy moss
Polytrichum	poliferum	a haircap moss
Preissia	quadrata	Thalloid liverwort
Pseudotaxiphyllum	distichaceum	a moss
Sphagnum	compactum	a sphagnum moss
Sphagnum	fallax	a sphagnum moss
Sphagnum	magellanicum	Magellan’s peat moss
Sphagnum	subtile	Northern peat moss

Appendix 4. Reptiles and Amphibians of the LaBarque Creek Watershed, 2007.

Blanchard's cricket frog	*Acris creptians blanchardi*
Eastern American toad	*Bufo americanus*
Gray treefrog	*Hyla chrysoscelis – H. versicolor*
Green frog	*Rana clamitans melanota*
Pickerel frog	*Rana palustris*
Southern leopard frog	*Rana sphenocephala*
Spring peeper	*Pseudacris c. crucifer*
Western chorus frog	*Pseudacris t. triseriata*
Central newt	*Notophthalmus viridescens louisianensis*
Four-toed salamander	*Hemidactylium scutatum*
Long-tailed salamander	*Eurycea longicauda*
Marbled salamander	*Ambystoma opacum*
Ringed salamander	*Ambystoma annulatum*
Southern red-backed salamander	*Plethodon serratus*
Spotted salamander	*Ambystoma maculatum*
Small-mouthed salamander	*Ambystoma texanum*
Western slimy salamander	*Plethodon albagula*
Broadhead skink	*Eumeces laticeps*
Five-lined skink	*Eumeces fasciatus*
Ground skink	*Scincella lateralis*
Northern fence lizard	*Sceloporus undulates hyacinthinus*
Western slender glass lizard	*Ophisaurus a. attenuatus*
Common snapping turtle	*Chelydra s. serpentina*
Three-toed box turtle	*Terrapene carolina triunguis*
Red-eared slider	*Trachemys scripta elegans*
Black rat snake	*Pantherophis o. obsolete*
Eastern garter snake	*Thamnophis s. sirtalis*
Eastern hog-nosed snake	*Heterodon platirhinos*
Eastern yellow-bellied racer	*Coluber constrictor flaviventris*
Midland brown snake	*Storeria d. wrightorum*
Northern red-bellied snake	*Storeria o. occipitomaculata*
Northern watersnake	*Nerodia s. sipedon*
Osage copperhead	*Agkistrodon contortrix phaeogaster*
Prairie kingsnake	*Lampropleltis calligaster*
Prairie ring-necked snake	*Diadophis punctatus*
Rough green snake	*Opheodrys aestivus*
Timber rattlesnake	*Crotalus horridus*
Western worm snake	*Carphophis vermis*

Appendix 5. Breeding Birds of LaBarque Creek Conservation Area, 2006.

Green Heron
Cooper's Hawk
Red-shouldered Hawk
Broad-winged Hawk
Wild Turkey
Mourning Dove
Yellow-billed Cuckoo
Great Horned Owl
Barred Owl
Common nighthawk
Chuck-will's-widow
Whip-poor-will
Chimney Swift
Ruby-throated Hummingbird
Belted Kingfisher
Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
Pileated Woodpecker
Eastern Wood-Pewee
Acadian Flycatcher
Eastern Phoebe
Great Crested Flycatcher
Eastern Kingbird
Barn Swallow
Blue Jay
American Crow
Carolina Chickadee/Black-Capped Chickadee
Tufted Titmouse
White-breasted nuthatch
Carolina Wren
House Wren
Blue-gray Gnatcatcher
Eastern Bluebird
Wood Thrush
American Robin
Cedar Waxwing
European Starling
White-eyed Vireo
Yellow-throated Vireo
Warbling Vireo
Red-eyed Vireo
Northern Parula
Black-and-white Warbler
American Redstart
Worm-eating Warbler
Ovenbird
Louisiana Water Thrush
Kentucky Warbler
Common Yellowthroat
Summer Tanager
Scarlet Tanager
Northern Cardinal
Rose-breasted Grosbeak
Indigo Bunting
Eastern Towhee
Chipping Sparrow
Song Sparrow
Red-winged Blackbird
Common Grackle
Brown-headed Cowbird
Baltimore Oriole
American Goldfinch

Appendix 6. Partial list of mammals observed in LaBarque Creek Watershed, 2005.

Eastern chipmunk	Tamias striatus
Raccoon	Procyon lotor
Opossum	Didelphis marsupualis
Coyote	Canis latrans
Gray fox	Urocyon cinereoargenteus
Red fox	Vulpes vulpes
Mink	Mustela vison
Striped skunk	Mephitis mephitis
Gray squirrel	Sciurus carolinensis
Fox squirrel	Sciurus niger
White-tailed deer	Odocoileus virginianus
White-footed mouse	Peromysvus maniculatus
Cottontail rabbit	Sylvilagus floridanus
Short-tailed shrew	Blarina brevicauda
Least shrew	Cryptotis parva
Little brown bat	Myotis lucifugus
Big brown bat	Eptesicus fescus
Woodchuck	Marmota monax
Beaver	Castor canadensis
Black bear	Ursus americanus

Appendix 7. Fish species found in LaBarque Creek, Jefferson County, 2001 - 2005.

banded sculpin*	(*Cottus carolinae*)
black bullhead**	(*Ameiurus melas*)
black redhorse *	(*Moxostoma duquesnei*)
blackspotted topminnow*	(*Fundulus olivaceus*)
blackstriped topminnow**	(*Fundulus notatus*)
bleeding shiner*	(*Luxilus zonatus*)
bigeye shiner*	(*Notropis boops*)
bluegill**	(*Lepomis macrochirus*)
bluntnose minnow**	(*Pimephales notatus*)
brook silversides*	(*Labidesthes sicculus*)
central stoneroller*	(*Campostoma pullum*)
common carp**	(*Cyprinus carpio*)
creek chub*	(*Semotilus atromaculatus*)
fantail darter*	(*Etheostoma flabellare*)
fathead minnow**	(*Pimephales promelas*)
golden redhorse*	(*Moxostoma erythrurum*)
golden shiner**	(*Notemigonus crysoleucas*)
green sunfish**	(*Lepomis cyanellus*)
greenside darter*	(*Etheostoma blennioides*)
hornyhead chub*	(*Nocomis biguttatus*)
hybrid sunfish**	(*Lepomis spp.*)
johnny darter*	(*Etheostoma nigrum*)
largemouth bass**	(*Micropterus salmoides*)
longear sunfish*	(*Lepomis megalotis*)
western mosquitofish****	(*Gambusia affinis*)
mottled sculpin*	(*Cottus bairdi*)
northern studfish*	(*Fundulus catenatus*)
northern hogsucker*	(*Hypentelium nigricans*)
orangethroated darter*	(*Etheostoma spectabile*)
Ozark minnow*	(*Notropis nubilus*)
rainbow darter *	(*Etheostoma caeruleum*)
red shiner***	(*Cyprinella lutrensis*)
redfin shiner**	(*Lythrurus umbratilis*)
rock bass*	(*Ambloplites ruprestris*)
silverjaw minnow*	(*Notropis buccatus*)
slender madtom*	(*Noturus exilis*)
smallmouth bass*	(*Micropterus dolomieu*)
southern redbelly dace*	(*Phoxinus erythrogaster*)
spotted bass*	(*Micropterus punctulatus*)
spotted sucker****	(*Minytrema melanops*)
striped shiner*	(*Luxilus chrysocephalus*)
warmouth****	(*Lepomis gulosus*)
white sucker*	(*Catostomus commersoni*)
yellow bullhead**	(*Ameiurus natalis*

Total number of species = 44

* = Ozark species
** = widely-distributed species
*** = Prairie species
**** = Lowland species

Appendix 8. Aquatic macroinvertebrates found in LaBarque Creek, Jefferson County, 2007-08.

LaBarque Creek Macroinvertebrate Taxa List

(Includes Fall 2007 and Spring 2008 Specimens)

Ephemeroptera (Mayflies):
Baetidae
Caenis latipennis
Stenonema femoratum

Plecoptera (Stoneflies):
Amphinemura
Chloroperlidae
Clioperla
Isoperla

Trichoptera (Caddisflies):
Brachycentrus
Cernotina
Cheumatopsyche
Nectopsyche
Neotrichia
Oxyethira
Polycentropodidae
Polycentropus
Rhyacophila

Diptera (True Flies):

Chironomidae (Midges)
Ablabesmyia
Cardiocladius
Chaetocladius
Chironomini
Chironomus
Cladopelma
Cladotanytarsus
Clinotanypus
Cricotopus
Cryptochironomus
Cryptotendipes
Dicrotendipes
Djalmabatista
Einfeldia
Eukiefferiella
Geothocladius
Geoldichironomus
Glyptotendipes
Hydrobaenus

Chironomidae continued
Kiefferulus
Labrundinia
Limnophyes
Micropsectra
Monodiamesa
Nanocladius
Natarsia
Orthocladius
Parametriocnenmus
Paraphaenocladius
Paratanytarsus
Paratendipes
Phaenospectra
Polypedilum
Procladius
Pseudochironomus
Pseudorthocladius
Rheocricotopus
Rheotanytarsus
Smittia
Stempellinella
Stictochironomus
Subletta
Sympotthastia
Tanytarsus
Tanypus
Thienemanniella
Thienemannimyia
Tvetenia
Zavrelimyia

Ceratopogonidae (Biting Midges)
Atrichopogon
Culicoides
Dasyhelea
Mallochohelea
Probezzia
Serromyia

Culicidae (Mosquitoes)
Anopheles

Empididae (Balloon Flies)
Chelifera
Clinocera

Simuliidae (Black Flies)
Simulium

Stratiomyidae (Soldier Flies)

Tabanidae (Horseflies)
Chrysops

Tipulidae (Crane Flies)
Eriopterini
Gonomyia
Hexatoma
Ormosia
Tipula

Odonata (Dragonflies and Damselflies):
Aeshna
Argia
Boyeria
Enallagma
Epiaeschna
Lestes
Neurocordulia
Progomphus
Somatochlora
Tramea

Coleoptera (Beetles):
Agabus
Ancyronyx
Berosus
Cyphon
Dubiraphia
Ectopria
Georyssus
Haliplus
Helichus
Hydrochara
Hydroporus
Lampyridae
Limnebius

Coleoptera Continued:

Macronychus
Neoelmis
Neoporus
Optioservus
Ordobrevia
Peltodytes
Psephenus
Rhantus
Staphylinidae
Stenelmis

Hemiptera (True Bugs):

Limnoporus
Salda
Trepobates

Lepidoptera (Butterflies and Moths):

Pyralidae

Megaloptera (Alderflies, Fishflies and Dobsonflies):

Nigronia

Decapoda (Crayfish, etc.):

Orconectes

Mollusca (Mollusks):

Corbicula
Unionidae

Amphipoda (Amphipods):

Crangonyctidae
Crangonyx
Gammarus fasciatus
Hyalella azteca

Isopoda (Sow Bugs):

Asellidae
Caecidotea

Gastropoda (Snails, etc.):

Ferrissia
Gyraulus
Lymnaea
Physella

Oligochaeta (Earthworms, etc.):

Lumbricina
Lumbriculidae
Enchytraeidae
Tubificidae

Acari (Mites):

Hydrachnida

Other:

Entomobryidae