Source: SD1

Taylor Creek
Watershed Characterization Report

Prepared for: Sanitation District No. 1 of Northern Kentucky

January 2009

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Ann Arbor, Michigan
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1. WATERSHED SUMMARY

Watershed characterization reports are being developed for sixteen watersheds located in Northern Kentucky that lie within Sanitation District No.1's (SD1) service area. The purpose of the watershed characterization reports is to describe the physical and natural features, land cover, infrastructure, waterbody conditions, potential pollutant sources and other features in each watershed. This information will allow SD1 and other interested parties to develop an understanding of important features, pollutant sources and water quality in the watersheds. This information will also assist SD1 and others in goal-setting, prioritization of improvement projects, and the assessment of the effectiveness of these projects. The watershed characterization reports meet the system characterization element for the receiving water that is required for a combined sewer overflow (CSO) Long-Term Control Plan (LTCP). Additionally, the Consent Decree requires that the Watershed Plans include elements of a LTCP.

The Taylor Creek watershed is 4.2 square miles in size and is located entirely in Campbell County, in the East Basin (Figure 1). This creek originates near Fort Thomas and flows northward into the Ohio River at Bellevue, Kentucky. The watershed is highly developed and flooding has been an issue in this area.

The Kentucky Division of Water (KDOW) has designated this creek and its tributaries for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, at applicable points of withdrawal. Recent data suggests elevated bacteria, as well as pH, dissolved oxygen, metals and unionized ammonia violations. Aquatic habitat has been rated as not supporting and biological assessments reflect fair to very poor conditions.

Potential pollutant sources in this watershed include CSOs, sanitary sewer overflows (SSOs), storm water runoff and KPDES-permitted dischargers. The potential for these sources to generate fecal coliform bacteria has been assessed using a Watershed Assessment Tool (WAT!)[1]. The WAT! identifies the potential sources within a watershed and estimates their possible impact. It also allows SD1 to compare and rank the sixteen different Northern Kentucky watersheds.

The WAT! calculated a very high fecal coliform loading potential for year-round conditions and a very low fecal coliform loading potential for base flow conditions. Overland storm water runoff is predicted to be the dominant source under year-round conditions.

The WAT! ranking is one of several factors that should be considered when prioritizing watersheds for improvement projects. Other factors include high public interest due to past flooding problems, the absence of any water supply intakes, and the absence of any aquatic-dependent threatened or endangered species in the watershed.

No additional data collection, beyond that already planned is recommended to characterize current conditions in the watershed, though future biological and habitat

[1] The WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

assessments would be useful to assess improvements as projects are implemented. Additionally, investigation of dry weather bacteria sources may be beneficial.

SD1 is developing an EPA SWMM5 model to evaluate runoff and instream water quality in the Taylor Creek watershed. Because improvement projects are planned to reduce collection system overflows, next steps might include the application of the Taylor Creek model and the WAT!, to better understand the appropriate level of control for the watershed.

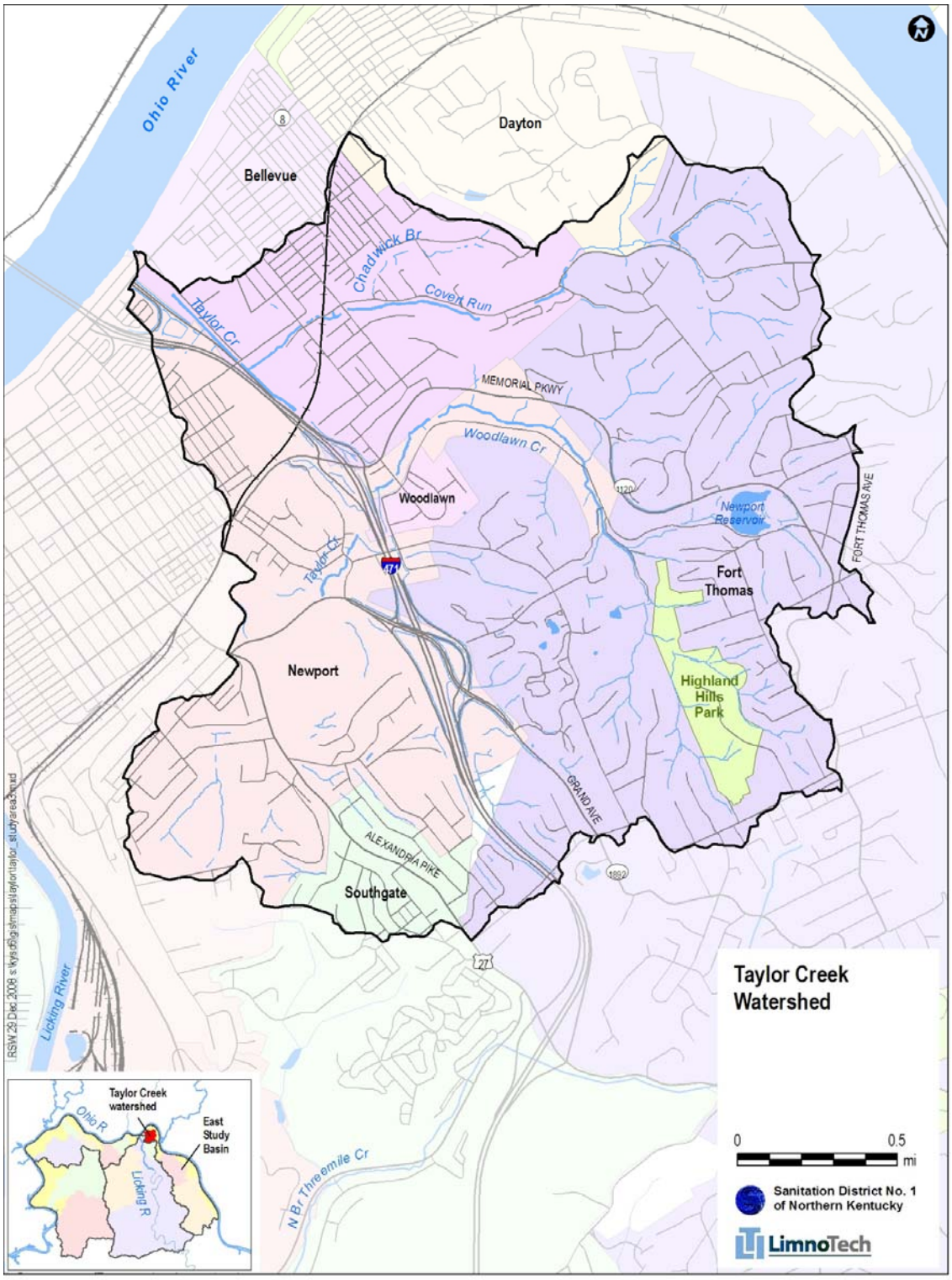

Figure 1. Taylor Creek Watershed

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2. WATERSHED FEATURES

Taylor Creek is located entirely in Campbell County in the East Basin. The watershed for this creek is 4.2 square miles in size. The creek is 2.6 miles long, with two major tributaries named Woodlawn Creek and Covert Run.

2.1 PHYSICAL AND NATURAL FEATURES

The following sections describe key features of the watershed and creek, including hydrology, geology, topography, soils, climate, and habitat. These features are important because they affect land uses, and shape the chemical, biological, and hydrological characteristics of Taylor Creek.

2.1.1 Hydrology

Taylor Creek flows through a well-developed watershed drained by a storm water collection and conveyance system consisting of a mix of open channel sections, culverts and piped networks (XCG Consultants, Inc. 2006). The Newport Reservoir at the headwater of Woodlawn Creek in Fort Thomas provides storage for water pumped from the Ohio River by the Northern Kentucky Water District and is used for drinking water.

There is one USGS continuous monitoring station in the watershed (03238140), Taylor Creek at Donnermeyer Drive at Bellevue, KY. This station has a drainage area of 4.1 square miles[2] and began operation in fall 2007. During a site visit in January 2007, the water at RM 0.6 was shallow and pooled, brown in color, with a gravel substrate. Just upstream, water was flowing and shallow, with some pools. Signs of erosion and channel modification were evident, and there was a sheen on the water surface.

Taylor Creek is fed by two tributaries, Covert Run and Woodlawn Creek. During the January 2007 site visit, flow in Covert Run just upstream of the confluence (RM 0.1) was low, and water was very shallow (about 4 inches) over a cobble substrate. There were signs of erosion and channel modification. Woodlawn Creek is a larger tributary that flows into Taylor Creek upstream of Covert Run. During the January 2007 site visit, Woodlawn Creek was shallow (less than 4 inches) at RM 1.3, and flowing over a cobble substrate. This tributary is deeper at the confluence (about 9 inches), brown in color, with signs of erosion.

Flooding is a problem in the Taylor Creek watershed, particularly in the lower third of the watershed in the City of Bellevue (XCG Consultants, Inc., 2006). Both the Covert Run and Woodlawn Creek tributaries to Taylor Creek have a history of flooding (XCG Consultants, Inc., 2006). Basement flooding of residences along Covert Run Road continues to be a problem (Kentucky Post, 2006, 2007, 2007a; Wartman, 2008). Causes of flooding include local drainage constraints, increased impervious area, alterations to the creek alignment and crossings, natural topography, stream conditions, debris build-up, and Ohio River stage (XCG Consultants, Inc., 2006).

[2] This drainage area was calculated using a detailed watershed delineation developed for this project; the reported drainage area differs slightly from that reported by the USGS.

As part of a master planning study released in 2006, an XP-SWMM model was developed to evaluate flooding issues. Previously, the US Army Corps of Engineers had developed the HEC-2 model that extends approximately 8,000 feet upstream from the confluence with the Ohio River. This model corresponded to pre-1980 conditions, and predated some major construction projects such as Interstate 471 (XCG Consultants, Inc., 2006).

2.1.2 Geology

The Taylor Creek watershed is located in the Outer Bluegrass Physiographic[3] Region, which is underlain primarily by Ordovician-age interbedded limestone and shale (Ray et. al., 1994). Although roughly half of this watershed is underlain by bedrock with a moderate potential for karst development (Paylor and Currens, 2002), rocks in this region generally contain higher percentages of shale layers and do not develop extensive karst features (Ray et al., 1994)[4].

The headwaters of Taylor Creek originate in the rolling hills of the Grant Lake Limestone/Fairview formation. This creek also traverses the erodible shale of the Kope formation, and then unconsolidated alluvial sediments near the shore of the Ohio River.

Groundwater is generally unavailable on hilltops and hillsides, but wells in the valley can yield 100-500 gallons per day. The groundwater is typically hard and may contain salt and hydrogen sulfide. Near the Ohio River, iron content may also be high (Carey and Stickney, 2005).

2.1.3 Topography

Rolling hills and tight valleys characterize the Taylor Creek watershed. The highest elevations are in the southeast corner of the watershed, near the intersection of Fort Thomas Avenue and Highland Avenue in the City of Fort Thomas (861 feet above sea level). The lowest elevation in the watershed (453.6 feet at normal Ohio River pool) occurs at the confluence with the Ohio River.

2.1.4 Soils

The nature of soils plays an important role in both the amount of runoff generated and the amount of soil erosion that can occur. Most (83%) of the soils in the Taylor Creek watershed are classified as hydrologic soil group C (NRCS, 2006), meaning they have slow infiltration rates when thoroughly wetted. Streams in watersheds having soils with slow infiltration rates may respond quickly to rain events and be prone to flooding.

Most (87%) of the soils in the watershed are ranked "fairly erodible", and the remaining soils are ranked "highly erodible" as indicated by an index for erodibility (NRCS, 2006). The erodibility of soils is important when soils are disturbed through activities such as land clearing for new development.

[3] Physiographic regions are based on differences in geology, topography and hydrologic regime. The State of Kentucky is divided into five physiographic regions.

[4] In areas with karst, an almost immediate connection between groundwater and surface water can exist, short-circuiting any attenuation of pollutant loads that might otherwise occur.

2.1.5 Climate

The temperatures in this area are generally lowest in January and highest in July. Precipitation averages 41.2 inches annually, with the wettest months observed between March and July. Minimum precipitation is recorded in the fall and late winter as shown in Figure 2 (NCDC, 2008).

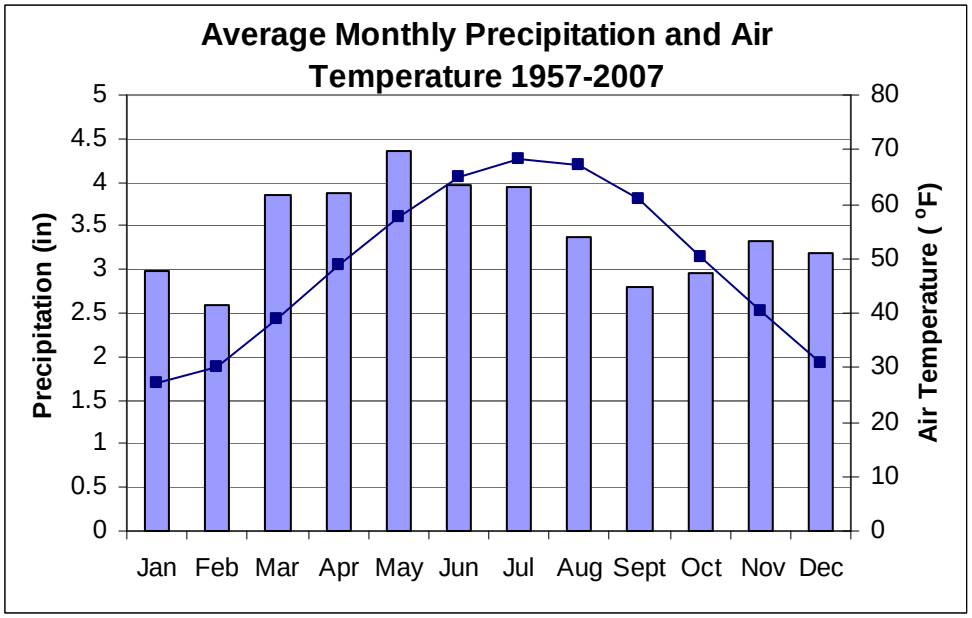

Figure 2. Average Monthly Precipitation and Air Temperature at the Cincinnati Northern Kentucky Airport (1957-2007)

2.1.6 Habitat

The Taylor Creek watershed lies within the Outer Bluegrass ecoregion[5], which is characterized as having sinkholes, springs, entrenched rivers and intermittent and perennial streams (Woods et al., 2002). Wetlands are not common in this ecoregion and are almost absent from this watershed. Streams generally have relatively high levels of suspended sediment and nutrients. Glacial outwash, which tends to be highly erodible, exists in a few areas within the Outer Bluegrass ecoregion.

Pre-settlement conditions in this watershed consisted of open woodlands with barren openings, and vegetation was mostly oak-hickory, with some white oak, maple-oak-ash and American beech-sugar maple forests (Woods et al., 2002). As described in Section 2.2.1, natural habitats have been altered from pre-settlement conditions. Urban and suburban areas dominate this watershed, but there are some small open areas and woodlands in the watershed (See Section 2.2). In most places, the streams in the Taylor Creek watershed are generally low-gradient, less than 1.5 feet deep and have gravel or

[5] Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Woods et al., 2002).

cobble substrate (Figure 3). However, in some areas of the watershed, streams also have limestone bedrock substrate (Figure 4). Throughout the watershed, streams have been channelized and generally have small sparse and narrow (0 to 30 feet) riparian zones[6] containing mostly hardwood trees (Figure 3 and Figure 4). Aquatic habitats in the Taylor Creek watershed are limited by the impacts of urbanization in the watershed. Evidence of sedimentation and eutrophication, channel straightening and reduced habitat heterogeneity is observed throughout the watershed (Figures 3 and 4).

Figure 3. Taylor Creek upstream from RM 0.7

[6] Riparian zones are important to aquatic systems for several reasons: they provide wood for aquatic habitat recruitment potential, they provide organic matter for instream invertebrates that support invertebrate food resources for fish, they filter sediment and toxics from entering the stream and they shade the water, maintaining ambient water temperatures.

Figure 4. Woodlawn Creek at Waterworks Road

SD1 has assessed instream habitat at three location(s) in this watershed[7] and all locations were assessed as not supporting, indicating aquatic habitat can not support a diverse and productive ecosystem.

Table 1. Aquatic Habitat and Biological Sampling

Stream	River Mile	Monitoring			
		Habitat		Macroinvertebrates	Fish
		Year	Ranking	Ranking	Ranking
Covert Run	0.2	2007	Not Supporting	Very Poor	Fair
Taylor Creek	0.6	2007	Not Supporting	Poor	Fair
Woodlawn Creek	1.3	2007	Not Supporting	Poor	Very Poor[a]

[a] No fish were collected during the fish survey of Woodlawn Creek. This is likely due to a large barrier (concrete bridge abutment and sewer crossing) at the lower end of the sampling zone.

[7] This assessment was conducted using EPA-established protocols, and rated several components of physical habitat within the stream such as epifaunal substrate, embeddedness, sediment deposition, channel flow status, bank stability and riparian vegetation zone width, among others.

2.2 LAND COVER CHARACTERISTICS

Land cover and land use play an important role in the quantity and quality of runoff into receiving waters. Current and future land cover in the Taylor Creek watershed are described below.

2.2.1 Current Land Cover

The Kentucky Division of Geographic Information, Commonwealth Office of Technology provided a GIS dataset showing 2005 Kentucky land cover. This dataset was updated and improved to approximate 2007 land cover conditions (Figure 5) using a variety of other datasets that represent current impervious conditions (roads, parking lots, buildings), open space lands (including parks), and surface waters.

This watershed is highly developed (75%) and portions of six communities are located within the watershed. These are Bellevue, Dayton, Fort Thomas, Newport, Southgate, and Woodlawn. Roughly 23% of the watershed is impervious. Undeveloped land is primarily forest. Parks in this watershed include Highland Hills Park, as well as other neighborhood parks and ballfields.

2.2.1.a Animal operations

There are no permitted concentrated animal feeding operations (CAFOs) or animal feeding operations (AFOs) in the watershed (Kentucky Geographic Network, 2008, 2008a).

2.2.1.b Septic Systems

The entire Taylor Creek watershed is serviced by sanitary sewers and there are no known areas of septic systems.

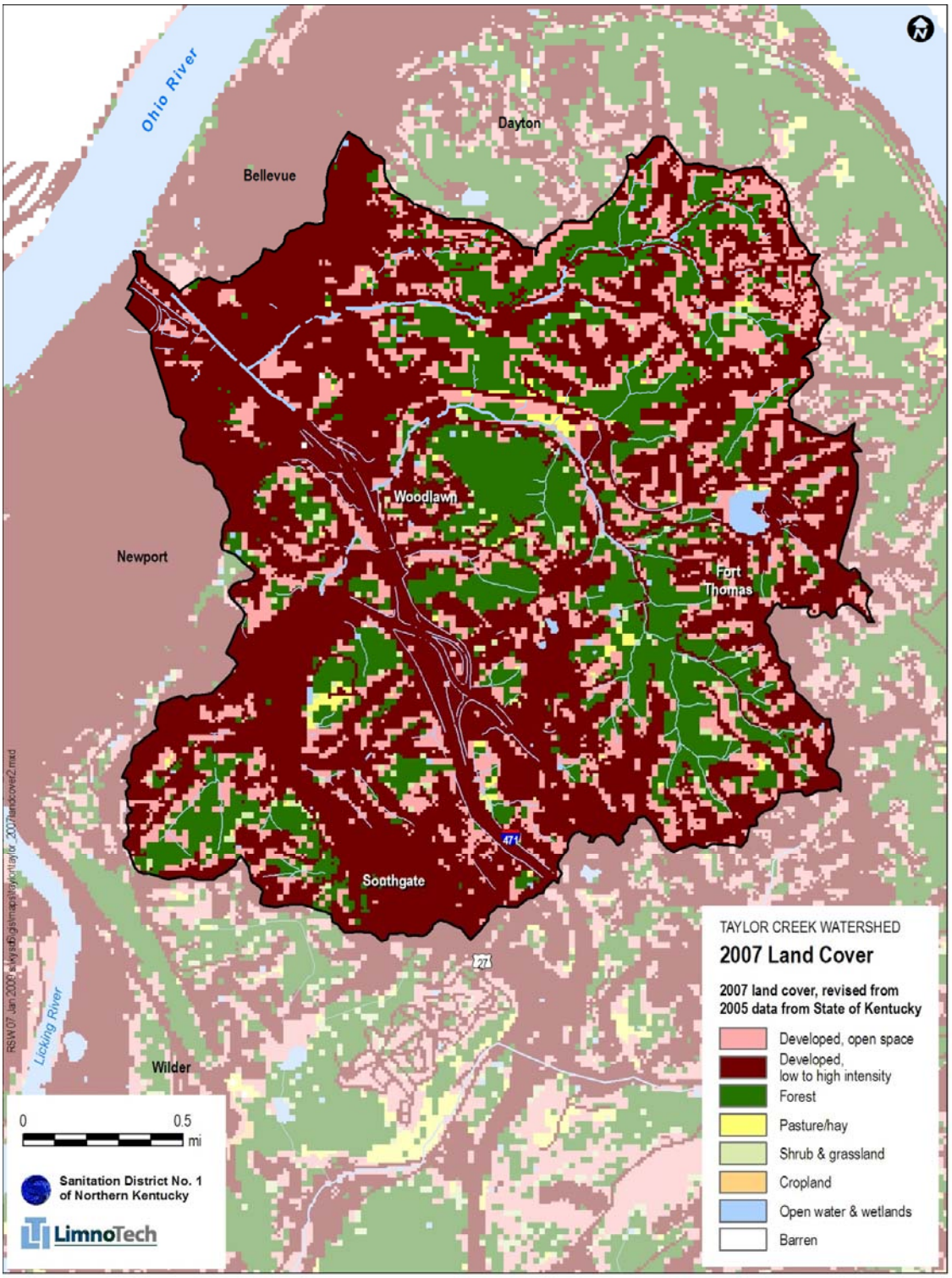

Figure 5. 2007 Land Cover

2.2.2 Future Conditions

The Taylor Creek watershed is highly developed, and development of forest and pasture land is expected to continue in the near future. One highway construction project, a widening of Riviera Drive to mitigate congestion, was in the six-year highway plan (Kentucky Transportation Cabinet, 2006).

2.2.2.a Future land cover

Future land cover was developed by modifying 2007 land cover to reflect potential future conditions (roughly 2030) obtained from SD1 and the Northern Kentucky Area Planning Commission (NKAPC).

In the future, developed lands will comprise most of the watershed (82%) and an estimated 25% of the watershed will be covered with impervious surfaces (Figure 6).

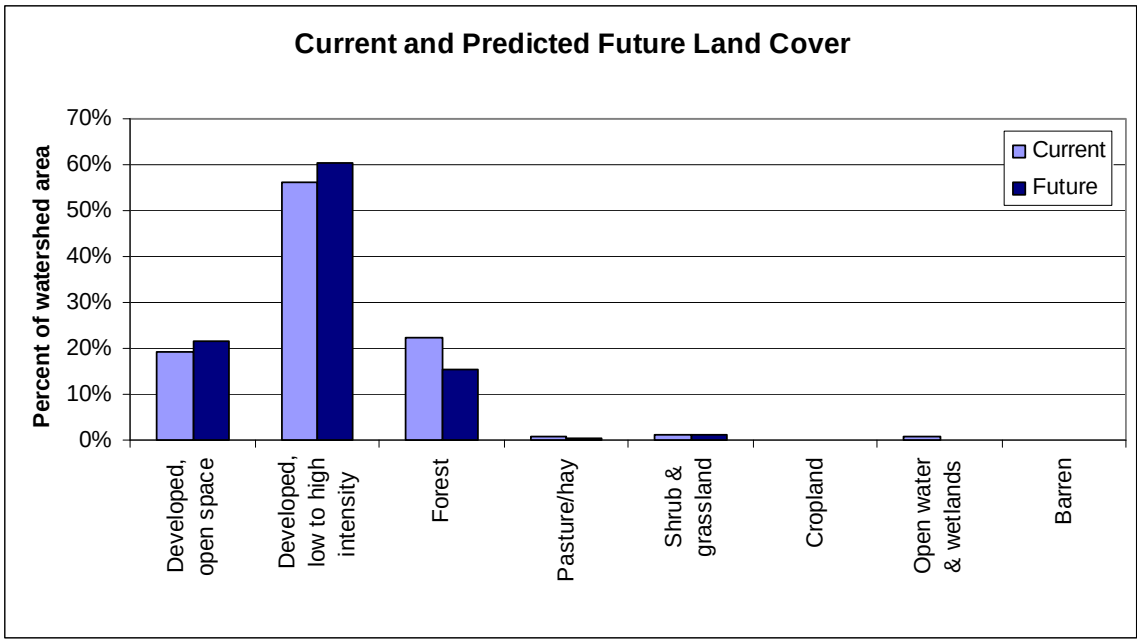

Figure 6. Current and Predicted Future Land Cover

2.3 INFRASTRUCTURE FEATURES

This section summarizes infrastructure features for the Taylor Creek watershed[8].

Approximately 81% of this watershed is located within SD1's sanitary sewer service area. This area contains approximately 55.1 miles of separate sanitary sewer lines.

Approximately 19% of this watershed is in SD1's combined sewer area. This area contains approximately 15.1 miles of combined sanitary sewer lines.

The Taylor Creek watershed lies entirely within SD1's storm water service area. The separate storm water system is comprised of approximately 31.1 miles of streams and channels and 35.9 miles of pipes.

The extent of the sanitary sewer, combined sewer and storm water service area in this watershed is shown in Figure 7.

[8] SD1 is undertaking a characterization and assessment of the sewer system, and overflows identified herein are subject to change. Information on the sanitary and storm water system in Section 2.3 was queried from SD1's geodatabase accessed on November 21, 2008.

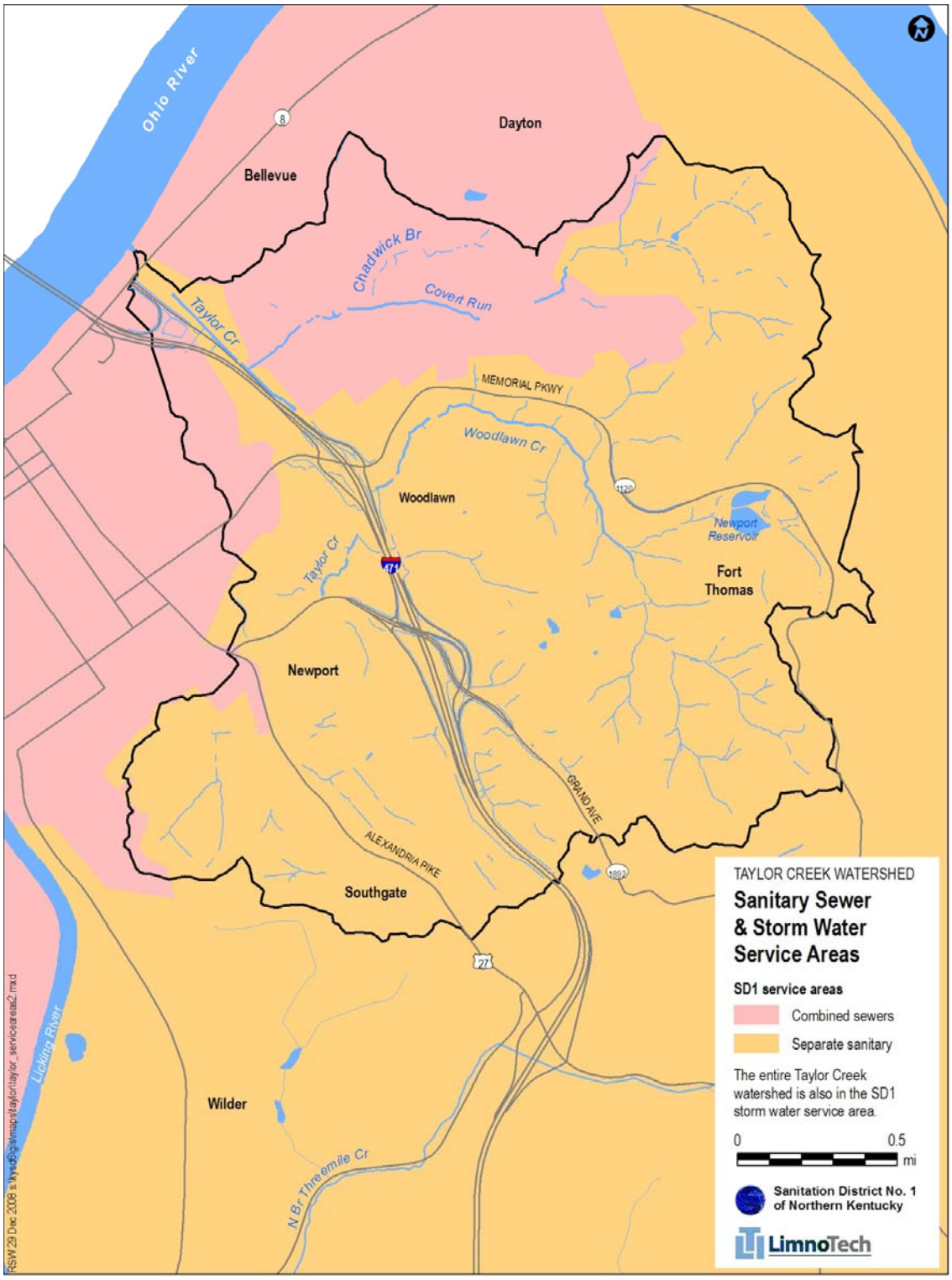

Figure 7. Sanitary Sewer, Combined Sewer and Storm Water Service Areas

2.3.1 Point Sources and Infrastructure

The occurrence of KPDES-permitted discharges, sewer overflows and storm water discharges are discussed below.

2.3.1.a KPDES dischargers

There are two KPDES-permitted dischargers in the Taylor Creek watershed (Table 2). A review of recent effluent monitoring data (January 2007 to June 2008) revealed monitoring data are not available for one permittee and the other has not violated its permit limits.

Permitted CSOs are not included in this tally and are discussed separately.

Table 2. Permitted Dischargers in the Taylor Creek Watershed

Receiving Water	KPDES ID	Facility Name	Outfall	Permit Type	Outfall Description	Permit Violations
Taylor Creek	KY0105252	Newport Branch Library	0011	Minor	Noncontact cooling water	None
Woodlawn Creek	KYG640002	Newport WTP	0011	Minor	Filter backwash water	NA

NA = no data available

2.3.1.b Sewer overflows

There are nine combined sewer overflows (CSOs) within this watershed (Table 3). One is permitted (0650100) and eight more are "to be permitted".

Table 3. Combined Sewer Overflow Points

Manhole ID	Common Name	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a]	Typical Year Volume (MG)[a]
0540009[b]	Berry	Covert Run	32	1.35
0540044[b]	Lafayette	Covert Run	33	2.27
0650008[b]		No	0	0.00
0650098[b]	Wildcat Run	Taylor Creek	16	4.41
0550134[b]		Covert Run	4	0.09
0650054[b]	Glazier (0630039)	Taylor Creek	0	0
0650100	Geiger Ave (0650041)	Taylor Creek	4	0.14
0690059[b]	Diversion (0690008)	No	4	0.12
0660085[b]	Diversion (0660057)	Ohio River Tributary	0	0

[a] The results presented were generated by models based on SD1's current understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual measured field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] This is a "to be permitted" CSO, i.e., SD1 has (or will) identified this location for KPDES permitting.

There are seven sanitary sewer overflows (SSOs) in the Taylor Creek watershed (Table 4), and these are located predominately in Newport and Fort Thomas (along Woodlawn Creek).

Table 4. Sanitary Sewer Overflow Points

Manhole ID	Direct Discharge to Waterbody	Typical Year Spill Frequency (# spills)[a]	Typical Year Volume (MG)[a]
0410019	No[b]	11	0.28
0410068	Woodlawn Creek Trib.	0	0
0410010	Woodlawn Creek Trib.	12	0.23
0530083	Woodlawn Creek Trib.	61	4.39
0410036	Woodlawn Creek Trib.	0	0
0440074	No[b]	3	0.04
0410011	Woodlawn Creek Trib.	0	0

[a] The results presented were generated by models based on SD1's current understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual measured field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

[b] Greater than 50 feet from waterbody.

2.3.1.c Storm water discharges

Storm water pipe outlets are located throughout the Taylor Creek watershed. In addition to storm water outfalls, there are approximately 18 suspected illicit activity points (SIAs) which are located in the Fort Thomas area and between Woodlawn and Bellevue. SIAs are locations where there was possible evidence of illicit discharges during SD1's storm water mapping project (2001-2002). These locations are being further investigated to determine if they are recurring.

2.3.2 Recently Completed Infrastructure Projects

A study was completed in 2006 (XCG, 2006), to investigate causes and potential improvements related to flooding in this watershed. As part of this study, SD1 developed the Woodlawn Creek Watershed Master Plan to understand flooding issues at a watershed level and develop effective solutions to address localized flooding problems for existing and future conditions. The Master Plan is focused on those problem areas where SD1 has some influence over corrective measures or causes.

SD1 recently eliminated one SSO (0550021) in this watershed, after flow monitoring showed that the overflow was inactive.

2.3.3 Ongoing or Planned Infrastructure Improvement Projects

There are a couple of ongoing projects in the Taylor Creek watershed.

- The Wilson-Waterworks Road Improvement project will help reduce the risk of basement backups. This project comprises a new sanitary sewer to address basement flooding along Waterworks Rd. and to address overflows along the Wilson Rd. Bridge. Construction is anticipated to start in 2009.
- The Newport Pavilion Improvement project will replace the 21-inch trunk sewer near Corothers and Grand Avenue with approximately 1,900 linear feet of 30-inch sewer. This sewer will significantly increase the conveyance capacity through this section and will help support upstream overflow reduction efforts.

The anticipated start and completion dates, the total cost of the project and goals of each project are detailed in Table 5.

Table 5. Ongoing Taylor Creek Water Quality Improvement Projects

Capital Improvement Project Title	Goals	Anticipated Start Date	Anticipated Completion Date	Project Total
Wilson-Waterworks Road Improvements	Reduce the risk of basement backups	2006	To be determined	$300,000
Newport Pavilion Improvements	Upsize trunk sewer for conveyence	2006	To be determined	To be determined

2.4 SENSITIVE AREAS

The federal CSO Control Policy (USEPA, 1994) states EPA's expectation that a permittee's Long-Term Control Plan (LTCP) give the highest priority to controlling CSOs in sensitive areas. The CSO Control Policy indicates that sensitive areas include:

- Waters designated as Outstanding National Resource Waters (ONRW);
- Waters with threatened or endangered species and their habitat;
- Waters with primary contact recreation, such as bathing beaches;
- Public drinking water intakes and their designated protected areas;
- National Marine Sanctuaries (NMS) and
- Shellfish beds.

These six criteria were evaluated individually. None of the waterbodies in the Big Bone Creek watershed have been designated as Outstanding National Resource Waters (401 KAR 10:030) nor are there any National Marine Sanctuaries (NOAA, 2008). Additionally, there are no known threatened or endangered species or commercial shellfish beds within the Taylor Creek watershed nor is shellfish harvest for consumption by private individuals known to occur. Therefore these three criteria were determined not to be relevant to the identification of sensitive waters in the Taylor Creek watershed. The remaining three criteria are discussed below.

2.4.1 Threatened & Endangered Species or Their Designated Critical Habitat

The Kentucky State Nature Preserves Commission (KSNPC) did not identify any aquatic-dependent threatened or endangered species in this watershed, but did identify three terrestrial species, two of which are state-threatened species (KSNPC, 2007). The six banded longhorn beetle (*Dryobius sexnotatus*) is a federal species of management concern (SOMC) and a state-threatened insect dependent upon climax hardwood forests where it primarily consumes sugar maple (Perry et al., 1974; Schweitzer, 1989). The stemless evening primrose (*Oenothera triloba)* is a state-threatened species dependent upon dry woods and prairie habitats (KSNPC, 2006). This species was last observed in the watershed in 1907. The eastern spotted skunk (*Spilogale putorius*) is also a state species of special concern. This terrestrial species has no reported observations in the area (KSNPC, 2007). The primary cause for its decline is thought to be the use of insecticides that reduce the prey of this insectivore (Murray State University, 2000).

2.4.2 Primary Contact Recreation Waters

Kentucky does not have a tiered approach for primary contact recreation (PCR). This means that the State has designated that all PCR waters should be suitable for full body contact recreation during the recreation season of May 1 through October 31 (401 KAR 10:001E). However, the State water quality standards do not define full body contact recreation, so the bacteria criteria that have been developed are based on the presumption that people will ingest the water and could therefore become ill if the water was sufficiently contaminated with bacteria.

Taylor Creek and its tributaries are designated for PCR. It is not clear whether or not swimming activity occurs in the creeks, as public surveys regarding that information are unavailable. No public swimming beaches were identified in the watershed. Additional data will be gathered about uses of the creek.

2.4.3 Public Drinking Water Intakes or their Designated Protection Areas

There are no public drinking water intakes from surface waters or public groundwater wells in the Taylor Creek watershed. The nearest public drinking water intake from surface waters is located on the Ohio River near Louisville, Kentucky.

Source Water Assessment and Protection (SWAPP) zones for the Ohio River intakes are determined by the Ohio River Valley Water Sanitation Commission (ORSANCO). SWAPP zones are not used in a regulatory sense, but are delineated to identify potential contaminants upstream of water intakes and are used to support identification of sources potentially impacting the intakes. ORSANCO has determined that this entire watershed lies within SWAPP Zone 2, reflecting the fact that this watershed is more than 25 miles upstream of the Louisville intake.

Drinking water supply features are shown in Figure 8.

Figure 8. Drinking Water Supply Features

2.5 PUBLIC INTEREST/WATERSHED GROUP ACTIVITIES

Public interest in this watershed is rated high due to recurring flooding issues in this watershed. Several newspaper articles describing basement back-ups and flooding along Covert Run Pike were located on-line (Kentucky Post, 2006, 2007, 2007a), and these indicate public interest in addressing the flooding issues. Furthermore, a discussion of past (2004) stakeholder and public meetings on the Woodlawn Creek Watershed Master Plan, indicates these meetings to solicit input from residents and business owners on flooding issues were well attended (XCG Consultants, Inc., 2006).

Interest in this watershed is also expressed through past monitoring by several organizations (Section 4.2).

3. WATERBODY USES

This section describes designated and current uses for Taylor Creek and its tributaries.

3.1 DESIGNATED USES

Taylor Creek and its tributaries are designated for warm water aquatic habitat, primary contact recreation, secondary contact recreation and domestic water supply, applicable at existing points of public water supply withdrawal (401 KAR 10:026). These are defined below.

- **Warm water aquatic habitat** means any surface water and associated substrate capable of supporting indigenous warm water aquatic life.
- **Primary contact recreation** waters means those waters suitable for full body contact recreation during the recreation season of May 1 through October 31.
- **Secondary contact recreation** waters means those waters that are suitable for partial body contact recreation, with minimal threat to public health due to water quality.
- **Domestic water supply** means surface waters that with conventional domestic water supply treatment are suitable for human consumption through a public water system as defined in 401 KAR 8:010, culinary purposes, or for use in any food or beverage processing industry; and meet state and federal regulations under the Safe Drinking Water Act, as amended, 42 U.S.C. 300f - 300j.

3.2 CURRENT USES

- Aquatic habitat has been assessed as not supporting of diverse aquatic communities.
- Biological conditions in this watershed range from very poor to fair.
- A statewide fish consumption advisory was issued on April 11, 2000 due to low levels of organic mercury found in fish taken from Kentucky waters (KDOW, 2007).
- No fishing access sites were found in the watershed (http://kygeonet.ky.gov/kdfwr/viewer.htm).
- There are currently no swimming advisories for waterbodies in this watershed. However, KDOW and the Division of Public Health Protection and Safety recommend against swimming or other full-body contact with surface waters immediately following heavy rainfall events, especially in dense residential, urban and livestock production areas (KDOW, 2007a).
- There are no surface drinking water intakes in this watershed.
- There are no active public water supply groundwater wells in this watershed (KDOW, 2008a; KDOW, 2007b).

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4. WATERBODY CONDITIONS

This section describes monitoring programs and observed water quality and biological conditions in this watershed.

4.1 303(d) STATUS AND POLLUTANTS OF CONCERN

Taylor Creek is not listed on Kentucky's 2008 303(d) list of impaired waters (KDOW, 2008).

4.2 MONITORING PROGRAMS

Water quality data have been collected in this watershed by Northern Kentucky University (NKU), Licking River Watershed Watch (LRWW), USGS and SD1. Data currently compiled by SD1 from known monitoring programs are presented in Table 6; however, only data which have been fully analyzed are discussed in Section 4.3 Water Quality Data Analysis. Available data exist for the main stem of Taylor Creek, as well as Covert Run, Woodlawn Creek and an unnamed tributary to Taylor Creek.

Data not included in this report will be reviewed and included in subsequent updates.

Table 6. Summary of Water Quality Data

Entity	Dates	Parameters Sampled	Sampling Locations[b]	Number of Samples
NKU	2002	DO, temperature, pH, atrazine	Taylor Cr. RM 0.3, RM 1.4; Covert Run RM 0.3	1 sample (5/18/2002)
NKU	2003	Fecal coliform, DO, pH, temperature	Taylor Cr. RM 1.4; Covert Run RM 0.3	1 sample (5/16/2003)
NKU	2003	Fecal coliform, boron, chloride, DO, hardness, pH, conductivity, silicon, sulfate, TSS, temperature, nutrients, metals	Taylor Cr. RM 0.3, 1.4; Covert Run RM 0.3	1 sample (9/6/2003)
NKU	2003	Fecal coliform	Taylor Cr. RM 0.3, RM 1.4; Covert Run RM 0.3	1 sample (7/10/2003)
LRWW	2002	Fecal coliform	Taylor Cr. RM 0.3, RM 1.4; Covert Run RM 0.3	1 sample (7/12/2002)
LRWW	2004	Fecal coliform, *E. coli*	Taylor Cr. RM 0.3, RM 1.4; Covert Run RM 0.3	3 samples (May, July, Sept.)
SD1	2006	Fecal coliform, E. coli, DO, pH, conductivity, turbidity, temperature	Taylor Cr. RM 0.6, RM 1.4; Covert Run RM 0.2; Woodlawn Cr. RM 1.3	2 surveys: baseline conditions (Oct, 2006)
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Taylor Cr. RM 0.6; Covert Run RM 0.2; Woodlawn Cr. RM 1.3; Unnamed Trib. RM 0.4 to Taylor Cr. at RM 1.6	1 sample (May) baseline conditions
SD1	2007	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients, metals and hardness	Taylor Cr. RM 0.6; Covert Run RM 0.2; Woodlawn Cr. RM 1.3; Unnamed Trib. RM 0.4 to Taylor Cr. at RM 1.6	3 Wet Weather Events in June, July, Oct. (11 samples from each station for all events)
SD1	2008[a]	Fecal coliform, E. coli, carbonaceous biological oxygen demand (5-day), DO, pH, conductivity, TSS, temperature, turbidity, nutrients	Taylor Cr. RM 0.6; Covert Run RM 0.2; Woodlawn Cr. RM 1.3; Unnamed Trib. RM 0.4 to Taylor Cr. at RM 1.6	1 sample (May) baseline conditions
USGS	2007-present[a]	Gage height, precipitation, DO, DO % sat, pH, conductivity, temperature	(Station No. 03238140) Taylor Cr. RM 0.6	15-minute intervals

[a]Data not analyzed in Section 4.3

[b] RM = River mile

4.2.1 Future Sampling

SD1 plans to continue monitoring in Taylor Creek during base flow conditions with at least one survey per year. The four sampling locations are: Woodlawn Creek RM 1.3; Covert Run RM 0.2; Unnamed tributary RM 0.4; and Taylor Creek RM 0.6. Typical analyses will include bacteria, nutrients, solids, oxygen-demanding constituents and physical parameters. Additionally, surveys to assess the degree of stream hydromodification are currently underway by SD1.

The USGS will continue to operate the stage gage, measure flow and water quality (physical parameters) at RM 0.6 (03238140). This station is operated and funded via a cooperative agreement between USGS and SD1.

Outfall sampling was initiated in 2007 to better characterize water quality and loadings from CSOs, SSOs and storm water runoff. One SSO and one storm water outfall locations are being sampled in this watershed and analyzed for bacteria, nutrients, solids, metals and oxygen-demanding constituents. This sampling program plan is anticipated to continue until ten events are monitored.

4.3 WATER QUALITY DATA ANALYSIS

Historical data (2002-2005) have been analyzed to identify past water quality problems in this watershed. Recent data (2006-present) have been analyzed in more detail to describe current stream conditions. These recent data better reflect the effect of existing sources on instream water quality.

4.3.1 Historical Data

A summary of historical water quality findings are presented in Table 7, for those parameters that exceeded their applicable criteria. Elevated fecal coliform and *E. coli* levels have been observed along the mainstem of Taylor Creek, as well as in Covert Run. Measurements at locations not shown met the respective water quality criteria.

Table 7. Historical Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform bacteria		*E. coli* bacteria	
		# samples	% of samples exceeding criteria[a]	# samples	% of samples exceeding criteria[a]
Taylor Creek	0.3	6	100%	2	100%
Taylor Creek	1.4	7	100%	2	100%
Covert Run	0.3	7	100%	2	100%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100 ml for *E. coli*." Even this comparison is conservative as the criterion is meant to be applied to a dataset of five or more samples collected over a 30-day period.

4.3.2 Recent Data

More recent water quality data were available for Taylor Creek (RM 0.6 and 1.4) and three tributaries (Covert Run, Woodlawn Creek, and an unnamed tributary to Taylor Creek). Fecal coliform and *E. coli* exceedances were observed at all five of the locations sampled. Dissolved oxygen violations were observed at four of the five monitored locations. pH violations were observed at two of the five monitored locations. Copper and zinc violations were observed at all four of the monitored locations and cadmium violations were only observed at one of the four monitored locations. Finally, unionized ammonia violations were observed at one of five monitored locations.

A summary of recent water quality data and findings is presented in Tables 8 - 12, for those parameters that exceeded applicable criteria. Measurements for parameters not shown met the respective water quality criteria. Recent data collected at the USGS station and 2008 data collected by SD1 are being reviewed and will be included in the next update of this report.

Table 8. Recent Bacteria Exceedances

Stream	River Mile	Parameters exceeding criteria			
		Fecal coliform bacteria		*E. coli* bacteria	
		# samples	% of samples exceeding criteria[a]	# samples	% of samples exceeding criteria[a]
Taylor Creek	0.6	29	100%	29	100%
Taylor Creek	1.4	3	100%	3	100%
Covert Run	0.2	29	100%	29	100%
Woodlawn Creek	1.3	29	100%	29	97%
Unnamed tributary entering Taylor Creek at RM 1.6	0.4	27	100%	27	100%

[a] There are no instances where 5 samples were collected from a single location within a 30-day period. Therefore the comparison to the geometric mean portion of the fecal coliform and *E. coli* criteria, which requires a minimum of 5 samples taken during a 30-day period, is not possible. Comparisons were, however, made to the part of the criteria that reads, "Content shall not exceed 400 colonies/100 ml in 20 percent or more of all samples taken during a 30-day period for fecal coliform or 240 colonies/100ml for *E. coli.*" Even this comparison is conservative as the criterion is meant to be applied to a dataset of five or more samples collected over a 30-day period.

Table 9. Recent Dissolved Oxygen Violations

Stream	River Mile	Parameters violating criteria	
		Dissolved oxygen	
		# measurements	% of measurements in violation[a]
Taylor Creek	0.6	19	5%
Covert Run	0.2	20	10%
Woodlawn Creek	1.3	19	5%
Unnamed tributary entering Taylor Creek at RM 1.6	0.4	17	6%

[a] The dissolved oxygen criterion is 4 mg/l.

Table 10. Recent pH Violations

Stream	River Mile	Parameters violating criteria	
		pH	
		# measurements	% of measurements in violation[a]
Taylor Creek	0.6	29	3%
Woodlawn Creek	1.3	29	7%

[a] The pH criteria are between 6.0 and 9.0 su.

Table 11. Recent Metals Violations

Stream	River Mile	Parameters violating criteria					
		Copper		Zinc		Cadmium	
		# samples	% of samples in violation[a]	# samples	% of samples in violation[a]	# samples	% of samples in violation[a]
Taylor Creek	0.6	24	25%	24	21%	24	0%
Covert Run	0.2	24	21%	24	8%	24	0%
Woodlawn Creek	1.3	24	17%	24	4%	24	0%
Unnamed tributary entering Taylor Creek at RM 1.6	0.4	24	13%	24	13%	24	4%

[a] Acute criteria to protect aquatic life are hardness-dependent. Individual criteria were calculated for each sampling event based on hardness at the time of sampling. Acute copper criteria ranged from 8.1 ug/l to 64 ug/l. Zinc criteria ranged from 73 ug/l to 472 ug/l. Acute cadmium criteria ranged from 1.2 ug/l to 11 ug/l.

Table 12. Recent Unionized Ammonia Violations

Stream	River Mile	Parameters violating criteria	
		Unionized ammonia[a]	
		# samples	% of samples in violation[a]
Woodlawn Creek	1.3	25	4%

[a]The unionized ammonia criteria is 0.05 mg/l

A discussion of recent water quality violations follows below by parameter.

4.3.2.a Bacteria

Fecal coliform data are available for both storm and base flow conditions. Storm flow results for bacteria are presented as an average over the storm event. As shown in Figure 9, base flow exceedances of the fecal coliform criteria were observed throughout the watershed. The maximum base flow fecal coliform concentration of 9,200 cfu/100 ml was recorded in Taylor Creek at RM 1.4. Storm flow exceedances of the criteria were also observed throughout the watershed. The maximum storm flow fecal coliform concentration of 180,075 cfu/100 ml was recorded in Taylor Creek at RM 0.6.

As shown in Figure 10, a similar pattern was observed for *E. coli*, with all of the base flow samples exceeding applicable criteria. The maximum base flow *E. coli* concentration of 9,677 cfu/100 ml was recorded in an unnamed tributary to Taylor Creek. The maximum storm flow *E. coli* concentration, 61,272 cfu/100 ml was recorded in Taylor Creek at RM 0.6.

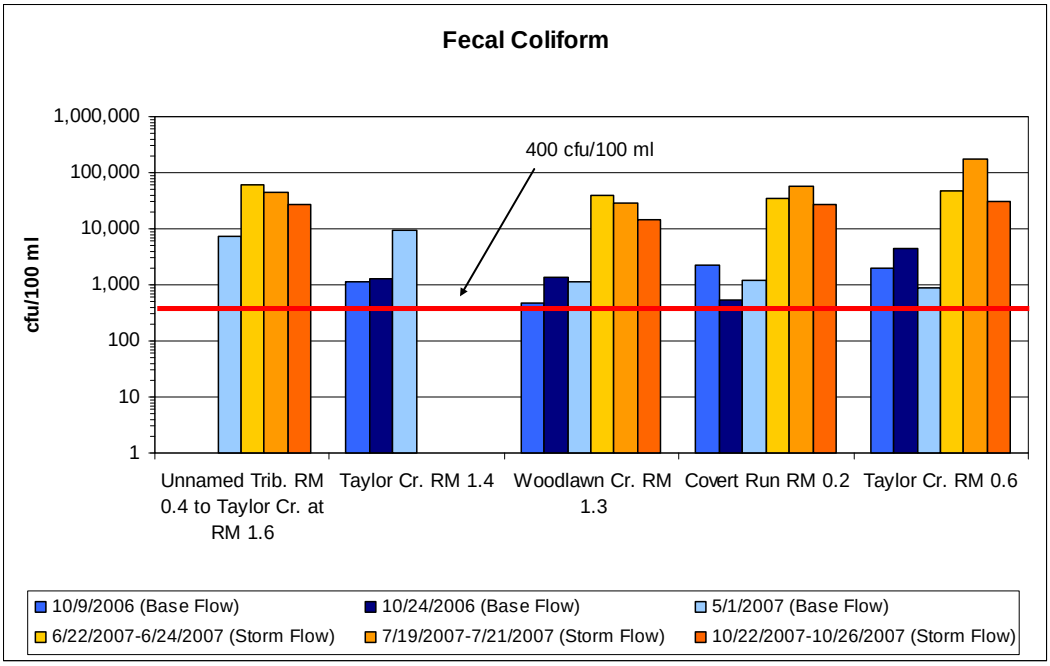

Figure 9. 2006-07 Base Flow and Average Storm Flow Fecal Coliform Concentrations Compared to 400 cfu/100 ml Criterion

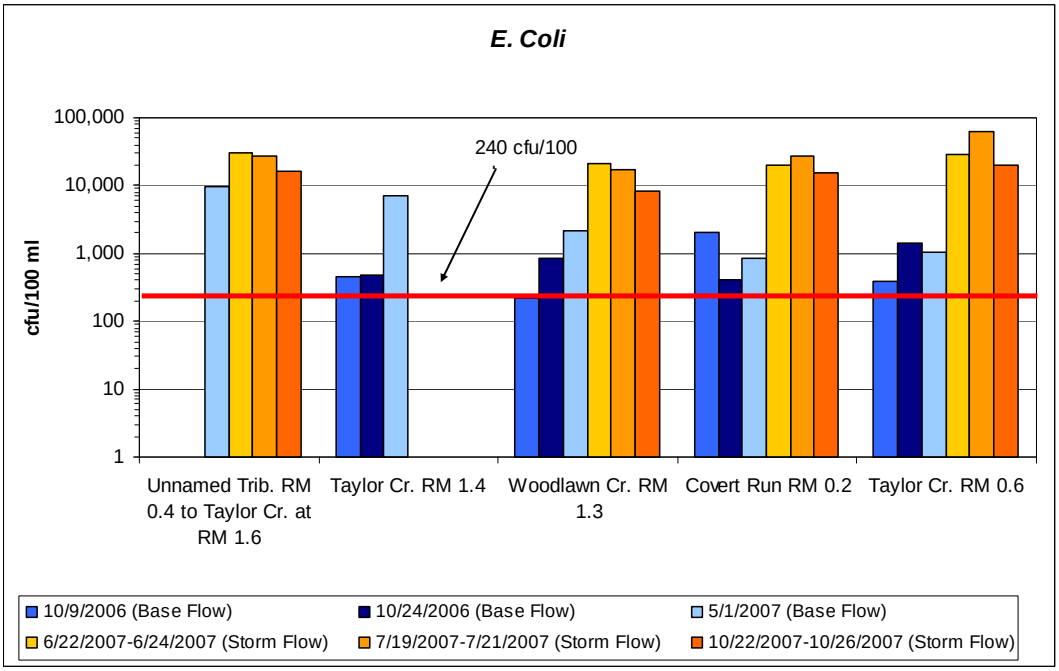

Figure 10. 2006-07 Base Flow and Average Storm Flow *E. coli* Concentrations Compared to 240 cfu/100 ml Criterion

4.3.2.b Dissolved Oxygen

Dissolved oxygen measurements were recorded in the Taylor Creek watershed between 2006 and 2008 during base flow and storm flow conditions. Dissolved oxygen concentrations in the 78 samples ranged from 3.3 mg/l to 15.3 mg/L.

Dissolved oxygen concentrations violated applicable criteria at four of the five locations for which recent data were available, with violations observed in 5-10% of measurements for these locations. Violations were only observed during storm flow conditions.

4.3.2.c pH

A total of 117 pH measurements were recorded in the Taylor Creek watershed between 2006 and 2008, during base flow and storm flow conditions.

Levels of pH in the watershed range from 7.3 to 9.8. Of the 117 measurements, three exceeded the upper allowable pH criterion of 9 su. A value of 9.8 su was recorded at Taylor Creek RM 0.6, and values of 9.8 and 9.9 su were measured in Woodlawn Creek. Two violations were observed during base flow conditions and one during storm flow conditions.

4.3.2.d Metals

A total of 96 metals samples were collected from Taylor Creek, Covert Run, Woodlawn Creek, and an unnamed tributary to Taylor Creek between 2006 and 2008. All metals samples were collected during storm flow conditions. These data were compared to acute

criteria to protect aquatic life. Samples at all four locations exceeded acute aquatic life criteria for copper and zinc. The copper criterion was exceeded in 13-25% of samples, while the zinc criterion was exceeded in 4-21% of the samples. One sample collected in the unnamed tributary to Taylor Creek exceeded the acute aquatic life criterion for cadmium.

4.3.2.e Unionized Ammonia

A total of 101 samples were collected from Taylor Creek, Covert Run, Woodlawn Creek, and an unnamed tributary to Taylor Creek between 2006 and 2008, during base flow and storm flow conditions. These data were compared to the unionized ammonia criteria. A value of 0.059 mg/l was measured in one of the 25 samples collected from Woodlawn Creek, during storm flow conditions. Violations were not observed at any of the other five recently-sampled locations.

4.4 BIOLOGICAL CONDITIONS

Biological conditions have been assessed in the Taylor Creek watershed and generally reveal conditions that range from "fair" to "very poor".

Macroinvertebrate communities are susceptible to water quality and habitat degradation, and data from these communities are used as a tool to detect changes in habitat and water quality and assessing stream health (KDOW, 2008b). MBI scores calculated for the three sites (Table 1) sampled for macroinvertebrates in 2007 resulted in "poor" to "very poor" rankings[9].

Fish sampling is valuable as a biological indicator because fish 1) have a widespread distribution from small streams to all but the most polluted waters; 2) utilize of a variety of trophic levels; 3) have stable populations during summer months; and 4) their life histories are relatively well understood (KDOW, 2008b). KIBI scores were calculated as "fair" for Taylor Creek and Covert Run locations, while Woodlawn Creek received a "very poor" ranking for not yielding any fish (Table 1)[10].

[9] The macroinvertebrate data were used to calculate the Kentucky macroinvertebrate biotic index (MBI). The MBI compiles attributes of the macroinvertebrate community such as taxa richness, pollution tolerant species and pollution intolerant species. Additional metrics are added depending on the stream size and/or ecoregion.

[10] The data from this survey were used to calculate the Kentucky Index of Biotic Integrity (KIBI), a multimetric index using fish as an indicator of stream health. The KIBI compiles attributes of the fish community such as taxa richness and abundance, pollution tolerance/ intolerance, feeding and reproductive needs, and presence or absence of native species in order to provide a numerical value and corresponding narrative classification for streams.

5. SOURCE ANALYSIS

This section summarizes potential pollutant sources to provide information related to observed recent impairments. Conclusions are based on the watershed characterization and available water quality data.

5.1 WATERSHED SOURCE ANALYSIS

Potential sources of bacteria, oxygen-demanding constituents, pH, metals and ammonia were identified based on the watershed characterization information discussed previously. Potential sources are summarized in Table 13 and their locations are shown in Figure 11. There are no septic systems or animal feeding operations in this watershed.

Table 13. Summary of Potential Sources

	Taylor Creek watershed
Recent observed impairments=>	Bacteria, dissolved oxygen, pH, metals, unionized ammonia[a]
SSOs[b]	7
CSOs[b]	9
KPDES- outfalls[c] (cooling water & filter backwash)	2
Storm water runoff	Urban
Watershed improvements	One SSO was recently eliminated. Wilson-Waterworks Road Improvements and Newport Pavillion projects are underway to reduce risk of basement backups in this watershed and support overflow reduction efforts. Model development is underway to investigate water quality.

[a]Flooding is also a problem in this watershed.

[b]SD1 is undertaking a characterization and assessment of the sewer system, and sources are subject to change.

[c] Excludes permitted CSOs

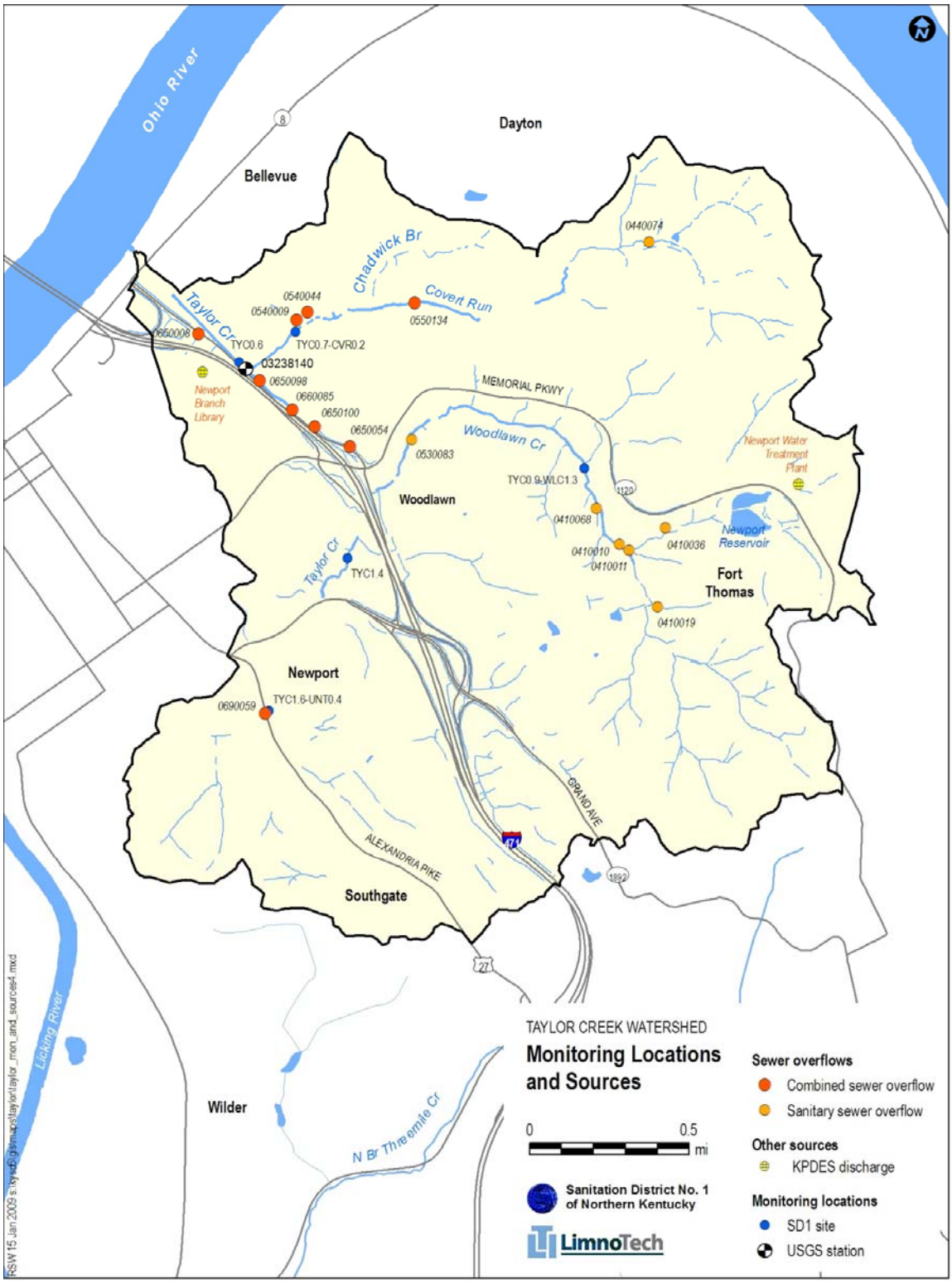

Figure 11. Monitoring Locations and Sources

6. RANKING

6.1 RESULTS

The WAT! is a tool that assesses the potential for point and nonpoint sources to generate fecal coliform, total solids and total phosphorus pollutant loads. WAT! was developed for these three pollutants because data to support modeling were readily available and they are representative indicators of potential water quality conditions. Calibration of the WAT! tool for total solids and total phosphorus is planned, and results should be available in future reports. Results for fecal coliform are discussed below.

This analysis was conducted for each of the sixteen watersheds located within SD1's study area. In addition to assessing pollutant loading potential by source, the WAT! also assesses pollutant loading potential by watershed, which allows for ranking and comparisons among the sixteen watersheds.

WAT! results[11] indicate that under year-round conditions, the Taylor Creek watershed has a high ranking (analogous to load) for fecal coliform, relative to the sixteen identified watersheds in SD1's jurisdictional area.

In addition to WAT! results, other factors such as presence of public drinking water features, presence of aquatic-dependent threatened and endangered (T&E) species, special designations, and public interest may affect watershed prioritization. These and other ranking considerations are summarized in Table 14.

Table 14. Watershed Ranking Considerations

CSO (#)	SSO (#)	SWAPP Zone	Aquatic-dependent T&E Species[a] (#)	Special designation	Public interest	WAT Rank, year-round conditions[b]
						Bacteria
9	7	Zone 2 (due to Louisville intake)	0	None	High	2 of 16

[a] There are no aquatic-dependent T&E species, however, there are two terrestrial species that are threatened and one terrestrial species of special concern in this watershed.

[b] The WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

6.2 SCREENING TO DETERMINE IF ADDITIONAL DATA ARE NEEDED

Sufficient data and information are currently available or planned for collection to support a reasonable understanding of current water quality conditions in the Taylor Creek watershed. However, the sources contributing to the elevated base flow bacteria concentrations in this watershed are not well understood. The SWMM5 model under development for this watershed should provide additional information on sources and future water quality.

[11] WAT is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

6.2.1 Data Gap Analysis

Biological sampling and habitat assessment was completed in 2007. Additional biological and habitat assessment would be useful to assess improvements as projects are implemented. A site visit is recommended to investigate dry weather bacteria sources.

6.3 SOURCE PRIORITIZATION

The sources identified through the process of watershed characterization have been quantified using the WAT!. WAT! has been applied for a five-year period (1992-1996 climatological conditions), to quantify fecal coliform contributions by source. Together the characterization and WAT! results help inform source prioritization for improvement or elimination.

6.3.1 WAT! Results

The relative fecal coliform load generated by source is shown in Figure 12. These WAT! results incorporate predicted sewer overflow volumes from infrastructure model simulations for 1992-1996 climatological conditions[12]. Flow estimates are available for six of the CSOs and five of the SSOs in this watershed.

Under year-round conditions, the largest source of fecal coliform bacteria is storm water runoff. There are no identified or modeled sources that contribute fecal coliform under base flow conditions.

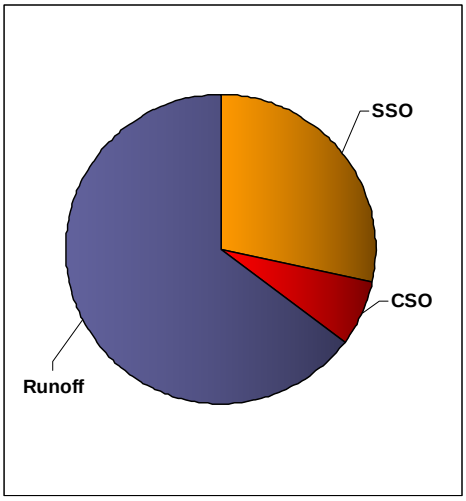

Figure 12. Initial Year-Round WAT! Results for Fecal Coliform

WAT! is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

[12] The results presented were generated by models based on SD1's current understanding of the collection system infrastructure. These models are predictive tools and are based on numerous variables and assumptions on the characteristics of the collection system, and may differ from actual measured field conditions. These models are subject to change based on improved knowledge of the system, improvements to the system, and changes in land use and development. These results are subject to change and should therefore not be relied on or considered definitive.

WAT! results should be considered preliminary as ongoing work may affect the WAT! source analysis and rankings. Work is currently ongoing to refine the bacteria contribution from septic systems.

6.4 WATERSHED RANKING

The WAT! produced a ranking, by watershed for sixteen watersheds, based on their potential to generate fecal coliform loads over a 1-year period. The water quality impact score (analogous to load) for each of the sixteen watersheds was used as a ranking metric. Additional detail on the ranking is available in the WAT! documentation.

The WAT! produces rankings of the watersheds for both base flow and year-round conditions. By separating base flow conditions, the impacts of dry weather sources on stream conditions can be differentiated from the combined impact of dry and wet weather sources. The ranking of the Taylor Creek watershed during year-round and base flow conditions is provided in Table 15.

Table 15. WAT! Watershed Rankings

	Rank for Year-Round Conditions[a,b]	Rank for Base flow Conditions[a,b]
Fecal coliform	2	16

[a] Rank ranges from 1 to 16. A rank of 1 indicates a high water quality impact score, which is analogous to load. The lowest rank possible is 16.

[b] WAT is still under development. All results presented here are for illustrative purposes only. The results are subject to change and should therefore not be relied on or considered definitive.

The Taylor Creek watershed ranks lowest (16^{th}) for fecal coliform under base flow conditions, contrary to the recent base flow bacteria results (section 4.3.2.a). Additional investigation of dry weather sources is recommended in Section 6.2.1.

The WAT! analysis for both total solids and total phosphorus will be presented in future reports upon completion of the WAT! calibration. Completion of the SWMM5 water quality model will help to better understand runoff and instream water quality, aiding in characterization of potential sources.

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