

**Water Quality Evaluation of Six Stream
Sites in Northern Stone County**

July 2005

PREPARED FOR:
TABLE ROCK LAKE WATER QUALITY, INC.
P.O. Box 606
Kimberling City, MO 65686

PREPARED BY:
MEC WATER RESOURCES, INC.
1000 North College Ave., Ste. 4
Columbia, MO 65201

MEC Water Resources, Inc.

Table Rock Lake Quality, Inc.

Water Quality Evaluation of Six Stream Sites in Northern Stone County

TABLE OF CONTENTS

I. INTRODUCTION	1
II. METHODOLOGY	1
III. RESULTS	1
IV. DISCUSSION	3

LIST OF APPENDICES

Appendix 1	Water Quality Data Collected at Spring Creek, Crane Creek and James River Sites in Stone County
------------	---

LIST OF TABLES

Table 1	Summary of Fecal Coliform and Total Phosphorus Concentrations
---------	---

LIST OF FIGURES

Figure 1	Monitoring Site Location
----------	--------------------------

MEC Water Resources, Inc.

Table Rock Lake Quality, Inc.

Water Quality Evaluation of Six Stream Sites in Northern Stone County

I. INTRODUCTION

Table Rock Lake Water Quality, Inc. (TRLWQ) retained the services of MEC Water Resources, Inc. to monitor stream water quality at six monitoring sites in northern Stone County (Figure 1) which included Spring Creek, Crane Creek, and the James River. Monitoring data were collected from March 2005 to July 2005. The monitoring was conducted to develop a better understanding of stream water quality in Stone County. No previous water quality problems at the selected streams had been identified by TRLWQ. The primary objective of the monitoring was to measure levels of coliform bacteria and phosphorous in selected Stone County streams. Coliform bacteria are indicators of potential water borne pathogens that may impact whole body contact recreation in the watershed. Sources of fecal coliform originate from on-site and centralized wastewater treatment system discharges as well as animal excrement. Total phosphorus has been recognized as the nutrient that limits algae growth in the James River and Table Rock Lake and was therefore selected as a critical water quality parameter.¹ Total phosphorous originates from on-site and centralized wastewater treatment systems as well as from fertilizer and manure in stormwater runoff. Additional water quality field measurements and water quality data were collected at several of the monitoring sites.

II. METHODOLOGY

Grab samples were collected at each monitoring site, stored in an ice-filled cooler and shipped or delivered to the selected laboratory for analysis. Stage was measured at most sampling locations. Field measurements including dissolved oxygen, temperature and conductivity were conducted using a YSI 85-D hand held meter. Additional discreet measurements included fecal coliform and total phosphorus on all samples. Several samples were also analyzed for pH, E. Coli, dissolved phosphorus, suspended solids, non-volatile suspended solids, the nitrogen series, biochemical and chemical oxygen demand.

III. RESULTS

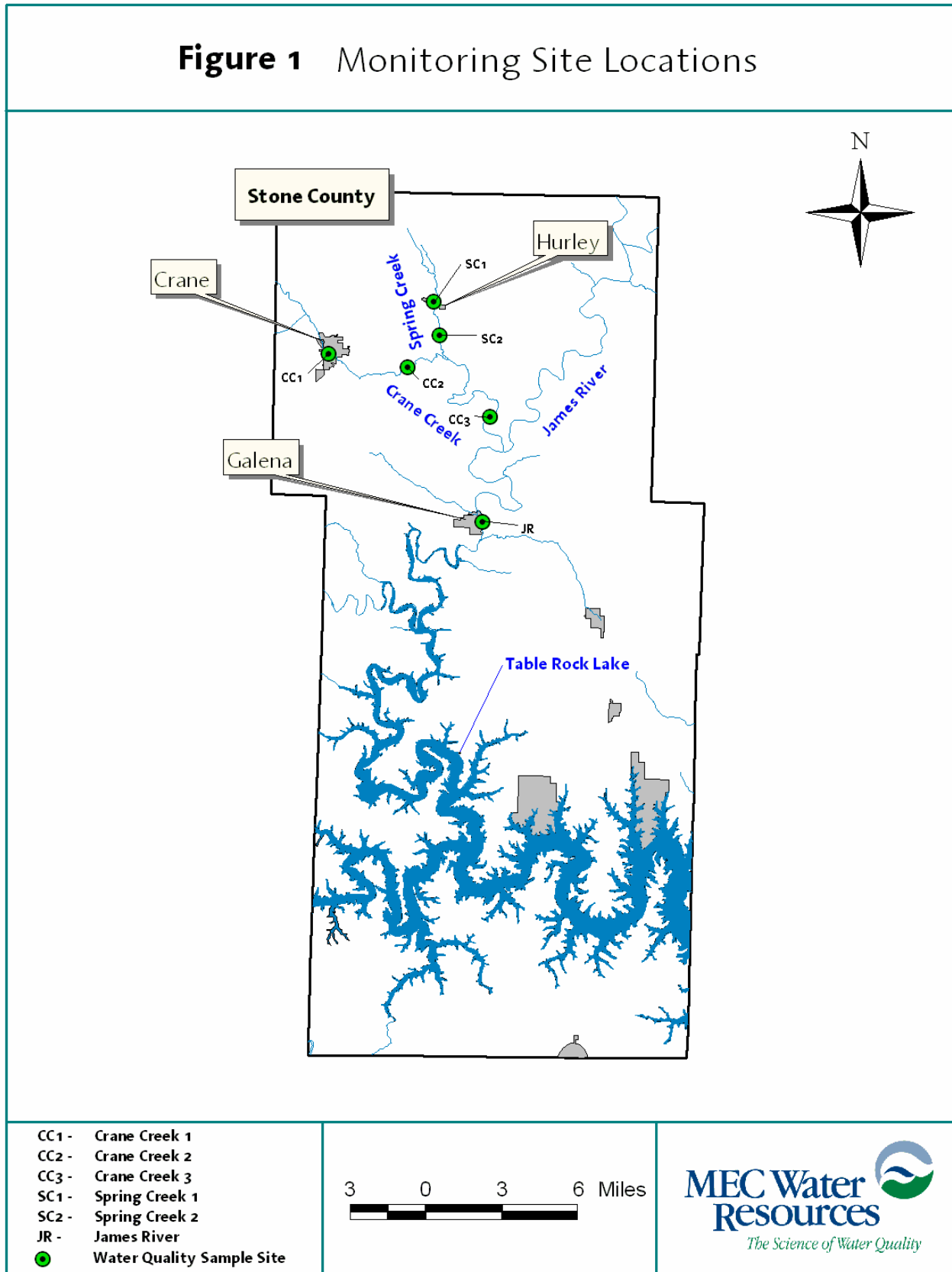
A summary of all the water quality data collected during the evaluation is provided in Appendix 1. The evaluation focused primarily on fecal coliform and total phosphorus concentrations which are described in the following two sections.

Fecal coliform

A summary of the fecal coliform bacteria and total phosphorous concentrations at the selected monitoring sites is provided in Table 1. Fecal coliform concentrations at the six sites ranged from 10 to 1,160 colonies per 100 mLs. Average fecal coliform concentrations exceeded the Missouri Whole Body Contact Recreation criteria (200 colonies per 100 mLs, per 10 CSR 20-7 Table A) at three of the six sites. These sites were Spring Creek 1, Spring Creek 2 and Crane Creek 2, averaging 628, 353 and 433 colonies per 100 mLs respectively.

¹ Missouri Department of Natural Resources Total Maximum Daily Load (TMDL) for James River, Webster, Greene, Christian and Stone Counties, Missouri, March 30, 2001.

Figure 1 Monitoring Site Locations



MEC Water Resources, Inc.

Table Rock Lake Quality, Inc.

Water Quality Evaluation of Six Stream Sites in Northern Stone County

Table 1
Summary of Fecal Coliform and Total Phosphorus Concentrations
 (Bold values indicate exceedance of water quality criteria)

Site ID	Number of Samples	Sampling Period	Fecal Coliform (Colonies/100 mL)			Total Phosphorus (ug/L)		
			Minimum	Maximum	Average*	Minimum	Maximum	Average
Crane 1 (Crane Cr. @ Crane)	5	6/14 - 7/5/05	38	310	111	20	30	24
Crane 2 (Crane Cr. @ Quail Spur)	7	3/23 - 7/5/05	63	1,160	433	13	56	36
Crane 3 (Crane Cr. @ Oto Rd)	7	3/23 - 7/5/05	29	180	111	8	40	34
James River (James R. @ Galena)	5	6/14 - 7/5/05	10	54	28	90	120	104
Spring 1 (Spring Cr. @ Hurley)	5	6/14 - 7/5/05	200	1,140	628	40	50	42
Spring 2 (Spring Cr. @ Hwy CC)	7	3/23 - 7/5/05	114	1,080	353	20	50	36

*Geometric Mean

Phosphorus

Total phosphorus concentrations at the six sites ranged from 10 to 120 µg/L (Table 1). Only the James River site exceeded the 75 µg/L total phosphorus limit established by the Missouri Department of Natural Resources' March 2001 James River Total Maximum Daily Load evaluation. The James River site ranged from 90 to 120 µg/L total phosphorus, with an average of 100 µg/L total phosphorus.

IV. DISCUSSION

Fecal coliform concentrations frequently exceeded the Missouri Whole Body Contact Recreation criteria in Spring Creek and in Crane Creek at Crane Creek Site 2. The source of the coliform loading was not identified, but could potentially be attributed to human waste. No municipal wastewater treatment plant discharges were identified as probable sources of fecal coliform for Spring Creek. Crane Creek Site 2 is approximately four miles downstream of the City of Crane wastewater treatment plant discharge. The City of Crane wastewater treatment plant uses an ultraviolet disinfection system which should likely reduce coliform concentrations lower than those observed at Crane Creek Site 2. Therefore, further investigation would likely be necessary to determine the source of the fecal coliform loading at all sites exceeding the water quality criteria. The persistent phosphorus concentrations in the James River are likely attributed to upstream discharges from municipal wastewater treatment plants, but this was not confirmed during the evaluation. Fecal coliform and phosphorus concentrations in Crane Creek Sites 1 and 3 were consistently below the water quality criteria, which indicated favorable water quality in these stream reaches.

MEC Water Resources, Inc.

Table Rock Lake Quality, Inc.

Water Quality Evaluation of Six Stream Sites in Northern Stone County

Appendix 1 – Water Quality Data Collected on Spring Creek, Crane Creek and James River Sites in Stone County

Table A.1 Data Summary

		Temp.	D.O.	pH	Cond.	TP	TDP	TN	NH3N	No2+No3	TSS	VSS	NVSS	F. Coliform	E. Coli
		(°C)	mg/L	(SU)	(µS)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(colonies/100mL)	(MPN/100mL)
Crane 1 (Crane Cr. @ Crane) 5 Samples 6/14/05-7/5/05	Maximum	16.90	9.83	7.75	289	0.03	---	---	---	---	---	---	---	310	79
	Minimum	14.80	7.57	6.93	230	0.02	---	---	---	---	---	---	---	38	30
	Arith. Mean	15.70	8.70	-----	274	0.02	---	---	---	---	---	---	---	139	50
	Geo. Mean	15.69	8.65	-----	273	0.02	---	---	---	---	---	---	---	111	46
Crane 2 (Crane Cr. @ Quail Spur) 7 Samples 3/23/05-7/05/05	Maximum	19.10	9.06	8.84	316	0.06	0.03	3.09	---	2.88	5.00	5	---	1160	1050
	Minimum	10.40	7.34	7.44	146	0.01	0.01	2.80	---	2.52	4.00	5	---	63	435
	Arith. Mean	16.21	8.33	-----	239	0.04	0.02	2.97	---	2.73	4.50	5	---	597	737
	Geo. Mean	15.90	8.32	-----	231	0.03	0.01	2.96	---	2.72	4.47	5	---	433	692
Crane 3 (Crane Cr. @ Oto Rd.) 7 Samples 3/23/05-7/05/05	Maximum	25.10	10.72	8.62	339	0.04	0.03	2.82	0.01	2.93	20.00	14	10	180	150
	Minimum	9.70	7.70	7.11	265	0.01	0.01	2.50	0.01	2.37	2.80	14	10	29	47
	Arith. Mean	20.00	9.18	-----	321	0.03	0.02	2.67	0.01	2.69	11.40	14	10	126	92
	Geo. Mean	19.21	9.15	-----	320	0.03	0.02	2.66	0.01	2.68	7.48	14	10	111	84
James River James R. @ Galena 5 Samples 6/14/05-7/05/05	Maximum	28.50	7.43	8.35	522	0.12	---	---	---	---	---	---	---	54	35
	Minimum	24.00	4.48	8.15	327	0.09	---	---	---	---	---	---	---	10	10
	Arith. Mean	25.94	6.00	-----	442	0.10	---	---	---	---	---	---	---	34	18
	Geo. Mean	25.90	5.89	-----	437	0.10	---	---	---	---	---	---	---	28	16
Spring 1 (Spring Cr. @ Hurley) 5 Samples 6/14/05-7/05/05	Maximum	22.50	11.03	8.12	347	0.05	---	---	---	---	---	---	---	1140	1550
	Minimum	17.10	7.46	7.64	269	0.04	---	---	---	---	---	---	---	200	248
	Arith. Mean	19.88	8.87	-----	305	0.04	---	---	---	---	---	---	---	628	682
	Geo. Mean	19.79	8.80	-----	303	0.04	---	---	---	---	---	---	---	509	535
Spring 2 (Spring Cr. @ Hwy CC) 7 Samples 3/23/05-7/05/05	Maximum	23.10	9.14	8.64	369	0.05	0.04	3.71	0.09	3.76	24.00	8	16	1080	259
	Minimum	9.70	5.73	7.53	344	0.02	0.01	3.18	0.01	2.90	2.00	2	16	114	93
	Arith. Mean	18.11	7.35	-----	358	0.04	0.02	3.45	0.04	3.41	9.33	5	16	440	161
	Geo. Mean	17.45	7.25	-----	358	0.03	0.01	3.44	0.03	3.39	4.58	4	16	353	147

Temp. - Temperature
D.O. - Dissolved Oxygen
Cond. - Conductivity
TP - Total Phosphorous
TN - Total Nitrogen
NH3N - Ammonia Nitrogen
No2+No3 - Nitrite + Nitrate
TSS - Total Suspended Solids
VSS - Volatile Suspended Solids
NVSS - Non-volatile Suspended Solids
F. Coliform - Fecal Coliform
E. Coli - Escherichia Coli

MEC Water Resources, Inc.

Table Rock Lake Quality, Inc.

Water Quality Evaluation of Six Stream Sites in Northern Stone County

Table A.2 Stream Measurement Dataset

Sample Site ID (name)	Date (mm/dd/yy)	Time (24:00)	Temp. (°C)	D.O. (mg/L)	pH (SU)	Conductivity (µS)	TP (mg/L)	TDP (mg/L)	TN (mg/L)	NH ₃ N (mg/L)	No ₂ +No ₃ (mg/L)	TSS (mg/L)	VSS (mg/L)	NVSS (mg/L)	Fecal (colonies/ 100mL)	E. Coli (MPN/ 100mL)	BOD (mg/L)	COD (mg/L)
Crane 1 (Crane Cr. @ Crane)	06/14/05	10:20	15.50	7.73	---	287	0.02	---	---	---	---	---	---	---	99	79	---	---
	06/16/05	9:30	14.80	7.57	---	275	0.03	---	---	---	---	---	---	---	310	---	---	---
	06/23/05	9:46	15.50	9.01	7.75	230	0.02	---	---	---	---	---	---	---	152	32	---	---
	06/28/05	10:20	15.80	9.83	6.93	287	0.02	---	---	---	---	---	---	---	95	59	---	---
	07/05/05	12:00	16.90	9.34	6.93	289	0.03	---	---	---	---	---	---	---	38	30	---	---
Crane 2 (Crane Cr. @ Quail Spur)	03/23/05	9:00	10.40	8.18	8.10	---	0.06	0.01	3.1	ND	2.78	ND	ND	ND	63	---	<5.0	<5.0
	04/19/05	7:55	13.40	8.24	8.84	244	0.01	0.01	3.0	ND	2.88	5.00	5.00	ND	220	---	<5.0	<5.0
	06/08/05	9:15	17.00	8.27	7.52	---	0.03	0.03	2.80	ND	2.52	4	ND	ND	1160	---	<5.0	---
	06/16/05	9:50	16.40	7.34	---	226	0.04	---	---	---	---	---	---	---	876	---	---	---
	06/23/05	10:20	18.80	8.57	8.17	316	0.04	---	---	---	---	---	---	---	857	727	---	---
	06/28/05	10:50	18.40	9.06	7.44	146	0.03	---	---	---	---	---	---	---	619	1050	---	---
	07/05/05	12:15	19.10	8.68	7.52	262	0.04	---	---	---	---	---	---	---	381	435	---	---
Crane 3 (Crane Cr. @ Oto Rd)	03/23/05	9:55	9.70	9.67	8.14	---	0.03	0.03	2.82	ND	2.77	ND	ND	ND	180	---	<5.0	10
	04/19/05	8:50	14.70	9.12	8.62	265	0.01	0.01	2.68	0.01	2.93	20.00	14.00	10.00	152	---	<5.0	<5.0
	06/08/05	10:00	20.50	9.08	7.11	---	0.04	0.03	2.50	ND	2.37	3	ND	ND	165	---	<5.0	---
	06/16/05	11:00	19.70	7.70	---	321	0.04	---	---	---	---	---	---	---	124	---	---	---
	06/23/05	11:00	22.50	9.12	8.52	339	0.04	---	---	---	---	---	---	---	152	66	---	---
	06/30/05	13:35	25.10	10.72	7.85	339	0.04	---	---	---	---	---	---	---	135	47	---	---
	07/05/05	13:20	23.90	9.03	7.70	332	0.04	---	---	---	---	---	---	---	67	105	---	---
James River (James R. @ Galena)	06/14/05	9:30	24.80	7.17	---	449	0.10	---	---	---	---	---	---	---	54	35	---	---
	06/16/05	9:00	24.00	4.48	---	327	0.11	---	---	---	---	---	---	---	48	---	---	---
	06/23/05	9:17	26.00	5.16	8.35	429	0.09	---	---	---	---	---	---	---	19	10	---	---
	06/28/05	9:45	26.40	5.76	8.15	484	0.10	---	---	---	---	---	---	---	38	17	---	---
	07/05/05	13:40	28.50	7.43	8.22	522	0.12	---	---	---	---	---	---	---	10	11	---	---
Spring 1 (Spring Cr. @ Hurley)	06/14/05	11:20	18.70	7.46	---	347	0.04	---	---	---	---	---	---	---	430	517	---	---
	06/16/05	10:35	17.10	8.42	---	286	0.04	---	---	---	---	---	---	---	1030	---	---	---
	06/23/05	11:00	19.90	8.51	8.12	278	0.05	---	---	---	---	---	---	---	1140	1550	---	---
	06/30/05	14:00	22.50	11.03	7.67	343	0.04	---	---	---	---	---	---	---	340	411	---	---
	07/05/05	12:40	21.20	8.93	7.64	269	0.04	---	---	---	---	---	---	---	200	248	---	---
Spring 2 (Spring Cr. @ Hwy CC)	03/23/05	9:25	9.70	9.14	7.98	---	0.02	0.01	3.5	0.01	3.56	2.00	2.00	ND	560	---	---	---
	04/19/05	8:25	13.60	8.51	8.64	360	0.02	0.01	3.71	0.02	3.76	24	8	16	210	---	---	---
	06/08/05	9:40	18.90	6.96	8.31	---	0.04	0.04	3.2	0.09	2.90	2	ND	ND	1080	---	---	---
	06/16/05	10:20	18.70	5.73	---	344	0.04	---	---	---	---	---	---	---	340	---	---	---
	06/23/05	10:40	20.90	6.87	8.04	354	0.04	---	---	---	---	---	---	---	493	259	<5.0	<5.0
	06/30/05	14:15	23.10	8.08	7.54	369	0.04	---	---	---	---	---	---	---	280	93	<5.0	<5.0
	07/05/05	12:50	21.90	6.13	7.53	363	0.05	---	---	---	---	---	---	---	114	131	<5.0	---

Temp. - Temperature
D.O. - Dissolved Oxygen
Cond. - Conductivity
TP - Total Phosphorous
TN - Total Nitrogen
NH₃N - Ammonia Nitrogen
No₂+No₃ - Nitrite + Nitrate
TSS - Total Suspended Solids
VSS - Volatile Suspended Solids
NVSS - Non-volatile Suspended Solids
F. Coliform - Fecal Coliform
E. Coli - Escherichia Coli