

Missouri  
Department of  
Natural Resources

**East Locust Creek  
*E. coli* Study  
Sullivan County, MO**

**September 1-27, 2006**

Prepared for:

Missouri Department of Natural Resources  
Division of Environmental Quality  
Water Protection Program

Prepared by:

Missouri Department of Natural Resources  
Field Services Division  
Environmental Services Program

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## 1.0 Introduction

At the request of the Water Protection Program (WPP), the Environmental Services Program (ESP) conducted five *Escherichia coli* (*E. coli*) samplings on East Locust Creek and Locust Creek. This sampling occurred between September 1-27, during the 2006 recreational season. The purpose of the sampling was to examine the impact of point sources on *E. coli* levels in East Locust Creek. Mandy Sappington, Wayne Maresch, and Randy Niemeyer of the ESP, Field Services Division performed sampling and analyses.

## 2.0 Study Area

The study area included five sites: three on East Locust Creek and two on Locust Creek. East Locust originates in southern Putnam County, northeast of Pollock, Missouri. East Locust runs for approximately 15 miles through rural agricultural areas before it reaches Elmwood Creek, just north of Milan, Missouri. Elmwood Creek receives the discharge of Premium Standard Farms (PSF) Milan Processing Plant (MO-0115487). East Locust then flows down the eastern edge of Milan for approximately 3 miles before receiving effluent from the Milan Wastewater Treatment Facility (WWTF) (MO-0048151). East Locust flows for another 11 miles through rural, agricultural areas before entering Locust Creek 0.5 mile north of Browning, Missouri. East Locust is a Class C stream from its headwaters to Highway 6 in Milan where it becomes a Class P stream with designated uses for livestock and wildlife watering, protection of warm water aquatic life, and whole body contact recreation type B (WBC-B). There is a section of the stream excluded from whole body contact recreation-from Highway 6 to sec.23, T. 62 N., R. 20 W. No sampling sites were located in this section.

Locust Creek originates in Iowa and runs south through rural, agricultural portions of Putnam and Sullivan counties. This portion of Locust Creek contains no point sources. Approximately 45 miles south of the Iowa border, East Locust enters Locust Creek. Locust Creek is a Class P stream with designated uses for livestock and wildlife watering, protection of warm water aquatic life, WBC-B, secondary contact recreation, and drinking water supply.

### 2.1 Site Descriptions

**Site 1** – (GPS Lat. 40.2835, Long. -93.0889) This site is located where Highway N crosses East Locust. It is upstream of the PSF and Milan WWTF discharges. This section of the stream is categorized as Class C. The substrate here is primarily sand with some smaller silt particles. The riparian corridor is narrow along steep banks, with residential and agricultural land use in the area.

**Site 2** – (GPS Lat. 40.2112, Long. -94.8944) This site is located where Highway 6 crosses East Locust. It is approximately 0.35 mile downstream of PSF's receiving stream, Elmwood Creek, but upstream of the Milan WWTF. This site is where the stream becomes Class P. The substrate here is primarily sand with some smaller silt particles. Adjacent land use includes residences and row crops, with commercial uses nearby.

**Site 3** – (GPS Lat.40.1639, Long. -93.1228) This site is located where Rolling Road crosses East Locust. It is approximately 4.5 miles downstream of Elmwood Creek and 2.75 miles downstream of the Milan WWTF. The substrate at this location is finer with more silt than upstream sites. The riparian corridor is narrow along steep banks. Adjacent land use is row crops. Within 0.5 mile upstream, cattle have access to the creek. The access is by a small gravel road.

**Site 4** – (GPS Lat. 40.0641, Long. -93.1673) This site is located on Locust Creek at Missouri Department of Conservation's Rocky Ford Access on Vernon Road. It is approximately 1.5 miles upstream of the East Locust-Locust Creek confluence. The substrate at this site consists of many large rocks. The riparian corridor is narrow, but contains more mature trees and shrubs than other sampling sites. Nearby fields are planted in row crops. A small gravel road crosses the stream.

**Site 5** – (GPS Lat. 40.0354, Long. -93.1722) This site is located where Highway MM crosses Locust Creek. It is approximately 0.5 mile downstream of the East Locust-Locust Creek confluence. The substrate here is primarily sand. Adjacent land use includes row crops and pasture. The banks are steep and mostly covered in herbaceous vegetation near the bridge. There are more trees up and downstream of the bridge than at the sampling site. The stream is accessible by what appears to be an all-terrain vehicle trail.

## **3.0 Methods**

### **3.1 Field Procedures**

Prior to each sampling event, ESP personnel calibrated water quality field instruments (pH, specific conductivity, and dissolved oxygen) per manufacturers' specifications. ESP personnel determined pH, specific conductivity, dissolved oxygen, and temperature of all surface water grab samples at the time of collection. Field measurements are summarized in Table 1, Appendix A.

#### **3.1.1 Surface Water Samples**

All samples were collected between 11:30 and 13:30, and analyzed for *E. coli* within six hours of collection. Grab samples were taken in-stream by immersing sterile sample containers directly into the stream. Personnel stood downstream of the sampling location and care was taken to minimize sediment disturbance during collection. *E. coli* data is summarized in Appendix B.

#### **3.1.2 Discharge Measurements**

Due to time constraints, ESP personnel were unable to take flow measurements in the field. Therefore, daily discharge records compiled by the United States Geological Survey (USGS) for Locust Creek, near Linneus, Missouri are included in Appendix C. Appendix D includes precipitation and flow records for the Milan WWTF supplied to ESP by the facility operator.

### **3.2 Chain-of-Custody**

All samples received a numbered label and were placed on ice in a cooler. The corresponding label number was entered onto a chain-of-custody form indicating the date, time, location of collection, and parameters to be analyzed.

### **3.3 Analyses Requested**

All samples collected were submitted for *E. coli* analysis. Water Quality Monitoring Section personnel performed analyses at the ESP laboratory in accordance with [MDNR-WQMS-109](#) standard operating procedure, *Analysis of E. coli and Total Coliforms Using IDEXX Colilert and Quantitray Test Method*, based on US EPA approved methods.

### **3.4 Quality Assurance/Quality Control**

#### **3.4.1 QA/QC Methods**

All analyses were in accordance with the *Fiscal Year 2007 Quality Assurance Project Plan for Complaints (FY-2007 QAPP)*.

#### **3.4.2 QA/QC Samples**

A duplicate sample was collected every 10 samples. Sample numbers 0609126 and 0609152 were collected at sites 4 and 3, respectively.

### **4.0 Observations**

On September 1, 2006 the samples at all sites appeared light brown to brown and turbid. As flows continued to decrease throughout the month the water became more clear and colorless, but often contained suspended particles.

The United States Geological Survey reports that the study area has received below average rainfall this year. Toward the end of the study there was little to no visible flow at East Locust Creek sites.

The geometric mean value for *E. coli* in East Locust Creek increased as water traveled downstream from Highway N. Locust Creek also had lower levels of *E. coli* upstream of its confluence with East Locust. Sites 2, 3, and 5 had considerable spikes in *E. coli* levels during the sampling period. The spikes could not be attributed to any apparent cause.

Some additional sampling was conducted to investigate the point sources on East Locust Creek. On September 13, 2006 one sample (0609187) was taken from the Milan Lagoon effluent, another sample (0609188) was taken from Elmwood Creek (tributary carrying PSF effluent), and additional samples were taken at sites 2 (0609189) and 3 (0609190) to be incubated and analyzed

the next day. These incubated samples addressed the possibility that *E. coli* stressed by PSF's treatment process may recover and cause a downstream increase in bacteria.

Milan Lagoon effluent yielded 3.0 mpn/100mL *E. coli*. Elmwood Creek, carrying PSF effluent, yielded 146.7 mpn/100mL *E. coli* when analyzed within six hours, and showed no regrowth when incubated and analyzed 24 hours later. The incubated samples from sites 2 and 3 were analyzed 24 hours later to investigate the possibility of bacterial regrowth from PSF effluent. It did not appear that regrowth is a significant factor in the elevated *E. coli* levels of East Locust Creek. Nor does it seem that Milan WWTF or PSF are contributing high levels of *E. coli* to the stream.

These results would indicate non-point sources influencing East Locust downstream of Highway N. In particular, a stockyard for the Milan Livestock Auction is located on East Locust Creek between the WWTF and Rolling Road. ESP personnel observed cows in, and on both sides of the creek.

Statistical analysis shows some significant variation between sites. A One-Way ANOVA test shows that variation among all five sites is significant. However, a Tukey Test (pairwise multiple comparison) shows that the significant difference lies between sites 3 and 4. There is no significant difference between sites 1 and 2, 2 and 3, or 4 and 5. However a t-test does reveal a significant difference between sites 1 and 3.

This study also revealed a water quality violation at site 3 (Rolling Road bridge). All sampling locations were situated within portions of the stream designated for WBC-B. Missouri Department of Natural Resources 10 CSR 20-7.031 states that for a stream designated WBC-B, the geometric mean shall not exceed 548 mpn/100mL during the recreational season.

## **5.0 Data Reporting**

Analytical results have been summarized in Tables 1 and 2.

Submitted by:

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Mandy Sappington  
Environmental Specialist  
Water Quality Monitoring Section  
Environmental Services Program

Date:

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Approved by:

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Alan Reinkemeyer  
Director  
Environmental Services Program

AR:mst

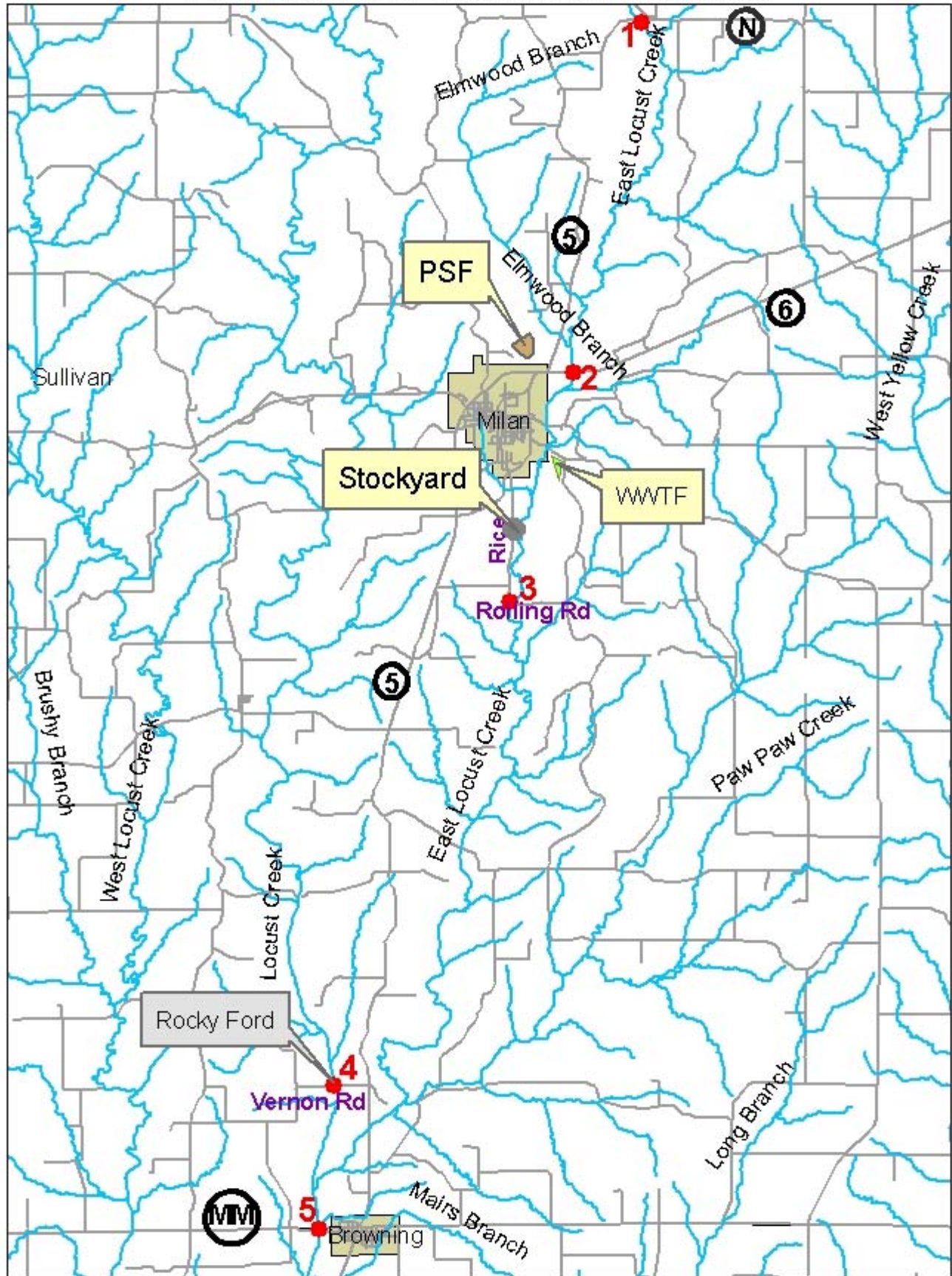
c: Phil Schroeder, Chief, Water Quality Monitoring and Assessment Section, Water Protection Program

**Figure 1**  
**Site Map**

East Locust Creek *E. coli* Study  
Sullivan County, MO

Figure 1.

### East Fork Locust/Locust Creek E. Coli Study



1 inch equals 1.972945 miles



**Appendix A**  
**Field Measurements**

East Locust Creek *E. coli* Study  
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**Table 1. Field Measurements**

<b>Sample #</b>	<b>Site</b>	<b>Date</b>	<b>Time</b>	<b>DO (mg/L)</b>	<b>pH</b>	<b>Cond (<math>\mu</math>S)</b>	<b>T (<math>^{\circ}</math>C)</b>
0605080	1	9/1/06	11:47	7.15	7.46	268	20.5
0605081	2	9/1/06	12:05	8.10	7.75	582	21.6
0605082	3	9/1/06	12:23	9.14	8.00	533	22.0
0605083	4	9/1/06	12:41	5.15	7.55	192	24.4
0605084	5	9/1/06	12:58	8.58	7.79	350	24.5
0605085	1	9/6/06	11:50	4.55	7.32	403	18.6
0605086	2	9/6/06	12:10	9.27	7.76	1140	19.8
0605087	3	9/6/06	12:30	9.67	8.02	778	20.8
0605088	4	9/6/06	12:55	6.81	7.57	237	23.2
0603380	5	9/6/06	13:10	14.0	8.19	438	25.7
0609121	1	9/13/06	13:00	6.65	7.55	481	17.6
0609122	2	9/13/06	12:40	9.36	7.19	1090	18.2
0609123	3	9/13/06	12:20	8.71	8.31	778	18.4
0609124	4	9/13/06	12:00	8.73	7.48	284	21.1
0609125	5	9/13/06	11:30	10.9	7.80	505	19.1
0609142	1	9/20/06	11:39	5.15	7.04	504	12.2
0609143	2	9/20/06	11:59	9.33	7.44	1000	14.1
0609144	3	9/20/06	12:19	9.50	7.64	880	12.9
0609145	4	9/20/06	12:49	6.88	7.37	298	17.7
0609146	5	9/20/06	13:01	15.6	8.01	555	18.2
0609147	1	9/27/06	12:00	5.21	7.08	540	15.2
0609148	2	9/27/06	12:25	9.32	7.75	1370	16.9
0609149	3	9/27/06	12:45	8.85	8.06	1070	16.4
0609150	4	9/27/06	13:15	7.60	7.82	336	17.6
0609151	5	9/27/06	13:30	17.9	8.52	529	18.2

**Appendix B**  
***E. coli* Results**

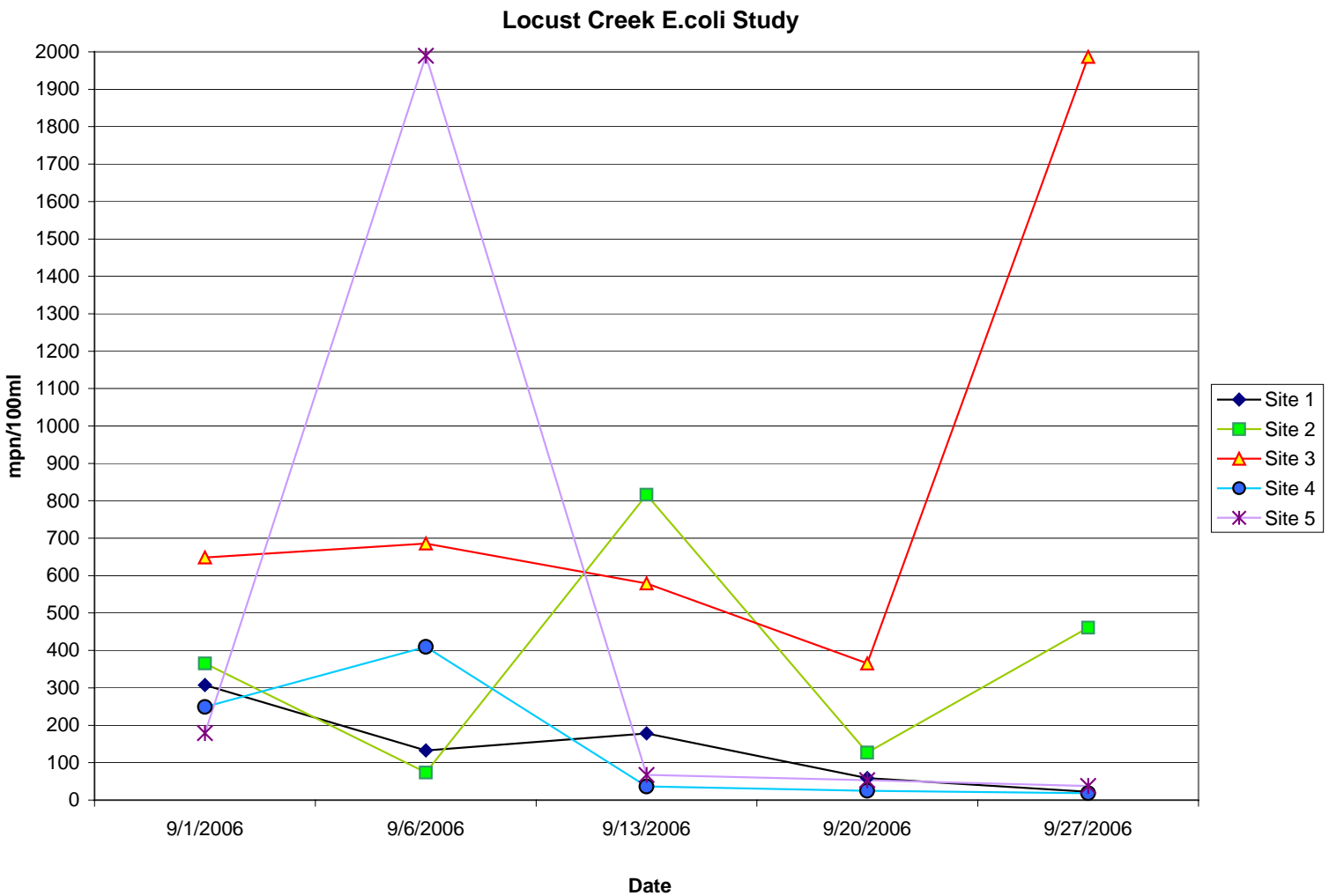
East Locust Creek *E. coli* Study  
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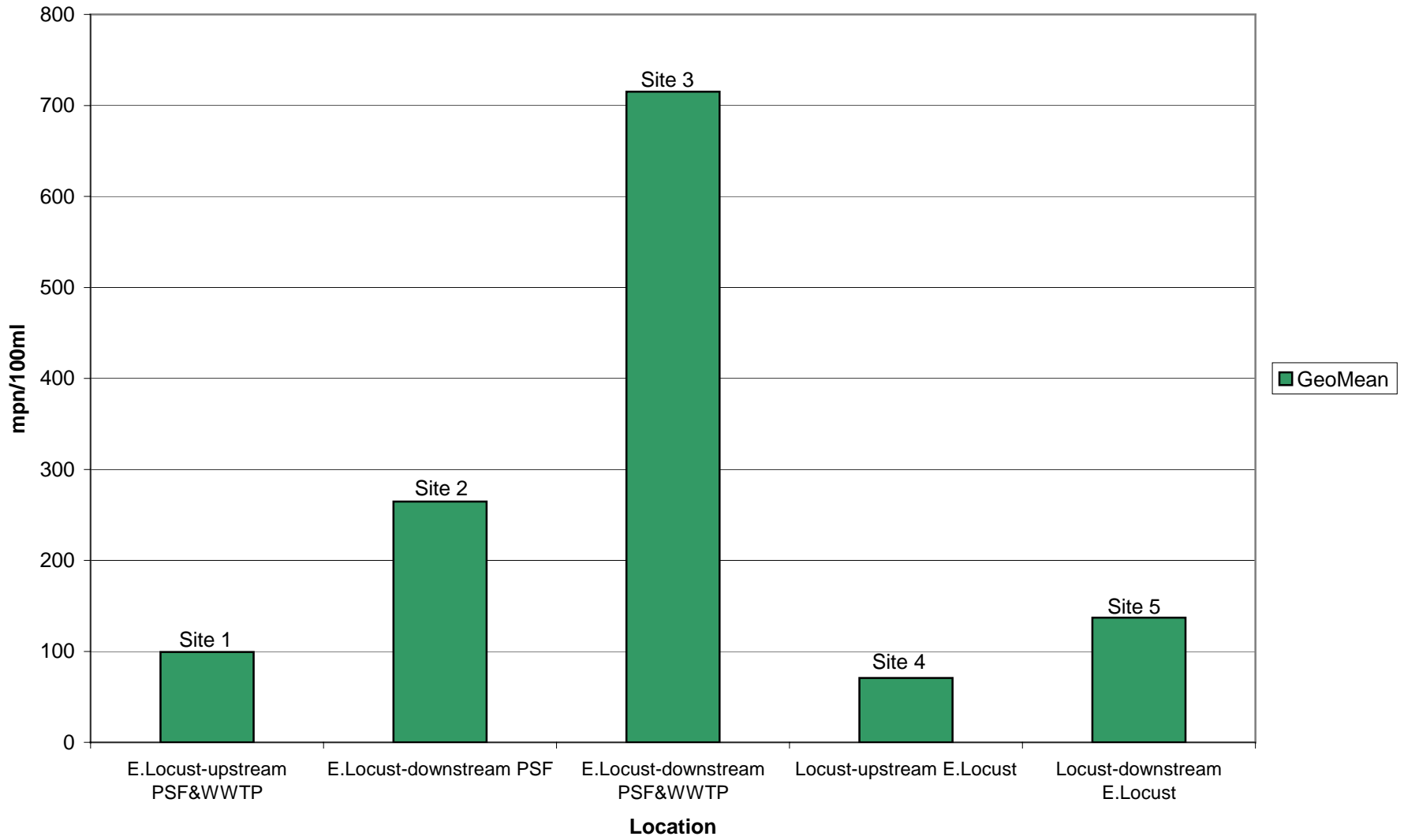
**Table 2. *Escherichia coli* Results**

Sample Date	Site 1	Site 2	Site 3	Site 4	Site 5
9/1/2006	307.6	365.4	648.8	248.9	178.9
9/6/2006	133	74	686	410	1990
9/13/2006	178.5	816.4	579.4	36.4	67.7
9/20/2006	59.1	127.4	365.4	25.3	53
9/27/2006	22.3	461.1	1986.3	18.7	37.9
Geometric Mean	99.23702	264.59	715.2294	70.6276	137.0861

**Figure 2. *Escherichia coli* Results**



**Figure 3. Geometric Mean Values in East Fork Locust Creek E.coli Study**



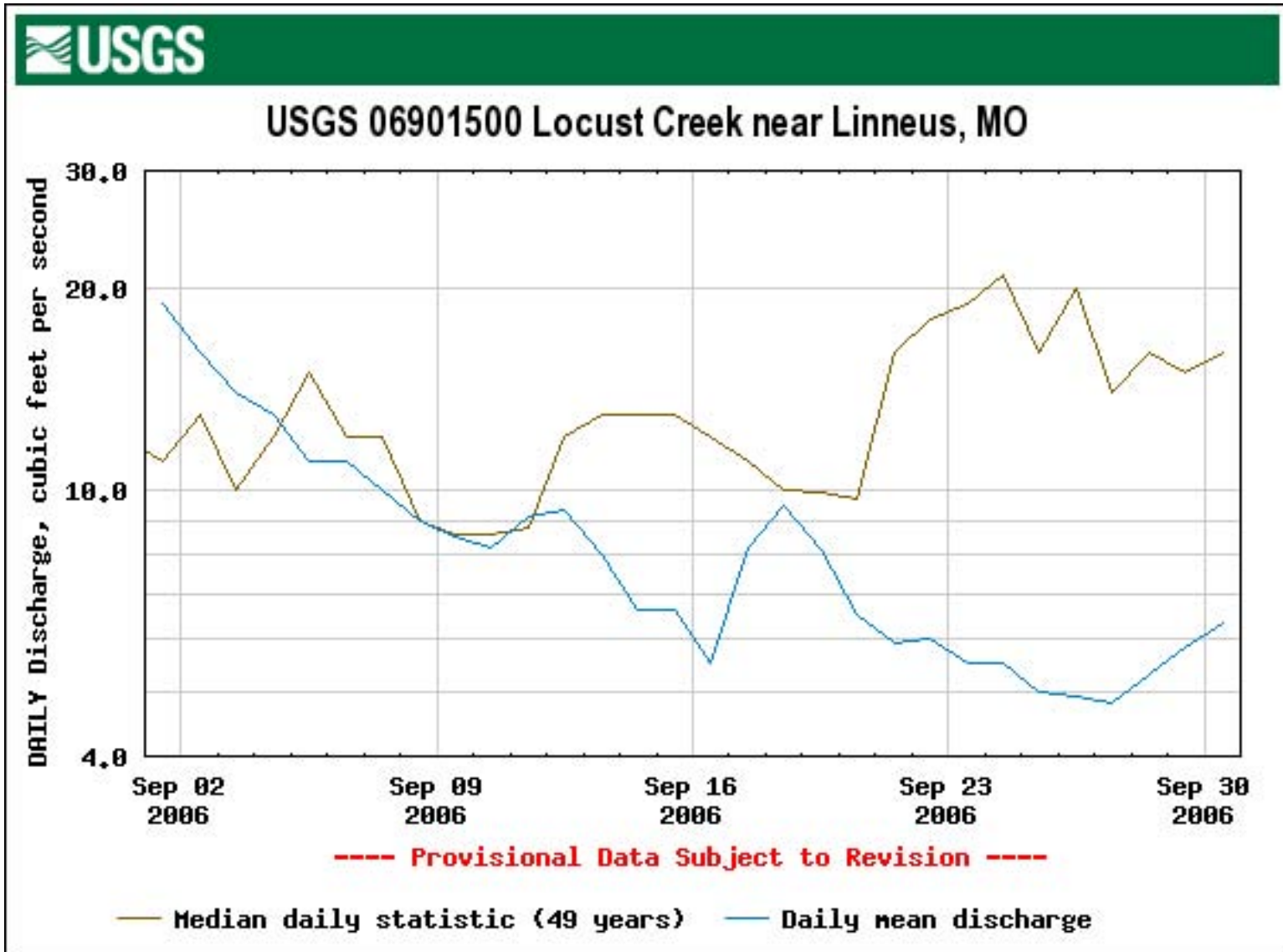


**Appendix C**  
**Daily Mean Discharge**  
**USGS Gauge Station – Locust Creek near Linneus**

East Locust Creek *E. coli* Study  
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Figure 4. Daily Mean Discharge

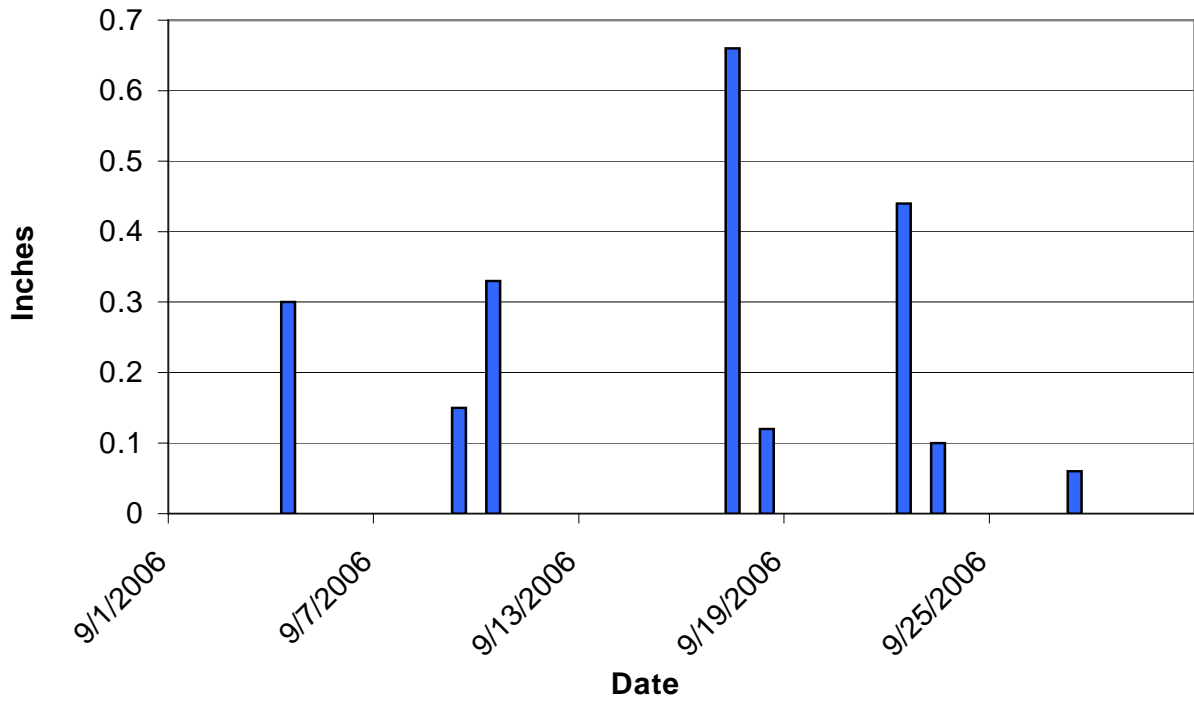


**Appendix D**  
**Milan WWTF Precipitation and Discharge**

East Locust Creek *E. coli* Study  
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**Figure 5. Precipitation at Milan WWTF**



**Figure 6. Milan WWTF Flow**

