Midwest Biodiversity Institute
Center for Applied Bioassessment & Biocriteria
P.O. Box 21561
Columbus, OH 43221-0561

Biological and Water Quality Study of the Salt Creek Watershed 2013-16

DuPage, Cook and Will Counties, Illinois

Midwest Biodiversity Institute
Center for Applied Bioassessment &
Biocriteria
P.O. Box 21561
Columbus, OH 43221-0561
mbi@mwbinst.com

Peter A. Precario, Executive Director
James E. Lane, Board President

Report citation:

Midwest Biodiversity Institute (MBI). 2018. Biological and Water Quality Study of Salt Creek and Tributaries 2013-16. DuPage and Cook Counties, Illinois. Technical Report MBI/2018-3-1. Columbus, OH 43221-0561. 116 pp.

Biological and Water Quality Study of Salt Creek and Tributaries 2013-16

DuPage and Cook Counties, Illinois

Final Report

Technical Report MBI/2018-3-1

March 31, 2018

Prepared for:

DuPage River Salt Creek Workgroup
10 S. 404 Knoch Knolls Road
Naperville, IL 60565

Submitted by:

Center for Applied Bioassessment and Biocriteria
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, Ohio 43221-0561

Table of Contents

List of Tables

List of Figures

Acknowledgements

This report was written and co-coordinated by Edward T. Rankin and Chris O. Yoder who served as the report editors and the latter as the project manager. Assistance with data management and analyses was provided by Vickie L. Gordon, Martin J. Knapp, Jack T. Freda, Matthew Sarver, and Lon E. Hersha of MBI. Database management and advanced data analysis was provided by Edward T. Rankin. Stephen McCracken and Deanna Doohaluk, The Conservation Foundation, each provided assistance with the coordination of the study plan, the chemical water quality results and many important details regarding field logistics. Dissolved oxygen data was collected by the DRSCW with the assistance of the Metropolitan Water Reclamation District of Greater Chicago, DuPage County Stormwater Management, the village of Addison, and the City of Elmhurst. We would also like to thank all of the private and public landowners who granted access to sampling sites. The following organizations provided helpful assistance: Metropolitan Water Reclamation District of Greater Chicago, the Forest Preserve District of DuPage County, and the Forest Preserve District of Cook County. The Forest Preserve District of DuPage County and the Downers Grove Sanitary District provided space for secure equipment storage.

FOREWORD

What is a Biological and Water Quality Survey?

A biological and water quality survey, or “biosurvey”, is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. The latter is the case with this study in that Salt Creek represents a defined watershed of approximately 150 square miles in drainage area that has a complex mix of overlapping stressors and sources in a highly developed urban and suburban landscape. This assessment is a follow-up, using data from 2013-2016, to prior surveys of Salt Creek performed in 2007 (MBI 2008) and 2010 (MBI 2011). Previous surveys and assessments by Illinois EPA and DNR were done with less intensive spatial detail. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, may also be assessed.

Scope of the Salt Creek Biological and Water Quality Assessment

Standardized biological, chemical, and physical monitoring and assessment techniques were employed to meet three major objectives: 1) determine the extent to which biological assemblages are impaired (using Illinois EPA guidelines); 2) determine the categorical stressors and sources that are associated with those impairments; and, 3) add to the broader databases for the DuPage and Salt Creek watersheds to track and understand changes through time that occur as the result of abatement actions or other factors. The data presented herein were processed, evaluated, and synthesized as a biological and water quality assessment of aquatic life use support status. The assessment made herein is directly comparable to those accomplished in 2007 and 2010, such that trends in status can be examined, and causes and sources of impairment can be confirmed, appended, or removed. This study contains a summary of major findings and recommendations for future monitoring, follow-up investigations, and any immediate actions that may be needed to resolve readily diagnosed impairments. It was not the role of this study to identify specific remedial actions on a site specific or watershed basis. However, the baseline data established by this study contributes to a process termed the Integrated Priority System (IPS; Miltner et al. 2010) that was developed to help determine and prioritize remedial projects within the Upper DuPage River and Salt Creek watersheds and which is currently being updated (2018).

Biological and Water Quality Study of Salt Creek 2013-2016

Center for Applied Bioassessment & Biocriteria
Midwest Biodiversity Institute
P.O. Box 21561
Columbus, OH 43221-0561

INTRODUCTION

Biological and water quality studies of Salt Creek and its tributaries were conducted in 2013 and 2016 to assess aquatic life condition status, identify proximate stressors, examine chemical/physical water quality and biological condition relative to publicly owned treatment works, and monitor for trends relative to baseline surveys conducted in 2007 (MBI 2008) and the first follow-up survey in 2010 (MBI 2012). This report covers surveys conducted in 2013 and 2016 as follow-ups to prior surveys and to track changes in biological condition and water quality in response to management and restoration actions.

Executive Summary

Status of the Illinois General Aquatic Life Use

Biological assemblages monitored in Salt Creek and its tributaries during 2013 and 2016 were rated in poor to fair condition (in accordance with Illinois EPA methods) at most locations sampled, with the exception of macroinvertebrates in the Salt Creek mainstem downstream from the Graue Mill Dam. Here, the macroinvertebrates were rated in good condition at 4 of 6 locations resulting in partial support of Illinois EPA aquatic life goal (Figure 1). Compared to 2007, the condition of the fish assemblage in 2010 was essentially unchanged; however, the condition of the macroinvertebrate assemblage in 2010 was significantly better, averaging about 10 macroinvertebrate Index of Biotic Integrity (mIBI) points higher than in 2007 (mIBI mean = 27.6 in 2010 compared to 17.0 in 2007). Coincidentally, concentrations of ammonia-nitrogen, total Kjeldahl nitrogen (TKN), and 5-day carbonaceous biochemical oxygen demand (cBOD5) were lower on average in 2010, 2013, and 2016 compared to 2007. The change in concentrations is partly related to loadings from municipal wastewater treatment plants (WWTP) which decreased in 2016 compared to the 2010 and 2013 time periods when loads were similar. Dilution by higher flows between 2007 and 2010 and 2013 to 2016 also played a role in reduced pollutant concentrations.

Pollutants and stressors associated with urban stormwater, wastewater effluent, and poor habitat quality remained the major factors most limiting to the biological assemblages in the Salt Creek watershed in 2013 and 2016 and the uniformly poor to fair biological conditions. Dissolved oxygen (D.O.) concentrations measured during the 2013 and 2016 survey resulted in exceedances of the Illinois WQS due to the combined effects of stormwater, wastewater effluent, and impoundment by low-head dams. The latter is an increasingly recognized factor that prevents fish from being reestablished in portions of the watershed and thus constituting a reduction in ecological connectivity.

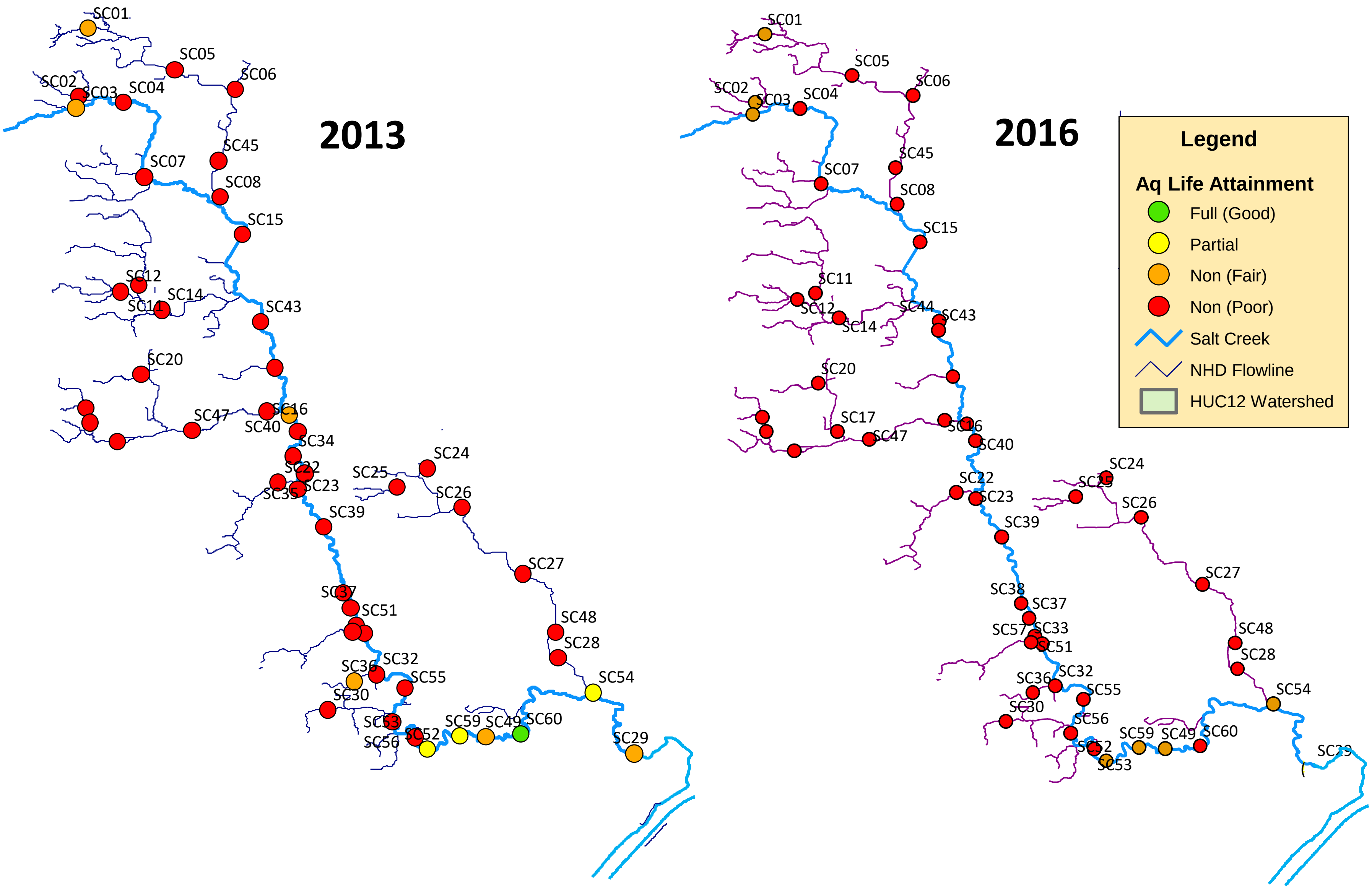


Figure 1*. Attainment status of sites sampled in the Salt Creek watershed, 2013 (left) and 2016 (right). No sites were in full attainment based on Illinois EPA biological assessment methods in either year.*

Table 1. *Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2016.*										
Site ID	**River Mile**	**Drain. Area (mi.^{2})**	**fIBI**	**MIwb[a]**	**mIBI**	**QHEI**	**Use Support Status**	**MBI Causes**	**MBI Sources**	**IEPA Causes**
Salt Creek										
SC04	39.50/39.50	6.3	18	n/a	28.45	50.5	Non - Poor	Habitat, Siltation, D.O., PAHs, Chlorides	Urban runoff, Habitat Alt.	Chloride, Flow, D.O., TP, Algae, Hg, PCBs, Bacteria
SC07	36.00/36.00	16	15	n/a	29.48	62.5	Non - Poor	Siltation, D.O., PAHs, Chlorides, Organic Enrich.	Urban runoff	
SC15	32.00/32.00	32	17.5	6.42	23.5	60	Non - Poor	Habitat, Siltation, D.O., Chlorides	Urban runoff, Habitat Alt.	
SC44	29.30/29.30	48.2			25.07	68.0	Non - Poor	Habitat, Siltation, D.O., Chlorides	Urban runoff, Habitat Alt.	
SC43	29.00/29.00	48.38	17	7.37	33.07	64.5	Non - Poor	Siltation, D.O., Chlorides, Organic Enrich., Nitrates	Urban runoff, WW Effluent	Riparian, Arsenic, Chloride, Hexa-chlorobenzene, Methoxychlor, Nickel, Flow, D.O., pH, Hg, PCBs, Bacteria
SC42	27.00/27.00	53.5	17	6.6	23.6	72	Non - Poor	Siltation, D.O., Chlorides, Unk. Toxicity, Nitrates	Urban runoff, WW Effluent	
SC41	25.00/25.00	70	19	6.84	36.56	61	Non - Poor	Siltation, D.O., PAH, Chlorides, Nutrients	Urban runoff, WW Effluent	Riparian, DDT, Heptachlor, D.O., PCBs, Siltation, TSS, TP, Flow, Hg
SC40	24.50/24.50	75	13	5.79	7.41	55.5	Non - Poor	Siltation, D.O., PAH, Chlorides, Organic Enrich., Nitrates	Urban runoff, WW Effluent	
SC23	22.50/22.50	84	13.5	6.05	21.18	56	Non - Poor	Siltation, D.O., PAH, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC39	20.50/20.50	86	13.5	5.24	37.16	66	Non - Poor	Siltation, D.O., PAHs, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC38	18.00/18.00	87	11.5	4.81	35.26	72.3	Non - Poor	Siltation, D.O., PAHs, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC37	17.50/17.50	95	11	5.13	30.27	71.5	Non - Poor	Siltation, D.O., Chlorides, Nitrates	Urban runoff, WW Effluent	
SC51	17.00/17.00	95	11.5	4.94	33.57	76.5	Non - Poor	Siltation, D.O., Chlorides, Organic Enrich., Nitrates	Urban runoff, WW Effluent	
SC57	16.50/16.50	95	13	5.39	27.05	63.5	Non - Poor	Siltation, D.O., Chlorides, Organic Enrich.	Urban runoff, WW Effluent	

Table 1. *Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2016.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
SC55	13.50/13.50	102	13	5.01	11.96	38	Non - Poor	Habitat, Siltation, D.O., Chlorides, Organic Enrich., Nitrates	Urban runoff, WW Effluent	Aldrin, Chloride, Methoxychlor, Flow, D.O., Siltation, TSS, TP, Hg, PCBs, Bacteria
SC56	12.50/12.50	107	16	5.76	20.17	41.5	Non - Poor	Habitat, Siltation, D.O., Chlorides, Nitrates	Urban runoff, WW Effluent, Habitat Alt.	
SC53	11.00/11.00	110	16	6.28	16.14	42.5	Non - Poor	Habitat, Siltation, D.O., PAH, Unknown Tox., Chlorides, Organic Enrich.	Urban runoff, WW Effluent, Habitat Alt.	
SC52	10.50/10.50	112	25	8.33	35.80	79.5	Non - Fair	Siltation, D.O., PAH, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC59	9.10/9.10	113	25	7.23	41.51	86.5	Non - Fair	Siltation, D.O., Chlorides	Urban runoff, WW Effluent	
SC49	8.00/8.00	114	23.5	6.79	41.78	74	Non - Fair	Siltation, D.O., PAH, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC60	7.20/7.20	118	15	6.31	49.29	75.5	Non - Poor	Siltation, D.O., Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC54	3.00/3.00	145	21	6.22	35.87	71.5	Non - Fair	Siltation, PAH, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	Chloride, Flow, Riparian, TSS, TP, Hg,, PCBs, Bacteria
SC29	0.50/0.50	150	24.5	6.77	48.9	76.8	Partial	Siltation, PAH, Chlorides	Urban runoff, WW Effluent	
Arlington Heights Branch										
SC06	4.00/4.00	7.7	10.5	n/a	22.17	41.5	Non - Poor	Hab., Siltation, Chloride, Ammonia, Organic Enrich.	Urban runoff, WW Effluent, Habitat Alt.	N/A
SC45	1.50/1.50	10	16.5	n/a	29.09	64.3	Non - Poor	Siltation, Chlorides, Ammonia, Organic Enrich.	Urban runoff, WW Effluent	
SC08	0.25/0.25	12.7	16.5	n/a	31.4	53.5	Non - Poor	Hab., Siltation, Chlorides, Ammonia, Organic Enrich.	Urban runoff, WW Effluent, Habitat Alt.	

Table 1. *Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2016.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
Baldwin Creek										
SC05	2.00/2.00	2	9.5	n/a	26.87	63	Non - Poor	Siltation, Chloride, Ammonia, Organic Enrich., PAHs	Urban runoff, WW Effluent	Not determined by IEPA
Unnamed Tributary to Arlington Branch @RM 4.14										
SC01	2.00/2.00	1.1	22.5	na	28.45	72	Non - Fair	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Unnamed Tributary to Salt Creek @RM 42.8										
SC02	0.25/0.25	0.9	12.0	na	18.70	61	Non - Poor	Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Unnamed Tributary to Salt Creek @RM 43.3										
SC03	0.50/0.50	2.5	17.0	na	28.40	69.25	Non - Fair	Siltation, Chlorides	Urban runoff	Not determined by IEPA
West Branch Salt Creek										
SC11	5.00/5.00	4	16.5	n/a	33.55	61.5	Non - Poor	Siltation, Chlorides, PAH	Urban runoff	Not determined by IEPA
Unnamed Tributary to Salt Creek @RM 2.4										
SC14	2.50/2.50	10.46	15	n/a	32.02	82	Non - Poor	Siltation, Chlorides	Urban runoff	Not determined by IEPA
Yeargin Creek										
SC12	0.25/0.25	1.8	20	n/a	19.55	71	Non - Poor	Siltation, Chlorides	Urban runoff	Not determined by IEPA
Ginger Creek										
SC30	1.50/1.50	5.2	12	n/a	16.04	70	Non - Poor	Siltation, Chlorides	Urban runoff	Not determined by IEPA
Sugar Creek										
SC33	0.25/0.25	3.5	12.5	n/a	9.63	43	Non - Poor	Habitat, Siltation, Chlorides, Organic Enrich.	Urban runoff, Habitat Alt.	Not determined by IEPA

Table 1. *Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2016.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
Addison Creek										
SC24	10.50/0.00	2	6	n/a	16.43	41	Non - Poor	Habitat, Siltation, PAH, Chlorides	Habitat Alt., Urban runoff, WW Effluent	Riparian, Cu, Fe, Flow, D.O., PCBs, Siltation, TSS, TP, Bottom Deposits, Algae, Oil
SC26	8.00/8.00	5	5.5	n/a	19.32	66	Non - Poor	Siltation, PAHs, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
SC27	5.00/5.00	10	11.5	n/a	13.35	56	Non - Poor	Siltation, PAHs, Chlorides	Urban runoff, WW Effluent	Aldrin, Riparian, Chloride, Chromium, DDT, Hexachlorobenzene, Nickel, Flow, TP, Bacteria, Debris
SC48	2.50/2.50	18	11	n/a	8.58	47.5	Non - Poor	Habitat, Siltation, PAHs, Chlorides, Organic Enrich., Lead	Habitat Alt., Urban runoff, WW Effluent	
SC28	1.50/1.50	20	17.5	n/a	6.52	43	Non - Poor	Habitat, Siltation, PAHs, Chlorides, Organic Enrich.	Habitat Alt., Urban runoff, WW Effluent	
Unnamed Tributary to Addison Creek @RM 10.35										
SC25	0.50/0.50	1	18	n/a	11.74	50.5	Non - Poor	Hab., Siltation, Ammonia, D.O., Chlorides	Urban runoff	Not determined by IEPA
Spring Brook										
SC21	6.50/6.50	2	14	n/a	15.79	72.8	Non - Poor	Siltation, Chlorides, PAH	Urban runoff	Not determined by IEPA
SC46	6.00/0.00	3.5	14	n/a	25.32	69.5	Non - Poor	Siltation, Chlorides, PAH, Nitrates	Urban runoff, WW Effluent	Not determined by IEPA
SC18	4.50/4.50	6.28	13	n/a	20.62	72.3	Non - Poor	Siltation, Chloride	Urban runoff	Not determined by IEPA
SC47	2.50/2.50	10	20.5	n/a	18.53	64	Non - Poor	Siltation, Chl., Organic Enrich., PAHs, Ammonia	Urban runoff, WW Effluent	Not determined by IEPA
SC16	0.25/0.25	14.2	19.5	n/a	16.12	47	Non - Poor	Hab., Siltation, Chlorides, Organic Enrich., Ammonia	Habitat Alt., Urban runoff, WW Effluent	Not determined by IEPA

***Table 1.** Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2016.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
Oakbrook Creek										
SC36	0.50/0.50	0.8	18	n/a	11.36	55	Non - Poor	Habitat, Siltation, Chlorides	Habitat Alt., Urban runoff	Not determined by IEPA
SC32	0.25/0.25	1.2	23.5	n/a	17.13	64.5	Non - Poor	Habitat, Siltation, Chlorides, Organic Enrich.	Habitat Alt., Urban runoff	Not determined by IEPA
Unnamed Tributary to Meacham Creek @RM 1.9										
SC20	0.25/0.25	2	13.5	n/a	13.47	41.5	Non - Poor	Habitat, Siltation, Ammonia, PAH, Chlorides	Habitat Alt., Urban runoff	Not determined by IEPA
Westwood Creek										
SC22	0.50/0.50	4	13	n/a	26.01	51.5	Non - Poor	Habitat, Siltation, Organic Enrich.	Habitat Alt., Urban runoff	Not determined by IEPA
Meacham Creek										
SC17	0.40/0.40	4.8	13	n/a	19.85	29.0	Non-Poor	Habitat, Siltation	Habitat Alt.	Flow, D.O.
Prairie Run (Reference Site)										
FA01	0.15/0.15	49.04	36	8.04	62.98	82.0	Partial	Siltation	Urban runoff	Not determined by IEPA
Auxsable Creek (Reference Site)										
DW07	17.50/17.50	99.88	41.5	7.94	61.66	83.9	Full	NA	NA	NA
DW01	6.40/6.40	171.79	53.5	9.66	70.4	89.25	Full	NA	NA	NA

[a] The Modified Index of Well-Being (MIwb; Gammon 1976; Ohio EPA 1987) does not have a use support threshold in IL – the default is the Ohio value for the E. Corn Belt Plains (ECBP) ecoregion wading (8.3) and boat sites (8.5) with a 0.5 unit nonsignificant departure designated as [ns]; the MIwb is not calculated for headwater sites <20 mi.^{2}.

IEPA Aquatic Life Use Support Thresholds

AQLU Status	fIBI	mIBI
Full Support	$\geq$41	$\geq$41.8
Non-Support Fair	>20,<41	$\geq$20.9,<41.8
Non-Support Poor	$\leq$20	<20.9

***Table 2**. Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2013.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
Salt Creek										
SC04	39.50/39.50	6.3	17	na	24.8	62	Non - Poor	Habitat, Siltation, Chlorides, Organic Enrich.	Habitat Alt., Urban runoff	Chloride, Flow, D.O., TP, Algae, Hg, PCBs
SC07	36.00/36.00	16	17.5	na	26.35	77.5	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Chloride, Flow, D.O., TP, Algae, Hg, PCBs
SC15	32.00/32.00	32	16	6.36	26	41.5	Non - Poor	Siltation, Chloride, PAH, Organic Enrich.	Urban runoff	Chloride, Flow, D.O., TP, Algae, Hg, PCBs
SC43	29.00/29.00	60	16	7.54	19.66	71.8	Non - Poor	D.O., Organic Enrich., Nutrients	Urban runoff, WW Effluent	Riparian, Arsenic, Chloride, Hexachlorobenzene, Methoxychlor, Nickel, Flow, D.O., pH , Aq. Plants, Algae, Hg, PCBs, Bacteria
SC42	27.00/27.00	53.5	16	6.95	23.93	70.3	Non - Poor	Siltation, D.O., Chlorides, Organic Enrich., Nitrates	Urban runoff, WW Effluent	Riparian, Arsenic, Chloride, Hexachlorobenzene, Methoxychlor, Nickel, Flow, D.O., pH , Aq. Plants, Algae, Hg, PCBs, Bacteria
SC41	25.00/25.00	70	17	7.51	29.77	67.5	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	Riparian, DDT, Heptachlor, D.O., PCBs, Siltation, TSS, TP, Habitat, Hg
SC40	24.50/24.50	75	15.5	6.93	35.08	61.5	Non - Poor	Siltation, Chloride, Nutrients, Organic Enrich.	Urban runoff, WW Effluent	Riparian, DDT, Heptachlor, D.O., PCBs, Siltation, TSS, TP, Habitat, Hg
SC34	23.50/23.50	76	15	6.18	23.19	51	Non - Poor	Siltation ,Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	Riparian, DDT, Heptachlor, D.O., PCBs, Siltation, TSS, TP, Habitat, Hg
SC35	23.00/23.00	80	18	6.63	24.1	55.5	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients, Unk. Toxicity	Urban runoff, WW Effluent	Riparian, DDT, Heptachlor, D.O., PCBs, Siltation, TSS, TP, Habitat, Hg
SC23	22.50/22.50	84	15	6.84	28.04	67	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	Riparian, DDT, Heptachlor, D.O., PCBs, Siltation, TSS, TP, Habitat, Hg

***Table 2**. Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2013.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
SC39	20.50/20.50	86	15	5.25	30.6	67.8	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC38	18.00/18.00	87	14	5.30	27.58	76.5	Non - Poor	Chloride, PAHs, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC37	17.50/17.50	95	13	5.87	23.45	64.3	Non - Poor	Siltation, Chlorides, PAH, Organic Enrich.	Urban runoff, WW Effluent	
SC51	17.00/17.00	95	14	4.99	16.79	82.8	Non - Poor	Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC57	16.50/16.50	95	15.5	6.11	24.23	61.5	Non - Poor	Siltation, D.O., Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC55	13.50/13.50	102	16.5	6.24	11.79	42.5	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	Aldrin, Chloride, Methoxychlor, Flow, D.O., Siltation, TSS, TP, Hg, PCBs, Bacteria
SC56	12.50/12.50	107	15.5	6.29	18.91	46	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC53	11.00/11.00	110	18	6.44	19.78	47.3	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC52	10.50/10.50	112	32	9.48	47.79	81.3	Non - Good	D.O., Chlorides, PAHs, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC59	9.10/9.10	113	30	8.12	45.5	92	Non - Good	D.O., Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC49	8.00/8.00	114	24.5	7.97	41.27	-	Non - Fair	D.O., Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	

***Table 2**. Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2013.*

Site ID	River Mile	Drain. Area (mi.²)	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
SC60	7.20/7.20	118	23.5-	7.46	45.43	81.5	Full	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC54	3.00/3.00	145	23	7.89	43.09	74.5	Non - Good	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	Riparian, Chloride, Flow, TSS, TP, Hg, PCBs, Bacteria
SC29	0.50/0.50	150	26	7.44	26.7	75	Non - Fair	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
Arlington Heights Branch										
SC06	4.00/4.00	7.7	15	na	14.09	45.5	Non - Poor	Habitat, Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
SC45	1.50/1.50	10	17	na	26.55	64	Non - Poor	Siltation, Chlorides, PAH, Organic Enrich.	Urban runoff	
SC08	0.25/0.25	12.7	14	na	28.38	59	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	
Baldwin Creek										
SC05	2.00/2.00	2	17.5	na	17.57	73	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Unnamed Tributary to Arlington Branch @RM 4.14										
SC01	2.00/2.00	1.1	24	na	38.43	76	Non - Fair	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Unnamed Tributary to Salt Creek @RM 42.8										
SC02	0.25/0.25	0.9	19.7	na	32.67	61	Non - Poor	Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA

***Table 2**. Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2013.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
Unnamed Tributary to Salt Creek @RM 43.30[1]										
SC03	0.50/0.50	2.5	25.5	na	25.03	70.5	Non - Fair	Siltation, Chlorides	Urban runoff	Not determined by IEPA
West Branch Salt Creek										
SC11	5.00/5.00	4	14	na	34.49	51	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Unnamed Tributary to W. Br. Salt Creek @RM 2.4										
SC14	2.50/2.50	10	15	na	32.55	82.8	Non - Poor	Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Yeargin Creek										
SC12	0.25/0.25	1.8	17.5	na	22.88	58	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Ginger Creek										
SC30	1.50/1.50	5.2	14	na	27.01	71.5	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Sugar Creek										
SC33	0.25/0.25	3.5	11	na	14.69	60	Non - Poor	Siltation, Chlorides, Organic Enrichment	Urban runoff	Not determined by IEPA
Addison Creek										
SC24	10.50/0.00	2	13	na	-	54	Non - Poor	Siltation, Habitat, Chlorides, PAHs, Nutrients	Urban runoff, WW Effluent, Habitat Alt.	a-BHC, Riparian, Cu, Hexa-chlorobenzene, Oil-Grease, Flow, D.O., PCBs, Siltation, TSS, TP, Oil, Bottom Deposits, Algae
SC26	8.00/8.00	5	5.5	na	20.37	51.5	Non - Poor	Siltation, Habitat, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	

[1] Cross-listed as Salt Creek at river mile 42.06 to conform to IEPA segment definition.

***Table 2**. Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2013.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
SC27	5.00/5.00	10	14.5	na	25.48	53.5	Non - Poor	Habitat, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent, Habitat Alt.	Aldrin, Riparian, Chloride, Cr, DDT, Hexa-chlorobenzene, Ni, Flow, TP, Habitat, Bacteria
SC48	2.50/2.50	18	9.5	na	14.61	52	Non - Poor	Siltation, Habitat, Chlorides, PAHs, Organic Enrich., Nutrients	Urban runoff, WW Effluent, Habitat Alt.	
SC28	1.50/1.50	20	13.5	na	13.38	55	Non - Poor	Siltation, Habitat, Chlorides, PAHs, Organic Enrich., Nutrients	Urban runoff, WW Effluent, Habitat Alt.	
Unnamed Tributary to Addison Creek @RM 10.35										
SC25	0.50/0.50	1	18	na	21.52	53	***Non - Poor***	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Spring Brook										
SC21	6.50/6.50	2	14.5	na	15.48	67.25	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Cause Unknown
SC46	6.00/0.00	3.5	11	na	-	67	Non - Poor	Siltation, Chlorides, Nutrients	Urban runoff, WW Effluent	
SC18	4.50/4.50	5.1	9	na	24.11	67	Non - Poor	Siltation, Chlorides, Organic Enrich., Nutrients	Urban runoff, WW Effluent	
SC47	2.50/2.50	10	21	na	16.57	68.5	Non - Poor	Siltation, Chlorides, PAH, Organic Enrich., Nutrients	Urban runoff, WW Effluent	Riparian, DDT, Endrin, Hexa-chlorobenzene, Flow, D.O., Siltation, TSS, TP, Algae
SC16	0.25/0.25	14.2	21	na	17.19	67	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff, WW Effluent	
Oakbrook Creek										
SC36	0.50/0.50	0.8	29	na	29.9	65	Non - Fair	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA

***Table 2**. Status of aquatic life use support and causes and sources of non-support for stream segments sampled in the Salt Creek watershed, 2013.*

Site ID	River Mile	Drain. Area (mi.^{2})	fIBI	MIwb[a]	mIBI	QHEI	Use Support Status	MBI Causes	MBI Sources	IEPA Causes
SC32	0.25/0.25	1.2	27.3	na	18.46	65	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Unnamed Tributary to Meacham Creek @RM 1.9										
SC20	0.25/0.25	2	10	na	14.33	37	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Westwood Creek										
SC22	0.50/0.50	4	8	na	17.31	53	Non - Poor	Siltation, Chlorides, Organic Enrich.	Urban runoff	Not determined by IEPA
Indian Creek - Reference Site										
I2	16.00/16.00	126	47	8.08	47.17	78.5	Full	NA	NA	NA
Little Indian Creek - Reference Site										
I3	5.10/5.10	82.6	40.5	7.68	71.4	83.5	Partial	NA	NA	NA

[a] The Modified Index of Well-Being (MIwb; Gammon 1976; Ohio EPA 1987) does not have a use support threshold in IL – the default is the Ohio value for the E. Corn Belt Plains (ECBP) ecoregion wading (8.3) and boat sites (8.5) with a 0.5 unit allowable departure designated as [ns]; the MIwb is not calculated for headwater sites <20 mi.^{2}.

IEPA Aquatic Life Use Support Thresholds

AQLU Status	fIBI	mIBI
Full Support	$\geq$41	$\geq$41.8
Non-Support Fair	>20,<41	$\geq$20.9,<41.8
Non-Support Poor	$\leq$20	<20.9

Causes and Sources of Impairment

The proportion of major causes of aquatic life impairment delineated in Tables 1 and 2 are depicted for the mainstem and tributaries separately in Figure 2. Three (3) principal sources included urban runoff (stormwater), habitat alteration, and wastewater effluent (Tables 1 and 2). Of these sources urban runoff was ubiquitous in both 2013 and 2016 being listed as a source at all except one location in Meacham Creek (SC17) in 2016 (Table 1). Wastewater effluent was listed as a source at 19 or 23 sites in the Salt Creek mainstem in 2016 compared to 21 of 24 locations in 2013. Habitat alteration was listed only slightly more frequently in the Salt Creek tributaries at seven (7) locations in 2016 up from four (4) locations in 2013. It was listed only four (4) times in the mainstem in 2016 compared to one (1) location in 2013.

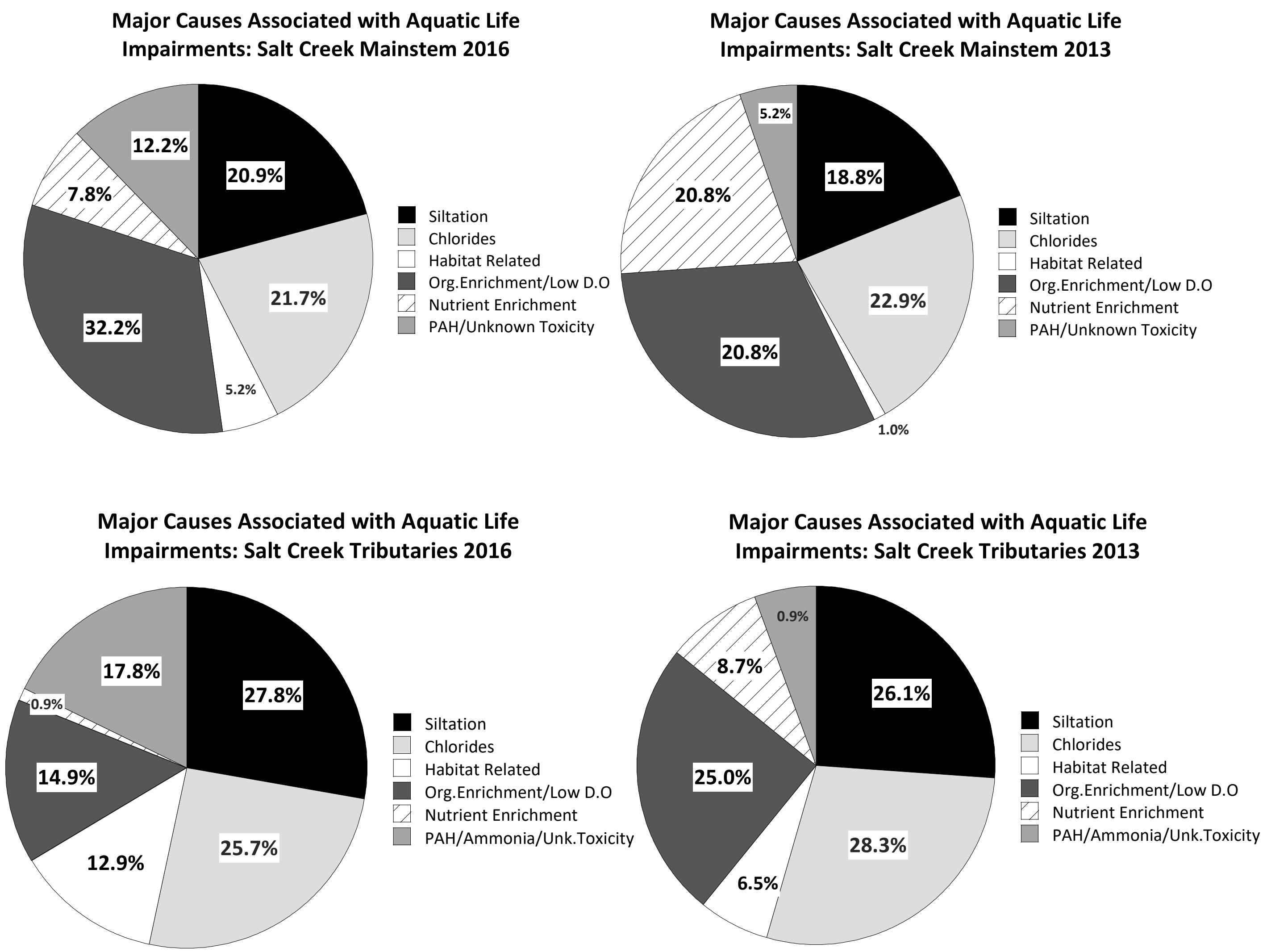


Figure 2*. Causes of aquatic life use impairment in the Salt Creek mainstem in 2016 (upper left) and 2013 (upper right) and the Salt Creek tributaries in 2016 (lower left) and 2013 (lower right).*

Salt Creek Mainstem

Six (6) causes were listed for the Salt Creek mainstem in both 2013 and 2016 (Figure 2). The proportions were roughly similar except that organic enrichment/low D.O. and chlorides were the leading causes at 32.2% and 21.7%, respectively, in 2016 compared to chlorides (22.9%), organic enrichment/low D.O. (20.8%), and nutrient enrichment (20.8%) in 2013. The latter cause (nutrient enrichment) was only 7.8% in 2016 and this reflects reduced loadings from the POTWs (see Pollutant Loadings by Publicly Owned Treatment Works section starting on p. 36) since 2013. As a consequence of the reduced proportion of nutrient enrichment impairments the share of impairment related causes increased for organic enrichment/low D.O. and the PAH/Unknown Toxicity causes in 2016.

Salt Creek Tributaries

Six (6) causes were listed for the Salt Creek tributaries in 2016 and 2013 (Figure 2). The proportions of the leading causes were roughly similar with siltation and chlorides being the leading causes in 2013 and 2016. The proportion of PAH/Ammonia/Unknown Toxicity (17.8%) and habitat (12.9%) related causes increased while organic enrichment/low D.O. (14.6%) and nutrient (0.9%) decreased between 2013 and 2016. The reduction in nutrient related impairments was related to reductions in loadings from POTWs and was exemplified by the reductions at the Bensenville WWTP with the installation of biological nutrient removal in 2016.

It is important to note here that the shifts in the causes of impairment between 2013 and 2016 were not accompanied by improvements in use attainment as biological quality was almost entirely non-fair or non-poor. However, the shifts do reflect incremental changes in the controls of certain sources, POTWs in particular. Continuing to address the major impairments as well as the ecological connectivity issue should begin to return benefits in the future.

STUDY AREA

The Salt Creek watershed study area (Figure 3) consists of approximately 152 square miles of urbanized land uses situated in western Cook and eastern DuPage Counties. The study area includes two major Salt Creek tributaries, Addison Creek and Spring Brook, and another 14 minor tributaries. The mainstem of Salt Creek is approximately 42.2 lineal miles and has a fall of 225 feet for a gradient of 5.3 ft./mi. Mean flow, measured at the USGS gage at Western Springs (Station 05531500) between 2000 and 2016 was 198.4 cfs.

Salt Creek flows into the Des Plaines River in Lyons, which is a principal branch of the Illinois River. There are 40 municipalities located within the watershed and 11 publicly owned treatment plants discharge treated effluent to Salt Creek and six active combined sewer overflows (CSOs). Land use in the Salt Creek watershed by acres and percentage of total watershed area are shown in Table 2. Permanently protected open space is concentrated around the Salt Creek mainstem with approximately 19.1 linear miles being contained within the Forest Preserve Districts of DuPage and Cook Counties.

Table 3. *Land uses types by area and percent for Salt Creek, and the East and West Branches of the DuPage River. Percentages are of total watershed area. Land use data is taken from Chicago Metropolitan Agency for Planning (CMAP) 2013 land use data.*

CMAP Code	Type	Area (acres)	%Coverage
11	Residential	37831.81	38.77%
12	Commercial and Services	7863.09	8.06%
13	Institutional	5273.70	5.41%
14	Industrial, Warehousing, and Wholesale Trade	5691.58	5.83%
15	Transportation, Communication, and Utilities	4336.81	4.44%
20	Agricultural Land	248.49	0.25%
30	Open Space	16942.24	17.36%
40	Vacant	1950.92	2.00%
50	Water	25.35	0.03%
60	Non-Parcel Areas (Open Space, Water, Right-of-Way)	17388.48	17.82%
90	Uncodeable	18.12	0.02%
	Totals	**97570.59**	**100.00%**

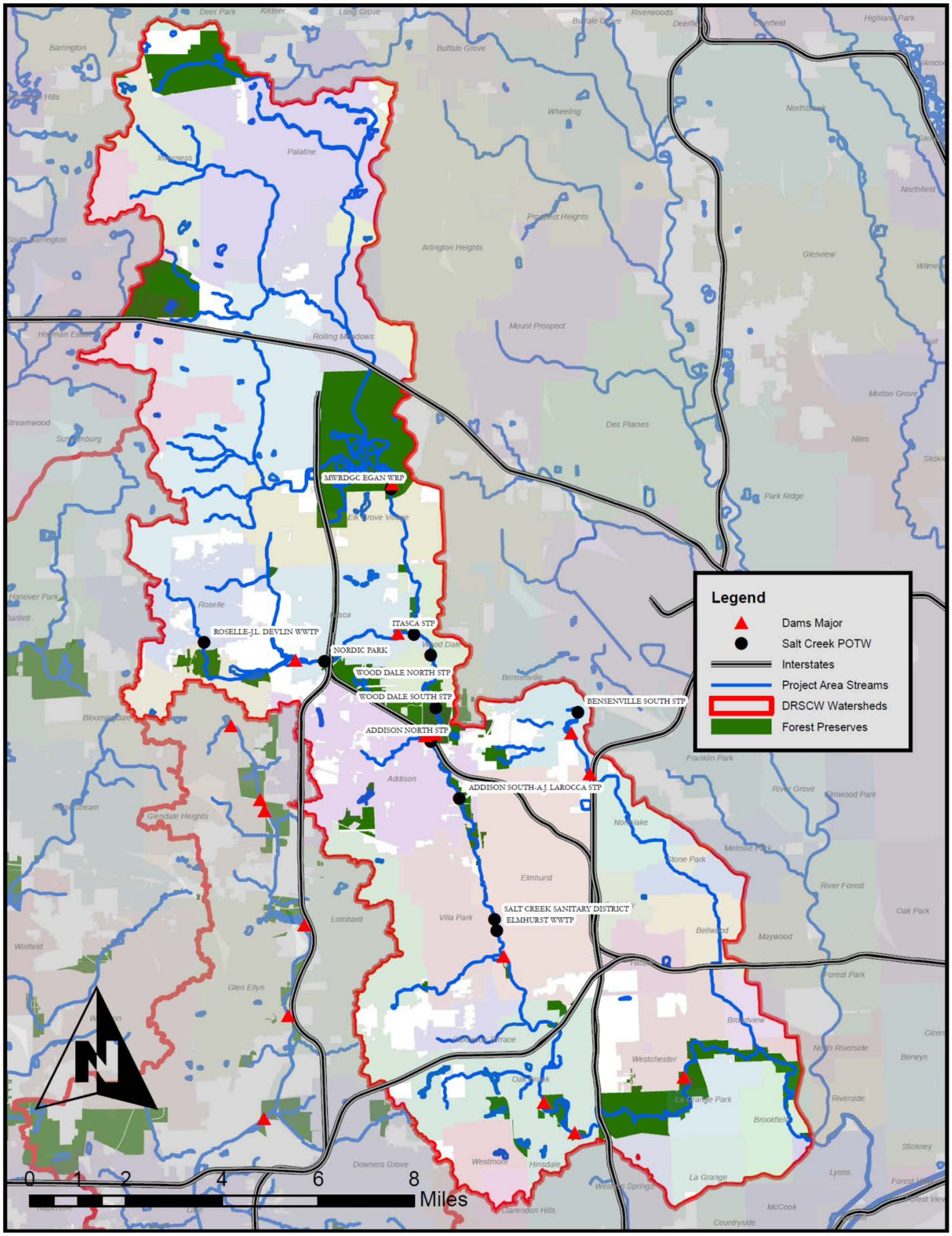


Figure 3. *The 2013 and 2016 Salt Creek study area showing major dischargers, dams, and distinctive geographic features of the watershed.*

SALT CREEK DAM DESCRIPTIONS

Busse Woods Reservoir South Dam: The Busse Woods Reservoir South Dam is located on Salt Creek within the Busse Woods Forest Preserve, Elk Grove Village (Figure 4). The dam is owned and maintained by the Illinois Department of Natural Resources Office of Water Resources while the Forest Preserve is owned by The Forest Preserve District of Cook County. Access is best gained from Arlington Heights Road to picnic groves 26 and 27 or 32. The dam was built for flood control and recreational purposes in 1977. The dam is of earthen construction and has a height of 23 feet and is 1381 feet long. The reservoir has a surface area of 415 acres.

Figurec4. *Busse Woods Reservoir South Dam. Looking north through the spillway.*

Itasca Country Club Dam: Situated on Spring Brook 50 feet upstream of Prospect Avenue. This Dam is privately owned and maintained. No other information was available.

Lake Kadijah Dam: This dam (Figure 5) is located 0.5 miles upstream of Rohlwing Road/IL Route 53. This dam is maintained by the Medinah County Club and serves as part of the DuPage County Division of Stormwater Management Spring Creek Reservoir operation system.

Figure 5. *Lake Kadijah Dam.*

Oak Meadows Golf Course Dam: The Oak Meadows Golf Course dam was located on Salt Creek within the Oak Meadows Golf Course (Figure 6). The dam was removed in 2016 by the FPDPC, the DRSCW and DuPage County Stormwater. The golf course is maintained by the Forest Preserve District of DuPage County and is located east of Addison Road and north of I-290. The date of original construction is unknown.

***Figure 6**. Oak Meadows Dam in Addison (removed in 2016).*

The dam was originally built by Elmhurst Country Club to provide a source of irrigation water for the golf course and impounded 6 acres over 4500 linear feet of the mainstem. The spillway was approximately 3 feet high and 75 feet wide.

***Figure 7**. Westwood Creek Dam and pump station.*

Westwood Creek Dam (Salt Creek Trib. WWTP dam): The Westwood Creek dam is located on Westwood Creek, a tributary to Salt Creek in Addison (Figure 7). The dam is approximately 500 feet east of Addison Road and 200 feet southwest of I-290 and is maintained by the Village of Addison. Access to the dam is best gained from a driveway off of Addison Road, south of I-290. The dam was put on line in 1994 as part of an effort by the DuPage County Stormwater Management Division to reduce flooding in the area. Residential areas to the west along Westwood Creek are protected during flood events by closing the gates of the dam and pumping Westwood Creek to Louis' Reservoir, a two stage 210 foot retention and detention area at the southwest corner of Lake Street and Villa Avenue.

Figure 8. *Redmond Reservoir Dam.*

Figure 9. *Mt. Emblem Cemetery Pond Dam.*

Redmond Reservoir Dam (George Street Reservoir): Located on Addison Creek in Bensenville and operated by the Village of Bensenville (Figure 8). Originally constructed in 1999. The headwaters originate in Wood Dale and Bensenville. More information can be found at the IDNR website[2].

Mt Emblem Cemetery Pond: Located in Bensenville at the southwest corner of Grand Avenue and County Line Road (Figure 9).

Graham Center Dam (Elmhurst Co. Forest Preserve Dam) The dam is located on Salt Creek near Elmhurst (Figure 10). The dam is ¼ mile east of Route 83 and ¼ mile south of Monroe Street. Access is best granted from Monroe Street on the west side of Salt Creek. The dam was constructed in the early 1990's as a result of dredging on Salt Creek from Oak Brook north to this point. The structure was installed to allow for a step down between the dredged and undredged portions of the river and to prevent sedimentation of the dredged portions. The structure was not intended to be a dam, but in low flow conditions acts as one. The dam originally consisted of a single line of sheet metal piling. However, the creek began to erode the banks at the point of contact with the sheet metal piling. This was repaired by cutting a notch in the original sheet metal piling and installing another line of sheet metal piling further downstream.

Old Oak Brook Dam: The Old Oak Brook dam is located on Salt Creek, downstream of 31st Street in Oak Brook. The dam is maintained by the Village of Oak Brook and is approximately 85 years old (Figure 10). Access to the dam is best gained from Natoma Drive with permission of landowner (access point is on private land). The dam was originally built by Paul Butler in the 1920's to maintain an aesthetic pool on his property during low flow periods. The original structure of the

[2] http://dnr.state.il.us/OWR/Williamredmond.htm.

Figure 10. Graham Center Dam (DuPage Co. Forest Preserve Dam).

Oak Brook Dam has undergone major rehabilitation over the last 20 years. There are two main spillway components: the fixed elevation spillway and a gated "emergency" spillway. The gated spillway section consists of two steel vertical slide gates. The dam was rehabilitated in 1992. The primary spillway is sixty-five feet wide, with about three feet of head at normal flow conditions, and consists of grouted stone with a concrete cap. The left and right training walls consist of grouted stone and reinforced concrete, overlain to a larger extent by concrete filled fabriform mats.

Fullersburg Woods Dam: The Fullersburg Woods Dam is located on Salt Creek associated with Graue Mill and within the Fullersburg Woods Forest Preserve (Figure 11). The dam is 300 feet upstream of York Road near the Village of Oak Brook. The dam is owned by the Forest Preserve District of DuPage County (FPDDC) and is 74 years old. Access to the dam is best granted from a trail and parking lot off of Spring Road. The

***Figure 11**. Fullersburg Woods Dam (Graue Mill Dam) in Oak Brook.*

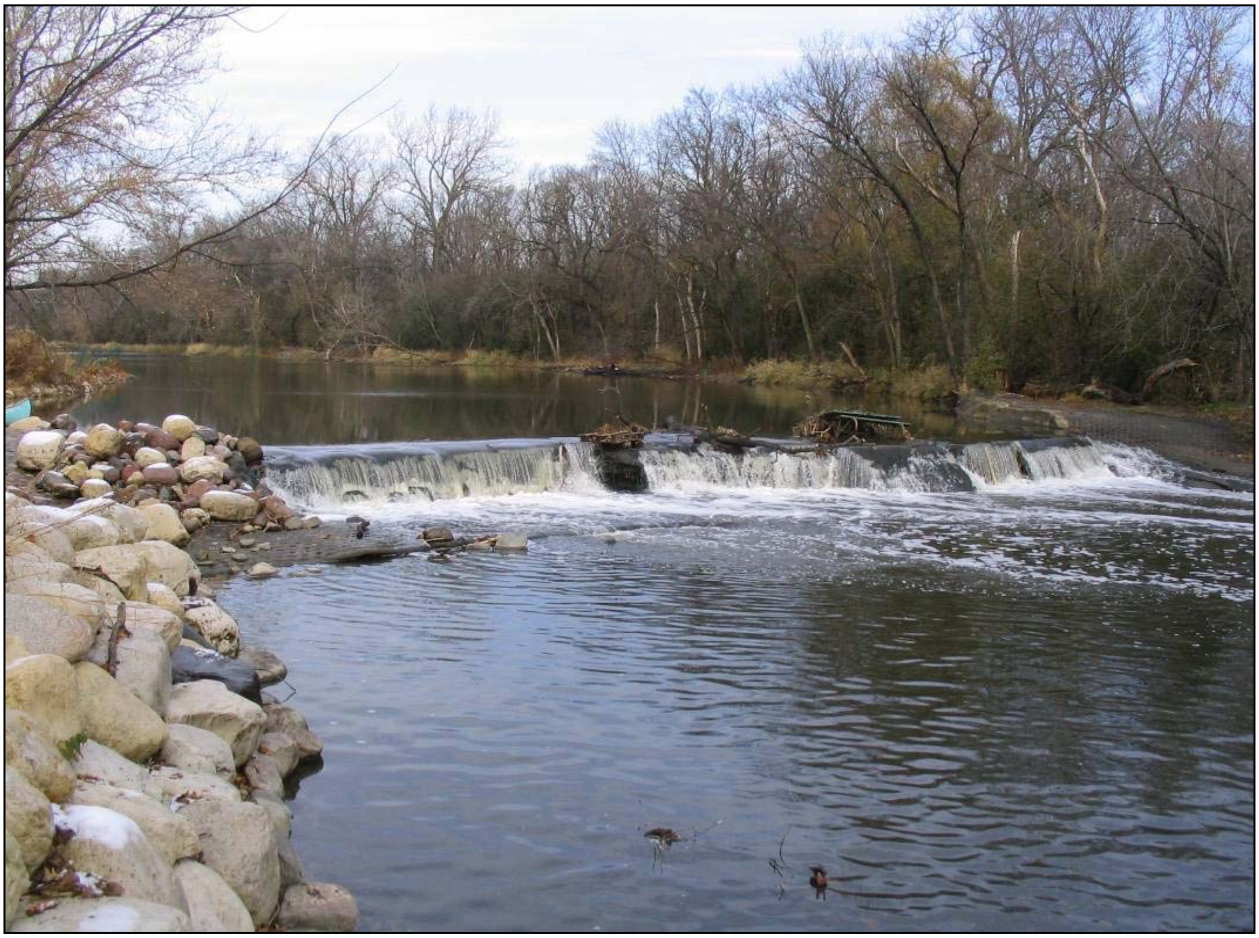


***Figure 12**. Old Oak Brook dam in Oak Brook.*

adjacent historic mill was originally constructed in 1852. The mill and dam were rebuilt by the Civilian Conservation Corps in the 1934. The dam is 123 feet across and 6.3 feet high. The impoundment created by the dam covers 16 acres and 3,900 linear feet.

Fox Lane Impoundment: An approximately five acre impoundment located at river mile 10.0 was created by what appears to be the remnant foundation of a former dam (Figure 13). The remnants currently function as a large riffle under low to average flow conditions.

Possum Hollow Woods Dam: Located in Westchester 3/4 miles east of Wolf Road, ¼ mile north of 31st Street on FPDCC property and it does not result in a notable impoundment (Figure 14). No additional data is available at this time.

***Figure 13**. The impoundment at Fox Lane (left panel) formed by the remnants of the Fox Lake dam (right panel).*

***Figure 14**. Possum Hollow Woods Dam.*

METHODS

Sampling sites (Table 3) were determined systematically using a geometric design that was supplemented by an intensive pollution survey design. The geometric site process starts at the downstream terminus of the watershed as the first site, and then selecting subsequent "levels" at fixed intervals of one-half the drainage area of the preceding level. Thus the upstream drainage area of each succeeding level, as one moves upstream, decreases by one-half. This resulted in seven levels of drainage area, starting from 150 $mi.^2$ through drainage levels of 75, 38, 19, 9, 5 and finally 2 mi^2. Each level was then supplemented with sites that targeted stream segments of particular interest such as those that have outfalls of publicly owned treatment works (POTW), major stormwater sources, CSOs, and dams, and to fill in gaps left by the geometric design in the larger mainstem reaches for a total of 51 sites.

Each site was sampled for macroinvertebrates, fish habitat, and water quality. Water quality parameters at all sites included nutrients (nitrogen and phosphorus), indicators of organic enrichment (5-day biochemical oxygen demand, ammonia-nitrogen, total Kjeldahl nitrogen), indicators of ionic strength (chloride, conductivity, total dissolved solids), total suspended solids, dissolved oxygen (D.O.), and water temperature. Water column metals (Ca, Cd, Cu, Fe, Mg, Pb and Zn and hardness) were included at 31 locations. Additionally, sediment quality was sampled at 25 locations, and continuous D.O. monitoring was conducted at 7 locations between 2013 and 2016. Sediments were analyzed for heavy metals, polycyclic aromatic hydrocarbons (PAHs), and pesticides.

Macroinvertebrate Assemblage

The macroinvertebrate assemblage was sampled using the Illinois EPA multi-habitat method (Illinois EPA 2005) at all sites. The Illinois EPA multi-habitat method involves the selection of a sampling reach that has instream and riparian habitat conditions typical of the assessment reach, has flow conditions that approximate typical summer base flows, has no highly influential tributary streams, contains one riffle/pool sequence or analog (i.e., run/bend meander or alternate point-bar sequence), if present, and is at least 300 feet in length. This method is applicable if conditions allow the sampler to collect macroinvertebrates (i.e., to take samples with a dip net) in all bottom-zone and bank-zone habitat types that occur in a sampling reach. The habitat types are defined explicitly in Appendix E of the project QAPP (MBI 2006b). Conditions must also allow the sampler to apply the 11-transect habitat-sampling method, as described Appendix E of the Quality Assurance Project Plan[3] or to estimate with reasonable accuracy via visual or tactile cues the amount of each of several bottom-zone and bank-zone habitat types. If conditions (e.g., inaccessibility, water turbidity, or excessive water depths) prohibit the sampler from estimating with reasonable accuracy the composition of the bottom zone or bank zone throughout the entire sampling reach, then the multi-habitat method is not applicable. In most cases, if more than one-half of the wetted stream channel cannot be seen, touched, or otherwise reliably characterized by the sampler, it is unlikely that reasonably

[3] http://www.drscw.org/reports/DuPage.QAPP_AppendixE.07.03.2006.pdf

***Table 4**. Sampling sites with biological and chemistry data types collected during the 2013 Salt Creek watershed assessment.*

Site ID	River Mile	Drain. Area (sq. mi.)	Bio. Types	Chem. Types	Latitude	Longitude	Location
Arlington Heights Branch							
SC06	4	7.7	MH, FHW	C, D, N	42.11639	-88.01231	Adj. to Maple Park, Palatine, Ill.
SC45	1.5	10	MH, FHW	C, D, N, H, O, S	42.08421	-88.01986	UST Campbell St. @ Roger Florey Park
SC08	0.25	12.7	MH, FHW	C, D, N	42.06796	-88.01922	UST Central Rd./adj. Opera In Focus bldg.
Baldwin Creek							
SC05	2	2	MH, FHW	C, D, N	42.12518	-88.03941	UST foot bridge @ Carpenter Rd.
Salt Creek							
SC04	39.5	6.3	MH, FHW	C, D, N	42.11064	-88.06239	Corner of Palatine Rd. and Quentin Rd.
SC07	36	16	MH, FHW	C, D, N, H	42.07708	-88.05303	At end of Plum Grove Rd.
SC15	32	32	MH, FB	C, D, N, H, O, S	42.05109	-88.00899	DST Golf Rd. (SR 581)
SC43	29	48.38	MH, FB	C, D, N, H, O, S	42.01197	-88.00092	DST Arlington Heights Ave at Elkgrove HS
SC42	27	53.5	MH, FB	C, D, N, H, O, S	41.99133	-87.99448	DST Devon Rd
SC41	25	70	MH, FB	C, D, N, H, O, S	41.9703	-87.98817	DST MWRDGC retention facility ramp
SC40	24.5	75	MH, FB	C, D, N, H, O, S	41.96274	-87.98439	DST Irving Park Rd.
SC34	23.5	76	MH, FB	C, D, N, H, O, S	41.95177	-87.98644	DST Elizabeth Drive
SC35	23	80	MH, FB	C, D, N, H, O, S	41.94409	-87.98108	UST second dam @ Oakwood G.C.
SC23	22.5	84	MH, FB	C, D, N, H, O, S	41.93694	-87.98423	Behind ball field off Stone Ave.
SC39	20.5	86	MH, FB	C, D, N, H, O	41.91998	-87.97275	DST Fullerton Ave.
SC38	18	87	MH, FB	C, D, N, H, O, S	41.89037	-87.96402	UST Charles Rd
SC37	17.5	95	MH, FB		41.88378	-87.96054	Between Salt Creek WWTP and Elmhurst WWTP
SC51	17	95	MH, FB	C, D, N, H	41.87577	-87.95799	DST Elmhurst WWTP/ UST low head dam
SC57	16.5	95	MH, FB		41.87232	-87.95457	DST low head dam below Elmhurst WWTP
SC55	13.5	102	MH, FB	C, D, N, H	41.84763	-87.93637	DST 22nd St bridge
SC56	12.5	107	MH, FB	C, D, N, H, O, S	41.83261	-87.94198	UST Oakbrook Rd/ DST GC bridge

***Table 4**. Sampling sites with biological and chemistry data types collected during the 2013 Salt Creek watershed assessment.*

Site ID	River Mile	Drain. Area (sq. mi.)	Bio. Types	Chem. Types	Latitude	Longitude	Location
SC53	11	110	MH, FB	C, D, N, H, O, S	41.82554	-87.93156	DST Fullerton F.P. bridge/ entrance off Spring Rd
SC52	10.5	112	MH, FB	C, D, N, H, O, S	41.82033	-87.92612	DST York Rd
SC59	9.1	113	MH, FB		41.8262	-87.91163	UST footbridge in Bemis Woods Forest Preserve
SC49	8	114	MH, FB	C, D, N, H, O, S	41.82576	-87.90004	DST Wolf Rd. bridge
SC60	7.2	118	MH, FB		41.82706	-87.88439	DST Nazareth Academy H.S.
SC54	3	145	MH, FB	C, D, N, H, O, S	41.84561	-87.85195	DST 17th Ave on Salt Creek F.P.
SC29	0.5	150	MH, FB	C, D, N, H, O, S	41.8183	-87.83371	UST SR 171 bridge and confluence w/ Des Plaines R.
Unnamed Tributary to Arlington Branch @RM 4.14							
SC01	2	1.1	MH, FHW	C, D, N, O	42.14366	-88.07816	DST service road culvert in Deer Grove F.P.
Unnamed Tributary to Salt Creek @RM 42.8							
SC02	0.25	0.9	MH, FHW	C, D, N	42.11327	-88.08243	DST Inverway Dr. off Palatine Rd
Unnamed Tributary to Salt Creek @43.30[4]							
SC03	0.5	2.5	MH, FHW	C, D, N	42.108	-88.08346	UST Plymouth St, culvert
West Branch Salt Creek							
SC11	5	4	MH, FHW	C, D, N	42.02837	-88.05552	Ust. Somburge Road
Unnamed Tributary to W. Br. Salt Creek @2.4							
SC14	2.5	10.46	MH, FHW	C, D, N, H	42.01734	-88.0451	DST Meacham Rd
Yeargin Creek							
SC12	0.25	1.8	MH, FHW	C, D, N	42.02557	-88.0636	UST Plum Grove Rd.
Ginger Creek							
SC30	1.5	5.2	MH, FHW	C, D, N	41.83787	-87.97082	DST Midwest Rd. below first pond
Sugar Creek							
SC33	0.25	3.5	MH, FHW	C, D, N	41.87296	-87.95973	DST Riverside/ DST SR 83
Addison Creek							
SC24	10.5	2	FHW	C, D, N, H, O	41.94622	-87.92612	UST Jefferson Rd
SC26	8	5	MH, FHW	C, D, N	41.92871	-87.91069	Adj. to park on Rhodes Ave./ S. of Grand
SC27	5	10	MH, FHW	C, D, N, H	41.89896	-87.88334	UST SR 45 @ PlayPen

[4] Cross-listed as Salt Creek at river mile 42.06 to conform to IEPA segment definition.

***Table 4**. Sampling sites with biological and chemistry data types collected during the 2013 Salt Creek watershed assessment.*

Site ID	River Mile	Drain. Area (sq. mi.)	Bio. Types	Chem. Types	Latitude	Longitude	Location
SC48	2.5	18	MH, FHW	C, D, N, H, O, S	41.87273	-87.86877	DST/UST Van Buren St.
SC28	1.5	20	MH, FHW	C, D, N, H, O, S	41.86116	-87.86774	UST Gardner Ave.
Unnamed Tributary to Addison Creek @RM 10.35							
SC25	0.5	1	MH, FHW	C, D, N	41.93782	-87.93989	UST Forest View Rd.
Spring Brook							
SC21	6.5	2	MH, FHW	C, D, N, H, O, S	41.97324	-88.07928	DST Walnut Ct.
SC46	6	3.5	FHW	C, D, N, H, O, S	41.96673	-88.07742	DST Foster Ave.
SC18	4.5	6.28	MH, FHW	C, D, N	41.95825	-88.06508	@ end of Lakeview Dr.
SC47	2.5	10	MH, FHW	C, D, N, H, O, S	41.96334	-88.03151	DST SR 53 (Rohlwing Rd)
SC16	0.25	14.2	MH, FHW	C, D, N, H, O, S	41.97178	-87.99803	DST Prospect Ave.
Oakbrook Creek							
SC36	0.5	0.8	MH, FHW		41.85062	-87.95894	SR 83 & Hodges Rd behind Barnes and Nobles
SC32	0.25	1.2	MH, FHW	C, D, N	41.85377	-87.94883	16th St. @Citibank pkg. lot
Unnamed Tributary to Meacham Creek @RM 1.9							
SC20	0.25	2	MH, FHW	C, D, N	41.9883	-88.05443	Behind Air-Liance Bldg. pkg. lot off Stevenson Ct.
Westwood Creek							
SC22	0.5	4	MH, FHW	C, D, N, O, S	41.93982	-87.99296	DST Rozanne Drive
Indian Creek – Reference Site							
I-2	16	126	MH,FWD		41.53476	-88.85178	Reference Site
Little Indian Creek – Reference Site							
I-3	5.1	82.6	MH,FWD		41.55383	-88.75048	Ref Site I-3, N 4275th Road

Biological Types: Macros: MH (IL Multihabitat Method); QL – (Qual Only); Fish: FHW (Fish Headwater); FWD (Fish Wadeable); FB (Fish Boatable); Chemical Parameter Types: (C – Conventional, D – Dissolved Oxygen; N – Nutrients; H – Heavy Metals; O – Organics, S – Sediment Chemistry.

accurate estimates of the bottom-zone and bank-zone habitat types are attainable, thus, the multi-habitat method is not applicable. The multi-habitat samples were preserved in 10% formalin. Laboratory procedures generally followed the Illinois EPA (2005) method. For the multi-habitat method this requires the production of a 300 organism subsample with a scan and pre-pick of large and/or rare taxa from a gridded tray. Taxonomic resolution was performed at the lowest practicable resolution for the common macroinvertebrate assemblage groups such as mayflies, stoneflies, caddisflies, midges, and crustaceans. This goes beyond the genus level

***Table 5**. Sampling sites with biological and chemistry data types collected during the 2016 Salt Creek watershed assessment.*

Site ID	River Mile	Drain. Area (sq. mi.)	Bio. Types	Chem. Types	Latitude	Longitude	Location
Arlington Heights Branch							
SC06	4	7.7	MH, FHW	C, D, N, O	42.11639	-88.01231	Adj. to Maple Park, Palatine, Ill.
SC45	1.5	10	MH, FHW	C, D, N, H, O, S	42.08421	-88.01986	UST Campbell St. @ Roger Florey Park
SC08	0.25	12.7	MH, FHW	C, D, N, O	42.06793	-88.01925	UST Central Rd./adj. Opera In Focus bldg.
Baldwin Creek							
SC05	2	2	MH, FHW	C, D, N, O	42.12518	-88.03941	UST foot bridge @ Carpenter Rd.
Salt Creek							
SC04	39.5	6.3	MH, FHW	C, D, N, O	42.11064	-88.06239	Corner of Palatine Rd. and Quentin Rd.
SC07	36	16	MH, FHW	C, D, N, H, O	42.07708	-88.05303	At end of Plum Grove Rd.
SC15	32	32	MH, FB	C, D, N, H, O, S	42.05109	-88.00899	DST Golf Rd. (SR 581)
SC50	29.8	47.86		C, D, N, H, O	42.02126	-88.0049	Upstream Busse Woods dam; Busse Woods Lake
SC44	29.3	48.24	MH, FB	C, D, N, H, O, S	42.01602	-88.0005	Immediately upstream from MWRDGC Egan WWTP; downstream Busse Woods South dam
SC43	29	48.38	MH, FB	C, D, N, H, O, S	42.01197	-88.00092	DST Arlington Heights Ave at Elkgrove HS
SC42	27	53.5	MH, FB	C, D, N, H, O, S	41.99133	-87.99448	DST Devon Rd
SC41	25	70	MH, FB	C, D, N, H, O, S	41.9703	-87.98817	DST MWRDGC retention facility ramp
SC40	24.5	75	MH, FB	C, D, N, H, O, S	41.96274	-87.98439	DST Irving Park Rd.
SC23	22.5	84	MH, FB	C, D, N, H, O, S	41.93694	-87.98423	Behind ball field off Stone Ave; Dst. Addison WWTP
SC39	20.5	86	MH, FB	C, D, N, H, O, S	41.91998	-87.97275	DST Fullerton Ave.
SC38	18	87	MH, FB	C, D, N, H, O, S	41.89037	-87.96402	UST Charles Rd
SC37	17.5	95	MH, FB	C, D, N, H, O, S	41.88378	-87.96054	Between Salt Creek WWTP and Elmhurst WWTP Dschg
SC51	17	95	MH, FB	C, D, N, H, O, S	41.87577	-87.95799	DST Elmhurst WWTP/ UST low head dam
SC57	16.5	95	MH, FB	none	41.87232	-87.95457	DST low head dam below Elmhurst WWTP

***Table 5**. Sampling sites with biological and chemistry data types collected during the 2016 Salt Creek watershed assessment.*

SC55	13.5	102	MH, FB	C, D, N, H, O	41.84763	-87.93637	DST 22nd St bridge
SC56	12.5	107	MH, FB	C, D, N, H, O	41.83261	-87.94198	UST Oakbrook Rd/ DST GC bridge
SC53	11	110	MH, FB	C, D, N, H, O, S	41.82554	-87.93156	DST Fullerton F.P. bridge/ entrance off Spring Rd
SC52	10.5	112	MH, FB	C, D, N, H, O, S	41.82033	-87.92612	DST York Rd
SC59	9.1	113	MH, FB		41.8262	-87.91163	UST footbridge in Bemis Woods Forest Preserve
SC49	8	114	MH, FB	C, D, N, H, O, S	41.82576	-87.90004	DST Wolf Rd. bridge
SC60	7.2	118	MH, FB		41.82706	-87.88439	DST Nazareth Academy H.S.
SC54	3	145	MH, FB	C, D, N, H, O, S	41.84561	-87.85195	DST 17th Ave on Salt Creek F.P.
SC29	0.5	150	MH, FB	C, D, N, H, O, S	41.8183	-87.83371	UST SR 171 bridge and confluence w/ Des Plaines R.
Unnamed Tributary to Arlington Branch @RM 4.14							
SC01	2	1.1	MH, FHW	C, D, N, O	42.14366	-88.07816	DST service road culvert in Deer Grove F.P.
Unnamed Tributary to Salt Creek @RM 42.8							
SC02	0.25	0.9	MH, FWD	C, D, N, O	42.11327	-88.08243	DST Inverway Dr. off Palatine Rd
Unnamed Tributary to Salt Creek @43.30[5]							
SC03	0.5	2.5	MH, FWD	C, D, N, O	42.108	-88.08346	UST Plymouth St, culvert
West Branch Salt Creek							
SC11	5	4	MH, FHW	C, D, N, O, S	42.02837	-88.05552	Ust. Somburge Road
Unnamed Tributary to W. Br. Salt Creek @2.4							
SC14	2.5	10.46	MH, FHW	C, D, N, H, O	42.01734	-88.0451	DST Meacham Rd
SC13	2	10.36		C, D, N, O	42.01569	-88.0542	At end of University Lane
Yeargin Creek							
SC12	0.25	1.8	MH, FHW	C, D, N, O	42.02557	-88.0636	UST Plum Grove Rd.
Ginger Creek							
SC30	1.5	5.2	MH, FHW	C, D, N, O	41.83787	-87.97082	DST Midwest Rd. below first pond
SC31	0.5	4.84		C, D, N, H, O	41.83938	-87.9532	Upstream from Jorie Blvd. at Oak Brook Park District Park at pedestrian bridge
Sugar Creek							
SC33	0.25	3.5	MH, FHW	C, D, N, O	41.87296	-87.95973	DST Riverside/ DST SR 83

[5] Cross-listed as Salt Creek at river mile 42.06 to conform to IEPA segment definition.

***Table 5**. Sampling sites with biological and chemistry data types collected during the 2016 Salt Creek watershed assessment.*

Addison Creek							
SC24	10.5	2	MH, FHW	C, D, N, O	41.94622	-87.92612	UST Jefferson Rd
SC26	8	5	MH, FHW	C, D, N, O	41.92871	-87.91069	Adj. to park on Rhodes Ave./ S. of Grand
SC27	5	10	MH, FHW	C, D, N, H, O	41.89896	-87.88334	UST SR 45 @ PlayPen
SC48	2.5	18	MH, FHW	C, D, N, H, O, S	41.87273	-87.86877	DST/UST Van Buren St.
SC28	1.5	20	MH, FHW	C, D, N, H, O, S	41.86116	-87.86774	UST Gardner Ave.
Unnamed Tributary to Addison Creek @RM 10.35							
SC25	0.5	1	MH, FHW	C, D, N, O	41.93782	-87.93989	UST Forest View Rd.
Spring Brook							
SC21	6.5	2	MH, FHW	C, D, N, H, O, S	41.97324	-88.07928	DST Walnut Ct.
SC46	6	3.5	MH, FHW	C, D, N, H, O, S	41.96673	-88.07742	DST Foster Ave.
SC18	4.5	6.28	MH, FHW	C, D, N, O	41.95825	-88.06508	@ end of Lakeview Dr.
SC47	2.5	10	MH, FHW	C, D, N, H, O, S	41.96334	-88.03151	DST SR 53 (Rohlwing Rd)
SC16	0.25	14.2	MH, FHW	C, D, N, H, O, S	41.97178	-87.99803	DST Prospect Ave.
Spring Brook							
SC36	0.5	0.8	MH, FHW	C, D, N, O	41.85062	-87.95894	SR 83 & Hodges Rd behind Barnes and Nobles
SC32	0.25	1.2	MH, FHW	C, D, N, O	41.85377	-87.94883	16th St. @Citibank pkg. lot
Unnamed Tributary to Meacham Creek @RM 1.9							
SC20	0.25	2	MH, FHW	C, D, N, O	41.9883	-88.05443	Behind Air-Liance Bldg. pkg. lot off Stevenson Ct.
Westwood Creek							
SC22	0.5	4	MH, FHW	C, D, N, H, O, S	41.93982	-87.99296	DST Rozanne Drive
Meacham Creek							
SC17	0.4	4.8	MH, FHW	C, D, N, O	41.93982	-87.99296	Medinah Golf Course
Prairie Creek – Reference Site							
FA01	0.15	49.04	MH, FWD		41.55383	-88.75048	Reference Site
Auxsable Creek – Reference Site							
DW07	17.5	99.88	MH, FWD		41.55383	-88.75048	Dst. U.S. 62
DW01	6.4	171.79	MH, FWD		41.55383	-88.75048	Ust. CR 9000

Biological Types: Macros: MH (IL Mutihabitat Method); QL – (Qual Only); Fish: FHW (Fish Headwater); FWD (Fish Wadeable); FB (Fish Boatable); Chemical Parameter Types: (C – Conventional, D – Dissolved Oxygen; N – Nutrients; H – Heavy Metals; O – Organics, S – Sediment Chemistry.

requirement of Illinois EPA (2005); however, calculation of the macroinvertebrate IBI followed Illinois EPA methods in using genera as the lowest level of taxonomy for mIBI scoring.

Fish Assemblage

Methods for the collection of fish at wadeable sites was performed using a tow-barge or long-line pulsed D.C. electrofishing equipment utilizing a T&J 1736 DCV electrofishing unit described by MBI (2006b). A Wisconsin DNR battery powered backpack electrofishing unit was used as an alternative to the long line in the smallest streams and in accordance with the restrictions described by Ohio EPA (1989). A three person crew carried out the sampling protocol for each type of wading equipment. Sampling effort was indexed to lineal distance and ranged from 150-200 meters in length. Non-wadeable sites were sampled with a raft-mounted pulsed D.C. electrofishing device. A Smith-Root 2.5 GPP unit was mounted on a 14’ raft following the design of MBI (2007). Sampling effort for this method was 500 meters. A summary of the key aspects of each method appears the project QAPP (MBI 2006b). Sampling distance was measured with a GPS unit or laser range finder. Sampling locations were delineated using the GPS mechanism and indexed to latitude/longitude and UTM coordinates at the beginning, end, and mid-point of each site. The location of each sampling site was indexed by river mile (using river mile zero as the mouth of each stream). Sampling was conducted during a June 15-October 15 seasonal index period.

Samples from each site were processed by enumerating and recording weights by species and by life stage (y-o-y, juvenile, and adult). All captured fish were immediately placed in a live well, bucket, or live net for processing. Water was replaced and/or aerated regularly to maintain adequate D.O. levels in the water and to minimize mortality. Fish not retained for voucher or other purposes were released back into the water after they had been identified to species, examined for external anomalies, and weighed either individually or in batches. Weights were recorded at level 1-5 sites only. Larval fish were not included in the data and fish measuring less than 15-20 mm in length were generally excluded from the data as a matter of practice. The incidence of external anomalies was recorded following procedures outlined by Ohio EPA (1989, 2006a) and refinements made by Sanders et al. (1999). While the majority of captured fish were identified to species in the field, any uncertainty about the field identification required their preservation for later laboratory identification. Fish were preserved for future identification in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile and site number). Identification was made to the species level at a minimum and to the sub-specific level if necessary. A number of regional ichthyology keys were used and included the Fishes of Illinois (Smith 1979) and updates available through the Illinois Natural History Survey (INHS). Vouchers were deposited and verified at The Ohio State University Museum of Biodiversity (OSUMB).

Physical Habitat

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995; Ohio EPA 2006b) and as recently modified by MBI for specific attributes. Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments in the Midwestern U.S. have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support an assemblage consistent with baseline Clean Water Act goal expectations (e.g., the General Use in Illinois). Scores greater than 75 frequently typify habitat conditions which have the ability to support an exceptional fish assemblage.

Data Management and Analysis

MBI employed the data storage, retrieval, and calculation routines available in the Ohio ECOS system as described in the project QAPP (MBI 2006b). Fish and macroinvertebrate data were reduced to standard relative abundance and species/taxa richness and composition metrics. The Illinois Fish Index of Biotic Integrity (fIBI) was calculated with the fish data as described by Illinois EPA. The macroinvertebrate data were analyzed using the Illinois macroinvertebrate Index of Biotic Integrity (mIBI).

Determination of Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine biological status (i.e., unimpaired or impaired, narrative ratings of quality) and assigning associated causes and sources of impairment utilizing the accompanying chemical/physical data and source information (e.g., point source loadings, land use). The identification of impairment in rivers and streams is straightforward - the numerical biological indices are the principal arbiter of aquatic life use attainment and impairment following the guidelines of Illinois EPA (2008). The rationale for using the biological results in the role as the principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a, b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995).

Describing the causes and sources associated with observed biological impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures (Yoder and Rankin 1995; Yoder and DeShon 2003; Miltner et al. 2010). Thus the assignment of principal associated causes and sources of biological impairment in this report represents the association of impairments (based on response indicators) with stressor and exposure indicators using linkages to the biosurvey data based on previous experiences within the strata of analogous situations and impacts. The reliability of the identification of associated causes and sources is increased where many such prior associations have been observed. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistically links symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experiences in interpreting symptoms (*i.e.,* multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and well-being of the patient, the ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including assemblage structure and function.

Hierarchy of Water Indicators

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. A tiered approach that links the results of administrative actions with true environmental measures was employed by our analyses. This integrated approach is outlined in Figure 15 and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include:

1) actions taken by regulatory agencies (permitting, enforcement, grants);
2) responses by the regulated community (treatment works, pollution prevention);
3) changes in discharged quantities (pollutant loadings);
4) changes in ambient conditions (water quality, habitat);
5) changes in uptake and/or assimilation (tissue contamination, biomarkers, assimilative capacity); and, changes in health, ecology, or other effects (ecological condition, pathogens).

In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). An example is the aggregate effect of billions of dollars spent on water pollution control since the early 1970s that have been determined with quantifiable measures of environmental condition (Yoder et al. 2005). Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise the Illinois EPA biological endpoints.

Other response indicators can include target assemblages, *i.e.,* rare, threatened, endangered, special status, and declining species or bacterial levels that serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each (Yoder and Rankin 1998).

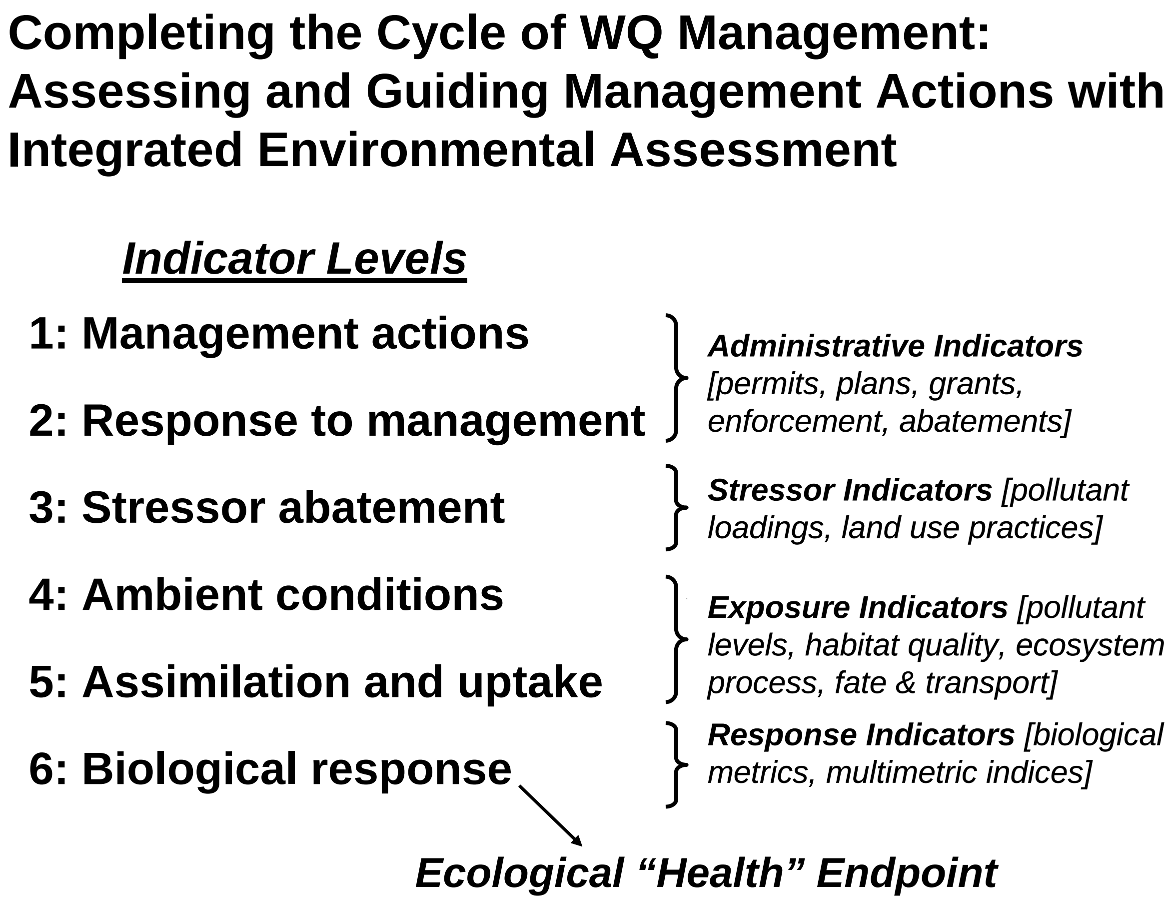


Figure 15*. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995) and further enhanced by Karr and Yoder (2004).*

Illinois Water Quality Standards: Designated Aquatic Life Uses

The Illinois Water Quality Standards (WQS; IL Part 303.204-206) consist of designated uses and chemical criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad categories, aquatic life and non-aquatic life uses. Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each use. The system of use designations employed in the Illinois WQS constitutes a general approach in that one or two levels of protection are provided and extended to all water bodies regardless of size or position in the landscape. In applications of state WQS to the management of water resource issues in rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality assessments. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all other uses.

Aquatic life use support for a water body in Illinois is determined by examining all available biological and water quality information. Where information exists for both fish and macroinvertebrate indicators, and both indicators demonstrate full support, the water body is considered in full support independent of the water chemistry results. Where information for both biological indicators exists, and one indicator suggests full support while the other shows moderate impairment, a use decision of full support can be made if the water chemistry data show no indication of impairment. Where one biological indicator is severely impaired, non-support is demonstrated. If information for only one biological indicator exists, water chemistry information is used to inform the use support decision in that a biological result of full support can be overridden if the water chemistry results clearly demonstrate impairment. However, in the Salt Creek survey biological data was available for each site.

RESULTS AND DISCUSSION

Salt Creek Flow Conditions

Salt Creek flows measured at the USGS gage near Western Springs, IL in 2013 and 2016 were generally at or above the median for the May-September period which ranges from 50-70 cfs during July-October. Flows in 2013 were lower than in 2016 during this period (Figure 16, right). Figure 16 (left) is a box-and-whisker plot that shows the distribution of summer stream flows during the 2007, 2010, 2013, and 2016 surveys. Median flows were the most similar between 2007 and 2013 and between 2010 and 2016, although more outliers (>1000 cfs) occurred in 2007 and 2010 than in 2013 and 2016 (Figure 16, right) indicating spates of very high flows.

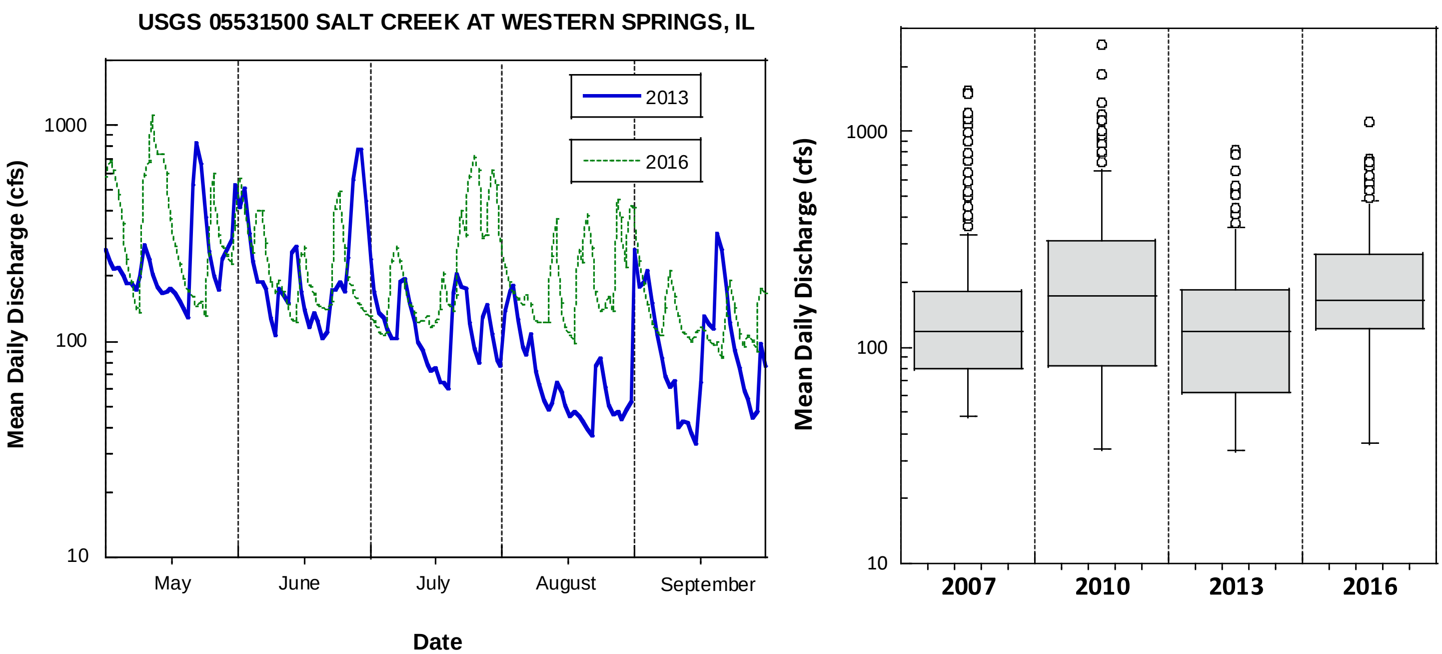


***Figure 16**. Flow hydrograph (left) and box-and-whisker plot (right) for Salt Creek flows measured at the USGS Western Springs gage (Station 05531500) during May-September 2013 and 2016 (right) and in 2007, 2010, 2013, and 2016 (right).*

Pollutant Loadings by Publicly Owned Treatment Works

Ten (10) wastewater treatment plants (WWTPs) with average daily design flows (ADF) greater than one million gallons per day (MGD) discharge to Salt Creek and its tributaries. Together the ADF is 125% of the critical low flow in Salt Creek (Table 6). During August of 2013 and 2016, the actual discharged volume of treated effluent was typically about 83 percent (41.5 MGD of 50 MGD) and 30.3 percent (41.5 MGD of 136.8 MGD), respectively of the $Q_{7,10}$ critical low flow and 80% duration flow measured at the Western Springs USGS gauge. The percent stream flow composed of effluent obviously depends on the amount of precipitation over an antecedent period, especially the amount of precipitation during the winter and spring months. Effluent quality data from major dischargers in the Salt Creek watershed (Table 4) were evaluated against permit limits to gauge the relative performance of each plant, especially with respect to plant flows (the amount of effluent leaving the plant) relative to treatment capacity, and concentrations of several key effluent constituents: 5-day carbonaceous biochemical oxygen demand (cBOD5), total suspended solids (TSS) and ammonia-nitrogen (NH_3-N). Detailed descriptions of each plant and effluent quality were provided in the 2006-7 report (MBI 2008) and more detailed trends in effluent quality were summarized in the 2010 report (MBI 2011). The discussion for each plant herein is limited to comparing effluent quality for the 2013 and 2016 third quarter (July 1-September 30) periods for comparative purposes.

Table 6. *Average and maximum design flows for publicly owned treatment plants (POTWs) that discharge to Salt Creek and selected tributaries. The proportion of the $Q_{7,10}$ critical low flow and the 80th percentile flow are provided (data from NPDES permit fact sheets).*

NPDES	POTW Name	Avg. Design Flow	Max. Design Flow	Receiving Stream	Longitude	Latitude
IL0036340	MWRDGC Egan WRP	30	50	Salt Creek	-88.0008	42.0153
IL0026280	Itasca WWTP	3.2	8.2	Salt Creek	-87.9919	41.9714
IL0030813	Roselle-J.L. Devlin WWTP	2.0	4.0	Spring Brook	-88.0767	41.9692
IL0020061	Wood Dale North WWTP	2.0	3.9	Salt Creek	-87.985	41.965
IL0034274	Wood Dale South WWTP	1.1	2.3	Salt Creek	-87.9831	41.9492
IL0021849	Bensenville South WWTP	4.7	10	Addison Creek	-87.9258	41.9478
IL0033812	Addison North WWTP	5.3	7.6	Salt Creek	-87.9869	41.9472
IL0027367	Addison South-A.J. Larocca WWTP	3.2	8.0	Salt Creek	-87.9739	41.9253
IL0030953	Salt Creek Sanitary District	3.3	8.0	Salt Creek	-87.9597	41.8853
IL0028746	Elmhurst WWTP	8.0	20	Salt Creek	-87.9589	41.8819
	Design Flow Totals	62.8	122			
	Proportion of $Q_{7,10}$ Stream Flow	126%	244%	$Q_{7,10}$ = 50 MGD[6]		
	Proportion of 80%ile Stream Flow	45.9%	89.2%	80th%ile = 136.7 MGD[6]		

The proportion of average daily effluent flows and loadings for $cBOD_5$, total suspended solids (TSS), and ammonia-N (NH_3-N) from these dischargers for 2013 and 2016 appear in Figures 17 and 18. The link between precipitation and effluent flow is directly related to combined storm and sanitary sewer collection system flows and inflow and infiltration in the collection system. During rainfall events, excess flows are minimally treated per NPDES permit requirements and bypassed to the receiving stream as overflows. The volume of diverted flows is largely a function of rainfall. Average daily loadings of $cBOD_5$, TSS and NH_3-N over 2008-2010 represented an approximate 8 percent increase for $cBOD_5$ and TSS, and a 5 percent decrease for NH3-N compared to 2005-7 (MBI 2011). The lower ammonia load in the face of increased flow is an indication that the treatment plants, as whole, have maintained high treatment

[6] Flow measured at the USGS Western Springs gage station (Station 05531500).

***Table 7**. Average daily effluent flow (MGD) and loadings (lbs./day) of cBOD5, total suspended solids (TSS), and ammonia-N (NH3-N) discharged to Salt Creek and selected tributaries in 2013 (upper) and 2016 (lower). Data provided by each entity to DRSCW.*

Facility	Flow (MGD)	%FLOW	$cBOD_5$ (lbs/day)	%$cBOD_5$	TSS (lbs/day)	%TSS	NH_3-N (lbs/day)	%NH_3-N
MWRDGC Egan WRP	21.6	53.2%	97.6	25.7%	490.6	47.1%	18.3	44.3%
Itasca WWTP	1.2	3.0%	19.7	5.2%	110.9	10.7%	0.4	1.0%
Roselle-J.L. Devlin WWTP	1.0	2.5%	21.9	5.8%	26.7	2.6%	0.6	1.5%
Wood Dale North WWTP	1.3	3.3%	27.2	7.2%	29.1	2.8%	0.0	0.0%
Wood Dale South WWTP	0.3	0.9%	5.9	1.6%	10.0	1.0%	0.0	0.0%
Bensenville South WWTP	2.8	7.0%	51.9	13.7%	43.5	4.2%	5.1	12.3%
Addison North WWTP	3.7	9.2%	38.6	10.2%	137.4	13.2%	1.8	4.4%
Addison South-A.J.Larocca WWTP	2.2	5.5%	33.0	8.7%	89.3	8.6%	8.4	20.3%
Salt Creek Sanitary District	2.2	5.3%	40.7	10.7%	33.6	3.2%	2.3	5.7%
Elmhurst WWTP	4.2	10.3%	42.7	11.3%	69.8	6.7%	4.4	10.6%
Totals	**40.6**	**100.0%**	**379.1**	**100.0%**	**1040.9**	**100.0%**	**41.4**	**100.0%**

Facility	Flow (MGD)	%FLOW	$cBOD_5$ (lbs/day)	%$cBOD_5$	TSS (lbs/day)	%TSS	NH_3-N (lbs/day)	%NH_3-N
MWRDGC Egan WRP	21.1	50.9%	74.4	19.8%	437.1	41.4%	37.1	76.6%
Itasca WWTP	1.3	3.2%	35.9	9.6%	97.5	9.2%	1.5	3.0%
Roselle-J.L. Devlin WWTP	1.2	3.0%	24.8	6.6%	34.5	3.3%	0.6	1.3%
Wood Dale North WWTP	1.3	3.0%	25.6	6.8%	14.2	1.3%	0.6	1.3%
Wood Dale South WWTP	0.3	0.7%	3.8	1.0%	3.6	0.3%	0.1	0.2%
Bensenville South WWTP	3.2	7.6%	45.4	12.1%	30.6	2.9%	1.7	3.6%
Addison North WWTP	2.9	7.1%	30.2	8.1%	250.4	23.7%	2.0	4.0%
Addison South-A.J.Larocca WWTP	1.6	4.0%	18.4	4.9%	70.7	6.7%	0.9	2.0%
Salt Creek Sanitary District	2.6	6.3%	43.8	11.7%	18.1	1.7%	2.5	5.2%
Elmhurst WWTP	5.9	14.3%	73.2	19.5%	99.9	9.5%	1.4	2.9%
Totals	**41.5**	**100.0%**	**375.5**	**100.0%**	**1056.6**	**100.0%**	**48.5**	**100.0%**

efficiency over time. An efficient level of treatment continued in 2013 and 2016 with similar or reduced daily loadings of $cBOD_5$, TSS, and NH_3-N between each year (Table 7).

The MWRDGC Eagan facility comprised just over one-half of the POTW effluent flow in both 2013 and 2016, more than 40% of the TSS loadings, and the highest proportion of ammonia-N comprising more than 76% in 2016 in which the loading more than doubled. While total flow and loadings among all 10 facilities were similar between 2013 and 2016 there was more variability between years for individual WWTPs. The Elmhurst WWTP ranked second in proportion of effluent flow (10.1% and 14.1%, respectively), but declined in both the proportion and total ammonia-N loading from 2013 to 2016 in which it ranked behind the Salt Creek SD, Addison North, Bensenville South, and Itasca WWTPs. A description of each facility follows.

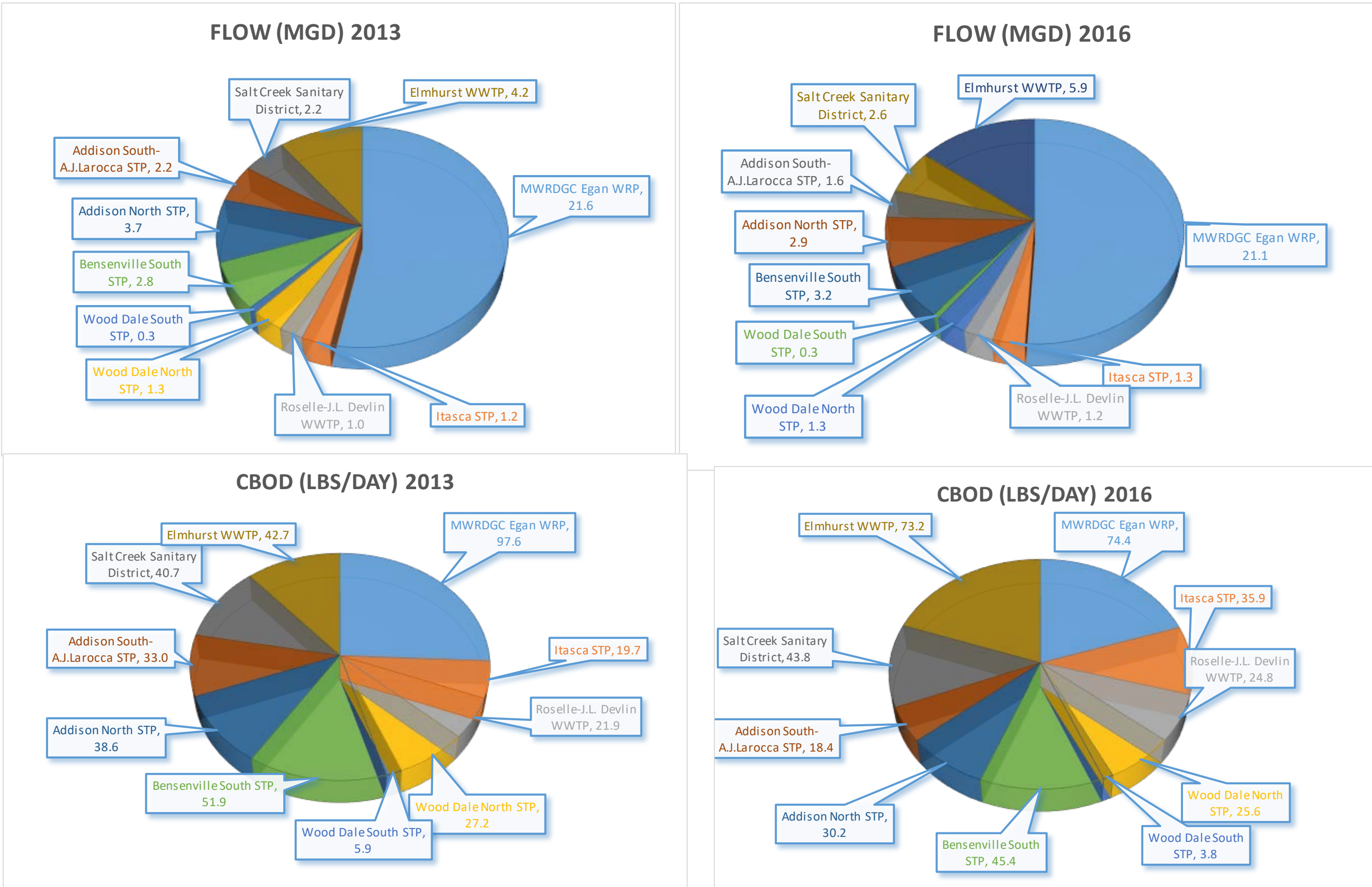


***Figure 17**. Mean daily effluent flows (upper panels) and mean daily cBOD$_5$ load (lbs./day, lower panels) during 2013 (left) and 2016 (right) for major municipal discharges in the Salt Creek watershed apportioned by facility.*

MWRDGC EGAN WRP [IL0036340] The design average flow (DAF) for this treatment facility is 30 MGD and the design maximum flow (DMF) for the facility is 50 MGD discharged to Salt Creek. Treatment consists of screening, grit removal, settling tanks, aeration tanks, tertiary filtration, anaerobic digestion, gravity belt thickeners, and excess flow facilities. Excess flow is permitted only when the main treatment facility is receiving its maximum practical flow. Excess flows, when they occur, are required to be monitored. Monthly average limits for the excess discharges are 30 mg/l for cBOD$_5$ and TSS, 400 colonies/100 ml of fecal coliform, 0.75 mg/l for residual chlorine (used as a disinfectant). The 10-year recurrent 7-day low flow ($Q_{7,10}$) of Salt Creek at the discharge point is 0 cubic feet per second (cfs). The Eagan facility comprised more than 50% of the flow among all 10 facilities analyzed in 2013 and 2016 and was the largest source of major point source cBOD$_5$ (24.6 and 18.8%), TSS (46.1 and 40.4%), and ammonia-N (43.8 and 75.8%) loadings that latter of which doubled in 2016.

CITY OF ELMHURST WWTP [IL0028746] The Elmhurst Sewage Treatment Plant discharges an average design flow of 8.0 MGD and a design maximum flow of 20 MGD to Salt Creek.

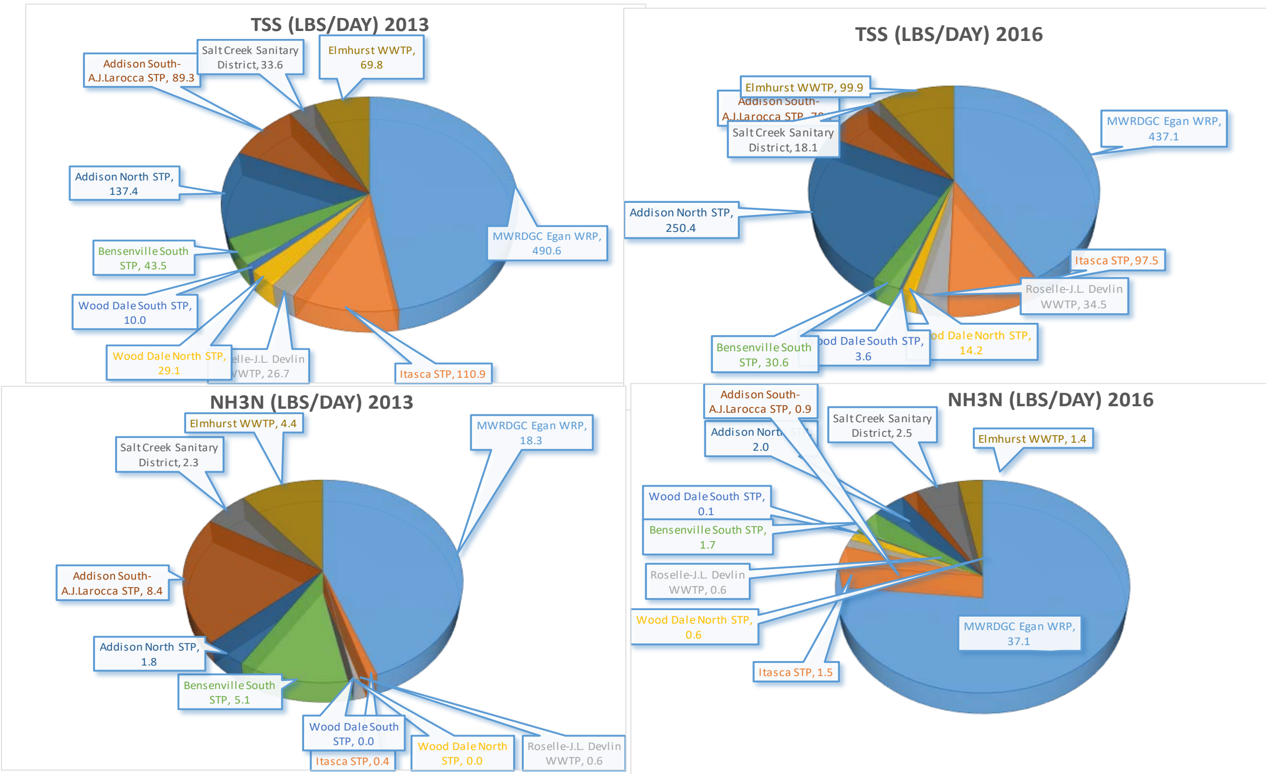


***Figure 18**. Mean daily total suspended solids load (upper), and mean daily ammonia-nitrogen load (lower) during 2013 (left) and 2016 (right), for major municipal discharges in the Salt Creek watershed apportioned by facility.*

Treatment consists of screening, grit removal, settling tanks, aeration tanks, tertiary filtration, anaerobic digestion, gravity belt thickeners, and solids handling for disposal as biosolids. Average discharge volume was 4.2 MGD in 2013 and 5.4 MGD in 2016 well below the volume discharged by the MWRDG Egan facility, but second among the 8 facilities (Figures 17 and 18). Average flow increased from 4.2 MGD to 5.9 MGD between 2013 and 2016 which ranked second and second among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ likewise increased from 42.7 to 73.2 lbs/day, TSS from 69.8 to 99.9 lbs/day, with ammonia-N declining from 4.4 to 1.4 lbs/day.

ADDISON NORTH WWTP [IL0033812] The design average flow (DAF) is 5.3 MGD and the design maximum flow (DMF) for the facility is 7.6 MGD discharged to Salt Creek. Treatment consists of screening, 2 stage activated sludge treatment clarification, excess flow treatment and effluent disinfection. Sludge is both aerobically and an aerobically digested, belt pressed and applied to agricultural land. Average discharge volume was 4.2 MGD in 2013 and 5.4 MGD in 2016 which ranked fifth and sixth among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ declined from 3.7 to 2.9 lbs/day, TSS increased from 137.4 to 250.4 lbs/day, with ammonia-N remaining about the same (1.8 to 2.0 lbs/day).

BENSENVILLE SOUTH WWTP [IL0021849] The primary discharge is outfall 001 to Addison Creek. The 10-year recurrent 7-day low flow ($Q_{7,10}$) of the receiving stream, Addison Creek, is 0 cfs.

The design average flow (DAF) for the treatment facility is 4.7 MGD and the design maximum flow (DMF) for the facility is 10 MGD. Treatment consists of screening, grit removal, primary treatment trickling filtration, activated sludge, sedimentation, tertiary filtration, disinfection and sludge handling facilities. Biological nutrient removal was installed and operational by late 2016. Average discharge volume was 2.8 MGD in 2013 and 3.2 MGD in 2016 which ranked fifth and fourth among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ declined from 51.9 to 45.4 lbs/day, TSS declined from 43.5 to 30.6 lbs/day, with ammonia-N also declining from 5.1 to 1.7 lbs/day).

ROSELLE- J.L. DEVLIN WWTP [IL0030813] Treatment consists of screening, primary clarifiers, activated sludge, sedimentation, filtration, disinfection, sludge handling facilities, and excess flow treatment. The design average flow (DAF) is 2.0 MGD and the design maximum flow (DMF) for the facility is 4.0 MGD discharged to Spring Brook. The 10-year recurrent 7-day low flow ($Q_{7,10}$) of the receiving stream, Spring Brook, is 0 cfs. Average discharge volume was 1.0 MGD in 2013 and 1.2 MGD in 2016 which ranked ninth and tenth among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ increased from 21.9 to 24.8 lbs/day, TSS increased from 26.7 to 34.5 lbs/day, with ammonia-N remaining unchanged at 0.6 lbs/day.

ADDISON SOUTH (A. J. Larocca) STP [IL0027367] The design average flow (DAF) is 3.2 MGD and the design maximum flow (DMF) for the facility is 8.0 MGD discharged to Salt Creek. Treatment consists of screening, grit removal primary settling, activated sludge, secondary settling chlorination and dechlorination. Sludge is stabilized with anaerobic digestion. Addison South is authorized to treat and discharge excess flow as follows through a combined sewer outfall (CSO) subject to secondary treatment standards. Average discharge volume was 2.2 MGD in 2013 and 1.6 MGD in 2016 which ranked sixth and seventh among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ declined from 33.0 to 18.4 lbs/day, TSS declined from 89.3 to 70.7 lbs/day, with ammonia-N declining 8.4 to 0.9 lbs/day.

SALT CREEK SANITARY DISTRICT STP [IL0030953] The design average flow is 3.3 MGD and design maximum flow for the facility is 8.0 MGD discharged to Salt Creek. Treatment consists of screening, pre-aeration, primary clarification, aeration, final clarification, filtration, chlorination, dechlorination, anaerobic digestion and sludge dewatering/application. Average discharge volume was 2.2 MGD in 2013 and 2.6 MGD in 2016 which ranked sixth and sixth among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ increased slightly from 40.7 to 43.8 lbs/day, TSS declined from 33.6 to 18.1 lbs/day, with ammonia-N essentially the same at 2.3 and 2.5 lbs/day.

WOOD DALE NORTH STP [IL0020061] The design average flow (DAF) is 1.97 MGD and the design maximum flow (DMF) for the facility is 3.93 MGD discharged to Salt Creek. Average discharge volume was 1.3 MGD in 2013 and 2016 which ranked eighth and eighth among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ decreased from 27.2 to 25.6 lbs/day, TSS declined from 29.1 to 14.2 lbs/day, with ammonia-N reported at 0.6 lbs/day in 2016 only.

WOOD DALE SOUTH WWTP [IL0034274] The design average flow (DAF) is 1.13 million gallons per day (MGD) and the design maximum flow (DMF) for the facility is 2.33 MGD discharged to Salt Creek. Average discharge volume was 0.3 MGD in 2013 and 2016 which ranked 11th and 11th among the 11 major POTWs between 2013 and 2016. Loadings of $cBOD_5$ decreased from 5.9 to 3.8 lbs/day, TSS declined from 10.0 to 3.6 lbs/day, with ammonia-N reported at 0.1 lbs/day in 2016 only.

Water Chemistry

The Salt Creek watershed is located in a highly urbanized landscape with a high human population density along with a number of significant point sources in terms of effluent volume and pollutant loadings. Pollutants associated with urbanized landscapes, especially heavy metals, polycyclic aromatic hydrocarbons, and road de-icing compounds enter streams via urban stormwater flows. Because heavy metals and hydrocarbons are typically adsorbed to sediment particles those pollutants can accumulate in the bottom sediments. However, de-icing compounds, being both soluble and persistent can contaminate soils and near surface groundwater, thus persisting in elevated concentrations and gradually increasing year after year in the water column. The first part of this section focuses on exceedances of parameters associated with point sources on the Salt Creek mainstem (e.g., BOD, nutrients, metals, and dissolved oxygen.) Latter sections address nutrients, urban pollutant parameters, and sediment contaminants in the mainstem and tributaries. Commonly detected chemical parameters were compared either to the criteria in the Illinois WQS or IEPA non-standard, reference, and biologically derived thresholds for stressors that are commonly associated with urban runoff, wastewater treatment plant discharges, and for nutrient parameters. As such, the chemical/physical data herein serves as an indicator of the degree of exposure and stress in support of using the biological data to assess the attainment of designated aquatic life uses and to assist in assigning associated causes and sources. Parameter groupings included field, demand, ionic strength, nutrients, heavy metals, and organic compounds. Available benchmarks are listed in Table 9.

Salt Creek Mainstem

Treated municipal effluent comprises a significant proportion of the flow in Salt Creek thus it strongly influences water quality, especially nitrogen and phosphorus. The water chemistry longitudinal plots for Salt Creek are plotted by river mile and key WWTP dischargers and dams along the mainstem are referenced on the graph based on the key in Table 8.

Biochemical Oxygen Demand (BOD5)

Biological oxygen demand (BOD) is usually associated with wastewater effluents and in Salt Creek BOD_5 increased as cumulative effluent volume increased, but declined in the lower reaches indicating that assimilation occurred. BOD_5 was higher in 2007 when, at most sites, it was above the 3.0 mg/L benchmark for eutrophication (Figure 19) derived for Southern Minnesota rivers (Heiskary et al. 2013). Other than the site below the Egan WRP in 2010 and some slight exceedances downstream of WWTPs in 2016, most sites were below the 3.0 mg/L benchmark, evidence of improved treatment at the WWTPs. BOD_5 values were generally higher in 2016 than in 2013, but remained mostly <3.0 mg/L.

***Table 8**. Key for Salt Creek dams and WWTPs used in chemical and biological graphs.*

Dam or Discharger Name	River Mile	Graph Reference
Dams		
Busse Woods Dam	29.3	A
Oak Meadows Dam (removed 2016)	22.8	B
Graham Center Dam	16.5	C
Old Oak Brook Dam	12.5	D
Fullersburg Woods Dam	10.5	E
Possum Hollow Woods Dam	6.0	F
WWTPs		
MWRDGC Egan WRP	31.8	1
Itasca STP	28.3	2
Wood Dale North STP	27.7	3
Wood Dale South STP	26.4	4
Addison North STP	26.3	5
Addison S.- Larocca STP	23.6	6
Salt Creek Sanitary D.	20.1	7
Elmhurst WWTP	19.9	8

Total Phosphorus

Total phosphorus (TP) in Salt Creek mainstem is strongly associated with WWTP effluent (Figure 20). Total phosphorus in the headwaters was at or slightly above the U.S. EPA ecoregional background levels upstream from the WWTPs and >1.0 mg/L downstream in all years except for 2007, a level that is above the Illinois non-standard benchmark of 0.61 mg/L (Table 9) and the 1.0 mg/L suggested effluent limit for TP. The level of TP remains elevated along the entire length of Salt Creek with a slight decline at the mouth. High TP concentrations can contribute to nuisance algal growths that result in excessively wide diurnal swings with very high daytime and low nighttime D.O. concentrations.

Total Nitrate and Total Ammonia

Total nitrate showed a pattern similar to TP with relatively low levels upstream of the WWTPs increasing markedly downstream from the first WWTP and remaining elevated above 3 mg/L to the mouth with a noticeably sharp spike to 15 mg/L at RM 17 (Figure 21). The high nitrate levels are mostly the result of the removal of ammonia in the WWTP effluents. The removal of ammonia is accomplished through biological nitrification which is the process of converting ammonia in wastewater to nitrate. Note that in 2007 nitrate levels were much lower than in subsequent years when total ammonia concentrations (and BOD_5) were higher and frequently above the IPS threshold compared to subsequent years when such exceedances were less frequent (Figure 22). Even though nitrate is produced to reduce ammonia, elevated nitrate can also potentially contribute to eutrophication and excessive algal growth, particularly where TP is high as in Salt Creek. There were only two exceedances of the Illinois WQS for ammonia in 2013-2016. One was at SC45 in Salt Creek (RM 1.5) in 2013 (ammonia = 0.101, temperature 24.3, pH 11.3) where the very high pH resulted in a lower the total ammonia criteria value, and the other from a high ammonia value at SC53 in Salt Creek (RM 11.0) in 2016 (ammonia-N = 2.37 mg/L, temperature 24.3°C, pH 7.8 S.U.). One concern with organic enrichment is that diel swings in pH from algal activity will elevate pH such that ammonia could become intermittently more toxic. The WQS exceedance at SC45 was the only instance in which a grab sample had an anomalously high pH compared to the pH values recorded with the Datasondes.

***Table 9**. Chemical thresholds consisting of Illinois water quality criteria, biological effects thresholds, and non-effect reference benchmarks used to support the assignment of causes to observed biological impairments in the Salt Creek watershed. Only chemical parameters that were detected in water samples are included.*

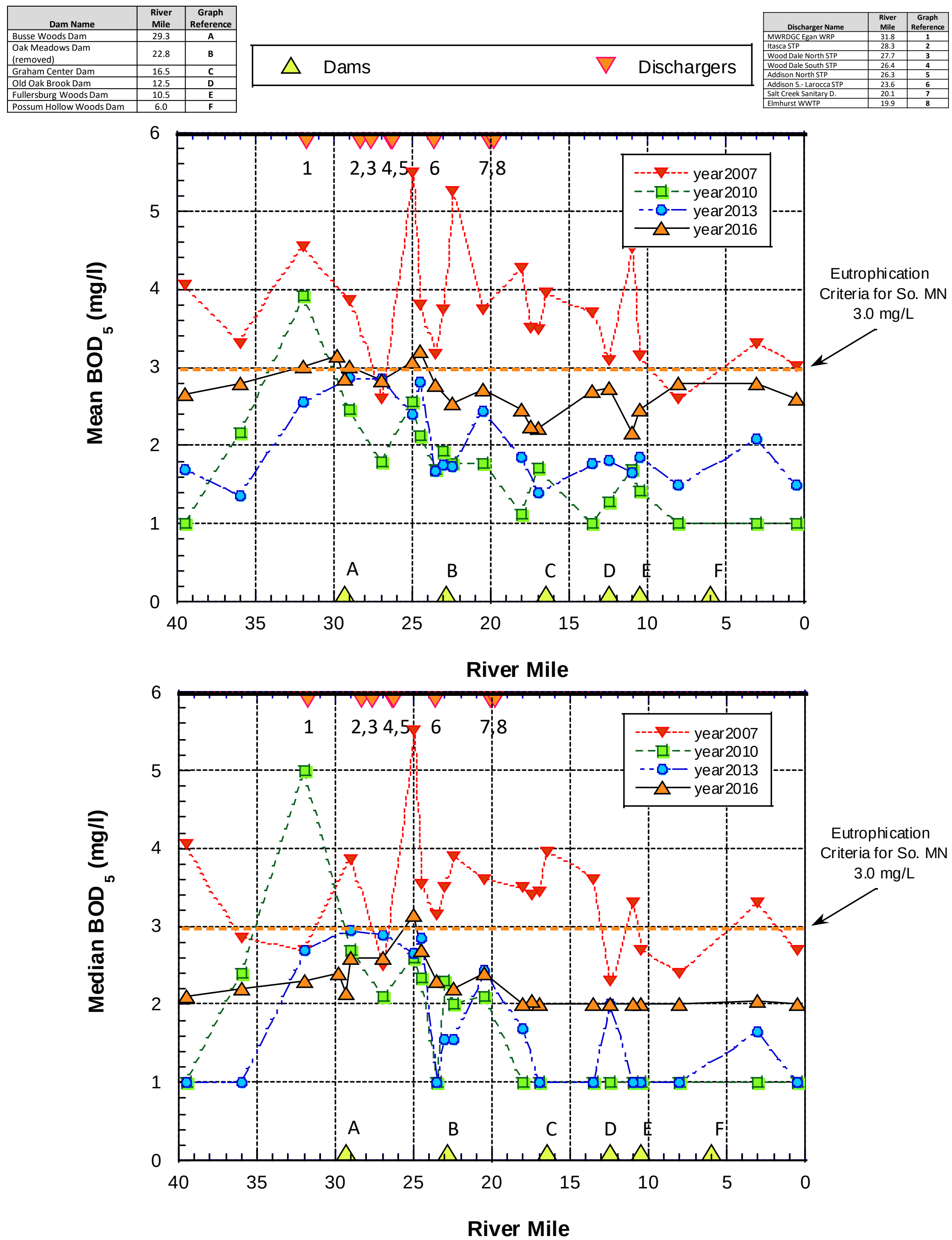
Parameter[1]	Water Quality Criteria[2]		Effect Thresholds[3]				Non-effect Benchmarks[4]	
	IL Chronic	**IL Acute**	**Ohio EPA[5]**	**SW Ohio[6]**	**NOAA SQRT[7]**	**Other**	**Regional Reference[8]**	**IL Non-Standard[9]**
Demand Group								
BOD_5	NA[10]	NA	--	2.48 mg/L [HW Streams] 2.96 mg/L [WD Streams] 2.60 mg/L [BT Rivers]	--	3.00 mg/L (So. MN Rivers)--	2.00 mg/L [HW Streams]	--
Dissolved Oxygen (D.O.)	5.5./6.0 mg/L [7-day rolling avg.]	3.5/5.0 mg/L [minimum]	7.2 mg/L [HW Streams]	5.32 mg/L [All Streams]	--	--	6.6 mg/L [HW Streams]	--
Suspended Solids (TSS)	NA	NA	16.0 mg/L [HW Streams]	65.7 mg/L [HW Streams] 70.8 mg/L [WD Streams] 74.3 mg/L [BT Rivers]	--	--	28.0 mg/L [HW Streams]	--
Nutrients Group								
Ammonia-N (NH_3-N)	1.24 mg/L [pH 8.0/25°C]	8.40 mg/L [pH 8.0/25°C]	0.05 mg/L [HW Streams]	0.31 mg/L [HW Streams]	--	0.15 mg/L [DRSCW IPS[12]]	0.025 mg/L [HW Streams]	--
Total Kjeldahl Nitrogen (TKN)	NA	NA	0.50 mg/L [HW Streams]	0.51 mg/L [HW Streams] 0.58 mg/L [WD Streams] 1.05 mg/L [BT Rivers]	--	1.00 mg/L [DRSCW IPS[12]]	0.70 mg/L	--

Parameter[1]	Water Quality Criteria[2]			Effect Thresholds[3]			Non-effect Benchmarks[4]	
	IL Chronic	IL Acute	Ohio EPA[5]	SW Ohio[6]	NOAA SQRT[7]	Other	Regional Reference[8]	IL Non-Standard[9]
Phosphorus	NA	NA	0.216 mg/L [HW Streams]	0.080 mg/L [HW Streams] 0.010 mg/L [WD Streams] 0.17 mg/L [BT Rivers]	--		0.072 mg/L	0.610 mg/L
Nitrate-N (NO_3-N)	NA	NA	0.90 mg/L [HW Streams]	0.96 mg/L [HW Streams] 1.38 mg/L [WD Streams] 1.68 mg/L [BT Rivers]	--		1.87 mg/L [HW Streams] 1.80 mg/L [EPA Ecoregion 54]	7.80 mg/L
Ionic Strength Group								
Chlorides	NA	500 mg/L;	46.0 mg/L [HW Streams]	52.6 mg/L [HW Streams] 59.1 mg/L [WD Streams] 68.4 mg/L [BT Rivers]	--	112 (fish); 141 (macro.) mg/L [DRSCW IPS[12]]	35.0 mg/L [HW Streams] 31 mg/L (WD Streams) 55 mg/L [BT Rivers]	--
Conductance, Specific	NA	NA	966 µS/cm [HW Streams] 861 µS/cm [WD Streams] 770 µS/cm [BT Rivers]	703 µS/cm [HW Streams] 660 µS/cm [WD Streams] 730 µS/cm [BT Rivers]	--	300 µS/cm [EPA draft[13]]	751 µS/cm [HW Streams]	--
Dissolved Solids (TDS)	NA	1500 mg/L [Dec. 1-Apr. 30; expires 2018]	--	364 mg/L [HW Streams] 384 mg/L [WD Streams] 395 mg/L [BT Rivers]	--	--	296 mg/L [SW Ohio HW]	--

Parameter[1]	Water Quality Criteria[2]			Effect Thresholds[3]			Non-effect Benchmarks[4]	
	IL Chronic	IL Acute	Ohio EPA[5]	SW Ohio[6]	NOAA SQRT[7]	Other	Regional Reference[8]	IL Non-Standard[9]
Sulfate	1809 mg/L	--	334 mg/L [HW Streams]	119 mg/L [HW Streams]	--	--	118.8 mg/L [HW Streams] 120 mg/L [WD Streams] 115 mg/L [BT Rivers]	--
Metals Group[14]								
Arsenic (As)	0.190 mg/L	0.360 mg/L	0.002 mg/L [HW Streams]	--	0.190 mg/L [Chronic]	See SQRT	0.001 mg/L [HW Streams]	--
Copper (Cu)	0.022 mg/L	0.036 mg/L	0.010 mg/L [HW Streams]	5.9 µg/L [HW Streams] 8.9 µg/L [WD Streams] 10.4 µg/L [BT Rivers]	0.009 mg/L[C] 0.130 mg/L[A]	See SQRT	5.0 µg/L [HW Streams] 5.0 µg/L [WD Streams] 5.0 µg/L [BT Rivers]	--
Lead (Pb)	0.051 mg/L	0.245 mg/L	0.002 mg/L [HW Streams]	2.7 µg/L [HW Streams] 17.4 µg/L [WD Streams] 26.8 µg/L [BT Rivers]	0.0025 mg/L[C] 0.065 mg/L[A]	See SQRT	2.5 µg/L [HW Streams] 2.5 µg/L [WD Streams] 3.0 µg/L [BT Rivers]	--
Manganese (Mn)	3.52 mg/L	8.15 mg/L	0.942 mg/L [HW Streams]	98 µg/L [HW Streams] 347 µg/L [WD Streams] 472 µg/L [BT Rivers]	0.080 mg/L[C] 2.300 mg/L[A]	See SQRT	0.185 mg/L [HW Streams]	--

Parameter[1]	Water Quality Criteria[2]			Effect Thresholds[3]			Non-effect Benchmarks[4]	
	IL Chronic	IL Acute	Ohio EPA[5]	SW Ohio[6]	NOAA SQRT[7]	Other	Regional Reference[8]	IL Non-Standard[9]
Zinc (Zn)	0.073 mg/L	0.273 mg/L	0.010 mg/L [HW Streams]	16.4 µg/L [HW Streams] 39.3 µg/L [WD Streams] 60.8 µg/L [BT Rivers]	0.120 mg/L [Chronic]	See SQRT	15 µg/L [HW Streams] 15 µg/L [WD Streams] 20 µg/L [BT Rivers]	--

All parameter values as total unless specific otherwise. [2] Illinois water quality criteria (Illinois Administrative Code Part 302) - http://www.epa.illinois.gov/topics/water-quality/standards/derived-criteria/index. [3] Field-based thresholds using fish and macroinvertebrate assemblage endpoints. [4] Minnesota Southern rivers eutrophication criteria value (Heiskary et al. 2013). [5] Values represent analyses of large scale ambient chemical databases with statistical approaches. [6] Biocriteria derived threshold values (2 Interquartile Ranges [2IQR] above median) in *Appendices to Association Between Nutrients and the Aquatic Biota of Ohio River and Streams* (Ohio EPA 1999). [7] Biological assemblage effect thresholds derived for SW Ohio in *Integrated Prioritization System (IPS) Documentation and Atlas of Biological Stressor Relationships for Southwest Ohio* (MBI 2015). [8] NOAA Screening Quick Reference Tables (SQRT; NOAA 2008) – hardness dependent parameters at 100 mg/L hardness; with EPA EcoUpdate Ecotox Thresholds EPA/F-95-038. [9] Ohio regional reference values (2 Interquartile Ranges [2IQR] above median) in *Appendices to Association Between Nutrients and the Aquatic Biota of Ohio River and Streams* (Ohio EPA 1999) unless otherwise specified. [10] Values are 1 and 2 standard deviations (SD) above the mean of all values measured statewide. [11] NA – not applicable, not included in IL WQS. [12] DRSCW IPS – DuPage River Salt Creek Workgroup integrated Prioritization System derived threshold. [13] U.S. EPA field-based threshold for Central Appalachian streams in A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams (U.S. EPA 2011). [14] Hardness dependent metals shown at 300 mg/L total hardness – see IAC Part 302 for formulae.



Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

***Figure 19**. Concentration of mean (top) and median (bottom) 5-day biological oxygen demand (BOD5) in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. One benchmark line is illustrated: the dashed orange line is the So. Minnesota eutrophication threshold (3.0 mg/L).*

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

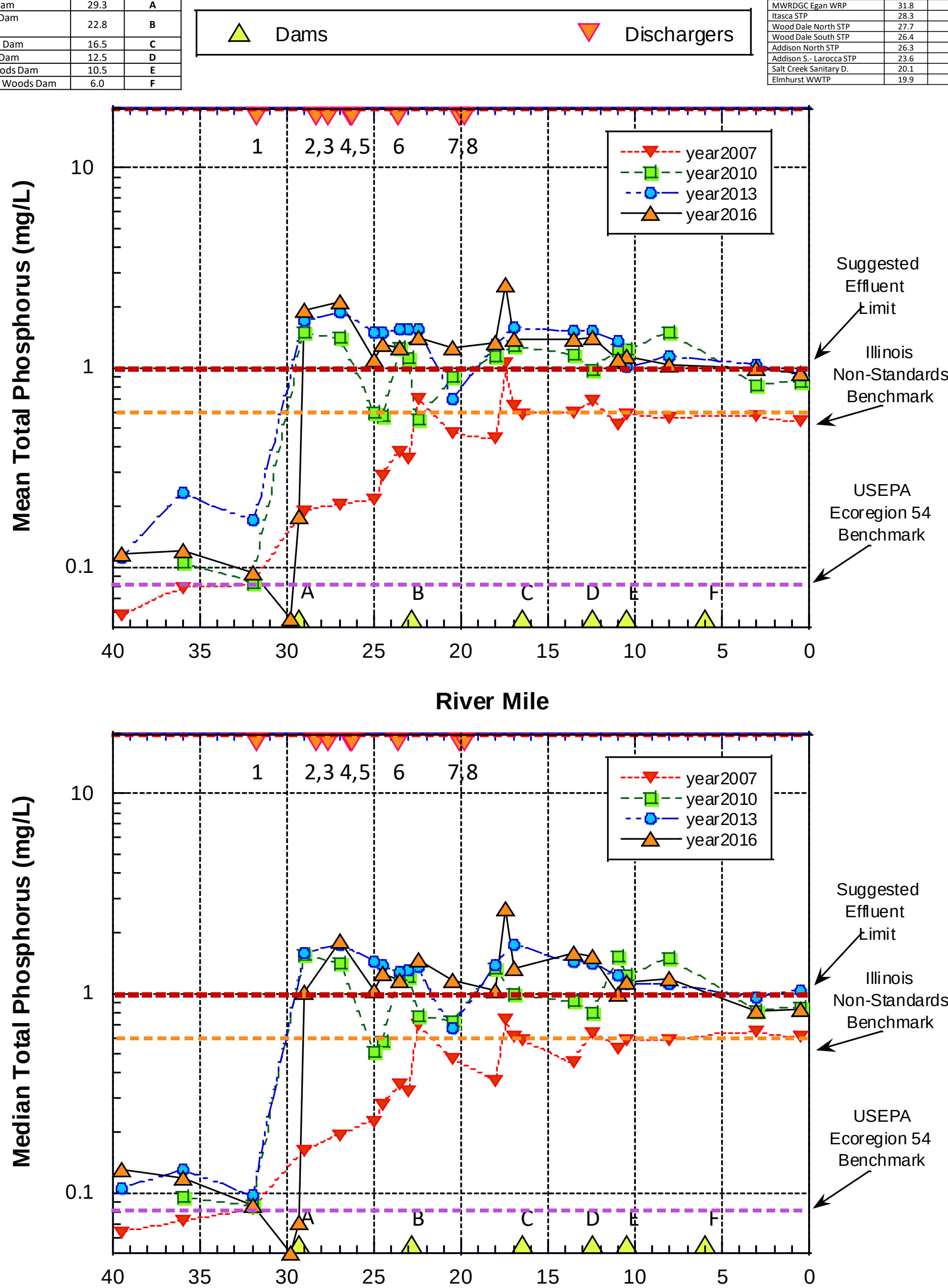


***Figure 20**. Concentration of mean (top) and median (bottom) total phosphorus (TP) in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. Three benchmark lines are illustrated: the top thick dashed line is a commonly suggested effluent limit for dischargers (1.0 mg/L), the second, thinner orange dashed line is the Illinois "non-standards" benchmark (0.61 mg/L) and the lower dashed purple line is the USEPA Ecoregion 54 reference benchmark (0.07 mg/L).*

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

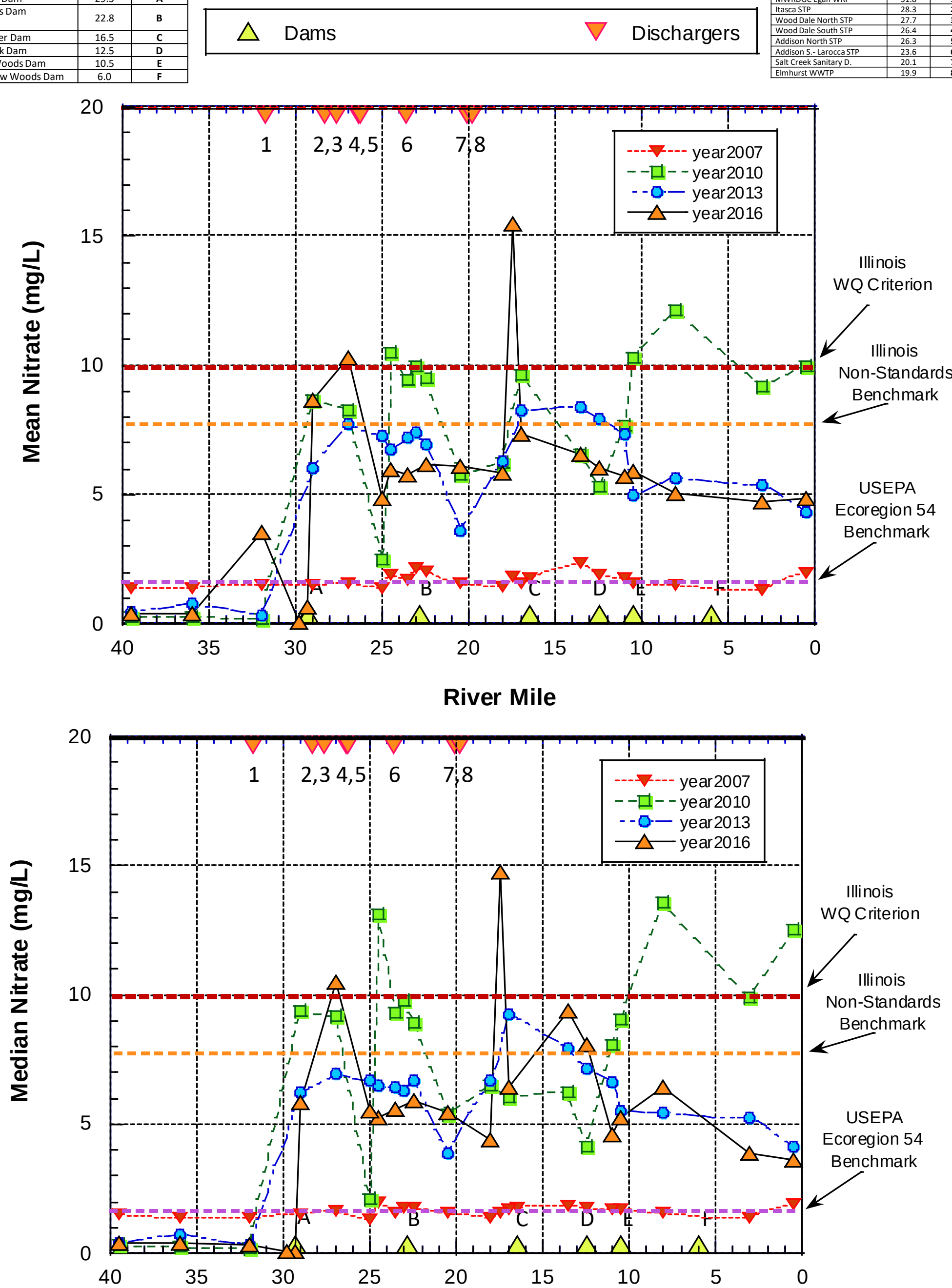
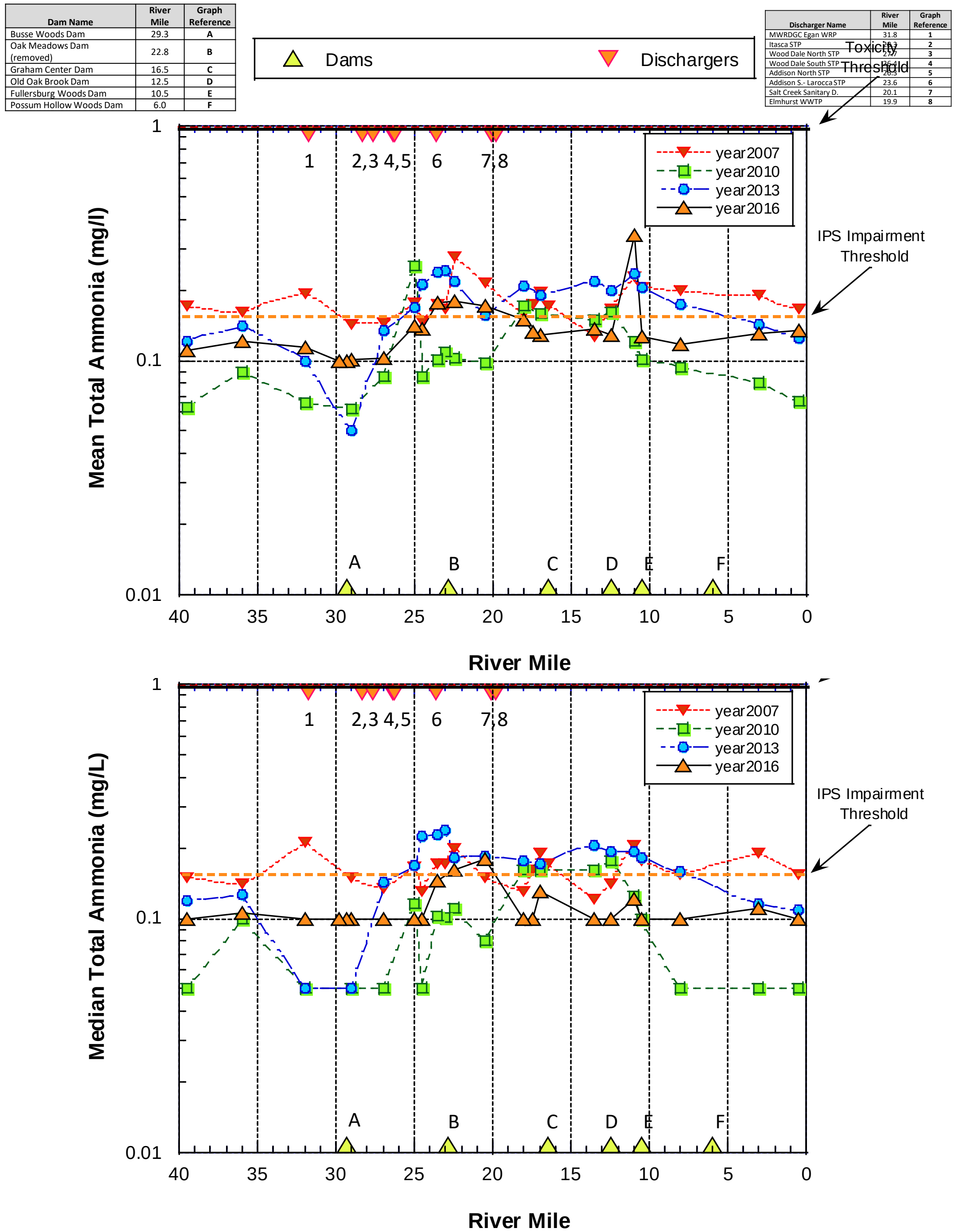


***Figure 1**. Concentration of mean (top) and median (bottom) total nitrate in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of low-head dams are arrayed along the x-axes. Three benchmark lines are illustrated: the top thick dashed line is the Illinois water quality criterion, the second, thinner orange dashed line is the Illinois "non-standards" benchmark (7.8 mg/L) and the lower dashed purple line is the USEPA Ecoregion 54 reference benchmark (1.78 mg/L).*



Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	A
Oak Meadows Dam (removed)	22.8	B
Graham Center Dam	16.5	C
Old Oak Brook Dam	12.5	D
Fullersburg Woods Dam	10.5	E
Possum Hollow Woods Dam	6.0	F

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	1
Itasca STP	28.3	2
Wood Dale North STP	27.7	3
Wood Dale South STP	26.4	4
Addison North STP	26.3	5
Addison S.- Larocca STP	23.6	6
Salt Creek Sanitary D.	20.1	7
Elmhurst WWTP	19.9	8

***Figure 2**. Concentration of mean (top) and median (bottom) total ammonia in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of low-head dams are arrayed along the x-axes. The IPS total ammonia threshold is the top thick dashed line (0.15 mg/L).*

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

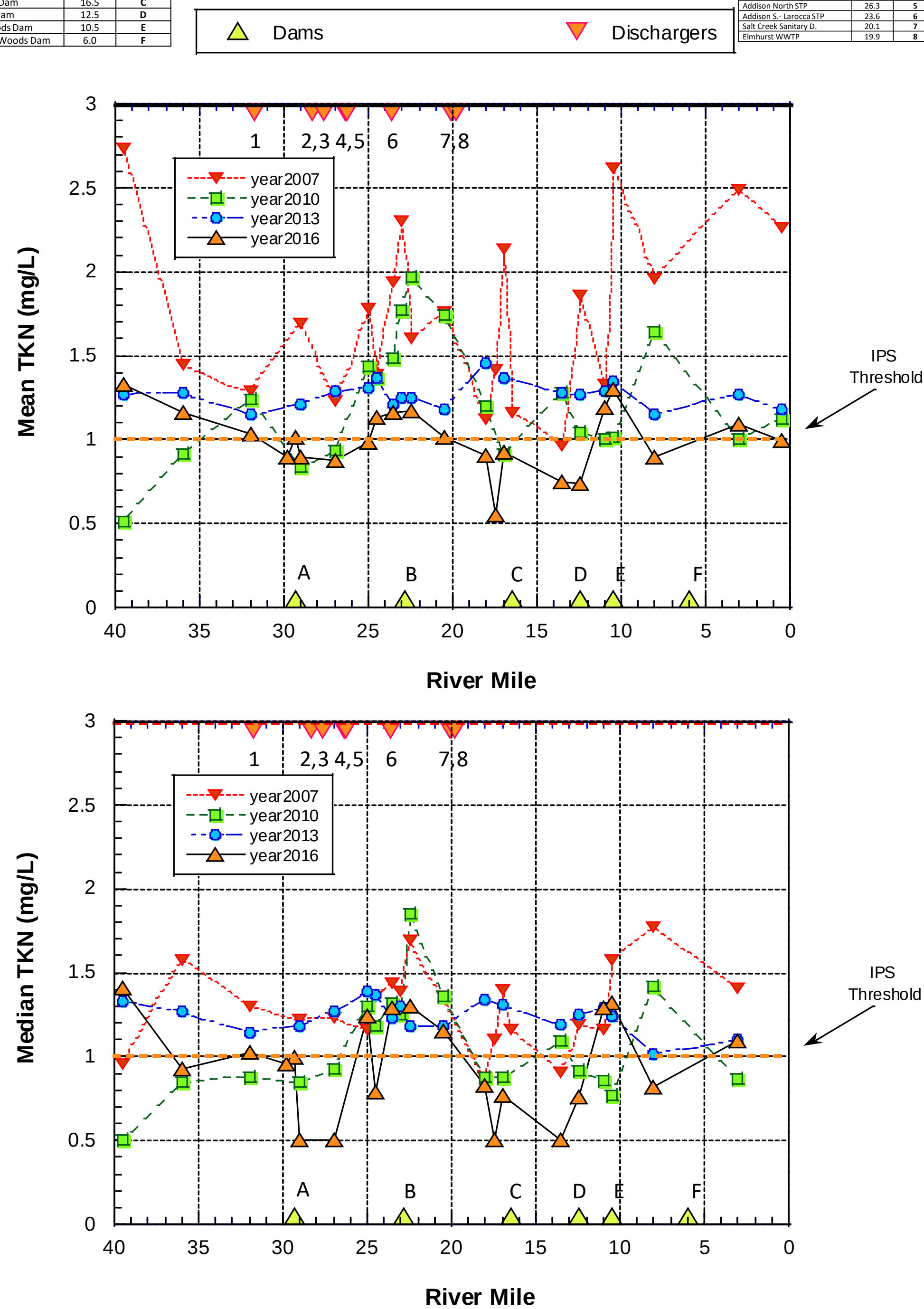


Figure 3. *Concentration of mean (top) and median (bottom) total Kjeldahl nitrogen (TKN) in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. One benchmark line is illustrated: the dashed orange line is the DuPage River IPS threshold (1.0 mg/L).*

Total Kjeldahl Nitrogen (TKN)

TKN is the total concentration of organic nitrogen plus ammonia and is an increasingly useful indicator of organic enrichment in streams. TKN was elevated in the Salt Creek mainstem, including upstream of the WWTPs (Figure 23). TKN values were generally the highest in 2007, when ammonia values were higher, elevated in 2013, and the lowest in 2016 with fewer values exceeding the IPS benchmark of 1.0 mg/L.

Dissolved Oxygen (D.O.) Exceedances

D.O. concentrations were measured in Salt Creek with Datasonde continuous recorders at multiple fixed locations during 2013 through 2016 (Table 10, Figures 24-27). Low D.O. concentrations were recorded during extended periods in both 2013 and 2016 at all locations for the four criteria thresholds that comprise the Illinois D.O. standard (i.e., minimum never-to-exceed, 30-day rolling average, 7-day rolling average, and 7-day rolling minimum average). The data were combined by sites across years in box-and-whisker plots to illustrate the longitudinal pattern in D.O. in the Salt Creek mainstem (Figure 24). Individual sites were plotted by date in 2013 and 2016 to illustrate exceedances of the minimum never-to-exceed, 30-day rolling average, 7-day rolling average, and 7-day rolling minimum average criteria (Figures 25-27).

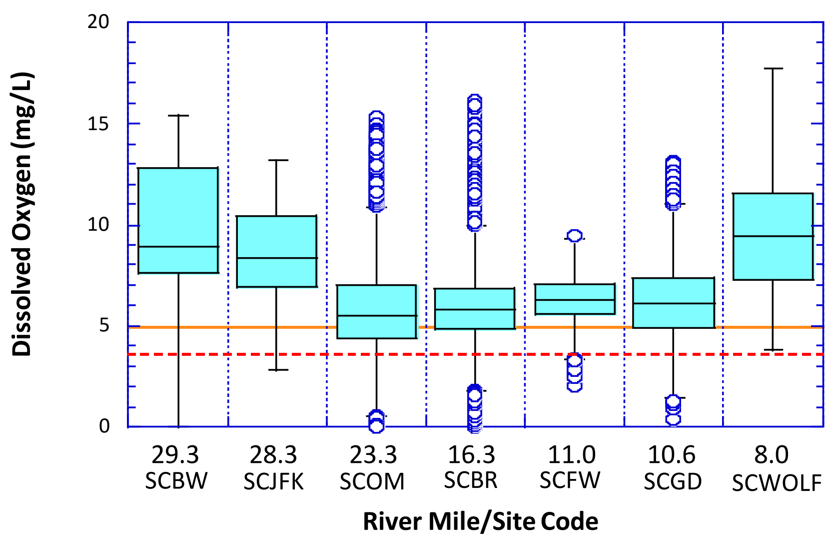


***Figure 24**. Box-and-whisker plot of all Datasonde data at sites in Salt Creek sampled from 2013-2016. Minimum Illinois D.O. standard exceedance thresholds are shown as solid (5.0 mg/L) and dashed lines (3.5 mg/L).*

Figure 24 illustrates that low D.O. occurs in a significant portion of Salt Creek. Wide diel swings also showed the effects of increased algal activity spurred by elevated nutrients. The wide diel swings also result in elevated daytime pH which can increase the toxicity of ammonia-N especially when it exceeds 8.0 S.U. The downstream most site at RM 8.0 had the fewest low D.O. values and is where the better performing macroinvertebrate assemblages were observed in the Salt Creek mainstem.

***Table 10**. Dissolved oxygen (D.O.) concentrations (mg/L) in violation of Illinois water quality standards from sites in the Salt Creek mainstem during 2013-2016.*

Site ID	River Mile	Year	Dates	Pollutant	Criterion Threshold	Standard
SCBW	29.3	2013	7/17 - 7/20	D.O.	<6.0	7-day Average
SCBW	29.3	2013	8/12 - 9/3	D.O.	<4.0 mg/l	7-day Minimum
SCBW	29.3	2013	9/ 8 - 9/17	D.O.	<4.0 mg/l	7-day Minimum
SCBW	29.3	2013	8/17	D.O.	<3.5 mg/l	Not to exceed
SCBW	29.3	2013	9/9	D.O.	<3.5 mg/l	Not to exceed
SCJFK	28.3	2013	1/1 - 1/5	D.O.	<6.0	7-day Average
SCJFK	28.3	2013	6/19 - 7/4	D.O.	<6.0	7-day Average
SCJFK	28.3	2013	7/14 - 7/23	D.O.	<6.0	7-day Average
SCJFK	28.3	2013	7/26 - 7/31	D.O.	<6.0	7-day Average
SCJFK	28.3	2013	8/9 - 9/1	D.O.	<4.0 mg/l	7-day Minimum
SCJFK	28.3	2013	9/11 - 9/11	D.O.	<4.0 mg/l	7-day Minimum
SCJFK	28.3	2013	6/3	D.O.	<5.0 mg/l	Not to exceed
SCJFK	28.3	2013	7/3	D.O.	<5.0 mg/l	Not to exceed
SCJFK	28.3	2013	8/4	D.O.	<3.5 mg/l	Not to exceed
SCJFK	28.3	2013	10/1	D.O.	<3.5 mg/l	Not to exceed
SCOM	23.3	2013	6/17 - 6/21	D.O.	<6.0	7-day Average
SCOM	23.3	2013	6/22 - 7/31	D.O.	<6.0	7-day Average
SCOM	23.3	2013	8/1 - 9/27	D.O.	<4.0 mg/l	7-day Minimum
SCOM	23.3	2013	6/13	D.O.	<5.0 mg/l	Not to exceed
SCOM	23.3	2013	7/27	D.O.	<5.0 mg/l	Not to exceed
SCOM	23.3	2013	8/18	D.O.	<3.5 mg/l	Not to exceed
SCOM	23.3	2013	9/10	D.O.	<3.5 mg/l	Not to exceed
SCOM	23.3	2014	5/30 - 7/7	D.O.	<6.0	7-day Average
SCOM	23.3	2014	8/19 - 9/23	D.O.	<4.0 mg/l	7-day Minimum
SCOM	23.3	2014	6/26	D.O.	<5.0 mg/l	Not to exceed
SCOM	23.3	2014	7/7	D.O.	<5.0 mg/l	Not to exceed
SCOM	23.3	2014	8/8	D.O.	<3.5 mg/l	Not to exceed
SCOM	23.3	2014	9/3	D.O.	<3.5 mg/l	Not to exceed
SCOM	23.3	2015	4/22 - 4/22	D.O.	<6.0	7-day Average
SCOM	23.3	2015	5/7 - 5/12	D.O.	<6.0	7-day Average
SCOM	23.3	2015	5/28 - 6/3	D.O.	<6.0	7-day Average
SCOM	23.3	2015	6/9 - 7/17	D.O.	<6.0	7-day Average
SCOM	23.3	2015	6/18	D.O.	<5.0 mg/l	Not to exceed
SCOM	23.3	2015	7/12	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2013	6/17 - 6/21	D.O.	<6.0	7-day Average
SCBR	16.3	2013	6/22 - 7/29	D.O.	<6.0	7-day Average
SCBR	16.3	2013	8/25 - 8/27	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2013	8/31 - 9/6	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2013	6/10	D.O.	<5.0 mg/l	Not to exceed

***Table 10**. Dissolved oxygen (D.O.) concentrations (mg/L) in violation of Illinois water quality standards from sites in the Salt Creek mainstem during 2013-2016.*

Site ID	River Mile	Year	Dates	Pollutant	Criterion Threshold	Standard
SCBR	16.3	2013	7/18	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2014	6/1 - 7/19	D.O.	<6.0	7-day Average
SCBR	16.3	2014	8/23 - 9/2	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2014	9/12 - 10/10	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2014	6/20	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2014	7/5	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2014	8/5	D.O.	<3.5 mg/l	Not to exceed
SCBR	16.3	2014	9/20	D.O.	<3.5 mg/l	Not to exceed
SCBR	16.3	2014	10/10	D.O.	<3.5 mg/l	Not to exceed
SCBR	16.3	2015	4/27 - 4/29	D.O.	<6.0	7-day Average
SCBR	16.3	2015	5/9 - 5/22	D.O.	<6.0	7-day Average
SCBR	16.3	2015	5/27 - 6/3	D.O.	<6.0	7-day Average
SCBR	16.3	2015	6/10 - 7/31	D.O.	<6.0	7-day Average
SCBR	16.3	2015	8/1 - 8/21	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2015	9/7 - 9/10	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2015	6/10	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2015	7/20	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2015	8/4	D.O.	<3.5 mg/l	Not to exceed
SCBR	16.3	2016	6/7 - 7/2	D.O.	<6.0	7-day Average
SCBR	16.3	2016	7/7 - 7/31	D.O.	<6.0	7-day Average
SCBR	16.3	2016	8/1 - 8/29	D.O.	<4.0 mg/l	7-day Minimum
SCBR	16.3	2016	6/21	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2016	7/31	D.O.	<5.0 mg/l	Not to exceed
SCBR	16.3	2016	8/4	D.O.	<3.5 mg/l	Not to exceed
SCFW	11.0	2013	6/22 - 7/29	D.O.	<6.0	7-day Average
SCFW	11.0	2013	6/10	D.O.	<5.0 mg/l	Not to exceed
SCFW	11.0	2013	7/16	D.O.	<5.0 mg/l	Not to exceed
SCGD	10.6	2014	5/29 - 6/2	D.O.	<6.0	7-day Average
SCGD	10.6	2014	6/14 - 7/9	D.O.	<6.0	7-day Average
SCGD	10.6	2014	8/29 - 9/1	D.O.	<4.0 mg/l	7-day Minimum
SCGD	10.6	2014	6/15	D.O.	<5.0 mg/l	Not to exceed
SCGD	10.6	2014	7/9	D.O.	<5.0 mg/l	Not to exceed
SCGD	10.6	2015	5/27 - 7/3	D.O.	<6.0	7-day Average
SCGD	10.6	2015	7/6 - 7/31	D.O.	<6.0	7-day Average
SCGD	10.6	2015	8/1 - 8/20	D.O.	<4.0 mg/l	7-day Minimum
SCGD	10.6	2015	9/7 - 9/12	D.O.	<4.0 mg/l	7-day Minimum
SCGD	10.6	2015	7/27	D.O.	<5.0 mg/l	Not to exceed
SCGD	10.6	2015	8/10	D.O.	<3.5 mg/l	Not to exceed
SCGD	10.6	2016	6/7 - 7/31	D.O.	<6.0	7-day Average

***Table 10**. Dissolved oxygen (D.O.) concentrations (mg/L) in violation of Illinois water quality standards from sites in the Salt Creek mainstem during 2013-2016.*

Site ID	River Mile	Year	Dates	Pollutant	Criterion Threshold	Standard
SCGD	10.6	2016	8/1 - 8/29	D.O.	<4.0 mg/l	7-day Minimum
SCGD	10.6	2016	6/19	D.O.	<5.0 mg/l	Not to exceed
SCGD	10.6	2016	7/31	D.O.	<5.0 mg/l	Not to exceed
SCGD	10.6	2016	8/15	D.O.	<3.5 mg/l	Not to exceed
SCWOLF	8.0	2013	6/25 - 7/5	D.O.	<6.0	7-day Average
SCWOLF	8.0	2013	7/9 - 7/31	D.O.	<6.0	7-day Average
SCWOLF	8.0	2013	6/3	D.O.	<5.0 mg/l	Not to exceed
SCWOLF	8.0	2013	7/2	D.O.	<5.0 mg/l	Not to exceed

Site Locations:
SCBW – Salt Creek at Busse Woods (RM 29.3)
SCJFK – Salt Creek at JFK Boulevard (RM 28.3)
SCOM – Salt Creek at Oak Meadows (RM 23.3)
SCBR- Salt Creek at Butterfield Road (RM - 16.3)
SCFW – Salt Creek at Fullersburg Woods (RM 11.0)
SCGD – Salt Creek at Graue Mill dam (RM 10.6)
SCWOLF – Salt Creek at Wolf Road (RM 8.0)

Heavy Metals

Heavy metals can be a chronic problem in urban areas and Table 11 summarizes exceedances of water quality criteria from grab samples taken during summer 2013 and 2016. There were no exceedances of Illinois WQS for any heavy metals (water column) in 2013 and only scattered and low magnitude exceedances of the copper WQS in Salt Creek and an unnamed tributary to lower Salt Creek (at RM 2.4) in 2016 (Table 11).

While the water column results do not indicate any acute issues with heavy metals the effects of polluted runoff in urban areas are most frequently exposed by the sediment chemistry. Table 12 presents heavy metals in Salt Creek watershed sediments in 2013 and 2016. The occasional copper exceedance in the water column is accompanied by widespread exceedances of the screening guidelines for copper in the sediment for both the Probable Effect Concentration (PEC), Threshold Effect Concentration (TEC), and the IEPA sediment “elevated” benchmarks at all sites sampled in 2013 and 2016. Several heavy metals (Cd, Pb, Mn, Ni, and Zn) frequently exceeded the TEC benchmark, but there was only a single exceedance of the PEC benchmark for lead (Pb) in Addison Creek (SC48) in 2013. All other values for lead were less than the PEC, but greater than the TEC. Infrequent exceedances of the TEC benchmarks occurred for mercury, arsenic, and silver and there were no exceedances of barium. The frequency of values above the TEC for multiple parameters suggests sediment metals could present a risk to the most sensitive organisms many of which are absent in Salt Creek due to other stressors – exceedances of the PEC would be a concern for all organisms However, the biological response signatures were predominated by organic enrichment and sedimentation/siltation related causes.

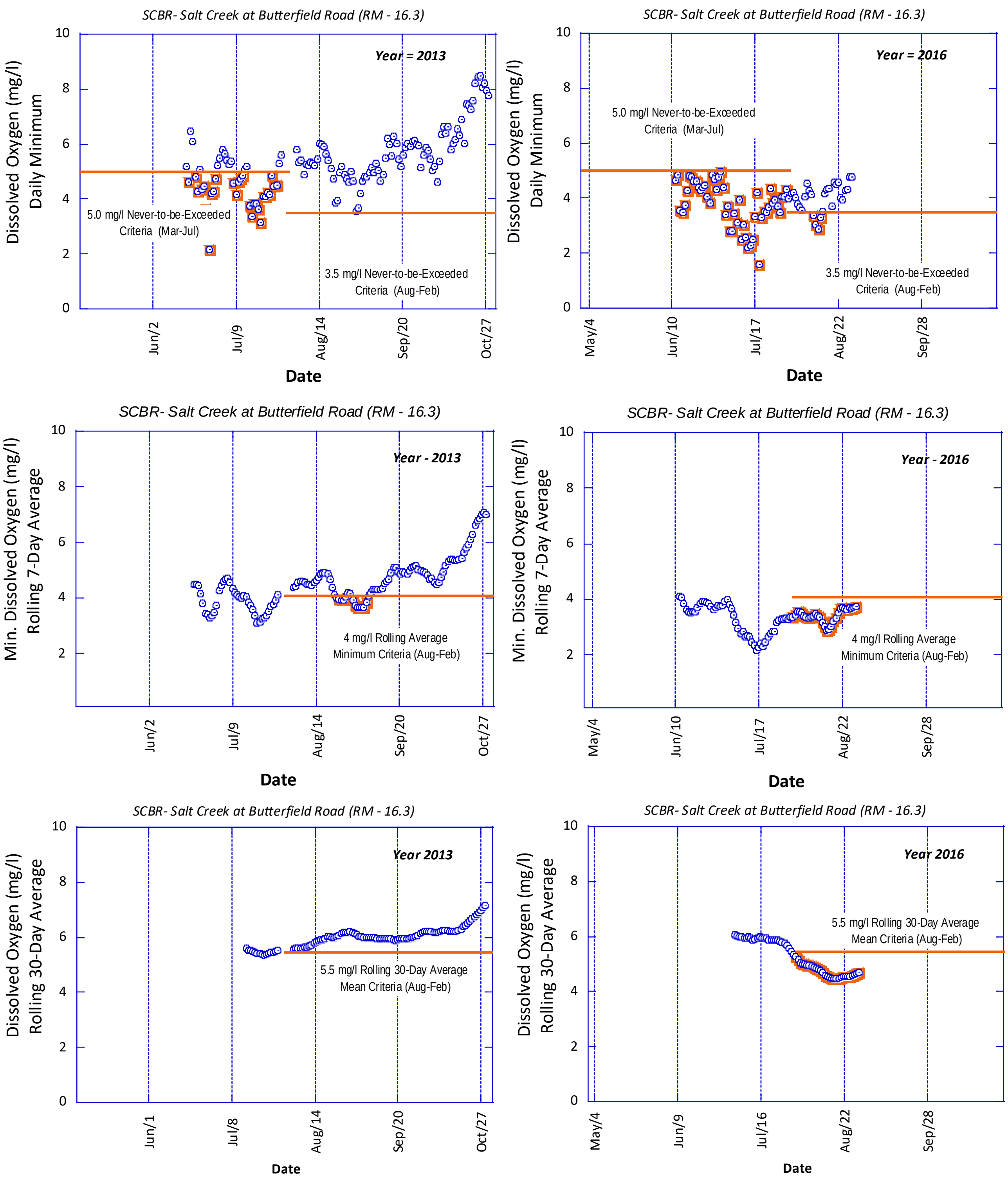


***Figure 25**. Statistical summaries of dissolved oxygen concentrations measured by Datasondes deployed at Butterfield Road in 2013 (left) and 2016 (right). Samples exceeding criteria (orange line) are highlight in orange. Top: Daily minimum concentrations; Middle: Minimum 7-Day rolling average concentrations; Bottom: rolling 30-day average values.*

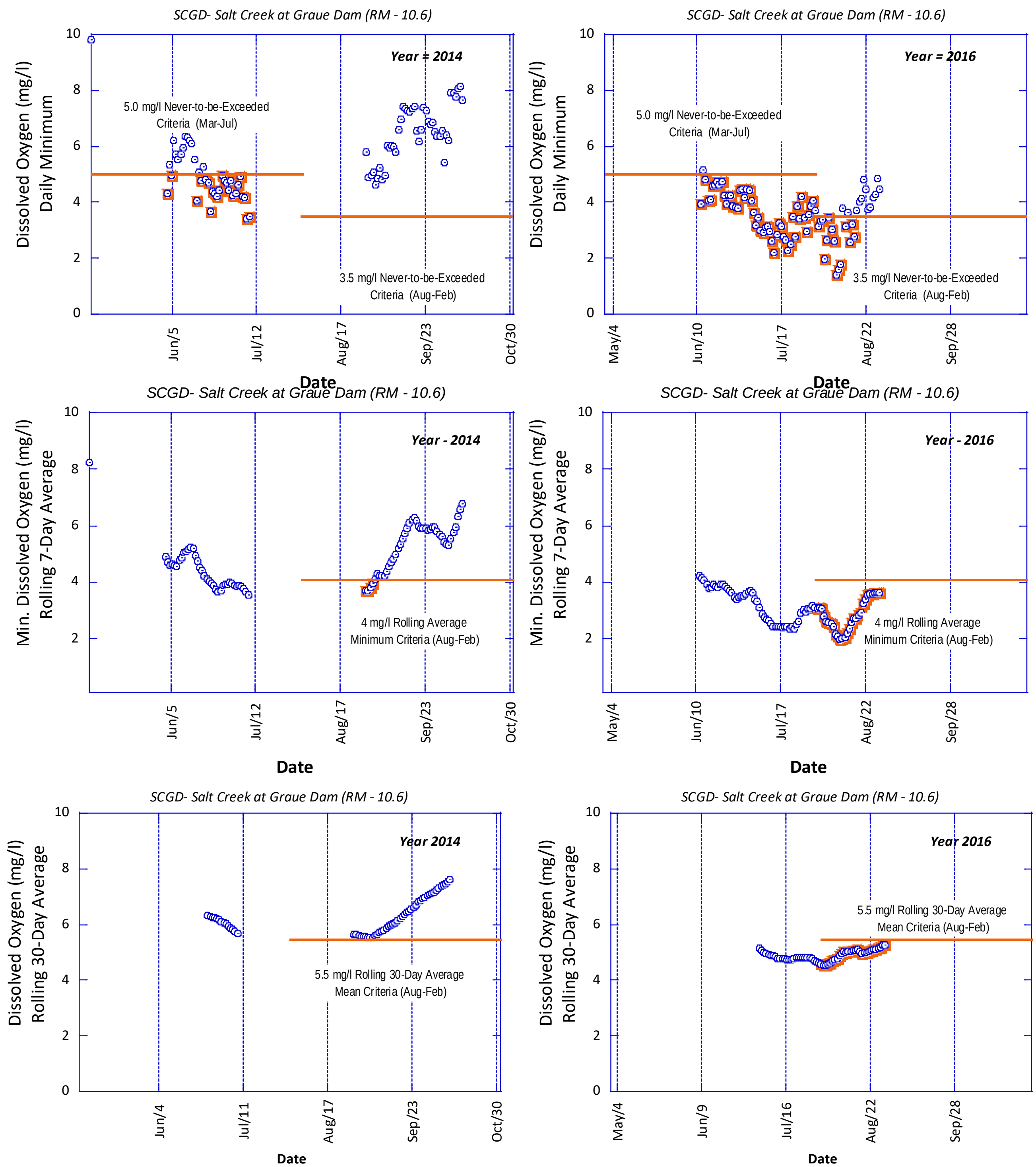


***Figure 26**. Statistical summaries of dissolved oxygen concentrations measured by Datasondes deployed at the Graue Mill Dam (RM 10.6) in 2014 (left) and 2016 (right). Samples exceeding criteria (orange line) are highlight in orange. Top: Daily minimum concentrations; Middle: Minimum 7-Day rolling average concentrations; Bottom: rolling 30-day average values.*

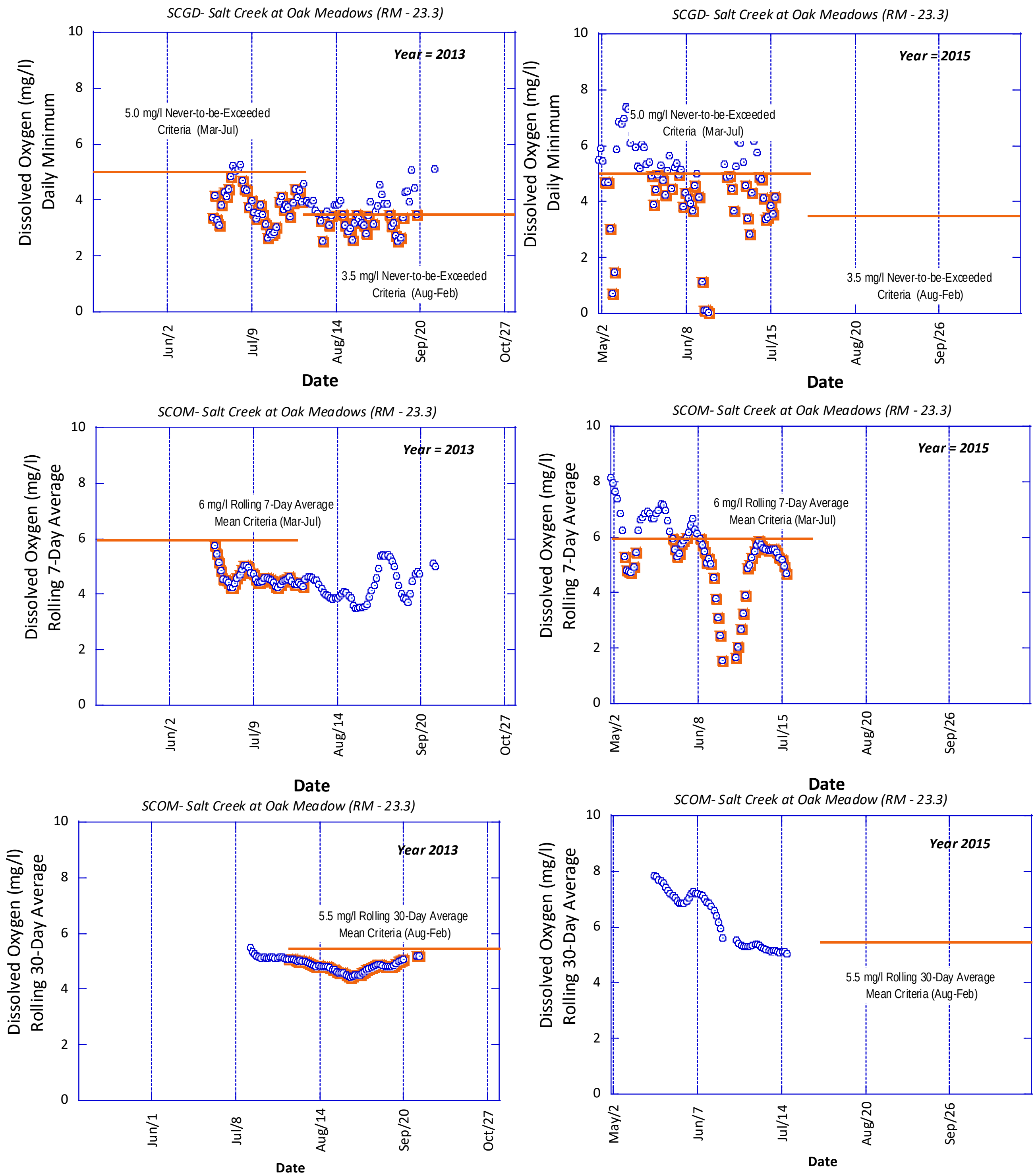


***Figure 27**. Statistical summaries of dissolved oxygen concentrations measured by Datasondes deployed at Oak Meadows (RM 23.3) in 2013 (left) and 2015 (right). Samples exceeding criteria (orange line) are highlight in orange. Top: Daily minimum concentrations; Middle: mean 7-Day rolling average concentrations; Bottom: rolling 30-day average values.*

***Table 11**. Water column metals concentrations on study sites on the Salt Creek study area during 2013 and 2016. Means with individual exceedances of Illinois WQS are shaded orange.*

Site ID	River Mile	Year	Hardness (mg/L)	Cadmium (µg/L)	Copper (µg/L)	Lead (µg/L)	Iron (µg/L)	Zinc (µg/L)
Salt Creek								
SC07	36.0	2013	316.5	0.07	5.5	1.0	862	5.9
		2016	214.7	0.05	5.8	2.5	1189	14.7
SC15	32.0	2013	231.8	0.07	4.2	1.0	765	7.0
		2016	236.3	0.05	7.4	2.5	1027	14.9
SC50	29.8	2016	146.5	0.05	2.5	2.5	269	12.5
SC44	29.3	2016	175	0.05	2.5	2.5	394	13.2
SC43	29.0	2013	217.8	0.08	4.9	0.5	187	18.6
		2016	173	0.05	3.7	2.5	266	15.4
SC43 Dup.			240	0.05	2.5	2.5	250	12.5
SC42	27.0	2013	204	0.06	5.2	0.5	245	15.9
SC42 Dup.			169	0.05	4.0	0.7	374	11.9
SC42		2016	222.5	0.05	6.7	2.5	250	23.2
SC41	25.0	2013	217.5	0.05	4.1	0.5	396	16.5
		2016	205.8	0.50	4.5	2.5	684	17.6
SC41 Dup.			132	0.50	2.5	2.5	560	12.5
SC40	24.5	2013	222	0.05	4.2	0.8	580	18.2
SC40 Dup.			242.5	0.05	4.4	0.7	507	20.5
SC40		2016	241.2	0.05	4.9	2.5	601	18.1
SC34	23.5	2013	220.8	0.05	3.7	0.5	344	16.4
SC34 Dup.			226	0.05	3.1	0.4	363	16.2
SC34		2016	250.7	0.05	6.4	2.5	573	20.2
SC34 Dup.			268	0.05	2.5	2.5	645	17.4
SC35	23.0	2013	218.8	0.05	3.5	0.5	340	14.6
SC35 Dup.			230	0.05	4.3	0.5	341	21.0
SC23	22.5	2013	223.2	0.05	4.6	0.6	391	17.3
		2016	255	0.05	7.3	2.5	855	21.3
SC23 Dup.			265	0.05	5.6	2.5	402	16.5
SC39	20.5	2013	202.5	0.05	3.9	0.9	620	9.4
		2016	212.8	0.05	6.4	2.5	837	17.3
SC38	18	2013	223	0.06	4.5	1.0	446	17.7
		2016	225.6	0.05	6.2	2.5	779	17.3
SC38 Dup.			215	0.05	2.5	2.5	307	17.2
SC37	17.5	2016	265	0.05	8.5	2.5	323	27.1
SC51	17	2013	224.3	0.05	5.4	0.9	442	20.6
		2016	222.3	0.05	7.8	2.5	478	21.7
SC55	13.5	2013	227.8	0.05	5.1	2.3	728	16.0
SC55 Dup.			200	0.05	5.8	1.1	554	18.7
SC55		2016	179.1	0.05	8.2	2.5	810	19.9

***Table 11**. Water column metals concentrations on study sites on the Salt Creek study area during 2013 and 2016. Means with individual exceedances of Illinois WQS are shaded orange.*

Site ID	River Mile	Year	Hardness (mg/L)	Cadmium (µg/L)	Copper (µg/L)	Lead (µg/L)	Iron (µg/L)	Zinc (µg/L)
SC56	12.5	2013	222.8	0.06	5.2	1.4	654	19.7
SC56 Dup.			271	0.05	4.0	1.0	491	13.0
SC56		2016	186.2	0.05	9.9	2.5	1692	28.2
SC53	11.0	2013	221.3	0.05	5.0	1.3	608	15.6
		2016	206.5	0.05	8.2	2.5	820	17.7
SC52	10.5	2013	223	0.05	4.7	1.5	746	15.9
		2016	215.5	0.05	7.9	2.5	649	17.7
SC49	8.0	2013	230.8	0.05	5.7	1.0	383	14. 8
		2016	226.2	0.05	7.1	2.5	1055	20.4
SC49 Dup.			142	0.05	6.6	2.5	1520	18.9
SC54	3.0	2013	227.2	0.07	5.0	1.9	444	19.6
		2016	217.1	0.05	9.1	2.5	1822	23.9
SC54 Dup.			195	0.05	11.1	2.5	1360	27.9
SC29	0.5	2013	238.2	0.06	4.5	1.6	501	14.0
		2016	208.3	0.05	8.9	2.5	1174	22.7
Arlington Heights Branch								
SC45	1.5	2013	258.8	0.05	2.6	0.4	456	4.6
	1.5	2016	254.8	0.05	3.3	2.5	434	12.5
Unnamed Tributary to Salt Creek @RM 2.4								
SC14	2.5	2013	159	0.05	3.4	1.1	1048	7.4
SC14 Dup.			122	0.05	3.3	1.4	1300	8.2
SC14		2016	162.7	0.5	7.7	2.5	1103	13.1
Ginger Creek								
SC31	0.5	2016	202	0.5	2.5	2.5	526	12.5
SC31 Dup.			197	0.5	2.5	2.5	401	12.5
Addison Creek								
SC24	10.5	2013	319	0.05	5.8	0.7	56	19.6
SC27	5.0		263	0.07	5.4	2.5	717	20.8
SC27 DUP		2013	264	0.05	6.	2.3	805	27.8
SC27		2016	222.5	0.5	7.4	2.5	765	26.5
SC48	2.5	2013	215.5	0.08	6.9	4.7	1015	25.7
SC48		2016	232	0.5	5.9	2.5	515	16.6
SC48 DUP			305	0.5	5.4	2.5	250	13.4
SC28	1.5	2013	212.3	0.1	7.2	5.6	1267	26.6
SC28 DUP			230	0.05	3.7	1.7	172	15.1
SC28		2016	202.3	0.5	8.3	2.5	993	36.0
SC28 DUP			157	0.5	10.4	2.5	1940	36.2
Spring Brook								
SC21	6.5	2013	232.5	0.05	1.7	0.5	492	7.4
SC21 DUP			190	0.05	1.6	0.6	536	7.8

***Table 11**. Water column metals concentrations on study sites on the Salt Creek study area during 2013 and 2016. Means with individual exceedances of Illinois WQS are shaded orange.*

Site ID	River Mile	Year	Hardness (mg/L)	Cadmium (µg/L)	Copper (µg/L)	Lead (µg/L)	Iron (µg/L)	Zinc (µg/L)
SC21		2016	275	0.5	4.2	2.5	476	12.5
SC46	6	2013	207	0.05	9.7	0.5	243	34.6
		2016	232	0.5	9.4	2.5	262	37.85
SC47	2.5	2013	310.3	0.05	2.7	2.2	1356	7.9
		2016	284.3	0.5	4.7	2.5	1207	15.5
SC16	0.25	2013	280	0.05	3.0	1.4	844	8.8
		2016	306.4	0.5	4.6	2.5	957	14.2
Westwood Creek								
SC22	0.5	2016	186	0.5	6.6	2.5	367	19.1

Dissolved Materials

The water quality "footprint" resulting from de-icing compounds has been documented in prior DRSCW assessments as being most obvious in the tributaries and especially in the headwater network upstream from the first wastewater treatment plant outfall at RM 29. This pattern persisted in 2013 and 2016 (Table 12). Chloride concentrations as well as TDS and conductivity were elevated well above background conditions for "un-impacted" or "least-impacted" reference sites and the IPS benchmarks derived for DRSCW (Figures 28-31). In the mainstem of Salt Creek in 2007, chloride and conductivity were lower compared to 2013 and 2016 (Figure 28 and Figure 30). The description of the influence of chlorides in the East Branch DuPage (MBI 2016) summarizes conditions that are similar to Salt Creek:

> "The Illinois EPA conducted a total chloride TMDL for the East Branch DuPage River in 2004 (CH2MHill 2004) and identified road salt and WWTP effluents as two key sources in the watershed. Kelly et al. (2012) has demonstrated the recent increase in chloride concentrations in the Chicago area correlated with a pattern of increasing road salt applications, particularly over the past 20 years. Kelly et al. (2012) also identified a strong, steady increasing trend in chlorides in the Illinois River at Peoria where the median increased from about 20 mg/L in 1947 to nearly 100 mg/L in 2004 with high values in the 1940s of less than 40 and spikes in 2003 of greater than 300."

Streams in the Salt Creek watershed are influenced by a mosaic of stressors including elevated concentrations of ions such as chloride. The upcoming IPS revision will identify the species and taxa in Northeast Illinois that are considered the most sensitive to chloride. This will improve our ability to attribute aquatic life impairments more directly to dissolved ions. This will be particularly important because chlorides have historically increased in rivers and streams across the U.S. states where road salt is used. DRSCW has an on-going program to reduce chlorides in runoff to all DRSCW watersheds.

***Table 5**. Sediment metal concentrations for the Salt Creek watershed during 2013 and 2016. Shaded areas reflect exceedances of various aquatic life screening benchmarks (see table footer).*

Site ID	River Mile	Year	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Potassium (mg/kg)	Zinc (mg/kg)
Salt Creek															
SC15	32.0	2013	0.58	70.8	1.52	27.5	45.1	16600	38.9	525	0.033	22.9	0.03	778	167
		2016	7.35	62.8	1.27	33.3	64.8	-	36.6	580	0.153	26.3	0.093	1	165
SC44	29.3	2016	11.2	66.4	1.22	30.6	44.9	-	35.2	536	0.141	29.7	0.059	1	79.5
SC43	29.0	2013	3.17	97.6	0.6	39.5	66.2	22600	35.2	972	0.046	31.4	0.49	1.24	164
		2016	5.88	84.3	0.77	27.7	61.2	-	34.3	570	0.11	26.1	0.191	1	115
SC42	27.0	2013	0.57	89.6	0.67	28.6	41.1	21600	30.7	525	0.033	24.1	0.03	1.24	112
		2016	3.98	80.9	0.82	25.4	47.3	-	30.4	271	0.124	24	0.058	1	96.6
SC41	25.0	2013	0.57	84.8	0.98	24.2	41.6	23800	29.8	494	0.03	23.8	0.03	1.24	117
		2016	7.17	90.8	1.08	30.8	44.7	-	35.9	395	0.173	26.2	0.059	1	116
SC40	24.5	2013	0.57	88.2	1	24.9	53.6	21600	30.1	464	0.035	22.6	0.197	1.23	142
		2016	4.94	80.8	0.75	28.2	49.1	-	30	499	0.172	23.9	0.092	1	124
SC34	23.5	2013	0.56	95.7	1.04	29	55.5	22500	31.6	487	0.143	24.6	0.142	1.2	150
SC35	23.0	2013	0.56	86.6	0.98	25.8	47.6	22200	31.8	411	0.038	25	0.14	1.22	135
SC23	22.5	2013	2.49	85.6	0.68	29.2	44.2	25700	33.7	366	0.034	26.4	0.065	1.22	135
		2016	8.9	76.9	0.85	22.1	40.2	-	27.1	347	0.256	24.1	0.058	1	106
SC39	20.5	2016	14.7	84.2	2.33	41.3	89.2	-	66.2	334	0.276	28.9	1.17	1	161
SC38	18.0	2013	0.57	95.2	1.26	25.9	59	16700	53.7	545	0.264	25.1	0.33	968	188
		2016	5.4	52.5	0.67	20.9	51.6	-	27	394	0.161	24.5	0.058	1	93.1
SC37	17.5	2016	4.75	75.1	0.84	25.6	67	-	38.9	474	0.221	23.1	0.22	1	137
SC51	17.0	2016	4.62	74.1	0.76	25.6	63.3	-	34.7	543	0.29	23.4	0.41	1	128
SC56	12.5	2013	3.95	99.8	0.9	31.1	50.3	25900	46.6	686	0.13	26.3	0.484	1.23	162
SC53	11.0	2013	2.97	84.4	1.04	30.4	64.9	22400	49.7	399	0.166	24.9	0.621	1.19	187
		2016	5.2	82.1	0.94	31.7	68.8	-	44.5	521	0.22	26.4	0.363	1	-
SC52	10.5	2013	3.36	96.55	0.98	41.2	65.65	25450	48.95	737.5	0.141	31.8	0.399	1.22	202

Table 5. *Sediment metal concentrations for the Salt Creek watershed during 2013 and 2016. Shaded areas reflect exceedances of various aquatic life screening benchmarks (see table footer).*

Site ID	River Mile	Year	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Potassium (mg/kg)	Zinc (mg/kg)
		2016	3.98	87.8	0.82	27	66.7	-	41.2	653	0.227	23.3	0.377	1	161
SC49	8.0	2013	3.75	125	1.34	59.7	77.7	27600	104	469	0.247	34	1.85	1.24	248
		2016	3.98	76.9	0.99	26.5	65.8	-	53.4	484	0.264	20.2	0.817	1	185
SC54	3.0	2013	0.56	77.5	0.89	35.9	48.1	24500	39.6	762	0.069	28.2	0.213	1.2	138
		2016	5.71	72.9	1.24	38.3	76.8	-	59.3	655	0.234	29.9	0.518	1	222
SC29	0.5	2013	0.57	101	1.78	48.1	77.9	21900	82.1	556	0.223	25.6	0.875	1.24	222
		2016	5.17	91.9	1.76	46.1	89.7	-	85.4	602	0.389	30.3	1.09	1	221
Arlington Heights Branch															
SC45	1.5	2013	6.18	56	1.26	25.6	44.1	19600	36.5	965	0.041	34.1	0.078	747	130
		2016	7.68	61.7	1.09	28.4	89.2	-	42.5	640	0.14	40.7	0.238	1	199
Unnamed Tributary to Salt Creek @RM (95-855)															
SC11	4.0	2016	8.66	81.2	0.91	24.7	44.5	-	46.9	592	0.254	27.1	0.058	1	146
Addison Creek															
SC48	2.5	2013	0.55	119	1.68	65.4	93	19500	129	485	0.139	30.6	0.707	1.19	349
		2016	6.14	106	1.58	57.4	126	-	113	532	0.197	35.1	0.662	1	413
SC28	1.5	2013	2.27	107	3.37	86	95.1	19400	131	389	0.214	38.6	0.645	1.24	351
		2016	6.76	73.6	1.77	55.3	97.7	-	93.1	388	0.211	36.4	0.409	1	304
Spring Brook															
SC21	6.5	2013	2.46	107	0.93	21.1	34.2	22600	43.7	872	0.027	26	0.029	1.19	213
		2016	7.15	96.5	0.81	21.1	44.4	-	45.8	876	0.106	25.1	0.069	1	234
SC46	6	2013	2.57	81.6	1.03	19	50.2	20900	35.4	835	0.03	23.2	0.359	1.19	222
		2016	6.12	78.6	0.73	21.9	50.3	-	40.6	699	0.096	24.5	0.203	1	200
SC47	2.5	2013	0.55	76.1	0.93	20.3	49.9	22600	34.5	322	0.07	21.9	0.029	1.19	127
		2016	6.65	86.1	0.9	26.7	55	-	40.7	463	0.435	26.5	0.113	1	128
SC16	0.25	2013	1.68	77	0.94	23	43.7	22300	32.6	366	0.274	20.8	0.029	1.19	130
		2016	5.42	73	0.76	23.1	51.8	-	32.9	371	0.289	20.6	0.06	1	127

***Table 5**. Sediment metal concentrations for the Salt Creek watershed during 2013 and 2016. Shaded areas reflect exceedances of various aquatic life screening benchmarks (see table footer).*

Site ID	River Mile	Year	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Silver (mg/kg)	Potassium (mg/kg)	Zinc (mg/kg)
Westwood Creek															
SC22	0.5	2013	5.69	67.2	0.42	21.1	26.9	34300	29.2	403	0.028	22.3	0.03	1.24	121
		2016	9.23	78.2	0.83	19.8	28	37	30.4	377	0.152	19.8	0.059	1	114
Sediment Quality Assessment Guidelines															
		TEC	9.79	None	0.99	43.40	31.6	20000	35.8	460	0.18	22.7	1.60	None	121.0
		PEC	33.00	None	4.98	111.0	149.0	40000	128.0	1100	1.06	48.6	2.20	None	459.0
		OH SRVs		190.0	0.79	29.00	32.0	41000	47.0	1500	0.12	33.0	0.43	6800	
		IL Elevated	7.20	145.0	2.00	37.00	37.0	26100	60.0	1100	0.28	26.0	None	1500	170.0
		IL Highly El.	18.00	230.0	9.30	110.0	170.0	53000	245.0	2300	1.40	45.0	5.00	2200	760.0

Total Suspended Solids
Mean and median concentrations of suspended solids (Figure 30) base summer-fall low flows were generally below benchmarks derived for SW Minnesota (60 mg/L) and unpolluted background reference site concentrations in Ohio (39 mg/L). However, only a very few individual values in excess of these benchmarks were observed in 2016. TSS universally increases with runoff events, but can also become elevated by suspended algae. Elevated TSS values are not unexpected where flows and runoff can be episodic and flashy as is the case in urban settings like Salt Creek.

Salt Creek Tributaries
While treated municipal effluent comprises a significant fraction of the total flow in the Salt Creek mainstem and strongly influences water quality, especially with respect to nitrogen and phosphorus (Figure 32; Table 13), only two tributaries receive WWTP effluent. Phosphorus concentrations in the headwaters of many tributaries were typical of developed urban landscapes and elevated above the U.S. EPA nutrient ecoregion reference levels at all sites (Figure 33, upper right). Phosphorus was highest in Addison Creek and Spring Brook with some values above the Illinois non-standard benchmark (85^{th} percentile of all sites in Illinois; Figure 32, upper right) in 2013. Addison Creek receives wastewater effluent from the Bensenville WWTP while Spring Brook receives effluent from the Roselle-J.L. Devlin WWTP. The Bensenville WWTP added biological nutrient removal in 2016 which came before the 2016 sampling. Nutrients listed as a cause of impairment in 2013 were absent in 2016 and total P levels were reduced 4-5 fold. The other tributaries are impacted by urban nonpoint source runoff. Nitrate was relatively low during normal summer-fall flows in the non-effluent affected tributaries, but was elevated in Addison Creek and Spring Brook (Figure 33, upper left). There were several nitrate values in Addison Creek and one in Spring Brook that exceeded 10 mg/L . TKN, which is a measure of organic nitrogen and organic enrichment was frequently above the DuPage IPS threshold of 1.0 mg/L in 2013 and 2016 suggesting that organic enrichment is an issue in the tributaries along with other urban stressors including siltation, chlorides, dissolved ions, flow alteration, and habitat alteration (Figure 33, lower left). Although there were no exceedances of the Illinois water quality standard for ammonia-N in the tributaries, concentrations were elevated above the IPS biological effect threshold in numerous samples (Figure 31, lower right).

Organics in Water
Water samples were collected at 18 sites in the Salt Creek watershed during 2013 (only) were scanned for 91 organic compounds including organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), and hydrocarbons that are commonly employed in manufacturing such as benzene and toluene. Detections were rare and where they occurred were mostly for compounds related to by-products of drinking water chlorination (e.g., chloroform, bromodichloromethane, chloro-dibromo-methane, and 1,2-dichloro-ethane; Table 15). Bromodichloromethane exceeded the Illinois water quality standard in upper Salt Creek (Table 15.

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	A
Oak Meadows Dam (removed)	22.8	B
Graham Center Dam	16.5	C
Old Oak Brook Dam	12.5	D
Fullersburg Woods Dam	10.5	E
Possum Hollow Woods Dam	6.0	F

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	1
Itasca STP	28.3	2
Wood Dale North STP	27.7	3
Wood Dale South STP	26.4	4
Addison North STP	26.3	5
Addison S.- Larocca STP	25.6	6
Salt Creek Sanitary D.	20.1	7
Elmhurst WWTP	19.9	8

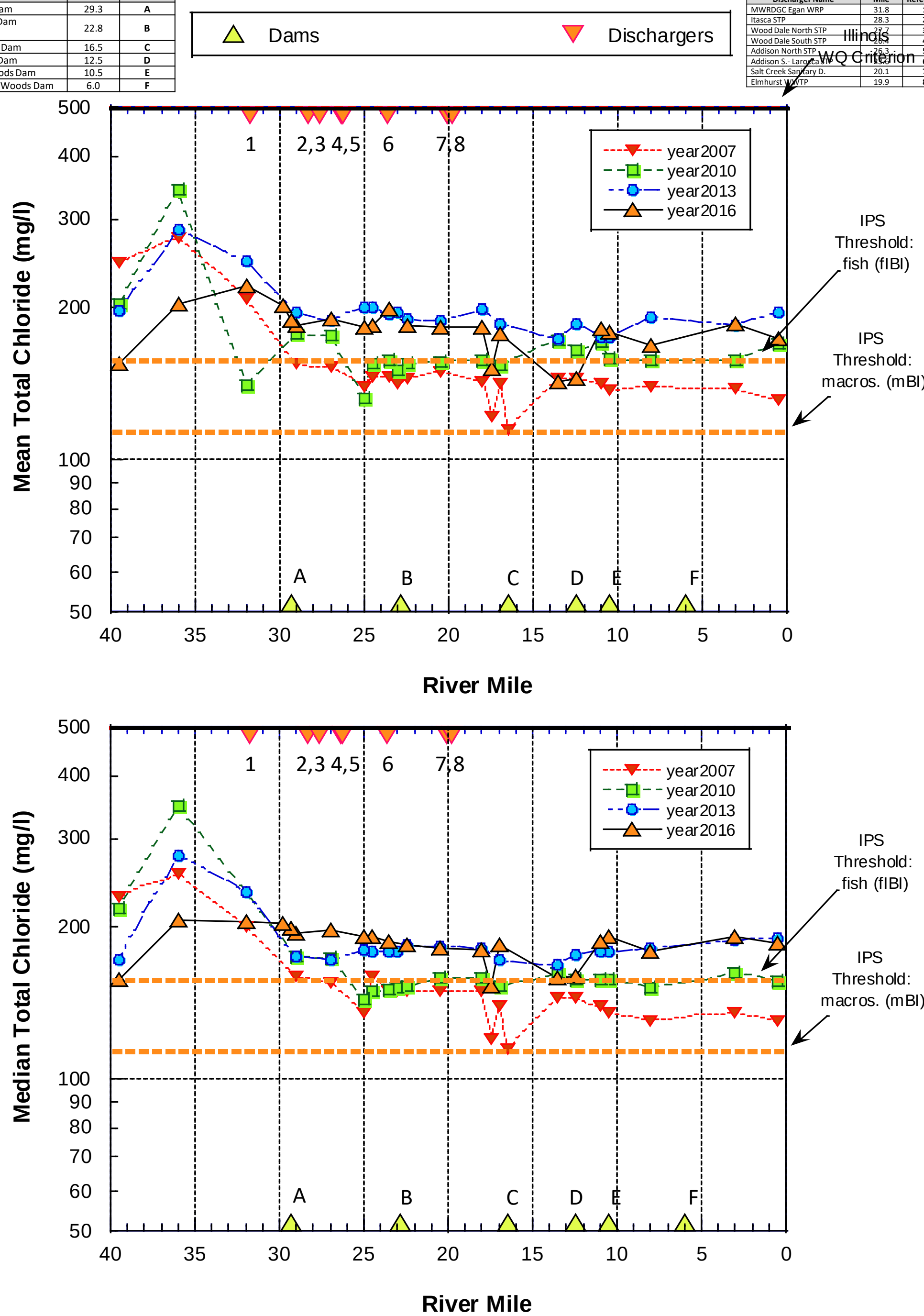
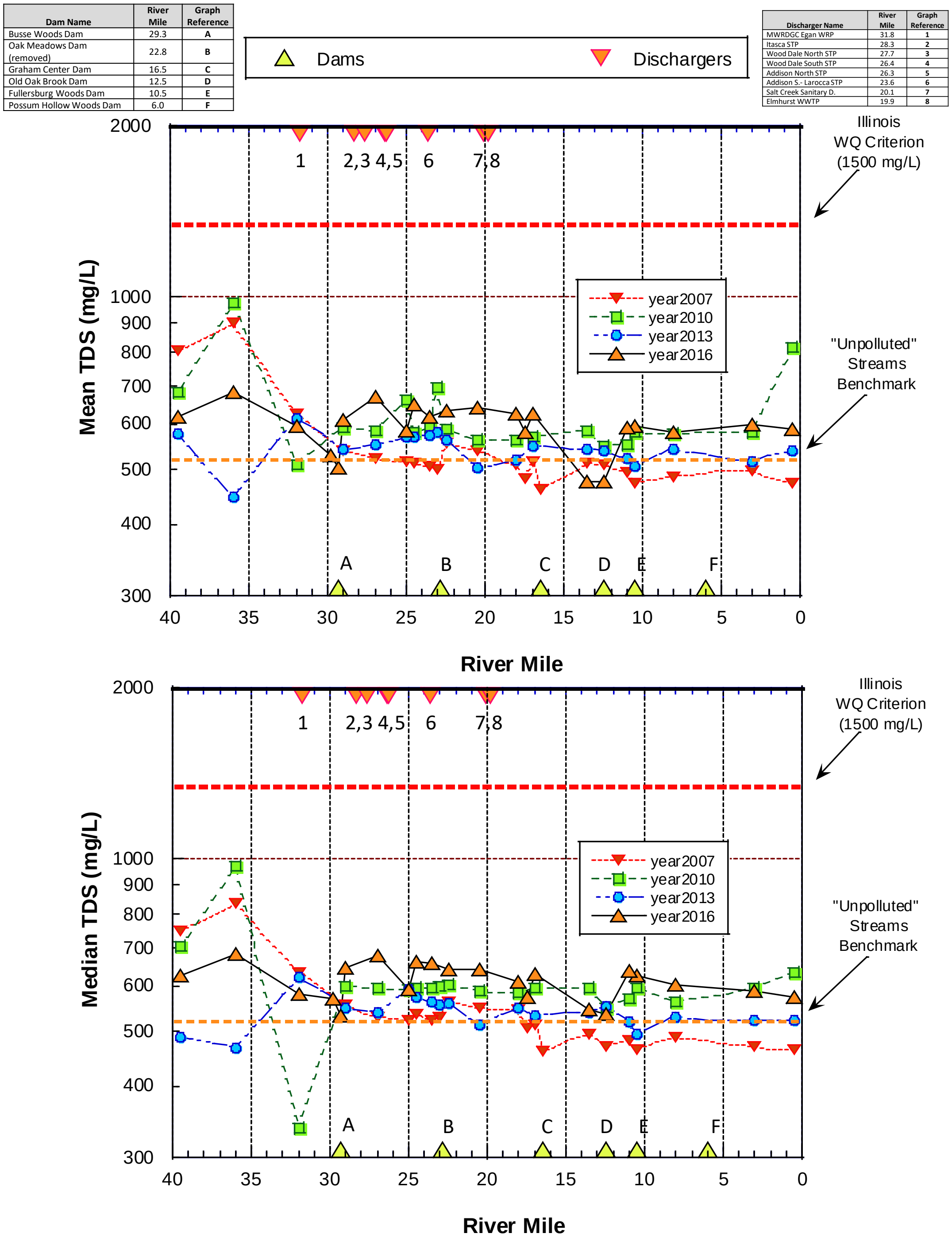


***Figure 28**. Concentration of mean (top) and median (bottom) total chloride in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. Benchmark line are illustrated as dashed orange lines for the fish and macroinvertebrate DuPage River IPS thresholds and the Illinois WQ criterion (500 mg/L).*



Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	A
Oak Meadows Dam (removed)	22.8	B
Graham Center Dam	16.5	C
Old Oak Brook Dam	12.5	D
Fullersburg Woods Dam	10.5	E
Possum Hollow Woods Dam	6.0	F

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	1
Itasca STP	28.3	2
Wood Dale North STP	27.7	3
Wood Dale South STP	26.4	4
Addison North STP	26.3	5
Addison S.- Larocca STP	23.6	6
Salt Creek Sanitary D.	20.1	7
Elmhurst WWTP	19.9	8

Figure 29. Concentration of mean (top) and median (bottom) total dissolved solids (TDS) in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. Benchmark line are illustrated as the Illinois WQ criterion (1500 mg/L) and an Ohio background (unpolluted) reference site concentration.

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

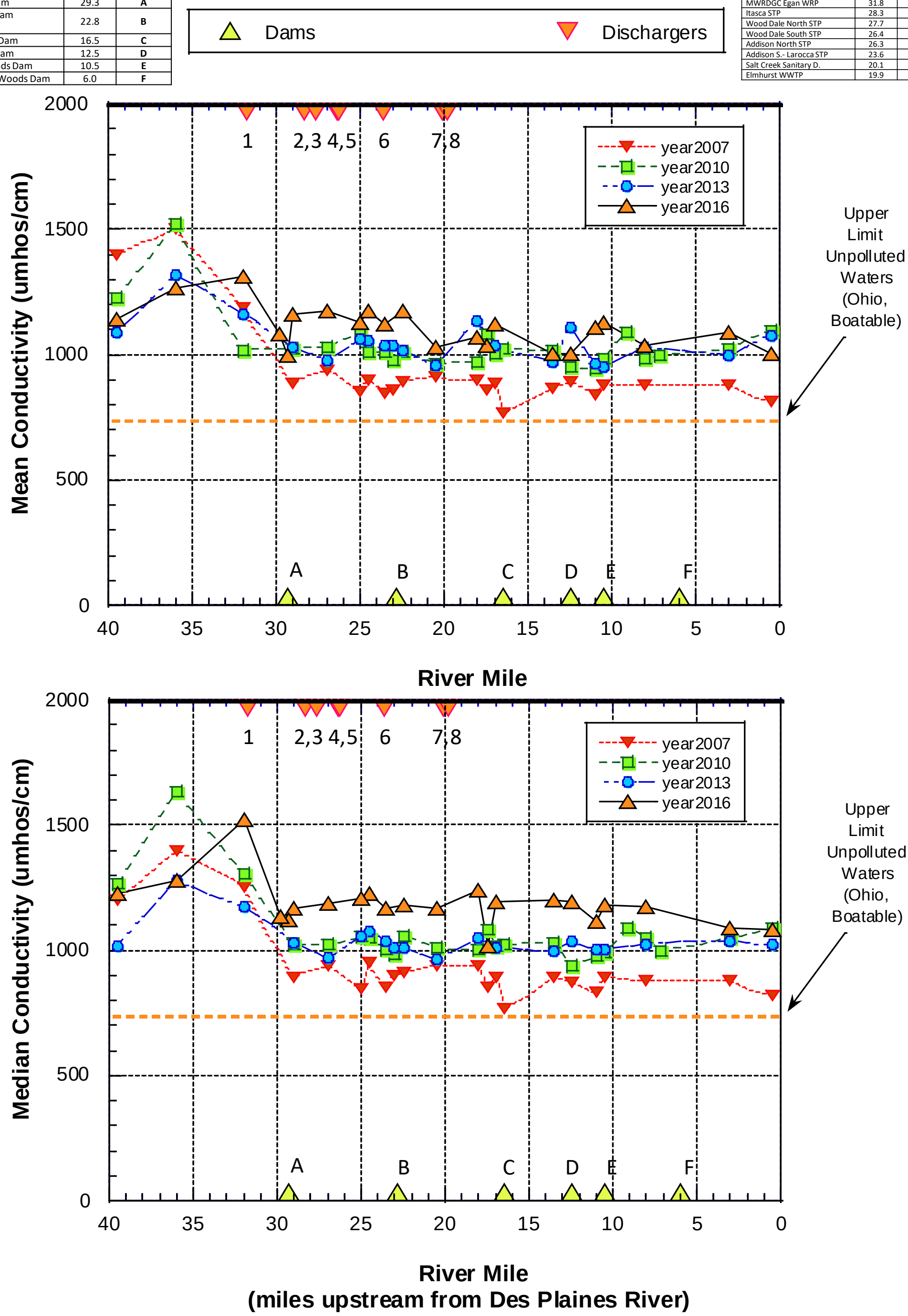


Figure 30*. Concentration of mean (top) and median (bottom) specific conductance (µS/cm) in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. Benchmark line is the Ohio background (unpolluted) boatable reference site values.*

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

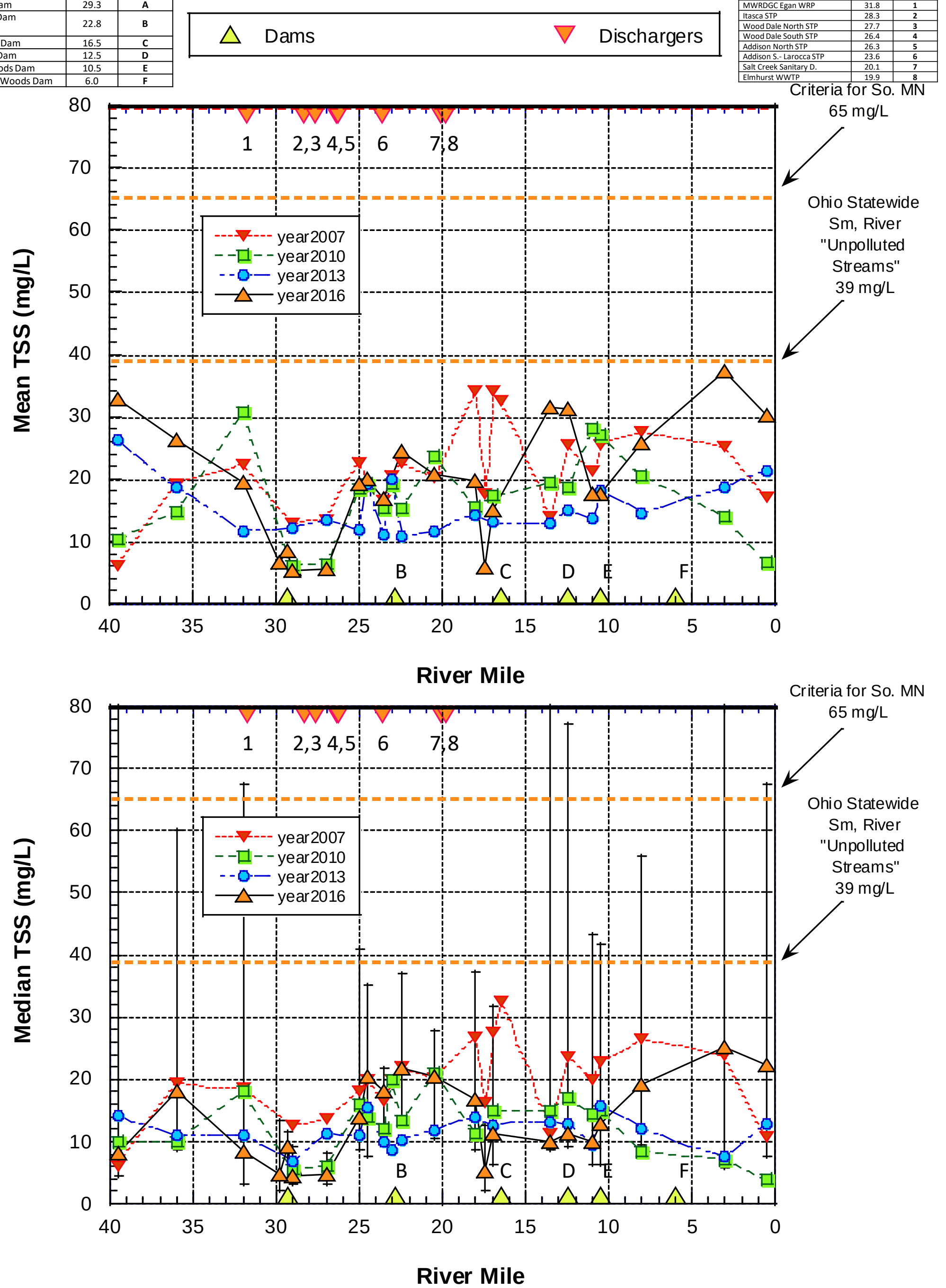


***Figure 31**. Concentration of mean (top) and median (bottom, with ranges of values) total suspended solids (TSS) in samples collected from Salt Creek during 2007, 2010, 2013, and 2016. All concentrations are in milligrams per liter. The locations of NPDES permitted facilities are arrayed and enumerated along the top of each plot. The locations of combined sewer overflows (CSO) and low-head dams are arrayed along the x-axes. Benchmark line are illustrated as a eutrophication criterion for SW Minnesota (65 mg/L) and an Ohio background (unpolluted) reference site concentration (39 mg/L).*

***Table 13**. Urban parameter sampling results in the Salt Creek watershed, during summer-fall 2013 and 2016. Median values above applicable reference targets are highlighted in yellow. No metals exceed their Illinois WQS thresholds.*

Site ID	River Mile	Year	Cond-uctivity (µS/cm)[1]	TDS (mg/L)	TSS (mg/L)	Chloride (mg/L)	TKN (mg/L)	Total Copper (mg/L)[5]	Total Lead (mg/L)[6]	Total Zinc (mg/L)
Salt Creek										
SC04	39.5	2013	1118	609	15.7	202	1.40	-	-	-
SC04 Dup.			1015	456	11.4	172	0.79	-	-	-
SC04		2016	1229	624	8.2	158	1.41	-	-	-
SC07	36.0	2013	1281	467	11.1	278	1.27	0.0054	0.0008	0.0039
		2016	1278	682	18.2	207	0.92	0.0070	0.0025	0.0125
SC15	32.0	2013	1173	621	11.1	236	1.15	0.0041	0.0011	0.0070
		2016	1524	582	8.4	205	1.03	0.0063	0.0025	0.0125
SC50	29.8	2016	1128	553	5.6	203	1.01	0.0050	0.0025	0.0125
SC50 Dup.			1180	642	2.0	209	0.96	0.0050	0.0025	0.0125
SC44	29.3	2016	1119	531	9.2	200	0.99	0.0050	0.0025	0.0125
SC43	29.0	2013	1027	548	6.8	175	1.19	0.0043	0.0003	0.0186
		2016	1162	627	4.9	194	0.50	0.0050	0.0025	0.0132
SC43 Dup.			1271	680	3.2	215	1.84	0.0050	0.0025	0.0125
SC42	27.0	2013	995	575	10.6	175	1.30	0.0047	0.0006	0.0144
SC42 Dup.			821	462	11.4	162	1.27	0.0040	0.0007	0.0119
SC42		2016	1191	678	4.8	198	0.50	0.0066	0.0025	0.0236
SC41	25.0	2013	1058	591	11	181	1.39	0.0041	0.0005	0.0157
		2016	1226	596	14.7	194	0.94	0.0055	0.0025	0.0174
SC41 Dup.			842	464	14.0	119	1.24	0.0050	0.0025	0.0125
SC40	24.5	2013	1047	573	15.6	179	1.33	0.0042	0.0007	0.0187
SC40 Dup.			1109	562	23.0	213	1.79	0.0044	0.0007	0.0205
SC40	24.5	2016	1225	660	20.6	192	0.78	0.0055	0.0025	0.0170
SC34	23.5	2013	1026	564	10.6	175	1.18	0.0038	0.0005	0.0157
SC34 Dup.			1191	688	9.2	249	1.53	0.0031	0.0004	0.0162
SC34		2016	1170	656	17.8	182	1.25	0.0058	0.0025	0.0211
SC34 Dup.			1013	696	22.8	192	2.04	0.0050	0.0025	0.0174
SC35	23.0	2013	1009	550	8.8	179	1.30	0.0034	0.0005	0.0136
SC35 Dup.			1097	700	8.0	206	1.30	0.0043	0.0005	0.0210
SC23	22.5	2013	1009	559	10.2	185	1.19	0.0047	0.0006	0.0182
		2016	1174	635	22.4	187	1.32	0.0074	0.0025	0.0192
SC23 Dup.			1285	674	13.4	183	0.85	0.0056	0.0025	0.0165
SC39	20.5	2013	964	513	11.8	184	1.18	0.0039	0.0009	0.0094
		2016	1167	640	20.6	182	1.15	0.0060	0.0025	0.0172
SC38	18.0	2013	1052	548	14.0	182	1.34	0.0044	0.001	0.0164
		2016	1232	638	17.0	186	1.05	0.0053	0.0025	0.0150
SC38 Dup.			1258	566	8.6	164	0.50	0.0050	0.0025	0.0172

Table 13*. Urban parameter sampling results in the Salt Creek watershed, during summer-fall 2013 and 2016. Median values above applicable reference targets are highlighted in yellow. No metals exceed their Illinois WQS thresholds.*

Site ID	River Mile	Year	Cond-uctivity (µS/cm)[1]	TDS (mg/L)	TSS (mg/L)	Chloride (mg/L)	TKN (mg/L)	Total Copper (mg/L)[5]	Total Lead (mg/L)[6]	Total Zinc (mg/L)
SC37	17.5	2016	1018	572	5.2	153	0.50	0.0089	0.0025	0.0279
SC51	17.0	2013	1012	533	12.7	173	1.31	0.0051	0.0010	0.0192
		2016	1195	630	11.2	185	0.77	0.0065	0.0025	0.0186
SC55	13.5	2013	1001	538	11.1	174	1.22	0.0054	0.0018	0.0159
SC55 Dup.			985	514	14.6	160	1.19	0.0058	0.0011	0.0187
SC55		2016	1199	546	10.0	159	0.50	0.0083	0.0025	0.0181
SC56	12.5	2013	1027	542	13.3	176	1.26	0.0047	0.0012	0.0160
SC56 Dup.			1040	678	10.8	222	1.20	0.0040	0.0010	0.0130
SC56		2016	1194	534	11.4	160	0.76	0.0082	0.0025	0.0195
SC53	11.0	2013	1003	520	9.4	179	1.29	0.0044	0.0009	0.0149
		2016	1118	636	10.0	188	1.29	0.0071	0.0025	0.0168
SC52	10.5	2013	1001	494	15.8	179	1.24	0.0043	0.0014	0.0160
		2016	1180	624	12.9	192	1.32	0.0064	0.0025	0.0178
SC49	8.0	2013	1024	530	12.1	183	1.01	0.0044	0.0011	0.0137
		2016	1172	610	19.2	190	0.85	0.0073	0.0025	0.0214
SC49 Dup.			1172	542	10.8	150	0.63	0.0068	0.0025	0.0144
SC54	3.0	2013	1037	521	7.7	190	1.11	0.0039	0.0010	0.0150
		2016	1100	609	22.9	196	1.09	0.0084	0.0025	0.0254
SC54 Dup.			1091	584	38.4	160	1.31	0.0111	0.0025	0.0279
SC03	0.5	2013	1145	636	13.65	226	1.30	-	-	-
SC29	0.5	2013	1024	501	12.8	187	1.11	0.0044	0.0016	0.0145
		2016	1081	574	22.4	186	0.94	0.0089	0.0025	0.0231
Arlington Heights Branch										
SC06	4.0	2013	1538	974	9.6	455	1.19	-	-	-
		2016	896	442	11.0	167	1.23	-	-	-
SC45	1.5	2013	1342	668	4.1	244	1.31	0.0025	0.0003	0.0047
		2016	1416	674	4.3	217	0.85	0.0050	0.0025	0.0125
SC08	0.25	2013	1285	641	7.8	238	1.13	-	-	-
		2016	1544	500	4.4	251	0.54	0.0070	0.0025	0.0125
Baldwin Creek										
SC05	2.0	2013	1001	674	12.7	257	1.21	-	-	-
SC13	0.1	2013	1092	546	37.0	239	1.97	-	-	-
Unnamed Tributary to Salt Creek @RM (95-851)										
SC01	2.0	2013	1035	602	10.6	196	1.53	-	-	-
		2016	1561	399.5	14.0	275	1.64	-	-	-
Unnamed Tributary to Salt Creek @RM (95-852)										
SC02	0.25	2013	1103	782	12.9	255	1.64	-	-	-

***Table 13**. Urban parameter sampling results in the Salt Creek watershed, during summer-fall 2013 and 2016. Median values above applicable reference targets are highlighted in yellow. No metals exceed their Illinois WQS thresholds.*

Site ID	River Mile	Year	Cond-uctivity (µS/cm)[1]	TDS (mg/L)	TSS (mg/L)	Chloride (mg/L)	TKN (mg/L)	Total Copper (mg/L)[5]	Total Lead (mg/L)[6]	Total Zinc (mg/L)
		2016	1361	854	12.8	219	0.50	-	-	-
Unnamed Tributary to Salt Creek @RM (95-853)										
SC03	0.5	2016	1355	778	10.43	187	0.65	-	-	-
Unnamed Tributary to Salt Creek @RM (95-855)										
SC11	4.0	2013	1181	594	15.5	273	1.19	-	-	-
		2016	1458	566	5.2	251	0.50	0.0070	0.0025	0.0125
Unnamed Tributary to Salt Creek @RM (95-856)										
SC14	2.5	2013	807	494	14.7	206	1.2	0.0032	0.0012	0.0074
SC14 Dup.			817	376	26.7	178	1.06	0.0033	0.0014	0.0082
SC14		2016	1024	445	23.0	177	0.80	0.0051	0.0025	0.0125
SC14 Dup.			695	338	25.2	120	0.93	-	-	-
SC13	2.0	2016	1073	496	25.2	161	0.59	0.0070	0.0025	0.0125
Yeargin Creek										
SC12	0.25	2013	1156	630	5.48	290	1.43	-	-	-
		2016	1480	683	4	270	0.50	0.0070	0.0250	0.0125
Ginger Creek										
SC30	1.5	2013	917	470	4.2	189	1.17	-	-	-
		2016	955	487	2.8	168	0.99	0.0089	0.0025	0.0231
SC31	0.55	2013	974	467	8	191	1.05	-	-	-
		2016	1051	586	8.6	171	1.22	0.0050	0.0025	0.0125
SC31 Dup.		2016	1208	540	9.2	200	1.38	0.0050	0.0025	0.0125
Sugar Creek										
SC33	0.25	2013	949	510	7.4	190	1.48	-	-	-
		2016	1149	576	14.4	174	1.25	0.0050	0.0025	0.0125
Addison Creek										
SC24	10.5	2013	1047	612	2.2	160	1.38	0.0058	0.0007	0.0196
		2016	1270	662	3.6	170	0.90	-	-	-
SC26	8.0	2013	1030	613	4.5	161	1.01	0.0058	0.0007	0.0196
		2016	1015	516	16.2	150	0.99	-	-	-
SC27	5.0	2013	1033	483	21.6	166	1.10	0.0052	0.0024	0.0224
SC27 Dup.			1157	692	19.2	170	1.40	0.0066	0.0023	0.0278
SC27		2016	1128	554	25.2	150	0.50	0.0074	0.0025	0.0265
SC48	2.5	2013	1160	571	12.6	198	1.29	0.0068	0.0046	0.0252
		2016	1336	687	9.2	224	0.94	0.0066	0.0025	0.0166
SC48 Dup.		2016	1500	818	4.4	284	0.76	0.0054	0.0025	0.0134
SC28	1.5	2013	1099	516	17.4	176	1.43	0.0074	0.0059	0.0265
SC28 Dup.			1016	604	2.8	181	1.06	0.0037	0.0017	0.0151

***Table 13**. Urban parameter sampling results in the Salt Creek watershed, during summer-fall 2013 and 2016. Median values above applicable reference targets are highlighted in yellow. No metals exceed their Illinois WQS thresholds.*

Site ID	River Mile	Year	Cond-uctivity (µS/cm)[1]	TDS (mg/L)	TSS (mg/L)	Chloride (mg/L)	TKN (mg/L)	Total Copper (mg/L)[5]	Total Lead (mg/L)[6]	Total Zinc (mg/L)
SC28		2016	994.5	529	24	160	1.12	0.0086	0.0025	0.0274
SC28 Dup.			676	376	39.6	121	1.01	0.0104	0.0025	0.0362
Unnamed Tributary to Addison Creek @RM (95-861)										
SC25	0.5	2013	646	760	12	261	1.16	0.0058	0.0007	0.0196
		2016	604	297	28.6	75	0.94	-	-	-
Spring Brook										
SC21	6.5	2013	1140	661	6.8	242	1.02	0.0017	0.0005	0.0074
SC21 Dup.			1011	518	7.8	212	0.70	0.0016	0.0006	0.0078
SC21		2016	1412	785	4.7	279	0.67	0.0054	0.0025	0.0125
SC46	6.0	2013	909	554	6.7	156	0.91	0.0097	0.0005	0.0346
		2016	1124	625	3.5	177	0.97	0.0094	0.0025	0.0379
SC18	4.5	2013	1009	470	3.2	169	1.00	-	-	-
		2016	1172	629	7.3	150	0.50	0.0055	0.0025	0.0125
SC47	2.5	2013	1194	672	41.6	216	3.19	0.0026	0.0020	0.0075
		2016	1206	625	55.0	168	1.49	0.0050	0.0025	0.0125
SC16	0.25	2013	1166	704	28.8	207	2.24	0.0025	0.0015	0.0083
		2016	1287	676	33.0	197	1.28	0.0055	0.0025	0.0125
Meacham Creek										
SC17	0.35	2013	1284	645	33.0	274	1.98	-	-	-
Oakbrook Creek										
SC36	0.5	2016	928	432	7.0	154	0.90	-	-	-
SC32	0.25	2013	1585	856	4.0	301	0.89	-	-	-
		2016	1418	392.5	4.8	296	0.52	0.0050	0.0025	0.0125
Unnamed Tributary to Meacham Creek @RM (095-881)										
SC20	0.25	2013	1031	496	11.9	180	1.86	-	-	-
		2016	1223	666	6.1	187	0.88	0.0055	0.0025	0.0125
Westwood Creek										
SC22	0.5	2013	1112	566	9.7	243	1.30	0.0016	0.0006	0.0078
		2016	1187	621	10.0	167	1.16	0.0066	0.0025	0.0191

[1] Median specific conductivity values above statewide reference levels (75th percentiles) from similar Ohio waters (e.g., headwater - 600, wadeable streams - 610, large river - 810).

[2] Median TDS values above statewide reference levels (75th percentiles) from similar Ohio waters (e.g., headwater – 468 mg/L, wadeable streams – 523 mg/L, large river – 727 mg/L).

[3] Median TSS values above statewide reference levels (75th percentiles) from similar Ohio waters (e.g., headwater - 16, wadeable streams - 25, large river - 50).

[4] DuPage IPS threshold derived in the 2010 IPS study (112 µg/L total chlorides).

[5] Copper biological effect levels from SW Ohio: headwater – 0.0059 mg/L, wadeable – 0.0089 mg/L, large river – 0.0141 mg/L.

[6] Lead biological effect levels from SW Ohio: headwater – 0.0027 mg/L, wadeable – 0.0174 mg/L, large river - 0.0503 mg/L.

[7] Zinc biological effect levels from SW Ohio: headwater – 0.0164 mg/L, wadeable – 0.0393 mg/L, large river - 0.0794 mg/L.

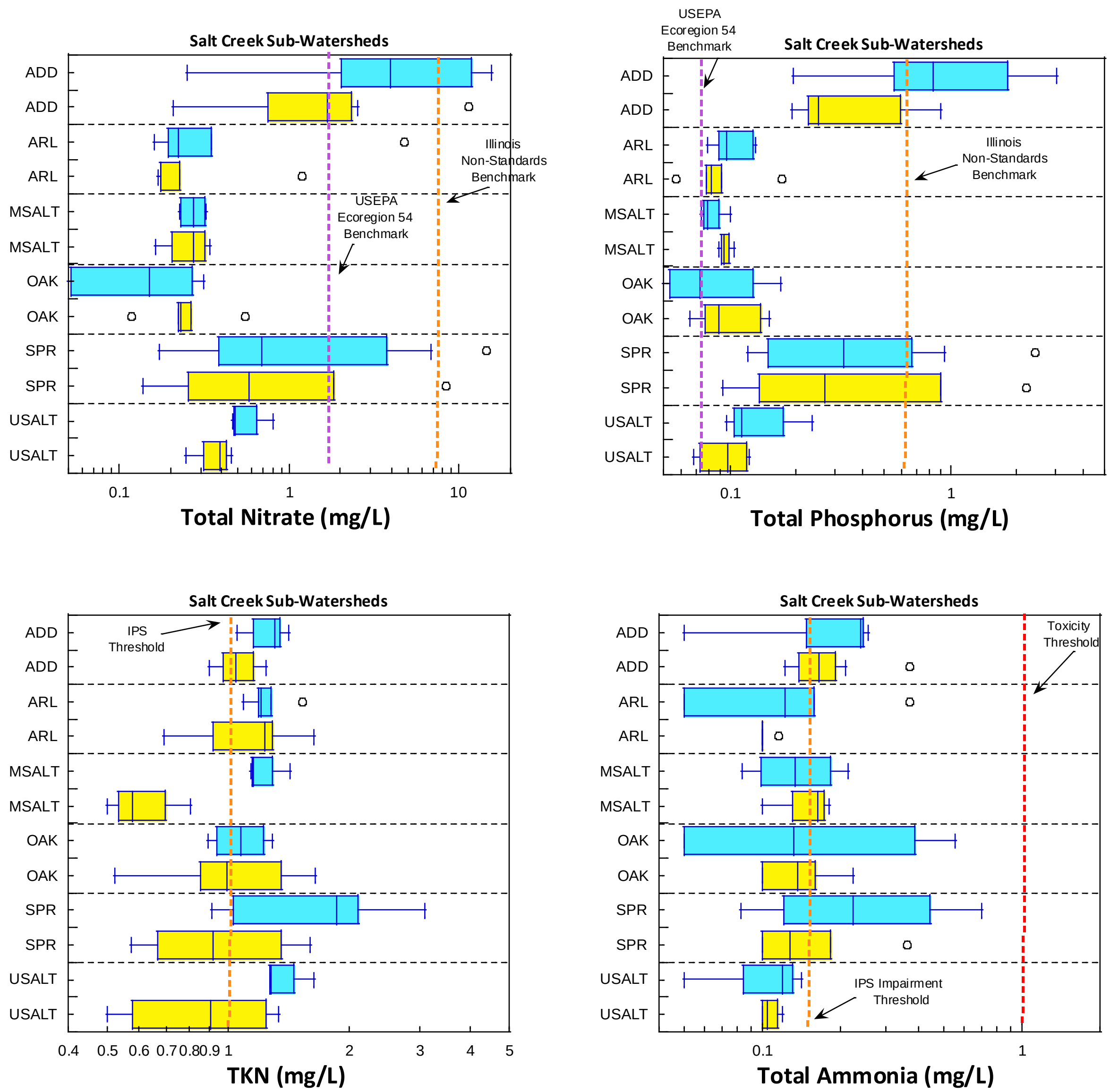


***Figure 32**. Nutrient concentrations in Salt Creek tributaries in 2013 (blue) and 2016 (yellow) by subwatershed for nitrate (upper left), total phosphorus (upper right), TKN (lower left) and total ammonia (lower right).*

Key to Subwatersheds: **ADD** – Addison Creek (Bensenville WWTP), Trib to Addison Creek, Westwood Creek; **SPR** – Spring Brook (2 Roselle WWTPs), Meacham Creek, Trib to Meacham Creek; **OAK** – Oakbrook Creek, Ginger Creek, Sugar Creek; **ARL** - Arlington Heights Branch Salt Creek, Baldwin Creek, Trib. to Arlington Branch Salt Creek (#1); **MSALT** – Wests Branch Salt Creek, Yeargin Creek, Trib to West Branch Salt Creek; **USALT** – Headwater sites of Salt Creek (≥ RM 36), Trib to Salt Creek @ RM 42.8.

Sediment Chemistry – Polycyclic Aromatic Hydrocarbons (PAHs)

Sediment samples collected from 27 sites in the Salt Creek watershed during 2013 and 2016 were analyzed for a variety of organic compounds including PAHs, organochlorine pesticides, polychlorinated biphenyls (PCBs), and organics commonly employed in industry (e.g., acetone, toluene). Table 17 summarizes the number of samples and compound detections for PAHs. PAH compounds were detected at nearly half of the sites and there many sites that frequently exceeded TEC and less frequently PEC levels. Sites above PEL screening considered more

***Table 6**. Median concentrations of nutrient parameters (ammonia, nitrate, TKN and TP) in streams in the Salt Creek watershed during 2013 and 2016. Shaded areas identify exceedances of various screening guidelines referenced in the table footer.*

Site ID	RM	Year	Ammonia[1] (mg/L)	Nitrate-N[2,3,4] (mg/L)	TKN[5] (mg/L)	Total Phosphorus[6,7,8,9] (mg/L)
Salt Creek						
SC04	39.5	2013	0.13	0.45	1.40	0.10
		2016	0.10	0.39	1.41	0.13
SC07	36.0	2013	0.13	0.71	1.27	0.13
		2016	0.11	0.40	0.92	0.12
SC15	32.0	2013	0.05	0.35	1.15	0.10
		2016	0.10	0.32	1.03	0.09
SC50	29.8	2016	0.10	0.10	1.01	0.05
SC44	29.3	2016	0.10	0.10	0.99	0.07
SC43	29.0	2013	0.05	6.25	1.19	1.60
		2016	0.10	8.87	0.50	2.11
SC42	27.0	2013	0.10	8.77	1.30	2.24
		2016	0.10	10.5	0.50	1.83
SC41	25.0	2013	0.17	6.71	1.39	1.43
		2016	0.12	5.51	0.94	1.21
SC40	24.5	2013	0.24	6.50	1.33	1.32
		2016	0.10	4.59	0.98	1.18
SC34	23.5	2013	0.23	6.49	1.18	1.31
SC35	23.0	2013	0.24	6.28	1.3	1.31
SC23	22.5	2013	0.18	6.72	1.19	1.35
		2016	0.16	5.84	1.32	1.31
SC39	20.5	2013	0.18	3.90	1.18	0.67
		2016	0.18	5.44	1.15	1.15
SC38	18.0	2013	0.17	6.68	1.34	1.39
		2016	0.10	4.14	1.05	1.04
SC37	17.5	2016	0.10	14.8	0.50	2.64
SC51	17.0	2013	0.17	9.28	1.31	1.75
		2016	0.13	6.41	0.77	1.34
SC55	13.5	2013	0.21	7.90	1.22	1.40
		2016	0.10	9.37	0.50	1.59
SC56	12.5	2013	0.19	7.83	1.26	1.48
		2016	0.10	8.09	0.76	1.52
SC53	11.0	2013	0.19	6.61	1.29	1.23
		2016	0.12	4.61	1.29	1.00
SC52	10.5	2013	0.18	5.53	1.24	1.11
		2016	0.10	5.28	1.32	1.14
SC49	8.0	2013	0.16	5.43	1.01	1.12
		2016	0.10	6.43	0.85	1.18
SC54	3.0	2013	0.12	5.28	1.11	0.95

***Table 6**. Median concentrations of nutrient parameters (ammonia, nitrate, TKN and TP) in streams in the Salt Creek watershed during 2013 and 2016. Shaded areas identify exceedances of various screening guidelines referenced in the table footer.*

Site ID	RM	Year	Ammonia[1] (mg/L)	Nitrate-N[2,3,4] (mg/L)	TKN[5] (mg/L)	Total Phosphorus[6,7,8,9] (mg/L)
		2016	0.11	3.85	1.09	0.81
SC03	0.5	2013	0.08	0.27	1.30	0.08
SC29	0.5	2013	0.12	4.60	1.11	1.05
		2016	0.10	3.64	0.94	0.83
Unnamed Tributary to Salt Creek @RM (95-851)						
SC01	2.0	2013	0.05	0.35	1.53	0.13
		2016	0.10	1.19	1.64	0.17
Unnamed Tributary to Salt Creek @RM (95-852)						
SC02	0.25	2013	0.05	0.48	1.64	0.10
		2016	0.10	0.24	0.50	0.08
Unnamed Tributary to Salt Creek @RM (95-853)						
SC03	0.5	2016	0.10	0.46	0.65	0.07
Unnamed Tributary to Salt Creek @RM (95-855)						
SC11	5.0	2013	0.11	0.22	1.19	0.08
		2016	0.14	0.19	0.50	0.09
Unnamed Tributary to Salt Creek @RM (95-856)						
SC14	2.5	2013	0.05	0.27	1.2	0.08
		2016	0.16	0.25	0.80	0.10
SC13	2.0	2016	0.17	0.25	0.59	0.10
Yeargin Creek						
SC12	0.25	2013	0.15	0.32	1.43	0.07
		2016	0.10	0.30	0.50	0.09
Ginger Creek						
SC30	1.5	2013	0.05	0.08	1.17	0.09
		2016	0.10	0.26	0.99	0.14
SC31	0.5	2016	0.10	0.10	1.22	0.07
Sugar Creek						
SC33	0.25	2013	0.54	0.22	1.48	0.19
		2016	0.12	0.28	1.91	0.11
Addison Creek						
SC24	10.5	2013	0.05	12.40	1.38	1.76
		2016	0.17	11.45	0.90	0.90
SC26	8.0	2013	0.25	15.60	1.01	2.92
		2016	0.24	2.52	0.99	0.32
SC27	5.0	2013	0.22	9.15	1.1	1.64
		2016	0.14	1.59	0.50	0.25
SC48	2.5	2013	0.23	3.21	1.29	0.78
		2016	0.10	1.54	0.94	0.27
SC28	1.5	2013	0.22	3.07	1.43	0.74
		2016	0.15	1.08	1.12	0.22

***Table 6**. Median concentrations of nutrient parameters (ammonia, nitrate, TKN and TP) in streams in the Salt Creek watershed during 2013 and 2016. Shaded areas identify exceedances of various screening guidelines referenced in the table footer.*

Site ID	RM	Year	Ammonia[1] (mg/L)	Nitrate-N[2,3,4] (mg/L)	TKN[5] (mg/L)	Total Phosphorus[6,7,8,9] (mg/L)
Unnamed Tributary to Addison Creek @RM (95-861)						
SC25	0.5	2013	0.24	0.25	1.16	0.29
		2016	0.21	0.21	0.94	0.21
Spring Brook						
SC21	6.5	2013	0.14	0.91	1.02	0.12
		2016	0.10	0.60	0.67	0.09
SC46	6.0	2013	0.09	14.35	0.91	2.43
		2016	0.10	8.41	0.97	2.21
SC18	4.5	2013	0.05	6.12	1.00	1.03
		2016	0.10	1.55	0.50	0.81
SC47	2.5	2013	0.62	0.40	3.19	0.44
		2016	0.10	0.10	1.24	0.24
SC16	0.25	2013	0.75	0.68	2.24	0.35
		2016	0.14	0.52	1.28	0.26
Oakbrook Creek						
SC36	0.5	2016	0.10	0.22	0.90	0.07
SC32	0.25	2013	0.22	0.31	0.89	0.05
		2016	0.16	0.55	0.52	0.09
Unnamed Tributary to Meacham Creek @RM (095-881)						
SC20	0.25	2013	0.33	0.35	1.86	0.15
		2016	0.33	0.20	0.50	0.20
Westwood Creek						
SC22	0.5	2013	0.09	0.25	1.30	0.18
		2016	0.10	0.33	1.16	0.17

[1]IPS ammonia-N aquatic life threshold (0.15 mg/L).
[2]U.S. EPA Ecoregion 54 reference target for nitrate (1.798 mg/L).
[3]Non-standards based numeric criteria for total nitrate (7.8 mg/L) in water based on the 85th percentile values determined from a statewide dataset from the Ambient Water Quality Monitoring Network, for water years 1978-1996 (Illinois EPA 2011).
[4]Illinois water quality criterion for nitrate-N (10.0 mg/L).
[5]IPS TKN aquatic life threshold (1.0 mg/L).
[6]U.S. EPA Ecoregion 54 reference target for total phosphorus (0.072 mg/L).
[7]Non-standards based numeric criteria for total phosphorus (0.61 mg/L) in water based on the 85th percentile values determined from a statewide set of observations from the Ambient Water Quality Monitoring Network, for water years 1978-1996 (Illinois EPA 2011).
[8]Suggested effluent limit for total phosphorus (1.0 mg/L).
[9]Eutrophication Criteria, Southern Minnesota (0.15 mg/L; Heiskary and Bouchard 2015).

likely to affect aquatic life (Table 17). The sum of 12 PAH compounds (Total PAH_{12} includes only parameters with detections) showed variable concentrations along the mainstem of Salt Creek with some values above the TEC screening threshold with variation between time periods as well (Figure 33). PAHs have numerous sources as a by-product of incomplete combustion of gasoline and the burning of coal and are common in urban areas. Coal Tar based sealants used

***Table 7**. Water column organic parameters with detects in then Salt Creek watershed during 2013. Values greater than acute or chronic Illinois water quality criteria for aquatic life are shaded.*

Site ID	River Mile	Year	Bromodi-chloro-methane µg/L	Chloro-dibromo-methane µg/L	Chloroform µg/L	1,2-Dichloro-ethane µg/L
Salt Creek						
SC43	29	2013	4.21	1.5	8.71	0.5BD
SC41	25	2013	2.17	0.5 BD	6.35	0.5 BD
SC40	24.5	2013	1.87	0.5 BD	5.40	0.5 BD
SC34	23.5	2013	1.46	0.5 BD	4.57	0.5 BD
SC34 Dup.		2013	1.38	0.5 BD	3.97	0.5 BD
SC35	23	2013	1.32	0.5 BD	5.27	0.5 BD
SC23	22.5	2013	1.60	0.5 BD	4.33	4.13
SC39	20.5	2013	0.5 BD	0.5 BD	1.74	0.5 BD
SC38	18	2013	0.5 BD	0.5 BD	1.75	0.5 BD
SC56	12.5	2013	0.5 BD	0.5 BD	1.70	0.5 BD
SC49	8	2013	0.5 BD	0.5 BD	1.59	0.5 BD
SC29	0.5	2013	0.5 BD	0.5 BD	1.67	0.50
SC24	10.5	2013	7.30	2.28	13.80	0.5 BD
SC21	6.5	2013	0.5 BD	0.5 BD	0.5 BD	0.5 BD
SC46	6	2013	1.43	0.5 BD	3.30	0.5 BD
SC47	2.5	2013	0.5 BD	0.5 BD	0.5 BD	0.5 BD
SC22	0.5	2013	0.5 BD	0.5 BD	0.5 BD	0.5 BD
Assessment Criteria						
		Acute	(10)	-	1900	25
		Chronic	(1)	-	150	4.5

Criteria values enclosed by "( )" were not calculated according to the regulations due to limited data - these values are used for advisory purposes such as establishing "reasonable potential".

on parking lots and driveways are another potential source of PAHs in the Salt Creek watershed.

Organochlorine pesticides were not detected in any of the samples and volatile organic compounds such as toluene, a commonly used industrial organic solvent and component of gasoline, were detected at only a few sites. Compared to 2013, the number of detections of metals exceeding PECs (McDonald et al. 2000) was less in 2016, whereas the number of PAH detections above TEC and PEC levels was roughly similar between the two years.

***Table 16**. Sediment samples and detect/non-detect counts in the Salt Creek study areas during 2013 and 2016. Shaded cells have at least one detection.*

Parameter	Analyte	Type	Sub-Type	Samples	Detects	Non-Detects
			PAHs			
P34208	Acenaphthene	OR	PAHs	49	6	43
P34203	Acenaphthylene	OR	PAHs	49	1	48
P34223	Anthracene	OR	PAHs	49	11	35
P34529	Benzo(a)anthracene	OR	PAHs	49	18	17
P34250	Benzo(a)pyrene	OR	PAHs	49	15	16
P34233	Benzo(b)fluoranthene	OR	PAHs	49	14	7
P34524	Benzo(g,h,i)perylene	OR	PAHs	49	16	14
P34245	Benzo(k)fluoranthene	OR	PAHs	49	18	18
P34323	Chrysene	OR	PAHs	49	17	10
P34559	Dibenz(a,h)anthracene	OR	PAHs	49	22	24
P34379	Fluoranthene	OR	PAHs	49	23	2
P34384	Fluorene	OR	PAHs	49	6	43
P34406	Indeno(1,2,3-cd)pyrene	OR	PAHs	49	15	17
P34445	Naphthalene	OR	PAHs	49	0	49
P34464	Phenanthrene	OR	PAHs	49	20	15
P34472	Pyrene	OR	PAHs	49	18	4
P39514	Aroclor 1016	OR	PCBs	49	0	49
P73155	Aroclor 1221	OR	PCBs	49	0	49
P39495	Aroclor 1232	OR	PCBs	49	0	49
P34499	Aroclor 1242	OR	PCBs	49	0	49
P39503	Aroclor 1248	OR	PCBs	49	0	49
P39507	Aroclor 1254	OR	PCBs	49	0	49
P39511	Aroclor 1260	OR	PCBs	49	2	47
P39311	4,4'-DDD	OR	Pesti	49	11	33
P39321	4,4'-DDE	OR	Pesti	49	11	32
P39301	4,4'-DDT	OR	Pesti	49	7	39
P39333	Aldrin	OR	Pesti	49	0	49
P39076	Alpha-BHC	OR	Pesti	49	0	49
P50784	Alpha-Chlordane	OR	Pesti	49	3	46
P33257	Beta-BHC	OR	Pesti	49	1	48
P39351	Chlordane	OR	Pesti	49	0	49
P34262	Delta-BHC	OR	Pesti	49	1	48
P39383	Dieldrin	OR	Pesti	49	0	49
P34364	Endosulfan I	OR	Pesti	49	0	49
P34359	Endosulfan II	OR	Pesti	49	0	49
P34354	Endosulfan sulfate	OR	Pesti	49	0	49
P39393	Endrin	OR	Pesti	49	0	49
P34369	Endrin aldehyde	OR	Pesti	49	0	49
P82557	Endrin ketone	OR	Pesti	49	0	49

***Table 16**. Sediment samples and detect/non-detect counts in the Salt Creek study areas during 2013 and 2016. Shaded cells have at least one detection.*

Parameter	Analyte	Type	Sub-Type	Samples	Detects	Non-Detects
P39343	Gamma-BHC	OR	Pesti	49	5	43
P49321	Gamma-Chlordane	OR	Pesti	49	2	47
P39413	Heptachlor	OR	Pesti	49	0	49
P39423	Heptachlor epoxide	OR	Pesti	25	0	25
P39481	Methoxychlor	OR	Pesti	25	0	25
P39403	Toxaphene	OR	Pesti	49	0	49
P75078	2-Butanone	OR	Semi-	49	0	49
NEW2	2-Chloroethyl vinyl ether	OR	Semi-	49	0	49
P75169	4-Methyl-2-pentanone	OR	Semi-	49	0	49
P34309	Dibromochloromethane	OR	Semi-	49	0	49
P34309	Dibromomethane	OR	Semi-	49	0	49
P34334	Dichlorodifluoromethane	OR	Semi-	49	0	49
P34509	1,1,1-Trichloroethane	OR	Volat	25	0	25
P34519	1,1,2,2-Tetrachloroethane	OR	Volat	49	0	49
P34514	1,1,2-Trichloroethane	OR	Volat	49	0	49
P34514	1,1,2-Trichloroethane	OR	Volat	49	0	49
P34499	1,1-Dichloroethane	OR	Volat	98	0	98
P34504	1,1-Dichloroethene	OR	Volat	49	0	49
P34504	1,1-Dichloroethene	OR	Volat	49	0	49
P38440	1,2-Dibromo-3-chloropropane	OR	Volat	49	0	49
P34539	1,2-Dichlorobenzene	OR	Volat	49	0	49
P34534	1,2-Dichloroethane	OR	Volat	49	0	49
P34544	1,2-Dichloropropane	OR	Volat	49	0	49
P34569	1,3-Dichlorobenzene	OR	Volat	49	0	49
P34574	1,4-Dichlorobenzene	OR	Volat	49	0	49
P75166	2-Hexanone	OR	Volat	49	0	49
P75059	Acetone	OR	Volat	49	9	36
P34213	Acrolein	OR	Volat	25	0	25
P34218	Acrylonitrile	OR	Volat	25	0	25
P34237	Benzene	OR	Volat	49	0	49
P34330	Bromodichloromethane	OR	Volat	49	0	49
P34290	Bromoform	OR	Volat	49	0	49
P34416	Bromomethane	OR	Volat	49	0	49
P78544	Carbon disulfide	OR	Volat	49	0	49
P34299	Carbon tetrachloride	OR	Volat	49	0	49
P34304	Chlorobenzene	OR	Volat	49	0	49
P34314	Chloroethane	OR	Volat	49	0	49
P34318	Chloroform	OR	Volat	49	0	49
P34421	Chloromethane	OR	Volat	49	0	49
P34374	Ethylbenzene	OR	Volat	49	0	49

***Table 16**. Sediment samples and detect/non-detect counts in the Salt Creek study areas during 2013 and 2016. Shaded cells have at least one detection.*

Parameter	Analyte	Type	Sub-Type	Samples	Detects	Non-Detects
P50928	Methyl tert-butyl ether	OR	Volat	49	1	47
P34426	Methylene chloride	OR	Volat	49	0	49
P75192	Styrene	OR	Volat	49	0	49
P34478	Tetrachloroethene	OR	Volat	49	0	48
P34483	Toluene	OR	Volat	49	2	47
P34487	Trichloroethene	OR	Volat	49	1	48
P34491	Trichlorofluoromethane	OR	Volat	49	0	49
P34495	Vinyl chloride	OR	Volat	49	0	49
P34020	Xylenes, Total	OR	Volat	49	0	49
P78497	cis-1,2-Dichloroethene	OR	Volat	49	0	49
P34702	cis-1,3-Dichloropropene	OR	Volat	49	0	49
P179601231	m,p-Xylene	OR	Volat	49	0	49
P78785	o-Xylene	OR	Volat	49	0	49
P34549	trans-1,2-Dichloroethene	OR	Volat	49	0	49
P34697	trans-1,3-Dichloropropene	OR	Volat	49	0	49
Heavy Metals						
P1003	Arsenic	SM	Metal	49	38	11
P1008	Barium, Total (mg/kg)	SM	Metal	49	49	0
P1028	Cadmium	SM	Metal	49	49	0
P1029	Chromium	SM	Metal	49	49	0
P1043	Copper	SM	Metal	49	49	0
P1170	Iron	SM	Metal	29	29	0
P1052	Lead	SM	Metal	49	49	0
P1053	Manganese	SM	Metal	49	49	0
P71921	Mercury	SM	Metal	49	36	13
P1068	Nickel	SM	Metal	49	49	0
P938	Potassium	SM	Metal	49	3	0
P1078	Silver	SM	Metal	49	34	15
P1093	Zinc	SM	Metal	48	48	0

***Table 17**. PAH compounds measured in sediment samples from the Salt Creek watershed in 2013 and 2016. Values above various screening benchmarks are highlighted with criteria at bottom of table.*

Site ID	River Mile	Year	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
Salt Creek																		
SC15	32.0	2013	71	71	71	812	71	2060	71	778	71	300	2960	71	71	71	811	2270
		2016	249	66.5	947	66.5	66.5	66.5	66.5	66.5	66.5	66.5	25	375	66.5	66.5	66.5	66.5
SC44	29.3	2016	65.5	65.5	65.5	65.5	65.5	263	144	65.5	199	65.5	259	65.5	65.5	65.5	65.5	243
SC43	29.0	2013	96	96	96	96	96	217	96	96	96	96	299	96	96	96	96	260
		2016	108	108	108	977	108	108	108	731	108	108	108	108	929	108	618	108
SC42	27.0	2013	68	68	68	68	68	183	68	68	145	68	239	68	68	68	68	207
		2016	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	101.5	307	101.5	101.5	101.5	101.5	255
SC41	25.0	2013	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5
		2016	64.5	64.5	64.5	420	64.5	64.5	589	270	718	64.5	64.5	64.5	472	64.5	327	64.5
SC40	24.5	2013	68	68	68	68	176	337	188	68	221	68	329	68	68	68	139	357
		2016	63	63	63	986	63	63	63	703	63	228	63	63	63	63	838	63
SC34	23.5	2013	98.5	98.5	98.5	98.5	98.5	345	98.5	98.5	204	98.5	311	98.5	98.5	98.5	98.5	353
SC35	23.0	2013	77.5	77.5	77.5	77.5	77.5	226	77.5	77.5	77.5	77.5	217	77.5	77.5	77.5	77.5	245
SC23	22.5	2013	66.5	66.5	66.5	66.5	66.5	153	66.5	66.5	66.5	66.5	224	66.5	66.5	66.5	66.5	193
		2016	89	89	89	540	658	89	720	402	971	89	89	89	606	89	466	89
SC39	20.5	2016	64.5	64.5	64.5	812	987	64.5	899	482	64.5	143	64.5	64.5	711	64.5	545	64.5
SC38	18.0	2013	78	78	78	555	828	78	721	516	913	188	78	78	628	78	548	78
		2016	54	54	54	770	998	54	976	594	54	154	54	54	774	54	703	54
SC37	17.5	2016	68.5	68.5	175	68.5	68.5	68.5	68.5	68.5	68.5	331	68.5	68.5	68.5	68.5	68.5	68.5
SC51	17.0	2016	67	67	139	67	67	67	67	789	67	270	67	67	67	67	67	67
SC56	12.5	2013	66	66	66	66	66	66	66	66	66	66	189	66	66	66	66	66

***Table 17**. PAH compounds measured in sediment samples from the Salt Creek watershed in 2013 and 2016. Values above various screening benchmarks are highlighted with criteria at bottom of table.*

Site ID	River Mile	Year	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
SC53	11.0	2013	72	72	72	72	72	72	72	72	161	72	311	72	72	72	72	222
		2016	73	73	182	73	73	73	73	73	73	361	73	73	73	73	73	73
SC52	10.5	2013	73.25	73.25	73.25	347.5	536.5	296.3	477.5	274	610.5	127.5	430.8	73.25	410	73.25	334.5	350.3
		2016	72.5	72.5	224	72.5	72.5	72.5	72.5	72.5	72.5	485	72.5	72.5	72.5	72.5	72.5	72.5
SC49	8.0	2013	65	65	65	65	65	65	65	65	65	65	237	65	65	65	65	194
		2016	57.5	57.5	161	57.5	57.5	57.5	57.5	57.5	57.5	296	57.5	57.5	57.5	57.5	57.5	57.5
SC54	3.0	2013	58	58	58	58	58	58	58	58	58	58	144	58	58	58	58	58
		2016	203	73	604	73	73	73	73	73	73	566	73	252	73	73	73	73
SC29	0.5	2013	67	67	67	175	222	274	159	67	258	67	498	67	136	67	154	364
		2016	83	83	346	83	83	83	83	83	83	719	83	83	83	83	83	83
Arlington Heights Branch																		
SC45	1.5	2013	85.5	85.5	85.5	493	811	85.5	739	487	947	193	85.5	85.5	627	85.5	683	85.5
		2016	287	81.5	81.5	81.5	81.5	81.5	81.5	81.5	81.5	81.5	19	427	81.5	81.5	81.5	81.5
Unnamed Tributary to Salt Creek @RM (95-855)																		
SC11	4.0	2016	68	68	228	68	68	68	68	68	68	353	68	68	68	68	68	68
Addison Creek																		
SC48	2.5	2013	63	63	63	610	883	63	887	472	63	239	63	63	732	63	571	63
		2016	574	206	83	83	83	83	83	83	83	83	20	809	83	83	83	14
SC28	1.5	2013	60	60	60	437	608	60	552	301	809	159	60	60	471	60	494	60
		2016	425	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	888	13	634	66.5	66.5	66.5	66.5

***Table 17**. PAH compounds measured in sediment samples from the Salt Creek watershed in 2013 and 2016. Values above various screening benchmarks are highlighted with criteria at bottom of table.*

Site ID	River Mile	Year	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(g,h,i)perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
Spring Brook																		
SC21	6.5	2013	57.5	57.5	57.5	57.5	160	312	162	121	204	57.5	286	57.5	57.5	57.5	141	349
		2016	161	59	369	59	59	59	59	59	59	539	59	261	59	59	59	59
SC46	6.0	2013	62.5	62.5	62.5	62.5	62.5	220	62.5	62.5	146	62.5	214	62.5	62.5	62.5	62.5	241
		2016	66	66	177	66	66	66	66	66	66	312	66	66	66	66	66	66
SC47	2.5	2013	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151	151
		2016	140	140	140	407	637	140	630	393	732	140	140	140	477	140	294	140
SC16	0.25	2013	61.5	61.5	61.5	61.5	61.5	159	61.5	61.5	61.5	61.5	155	61.5	61.5	61.5	61.5	174
		2016	81	81	81	871	996	81	81	665	81	183	81	81	957	81	693	81
Westwood Creek																		
SC22	0.5	2013	57.5	57.5	57.5	168	236	396	223	130	298	57.5	543	57.5	179	57.5	176	468
		2016	85.5	85.5	85.5	989	85.5	85.5	85.5	775	85.5	208	85.5	85.5	85.5	85.5	792	85.5
Sediment Assessment Thresholds																		
		TEL	6.7	5.87	46.9	31.7	31.9	**None**	**None**	**None**	57.1	6.22	111	77.4	**None**	34.6	41.9	53
		PEL	88.9	128	245	385	782	**None**	**None**	**None**	862	135	2,355	144	**None**	391	875	875
		TEC	**None**	**None**	57.2[a]	108	150	240	170	240	166	33[a]	423	77.4	200	176	204	195
		PEC	**None**	**None**	845	1050	1450	13400	320	13,400	1,290	135	2,230	536	3,200	561	1,170	1,520
		LEL	**None**	**None**	220	320	150	**None**	170	240	340	60	750	190	200	None	560	490
		SEL	**None**	**None**	3,700	14,800	14,400	**None**	3,200	13,400	4,600	1,300	10,200	1,600	3,200	None	9,500	8,500

[a] Below detection

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	A
Oak Meadows Dam (removed)	22.8	B
Graham Center Dam	16.5	C
Old Oak Brook Dam	12.5	D
Fullersburg Woods Dam	10.5	E
Possum Hollow Woods Dam	6.0	F

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	1
Itasca STP	28.3	2
Wood Dale North STP	27.7	3
Wood Dale South STP	26.4	4
Addison North STP	26.3	5
Addison S.- Larocca STP	23.6	6
Salt Creek Sanitary D.	20.1	7
Elmhurst WWTP	19.9	8

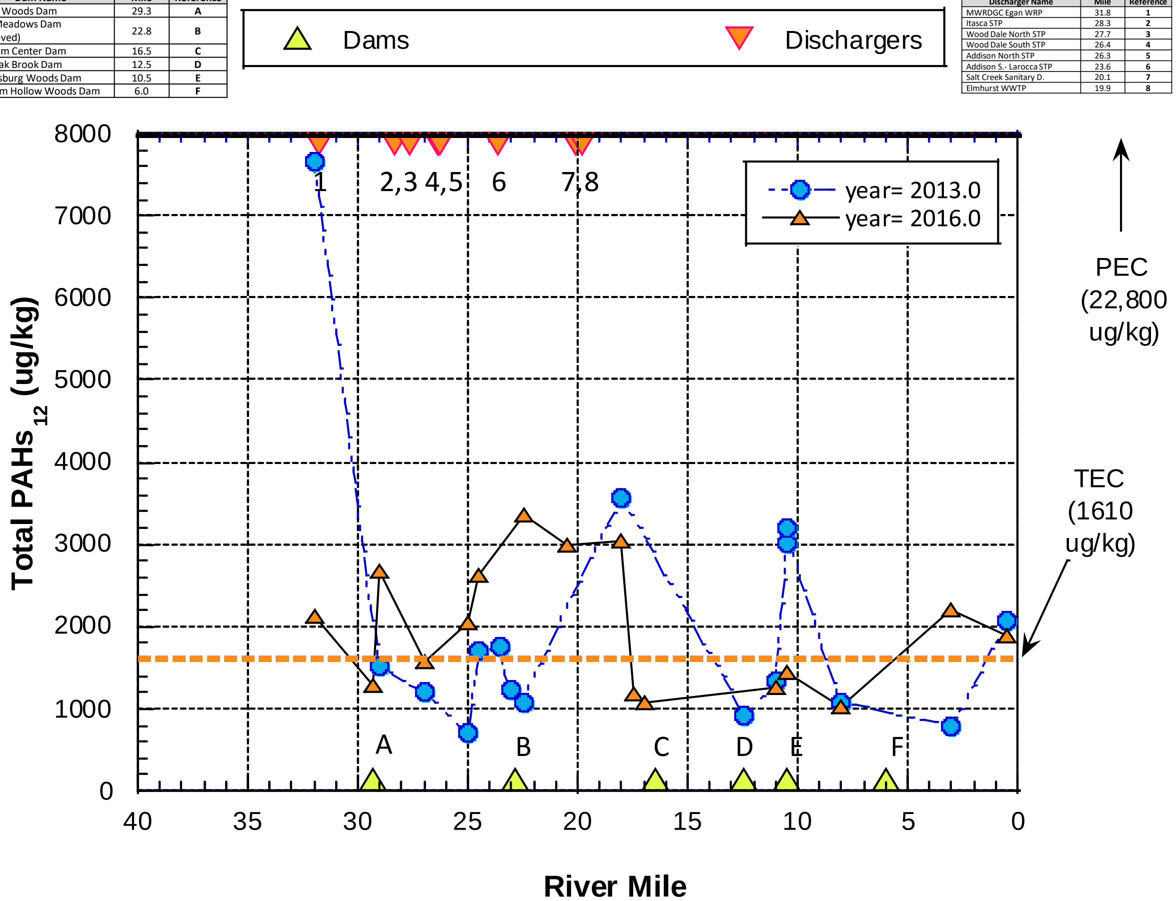


***Figure 33**. Total PAHs (sum of 12 detected compounds of 16 analyzed) in the Salt Creek mainstem during 2013 and 2016. Orange dashed line is the TEC value for total PAHs.*

Physical Habitat Quality for Aquatic Life

Salt Creek Mainstem

Physical habitat quality was evaluated using the Qualitative Habitat Evaluation Index (QHEI) at 23 sites along the Salt Creek mainstem in 2013 and 2016. Most of the sites possessed the types and amounts of habitat features necessary to support aquatic life consistent with the Illinois General Use (Figure 33), with QHEI scores averaging 66.0 (range: 41.5-92.0) in 2013 and 64.3 (range: 38.0-86.5) in 2016. The longitudinal pattern in habitat quality was consistent between all years (2007, 2010, 2013 and 2016) with habitat generally improving in a downstream direction except where it is influenced by impoundments (Figure 34). Habitat was generally the lowest quality in the headwaters and in impoundments formed by low head dams. As in 2007 and 2010, the total number of modified attributes relative to the number of good attributes at any given site generally did not overwhelm the capacity of a site to support aquatic life consistent with the Illinois General Use in 2013 and 2016, excepting in the impoundments formed by low head dams and a single site in Addison Creek (Table 18). The attributes of the QHEI that are most consistently limiting to aquatic life are the embeddedness and siltation attributes with most sites having moderate-high silt cover and moderate-extensively embedded substrates. The prevalence of coarse substrates can support good biological potential if the delivery of fine materials within the watershed can be better controlled.

Salt Creek Tributaries

Habitat quality in the tributaries to Salt Creek varied between tributaries and from site-to-site, although habitat quality did not vary appreciably over time between each of the four major survey years (2007, 2010, 2013, 2016, Figure 34). Based on data collected throughout the Midwest, the accumulation of habitat attributes within a watershed or river segment provides for a better representation of biological potential than single, site-based measures of habitat. Where habitat quality varies widely over a reach or within a subwatershed, the reach or subwatershed average tends to be a better predictor of aquatic life than the local habitat quality. Figure 35 is a box-and-whisker plot of QHEI scores by sub-watershed ordered by the 2016 median QHEI. Although there is variation within any subwatershed, cumulative habitat impacts were the greatest in Addison Creek. Most of the other subwatersheds had sites with excellent habitat quality, but combined with other sites that were of fair quality and even a few rated as poor quality. A combination of localized channelization and riparian encroachment contributed to the variation in stream habitat quality along with the more widespread occurrence of siltation and embedded substrates.

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

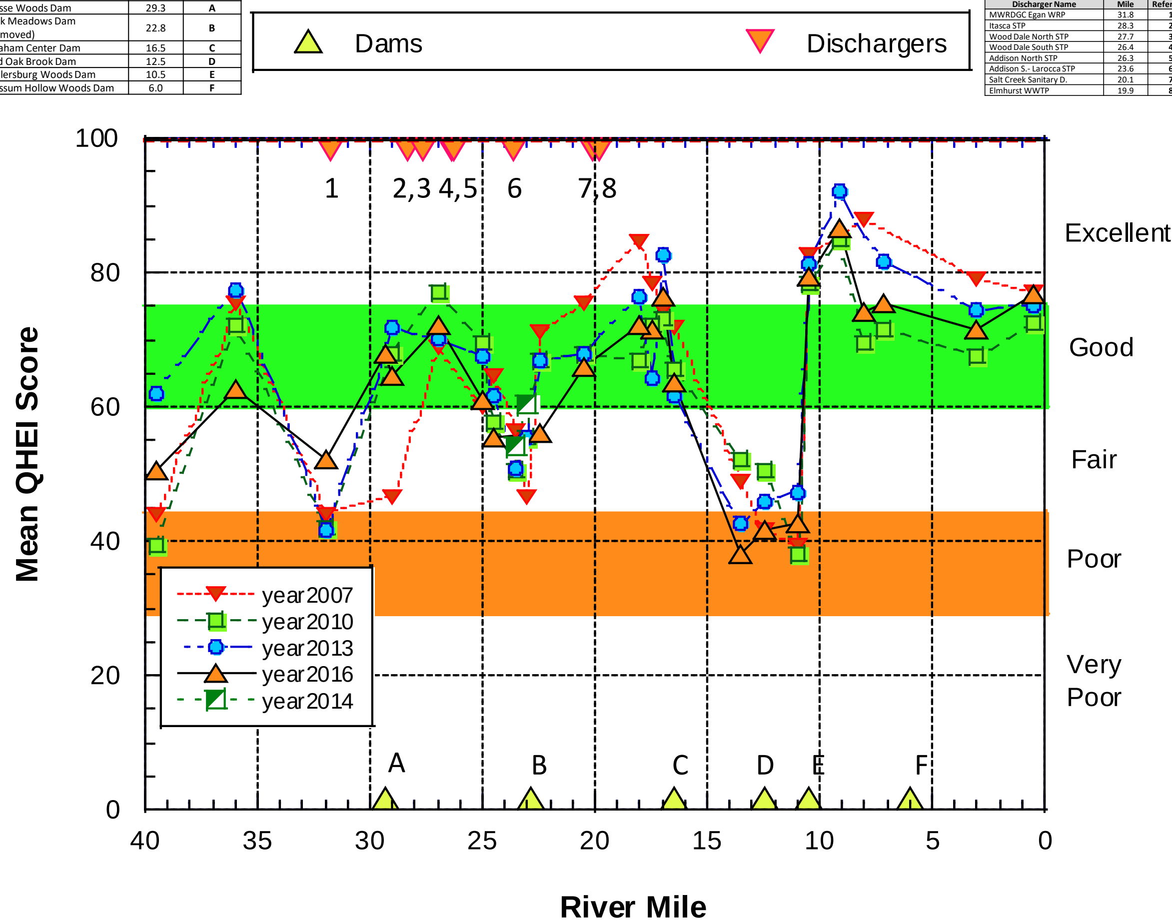


***Figure 34**. Qualitative Habitat Evaluation Index (QHEI) scores for Salt Creek plotted by river mile for data from 2007, 2010, 2013, 2014, and 2016. The orange-shaded region depicts the range of QHEI scores where habitat quality is marginal and limiting to aquatic life. QHEI scores less than 45 are typical of highly modified channels. The triangles arrayed along the x-axis in both plots show the locations of low-head dams.*

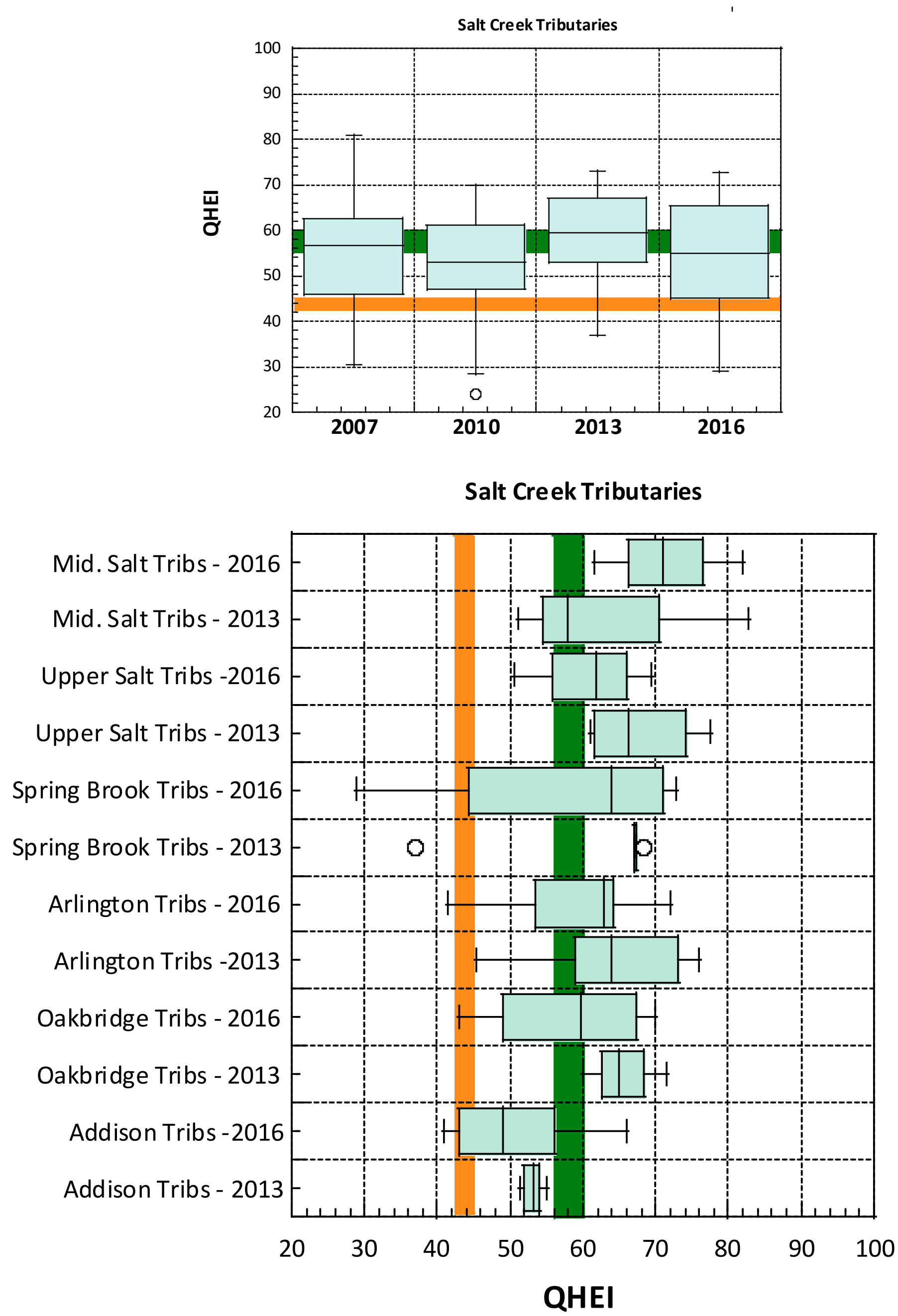


***Figure 35**. Box and whisker plot of Qualitative Habitat Evaluation Index (QHEI) scores for Salt Creek tributaries plotted by subwatershed for 2013 and 2016. The orange-shaded region depicts the range of QHEI scores where habitat quality is marginal and limiting to aquatic life. QHEI scores less than 45 are typical of highly modified channels. The green-shaded region depicts the range of QHEI scores associated with good or better biological assemblages.*

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											**High Influence Modified Attributes**						**Moderate Influence Modified Attributes**													**Ratios**	
Site ID	**River Mile**	**QHEI**	**No Channelization**	**Boulder, Cobble, Gravel**	**Silt Free**	**Good-Excellent Development**	**Moderate-High Sinuosity**	**Moderate-Extensive Cover**	**Fast Flow w Eddies**	**Little to No Embeddedness**	**Max Depth > 40 cm**	**No Riffle Embeddedness**	**"Good" Habitat Attributes**	**Channelized or No Recovery**	**Silt/Muck Substrates**	**No Sinuosity**	**Sparse No Cover**	**Max Depths <40 cm**	**High Influence Poor Attributes**	**Recovering from Channelization**	**Mod-High Silt Cover**	**Sand Substrates (Boatable sites)**	**Hardpan Origin**	**Fair- Poor Development**	**Low Sinuosity**	**≤ 2 Cover Types**	**Intermittent Flow or Pools <20 cm**	**No Fast Current Types**	**Mod-Extensive Embeddedness**	**Mod-Extensive Riffle**	**No Riffle**	**Poor Habitat Attributes**	**Ratio of Poor (High) to Good**	**Ratio of Poor (All) to Good**
Salt Creek 2016																																		
SC03	43.3	69.3	■			■	■	■			■	■	6						0		●							●	●			3	0.00	0.50
SC04	39.5	50.5							■	■			2	●		●	●	●	4	●				●						●		3	2.00	3.50
SC07	36.0	62.5		■			■	■			■		4						0	●	●			●				●	●	●		6	0.00	1.50
SC15	32.0	52.0						■			■		2	●		●	●		3		●			●				●	●		●	5	1.50	4.00
SC15	31.8	68.0		■				■	■		■		4	●					1	●	●			●	●			●	●	●		7	0.25	2.00
SC43	29.0	64.5	■	■		■	■	■		■	■		7						0					●				●		●		3	0.00	0.43
SC42	27.0	72.0	■	■		■	■	■	■		■		7						0	●	●							●	●	●		5	0.00	0.71
SC41	25.0	61.0						■	■		■		3						0	●	●			●	●				●	●		6	0.00	2.00
SC40	24.5	55.5		■			■	■	■		■		5		●				1	●	●			●				●	●	●		6	0.20	1.40
SC23	22.5	56.0					■	■	■		■		4						0	●	●			●					●	●		5	0.00	1.25
SC39	20.5	66.0	■	■			■	■	■		■		6						0		●			●					●	●		4	0.00	0.67
SC38	18.0	72.3		■		■		■	■		■	■	6						0	●	●				●				●			4	0.00	0.67
SC37	17.5	71.5	■	■		■	■	■	■		■		7						0		●								●	●		3	0.00	0.43
SC51	17.0	76.5	■	■		■	■	■	■		■		7						0		●								●	●		3	0.00	0.43
SC57	16.5	63.5		■				■			■		3						0	●	●			●	●			●	●	●		7	0.00	2.33

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
SC55	13.5	38.0						■			■		2		●				1		●			●	●			●	●		●	6	0.50	3.50
SC56	12.5	41.5						■			■		2		●	●			2		●			●				●	●		●	5	1.00	3.50
SC53	11.0	42.5					■	■			■		3		●				1		●			●	●			●	●		●	6	0.33	2.33
SC52	10.5	79.5	■	■		■	■	■	■	■	■		8						0		●									●		2	0.00	0.25
SC59	9.10	86.5	■	■		■	■	■	■	■	■	■	9						0		●											1	0.00	0.11
SC49	8.00	74.0		■		■		■	■	■	■		6						0	●	●			●	●					●		5	0.00	0.83
SC60	7.20	75.5	■	■		■	■	■	■		■		7						0		●			●				●	●	●		5	0.00	0.71
SC54	3.00	71.5		■				■	■		■	■	5						0	●	●			●	●				●			5	0.00	1.00
SC29	0.50	76.8		■		■	■	■	■		■	■	7						0	●	●								●			3	0.00	0.43
Salt Creek 2013																																		
SC03	43.3	70.5		■		■	■	■		■	■	■	7						0	●	●							●		●		4	0.00	0.57
SC04	39.5	62.0		■		■		■	■		■		5						0	●					●				●	●		4	0.00	0.80
SC07	36.0	77.5	■	■		■	■	■		■	■	■	8						0		●							●				2	0.00	0.25
SC15	32.0	41.5						■			■		2		●	●			2		●			●				●	●		●	5	1.00	3.50
SC43	29.0	71.8		■			■	■	■	■	■	■	7						0	●				●								2	0.00	0.29
SC42	27.0	70.3	■	■		■	■	■	■		■		7						0										●	●		2	0.00	0.29
SC41	25.0	67.5		■		■	■	■	■		■		6						0	●	●								●	●		4	0.00	0.67

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
SC40	24.5	61.5		■			■	■	■		■		5						0	●				●					●	●		4	0.00	0.80
SC34	23.5	51.0					■	■			■		3		●				1	●	●			●				●	●		●	6	0.33	2.33
SC35	23.0	55.5		■			■	■			■		4						0	●	●			●				●	●		●	6	0.00	1.50
SC23	22.5	67.0		■			■	■	■		■		5						0	●	●			●					●	●		5	0.00	1.00
SC39	20.5	67.8	■	■			■	■	■		■		6						0		●			●					●	●		4	0.00	0.67
SC38	18.0	76.5		■		■	■	■	■	■	■	■	8						0	●												1	0.00	0.13
SC37	17.5	64.3		■			■	■	■	■	■		6						0	●	●			●						●		4	0.00	0.67
SC51	17.0	82.8	■	■		■	■	■	■	■	■	■	9						0													0	0.00	0.00
SC57	16.5	61.5		■				■	■		■		4	●					1		●			●	●				●	●		5	0.25	1.50
SC55	13.5	42.5		■				■			■		3			●			1		●			●				●	●		●	5	0.33	2.00
SC56	12.5	46.0		■				■			■		3			●			1		●			●				●	●		●	5	0.33	2.00
SC53	11.0	47.3		■				■			■		3						0		●			●	●			●	●		●	6	0.00	2.00
SC52	10.5	81.3		■		■	■	■	■	■	■	■	8						0	●												1	0.00	0.13
SC59	9.10	92.0	■	■		■	■	■	■	■	■	■	9						0													0	0.00	0.00
SC60	7.20	81.5	■	■		■	■	■	■		■		7						0										●	●		2	0.00	0.29
SC54	3.00	74.5		■			■	■	■		■	■	6						0	●	●			●					●			4	0.00	0.67
SC29	0.50	75.0		■		■	■	■	■	■	■	■	8						0	●	●											2	0.00	0.25

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
Arlington Heights Branch 2016																																		
SC06	4.00	41.5						■	■				2			●	●	●	3	●	●			●					●	●		5	0.50	2.00
SC45	1.50	64.3		■				■	■	■	■		5						0	●				●	●					●		4	1.20	0.83
SC08	0.25	53.5		■				■			■		3			●	●		2	●				●	●			●	●	●		6	0.60	1.75
Arlington Heights Branch 2013																																		
SC06	4.00	45.5		■				■			■		3	●	●	●	●		4		●			●				●	●	●		5	1.33	3.00
SC45	1.50	64.0		■				■	■	■	■		5			●			1	●				●						●		3	0.20	0.80
SC08	0.25	59.0		■				■		■	■		4			●			1	●	●			●				●		●		5	0.25	1.50
Baldwin Creek 2016																																		
SC05	2.00	63.0	■			■	■	■	■		■		6						0		●								●	●		3	0.00	0.50
Baldwin Creek 2013																																		
SC05	2.00	73.0	■	■		■	■	■	■		■		7						0		●								●	●		3	0.00	0.43
Unnamed Tributary to Arlington Heights Branch @RM 4.14 - 2016																																		
SC01	5.17	72.0	■	■		■	■	■			■	■	7						0		●							●	●	●		4	0.00	0.63
Unnamed Tributary to Arlington Heights Branch @RM 4.14 - 2013																																		
SC01	5.17	72.0	■	■		■	■	■	■		■		7						0										●	●		2	0.00	0.29

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
Unnamed Tributary to Salt Creek @RM 42.8 - 2016																																		
SC02	0.25	61.0	■		■	■	■	■	■	■			7					●	1											●		1	0.14	0.25
Unnamed Tributary to Salt Creek @RM 42.8 - 2013																																		
SC02	0.25	61.0	■			■	■	■		■		■	6					●	1				●					●				2	0.17	0.50
West Branch Salt Creek 2016																																		
SC11	4.00	61.5	■	■		■	■	■	■		■		7						0	●	●								●	●		4	0.00	0.63
SC14	2.50	82.0	■	■	■	■	■	■	■	■	■		9						0											●		1	0.00	0.20
West Branch Salt Creek 2013																																		
SC11	4.00	51.0		■				■					2					●	1	●	●			●	●			●	●	●		7	0.50	4.00
SC14	2.50	82.8		■		■	■	■	■	■	■	■	8						0	●												1	0.00	0.13
Yeargin Creek 2016																																		
SC12	0.25	71.0	■	■	■	■	■	■	■	■	■	■	10						0											●		1	0.00	0.18
Yeargin Creek 2013																																		
SC12	0.25	58.0				■	■	■			■		4						0	●	●							●	●	●		5	0.00	1.25
Ginger Creek 2016																																		
SC30	1.50	70.0		■				■	■	■	■	■	6			●			1	●	●			●								3	0.17	0.57

Table 8*. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
Ginger Creek 2013																																		
SC30	1.50	71.5		■				■	■		■	■	5			●			1	●	●			●					●			4	0.20	1.00
Sugar Creek 2016																																		
SC33	0.25	43.0		■					■		■		3	●		●	●		3		●			●					●	●		4	1.00	1.33
Sugar Creek 2013																																		
SC33	0.25	60.0		■				■		■		■	4			●		●	2	●	●			●				●				4	0.50	1.50
Addison Creek 2016																																		
SC24	10.5	41.0						■			■		2	●	●	●			3		●			●				●	●		●	5	1.50	4.00
SC26	8.00	66.0		■		■		■	■		■	■	6			●			1	●	●								●	●		4	0.17	0.71
SC27	5.00	56.0		■				■	■		■	■	5	●		●			2		●			●	●				●	●		5	0.40	1.00
SC48	2.50	47.5									■		1	●		●	●		3		●			●				●	●		●	5	3.00	8.00
SC28	1.50	43.0						■			■		2	●		●	●		3		●			●				●	●		●	5	1.50	4.00
Addison Creek 2013																																		
SC24	10.5	54.0		■				■			■		3	●		●			2		●			●				●	●		●	5	0.67	2.33
SC26	8.00	51.5		■				■			■		3	●		●			2		●			●				●	●	●		5	0.67	2.33
SC27	5.00	53.5		■				■	■	■	■	■	6	●					1					●	●							2	0.17	0.50
SC48	2.50	52.0		■				■			■		3	●		●			2		●			●				●	●		●	5	0.67	2.33

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
SC28	1.50	55.0		■				■			■		3	●		●			2		●			●				●	●	●		5	0.67	2.33
Unnamed Tributary to Addison Creek @RM 10.35 -2016																																		
SC25	0.50	50.5		■			■	■			■		4				●		1	●	●			●	●			●	●	●		7	0.25	2.00
Unnamed Tributary to Addison Creek @RM 10.35 -2013																																		
SC25	0.50	53.0		■			■	■					3				●	●	2	●	●			●				●	●	●		6	0.67	2.67
Spring Brook 2016																																		
SC21	6.50	72.8		■		■	■	■	■	■	■	■	8						0	●					●					●		3	0.00	0.38
SC46	6.00	69.5		■		■	■	■	■	■	■		7						0	●					●					●		3	0.00	0.43
SC18	4.50	72.3	■	■	■	■		■	■	■	■		8						0	●					●					●		3	0.00	0.38
SC47	2.50	64.0				■		■	■		■	■	5						0	●	●			●	●				●			5	0.00	1.00
SC16	0.25	47.0						■			■		2		●	●			2	●	●			●				●	●	●		6	1.00	4.00
Spring Brook 2013																																		
SC21	6.50	67.3		■		■	■	■	■	■	■	■	8						0	●	●											2	0.00	0.25
SC46	6.00	67.0		■		■		■			■		4						0	●	●				●			●	●	●		6	0.00	1.50
SC18	4.50	67.0		■				■			■	■	4						0	●				●	●			●	●			5	0.00	1.25
SC47	2.50	68.5		■				■	■		■		4			●			1	●	●			●					●	●		5	0.25	1.50
SC16	0.25	67.0		■				■	■		■		4			●			1	●	●			●					●	●		5	0.25	1.50

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (🟦- good habitat attribute; 🔴 - high influence modified attribute; 🟡- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
Oakbrook Creek 2016																																		
SC36	0.50	55.0		🟦		🟦		🟦					3					🔴	1	🟡	🟡			🟡	🟡			🟡	🟡	🟡		7	0.67	2.67
SC32	0.25	64.5						🟦	🟦		🟦		3			🔴			1	🟡	🟡			🟡					🟡	🟡		5	0.67	2.00
Oakbrook Creek 2013																																		
SC36	0.50	65.0		🟦		🟦		🟦	🟦	🟦		🟦	6					🔴	1	🟡					🟡							2	0.17	0.50
SC32	0.25	65.0		🟦				🟦	🟦		🟦	🟦	5			🔴			1	🟡	🟡			🟡					🟡			4	0.20	1.00
Unnamed Tributary to Meacham Creek @RM 1.9 - 2016																																		
SC20	0.25	41.5						🟦			🟦		2		🔴	🔴	🔴		3	🟡	🟡			🟡	🟡			🟡	🟡		🟡	7	1.50	5.00
Unnamed Tributary to Meacham Creek @RM 1.9 - 2013																																		
SC20	0.25	37.0						🟦			🟦		2	🔴	🔴	🔴			3		🟡			🟡				🟡	🟡		🟡	5	1.50	4.00
Westwood Creek 2016																																		
SC22	0.50	51.5		🟦				🟦	🟦		🟦		4						0	🟡	🟡			🟡	🟡				🟡	🟡		6	0.00	1.50
Westwood Creek 2013																																		
SC22	0.50	53.0		🟦				🟦			🟦		3			🔴			1	🟡	🟡			🟡				🟡	🟡	🟡		6	0.33	2.33
Meacham Creek - 2016 (only)																																		
SC17	0.40	29.0									🟦		1	🔴	🔴		🔴		3		🟡			🟡	🟡			🟡	🟡		🟡	6	3.00	9.00

***Table 8**. Qualitative Habitat Evaluation Index (QHEI) scores showing Good and Modified Habitat attributes at sites in the Salt Creek drainage and reference sites sampled in 2016 and 2013. (■- good habitat attribute; ● - high influence modified attribute; ●- moderate influence modified attribute). Color code legend for modified:good ratios: yellow – altered; orange – moderately altered; red – severely altered.*

			Good Habitat Attributes											High Influence Modified Attributes						Moderate Influence Modified Attributes													Ratios	
Site ID	River Mile	QHEI	No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	"Good" Habitat Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development	Low Sinuosity	≤ 2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness	Mod-Extensive Riffle	No Riffle	Poor Habitat Attributes	Ratio of Poor (High) to Good	Ratio of Poor (All) to Good
Indian Creek (Reference Site) 2013																																		
I-2	16.0	78.5	■	■		■		■	■	■	■	■	8						0						●							1	0.00	0.14
Little Indian Creek (Reference Site) 2013																																		
I-3	5.10	83.5	■	■		■	■	■	■		■	■	8						0										●			1	0.00	0.14
Prairie Run (Reference Site) 2016																																		
FA-01	0.15	82.0	■	■		■		■	■	■	■	■	8						0		●				●							2	0.00	0.25
Aux Sable Creek (Reference Site) 2016																																		
DW07	17.5	83.0	■	■		■		■	■	■	■	■	8						0		●				●							2	0.00	0.25
DW01	6.40	89.3	■	■		■		■	■	■	■	■	8						0						●							1	0.00	0.14

Biological Assemblages – Fish

Salt Creek Mainstem

Fish assemblages sampled in Salt Creek mainstem in 2016 were consistently in poor condition upstream from the Graue Mill Dam and mostly fair downstream to the confluence with the Des Plaines River (Figure 36). This was similar to the pattern observed in 2013 although fIBI scores were slightly higher than in 2016 at most sites in the lower one-half of the mainstem (Figure 36). In fact, the general response of the fish assemblage was similar longitudinally among all four survey periods (Figure 36). The two sites immediately downstream from the Graue Mill Dam with an fIBI of 32 in 2013 and 25 in 2016 and the sites immediately below the dam with the only MIwb score in the good range in both 2013 and 2016 (Figure 37).

The Graue Mill Dam is a barrier to upstream fish movement with 17 of 53 fish species found only downstream from the dam and only two species found exclusively upstream (Table 18). Many of the species only found downstream should have populations that extend well upstream from the dam (Johnny Darter, Smallmouth Bass, Rock Bass, Hornyhead Chub, etc.). The dam acting as a barrier is a key factor that limits the ability of certain species to recolonize the upper reaches of Salt Creek as formerly precluding stressors (e.g., D.O., siltation, organic enrichment) are resolved. This also has the potential to limit IBI and MIwb scores relative to the potentially limiting effects of other stressors.

Salt Creek Tributaries

There was a wide variation in fIBI scores among the tributaries with no sites meeting the General Use fIBI threshold and many sites in poor condition (Figure 38, upper left). Sites in the Addison Creek subwatershed had the lowest fIBI scores with most rated as poor across all years. This generally matches the pattern observed with the QHEI in Addison Creek that reflects uniformly poor habitat. However, Addison Creek also has several water quality stressors and poor habitat condition in other tributaries did not result in the same skew of fIBI scores in the poor range.

Biological Assemblages – Macroinvertebrates

Salt Creek Mainstem

In 2013 and 2016 the macroinvertebrate assemblages in the Salt Creek mainstem were rated fair at most sites upstream from the Graue Mill Dam, and good at four and fair at two of the six sites downstream from the dam with 2007 having the better results (Figure 39). Longitudinally, scores declined downstream from Spring Brook relative to those upstream. The confluence with Spring Brook marks the reach where multiple WWTPs discharge in short succession.

Salt Creek Tributaries

Figure 40 shows mIBI results for the lower part of Salt Creek (<RM 10), the upstream reaches of Salt Creek, and in tributaries for each of the four survey years. While there was a clear pattern between the three spatial groupings, there was little to no difference between the four survey

***Table 19**. Fish species collected upstream (U) and downstream (D) of the Graue Mill (Fullersburg Woods) dam by survey year in the Salt Creek mainstem. Blue shaded species were only found downstream and orange shaded species were only found upstream.*

Species Code		Common Name	Latin Name	1983		2007		2010		2013		2016	
				U	D	U	D	U	D	U	D	U	D
10	004	Longnose Gar	*Lepisosteus osseus*										X
20	003	Gizzard Shad	*Dorosoma cepedianum*			X	X	X	X	X	X	X	X
34	001	Central Mudminnow	*Umbra limi*			X		X		X		X	
37	003	Northern Pike	*Esox lucius*				X		X	X	X		X
37	004	Muskellunge	*Esox masquinongy*					X		X		X	X
40	016	White Sucker	*Catostomus commersonii*	X	X	X	X	X	X	X	X	X	X
40	018	Spotted Sucker	*Minytrema melanops*				X	X	X	X			
43	001	Common Carp	*Cyprinus carpio*	X	X	X	X	X	X	X	X	X	X
43	002	Goldfish	*Carassius auratus*	X	X	X	X	X	X	X	X	X	X
43	003	Golden Shiner	*Notemigonus crysoleucas*			X	X	X	X	X	X	X	X
43	004	Hornyhead Chub	*Nocomis biguttatus*				X		X		X		X
43	013	Creek Chub	*Semotilus atromaculatus*	X	X	X	X	X	X	X	X	X	X
43	015	Suckermouth Minnow	*Phenacobius mirabilis*								X		
43	020	Emerald Shiner	*Notropis atherinoides*				X				X		
43	022	Rosyface Shiner	*Notropis rubellus*										X
43	026	Common Shiner	*Luxilus cornutus*								X		
43	028	Spottail Shiner	*Notropis hudsonius*								X		X
43	032	Spotfin Shiner	*Cyprinella spiloptera*			X	X	X	X	X	X	X	X
43	033	Bigmouth Shiner	*Notropis dorsalis*			X	X	X	X	X	X	X	
43	034	Sand Shiner	*Notropis stramineus*			X	X		X		X		X
43	042	Fathead Minnow	*Pimephales promelas*	X	X	X	X	X	X	X	X	X	X
43	043	Bluntnose Minnow	*Pimephales notatus*			X	X	X	X	X	X	X	X
43	044	Central Stoneroller	*Campostoma anomalum*								X		X
43	045	Common Carp X Goldfish	*HYBRID*	X	X	X	X	X				X	X
47	002	Channel Catfish	*Ictalurus punctatus*			X	X	X	X	X	X	X	X
47	004	Yellow Bullhead	*Ameiurus natalis*			X	X	X	X	X	X	X	X
47	006	Black Bullhead	*Ameiurus melas*			X	X	X	X	X	X	X	X
47	013	Tadpole Madtom	*Noturus gyrinus*								X		X
54	002	Blackstripe Topminnow	*Fundulus notatus*			X	X	X	X	X	X	X	X
57	001	W. Mosquitofish	*Gambusia affinis*			X							X
70	001	Brook Silverside	*Labidesthes sicculus*	X								X	
74	001	White Bass	*Morone chrysops*			X	X						

***Table 19**. Fish species collected upstream (U) and downstream (D) of the Graue Mill (Fullersburg Woods) dam by survey year in the Salt Creek mainstem. Blue shaded species were only found downstream and orange shaded species were only found upstream.*

Species Code		Common Name	Latin Name	1983		2007		2010		2013		2016	
				U	D	U	D	U	D	U	D	U	D
74	006	Yellow Bass	*Morone mississippiensis*			X	X	X		X	X	X	
77	001	White Crappie	*Pomoxis annularis*									X	X
77	002	Black Crappie	*P. nigromaculatus*	X		X	X	X	X	X	X	X	X
77	003	Rock Bass	*Ambloplites rupestris*				X		X		X		
77	004	Smallmouth Bass	*Micropterus dolomieui*								X		X
77	006	Largemouth Bass	*Micropterus salmoides*	X	X	X	X	X	X	X	X	X	X
77	007	Warmouth Sunfish	*Lepomis gulosus*								X	X	X
77	008	Green Sunfish	*Lepomis cyanellus*	X	X	X	X	X	X	X	X	X	X
77	009	Bluegill Sunfish	*Lepomis macrochirus*	X	X	X	X	X	X	X	X	X	X
77	010	Orangespotted Sunfish	*Lepomis humilis*			X	X	X	X	X	X	X	X
77	012	Redear Sunfish	*Lepomis microlophus*			X	X					X	X
77	013	Pumpkinseed Sunfish	*Lepomis gibbosus*	X		X	X	X	X	X	X	X	
78	001	Oriental Weatherfish	*Misgurnus anguillicaudatus*										X
80	001	Sauger	*Sander canadensis*										X
80	002	Walleye	*Sander vitreus*			X	X	X	X	X	X	X	X
80	003	Yellow Perch	*Perca flavescens*			X		X	X	X		X	
80	005	Blackside Darter	*Percina maculata*						X		X		X
80	011	Logperch	*Percina caprodes*								X		X
80	014	Johnny Darter	*Etheostoma nigrum*				X		X		X		X
87	001	Round Goby	*Neogobius melanostomus*								X		X
			Total Species (53)	12	9	29	32	27	29	27	38	30	40

years (Figure 39) excepting 2007 having the highest mIBI scores compared to the other years for the upstream most Salt Creek sites. The relatively poor condition of the macroinvertebrates in the tributaries (Figure 40) is further explored in Figure 41 where the tributary results are split by sub-watershed between 2013 and 2016. The Addison Creek and Spring Book sites had mostly poor macroinvertebrate assemblages with Oak Brook declining to poor in 2016. Arlington Creek and the middle and upper tributaries to Salt Creek were mostly in the fair range while no tributary sites were in the good mIBI range in any year.

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

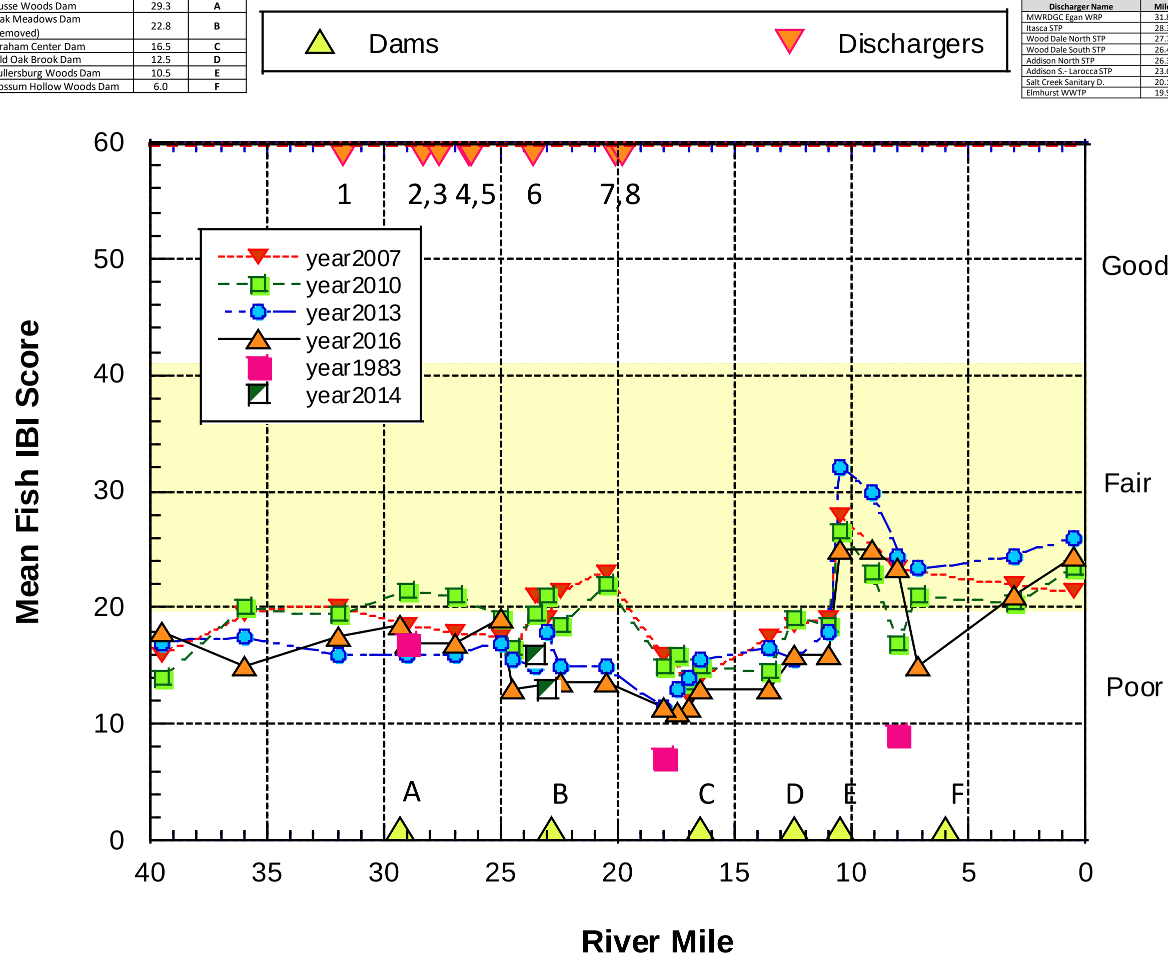


Figure 36. *Fish Index of Biotic Integrity scores for samples collected from Salt Creek in 1983, 2007, 2010, 2013, 2014 and 2016 in relation to the locations of NPDES permitted facilities, combined sewer overflow (CSO) outfalls, dams and principal tributaries. The locations of dams are arrayed along the x-axis and noted as triangles. The shaded area indicates the range for a restricted fish assemblage as defined by Illinois EPA.*

Biological Assemblages – Response Signatures

Selected indicators of biological condition and response were arrayed by sampling site for 2016 (Table 19) and 2013 (Table 20) to detect any indications of a response to a particular category of pollutional impact. In addition to the fIBI and MIwb for fish and the mIBI and MBI for macroinvertebrates, selected metrics and attributes were listed with important threshold exceedances that are indicative of categorical responses to toxicity, habitat alteration, and organic and nutrient enrichment. Metrics and attributes such as the highly elevated incidence of DELT anomalies on fish in combination with poor fIBI and MIwb scores can be an indication of chronic toxicity along with an increased dominance by toxic tolerant macroinvertebrate taxa

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	**A**
Oak Meadows Dam (removed)	22.8	**B**
Graham Center Dam	16.5	**C**
Old Oak Brook Dam	12.5	**D**
Fullersburg Woods Dam	10.5	**E**
Possum Hollow Woods Dam	6.0	**F**

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	**1**
Itasca STP	28.3	**2**
Wood Dale North STP	27.7	**3**
Wood Dale South STP	26.4	**4**
Addison North STP	26.3	**5**
Addison S.- Larocca STP	23.6	**6**
Salt Creek Sanitary D.	20.1	**7**
Elmhurst WWTP	19.9	**8**

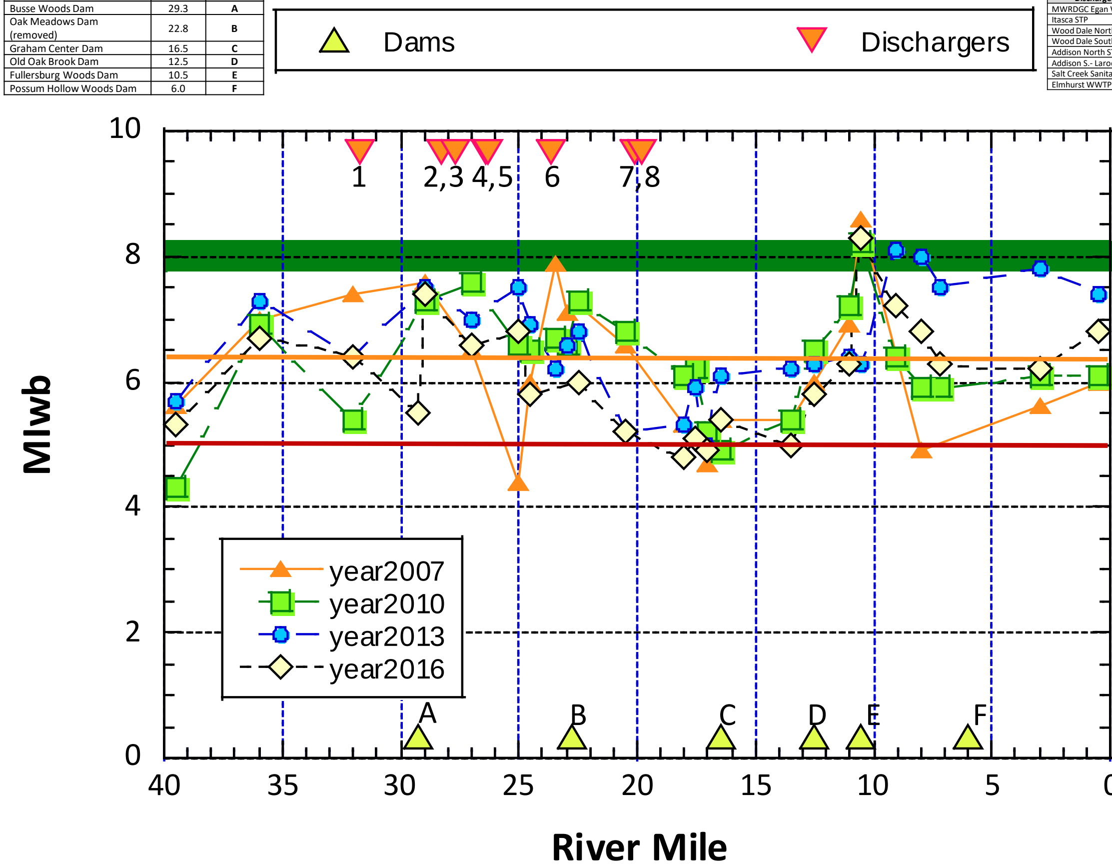


***Figure 37**. Fish Modified Index of Well-Being (MIwb) scores for samples collected from Salt Creek in 2007, 2010, 2013, and 2016 in relation to the locations of NPDES permitted facilities, combined sewer overflow (CSO) outfalls, dams and principal tributaries. The locations of dams are arrayed along the x-axis and noted as triangles. The shaded area indicates the narrative ranges (green=good) for boatable fish assemblages as defined by Ohio EPA.*

(Yoder and DeShon 2003; Yoder and Rankin 1995). Indicators of excessive organic and nutrient enrichment include dominance by organic enrichment tolerant macroinvertebrate taxa and tolerant macroinvertebrate taxa. The 2016 results showed indications of chronic toxicity in elevated toxic tolerant macroinvertebrate taxa at selected sites in Salt Creek (SC 42 and 53). Highly elevated DELT anomalies occurred at 5 of the 6 downstream most sites in Salt Creek, but these were accompanied by fair fIBI scores and even one good MIwb score which is more an indication of organic and nutrient enrichment as opposed to acute toxicity. Organic enrichment tolerant macroinvertebrates exceeded that screening threshold at three sites in Salt Creek (SC 23, 40, and 55). Tributaries with indications of excessive organic and nutrient enrichment include Addison Creek, Oakbrook Creek at the mouth, and the middle site on the Unnamed Tributary to Meacham Creek. The 2013 results were roughly similar except that exceedances of the organic enrichment tolerant macroinvertebrate taxa were more frequent along the Salt Creek mainstem and selected tributaries. Exceedances of toxic tolerant taxa thresholds occurred at only two sites and DELT anomalies, while moderately elevated at many sites and in Addison Creek, were not at the highly elevated levels observed in 2016. By contrast the

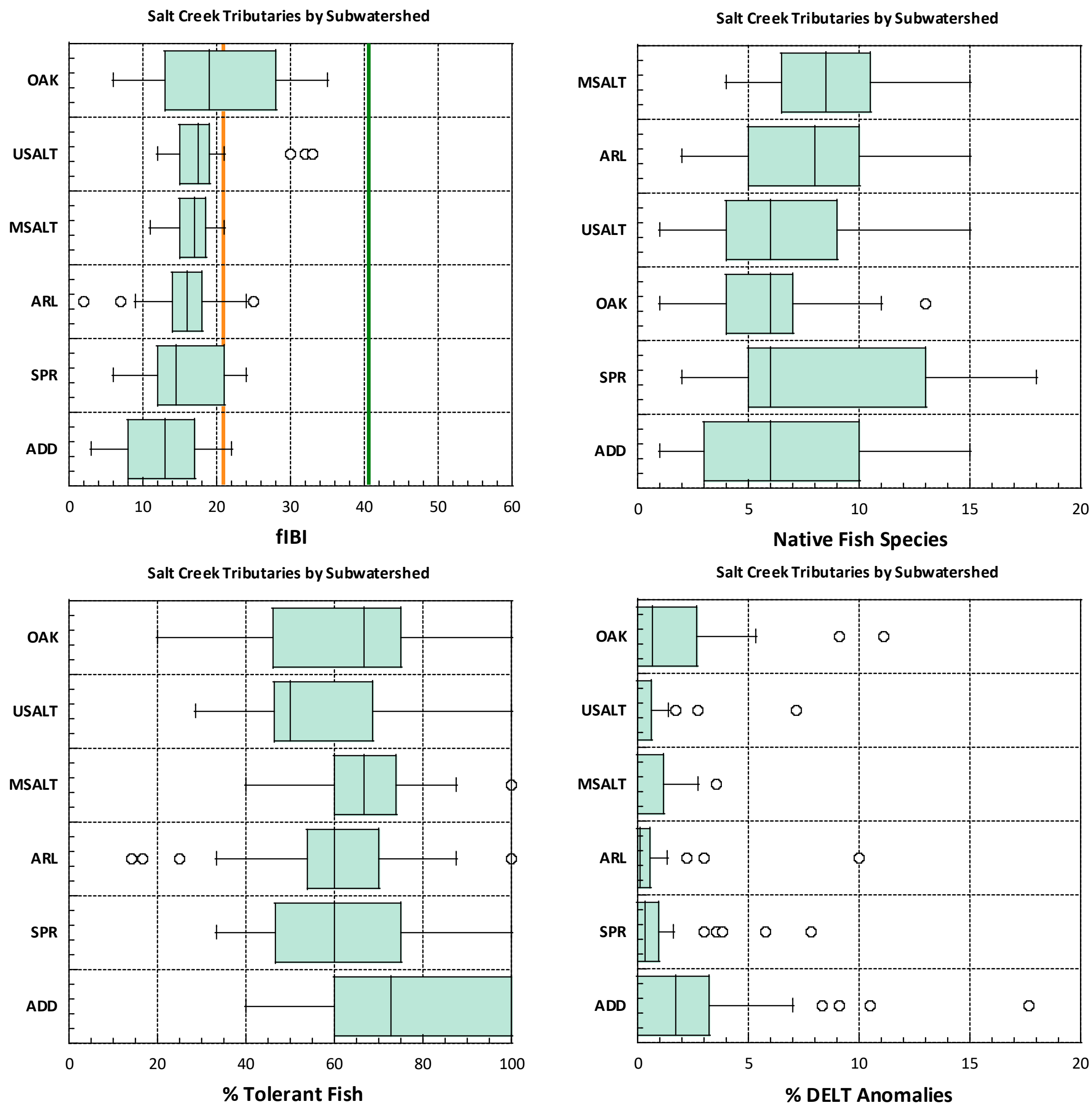


***Figure 38**. Distribution of the fish IBI, native fish species, percent tolerant fish and % DELT anomalies in small Salt Creek tributaries by sub-watershed for all years (2013-2016).*

Key to Subwatersheds: **ADD** – Addison Creek, Trib to Addison Creek, Westwood Creek; **SPR** – Spring Brook, Meacham Creek, Trib to Meacham Creek; **OAK** – Oakbrook Creek, Ginger Creek, Sugar Creek; **ARL** - Arlington Heights Branch Salt Creek, Baldwin Creek, Trib. to Arlington Branch Salt Creek (#1); **MSALT** – Wests Branch Salt Creek, Yeargin Creek, Trib to West Branch Salt Creek; **USALT** – Headwater sites of Salt Creek (≥ RM 36), Trib to Salt Creek @ RM 42.8.

reference sites sampled in 2013 and 2016 had nearly inverse results with an almost complete absence of signatures of any type of stressor in addition to fIBI, MIwb, and fIBI scores that attain the General Use biocriteria.

Dam Name	River Mile	Graph Reference
Busse Woods Dam	29.3	A
Oak Meadows Dam (removed)	22.8	B
Graham Center Dam	16.5	C
Old Oak Brook Dam	12.5	D
Fullersburg Woods Dam	10.5	E
Possum Hollow Woods Dam	6.0	F

Discharger Name	River Mile	Graph Reference
MWRDGC Egan WRP	31.8	1
Itasca STP	28.3	2
Wood Dale North STP	27.7	3
Wood Dale South STP	26.4	4
Addison North STP	26.3	5
Addison S.- Larocca STP	23.6	6
Salt Creek Sanitary D.	20.1	7
Elmhurst WWTP	19.9	8

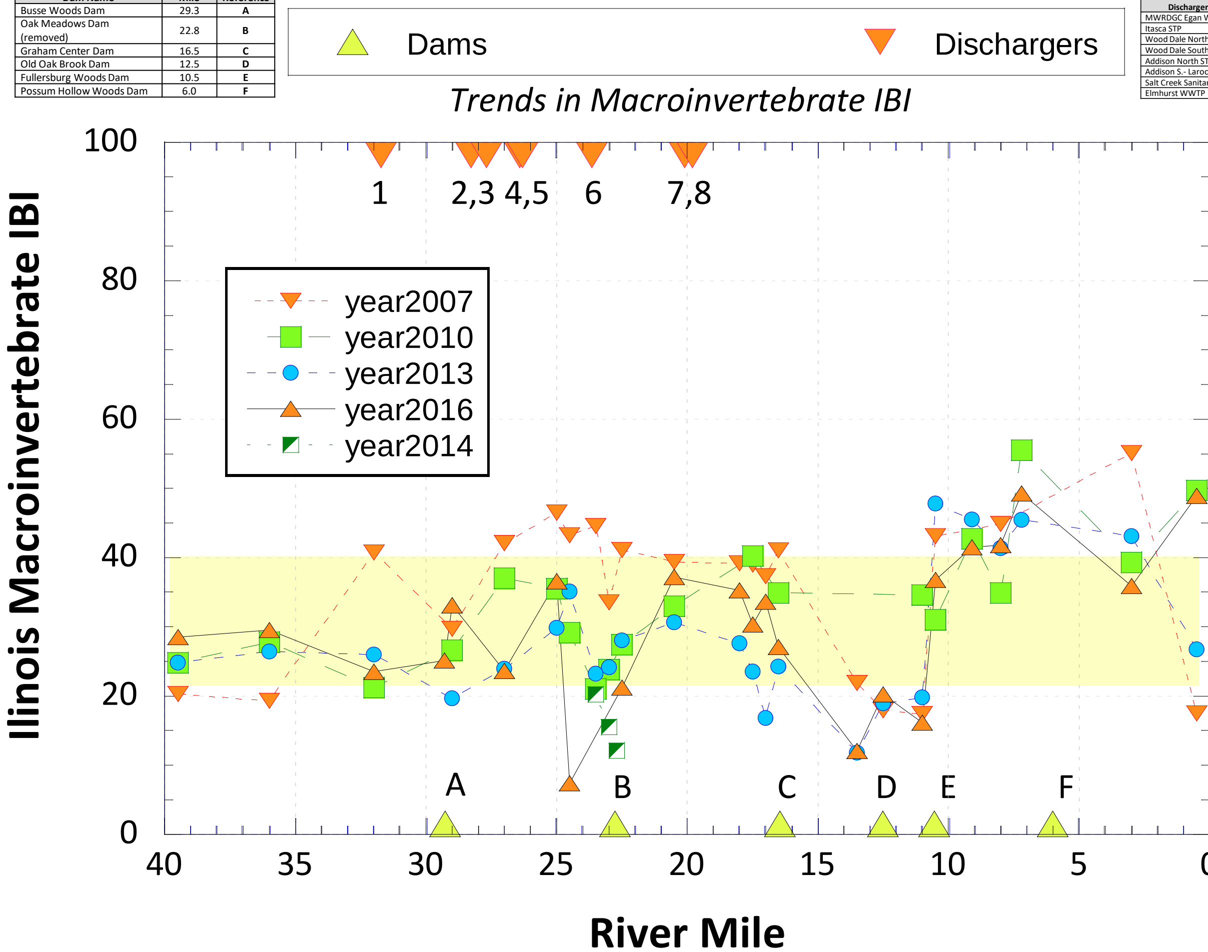


***Figure 39**. Macroinvertebrate IBI scores for samples collected from the Salt Creek mainstem, 2007, 2010, 2013, 2014 (Oak Meadows only), and 2016 (no Oak Meadows sites) in relation to publicly owned treatment works, low head dams (noted by diamond tipped bars adjoining the x-axis), and combined sewer outfalls (CSO). The shaded region demarcates the "fair" narrative range.*

Key to Subwatersheds: **ADD** – Addison Creek, Trib to Addison Creek, Westwood Creek; **SPR** – Spring Brook, Meacham Creek,

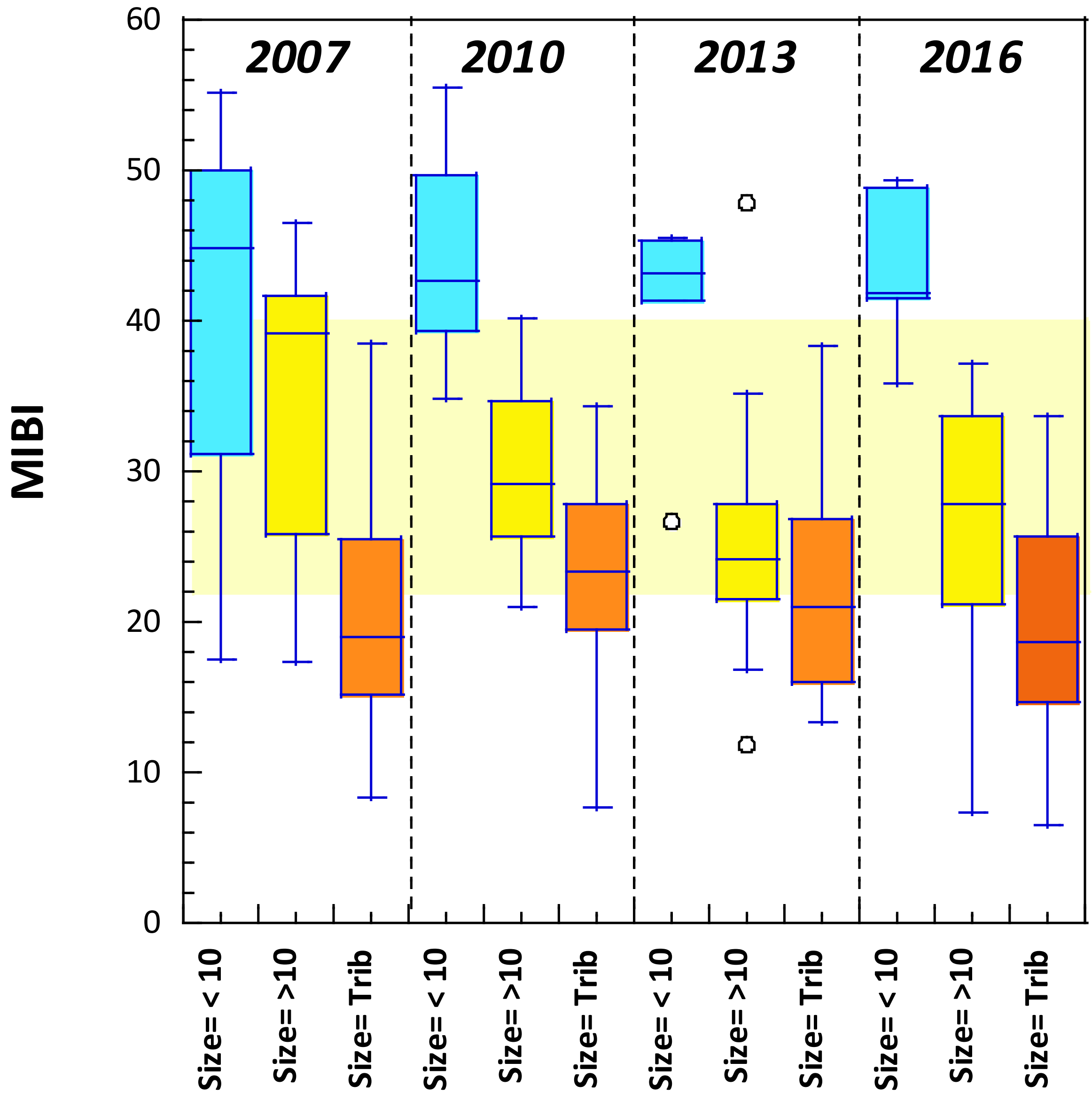


***Figure 40**. Illinois MIBI data in Salt Creek downstream of Graue Mill dam, upstream of Graue Mill dam and in tributaries by sample year (2007, 2011, 2013 and 2016).*

Trib to Meacham Creek; **OAK** – Oakbrook Creek, Ginger Creek, Sugar Creek; **ARL** - Arlington Heights Branch Salt Creek, Baldwin Creek, Trib. to Arlington Branch Salt Creek (#1); **MSALT** – Wests Branch Salt Creek, Yeargin Creek, Trib to West Branch Salt Creek; **USALT** – Headwater sites of Salt Creek (≥ RM 36), Trib to Salt Creek @ RM 42.8.

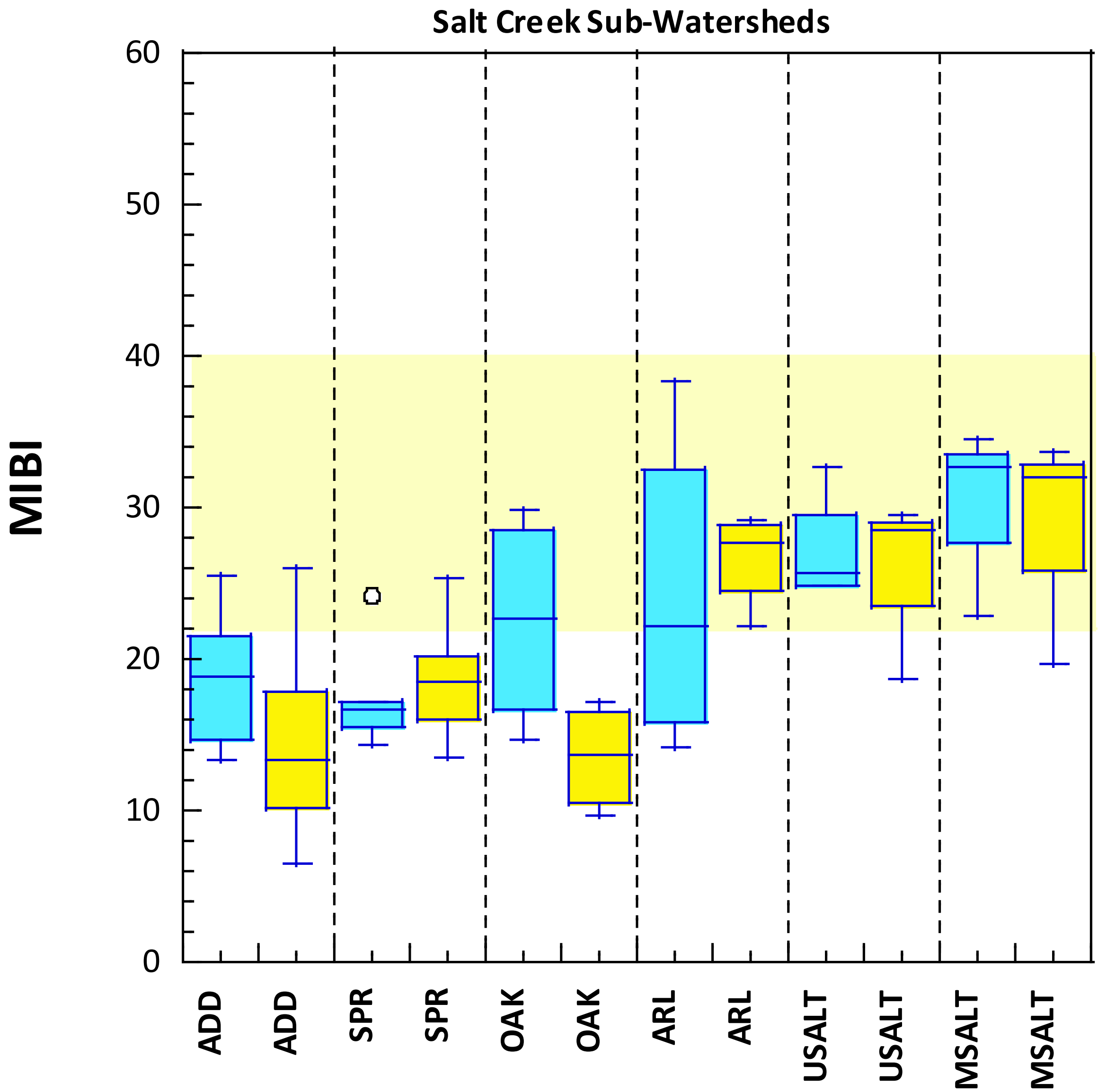


Figure 41. *Illinois MIBI data in Salt Creek tributaries and headwaters by sub-watershed for 2013 (left) and 2016 (right) for each data pair.*

Key to Subwatersheds: **ADD** – Addison Creek, Trib to Addison Creek, Westwood Creek; **SPR** – Spring Brook, Meacham Creek, Trib to Meacham Creek; **OAK** – Oakbrook Creek, Ginger Creek, Sugar Creek; **ARL** - Arlington Heights Branch Salt Creek, Baldwin Creek, Trib. to Arlington Branch Salt Creek (#1); **MSALT** – West Branch Salt Creek, Yeargin Creek, Trib. to West Branch Salt Creek; **USALT** – Headwater sites of Salt Creek (≥RM 36), Trib. to Salt Creek @ RM 42.8.

Table 20. *Selected attributes of the fish and macroinvertebrate assemblages in the Salt Creek watershed in 2016 that serve as indicators of status and response to categories of stressors. Thresholds and color shading key at bottom of table.*

			Fish Assemblage							Macroinvertebrate Assemblage								
Site ID	**River Mile**	**Drain-age Area (mi².)**	**fIBI**	**MIwb**	**Native Sp.**	**%DELT Anom-alies**	**Intol. Sp.**	**%Mineral Spawners**	**%Toler -ant**	**mIBI**	**Total Taxa**	**Intol. Taxa**	**%Toler-ants**	**EPT Taxa**	**%EPT**	**MBI**	**%Toxic Toler-ant**	**% Org. Enrich. Taxa**
Salt Creek																		
SC04	39.50	6.3	18	-	6.5	3.57	0	0	38.1	28.5	26	2	16.5	3	1.0	5.8	1.4	14.1
SC07	36.00	16	15	-	11.5	0.70	0	0	48.08	29.5	21	4	5.6	2	1.0	6.1	2.3	13.8
SC15	32.00	32	17.5	6.42	11	2.09	0	0.21	50	23.5	15	1	17.7	3	2.4	6.7	6.9	32.6
SC44	29.30	48.24	18.5	5.53	6.5	0.24	0	50	8.34	25.1	25	1	24.6	3	5.3	7.2	1.3	34.7
SC43	29.00	48.38	17	7.37	11.5	0.72	0	0.47	54.59	33.1	20	2	13.9	3	16. 6	6.2	24.5	23.2
SC42	27.00	53.5	17	6.60	11	2.31	0	0.15	52.57	23.6	17	1	3.0	2	3.6	6	65.6	12.1
SC41	25.00	70	19	6.84	13	2.96	0	0	42.31	36. 6	27	2	12.9	5	28.0	6.2	3.5	25.5
SC40	24.50	75	13	5.79	10.5	2.54	0	0	63.89	7.4	6	0	45.5	1	4.6	9.6	0	94.5
SC23	22.50	84	13.5	6.05	10.5	5.11	0	0.4	62.28	21.2	23	1	40.7	2	3.4	9.1	2.5	81.7
SC39	20.50	86	13.5	5.24	10.5	0.91	0	0	56.95	37.2	24	1	11.6	2	3.6	6.6	7.2	39
SC38	18.00	87	11.5	4.81	9.5	1.40	0	0	67.86	35.3	27	3	9.9	3	6.0	6.5	16.3	25.8
SC37	17.50	95	11	5.13	8.5	3.68	0	0	70.14	30.3	24	0	14.5	4	3.1	6.8	1.2	29
SC51	17.00	95	11.5	4.94	9	4.27	0	0	67.5	33.6	25	3	5.9	4	9.8	6	2.5	11.1
SC57	16.50	95	13	5.39	10.5	2.36	0	0	64.29	27.1	26	1	5.6	4	2.2	6.2	17.6	19.2
SC55	13.50	102	13	5.01	9	0	0	0	62.5	12.0	16	1	44.4	1	0.3	9.4	0.3	84.6
SC56	12.50	107	16	5.76	11	1.07	0	0	40.18	20.2	18	2	16.7	2	0.6	6.9	24.4	29.8
SC53	11.00	110	16	6.28	12	1.98	0	0	46.88	16.1	15	1	12.8	0	0	6.8	62.5	17.4
SC52	10.50	112	25	8.33	16.5	3.09	1	12.59	36.67	35.8	26	2	6.1	5	9.1	5.8	19.7	11.7
SC59	9.10	113	25	7.23	15	4.48	1	15.98	40.18	41.5	27	3	9.2	5	10.0	6.1	33.2	9.3
SC49	8.00	114	23.5	6.79	14	3.20	1	7.54	46.43	41.8	21	1	10.6	5	9.0	6.5	2	17.1
SC60	7.20	118	15	6.31	11.5	8.22	0	0	43.08	49.3	33	3	10.2	6	17.5	5.8	14.1	9.3
SC54	3.00	145	21	6.22	13.5	3.81	1	9.01	44.51	35.9	31	3	21.5	6	10.7	7.1	6.1	43
SC29	0.50	150	24.5	6.77	16	2.74	2	14.33	45	48.9	25	3	11.8	4	31.8	5.8	0.4	12
Arlington Heights Branch																		
SC06	4.00	7.7	10.5	-	4	0	0	0	63.34	22.2	16	3	14.3	0	0	6.1	0.3	31.5
SC45	1.50	10	16.5	-	11.5	1.12	0	0	56.35	29.1	27	2	11.1	4	1.3	6.4	2	47.2
SC08	0.25	12.7	16.5	-	11	1.01	0	0.34	54.71	31.4	22	2	4.1	3	4.4	5.4	0.8	10.4

***Table 20**. Selected attributes of the fish and macroinvertebrate assemblages in the Salt Creek watershed in 2016 that serve as indicators of status and response to categories of stressors. Thresholds and color shading key at bottom of table.*

Site ID	River Mile	Drain-age Area (mi².)	Fish Assemblage fIBI	MIwb	Native Sp.	%DELT Anom-alies	Intol. Sp.	%Mineral Spawners	%Toler-ant	Macroinvertebrate Assemblage mIBI	Total Taxa	Intol. Taxa	%Toler-ants	EPT Taxa	%EPT	MBI	%Toxic Toler-ant	% Org. Enrich. Taxa
Baldwin Creek																		
SC05	2.00	2	9.5	-	5	0.23	0	0	87.5	26.9	24	1	13.6	1	1.6	6.6	2.6	44.8
Unnamed Tributary to Salt Creek @RM (95-855)																		
SC11	5.00	4	16.5	-	7	0	0	0	79.17	33.6	23	2	6.1	3	5.6	5.8	2	23.7
Unnamed Tributary to Salt Creek @RM (95-856)																		
SC14	2.50	10.46	15	-	9.5	0.21	0	0.18	63.34	32.0	25	1	6.7	4	12.3	6	15.4	18.9
Yeargin Creek																		
SC12	0.25	1.8	20	-	7.5	0	0	0	59.82	19.6	15	1	15.4	0	0	6.9	0.3	47.5
Ginger Creek																		
SC30	1.50	5.2	12	-	4	2.05	0	0	43.34	16.0	16	2	25.6	1	0.3	7.8	12.8	66.7
Sugar Creek																		
SC33	0.25	3.5	12.5	-	8.5	1.32	0	0	75	9.6	15	0	36.8	0	0	8.9	0.7	76
Addison Creek																		
SC24	10.50	2	6	-	3	4.29	0	0	100	16.4	7	0	41.9	0	0	9.1	0.3	84.5
SC26	8.00	5	5.5	-	3	0.91	0	0	83.34	19.3	20	1	15.1	1	0.3	6.8	11.7	56.5
SC27	5.00	10	11.5	-	7.5	1.69	0	0	69.45	13.4	16	0	29.3	2	2.0	8.2	0.3	60.5
SC48	2.50	18	11	-	7.5	1.38	0.5	0.16	72.22	8.6	14	0	41.7	0	0	9.3	0.6	85.4
SC28	1.50	20	17.5	-	11.5	0.86	1	0.82	64.62	6.5	12	0	47.4	0	0	9.8	1.5	93.2
Unnamed Tributary to Addison Creek @RM (95-861)																		
SC25	0.50	1	18	-	2	0	0	0	100	11.7	15	0	27.7	0	0	8	0.6	72.8
Spring Brook																		
SC21	6.50	2	14	-	6	1.5	0	0	83.33	15.8	11	1	7.1	1	0.4	6.5	0	17.1
SC46	6.00	3.5	14	-	6	0.52	0	0	66.67	25.3	21	2	3.4	1	3.3	5.9	0.3	10.8
SC18	4.50	6.28	13	-	6	0	0	0	66.67	20.6	15	1	1.7	3	2.9	5.9	0	7.5
SC47	2.50	10	20.5	-	14	0.41	0	0	55.35	18.5	20	1	26.1	2	4.2	7.8	22.3	53.7
SC16	0.25	14.2	19.5	-	13.5	1.51	0	0	52.5	16.1	20	0	25.8	1	1.4	7.6	6.4	43.5
Oakbrook Creek																		
SC36	0.50	0.8	18	-	1	0	0	0	0	11.4	12	0	24.38	0	0	7.8	0	65.5
SC32	0.25	1.2	23.5	-	6.5	1.19	0	0	77.38	17.1	20	2	27.12	0	0	8	1	70.3

***Table 20**. Selected attributes of the fish and macroinvertebrate assemblages in the Salt Creek watershed in 2016 that serve as indicators of status and response to categories of stressors. Thresholds and color shading key at bottom of table.*

			Fish Assemblage								Macroinvertebrate Assemblage								
Site ID	River Mile	Drain-age Area (mi^2.)	fIBI	MIwb	Native Sp.	%DELT Anom-alies	Intol. Sp.	%Mineral Spawners	%Toler -ant	mIBI	Total Taxa	Intol. Taxa	%Toler-ants	EPT Taxa	%EPT	MBI	%Toxic Toler-ant	% Org. Enrich. Taxa
Unnamed Tributary to Meacham Creek @RM (095-881)																		
SC20	0.25	2	13.5	-	5	5.83	0	0	60	13.5	18	0	24.39	0	0	7.7	2.1	47
SC22	0.50	4	13	-	5	5.77	0	0	60	26.0	26	1	18.83	3	2.5	7.4	13.6	39.2
SC17	0.40	4.8	13	-	5	5.77	0	0	60	19.9	21	1	22.03	2	1.2	7.3	5	25.3
Prairie Run – Reference Site																		
FA01	0.15	49.04	36	8.04	13.5	0	2.5	56	25.83	63.0	30	4	5.686	8	12.7	5.8	0	9
Auxsable Creek – Reference Site																		
DW07	17.50	99.88	41.5	7.94	22	0.27	3	19.32	25	61.7	39	6	3.743	8	29.0	4.7	0.9	3.3
DW01	6.40	171.79	53.5	9.66	35	0.44	8	18.19	9.96	70.4	35	9	2.993	16	54.2	4.9	2.5	3.9

fIBI/mIBI excellent –blue; good – green; non-fair – yellow; non-poor – red.
Screening criteria for MIwb, Boatable Sites: Very Poor <5 (red); Poor 5.0 - 6.3 (orange); Fair 6.4 – 8.3 (yellow); Good >8.3 (green); Excellent >9.4.
Screening criteria for MIwb, Wadeable Sites: Very Poor < 4.5 (red); Poor 4.5 - 5.8 (orange); Fair 5.9 – 8.6 (yellow); Good >8.6 (green); Excellent >9.6.
Screening criteria for macroinvertebrate organic enrichment response signature (Yoder and DeShon 2003) >35% (orange)
Screening criteria for percent macroinvertebrate toxic tolerant taxa (Yoder and DeShon 2003) >35% (red)
Screening criteria for percent tolerant fish individuals (Yoder and DeShon 2003) >70% (yellow)
Screening criteria for number of intolerant fish species (Yoder and DeShon 2003) <1 (yellow)
Screening criteria slightly elevated %DELT (Ohio EPA 2015) >0.5 (yellow); moderately elevated >1.3 (orange); highly elevated >3.0 (red).

***Table 21**. Selected attributes of the fish and macroinvertebrate assemblages in the Salt Creek watershed in 2013 that serve as indicators of status and response to categories of stressors. Thresholds and color shading key at bottom of table.*

			Fish Assemblage								Macroinvertebrate Assemblage								
Site ID	River Mile	Drain-age Area (mi².)	fIBI	MIwb	Native Sp.	%DELT Anom-alies	Intol. Sp.	%Min-eral Spawn ers	%Toler ant	mIBI	Total Taxa	Intol. Taxa	%Toler ants	EPT Taxa	%EPT	MBI	%Toxic Toler-ant	% Org. Enrich Taxa
Salt Creek																		
SC04	39.50	6.3	17	-	7.5	0.37	0	0	59.8	24.8	21	1	10.5	1	3.9	6.3	2.5	19.6
SC07	36.00	16	17.5	-	14	1.79	0	0.06	50.3	26.4	28	0	18.3	3	2.9	7.2	10.6	38.6
SC15	32.00	32	16	6.36	11	0.52	0	0	45.5	26.0	24	2	14.1	2	0.9	6.7	19.6	32.3
SC43	29.00	48.38	16	7.54	11.5	0.44	0	4.02	43.6	19.7	15	1	2.5	1	0.7	6.1	24.4	67.0
SC42	27.00	53.5	16	6.95	12	0.98	0	0.42	45.8	23.9	21	1	23.5	4	9.0	7.5	20.7	54.8
SC41	25.00	70	17	7.51	14	0.20	0	0.18	46.9	29.8	25	4	14.1	4	8.2	6.3	31.1	17.4
SC40	24.50	75	15.5	6.93	11.5	2.07	0	1.04	39.4	35.1	27	2	10.6	4	12.3	6.2	15.9	22.1
SC34	23.50	76	15	6.18	11	1.29	0	0	54.6	23.2	27	1	23.4	4	2.2	7.1	15.9	36.8
SC35	23.00	80	18	6.63	10.5	2.59	0.5	0.74	52.7	24.1	23	0	11.3	3	1.4	6.6	40.6	28.2
SC23	22.50	84	15	6.84	12.5	2.04	0	0.25	48.1	28.0	30	1	23.0	3	0.8	7	11.9	46.3
SC39	20.50	86	15	5.25	11.5	0.77	0	0	56.4	30.6	26	2	6.9	2	2.9	6	21.5	27.5
SC38	18.00	87	11.5	5.3	10	3.75	0	0	72.9	27.6	23	0	6.1	2	1.1	6.1	7.2	12.2
SC37	17.50	95	13	5.87	9.5	2.60	0	0	63. 9	23. 5	23	1	9.1	1	0.3	6.5	7.3	24.0
SC51	17.00	95	14	4.99	10.5	2.56	0	0	61.8	16.8	16	0	6.0	0	0	6.3	10.7	14.2
SC57	16.50	95	15.5	6.11	11.5	2.34	0	0	61.9	24.2	18	0	4.2	2	7.2	6.1	43.8	22.1
SC55	13.50	102	16.5	6.24	10	2.53	0	0	55.0	11.8	16	0	27.2	0	0	8.1	0	73.2
SC56	12.50	107	15.5	6.29	10	3.63	0	0	55.0	18.9	20	0	15.8	0	0	6.9	27.4	36.3
SC53	11.00	110	18	6.44	10.5	2.08	0.5	0.26	48.1	19. 8	18	0	18.5	2	1.0	6.7	25.3	19.2
SC52	10.50	112	32	9.48	22.5	1.94	1.5	18.07	35.6	47.8	20	1	6.3	4	35.1	5.9	3.2	15.3
SC59	9.10	113	30	8.12	19	1.16	1	21.1	37.3	45.5	26	4	5.4	4	4.2	6	16.6	4.5
SC49	8.00	114	24.5	7.97	14	1.42	1	18.89	53.6	41.3	19	1	2.3	3	4.0	6	25	6.7
SC60	7.20	118	23.5	7.46	16.5	1.69	1	7.82	45.4	45.4	25	3	5.2	4	12.1	5.7	26.6	5.7
SC54	3.00	145	24.5	7.76	16	1.92	1	8	43.9	43.1	22	1	3.9	4	8.2	6	29.2	8.2
SC29	0.50	150	26	7.44	19	1.61	1	10.42	39.6	26.7	22	2	15.1	1	0.3	6.3	22.5	16.7
Arlington Heights Branch																		
SC06	4.0	7.7	15	-	5.7	0.28	0	0	59.1	14.1	21	1	38.6	0	0	8.8	3.9	72.1
SC45	1.50	10	17	-	13	0.13	0	0.13	59.7	26.6	25	2	10.3	3.5	11.2	6.2	13.8	35.9

***Table 21**. Selected attributes of the fish and macroinvertebrate assemblages in the Salt Creek watershed in 2013 that serve as indicators of status and response to categories of stressors. Thresholds and color shading key at bottom of table.*

			Fish Assemblage								Macroinvertebrate Assemblage								
Site ID	River Mile	Drain-age Area (mi².)	fIBI	MIwb	Native Sp.	%DELT Anom-alies	Intol. Sp.	%Min-eral Spawn ers	%Toler ant	mIBI	Total Taxa	Intol. Taxa	%Toler ants	EPT Taxa	%EPT	MBI	%Toxic Toler-ant	% Org. Enrich Taxa
SC08	0.25	12.7	14	-	10.5	0	0	0	62.3	28.4	23	1	10.7	2	22.34	6	20.6	17.9
Baldwin Creek																		
SC05	2.00	2	17.5	-	9	0.49	0	0	61.1	17.6	16	0	16.2	1	0.3	6.7	2.4	41.4
Unnamed Tributary to Salt Creek @RM (95-851)																		
SC01	2.00	1.1	24	-	5	0.42	0	0	40.0	38.4	36	2	12.2	5	10.6	6.4	2.9	18.2
Unnamed Tributary to Salt Creek @RM (95-852)																		
SC02	0.25	0.9	19.7	-	5.7	0	0	0.14	28.6	32. 7	33	2	8.9	4	2.0	6.2	1.6	31.3
Unnamed Tributary to Salt Creek @RM (95-853)																		
SC03	0.50	2.5	25.5	-	6.5	0	0	16.73	39.3	25.0	24	1	5.5	1	1.0	6.1	20.5	24.9
Unnamed Tributary to Salt Creek @RM (95-855)																		
SC11	5.00	4	14	-	8.5	0	0	0	77.1	34.5	23	1	3.8	3	13.7	5.8	15.2	18.8
Unnamed Tributary to Salt Creek @RM (95-856)																		
SC14	2.50	10.46	15	-	10	2.27	0	0	75.3	32.6	23	0	9.7	2	32.7	6.3	10.2	31.6
Yeargin Creek																		
SC12	0.25	1.8	17.5	-	5.5	0	0	0	63.3	22.9	14	0	12.0	0	0	6.7	3	73
Ginger Creek																		
SC30	1.50	5.2	14	-	5.5	2.99	0	0.16	45.0	27.1	26	2	14.1	2	3.8	6.5	18.8	33.7
Sugar Creek																		
SC33	0.25	3.5	11	-	7	2.33	0.5	1.17	85.7	14.7	22	0	24.8	0	0	7.8	11.7	56
Addison Creek																		
SC24	10.50	2	13	-	5	0	0	0	70.8	-	-	-	-	-	0	-	-	-
SC26	8.00	5	5.5	-	4	0.37	0	0	90.0	20.4	23	1	19.9	1	0.3	7.1	10.5	50.3
SC27	5.00	10	14.5	-	9.5	1.23	0	0.43	57. 8	25.5	22	1	16.4	4	5.4	6.9	3	26
SC48	2.50	18	9.5	-	8	3.67	0	0	94. 5	14.6	16	1	32.0	1	0.3	8.4	3.9	75.7
SC28	1.50	20	13.5	-	8.5	6.8	0.5	0.83	78.0	13.4	19	1	38.3	0	0	8.9	12.3	78.1
Unnamed Tributary to Addison Creek @RM (95-861)																		
SC25	0.50	1	18	-	1.5	0	0	0	50.0	21.5	24	2	11.2	0	0	6.4	20.4	22.2

***Table 21**. Selected attributes of the fish and macroinvertebrate assemblages in the Salt Creek watershed in 2013 that serve as indicators of status and response to categories of stressors. Thresholds and color shading key at bottom of table.*

			Fish Assemblage							Macroinvertebrate Assemblage								
Site ID	River Mile	Drain-age Area (mi².)	fIBI	MIwb	Native Sp.	%DELT Anom-alies	Intol. Sp.	%Min-eral Spawn ers	%Toler ant	mIBI	Total Taxa	Intol. Taxa	%Toler ants	EPT Taxa	%EPT	MBI	%Toxic Toler-ant	% Org. Enrich Taxa
Spring Brook																		
SC21	6.50	2	14.5	-	6.5	0.50	0	0	84.5	15.5	13	0	2.4	0	0	6.1	4.2	21.8
SC46	6.00	3.5	11	-	4.5	0.14	0	0	77.5	-	-	-	-	-	-	-	-	-
SC18	4.50	6.28	9	-	4.5	0	0	0	80.0	24.1	26	0	10.9	1	0.3	6.4	31.7	18.1
SC47	2.50	10	21	-	13	0.49	0	0	46.2	16.6	12	0	38.4	0	0	8.9	9.1	86.6
SC16	0.25	14.2	21	-	14.5	1.13	0	0	48.3	17.2	21	0	27.9	1	1.0	7.8	13.7	51.9
Oakbrook Creek																		
SC36	0.50	0.8	29	-	5.7	1.52	0	0	35.6	29.9	24	3	18.8	2	1.6	7.2	3.9	46.2
SC32	0.25	1.2	27.3	-	5.3	0.82	0	0	75. 6	18.5	29	1	31.3	1	0.6	8.3	12.2	52.1
Unnamed Tributary to Meacham Creek @RM (095-881)																		
SC20	0.25	2	10	-	3	0	0	0	50.0	14.3	22	0	34.4	1	0.3	8.6	4.2	71.7
Westwood Creek																		
SC22	0.50	4	11	-	6.5	0.68	0	0	82.2	17.3	21	1	22.8	0	0	7.5	21.1	36.1
Reference Sites																		
Indian Creek – Reference Site																		
I-2	16.00	126	47	8.08	22	0.69	6	28.3	25.0	47.2	33	2	11.9	6	29.3	5.6	6.7	18.6
Little Indian Creek - Reference Site																		
I-3	5.10	82.6	40.5	7.68														

fIBI/mIBI excellent – blue; good – green; non-fair – yellow; non-poor – red.
Screening criteria for MIwb, Boatable Sites: Very Poor <5 (red); Poor 5.0 - 6.3 (orange); Fair 6.4 – 8.3 (yellow); Good >8.3 (green); Excellent >9.6.
Screening criteria for MIwb, Wadeable Sites: Very Poor < 4.5 (red); Poor 4.5 - 5.8 (orange); Fair 5.9 – 8.6 (yellow); Good >8.6 (green); Excellent >9.4.
Screening criteria for macroinvertebrate organic enrichment response signature (Yoder and DeShon 2003) >35% (orange)
Screening criteria for percent macroinvertebrate toxic tolerant taxa (Yoder and DeShon 2003) >35% (red)
Screening criteria for percent tolerant fish individuals (Yoder and DeShon 2003) >70% (yellow)
Screening criteria for number of intolerant fish species (Yoder and DeShon 2003) <1 (yellow)
Screening criteria slightly elevated %DELT (Ohio EPA 2015) >0.5 (yellow); moderately elevated >1.3 (orange); highly elevated >3.0 (red).

REFERENCES

Center for Applied Bioassessment and Biocriteria. 2003. Comparison of biological-based and water chemistry-based aquatic life attainment/impairment measures under a tiered aquatic life use system. Aquatic Life Use Attainment Fact Sheet 3-CABB-03. CABB, P.O. Box 21541, Columbus, Ohio 43221-0541.

DeShon, J. E. 1995. Development and application of the Invertebrate Community Index (ICI). Pages 217 – 243 in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Heiskary, S., R. W. Bouchard, Jr. and H. Markus. 2013. Minnesota Nutrient Criteria Development for Rivers, DRAFT. January, 2013. Minnesota Pollution Control Agency, Environmental Analysis and Outcomes Division

Karr, J. R. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1: 66-84.

MacDonald, D. D., C. G. Ingersoll, and T. A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxicol. 39: 20–31.

Midwest Biodiversity Institute (MBI). 2011. 2010 Biological and Water Quality Study of Salt Creek and Tributaries. DuPage and Cook Counties, Illinois. Final Report. Technical Report MBI/2011-12-8. 78 pp.

Midwest Biodiversity Institute (MBI). 2008. Biological and water quality study of the East and West Branches of the DuPage river and the Salt Creek watersheds. Technical Report MBI/2008-12-3.

Midwest Biodiversity Institute (MBI). 2006a. Bioassessment Plan for the DuPage and Salt Creek Watersheds. DuPage and Cook Counties, Illinois. Technical Report MBI/03-06-1. Submitted to Conservation Foundation, Naperville, IL. 45 pp.

Midwest Biodiversity Institute (MBI). 2006b. Quality Assurance Project Plan: Biological and Water Quality Assessment of the DuPage and Salt Creek Watersheds. DuPage River-Salt Creek Watershed Group, Naperville, IL. 28 pp. + appendices.

Midwest Biodiversity Institute (MBI). 2004. Region V state bioassessment and ambient monitoring programs: initial evaluation and review. Report to U.S. EPA, Region V. Tech. Rept. MBI/01-03-1. 36 pp. + appendices (revised 2004).

Miner, R., and D. Barton. 1991. Considerations in the development and implementation of biocriteria. Pages 115-119 in G. H. Flock (editor). Water Quality Standards for the 21st Century. Proceedings of a National Conference. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Ohio Environmental Protection Agency. 1996a. The Ohio EPA bioassessment comparability project: a preliminary analysis. Ohio EPA Tech. Bull. MAS/1996-12-4. Division of Surface Water, Monitoring and Assessment Section, Columbus, Ohio. 26 pp.

Ohio Environmental Protection Agency. 1999. Ohio EPA Five Year Monitoring Surface Water Monitoring and Assessment Strategy, 2000-2004. Ohio EPA Tech. Bull. MAS/1999-7-2. Division of Surface Water, Monitoring and Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1987. Biological criteria for the protection of aquatic life. volume III: Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities, Division of Water Quality Monitoring and Assessment, Columbus, Ohio.

Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pages 181-208. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E. T. 1989. The qualitative habitat evaluation index (QHEI), rationale, methods, and application, Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Sanders, R. E., Miltner, R. J., Yoder, C. O., & Rankin, E. T. (1999). The use of external deformities, erosions, lesions, and tumors (DELT anomalies) in fish assemblages for characterizing aquatic resources: A case study of seven Ohio streams. In T. P. Simon (Ed.), Assessing the sustainability and biological integrity of water resources using fish communities (pp. 225–248). Boca Raton, FL: CRC.

Smith, P. W. 1979. The Fishes of Illinois. University of Illinois Press.

U.S. Environmental Protection Agency. 1995a. Environmental indicators of water quality in the United States. EPA 841-R-96-002. Office of Water, Washington, DC 20460. 25 pp.

U.S. Environmental Protection Agency. 1995b. A conceptual framework to support development and use of environmental information in decision-making. EPA 239-R-95-012. Office of Policy, Planning, and Evaluation, Washington, DC 20460. 43 pp.

Yoder, C.O. and 9 others. 2005. Changes in fish assemblage status in Ohio's nonwadeable rivers and streams over two decades, pp. 399-429. *in* R. Hughes and J. Rinne (eds.).

Historical changes in fish assemblages of large rivers in the America's. American Fisheries Society Symposium Series.

Yoder, C.O. and J.E. DeShon. 2003. Using Biological Response Signatures Within a Framework of Multiple Indicators to Assess and Diagnose Causes and Sources of Impairments to Aquatic Assemblages in Selected Ohio Rivers and Streams, pp. 23-81. *in* T.P. Simon (ed.). Biological Response Signatures: Patterns in Biological Integrity for Assessment of Freshwater Aquatic Assemblages. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1998. Important concepts and elements of an adequate State watershed monitoring and assessment program. Prepared for U.S. EPA, Office of Water (Coop. Agreement CX825484-01-0) and ASIWPCA, Standards and Monitoring. Ohio EPA, Division of Surface Water, Columbus, OH. 38 pp.

Yoder, C.O. and E.T. Rankin. 1998. The role of biological indicators in a state water quality management process. J. Env. Mon. Assess. 51(1-2): 61-88.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1995. Policy issues and management applications for biological criteria, pp. 327-344. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.