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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

Thorn Creek Watershed TMDL
Stage 1 Report

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As required by Section 303(d) of the Clean Water Act (CWA), the Illinois EPA (IEPA) is required to identify and list all state waters that fail to meet water quality standards. This list is referred to as the 303(d) list and is revisited every two years to either remove those waters that have attained their designated uses, or to include additional waters not previously deemed impaired. Waterbodies included on the 303(d) list are often targeted for Total Maximum Daily Load (TMDL) development.

A TMDL is an estimation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It assesses contributing point and nonpoint sources to identify pollution reductions necessary for designated use attainment. A TMDL identifies the source of impairment and provides reduction estimates to meet water quality standards. Pollutant reductions are then allocated to contributing sources, thus triggering the need for pollution control and increased management responsibilities amongst sources in the watershed.

For Thorn Creek 10 impaired waterbodies (out of 12) were identified for TMDL development. The Thorn Creek watershed is located approximately 30 miles south of Chicago and incorporates numerous tributaries of Thorn Creek, including Butterfield Creek, Deer Creek and North Creek. The only waterbody classification applicable to the Thorn Creek watershed is the General Use classification which includes designated uses such as aquatic life, aesthetic quality, and primary contact recreation uses. The identified impairments include dissolved oxygen (DO), fecal coliform, chloride, copper, fluoride, pH, phosphorus (total), silver, and zinc. The water quality criteria identified for these impairments provide an explicit assessment as to whether or not these waterbodies are in compliance. The water bodies were considered impaired if the water quality exceeded the Illinois standards.

Available data used for assessing these waterbodies originated from numerous water quality stations within the Thorn Creek watershed. Data were obtained from both legacy and modernized USEPA Storage and Retrieval (STORET) databases, Thorn Creek Sanitary District data, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) data, and IEPA database data. Data relevant to impairments were compiled for each impaired waterbody and summary statistics were calculated to further characterize each pollutant.

Various models were recommended for TMDL development, the level of which was primarily based on the complexity of the system and the availability of data. Simple spreadsheet models were recommended for DO TMDLs and the ENSR Lake Response Model (ENSR LRM) was recommended to analyze total phosphorus impairment. Load duration curves were recommended for fecal coliform and metals analyses and could also be used to estimate BOD loading for the DO TMDL. If the system requires a more complex DO model for creek simulation, then QUAL2K could be used. QUAL2K was recommended for the pH TMDL, but is capable of simulating instream DO concentrations.

1.0 Introduction

This Stage 1 Total Maximum Daily Load (TMDL) report is presented as partial fulfillment by the Illinois Environmental Protection Agency (IEPA) and the United States Environmental Protection Agency (U.S.EPA) in the development of TMDLs, as part of that state's Clean Water Act (CWA) Section 303(d) compliance. The purpose of the project is to develop TMDLs for ten impaired waterbodies in the Thorn Creek watershed in northeastern Illinois.

Section 303(d) of the CWA and U.S. EPA's Water Quality Planning Regulations (40 CFR Part 130) require states to develop TMDLs for impaired waterbodies that are not supporting designated uses or meeting water quality standards. A TMDL is a calculation of the maximum amount of pollutants that a waterbody can receive and still meet the water quality standards necessary to protect the designated beneficial use (or uses) for that waterbody. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and water quality conditions, so that states and local communities can establish water quality based controls to reduce pollutants from both point and nonpoint sources and restore and maintain the quality of their water resources.

Water is an essential resource for the inhabitants of the Earth and protecting this resource is the goal for many across the globe. United States policies and regulations, such as the CWA, were created and are implemented to help maintain the quality of our water resources in the United States. The U.S. EPA, via the CWA, charged each state with developing water quality standards (WQS). These WQS are laws or regulations that states authorize to protect and/or enhance water quality, to ensure that a waterbody's designated use (or uses) is (are) not compromised by poor water quality and to protect public health and welfare. In general, WQS consist of three elements:

- The designated beneficial use (e.g., recreation, protection of aquatic life, aesthetic quality, and public and food processing water supply) of a waterbody or segment of a waterbody,
- The water quality criteria necessary to support the designated beneficial use of a waterbody or segment of a waterbody, and
- An anti-degradation policy, so that water quality improvements are conserved, maintained and protected.

The Illinois Pollution Control Board (IPCB) established its WQS in Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter 1: Pollution Control Board, Part 302: Water Quality Standards. Every two years IEPA submits the Illinois Integrated Water Quality Report and Section 303(d) List. This report documents surface and groundwater conditions throughout the state. The 303(d) List portion of this report identifies impaired water bodies, grouped by watershed, and identifies suspected sources of impairment. These waters are prioritized for TMDL development into high, medium, and low categories based on designated use and pollution severity and are then targeted for TMDL development. Non-pollutant causes of impairment, such as habitat degradation and dissolved oxygen not addressed under the TMDL, but are addressed by programs such as the 319 program and other nonpoint source grant programs.

A TMDL is a calculation of the maximum load a waterbody can receive without exceeding water quality standards or result in non attainment of a designated use. A watershed's TMDL report consists of data analysis to quantitatively assess water quality, documentation of waterbodies or segments of waterbodies that are impaired, and identification of potential contributing sources to impairment. Based on these data, the amount and type of load reduction that is needed to bring water quality into compliance is calculated. The TMDL report provides the scientific basis for states and local communities to establish water quality-based controls to reduce pollutant loads from both point (i.e., wasteload allocations) and non-point sources (i.e., load allocations).

IEPA uses a three-stage approach to develop TMDLs for a watershed:

- **Stage 1** – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification;
- **Stage 2** – Data collection to fill in data gaps, if necessary; and
- **Stage 3** – Model calibration, TMDL scenarios, and implementation plans.

The purpose of Stage 1 is to characterize the watershed background; verify impairments in the listed waterbody by comparing observed data with water quality standards or appropriate targets; evaluate spatial and temporal water quality variation; provide a preliminary assessment of sources contributing to impairments; and describe potential TMDL development approaches. If available water quality data collected for the watershed are deemed sufficient by IEPA, Stage 2 may be omitted and Stage 3 will be completed. If sufficient water quality data or supporting information are lacking for an impaired waterbody, then Stage 2 is required and field sampling will be conducted in order to obtain necessary data to complete Stage 3.

This report documents Stage 1 in the IEPA approach for TMDL development. The report is organized into six main sections. Section 1.0 discusses the definition of TMDLs and targeted impaired waterbodies in the Thorn Creek watershed, for which TMDLs will be developed. Section 2.0 describes the characteristics of the watershed, and Section 3.0 briefly discusses the process of public participation and involvement. Section 4.0 describes the applicable water quality standards and water quality assessment. Section 5.0 presents the assessment and analysis of available water quality data. Section 6.0 discusses the methodology selection for the TMDL development, the data gaps, and provides recommendations for additional data collection, if necessary.

1.1 Definition of a Total Maximum Daily Load (TMDL)

According to the 40 CFR Part 130.2, the TMDL (the maximum load a waterbody can be receive without exceeding water quality standards or result in non attainment of a designated use) for a waterbody is equal to the sum of the individual loads from point sources (i.e., wasteload allocations or WLAs), and load allocations (LAs) from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. In equation form, a TMDL may be expressed as follows:

$$\mathbf{TMDL = WLA + LA + MOS}$$

Where:

WLA = Waste Load Allocation (i.e., loadings from point sources);
LA = Load Allocation (i.e., loadings from nonpoint sources including natural background); and
MOS = Margin of Safety.

TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measures [40 CFR, Part 130.2 (i)]. US EPA recommends that all TMDLS and associated LA and WLAs be expressed in terms of daily increments but may include alternative non-daily expression of pollutant loads to facilitate implementation of the applicable water quality standard. TMDLs also shall take into account the seasonal variability of pollutant loading and hydrology to ensure water quality standards are met in all seasons and during all hydrologic conditions. Though not required by CWA, IEPA requires that an implementation plan be developed for each watershed, which may be used as a guideline for local stakeholders to restore water quality. This implementation plan will include recommendations for implementing best management practices (BMPs),

cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and time frame for completion of implementation activities.

The MOS accounts for the lack of knowledge or uncertainty concerning the true relationship between loading and attainment of water quality standards. This uncertainty is often a product of data gaps, either temporally or spatially, in the measurement of water quality. The MOS should be proportional to the anticipated level of uncertainty; the higher the uncertainty, the greater the MOS. The MOS is generally based on a qualitative assessment of the relative amount of uncertainty as a matter of best professional judgment (BPJ). The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS, but is already factored in during the TMDL development process. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they sufficiently account for the MOS.

1.2 Targeted Waterbodies for TMDL Development

In May 2008, IEPA prepared a draft Illinois Integrated Water Quality Report and Section 303(d) List-2008 (commonly referred to as the 303(d) List) to fulfill the requirement of Section 305(b), 303(d) and 314 of the CWA. Under US EPA's review and approval, the report presents a detailed water quality assessment process and results for streams and lakes in the State of Illinois. The water quality assessments are based on biological, physicochemical, physical habitat, and toxicity data. Each waterbody has one or more of designated uses which may include aquatic life, aesthetic quality, indigenous aquatic life (for specific Chicago-area waterbodies), primary contact (swimming), secondary contact (recreation), public and food processing water supply, and fish consumption. The degree of support (attainment) of a designated use in a waterbody (or segment) is assessed as Fully Supporting (good), Not Supporting (fair), or Not Supporting (poor). Waters in which at least one applicable use is not fully supported is designated as "impaired." Potential causes and sources of impairment are also identified for these waters. The 303(d) List is prioritized on a watershed basis based on the requirements of 40 CFR Part 130.7(b)(4). Watershed boundaries are based on United States Geological Survey (USGS) ten-digit hydrologic units, to provide the state with the ability to address watershed issues at a manageable level and document improvements to a watershed's health. TMDL development is also conducted on a watershed basis so that the impaired waters upstream of an individual segment may be addressed at the same time.

Table 1-1 presents the 2008 303(d) List for the Thorn Creek watershed. The table includes impaired designated uses and potential causes. The segments in bold font are scheduled for TMDL development and are the focus of this report. TMDLs will not be developed for the lakes with a surface area less than 20 acres since the Illinois phosphorus standard applies to only those lakes where surface area is 20 or more acres. Further, TMDLs will not be developed for segments impaired by water quality variables that do not have numerical WQS.

Nine river segments and one lake are identified as impaired and selected for TMDL development in the Thorn Creek watershed. The designated uses for these waterbodies are primarily aquatic life with some aesthetic quality and primary contact recreation uses. The identified causes for impairment that have numerical WQS include dissolved oxygen (DO), fecal coliform, chloride, copper, fluoride, pH, total phosphorus, silver, and zinc. The WQS provide numerical criteria to measure compliance for each of these water quality variables. However, DO is considered a non-pollutant by IEPA. The IEPA will ascertain potential causes for low dissolved oxygen using the TMDL process and will develop a TMDL only if the cause is attributable to a pollutant that has a numerical WQS. For example, if a 50-acre lake suffers from low DO due to excessive algal densities which is related to elevated phosphorus concentrations, the IEPA will develop a phosphorus TMDL for this waterbody. TMDLs will not be developed for waterbodies listed as impaired based on non numerical WQS, such as aesthetic quality impairment with an unknown cause or aquatic life impairment due to insecticides. Waterbodies targeted for TMDL development are listed in Table 1-2.

Table 1-1: Illinois' 2008 303(d) List for Thorn Creek Watershed

Water ID	Waterbody Name	Miles/ Acres	Priority	Designated Use	Potential Cause(s)
IL_HBD-02	Thorn Creek	3.68	Medium	Aquatic Life	Aldrin, Chlordane, DDT, Dieldrin, Dissolved oxygen (1), Endrin, Hexachlorobenzene, Total phosphorus, Polychlorinated biphenyls, **Silver (1)**, Total suspended solids, **Zinc (1)**
				Primary Contact Recreation	**Fecal coliform (1)**
IL_HBD-03	Thorn Creek	4.68	Medium	Primary Contact Recreation	**Dissolved oxygen (1), Fecal coliform (1)**
IL_HBD-04	Thorn Creek	4.13	Medium	Primary Contact Recreation	**Fecal coliform (1)**
				Aquatic Life	Aldrin, Chlordane, **Chloride (1)**, **Copper (1),** DDT, Dieldrin, Endrin, **Fluoride (2)**, Hexachlorobenzene, **pH (1)**, Total phosphorus, Polychlorinated biphenyls, **Silver (1)**, Total suspended solids, **Zinc***
IL_HBD-05	Thorn Creek	2.64	Medium	Primary Contact Recreation	**Fecal coliform (1)**
				Aquatic Life	Total phosphorus
IL_HBD-06	Thorn Creek	1.98	Medium	Primary Contact Recreation	**Fecal coliform (1)**
				Aquatic Life	Aldrin, Dieldrin, Hexachlorobenzene, **pH (1),** Total phosphorus, **Silver***
IL_HBDA-01	North Creek	11.66	Medium	Aquatic Life	Aldrin, Hexachlorobenzene, Sedimentation/Siltation
IL_HBDB-03	Butterfield Creek	14.65	Medium	Aquatic Life	DDT, Total phosphorus
				Primary Contact Recreation	**Fecal Coliform (1)**
IL_HBDC	Deer Creek	6.62	Medium	Primary Contact Recreation	**Fecal coliform (1)**
				Aquatic Life	Total phosphorus
IL_HBDC-02	Deer Creek	9.17	Medium	Aquatic Life	Total phosphorus, Sedimentation/Siltation
				Primary Contact Recreation	**Fecal coliform (1)**
IL_RHI	Sauk Trail	28.80	Medium	Aesthetic Quality	**Total phosphorus (1),** Total suspended solids
				Aquatic Life	**Total phosphorus (1),** Polychlorinated biphenyls, Sedimentation/Siltation, Total suspended solids (TSS)
IL_RHL	Waumpum	35.0	Medium	Aesthetic Quality	Cause unknown

Water ID	Waterbody Name	Miles/ Acres	Priority	Designated Use	Potential Cause(s)
IL_RHR	George (Cook)	8.0	Medium	Aesthetic Quality	Total phosphorus

(1) These parameters have numeric standards and will have TMDL allocations.

(2) These parameters will be recommended for 303(d) delisting as a result of the 2010 Integrated Report assessment.

*The source causing impairment is believed to originate solely from point sources. The point source will be required to meet the water quality standard at the point of discharge. The IEPA, based on the information available, believes that the compliance with the WQS will be achieved after all point source dischargers have installed the appropriate controls. A TMDL will not be prepared for this pollutant at this time, but will assess the waterbody again after the appropriate point source controls have been operational.

Table 1-2: Waterbodies targeted for TMDL development in the Thorn Creek Watershed

Segment ID	Waterbody Name	Waterbody Size (Miles/ Acres)	Designated Use	Impairment
IL_HBD-02	Thorn Creek	3.68	Aquatic Life	Dissolved oxygen, fecal coliform, silver, zinc
IL_HBD-03	Thorn Creek	4.68	Primary Contact Recreation	Dissolved oxygen, Fecal Coliform
IL_HBD-04	Thorn Creek	4.13	Primary Contact Recreation	Dissolved oxygen, fecal coliform, silver, pH, copper, chloride
IL_HBD-05	Thorn Creek	2.64	Primary Contact Recreation	Fecal coliform, dissolved oxygen
IL_HBD-06	Thorn Creek	1.98	Primary Contact Recreation	Dissolved oxygen, fecal coliform, pH
IL_HBDA-01	North Creek	11.66	Aquatic Life	Dissolved oxygen
IL_HBDB-03	Butterfield Creek	14.65	Aquatic Life	Dissolved oxygen, Fecal Coliform
IL_HBDC	Deer Creek	6.62	Primary Contact Recreation	Fecal coliform
IL_HBDC-02	Deer Creek	9.17	Aquatic Life	Dissolved oxygen, Fecal Coliform
IL_RHI	Sauk Trail	28.80	Aesthetic Quality	Dissolved oxygen, phosphorus

2.0 Watershed Characterization

This section describes the general characteristics of the Thorn Creek watershed including location (Section 2.1), topography (Section 2.2), land use (Section 2.3), soil information (Section 2.4), population (Section 2.5), climate and precipitation (Section 2.6) and hydrology (Section 2.7).

2.1 Watershed Location

A watershed is a geographic area that shares a hydrologic connection - all the water within that area drains to a common waterway. Water movement can be influenced by topography, soil composition and water recharge (i.e. precipitation, snow melt, groundwater)[1]. Watersheds are important because pollution at the water's source may impact water quality in all downgradient areas including its convergence with a common waterway. Understanding the watershed is an essential step in the TMDL process – an essential tool in maintaining water quality standards within Illinois.

Located about 30 miles south of Chicago, the Thorn Creek watershed (a sub-watershed of the larger Chicago watershed) consists of Thorn Creek, its tributaries (Butterfield Creek, Deer Creek, Third Creek, and North Creek), engineered ditch systems (such as Lansing Ditch and State Street Ditch), and numerous small lakes and wetlands (Figure 2-1). In total, over 65 miles of streams wind throughout 104 square miles of northeastern Illinois and three square miles of northwestern Indiana. Most streams of the Thorn Creek watershed flow from southwest to northeast from their origins in Eastern Will County to their confluence with Thorn Creek and continue to the Little Calumet River in southern Cook County. North Creek, however, flows west from its headwaters in northeastern Indiana, receiving additional drainage from the Lansing Ditch system and then meanders northwest to its junction with Thorn Creek (Figure 2-1). The TMDL watershed segments are identified on Figure 2-2.

The Thorn Creek watershed is further sub-divided into four sub-watersheds, each related to one of its major creeks. The Thorn Creek watershed drains more than 66,000 acres from the area encompassing the western most point near Frankfort, IL to its easternmost point in northwestern Indiana and from the southern most point outside of Monee, IL to the northern most point near South Holland, IL. General characteristics of the major streams within the Thorn Creek watershed are given in Table 2.1.

Table 2-1: Thorn Creek Watershed Stream Characteristics

Stream	Length (*approx. miles*)	Area drained (*square miles*)	Area drained (*acres*)
Butterfield Creek	16	26	16,356
Thorn Creek	17	32	20,441
Deer Creek	16	26	16,801
North Creek	12	20*	12,924

* An additional 3 square miles of the North Creek watershed exists in Northeastern Indiana. This TMDL report, however, covers only the Illinois portion of Thorn Creek watershed.

[1] United States Environmental Protection Agency (USEPA). 2007. What is a Watershed. Website accessed February 14, 2008. <http://www.epa.gov/owow/watershed/whatis.html>

Figure 2-1: Thorn Creek Watershed Overview

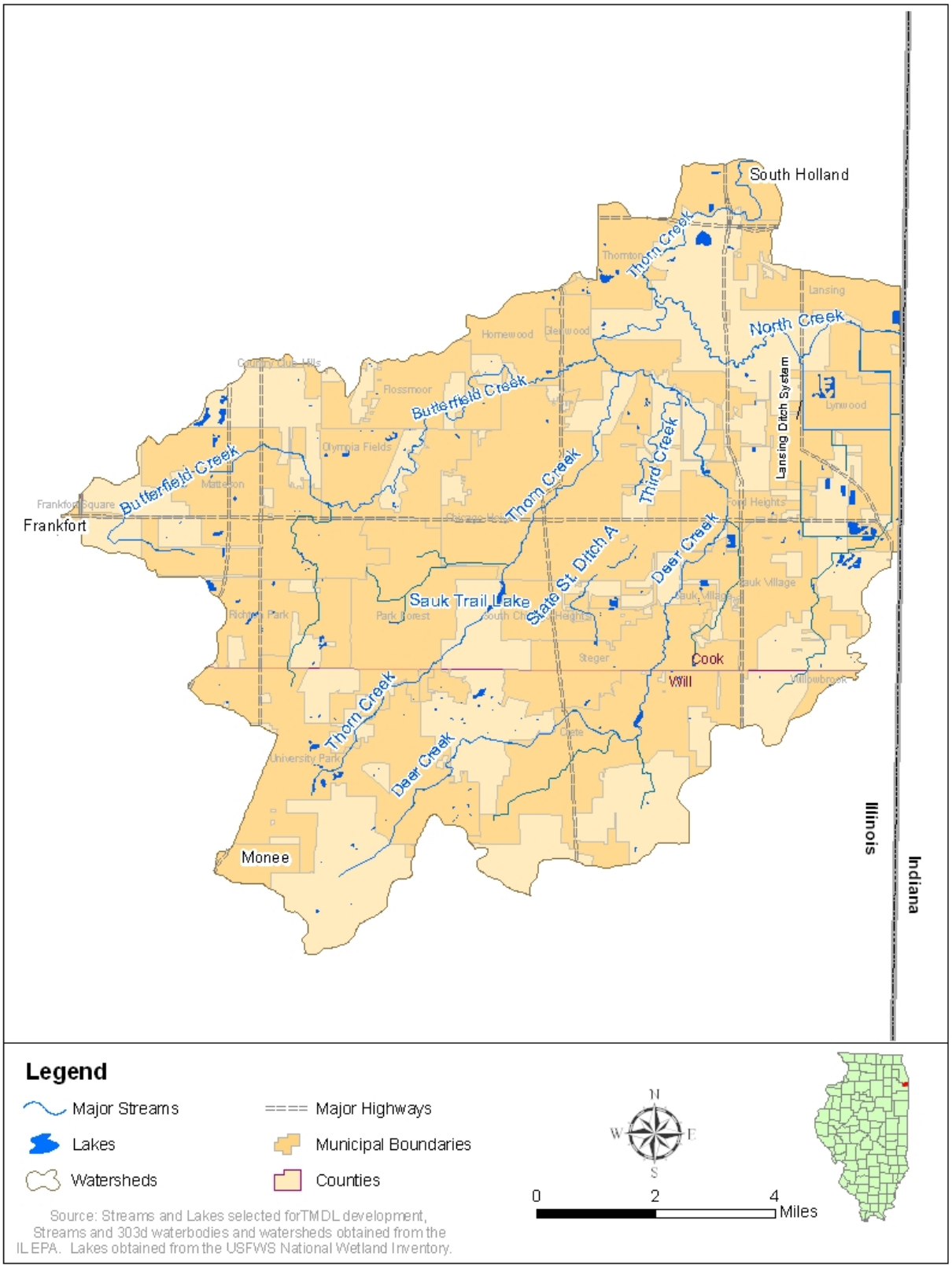
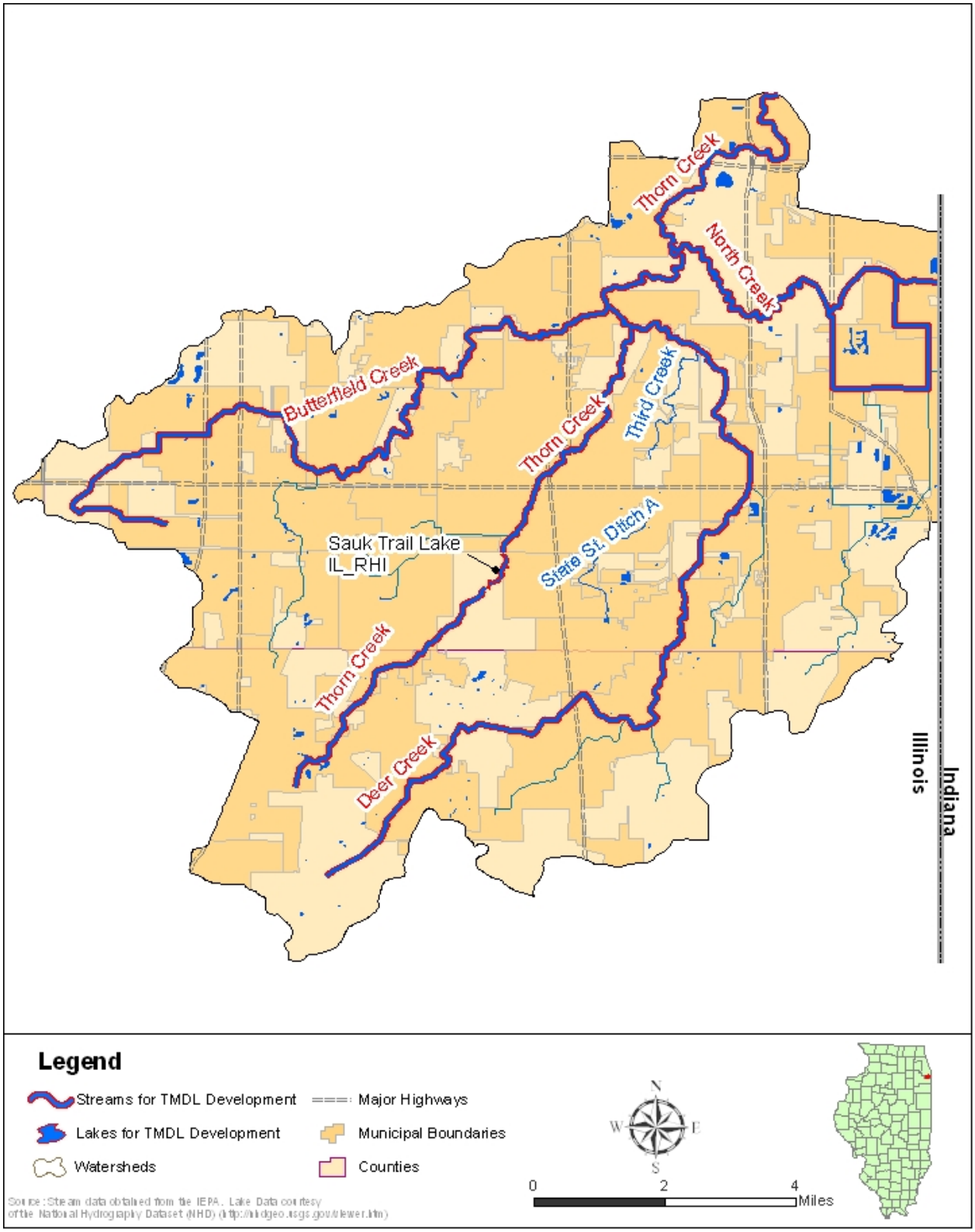


Figure 2-2: Thorn Creek Watershed TMDL Waterbodies



2.2 Topography

Topography influences soil types, precipitation, and subsequently watershed hydrology and pollutant loading. For the Thorn Creek watershed, a USGS 30-meter resolution Digital Elevation Model (DEM) was obtained from the Illinois Natural Resources Geospatial Data Clearinghouse to characterize the topography. Figure 2-3 displays elevations in color ramp throughout the watershed.

The land surface of the Thorn Creek watershed owes its relief to two major influences: large ancient waterbodies and glaciation events. The result is two distinct physiographic regions that are still apparent despite modern developments.

The northeastern third of the watershed is relatively flat, interrupted only by two beach ridges (the Calumet and the Glenwood). This area marks the southernmost edges of the Chicago Lake Plain and moraines associated with the Wisconsonian Glaciation. Hundreds of millions of years ago, before the glaciers, this area was part of an inundated basin covered by warm, shallow seas: the remains of which are still found as fossil evidence in the Thornton quarries and throughout the basin. Later, waters left behind by the last retreat of the glaciers formed prehistoric Lake Chicago; the remnant of these waters became Lake Michigan.

Located on the Chicago Lake Plain and north of the creek's connection to the Lansing Ditch system, North Creek meanders slowly along 12 miles from the Indiana border. North Creek's average channel slope is just over 1 foot per mile, with only 14 feet difference between its 610 feet elevation at the Indiana border and the 596 feet of elevation at its junction with the main stem of Thorn Creek. The North Creek watershed consists of the main stem of North Creek (flowing from east to west) and the Lansing Ditch system (flowing from south to north; linking twice to North Creek). The Lansing Ditch system was originally engineered in 1862 to improve farming opportunities and alleviate drainage problems by channeling off excess waters to North Creek. North Creek has cut a relatively wide, shallow, meandering channel from east to west across the northeastern portion of the Thorn Creek watershed.

The southwestern two-thirds of the watershed is a broad upland that is the result of glaciations. Composed of the Tinley and the Westmont Moraines, as well as, other associated ground moraines of the Valparaiso system, the topography is rolling and deeply cut by Butterfield, Thorn and Deer Creeks. The southern-most boundary of this portion marks the historic mid-continental divide between the Great Lakes/North Atlantic and Mississippi/Gulf of Mexico watersheds[2]. Rain falling in the Thorn Creek watershed has the Great Lakes (and North Atlantic) as its ultimate destination: rain falling south and south west of this boundary, is directed, ultimately, to the Mississippi River and on to the Gulf of Mexico.

Butterfield Creek, in the southwestern most portion of the watershed, is approximately 16 miles long and drains about 26 square miles (16,356 acres). It has a moderate channel slope of 5-8 feet per mile, and like Thorn and Deer creeks, it has a small but well-defined valley[3]. From the headwaters just outside of Frankfort, IL to its junction with the main stem of Thorn Creek, Butterfield Creek is entirely within Illinois. Butterfield Creek flows from southwest to northeast; from the upland out onto the Chicago Lake Plain.

The main stem of Thorn Creek also flows from the southwestern upland out onto the Chicago Lake Plain as it joins the Little Calumet in the northeast carrying the aggregate drainage of the entire watershed. Thorn Creek's headwaters begin in the Westmont moraine just south of University Park, continue along the western margin of glacial period Lake Steger, cross the Tinley moraine at a low point in Chicago Heights, and enter the Little Calumet River after traversing about six miles of the Lake Chicago Plain.

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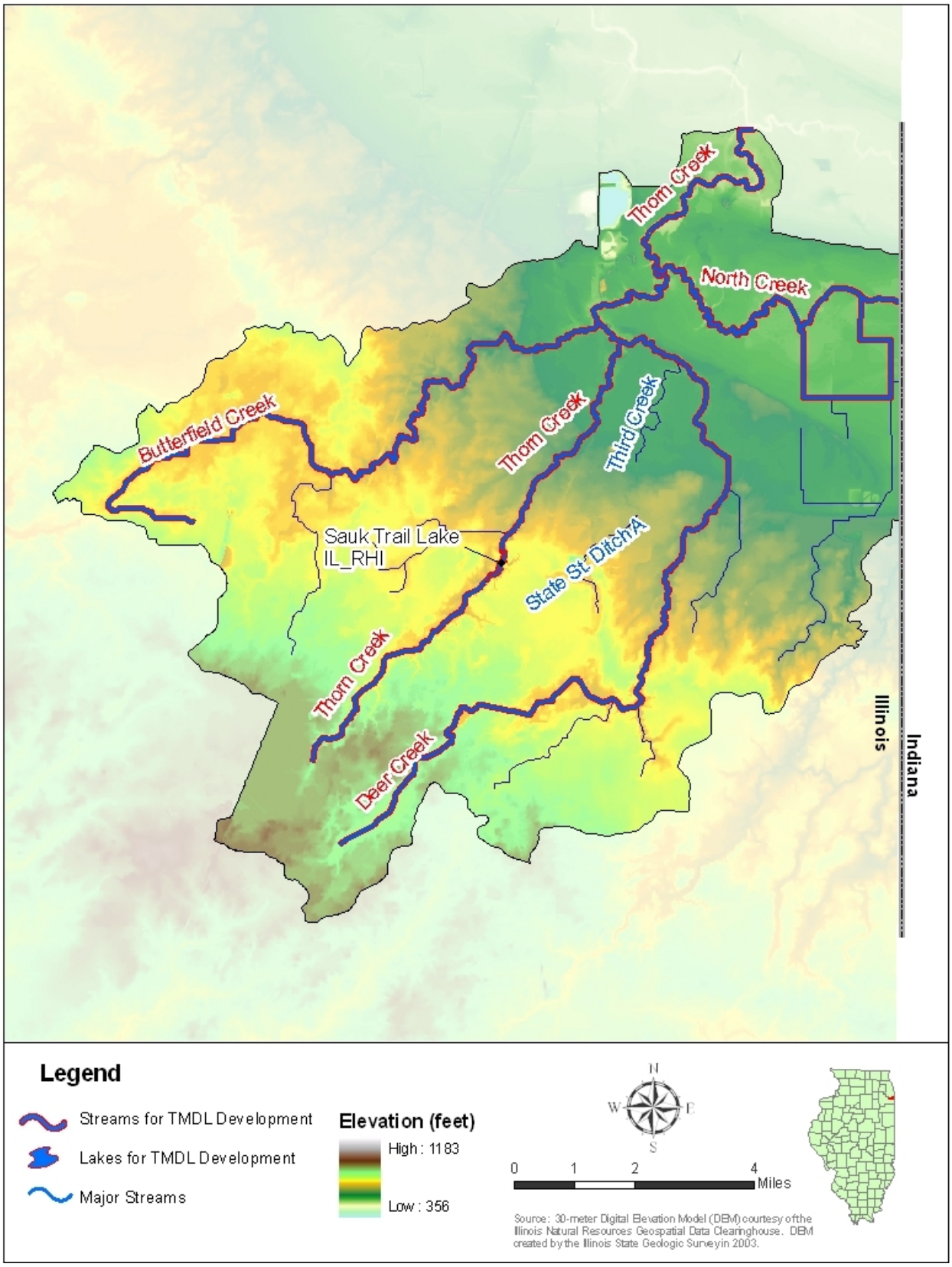
[2] A Watershed Plan for Thorn Creek in Southern Cook County & Eastern Will County, Illinois. 2000.

[3] Illinois Department of Natural Resources. 2000. Thorn Creek: An Inventory of the Regions Resources.

Figure 2-3: Thorn Creek Watershed Digital Elevation Model (DEM)



The elevation change from the headwaters, at 790 feet, to its confluence with the Little Calumet, at 585 feet, gives an average channel slope gradient of 10 feet per mile. However, unlike North Creek's gradual channel slope over its length, Thorn Creek has a substantial difference in the channel gradient occurring in the upland moraine portion of the watershed as compared to the gradient occurring on the Chicago Lake Plain. On the plain the gradient is less than 3 feet per mile, while the gradient on the upland portions is over 17 feet per mile[4]. This pattern of stream channel gradient change, from upland gradient to lake plain gradient, is repeated in Butterfield and Deer Creeks as well.

Deer Creek's general orientation is from the southwest to northeast. This 16 mile creek drains about 26 square miles (16, 801 acres). Its headwaters lie in an area between the Wheaton and Westmont moraines in the southeastern most portion of the watershed. The difference in headwater elevation (748 ft.) and the elevation at its junction with the main stem of Thorn Creek (608 ft.) give an average stream channel slope gradient of about nine feet per mile.

2.3 Land Use

Land use is as dynamic as the water moving throughout a watershed. It is constantly changing and has a large impact on the water quality within a watershed. Land use data for the watershed were extracted from the Illinois Gap Analysis Project (IL-GAP) Land Cover data layer. IL-GAP was started at the Illinois Natural History Survey (INHS) in 1996, and the land cover layer was the first component of the project. The IL-GAP Land Cover data layer is a product of the Illinois Interagency Landscape Classification Project (IILCP), an initiative to produce statewide land cover information on a recurring basis cooperatively managed by the United States Department of Agriculture National Agricultural Statistics Service (NASS), the Illinois Department of Agriculture (IDA), and the Illinois Department of Natural Resources (IDNR). The land cover data were generated using 30-meter grid resolution satellite imagery taken during 1999 and 2000. The IL-GAP Land Cover data layer contains 23 land cover categories, including detailed classification in the vegetated areas of Illinois.

Thorn Creek watershed's original landscape of prairie, forest-savanna mosaics, and wetlands gave way to agricultural use beginning as early as 1820[3]. By the 1860's farmers were actively engineering a ditch system in the Lansing/Lynwood area of the Chicago Lake Plain in order to improve drainage and increase the agricultural usability of the land. Changes in land use from natural areas to agricultural to urban have been steadily progressing.

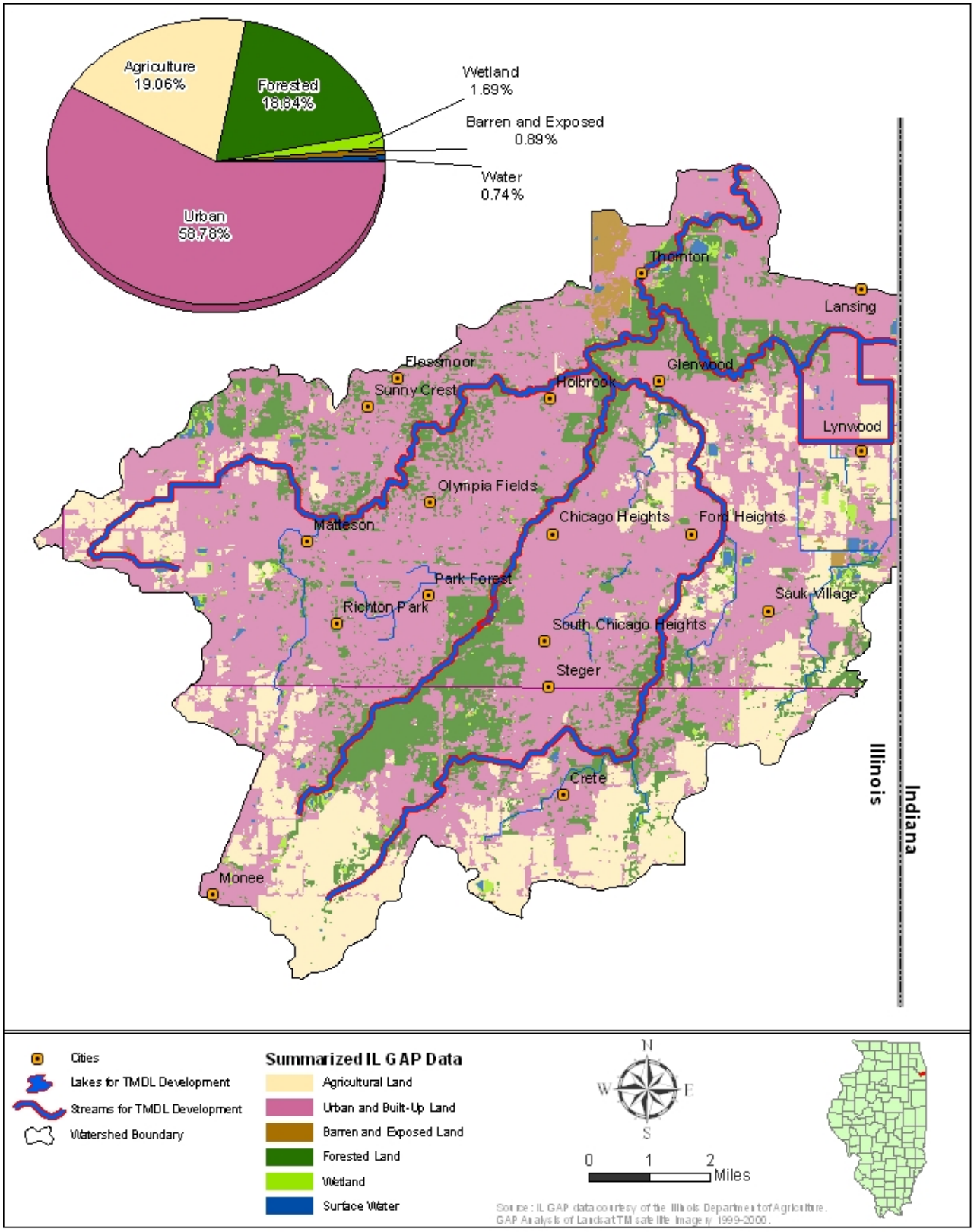
Current land use statistics for the Thorn Creek watershed were determined using IL-GAP data obtained from the Illinois Department of Agriculture (http://www.agr.state.il.us/gis). Today, the Thorn Creek watershed is over 58% Urban and built-up land and 19% agricultural. Forested Lands (including remnants of partial canopy/savannah mosaics) also comprise approximately 19% of the land usage. This is a slightly higher percentage than would be expected, as the entire state of Illinois as a whole reports only 11% forested lands, and is due largely to early purchases by both Will and Cook County Forest Preserves. About 2% of the land use is wetlands and surface waters represent less than 1% of the total land surface. A breakdown of land use classification types given in Table 2.2 and a map of current land uses is provided in Figure 2-4.

[4] Thorn Creek Watershed Based Plan. 2005.

Table 2-2: Summary of IL-GAP Data for the Thorn Creek Watershed

IL GAP Classification	Acreage	Percent	Summary for Land Use Group
Urban and built-up land: Urban open space	17,100	25.5%	Urban and Built-Up 39,100 acres 58.8%
Urban and built-up land: Low/Medium density: Medium	14,000	20.8%	
Urban and built-up land: Low/Medium density: Low	4,000	6.4%	
Urban and built-up land: High density	4,000	6.1%	
Agricultural land: Corn	5,000	7.5%	Agricultural Land 12,768 acres 19.1%
Agricultural land: Soybeans	4,500	6.8%	
Agricultural land: Rural grassland	3,000	4.3%	
Agricultural land: Other small grains and hay	250	0.4%	
Agricultural land: Winter wheat	11	<0.1%	
Agricultural land: Other agriculture	7	<0.1%	
Forested land: Partial canopy/Savanna upland	4,700	7.1%	Forested Land 12,768 acres 18.8%
Forested land: Upland: Mesic	4,600	6.9%	
Forested land: Upland: Dry-Mesic	3,200	4.8%	
Forested land: Coniferous	16	<0.1%	
Wetland: Shallow marsh/Wet meadow	600	0.9%	Wetland 1,080 acres 1.7%
Wetland: Floodplain forest: Wet	250	0.4%	
Wetland: Floodplain forest: Wet-Mesic	100	0.2%	
Wetland: Shallow water	100	0.2%	
Wetland: Deep marsh	30	<0.1%	
Other: Barren and exposed land	600	0.9%	Barren and Exposed Land 600 acres 0.9%
Other: Surface water	500	0.7%	Surface Water 500 acres 0.7%

Figure 2-4: Thorn Creek Watershed Land Use Map



2.4 Soils

Soils data and Geographic Information Systems (GIS) files from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the Thorn Creek watershed. General soils data and map unit delineations for the country are provided as part of the Soil Survey Geographic (SSURGO) database. Field mapping methods using national standards are used to construct the soil maps in the SSURGO database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping prepared by the NRCS. A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverage can be linked to a database that provides information on chemical and physical soil characteristics. The SSURGO database contains many soil characteristics associated with each map unit. Of particular interest are the hydrologic soil group and the K-factor of the Universal Soil Loss Equation (USLE).

The SSURGO data was analyzed based on drainage class, hydrologic group and K-factor. The drainage class, as stated in the SSURGO database is, "…the natural drainage condition of the soil [which] refers to the frequency and duration of wet periods".[5] Figure 2-5 exhibits the drainage classes of SSURGO data in the Thorn Creek watershed. However, some excessively drained areas can be found on the slopes near streams. These excessively drained areas may be in part due to the natural geology or pipes leading into the stream, built for anthropogenic outfalls. In general, however, the majority of the watershed is well drained.

The hydrologic soil group classification identifies soil groups with similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. The United States Department of Agriculture (USDA) has defined four hydrologic groups (A, B, C, or D) for soils. Type A soil has high infiltration while D soil has very low infiltration rate. Figures 2-6 show the distribution of hydrologic soil groups. Generally, areas to the east along the Indiana border have a moderately slow infiltration rate (hydrologic group C) with very poorly drained areas along the western border of the watershed. The central portion of the watershed is mostly hydrologic group B with a moderately high infiltration rate and corresponds to the well drained areas. Unfortunately, no data are available for some of central portions of the watershed.

A commonly used soil attribute of interest is the K-factor, a dimensionless coefficient used as a measure of a soil's natural susceptibility to erosion. Factor values may range from 0 for water surfaces to 1.00 (although in practice, maximum K-factor values do not generally exceed 0.67). Large K-factor values reflect greater potential soil erodibility.

The compilation of K-factors from the SSURGO data was done in several steps. Soils are classified in the SSURGO database by map unit symbol. Each map unit symbol is made up of components consisting of several horizons (or layers). The K-factor was determined by selecting the dominant components in the most surficial horizon for each map unit. The distribution of K-factor values in the Thorn Creek watershed is shown in Figure 2-7.

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[5] Soil Survey Staff. "Spatial and tabular data of the Soil Survey for Cook, DeKalb, DuPage, Grundy, Kane, Kendall, Lake, LaSalle, Lee, McHenry, and Will Counties, IL". United States Department of Agriculture (USDA), Natural Resources Conservation Service. Fort Worth, TX. Website accessed January 2008. <http://soildatamartnrcs.usda.gov/>

Figure 2-5: Thorn Creek Watershed SSURGO Drainage Class

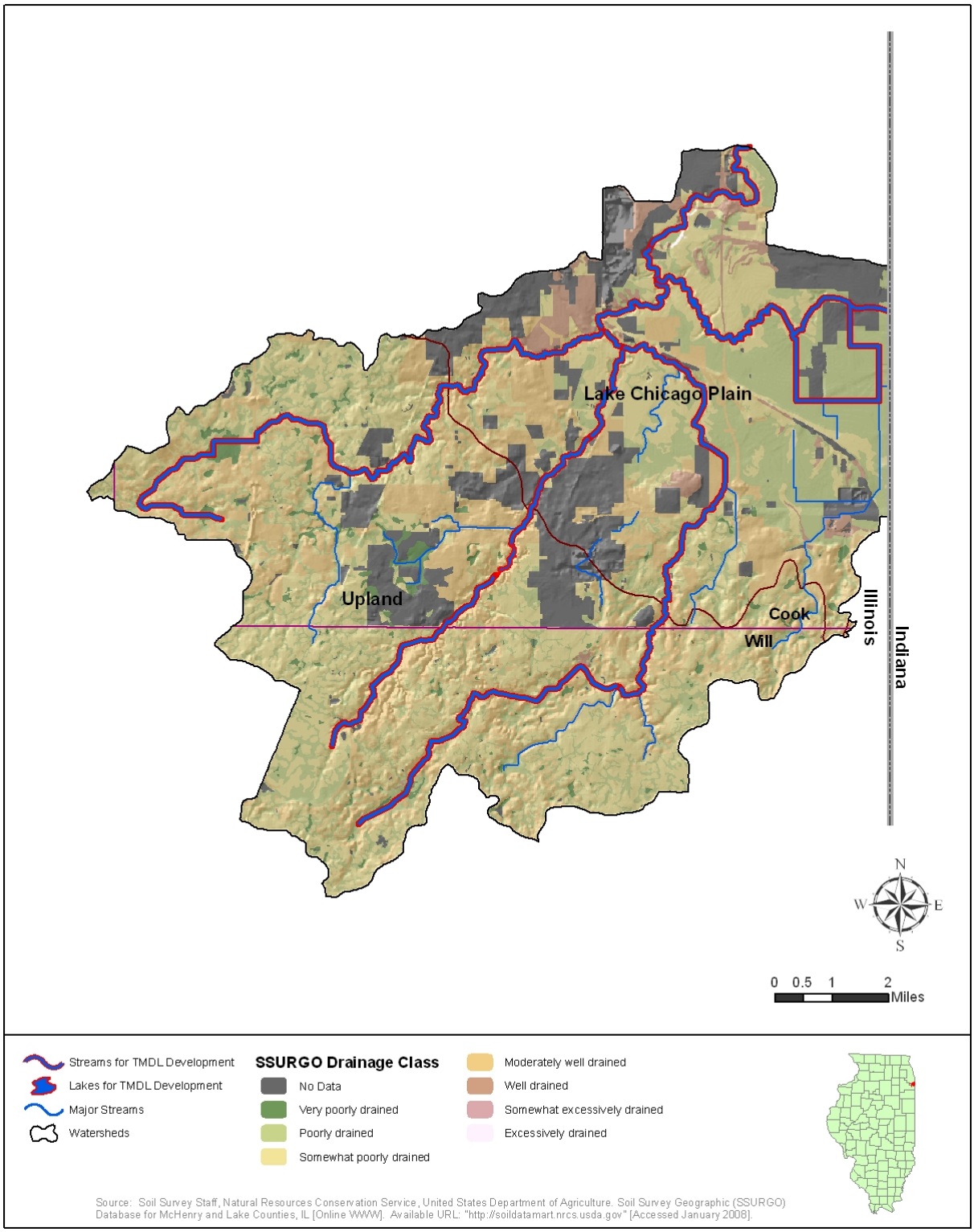


Figure 2-6: Thorn Creek Watershed SSURGO Hydrologic Group

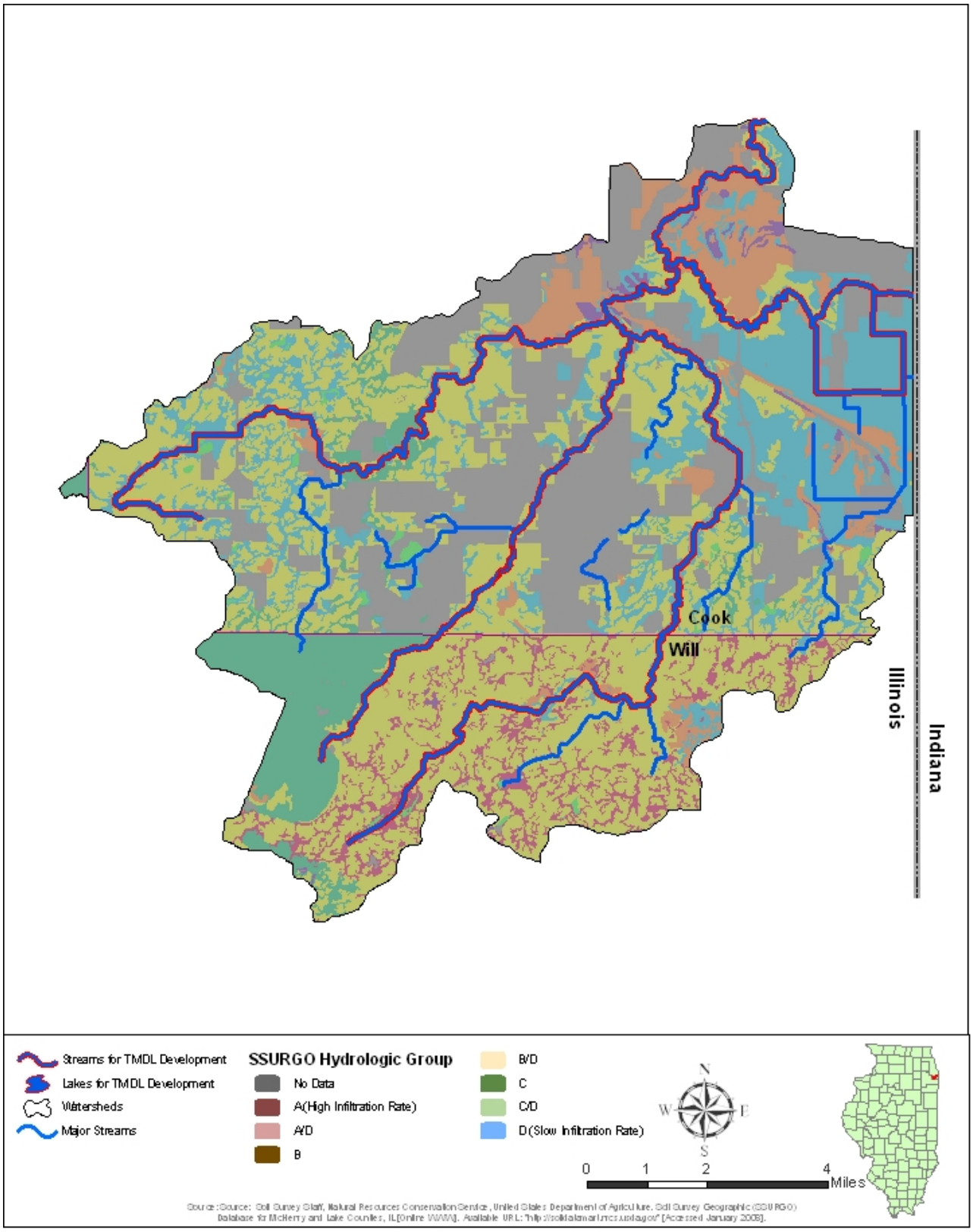
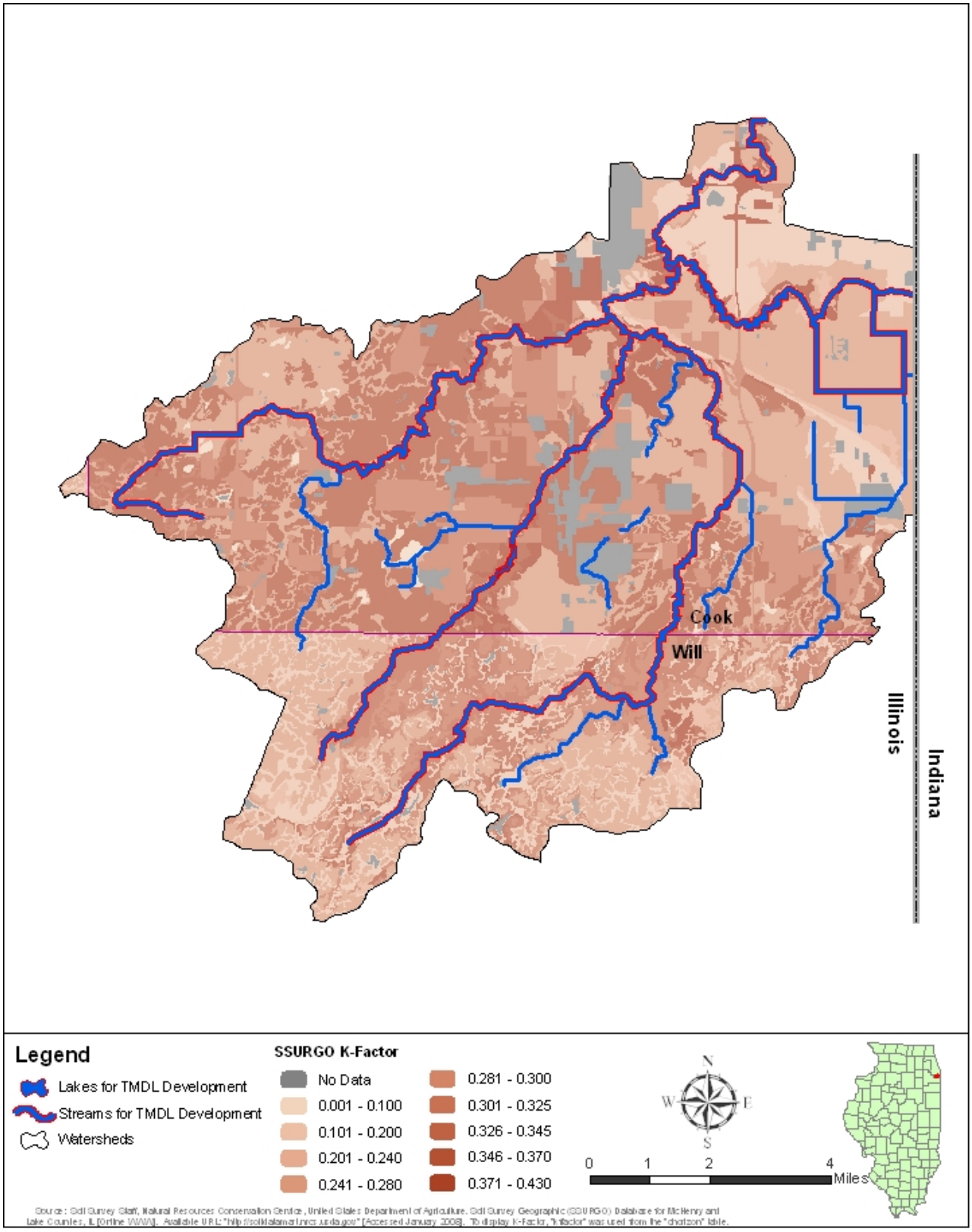


Figure 2-7: Thorn Creek Watershed SSURGO K-Factor

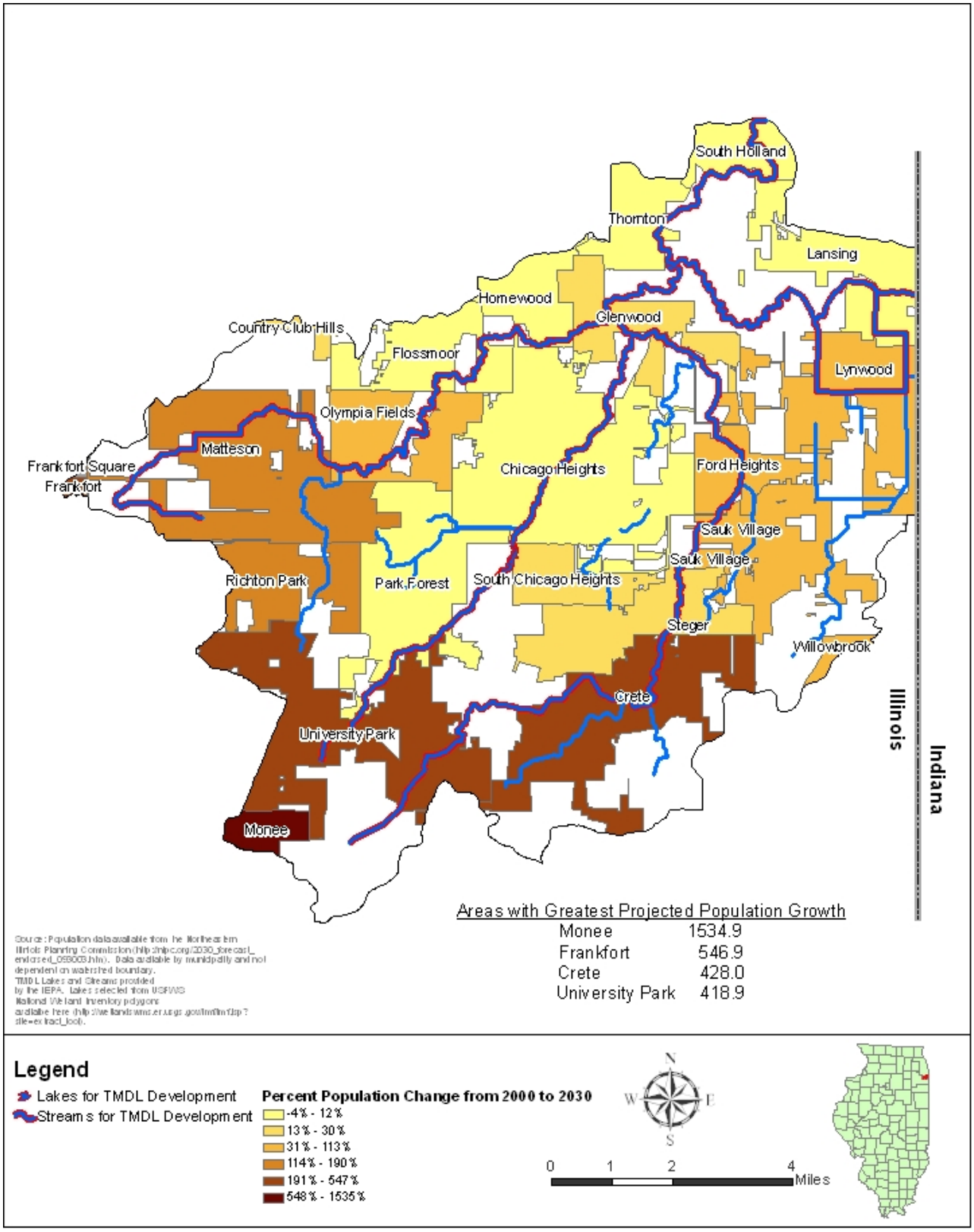


2.5 Population

Census 2000 data in format of TIGER/Line Shape file were downloaded to analyze the population in the Thorn Creek watershed. According to the 2000 Census, approximately 200,000 people reside in the Thorn Creek watershed; giving an average population density of about 1,900 people per square mile. Areas with the greatest population are in the north and central parts of the watershed including Chicago Heights, South Holland, Lansing and Park Forest.

Based on the Northern Illinois Planning Commission's (NIPC) 2030 forecasts (Figure 2-8), both Cook and Will counties are expected to increase their populations in the coming decades. Cook County is expected to increase by an estimated 10%. Will County is anticipated to rise from 500,000 to over a million, an estimated 114%. Although only about 1/3 of the watershed is in Will County, the impacts from such an increase are already underway as the once rural areas around Frankfort, Matteson, Richton Park and Monee develop new housing, undergo shopping mall redevelopments and light industry expansions. Predictions for Monee alone show over a 1,500% increase from 2000 census to 2030.

Figure 2-8: Thorn Creek Watershed Population Projection



2.6 Precipitation

Northeastern Illinois has a continental climate with highly variable weather. The temperatures of continental climates are not buffered by the influence of a large waterbody (like an ocean, inland sea or Great Lake). Areas with continental climates often experience wide temperature fluctuations throughout the year. For Thorn Creek watershed, the highest temperatures in the summer can range from high 80s to over 100 degrees Fahrenheit and the lowest winter temperatures might range between sub-zero and the teens. The average temperatures, however, will range from the 20s in winter to the mid 70s in summer (Table 2-3). Precipitation in the form of rainfall is greatest in the growing season (April through September; Figure 2-9). Snow fall averages less than one foot in any given month[6].

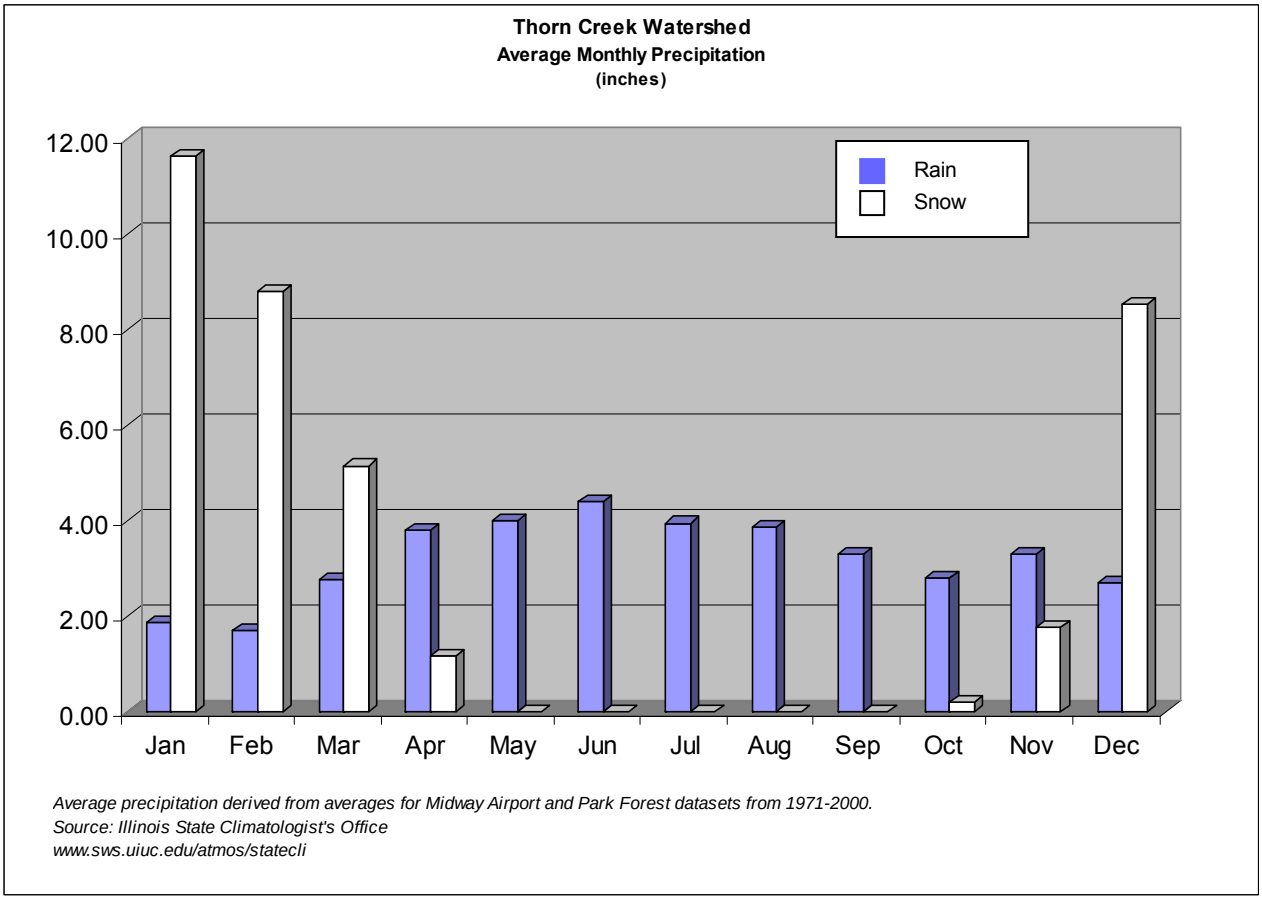
Table 2-3: Park Forest, Illinois Temperature Threshold Climatology

Temperature Threshold Climatology: Park Forest
Derived from 1971-2000 Averages
(Annual/seasonal values may differ from the sum of the monthly values due to rounding.)
http://www.sws.uiuc.edu/atmos/statecli

Month	# Days High ≥ 90°F	# Days High ≤ 32°F	# Days Low ≤ 32°F	# Days Low ≤ 0°F	AVG Temp *(0°F)*
January	0	18.2	29.4	5.9	22
February	0	11.9	24.8	3	27.2
March	0	4.2	21	0.1	37.7
April	0	0.2	7.5	0	48.8
May	0.7	0	0.6	0	60
June	3.6	0	0	0	69.8
July	5.8	0	0	0	74.2
August	3.3	0	0	0	72.4
September	1.1	0	0.1	0	65
October	0	0	4.6	0	53.1
November	0	2.3	16.5	0	40.2
December	0	11	27.2	2.6	28
Annual	14.5	47.8	132	11.6	50
Winter	0	41.2	81.4	11.5	26
Spring	0.7	4.4	29.2	0.1	49
Summer	12.8	0	0	0	72
Fall	1.1	2.3	21.1	0	53

[6] Illinois State Climatologists Office. 2005.

Figure 2-9: Thorn Creek Watershed Average Precipitation



2.7 Hydrology

Understanding how water moves and flows is an important component of understanding a watershed. All of the parameters listed in the previous sections (i.e. topography, soils, and precipitation) impact hydrology. Hydrologic data are available from the USGS website[7]. The USGS maintains stream gages throughout the U.S. and they monitor conditions such as gage height, stream flow, and at some locations, precipitation.

Since 1948, the USGS has monitored seven stream gages along Thorn, Deer, Butterfield and North Creeks, as well as the Lansing Ditch system (Figure 2-10). All of these gages lie in the Lake Chicago Plain area in the northern third of the watershed. By 1948 this portion of the watershed already had urbanized development around the main channels; therefore, there is no baseline dataset that accurately reflects the natural flow conditions of the streams prior to their urbanization.

Analyses of monthly stream flow datasets presented in the 2005 Thorn Creek Watershed-based Management Plan show that the seasonal flow trend of the creeks follows the general precipitation pattern for the area: highest flows in April and the lowest flows in October. Base flow analysis, taking into consideration the influence of the Thorn Creek Basin Sanitary District, shows that apparent increases in base flow were due primarily to the wastewater treatment plant's (WWTPs) increased effluent flows, for those portions of Thorn

[7] United States Geological Survey. 2008. www.usgs.gov. Website accessed September 2008.

Creek downstream of the WWTP in Chicago Heights. Effluent discharge increases from the Aqua of Illinois, University Park WWTP probably account for a similar pattern of increases in base flow for Deer Creek as well.

In 1979 the USGS abandoned many stream gages throughout the United States[8]. During this time, two Thorn Creek watershed gages were inactive; 05536210 (Thorn Creek near Chicago Heights, IL just upstream of the Thorn Creek Basin WWTP) and 05536270 (North Creek near Lansing IL). In the case of 05536210 (active only from 1965 to 1979), the Thorn Creek Basin WWTP is so close to the original gage site that the plant's own entry data makes the USGS gage effort repetitive. The gage at the western most confluence of the Lansing Ditch system with North Creek (05536270) showed an average difference of only seven cubic feet per second (cfs) from the gage at Lansing Ditch near Lansing, IL (05536265) for most of its 1948-1979 dataset. Around this same time, the peak flows for the gage at Lansing Ditch tend to remain between 100 and 250 cfs. Although it might be surmised that the overall measurements were redundant or that some regulating entity came on line at this time, no record remains with the USGS to explain its decision to abandon one gage over another.

The highest peak flow recorded for the gage at Lansing Ditch near Lansing, IL (05536265) was in July of 1957, at 4,700 cfs. The average peak flow for any given year was 190 cfs. The waters flowing from the Lansing Ditch system into North Creek and North Creek waters flowing from the east (including water from the Indiana portion of the watershed) enter the main stem of Thorn Creek above the Thorn Creek Basin WWTP. Although the mean annual flow fluctuates from year to year (depending on the annual precipitation) the average is about eight cfs with no apparent trend over time.

The gage on Deer Creek near Chicago Heights, IL (05536235) has operated continuously since 1948 (Figure 2-11). The highest peak flow recorded was also in July of 1957, at 1,380 cfs. The average peak flow for any given year is about 584 cfs. The only WWTP on Deer Creek is in University Park, about 2.5 miles from its headwaters. A quick look at the annual peak flows show that Deer Creek may have reacted to a regulation of its flow beginning around 1972: this coincides with the establishment of Aqua of Illinois' University Park WWTP. Deer Creek now shows its peak flows steadily between 400 and 900 cfs.

Butterfield Creek's gage (05536255 Butterfield Creek at Flossmoor), like the Deer Creek gage, has operated since 1948 (Figure 2-12). Its highest peak flow year was 2006 with 2,640 cfs. However, it must be noted that since 1992 all peak flows have carried the caveat that stream records are now affected by urbanization and channelization. A chart of the peak flow information from 1948 to the present shows increasing annual peak flow over time. The mean annual flow also shows an increasing trend over time, with a steeper rise occurring in the last 10 years (Figure 2-13). Butterfield Creek does not have a WWTP and the Frankfort, Matteson and Richton Park areas have converted agricultural lands to housing and shopping malls. The impermeable surfaces that have been added due to this development have contributed, in part, to an increase in runoff.

The main stem of Thorn Creek has datasets for three stream gages also stretching back to 1948. In 1979 the stream gage just upstream of the Thorn Creek Basin Sanitary District WWTP was made inactive. Currently, the main stem peak flows are being measured at a point just below the WWTP (05536215, Thorn Creek near Glenwood, IL) and have consistently shown a regulation by the WWTP (Figure 2-14). An examination of the peak flows recorded clearly show that, while higher annual peak flows are occurring, most peak flows remain between about 600 and 1,000 cfs. These recent data carry the caveat that the stream flows are affected by urbanization and channelization.

An additional stream gage, (05536275) Thorn Creek at Thornton, measures the Thorn Creek main stem flow after receiving the aggregate flow from Butterfield, Thorn, Deer, and North Creeks (including the Lansing ditch

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[8] Knapp, H.V. and M. Markus. 2003. Evaluation of the Illinois Streamflow Gaging Network. Prepared for the Illinois Department of Natural Resource.

system flow). These data include two or more peak flows for almost every year. When years containing two or more peak flow records are plotted for a maximum and minimum peak flow, the consistency of the minimum peak flow at around 1,000 cfs is clearly seen (Figure 2-14). The highest peak flow ever recorded is the July 1957 event also seen in the other creeks (4,700 cfs).

Over time, the Thorn Creek watershed as a whole may have higher high peak flows due to increasing urbanization, channelization and other reasons, but there is also more regulation of the stream flows by WWTPs and other uses.

Figure 2-10: Thorn Creek Watershed USGS Gaging Stations and Water Quality Stations

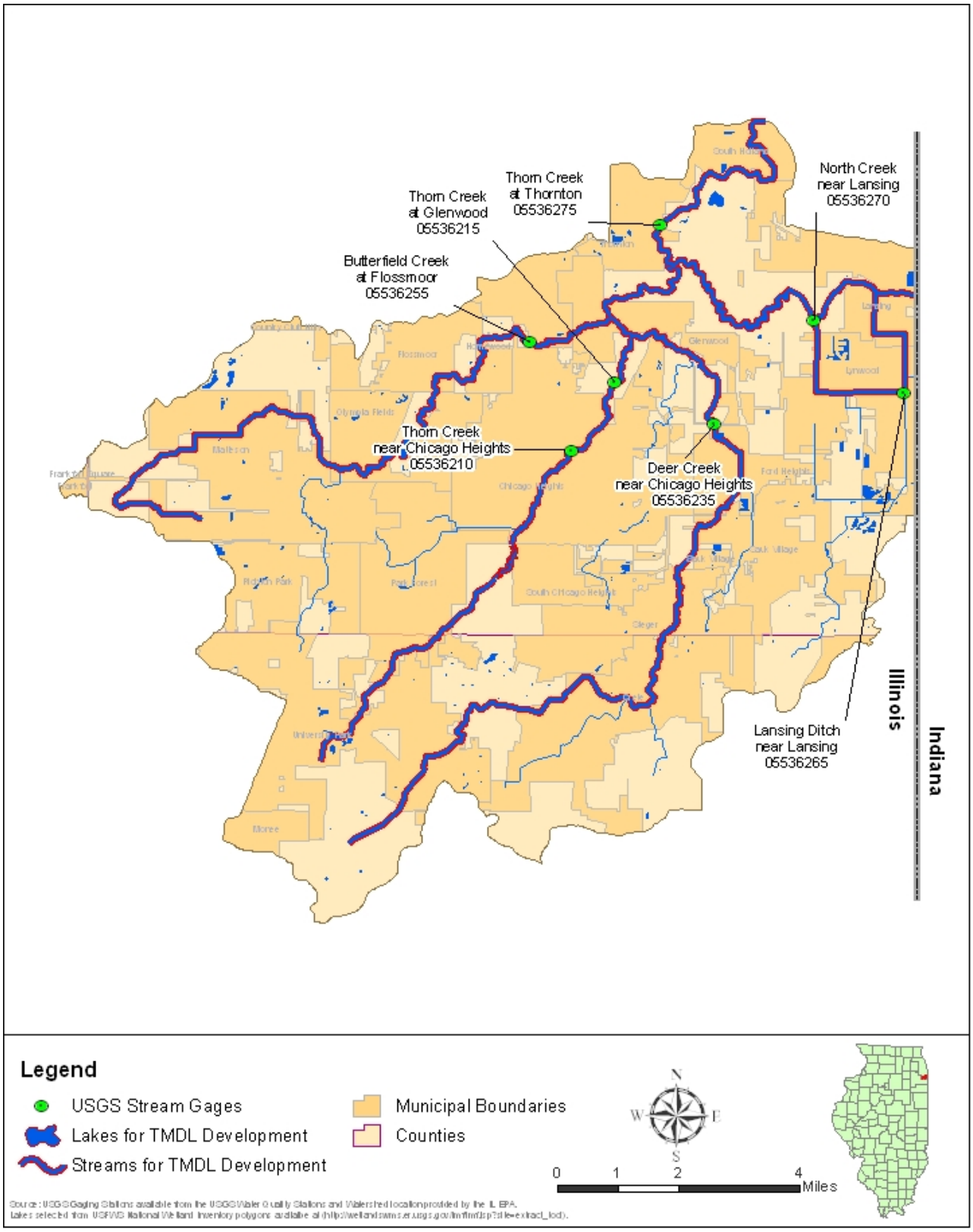


Figure 2-11: USGS Flow Records for Deer Creek near Chicago Heights, IL (1948-2006)

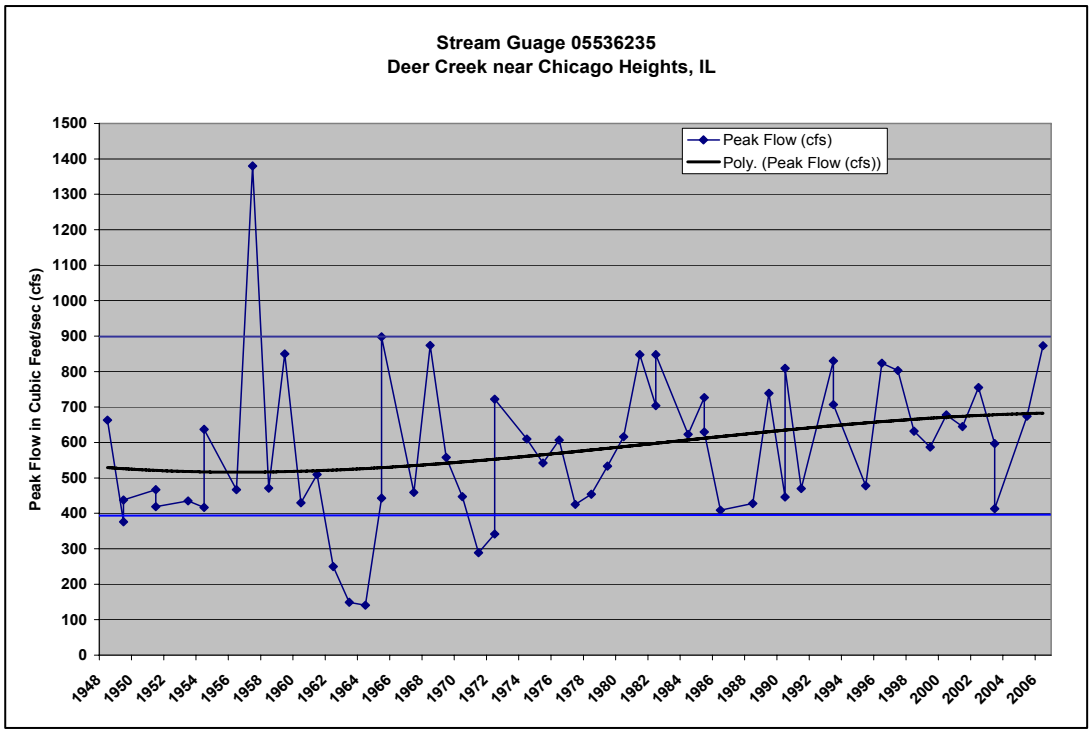


Figure 2-12: USGS Flow Records for Butterfield Creek at Flossmoor, IL (1948-2006)

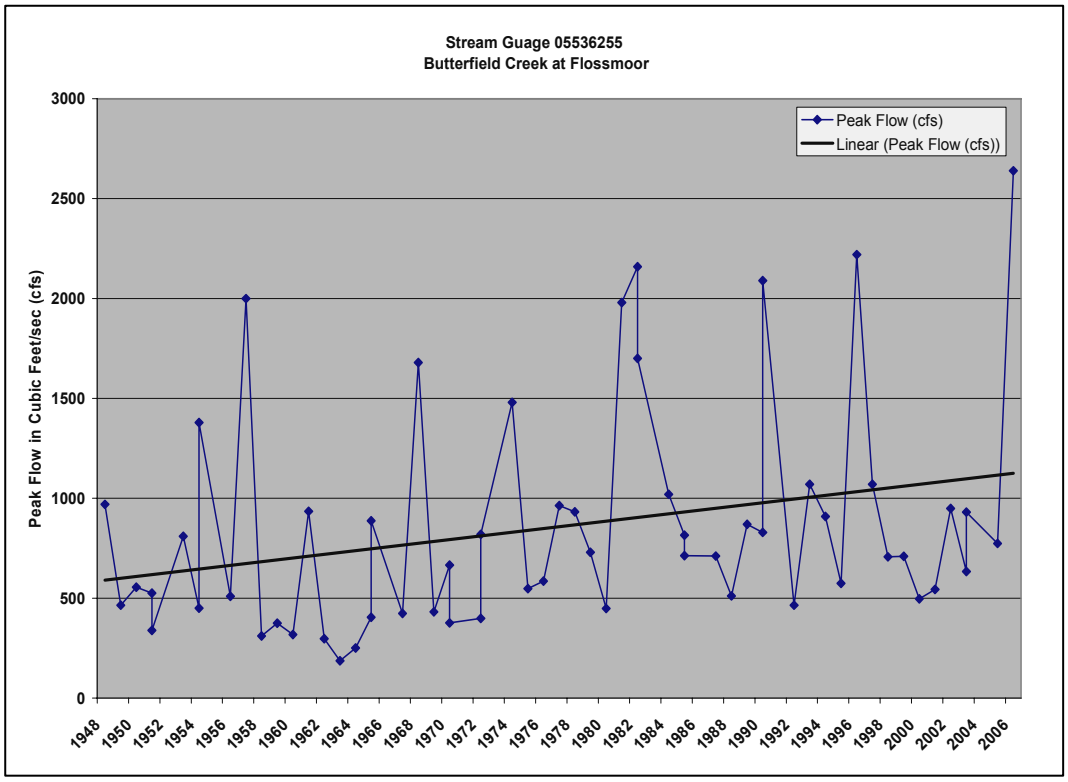


Figure 2-13: USGS Flow Records for Butterfield Creek at Flossmoor, IL (1948-2006)

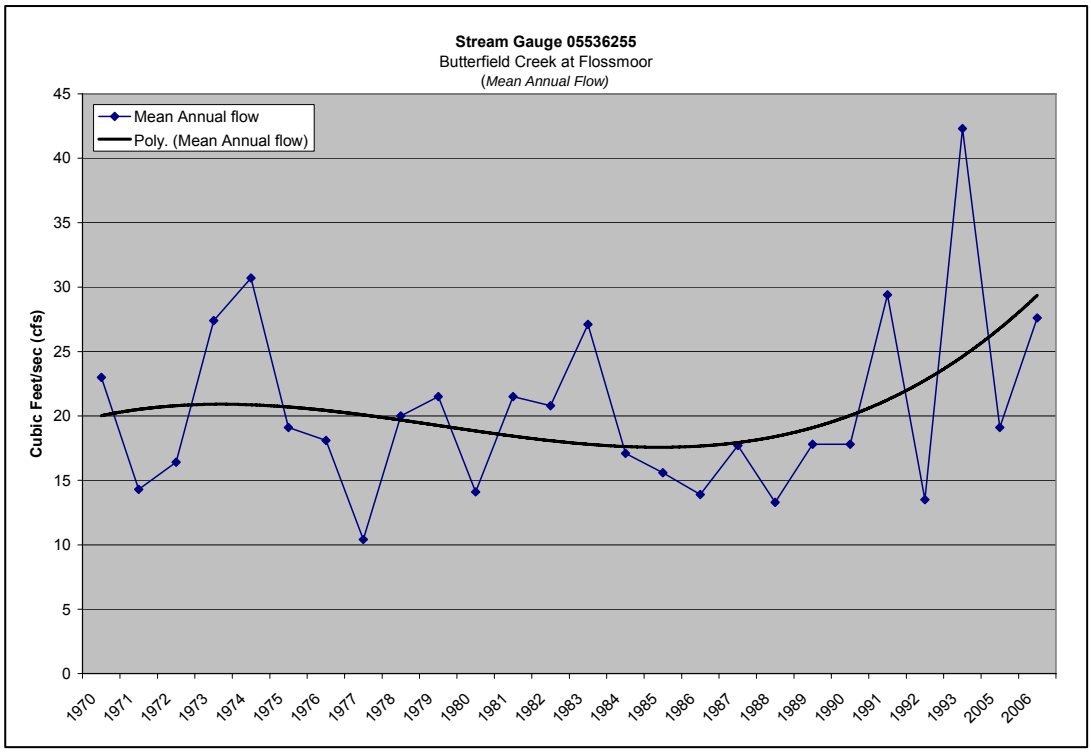
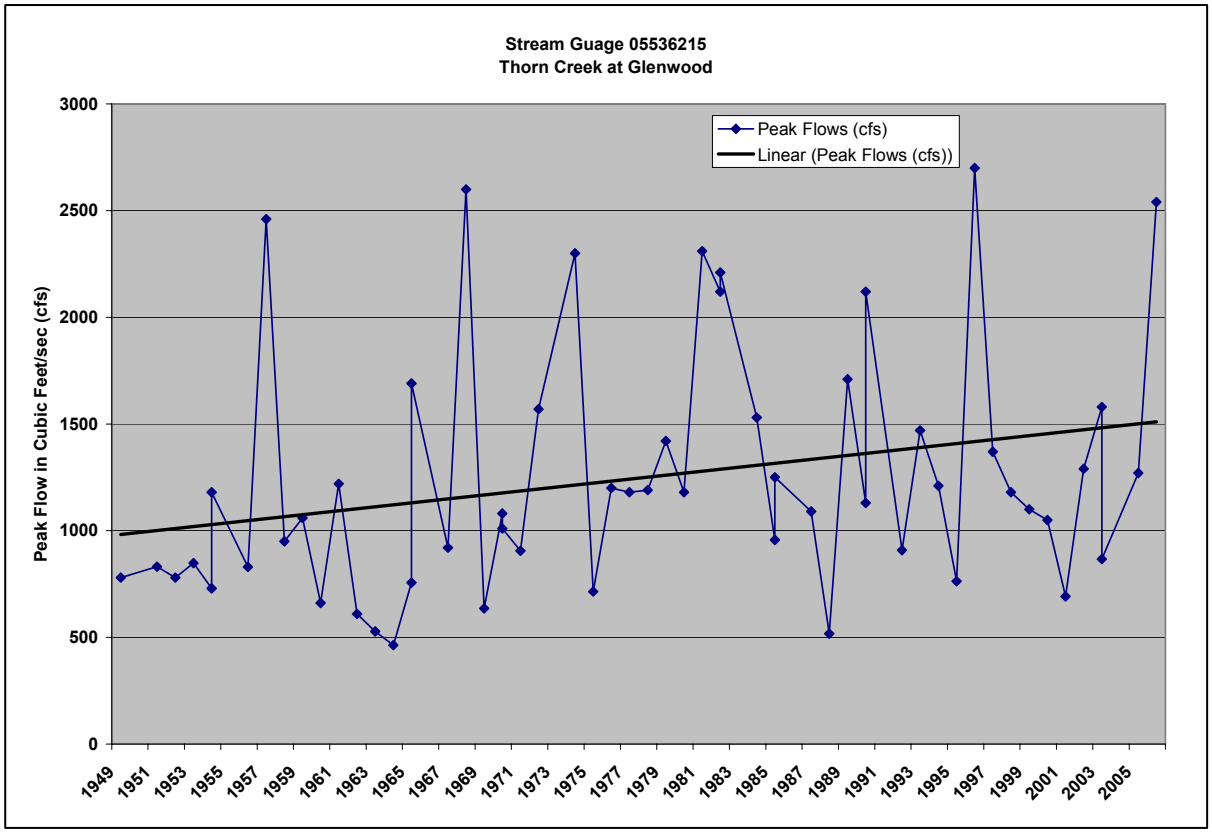


Figure 2-14: USGS Flow Records for Thorn Creek at Glenwood, IL (1949-2005)



3.0 Public Participation and Involvement

The IEPA is committed to keeping the watershed stakeholders and general public informed and involved throughout the TMDL process. Success for any TMDL implementation plan relies on a knowledgeable public to assist in follow-through required for attainment of water uses within their watershed. It is important to engage the local citizens as early in the process as possible by providing opportunities to learn and process information. This ensures that concerns and issues are identified at an early stage, so that they can be addressed and facilitate maximum cooperation in the implementation of the recommended courses of actions identified in the TMDL process. All stakeholders should have access to enough information to allay concerns, gain confidence in the TMDL process and understand the purpose and the regulatory authority or other responsible party that will implement recommendations.

IEPA, along with ENSR/AECOM, will hold up to two public meetings within the Thorn Creek watershed throughout the course of TMDL development. This section will be regularly updated following public meetings.

General information regarding the process of TMDL development in Illinois can be found at http://www.epa.state.il.us/water/tmdl. This link also contains paths to notice of public meetings and other TMDL-related watershed information for the entire state of Illinois.

Background learning about watersheds, watershed management, best management practices and the Clean Water Act (CWA) can be found on the EPA's water website at http://www.epa.gov/watertrain/.

For other reports and studies concerning the Thorn Creek watershed please visit the Illinois Rivers Decision Support System: Chicago/Calumet River watershed Investigation website: http://ilrdss.sws.uiuc.edu/. The website contains reports, data and additional links to other sources specifically related to this watershed.

4.0 Water Quality Standards and TMDL Targets

Water pollution control programs are designed to protect the beneficial uses of the water resources within the state. Each state has the responsibility to set water quality standards that protect these beneficial uses, also called "designated uses." Illinois waters are designated for various uses including aquatic life, wildlife, agricultural use, primary contact (e.g., swimming, water skiing), secondary contact (e.g., boating, fishing), industrial use, drinking water, food-processing water supply and aesthetic quality. Illinois' WQS provide the basis for assessing whether the beneficial uses of the state's waters are being attained.

4.1 Illinois Pollution Control Program

The Illinois Pollution Control Program (IPCB) is responsible for setting WQS to protect designated uses. The IEPA is responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. The Illinois WQS are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards. The federal CWA requires states to review and update WQS every three years. IEPA, in conjunction with U.S. EPA, identifies and prioritizes those standards to be developed or revised during this three-year period. The IPCB has established four primary sets (or categories) of narrative and numeric WQS for surface waters.

4.2 Designated Uses

The waters of Illinois are classified by designated uses, which include: General Use, Public and Food Processing Water Supplies, Lake Michigan, and Secondary Contact and Indigenous Aquatic Life Use[9]. The only waterbody classification applicable to the Thorn Creek watershed is the General Use classification.

General Use standards, as defined by IPCB, will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses and ensure the aesthetic quality of the state's aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use.

4.3 Applicable Illinois Water Quality Standards

To make 303(d) listing determinations for aquatic life uses, IEPA first collects biological data and if these data suggest that impairment to aquatic life exists then a comparison of available water quality data with WQS occurs. Table 4-1 summarizes the applicable water quality standards for the Thorn Creek watershed.

[9] Illinois Environmental Protection Agency (IL EPA), Bureau of Water, Illinois Integrated Water Quality Report and Section 303(d) List – 2008 (draft), Water Resources Assessment Information and Listing of Impaired Water, March.

Table 4-1: Applicable Water Quality Standards for the Thorn Creek Watershed

Parameter	Units	General Use Water Quality Standard
Chloride - Dissolved	mg/L	500*
Copper - Dissolved	mg/L	Acute – 0.07** Chronic – 0.04**
Dissolved Oxygen (above thermocline in thermally stratified waters or entire water column in unstratified waters)	mg/L	March – July 5.0 instantaneous minimum 6.0 as daily mean averaged over 7 days August – February 3.5 instantaneous minimum 4.0 as daily mean averaged over 7 days 5.5 as daily mean averaged over 30 days
Fecal Coliform	cfu/100 ml	200 geometric mean based on a minimum of 5 samples taken over any 30 day period; 400 maximum not to be exceeded in more than 10% of samples taken during any 30 day period.
pH	s.u.	6.5 – 9.0 except for natural causes
Phosphorus - Total	mg/L	0.05 in any reservoir or lake with a surface area of at least 20 acres or in any stream at the point where it enters any such lake or reservoir
Silver - Total	µg/L	5.0*
Zinc - Dissolved	µg/L	Acute – 336.6** Chronic – 64.6**

*Indicates protection of Human Health criteria.
**Standard is based on the average ambient hardness of the waterbody.

4.4 TMDL Targets

In order for a water body to be listed as Full Support, it must meet all of its applicable designated uses. Because WQS are designed to protect those designated uses, a pollutant's numeric WQS is therefore used as the target or endpoint for establishing a TMDL. Table 4-2 summarizes the targets that will be used in the TMDL development for the Thorn Creek watershed.

Table 4-2: TMDL Targets for Impaired Waterbodies in the Thorn Creek Watershed

Segment ID	Waterbody Name	Impairment	TMDL Target	Units
IL_HBD-02	Thorn Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Fecal Coliform	<200	cfu/100 ml
		Silver	<5.0	µg/L
		Zinc	<64.6	µg/L
IL_HBD-03	Thorn Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Fecal Coliform	<200	cfu/100 ml

Segment ID	Waterbody Name	Impairment	TMDL Target	Units
IL_HBD-04	Thorn Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Fecal Coliform	<200	cfu/100 ml
		Silver	<5.0	µg/L
		pH	6.5 – 9.0	s.u.
		Copper	<0.004	mg/L
		Chloride	<500	mg/L
IL_HBD-05	Thorn Creek	Fecal Coliform	<200	cfu/100 ml
		Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
IL_HBD-06	Thorn Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Fecal Coliform	<200	cfu/100 ml
		pH	6.5 – 9.0	s.u.
IL_HBDA-01	North Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
IL_HBDB-03	Butterfield Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Fecal Coliform	<200	cfu/100 ml
IL_HBDC	Deer Creek	Fecal Coliform	<200	cfu/100 ml
IL_HBDC-02	Deer Creek	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Fecal Coliform	<200	cfu/100 ml
IL_RHI	Sauk Trail	Dissolved Oxygen	>5.0 Mar-Jul, >3.5 Aug-Feb	mg/L
		Total Phosphorus	0.05	mg/L

5.0 Water Quality Assessment

Data were collected and reviewed from many sources in order to further characterize the Thorn Creek watershed. Data have been collected from surface waters and point and nonpoint sources. This information is presented and discussed in further detail throughout the remainder of this section.

5.1 Water Quality Data

The Thorn Creek watershed has 12 impaired segments within its drainage area, 10 of which are targeted for TMDL development. Available data used for assessing these waterbodies originated from 24 water quality stations within the Thorn Creek watershed. Figure 5-1 shows the water quality data stations within the watershed that contain data relevant to the impaired segments.

Data used for analysis are a combination of both legacy and modernized U.S. EPA Storage and Retrieval (STORET) databases, Thorn Creek Sanitary District data, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) data, and IEPA database data. The compiled database ranges from 1957 through 2007.

Data relevant to impairments were compiled for each impaired waterbody and summarized. The following parameters are grouped by impairment and discussed in relation to the relevant Illinois numeric WQS. For all assessments, compliance is determined at the surface of a stream or at the one-foot depth from the lake surface.

5.1.1 Dissolved Oxygen

The distribution of DO concentrations for each segment in the Thorn Creek watershed are presented in Figure 5-2. The water quality standard for DO includes a seasonal component. From March through July the instantaneous minimum is 5.0 mg/L, and the daily mean averaged over seven days must not be less than 6.0 mg/L. From August through February the instantaneous minimum is 3.5 mg/L, the daily mean averaged over seven days must not be less than 4.0 mg/L, and the daily mean averaged over 30 days must not be less than 5.5 mg/L. Data used for assessments ranged from 1959 to 2007.

5.1.2 Fecal Coliform

The distribution of fecal coliform for each impaired segment in the Thorn Creek watershed is presented in Figure 5-3. The WQS for fecal coliform is a 200 cfu/100ml geometric mean based on a minimum of five samples collected over any 30 day period or a 400 cfu/100ml maximum not to be exceeded in more than 10% of samples collected during any 30 day period. Due to the unlikelihood of having five fecal coliform samples per month upon which to judge compliance, a single exceedance of 400 cfu/100 ml is often interpreted as an instantaneous maximum. Data used for assessments ranged from 1970 to 2007.

5.1.3 Total Phosphorus

Compliance with the total phosphorus standard is based on samples collected at a one foot depth from the surface. The water quality standard for total phosphorus is a maximum concentration of 0.05 mg/L and is applicable only to lakes with a surface area of 20 acres or greater. The only impaired lake within the Thorn Creek watershed is Sauk Trail. Data, however, were not available for analysis.

Figure 5-1: Monitoring Stations Used for Assessing Impairments

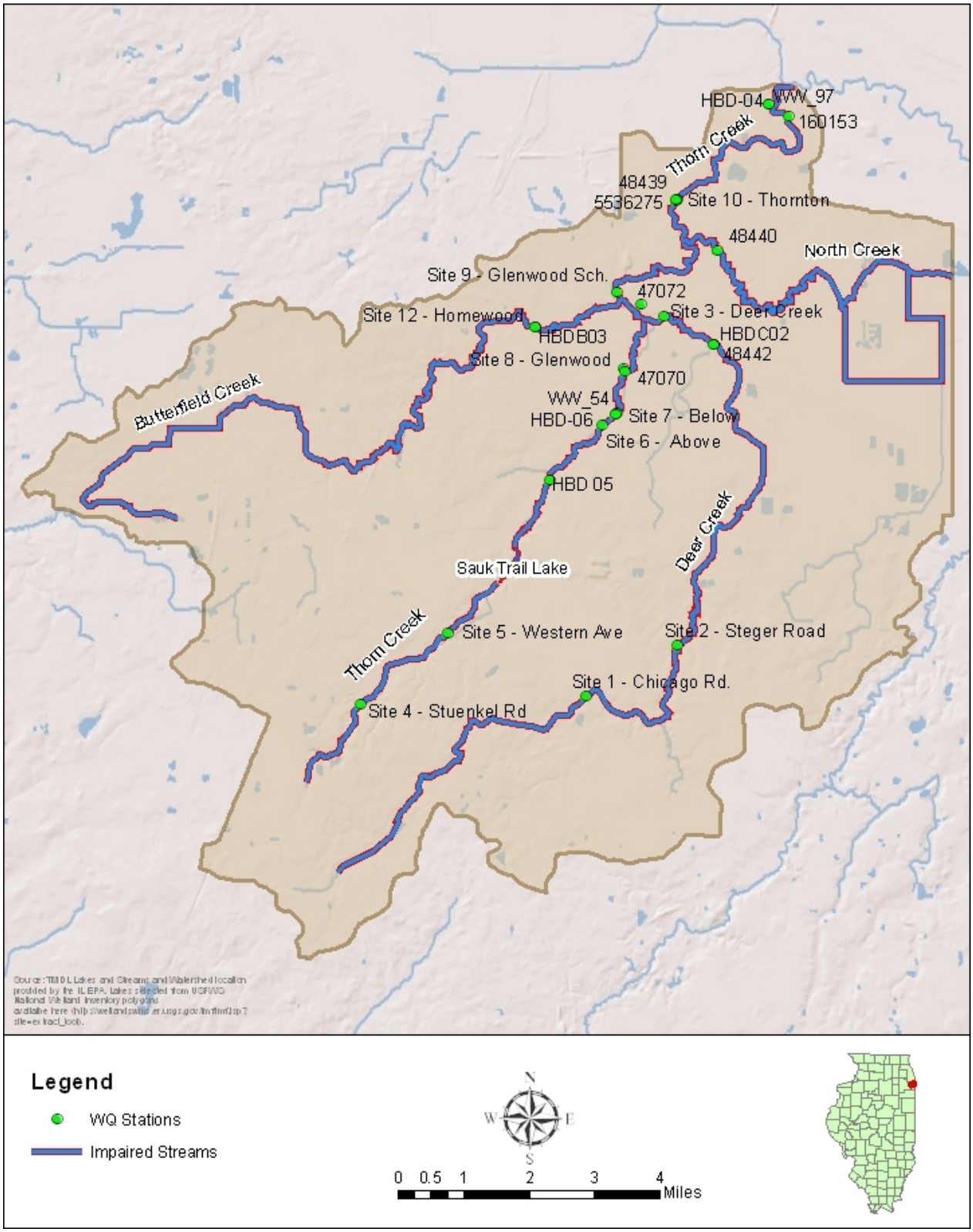


Figure 5-2: Dissolved Oxygen Distribution 1959-2007

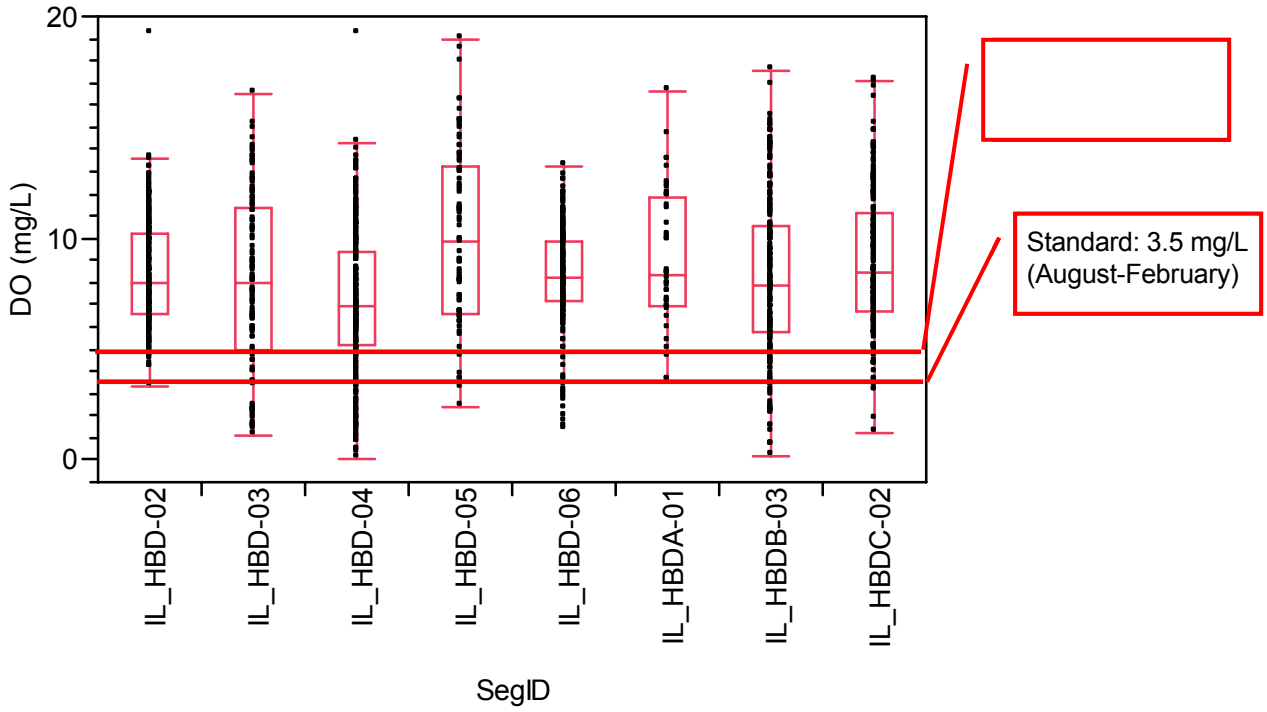
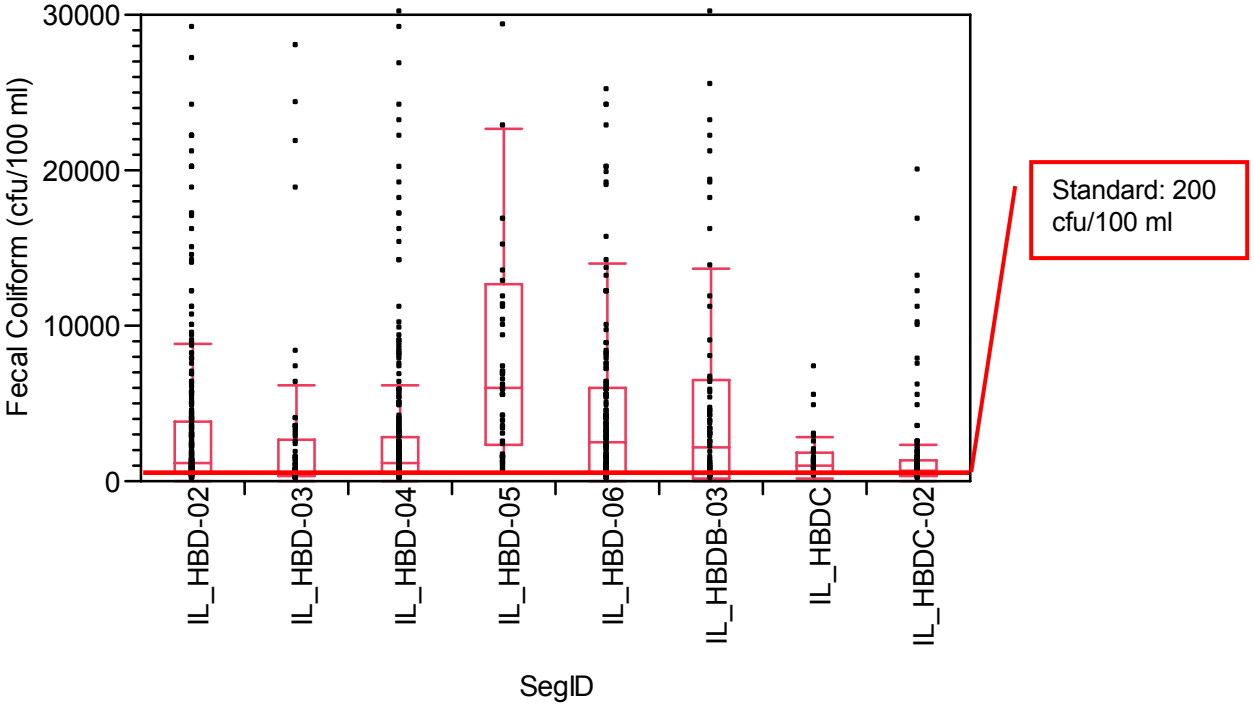


Figure 5-3: Fecal Coliform Distribution 1970-2007



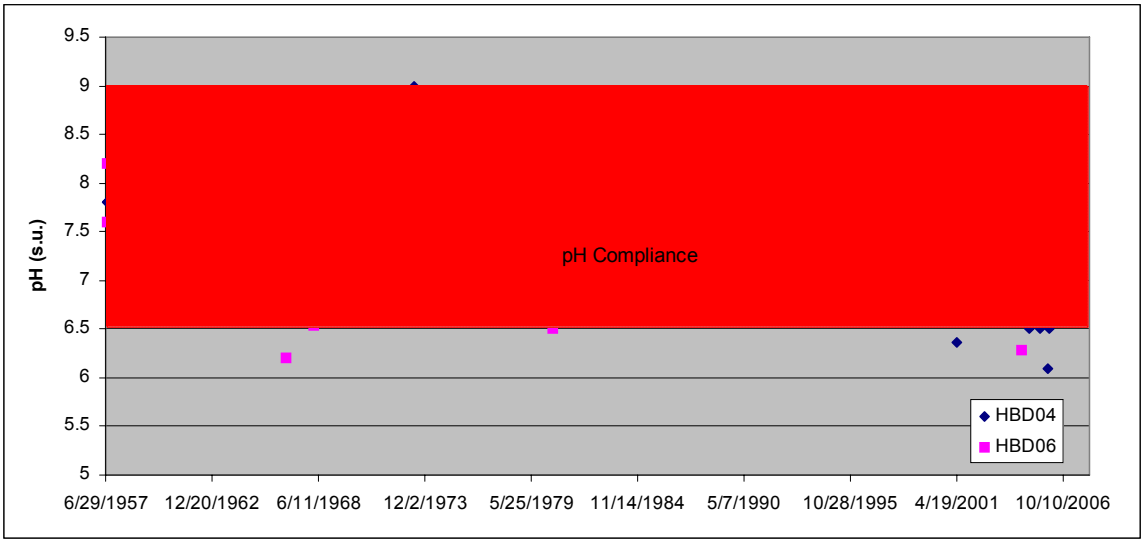
5.1.4 pH

The average pH values for each impaired segment within the Thorn Creek watershed are presented in Table 5-1 and Figure 5-4. The WQS dictates an acceptable pH range between 6.5 and 9 standard units (s.u.). Data used for analysis ranged from 1957 to 2007 at HBD04 and from 1973 to 2007 at HBD06.

Table 5-1: pH Data Summary 1957-2007

Segment	Units	# Observations	# Violations	Min	Max
IL_HBD-04	s.u.	335	3	6.1	9
IL_HBD-06	s.u.	262	2	6.2	8.5

Figure 5-4: pH Time Series for IL_HBD-04 and IL_HBD-06



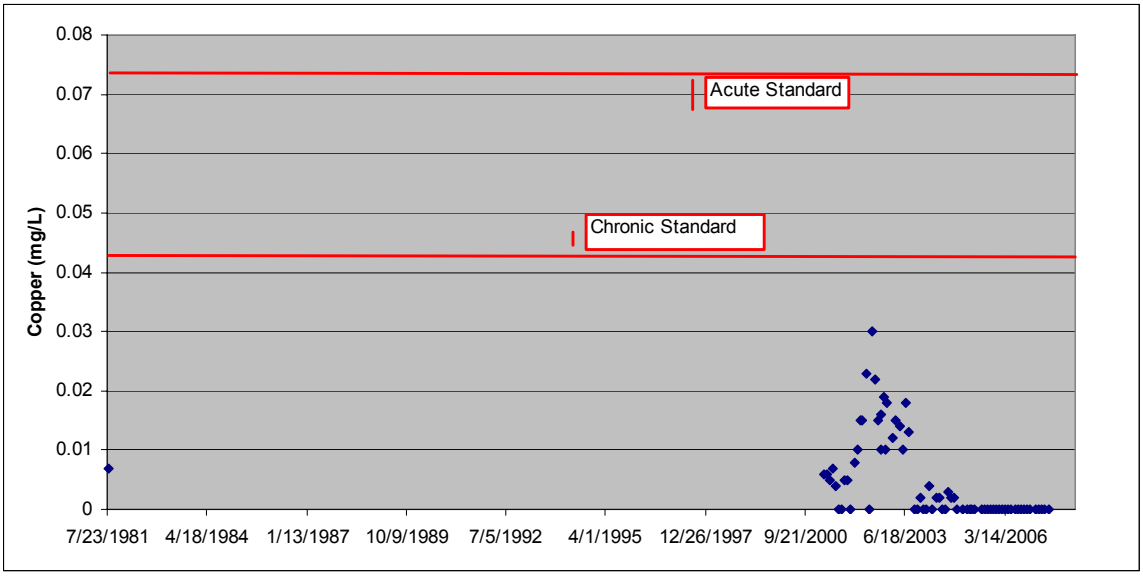
5.1.5 Copper

The IL_HBD-04 segment of Thorn Creek is the only segment impaired for copper. State language dictates that acute and chronic WQS apply to dissolved copper and that each must be calculated based on ambient hardness values. The acute and chronic standards were calculated to be 0.07 and 0.04 mg/L respectively based on an average ambient hardness value of 549 mg/L. Table 5-2 summarizes the average copper values for IL_HBD-04. However, available data (2001 – 2004) suggest that no copper impairment exists (Figure 5-5).

Table 5-2: Copper Data Summary 2001-2004

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
HBD04	mg/L	73	N/A	0	0.03	0.005	0.000	0.007

Figure 5-5: Copper Time Series for IL_HBD-04



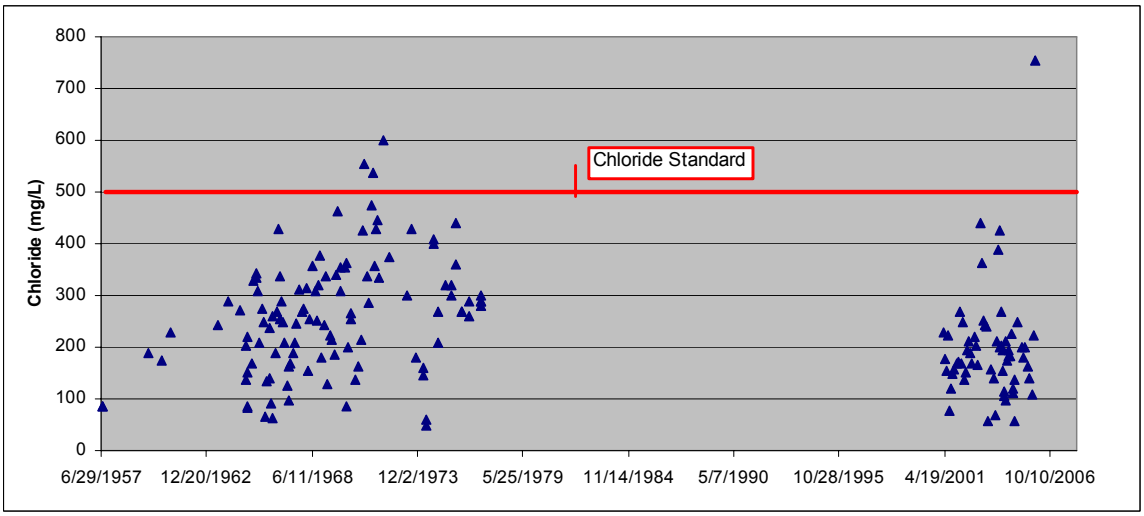
5.1.6 Chloride

Chloride exceedances were only recorded in the IL_HBD-04 segment of Thorn Creek. Table 5-3 and Figure 5-6 summarize the average copper values for IL_HBD-04. The general use WQS for chloride is 500 mg/L and dates for available data used for assessment ranged from 1957 to 2005.

Table 5-3: Chloride Data Summary 1957-2005

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
IL_HBD-04	mg/L	171	4	50	753	239	222	113

Figure 5-6: Chloride Time Series at IL_HBD-04



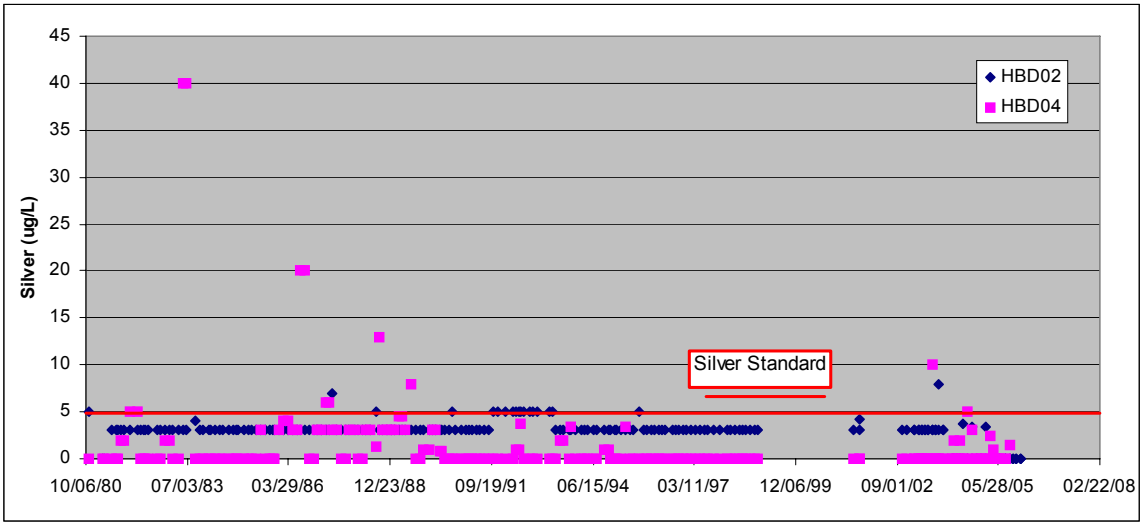
5.1.7 Silver

Table 5-4 and Figure 5-7 summarize total silver values within IL_HBD-02 and IL_HBD-04, the only two segments where silver exceedances were recorded. HBD02 and HBD04 violated the silver WQS of 5 µg/L six and five times, respectively. Data used for analysis ranged from 1980 to 1998 at IL_HBD-02 and from 2001 to 2007 at IL_HBD-04.

Table 5-4: Silver Data Summary 1980-2007

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
HBD02	µg/L	272	6	0	40	2.52	3.00	3.3
HBD04	µg/L	83	5	0	40	1.91	0.00	4.9

Figure 5-7: Silver Time Series at IL_HBD-02 and IL_HBD-04



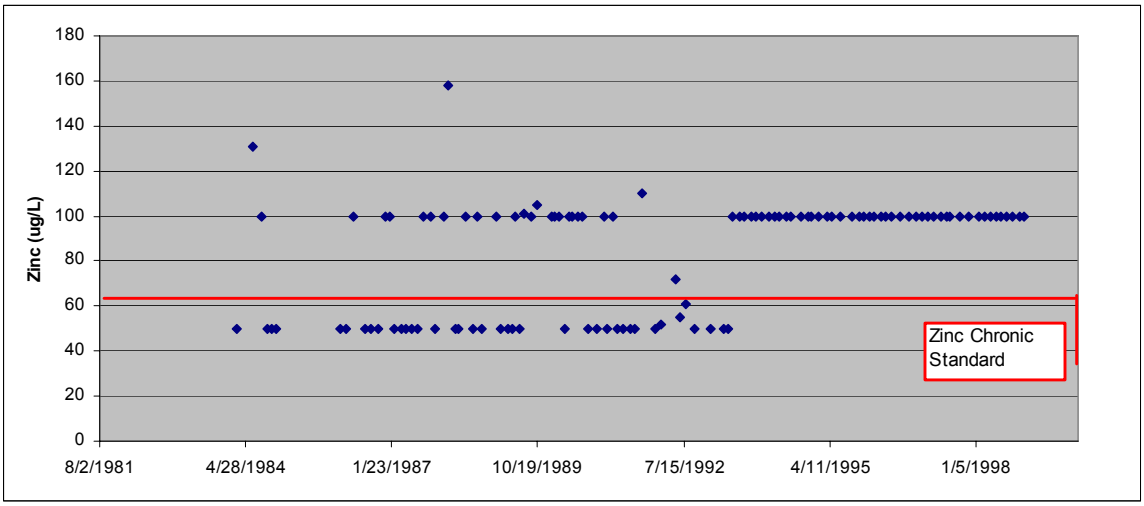
5.1.8 Zinc

Zinc exceedances were only recorded in the IL_HBD-02 segment of Thorn Creek (Table 5-5, Figure 5-8). Similar to copper acute and chronic water quality standards only apply to dissolved zinc and each must be calculated based on ambient hardness values. The acute and chronic water quality standards for zinc were calculated to be 336 and 64 µg/L respectively using an average ambient hardness value of 385 mg/L. Dates for available data at IL_HBD-02 ranged from 1981 to 2004.

Table 5-5: Zinc Data Summary 1981-1998

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
IL_HBD-02	µg/L	**214**	**83**	**0**	**158**	**59.6**	**50**	**35.2**

Figure 5-8: Zinc Time Series at IL_HBD-02



5.2 Point Sources

A number of point source dischargers actively maintain National Pollutant Discharge Elimination System (NPDES) permits within the Thorn Creek watershed. Discharge Monitoring Reports (DMRs) for each discharger will be required for the Stage 3 analysis of the TMDL, as available data will be quantified and analyzed to determine the point source loading for each receiving water. Table 5-6 lists the existing NPDES permits as provided by EPA's Enforcement Compliance History Online (ECHO) database. Geographic locations are provided in Figure 5-9.

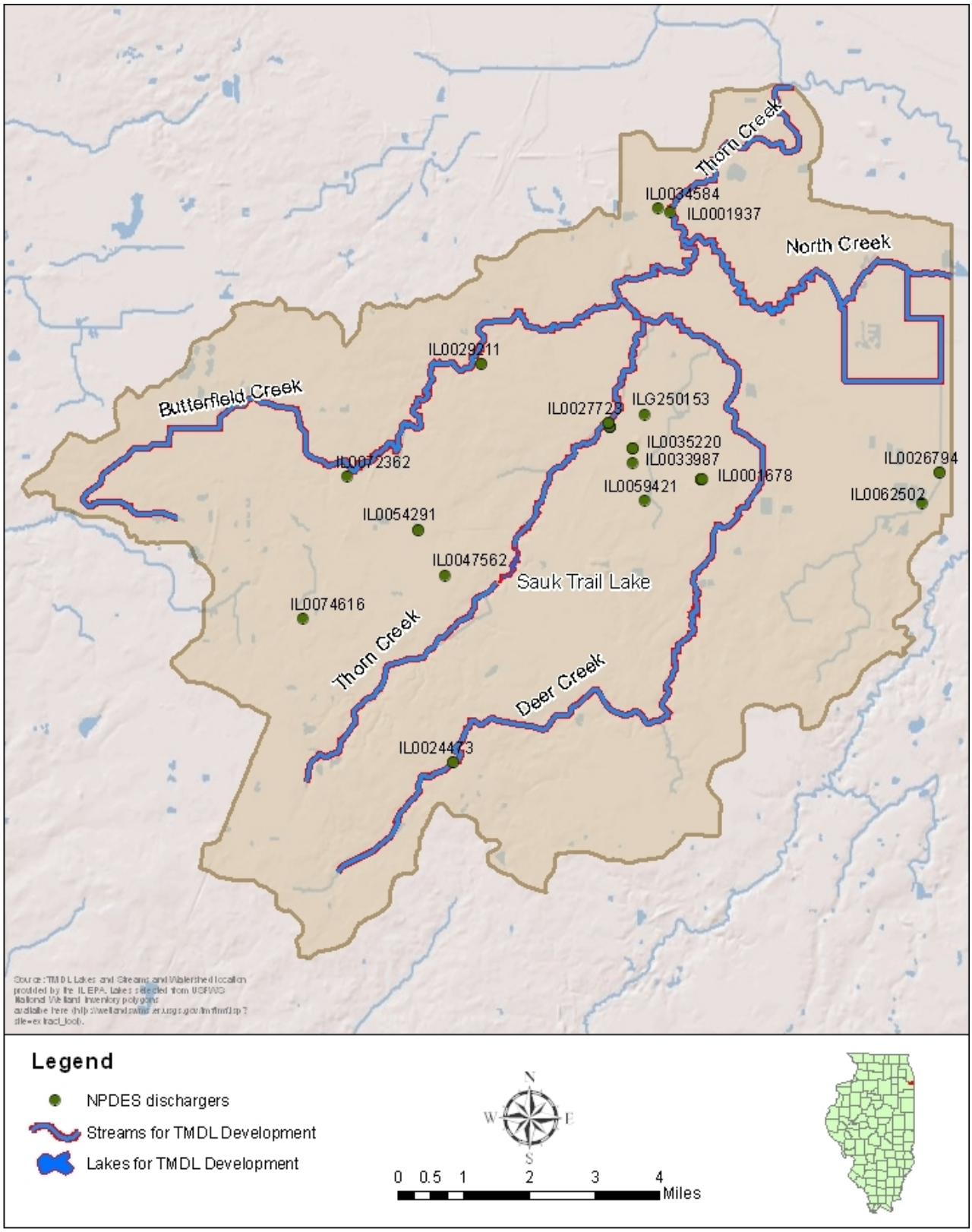
Table 5-6: Existing NPDES Dischargers in the Thorn Creek Watershed

Facility	NPDES Number	Receiving Water	Receiving Water Segment	Max Permitted Flow (MGD)	Average Permitted Flow (MGD)
Consumers IL Water-Univ. Park	IL0024473	Deer Creek	IL-HBDC	5.43	2.17
BP Pipeline	IL0074616	UT to Butterfield Creek	IL-HBDB-03	3.0	1.27
Park Forest Excess Flow Facility	IL0047562	UT to Thorn Creek	IL-HDB-03	No Limit	0.099
Park Forest WTP	IL0054291	UT to Thorn Creek	IL-HDB-05	No Limit	No Limit
Alliance Tubular Products	IL0059421	UT to Thorn Creek	IL-HBD-06	2.0	0.0002
Einoder Sand Pit	IL0062502	Lansing Drain	IL-HBDA-01	No Limit	No Limit
Speedway Superamerica LLC	IL0072362	Butterfield Creek	IL-HBDB-03	No Limit	0.006

Facility	NPDES Number	Receiving Water	Receiving Water Segment	Max Permitted Flow (MGD)	Average Permitted Flow (MGD)
Chicago Heights Steel Acquisition Corp.	IL0001678	UT to Thorn Creek	IL-HBD-06	No Limit	0.099
Paradise MHP	IL0026794	Lansing Drain	IL-HBDA-01	0.16	0.064
Kimble Glass Company	IL0033987	UT to Third Creek	IL-HBD-06	No Limit	2.62
Innophos, Inc.	IL0035220	UT to Thorn Creek	IL-HBD-06	No Limit	0.101
Thorn Creek Basin S.D.	IL0027723	Thorn Creek	IL-HBD-06	40.25*	15.94
CFC International	ILG250153	UT to Thorn Creek	IL-HBD-06	7.0	0.0027
Homewood WWTP	IL0029211	Butterfield Creek	IL-HBDB-03	No Limit	0.0999
Hanson Material Service Corp.	IL0001937	Thorn Creek	IL-HBD-02	7.0	2.78
Gallagher Asphalt Corp.	IL0034584	UT to Thorn Creek	IL-HBD-02	No Limit	No Limit

***Maximum permitted flow during dry weather. Wet weather design capacity is 64.25 MGD.**

Figure 5-9: Existing NPDES Dischargers in the Thorn Creek Watershed



5.3 Non-Point Sources

The Thorn Creek watershed is dominated by urban growth; current land use is approximately 60% urban. Further, almost 20% of the remaining land use is considered agricultural, a primary source of non-point source pollution in waterbodies. To properly manage and maintain water quality in the Thorn Creek watershed, the impacts associated with new development and agriculture must be carefully evaluated.

Urban and suburban development can adversely impact water quality in a number of ways. During the construction phase of development, soils destabilized as a result of clearing, grading, and excavation are subject to increased erosion by wind and water. These eroded soils can be carried offsite and deposited in receiving waters such as lakes, rivers and wetlands. Adverse impacts associated with such sediment loading include increased turbidity and habitat modification, including smothering of invertebrates and covering spawning beds. Typically, the construction phase is relatively short-lived; however, the impacts to receiving waters from poorly managed construction activities may be extremely severe and the effects can endure long after the project is over.

Post-construction receiving water quality impacts may become more pronounced due to potentially dramatic changes to the area's hydrology (reduced baseflow and exaggerated peak flow volumes), and the change in land use compared to predevelopment conditions. The increase in impervious areas, such as roadways and parking lots, can often result in increased runoff rates and volumes. This can result in increased streambank erosion which can lead to increased sediment loading and its associated water quality problems. The increased runoff can also accelerate the transport of land-borne pollutants such as heavy metals, oil and grease, pesticides, fertilizers and other nutrients, and toxic organic contaminants. Increased imperviousness can also cause significant elevations in receiving water temperatures during summer months. Winter road deicing activities can contribute high levels of chlorides or sediment.

Agricultural practices in the Thorn Creek watershed can also adversely impact water quality. The dominant crops found in the watershed are corn (40%) and soybean (35%), but other harvested crops include winter wheat, grain, and hay. Fertilizers used for such crops typically consist of nitrogen and phosphorus and are considered a potential source of nutrient enrichment in waterbodies.

Water quality impacts may be evaluated in terms of short-term impacts, and long-term impacts. Individual runoff events can cause short-term impacts to receiving waters, and are typically on a timescale of hours to days. Changes to the dry and wet weather hydrology, streambank morphology, and water chemistry of the receiving water are considered long-term impacts. Such long-term chemical impacts are most critical for those waters with longer residence times such as lakes and wetlands, and slow-moving stream segments. With regards to urban development and agriculture, pollutant concentrations are best used to evaluate short-term effects, while pollutant loadings are appropriate for assessing long-term impacts. Thorn Creek watershed planners and developers need to understand these impacts and carefully plan in order to mitigate the negative water quality impacts of development and agriculture.

6.0 TMDL Approach and Data Needs

This chapter discusses the methodology that may be used for the development of TMDLs for the Thorn Creek watershed. While a detailed watershed modeling approach can be advantageous, a simpler approach is often able to efficiently meet the requirements of a TMDL and yet still support a TMDL-guided and site-specific implementation plan. The final selection of a methodology will be determined with consultation with the IEPA based on following factors:

- Fundamental requirements of a defensible and approvable TMDL
- Data availability
- Fund availability
- Public acceptance
- Complexity of water body

A simpler approach shall be used as long as it adequately supports the development of a defensible TMDL. If it is deemed that this approach will not suffice, a more sophisticated modeling approach will be recommended for analysis to help better establish a scientific link between the pollutant sources and the water quality indicators for the attainment of designated uses. Methodology for estimating daily loads will depend on available data as well as the selected analysis.

6.1 Recommended Modeling Approach for Fecal Coliform

Many states currently use load duration curves for fecal coliform TMDLs for its simplicity and effectiveness. Load duration curves use water quality criteria, ambient concentrations, and observed flows to estimate loading capacities for streams under various flow conditions.

The first step in this process is to obtain an appropriate stream flow record. This is often difficult for streams not monitored by the USGS. There are methods, however, for developing streamflow statistics on ungaged streams. Regional curve numbers and regression equations are typically used in such instances. Alternatively, a gaged reference watershed can be used to obtain a streamflow record.

Flow duration curves are developed from streamflow records spanning multiple decades. The flow duration curve is based on flow frequency which provides a probability of meeting or exceeding a given flow. The duration curve is broken into hydrologic categories where high flows represent a duration interval of 0-10%, moist conditions represent 10-40%, mid-range flows 40-60%, dry conditions 60-90% and low flows 90-100%.

Once the flow duration curve is established, a load duration curve can be generated by multiplying streamflow with the numerical water quality standard and a conversion factor to obtain the load per day for a given streamflow. Individual measurements can be plotted against the load duration curve to evaluate patterns of impairment. Values that fall above the load duration line indicate an exceedance of the daily load and hence, water quality standard. These data can aid in determining whether impairment occurs more frequently in one of the hydrologic categories (wet, moist, mid-range, dry or low).

The margin of safety (MOS) for duration curves can be implicit or explicit. Implicit MOS are derived from the inherent assumptions in establishing the water quality target. Explicit MOS include setting the water quality target lower than the WQS or not allocating a portion of the allowable load. For the Thorn Creek TMDL, an explicit MOS of 5% lower than the WQS is proposed. The standard of 400 col/100ml not to exceed 10% of the samples in a 30-day period will be used, and thus the standard used to generate the load duration curve will be 380 col/100ml.

Wasteload allocations (WLA) will be based on NPDES permit limits. Average discharge flow and permit limits will be used to calculate a daily load and serve as the WLA. WLAs for NPDES-permitted stormwater discharges, including current and future Municipal Separate Storm Sewer Systems (MS4s), "Urbanized" areas, construction and industrial discharges and sanitary sewer overflows (SSOs) that do not have numerical effluent limitations will be expressed as a percent reduction instead of a numerical target. The NPDES Phase II Stormwater Regulations require all areas defined as "Urbanized" by the US Census obtain a permit for the discharge of stormwater. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern, whichever is less restrictive. The load allocation (LA) for all non-regulated sources, including non-point sources, will also be expressed as a percent reduction. The percent reduction is based on the maximum reduction required to meet WQS plus a margin of safety under critical conditions.

The critical condition for fecal coliform load duration TMDLs is established by hydrologic category. It is defined as the greatest reduction needed to meet WQS among all hydrologic categories. For example, if an 89% reduction is required to meet the TMDL under wet conditions and a 50% reduction is required under dry conditions, an 89% reduction will be required under all hydrologic conditions to ensure that the TMDL is protective under all hydrologic conditions.

Seasonality of loading will also be evaluated. Flow duration intervals will be plotted by month to determine if there is a strong seasonal component. Although this will not change allocations, this may assist in implementation planning.

6.2 Recommended Modeling Approach for Dissolved Oxygen

QUAL-2K, a spreadsheet model that is based on the fundamental Streeter-Phelps DO sag equation, is recommended for DO TMDL development for impaired waterbodies in the Thorn Creek watershed. QUAL-2K is a one-dimensional, steady-state model that can accommodate point and non-point source loading and is capable of modeling DO in streams and well-mixed lakes. QUAL-2K is an updated version of QUAL-2E and has been developed using a Microsoft Excel interface. QUAL-2K allows for model segmentation, the use of two forms of carbonaceous BOD (both slow and rapid oxidizing forms), and is also capable of accommodating anoxia and sediment – water interactions. While the model is simplistic in nature, it is capable of estimating critical BOD concentrations associated with instream DO concentrations of 5 mg/L.

If sufficient data are available, load duration curves could also be used to adequately simulate BOD loading associated with DO sags in streams. These calculated loads will be the basis for recommending TMDL reductions if necessary.

6.3 Recommended Modeling Approach for Total Phosphorus

Ongoing sampling at Sauk Trail will provide data to be used for TMDL development. An export coefficient model linked to empirical in-lake response models will be used to determine existing loading and load reductions required to bring Sauk Trail into compliance with current WQS. This model, ENSR-LRM (lake response model), was developed by ENSR and has been used on more than 35 lake TMDLs.

ENSR-LRM uses export coefficients for runoff, groundwater and nutrients to estimate loading as a function of land use. Yields will be assigned to each defined parcel (sub-watershed) in the lake watershed. Loading estimates will be adjusted based on proximity to the lake, soils and major Best Management Practices (BMPs) in place. Model yields will be compared to measured data, where available. Export coefficients and attenuation factors will be adjusted such that model loading accurately reflects actual loading based on sample data and measured in-lake concentrations.

Watershed and subwatershed boundaries will be delineated based on topography. Watershed land use will be determined using publically available GIS datalayers from the Illinois Natural Resource Geospatial Data Clearinghouse, or similar source. ENSR-LRM will be set-up on a sub-watershed level using available land use

and average annual precipitation data. The spreadsheet-based export coefficient model allows the user to select watershed yield coefficients and attenuation factors from a range appropriate in the region. The model also includes direct inputs for atmospheric deposition, septic systems, point sources, waterfowl and internal loading from lake sediments.

The generated load to the lake is processed through five empirical models: Kirchner & Dillon 1975, Vollenweider 1975, Larsen & Mercier 1976, Jones & Bachmann 1976 and Reckhow 1977. These empirical models predict in-lake phosphorus concentrations based on loading and lake characteristics such as mean water depth, volume, inflow, flushing and settling rates. Predicted in-lake phosphorus is compared to measured data. An acceptable agreement between measured and predicted concentrations indicates loading estimates are appropriate for use in the preparation of a TMDL. Adjustments to the loading portion of the model are made when necessary based on best professional judgment to ensure acceptable agreement between measured and predicted concentrations. These empirical models also predict chlorophyll concentrations and water clarity (Secchi disk transparency). ENSR-LRM also includes a statistical evaluation of algal bloom probability.

Once the model has been calibrated to existing conditions, adjustments to the model can be made to determine predevelopment conditions and the load reductions necessary to meet WQS. In some instances, waterbodies are naturally eutrophic and may not achieve numerical WQS even under predevelopment conditions. In such instances, site specific criteria or maximum practical reductions have been used for TMDL targets and is proposed.

ENSR-LRM is most effective when calibrated with water quality data for the target system, but can be used with limited data. While it is a spreadsheet model with inherent limitations on applied algorithms and resultant reliability of predictions, it provides a rational means to link actual water quality data and empirical models in an approach that addresses the whole watershed and lake. ENSR-LRM is an easy and efficient method of estimating current loads to lakes as well as providing predictions on lake response under countless loading scenarios.

ENSR-LRM, as well as most simplified lake models, predicts phosphorus concentrations and estimates loading on an average annual basis. As required by the EPA, the TMDL must be expressed on a daily basis. However, there is some flexibility in how the daily loads may be expressed. Several of these options are presented in "Options for Expressing Daily Loads in TMDLs"[10]. For TMDLs based on watershed load and in-lake response models providing predictions on an annual basis, the EPA offers a method for calculating the maximum daily limit based on long-term average and variability. This statistical approach is preferred since long periods of continuous simulation data and extensive flow and loading data are not available. The following expression assumes that loading data are log-normal distributed and is based on a long term average load calculated by the empirical model and an estimation of the variability in loading.

$$MDL = LTA * e^{[z\sigma - 0.5\sigma^2]}$$

Where:
MDL = maximum daily limit
LTA = long-term average
Z = z-statistic of the probability of occurrence
$\sigma^2 = \ln(CV^2 + 1)$
CV= coefficient of variation

[10] United States Environmental Protection Agency. 2007. Options for Expressing Daily Loads in TMDLs.

Data from similar lakes will be used in situations where there are not enough data to determine probability of occurrence or coefficient of variation for the impaired waterbody.

MOS for phosphorus using this method is implicit. There is substantial uncertainty in concentration inputs to the models related to the timing of sampling and analytical methods, and the empirical equations used to predict in-lake phosphorus concentrations, mean and maximum chlorophyll, Secchi disk transparency, and bloom probability also introduce variability into the predictions.

WLA will be determined based on NPDES permit effluent limitations and average flow. WLAs for NPDES-permitted stormwater discharges, including current and future MS4s, "Urbanized" areas, construction and industrial discharges and SSOs that do not have numerical effluent limitations will be expressed as a percent reduction instead of a numerical target. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern, whichever is less restrictive. LAs will also be expressed as a percent reduction. The percent reduction is based on the maximum practical reduction, which is generally 60% of the target load achievable through BMPs including source reduction, transport mitigation and behavior modification[11].

Critical conditions for lakes typically occur during the summertime, when the potential (both occurrence and frequency) for nuisance algal blooms are greatest. The loading capacity for total phosphorus is set to achieve desired water quality standards during this critical time period and also provide adequate protection for designated uses throughout the year. The target goal is based on average annual values, which is typically higher than summer time values. Therefore a load allocation based on average concentrations will be sufficiently low to protect designated uses in the critical summer period

The ENSR-LRM derived TMDL takes into account seasonal variations because the allowable annual load is developed to be protective of the most sensitive (i.e., biologically responsive) time of year (summer), when conditions most favor the growth of algae. Maximum annual loads are calculated based on an overall annual average concentration. Summer epilimnetic concentrations are typically lower than the average annual concentration, so it is assumed that loads calculated in this manner will be protective of designated uses in the summer season, in which the most sensitive of designated uses (swimming) occurs. It is possible that concentrations of phosphorus will be higher than the annual average during other seasons, most notably in the spring, but higher phosphorus levels at that time do not compromise uses. The proposed TMDL is expected to protect all designated uses of the impaired waterbody.

6.4 Recommended Modeling Approach for pH

QUAL-2K is also capable of estimating instream pH. In the modeling framework, both total inorganic carbon and alkalinity are simulated based on inputs. Using these two quantities, the model then simulates instream pH. These calculated values will then be the basis for recommending TMDL reductions if necessary.

6.5 Recommended Modeling Approach for Chloride and Metals

Similar to fecal coliform, load duration curves are recommended for the copper, chloride, silver, and zinc TMDLs. The duration curve will be used to estimate the percent of time that a water quality standard is exceeded. The wasteload allocations will be based on criteria concentrations which will then be converted into a distribution of allowable loads as a function of daily flow.

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[11] Center for Watershed Protection. 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph 1. Center for Watershed Protection Ellicott City, MD. March 2003.

6.6 Data Needs

Effective TMDL development heavily relies on site-specific data. Sufficient flow and water quality data are required for the evaluation of water conditions and for model calibration. In fact, data availability often dictates the modeling approach used for various watersheds. Five types of data are crucial for the Thorn Creek watershed TMDL development:

- Flow data
- Meteorological data
- Water quality data
- Watershed and water body physical parameters
- Source characteristics data

Most necessary data are available for the TMDL with the exception of some ambient water quality data. Impairments based on available data sources indicate exceedance of standard in most of the Thorn Creek watershed. However, available copper data at IL_HBD04 show that ambient conditions were below applicable WQS. It is recommended that additional sampling be conducted to confirm that impairment exists at this waterbody segment. No available data were identified for Sauk Trail which is currently listed on the 303(d) list for total phosphorus. Ongoing sampling will help to address the data gaps at Sauk Trail.

Point source discharge data from all NPDES permittees within the watershed will also be necessary for the Stage 3 analysis. Individual NPDES permits, DMRs, and measured discharge data are all pertinent to TMDL development. Data will be obtained either using EPA's ECHO database or by directly contacting permittees.

Appendix A

Water Quality Data
(Provided Separately)

Appendix B

NPDES Permit Limits
(Provided Separately)

Appendix C

Stage 1 Responsiveness Summary

Thorn Creek Total Maximum Daily Load - Response to Comments

The following comments were submitted by the public in response to the Stage I TMDL for the Thorn Creek watershed.

- ***Comment***: *A summary explanation of the location of the numbered stream segments would be extremely helpful. Also, presenting data in Chapter 5 in order of stream segment rather than by stream number would be very useful for seeing data trends. For example, fecal coliform is higher in the upstream reaches of Thorn Creek and decreases downstream.*

  Response: An explanation of segment locations will be added. Box-and-whisker plots were created for those segments with multiple monitoring stations. They are presented in Appendix C-1 of this document.

- ***Comment****: As discussed further below, metal limits are dissolved, but data presented in the report are total. Also, there appear to be instances of existing data at non-detect limits where the non-detect value is actually higher than the current standard. This data is not valid for inclusion in the TMDL analysis.*

  Response: Both dissolved and total metals were used to determine impairment status where appropriate. In situations where non-detect values were greater than the standard, the data were re-plotted and non-detect values were flagged (see Appendix C-2).

- ***Comment****: Regarding QUAL-2K, Thorn Creek Basin Sanitary District understands that it is not a watershed model but instead works as a dry weather model, with non-point sources input as part of sediment oxygen demand (SOD) assumptions. It is recommended that a sensitivity analysis be performed on the model to determine what inputs drive the dissolved oxygen results. If the modeling is performed with worst case inputs, a margin of safety should not also be added. It is also recommended that the model be calibrated with a first set of data, then used to predict DO concentrations and compared to a second set of data. Adequate SOD data, continuous DO data, and chlorophyll data are all essential components of a useful model and should be considered as part of a Stage 2 data collection effort.*

  Response: A sensitivity analysis will be performed during Stage 3 in conjunction with the QUAL-2K modeling to evaluate the critical parameters that results in DO exceedance. SOD parameter will be calibrated and compared with those in similar urban watershed. QUAL-2K is steady state model. A critical condition will be selected to estimate existing pollutant load.

- ***Comment****: The TMDL process shows that Illinois EPA considers any data point exceedance to be grounds for impairment and TMDL development. That is an understandable approach given the limited amount of water quality data for many streams in Illinois. However, Thorn Creek is a strong exception, especially for a small stream, and deserves to be treated differently. With the unusually*

large amount of water quality data on Thorn Creek, an occasional high result is likely an outlier and may be related to sampling or laboratory error.

To determine potential for whether exceedances are legitimate and have potential to cause water quality issues into the future, we recommend: 1) Ranking the data to see if the highest results are on the trend line or above it. If they are above the line, it suggests that they are anomalies and that the data should be discarded.

Response: No impaired segment within the Thorn Creek watershed was placed on the 303(d) list simply due to one exceedance. Therefore, multiple exceedances of standard suggest such data may not, in fact, be outlier data.

- ***Comment****: Reviewing circumstances surrounding the exceedance to determine whether the cause can be identified. This will help prevent the implementation of ineffective control measures that do not relate to the cause of exceedance, which may result in continued water quality noncompliance. For example, stream flows could be reviewed to determine whether it is possible that an exceedance is caused by a wet weather non-point source.*

  Likewise, it is possible that a source of exceedance has been eliminated since the data was collected. A review of projects in the watershed initiated as a result of Illinois EPA enforcement action could be very helpful in this regard. There are two instances in the Thorn Creek watershed where significant water quality improvements have been made. First, it is believed that a wastewater lift station owned by Aqua Illinois that had capacity issues has since been remodeled in order to provide increased capacity. Also, Thorn Creek Basin Sanitary District has recently required sewer connections for over sixty residential properties that have been illegally discharging raw sewage to Butterfield Creek.

  Finally, the effect of non-point and illegal discharges cannot be overemphasized in the Thorn Creek watershed. The December 2005 Thorn Creek Watershed Plan (prepared by Illinois EPA, NIPC [now CMAP], and the Thorn Creek Ecosystem Partnership) suggests that is likely that issues in the Thorn Creek watershed are primarily due to either non-point sources or illegal point sources. While identifying and controlling these sources can require significant effort, they must be addressed in order for any real water quality improvement effort in the Thorn Creek watershed. Non-point and illegal discharges are discussed further below.

  Response: The source of the impairments will be further investigated in the Stage 3 portion of the TMDL. The correlation between the exceedance and flow condition will be evaluated. IEPA will look into the possibility to collect additional water quality data.

- ***Comment****: Page ES-1, Paragraph 3: "The water quality criteria identified for these impairments provide an explicit assessment as to whether or not these water bodies are in compliance." It is recommended that this statement be qualified. It is possible that even if all water quality criteria are met, the expected aquatic community may not emerge. For example, habitat is a major factor that*

may prevent the existence of a viable aquatic community regardless of water quality, but habitat is not considered in the TMDL development.

***Response**:* TMDLs in Illinois are developed for impairments with numeric water quality standards. TMDLs are mandated for pollutants on the 303(d) List of impaired waters. Habitat impairment is not considered a pollutant by USEPA. A TMDL will not be developed if water quality standards are met. In watersheds where there are stakeholder and watershed groups, a watershed plan be developed for habitat alteration.

- ***Comment**: Page 2-1, Paragraph 3: Third Creek and State Street Ditch are tributary to the Thorn Creek watershed (as shown on Figure 2-1), and should be included in the watershed description.*

  ***Response**:* The Stage 1 report has been revised to incorporate this comment.

- ***Comment**: Page 2-20, Paragraph 4: Assuming that "below" means "downstream", the description of the abandoned USGS stream gauge 05536210 is inaccurate. It was located at Halsted Street, upstream of the Thorn Creek Basin Sanitary District Wastewater Treatment Plant (TCBSD WWTP) discharge, not below as stated. The error is repeated on Page 2-21, Paragraph 3.*

  As stated in the report, it is correct that USGS gauge 05526210 was close to TCBSD WWTP's discharge, but Third Creek/State Street Ditch enters Thorn Creek between TCBSD WWTP and USGS gauge 05526210. This makes it impractical to estimate from USGS gauge 05526210. Therefore, there is no measure available of Thorn Creek flow upstream of TCBSD WWTP.

  ***Response**:* The reference to USGS gage 05526210 is a typo in the report and have be corrected. As such, watershed scaling will likely be used in Stage 3 to determine flow upstream of TCBSD WWTP using data from gage 05536210. The editorial comments will be addressed in the text portion of the Stage I document.

- ***Comment**: Page 2.20, Paragraph 6: The Aqua Illinois WWTP discharge does not have regulated flows as implied, if "regulated" means to have moderated the peaks.*

  It should be noted that a Ford Heights WWTP was taken out of service during the 1960s when an MWRDGC interceptor was extended to serve it.

  ***Response**:* The regulation of flow refers to permitted flow. The Ford Heights WWTP is removed from the report.

- ***Comment**: Page 2-21, Paragraph 3: Assuming that "above" means "upstream", the description of gauge 05536215 is inaccurate. The report states that it is above TCBSD WWTP, but it is downstream.*

***Response**:* The report has been revised accordingly

- ***Comment**: Page 5-1, It is recommended that a comprehensive summary table describing the location, station number and sponsor of each monitoring station be provided to complement Figure 5-1.*

  Thorn Creek Basin Sanitary District submitted data to Illinois for the TMDL effort, dated August 15, 2007 and May 7, 2009. It is not clear that all of this data has been incorporated into the TMDL analysis. The submittals are provided again for your use as an attachment to these comments.

  It appears that the MWRDGC monitoring station at 170th and its associated data are not included in the report.

  ***Response**:* A summary table has been created and is included in Appendix C-3 of this document. With regards to the additional data (from August 2007 to May 2009), the data assessment for Thorn Creek was conducted using data up to July 2007, as it was the only data available at the time. The additional data will be incorporated into the Stage 3 analysis, but for the purposes of assessment, they will not be included.

- ***Comment**: Page 5-7, Table 5-6: As a point of clarification, the maximum flows listed here are maximum flows during dry weather. TCBSD WWTP's design peak flow during wet weather, per its approved basis of design, is 64.25 MGD.*

  Response: This comment will be addressed in the text portion of the Stage I document.

- ***Comment**: Page 6-1, Paragraph 6: The use of Load Duration Curves is described. The text implies that the single highest result will be used to determine how much reduction in a given load is needed. However, it would be statistically appropriate to discard a certain percentage of the highest values as outliers.*

  It is also stated that the worst-case flow range will be used to set discharge reductions for all flow ranges. If a wet weather flow rage is the worst case, the percent reduction needed for wet weather will also apply to dry weather. As any wastewater treatment plant NPDES permit illustrates, proportional assignment of water quality expectations based on flow rate is not appropriate. Water quality characteristics have a completely different profile for dry weather versus wet weather conditions due (among other reasons) to the relative difference in the quantity of non-sanitary water (stormwater) present, and due to the flushing of pollutants by stormwater into streams through sewers and over land during wet weather events. Incidentally, during the public meeting AECOM discussed the need to understand dry weather and wet weather flows in the watershed as part of the study. Illinois EPA may want to review watershed work recently completed by MWRDGC and their consultant (CDM) in developing a watershed plan for Thorn Creek. This effort, which includes updated inundation mapping, was completed as part of the Cook County Watershed Management Ordinance.

  Response: The nature of the flows and the associated Load Duration curves will be further investigated in the Stage 3 portion of the TMDL. The watershed study done by MWRDGC will be reviewed and referenced in Stage 3

- ***Comment***: *Fecal Coliform: As discussed further below, it is highly likely that illegal and non-point sources of fecal coliform exist. Detecting and controlling or eliminating these sources will be difficult but necessary in order to achieve water quality standards.*

  Based on comments during the public meeting, it is understood that Illinois EPA is applying its fecal coliform analysis seasonally. Thorn Creek Basin Sanitary District is pleased that this correct approach is being utilized. Figure 5-3 shows that the highest concentration of fecal coliform is well upstream in segment HBD-05. If that segment is brought within water quality limits, then the rest of the stream should meet the limits in the summer when TCBSD WWTP is disinfecting.

  The fecal coliform water quality standard allows for no more than 10% of the samples in one month to exceed 400. However, the TMDL report appears to apply a margin of safety of 5% to 400, making the target 380. This approach appears to be inconsistent with the water quality standard. By using 400 and ignoring the 10% exceedance, a margin of safety would already be applied.

  It is likely that in a relatively developed area such as the Thorn Creek watershed, high fecal coliform counts might be from illegal discharges. For example, only recently has Thorn Creek Basin Sanitary District annexed and begun to forcibly require sewer connection for over sixty residential properties in Cook County that have been illegally discharging raw sewage to Butterfield Creek. For some of the properties, this illegal arrangement had previously been in place for up to 80 years. Anecdotal information exists regarding other possible illegal discharges and should be further researched.

  It is recommended that during Stage 2, investigative sampling of Thorn Creek be performed in order to locate and identify specific sources of contamination. In addition to BOD and fecal coliform, more in-depth biological analyses can be performed on split samples to determine the host specific origin of e coli bacteria found in fecal coliform contaminated samples. Also, in the report, it should be noted that fecal coliform may have human or animal sources.

  ***Response*:** The percent exceedance of the fecal coliform standard and the margin of safety applied to a TMDL are two different concepts and cannot be used in lieu of one another. The 10% applied to the fecal coliform standard is a threshold exceedance designed to indicate noncompliance with a water quality standard. The 5% margin of safety used for a TMDL is applied to account for model/analysis uncertainty, thus providing conservative load estimates. That being said, we found an error in our report. We are actually setting the fecal coliform target at 190 cfu/100 ml (or 5% of 200 cfu/100 ml, not 400 cfu/100 ml).

  With regards to researching anecdotal data, such as recent TCBSD annexing activities, we can certainly address such issues during Stage 3. However, such data/information will have to be readily provided.

- ***Comment***: *pH: Less than 1% of the samples are outside of the limits and those few excursions are close to the limits. It is stated that the QUAL-2K model will identify any pH problems, but based on the data presented in the Stage 1 report and the previous discussion in Item 1 above, there does not appear to be a problem.*

  ***Response*:** As discussed previously, a few exceedances of standard warrants impairment status. As such, a TMDL will be required for pH. With regards to use of QUAL-2K, if it is discovered during Stage 3 that QUAL-2K cannot adequately address the pH impairment then an alternative method will be proposed.

- ***Comment*:** *Copper: The limits are for dissolved copper. It should be noted that TCBSD's data is for total copper, and it is suspected that other data is as well. It is suggested that dates of*

excursions be reviewed to determine whether the detection limit at the time of analysis might have been above the current standard.

Response: The assessment for copper was conducted using dissolved copper values, not total copper. While TCBSD does not analyze for dissolved copper, other organizations, such as MWRDGC, do in fact analyze for dissolved metals.

- ***Comment*****:** *Chloride: Only 5% of the samples are over the limit and the mean and median are less than half of the limit. It would be useful to at least attempt to ascertain what is happening when the few high results occur, rather than requiring every source of chloride to reduce their discharge. It is possible that the few high chloride results are from road salt, and perhaps modeling will show that to be the case.*

  Response: The nature of the chloride impairment will be further investigated in the Stage 3 portion of the TMDL.

- ***Comment*****:** *Silver: The number of excursions is low, 5 to 10% per segment. It is suggested that dates of excursions be reviewd to determine whether the detection limit at the time of analysis might have been above the current standard.*

  Response: The values of exceedance for silver were all above detection limit. As such, the impairment is accurate and a TMDL will be conducted for silver.

- ***Comment*****:** *Zinc: The large number of results at 100 ug/l are suspect. A review of Illinois EPA data from 2001 shows non-detect results for zinc with a detection limit of 100 ug/l. The detection limit for TCBSD's current analyses is lower than the stream standard, but TCBSD's older data is (and MWRDGC's is likely to be) based on higher detection limits. If all of the results shown at 100 ug/l are non-detects then there are only 5 samples known for sure to be over the limits, yielding a non-compliance rate of only 2.5%. The most recent data could show an even better picture.*

  As with copper, the limits are for dissolved zinc. It should be noted that TCBSD's data is for total zinc.

  Response*:* The time-series plot was re-created that flagged non-detect values for zinc (Appendix C-2). The zinc impairment is still accurate and a TMDL will be conducted. Similar to copper, dissolved zinc was used for assessment purposes. Dissolved metals data were obtained from other organizations such as MWRDGC.

- ***Comment*****:** *As indicated in prior correspondence with Mr. Michael Eppley, the District would be open to assisting Illinois EPA with filling data gaps prior to that point, in order to make the TMDL process as useful and complete as possible. The District would specifically be willing to assist with additional data collection for Stage 2 of the TMDL process. As discussed in detail above, the District respectfully requests the following activities be included in Stage 2 of the TMDL:*

  Investigative sampling and analysis in order to locate and identify specific sources of contamination. In addition to BOD and fecal coliform, more in-depth biological analyses can be performed on split samples to determine the host specific origin of e coli bacteria found in fecal coliform contaminated samples.

Sampling and analysis for SOD data, continuous DO data, and chlorophyll data in order to develop a robust and useful QUAL-2K modeling effort.

***Response**:* Up to date and more additional data may be collected prior to completion of the final report.

- ***Comment**: Because one data point exceeding an impairment limit may trigger the TMDL process for a given segment, the data quality should be analyzed closely. Were the quality control efforts the IEPA typically requires being followed equally for all samples collected? What effect did analysis of the data have on the set of data? What effect does the detection limit and margin of error on results have in relation to exceedance limit?*

  Response: The only assessment data used from outside agencies originated from the MWRDGC and TCBSD. The IEPA project manager coordinates the efforts of both agencies to ensure that project data will be usable by the IEPA for assessment of water quality. Both data sources have QAPPs with the Agency. The IEPA QA Officer oversees project activities and project quality control.

- ***Comment:*** What effect did analysis of the data have on the set of data?

  Response: MWRDGC does have a data validation section written within their QAPP (pages 25 - 26). Whether or not any of the data were affected by such validation can only be determined by the QA/QC officer of MWRDGC.

  Comment: What effect does the detection limit and margin of error on results have in relation to exceedance limit?

  Response: There's no really easy way to answer this question. Without having seen the raw laboratory data or the data validation results we cannot address this question with regards to exceedance limits. IEPA should have such data/results from MWRDGC and TCBSD.

- ***Comment**: The sampling data used in the report has questionable integrity. Multiple zinc exceedances appear to be a result of method detection limits being above the water quality standards. Method detection limits may have been a factor in silver exceedances as well. Copper is also listed as a cause of impairment, but sampling results show that copper concentrations have been below water quality standards during all sampling events. Data records for fecal coliform and dissolved oxygen concentrations begin in 1959 and 1970, respectively, and are not temporarily distributed. Comparison between old and new fecal and DO data would be helpful.*

  ***Response**:* Method detection limits above standard did not impact the impairment status for those segments listed for zinc and silver (Appendix C-2). It was noted in the Stage I report that copper values did not indicate impairment. A decision as to whether or not the copper impairments remain on the 303(d) list will be determined in Stage 3 of the TMDL.

  With regards to the temporal distribution of data, fecal coliform and dissolved oxygen time-series have been created and are provided in Appendix C-4 of this response.

  ***Comment**: The margin of safety described for the fecal coliform TMDL development is 5 percent. The 5 percent appears to be arbitrary within the context of the report. The fecal concentrations in a stream will be highly variable from animal loading and combined and sanitary sewer overflows. Additional data that would be helpful in the fecal allocation development include any historical sources of fecal contamination that have been removed (possibly accessible through NPDES Phase II illicit discharge*

reports), and IDNR data for wildlife populations in the area. Other margins of safety used in the report should consider the location and rate of growth projected in the watershed.

***Response**:* The appropriate margin of safety will be determined during the Stage 3 portion of the TMDL.

***Comment**: Daily loads should be evaluated using actual data rather than permitted limits. Wastewater treatment plants consistently discharge at pollutant concentrations that are lower than their permitted limits. A more accurate model will be created through the use of actual data for wastewater treatment plan pollutant loadings, and may result in recognition that pollution from non-point sources will be more cost effective to reduce. Modeling of loadings should consider that the Park Forest Excess Flow Facility seldom discharges and the intermittent nature of other discharges.*

***Response**:* Actual data will be used, if available, for the Stage 3 portion of the TMDL.

- ***Comment**: The accuracy of land cover information should be improved. The land cover data referenced in the report is 10 years old. Urbanization has increased in the watershed over the past 10 years. Increased urbanization has likely resulted in higher pollutant loadings from non-point sources and increases in peak stream flows. The only stream gauges in the watershed are in the Chicago Lake Plain downstream sections of each stream segment, meaning that land cover data will be relied upon heavily to generate flow values in the upper reaches of the watershed, including Thorn Creek segments ILHDB-03 and ILHDB-05.*

***Response**:* The land coverage data is not always up to date as inventories are not compiled every year. Additional up to date land cover data will be analyzed during Stage 3 and added to the final report.

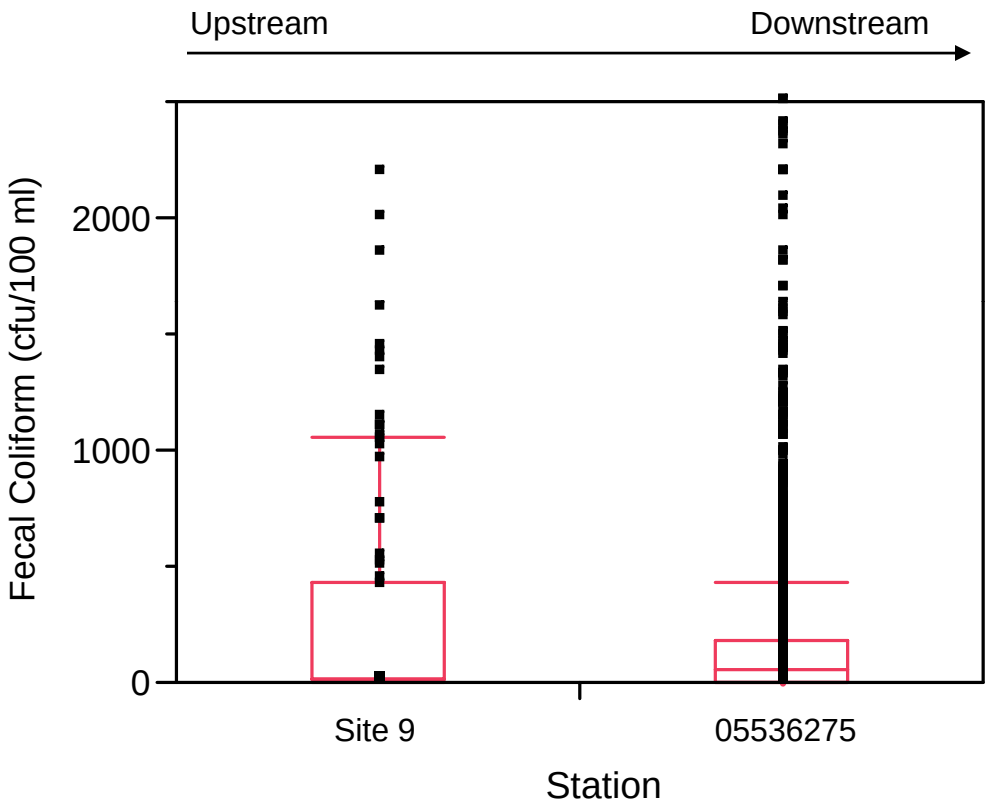
- ***Comment**: The 5.84 MGD average wastewater flow attributable to direct industrial discharges indicates that there is a heavy industrial presence within the watershed. The fact that the discharges are direct implies that the contributing industries are not connected to municipal sewer systems. Consideration should be given to industrial stormwater discharges during the development of the TMDL and the Implementation Plan.*

Response: Industrial stormwater discharges will be further investigated during the Stage 3 portion of the TMDL.

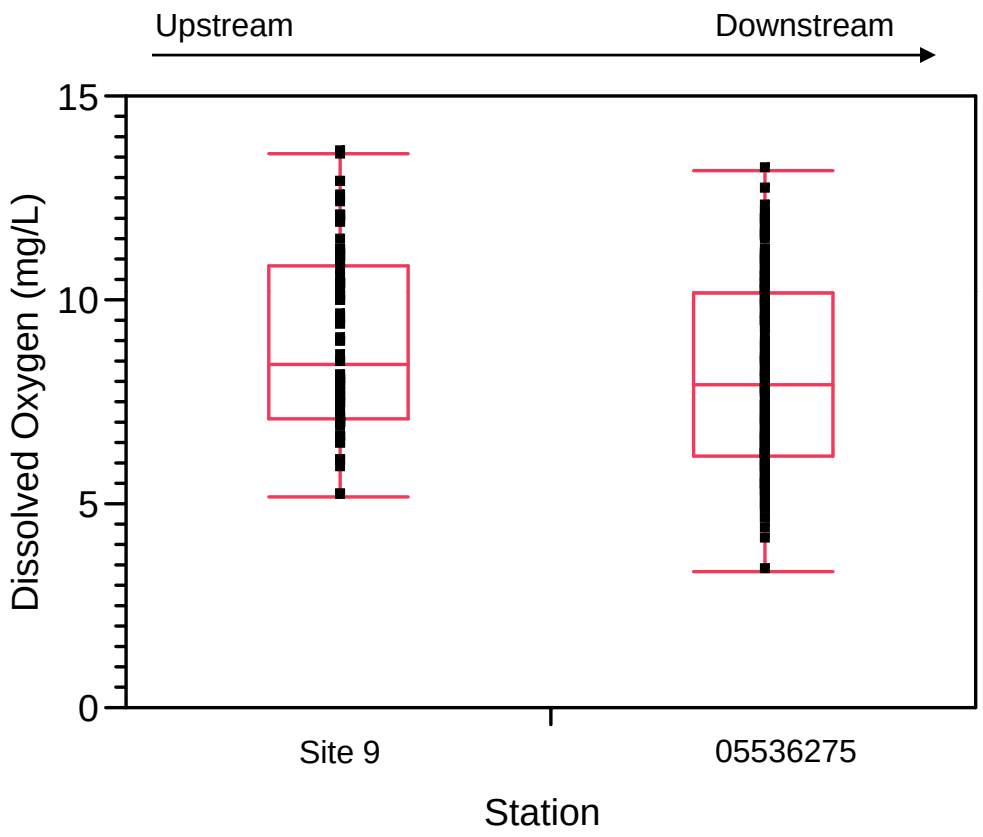
Appendix C-1

Box Plots by Station

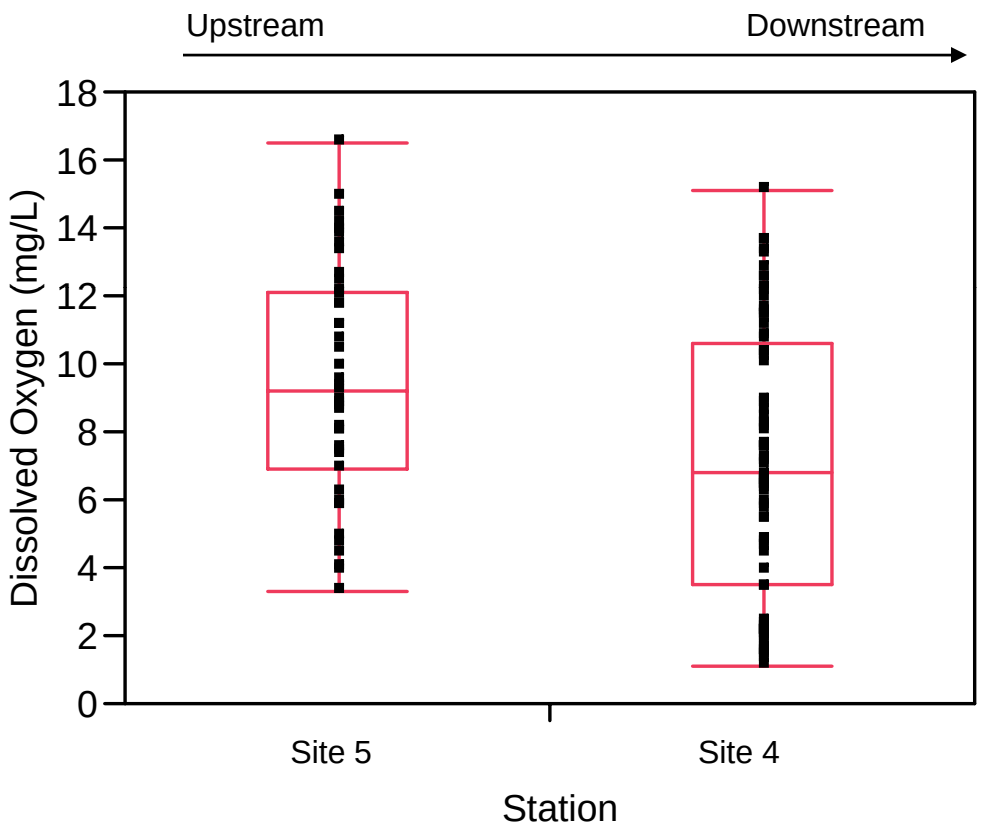
IL_HBD-02 – Fecal Coliform



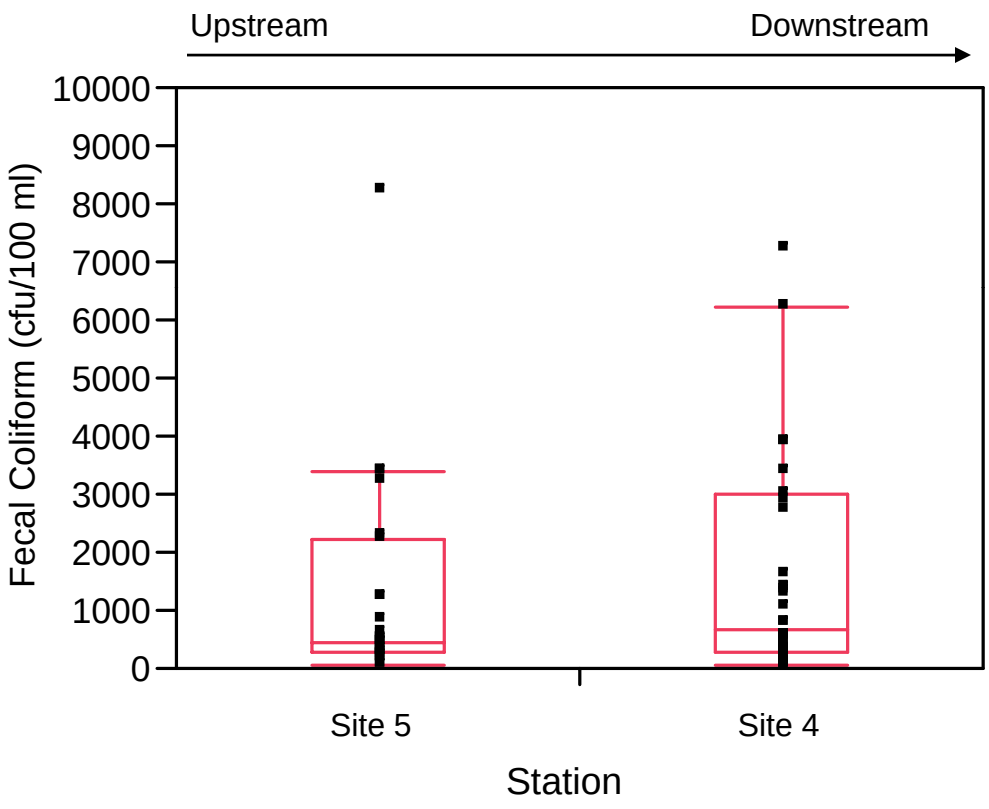
IL_HBD-02 – Dissolved Oxygen



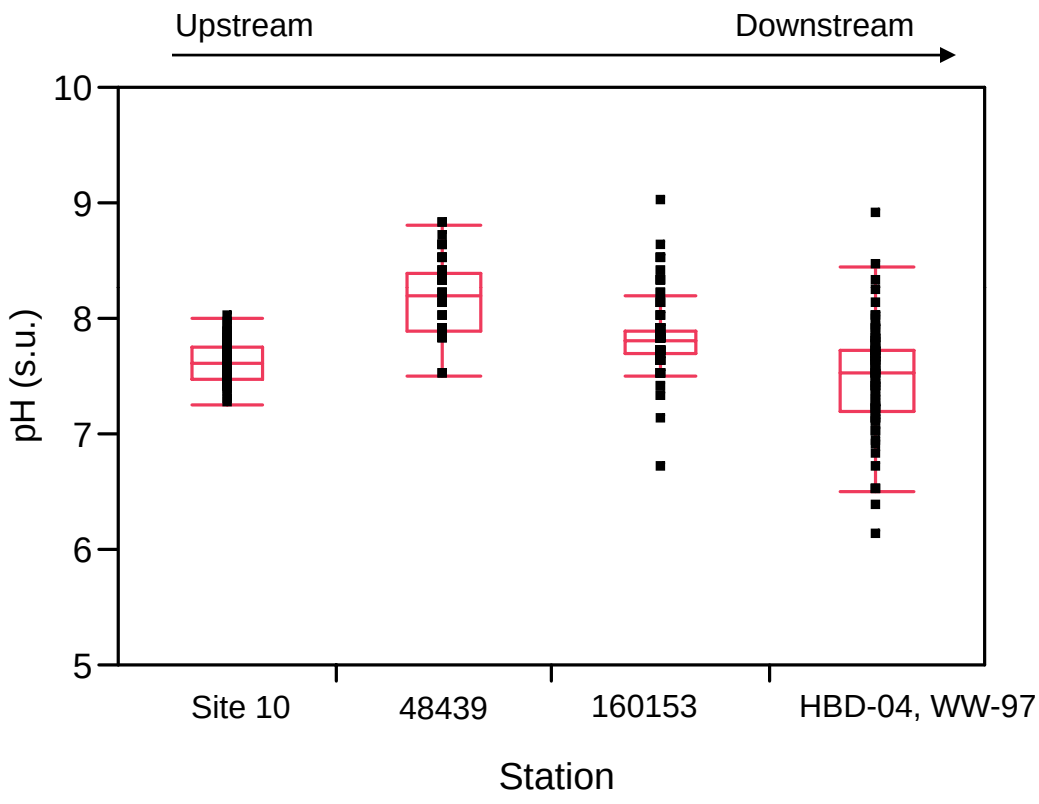
IL_HBD-03 – Dissolved Oxygen



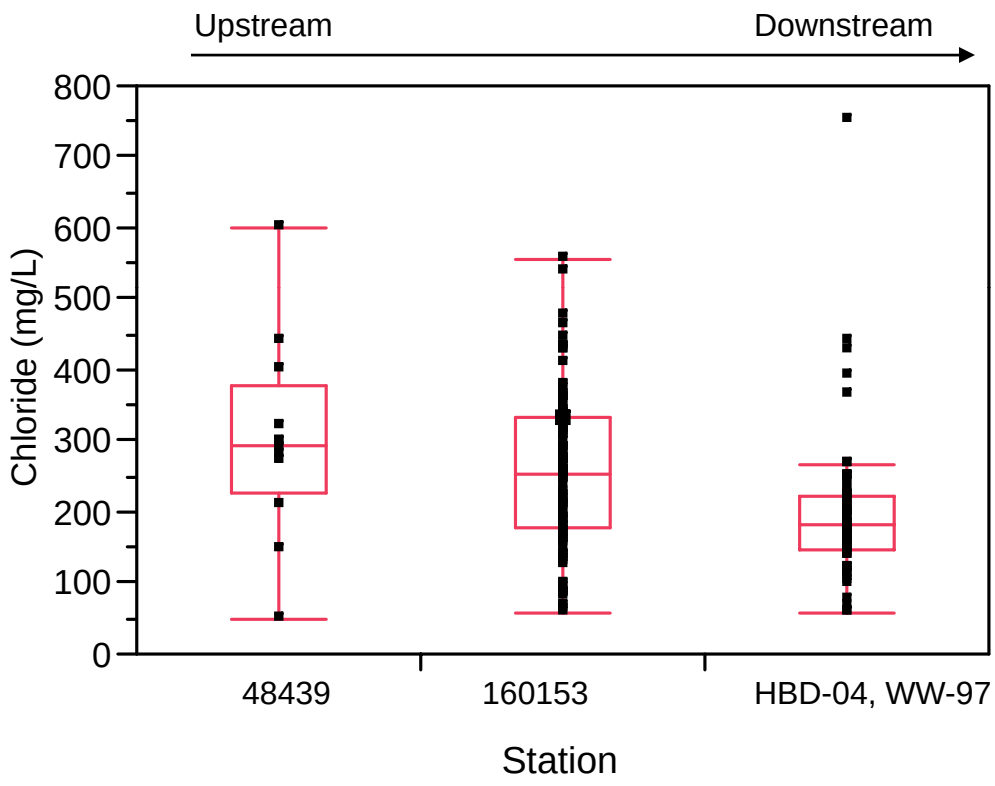
IL_HBD-03 – Fecal Coliform



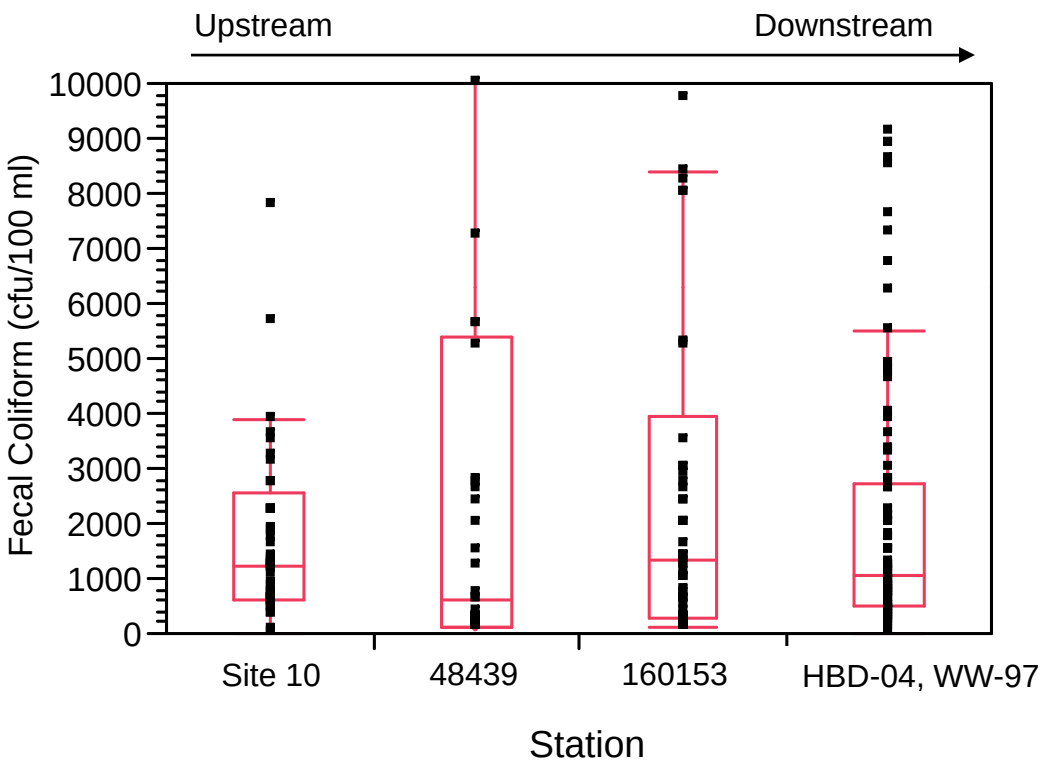
IL_HBD-04 - pH


Upstream
Downstream
10
9
8
7
6
5
pH (s.u.)
Site 10
48439
160153
HBD-04, WW-97
Station

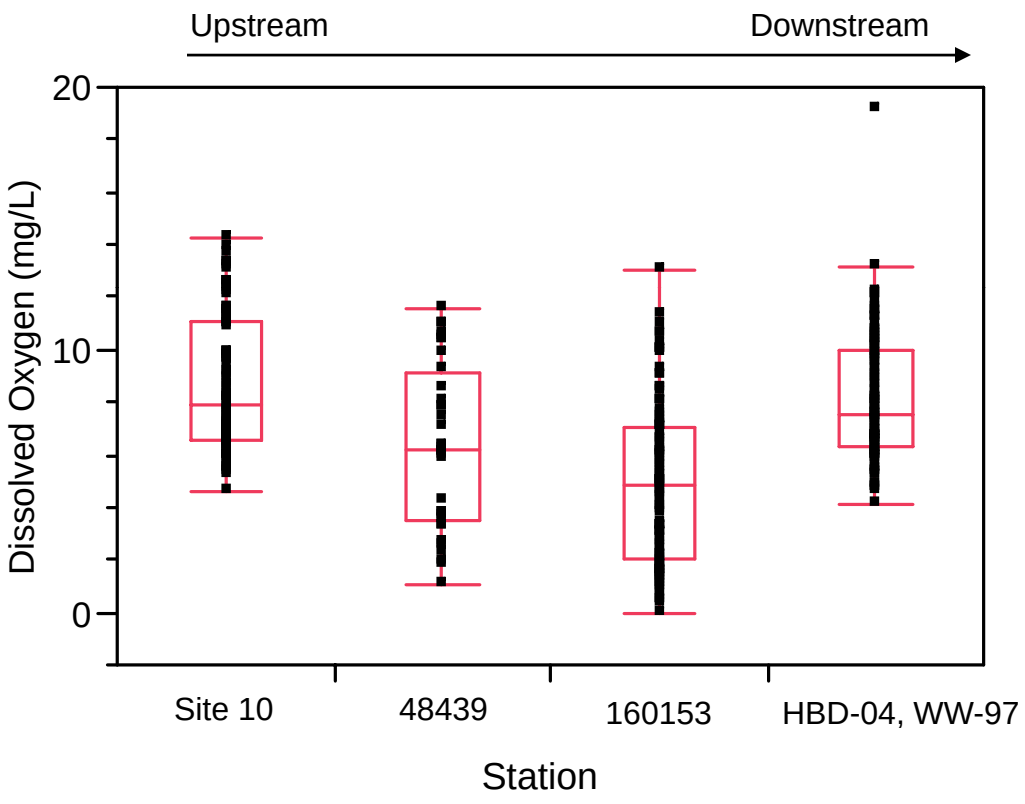
IL_HBD-04 - Chloride



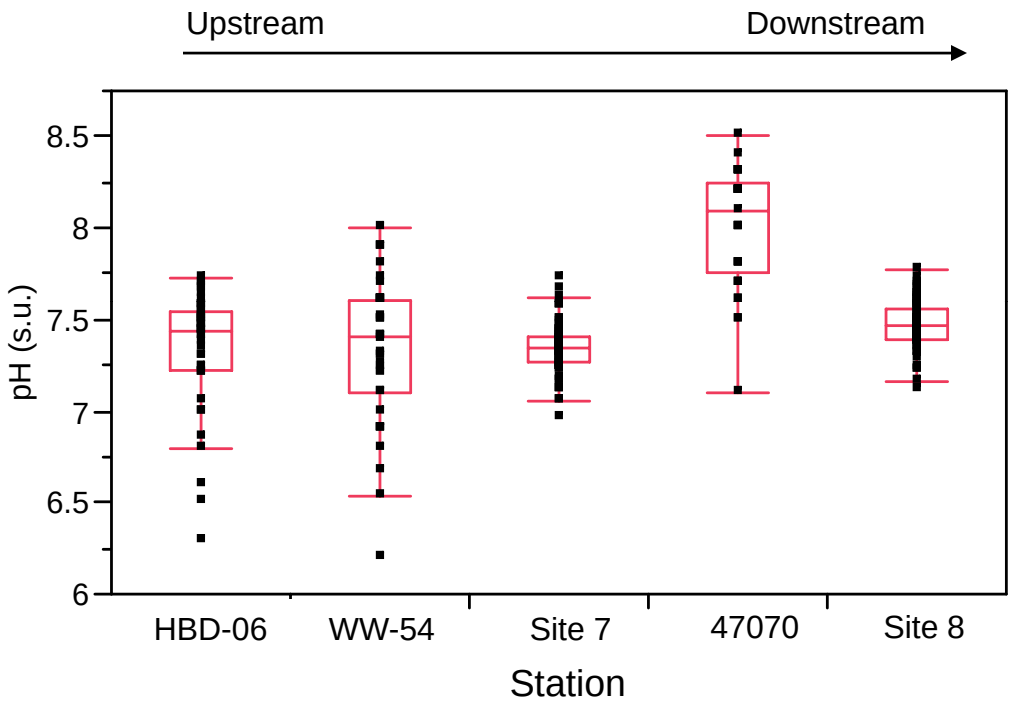
IL_HBD-04 – Fecal Coliform



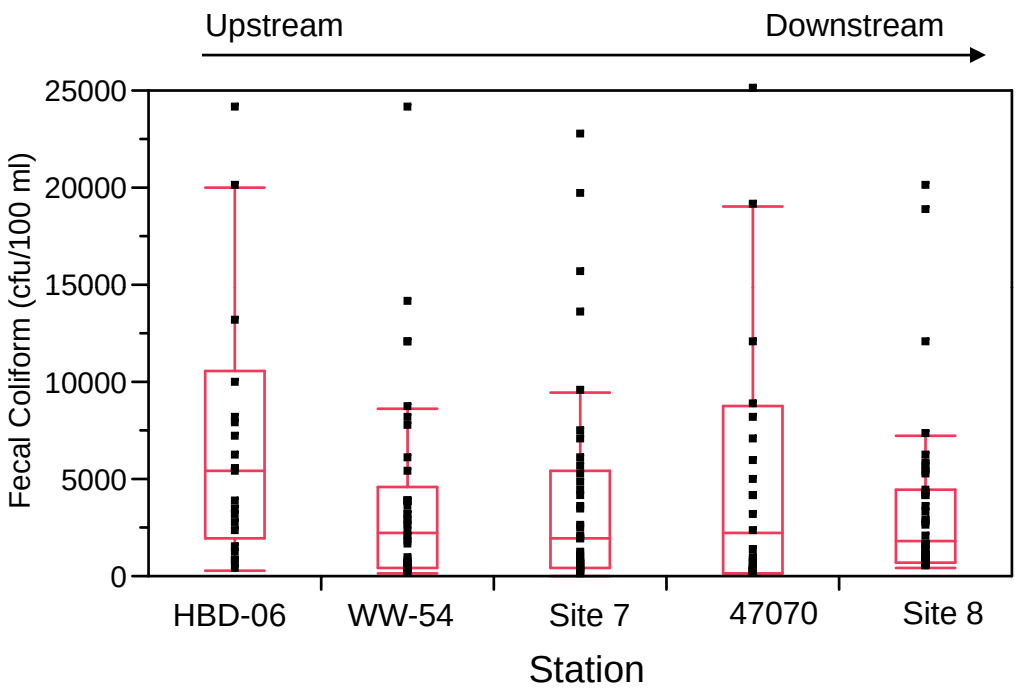
IL_HBD-04 – Dissolved Oxygen



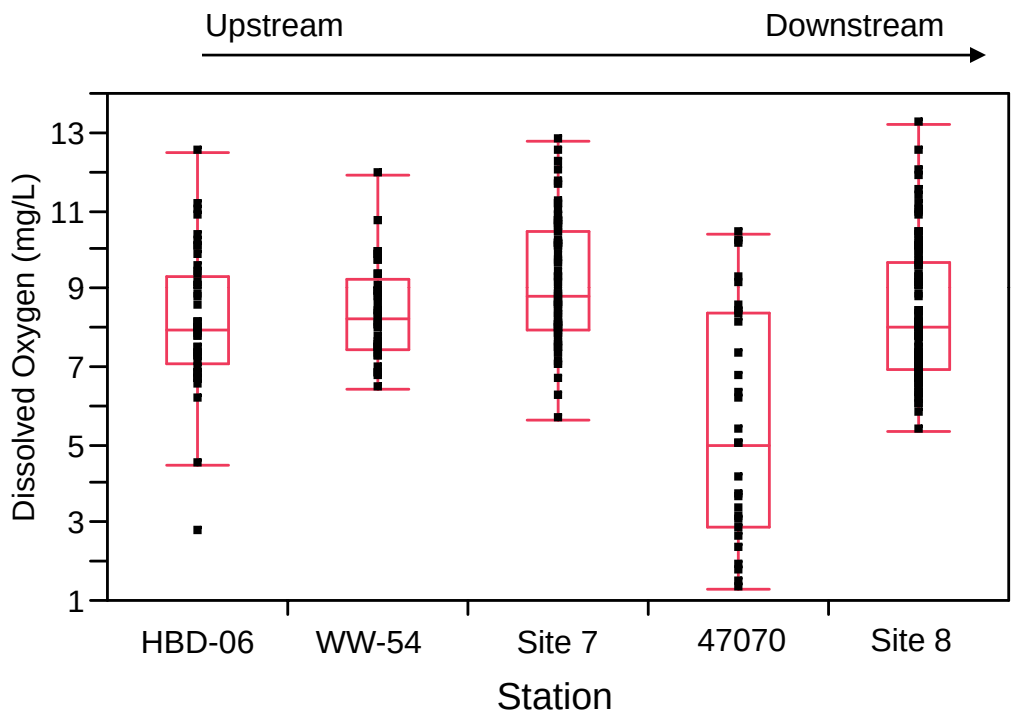
IL_HBD-06 - pH


Upstream
Downstream
8.5
8
7.5
7
6.5
6
pH (s.u.)
HBD-06
WW-54
Site 7
47070
Site 8
Station

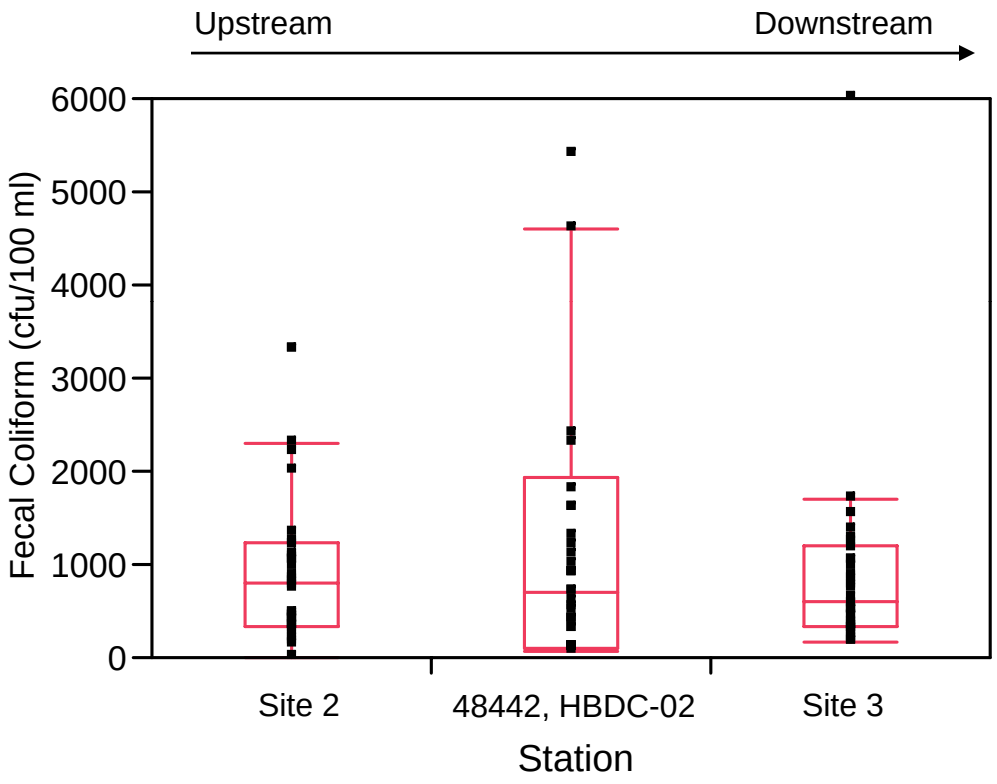
IL_HBD-06 – Fecal Coliform



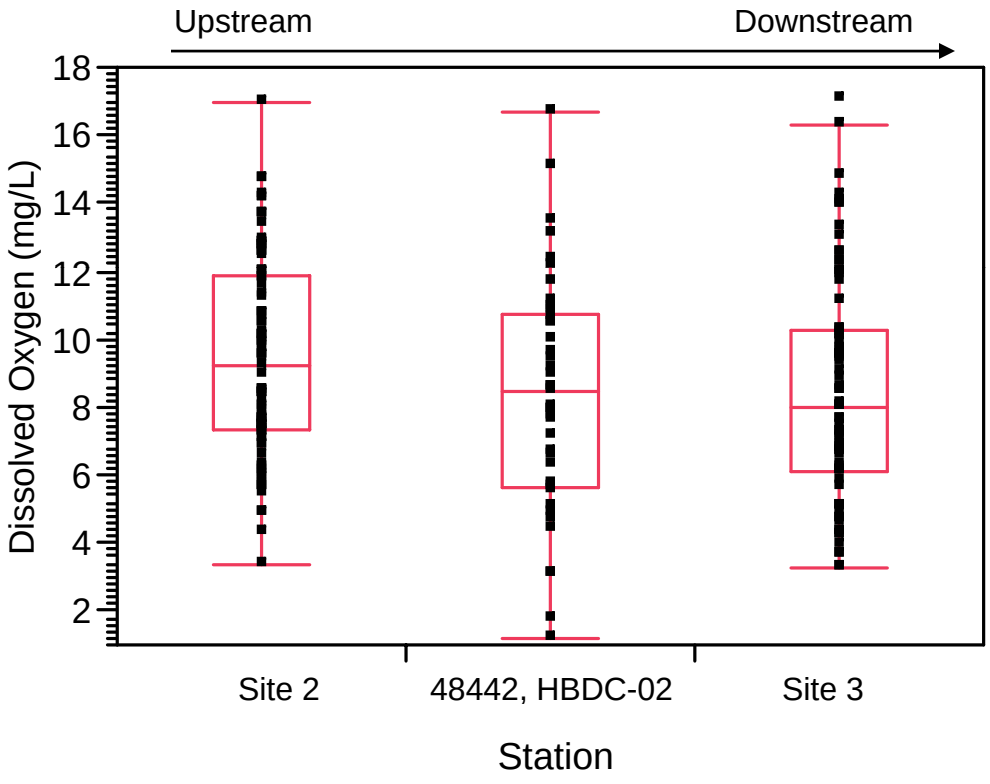
IL_HBD-06 – Dissolved Oxygen



IL_HBDC-02 – Fecal Coliform



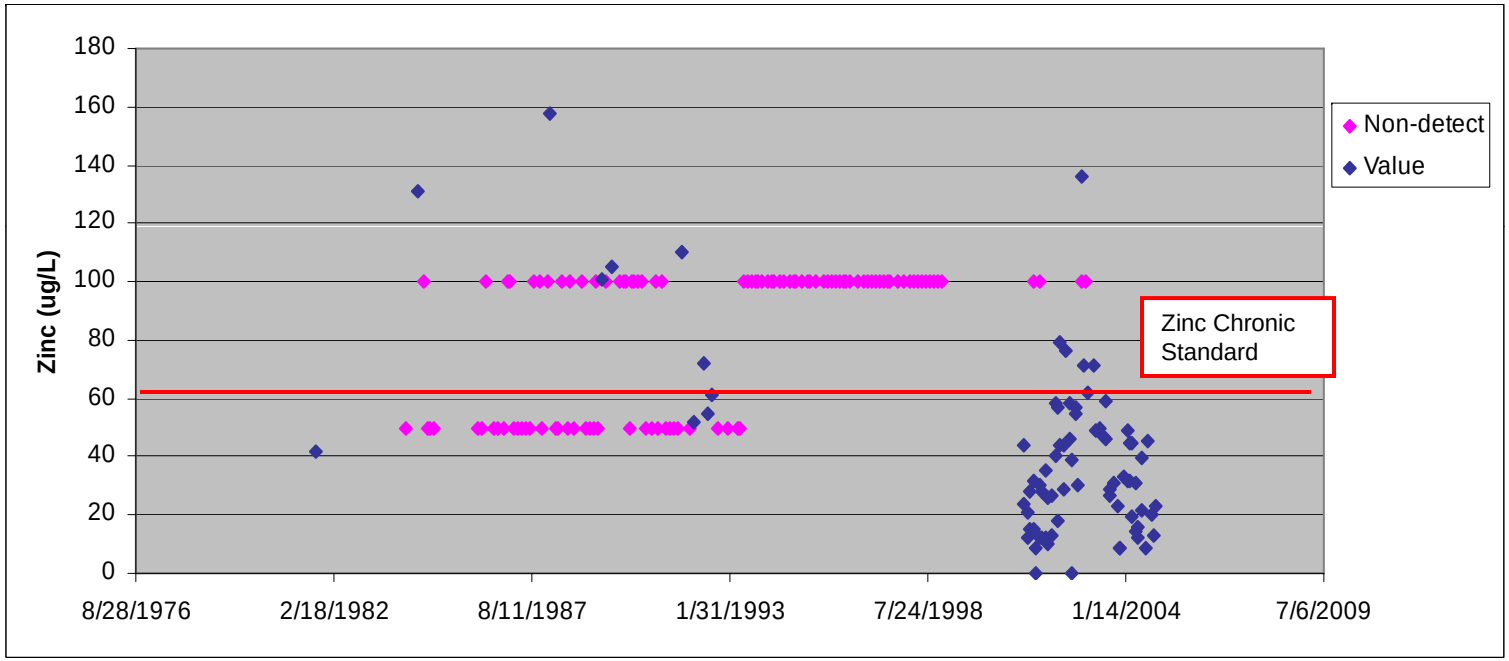
IL_HBDC-02 – Dissolved Oxygen



Appendix C-2

Zinc Time-Series

IL_HBD-02 - Zinc



Appendix C-3

Monitoring Station Summary Table

Segment	Station	Monitoring Agency	Latitude	Longitude
IL_HBD-02	Site 9 - Glenwood Sch.	Thorn Creek Sanitary Data	N 41.547633°	W -87.62525°
IL_HBD-02	5536275	N/A	N 41.568056°	W -87.608333°
IL_HBD-03	Site 5 - Western Ave	Thorn Creek Sanitary Data	N 41.472083°	W -87.6742°
IL_HBD-03	Site 4 - Stuenkel Rd	Thorn Creek Sanitary Data	N 41.45645°	W -87.69955°
IL_HBD-04	Site 10 - Thornton	Thorn Creek Sanitary Data	N 41.568216°	W -87.608083°
IL_HBD-04	48439	N/A	N 41.568333°	W -87.607778°
IL_HBD-04	160153	N/A	N 41.586667°	W -87.575111°
IL_HBD-04	HBD-04	IL EPA & Metropolitan Water Reclamation District of Greater Chicago	N 41.58928°	W -87.58103°
IL_HBD-04	WW_97	Metropolitan Water Reclamation District of Greater Chicago	N 41.58928°	W -87.58103°
IL_HBD-05	HBD-05	N/A	N 41.506111°	W -87.644444°
IL_HBD-05	Site 6 - Above	Thorn Creek Sanitary Data	N 41.518366°	W -87.629333°
IL_HBD-06	HBD-06	Metropolitan Water Reclamation District of Greater Chicago & Thorn Creek Sanitary Data	N 41.52083°	W -87.62537°
IL_HBD-06	WW_54	Metropolitan Water Reclamation District of Greater Chicago	N 41.52083°	W -87.62537°
IL_HBD-06	Site 7 - Below	Thorn Creek Sanitary Data	N 41.520983°	W -87.625133°
IL_HBD-06	47070	N/A	N 41.530833°	W -87.623333°
IL_HBD-06	Site 8 - Glenwood	Thorn Creek Sanitary Data	N 41.530366°	W -87.622633°
IL_HBDA-01	HBDA-01	IL EPA	N 41.556944°	W -87.595833°
IL_HBDA-01	48440	N/A	N 41.556944°	W -87.595833°
IL_HBDB-03	47072	N/A	N 41.545°	W -87.618333°
IL_HBDB-03	HBDB03	N/A	N 41.539722°	W -87.649444°
IL_HBDB-03	Site 12 - Homewood	Thorn Creek Sanitary Data	N 41.542166°	W -87.6358°
IL_HBDB-03	Site 13 - Homewood	Thorn Creek Sanitary Data	N 41.54°	W -87.64945°
IL_HBDC	Site 1 - Chicago Rd.	Thorn Creek Sanitary Data	N 41.4586°	W -87.633633°
IL_HBDC-02	Site 2 - Steger Road	Thorn Creek Sanitary Data	N 41.46995°	W -87.606716°
IL_HBDC-02	48442	N/A	N 41.536389°	W -87.596667°
IL_HBDC-02	HBDC02	N/A	N 41.536389°	W -87.596667°
IL_HBDC-02	Site 3 - Deer Creek	Thorn Creek Sanitary Data	N 41.542366°	W -87.611466°

Appendix C-4

Fecal Coliform and Dissolved Oxygen Time-Series

Dissolved Oxygen Time-Series

Fecal Coliform Time-Series