



# **Report on Biological & Water Quality Monitoring in the East Branch DuPage Watershed: 2014**

**DuPage River-Salt Creek Work Group  
April 26, 2017**

**Chris O. Yoder  
Midwest Biodiversity Institute  
Columbus, OH**

# **2014 E. Branch DuPage Watershed Biological & Water Quality Assessment**

**Standardized biological, chemical, and physical monitoring and assessment techniques were employed to meet three major objectives:**

- Determine the extent to which biological assemblages are impaired (using Illinois EPA guidelines);**
- Determine the categorical stressors and sources that are associated with those impairments; and,**
- Add to the broader databases for the DuPage River and Salt Creek watersheds to track and understand changes through time in response to abatement actions or other influences.**

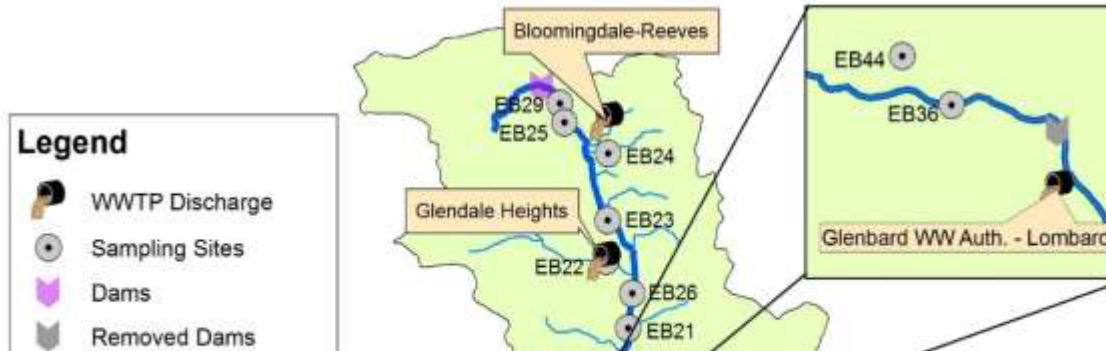


A photograph of a river with fallen logs and bare trees in the background. The text is overlaid on the image.

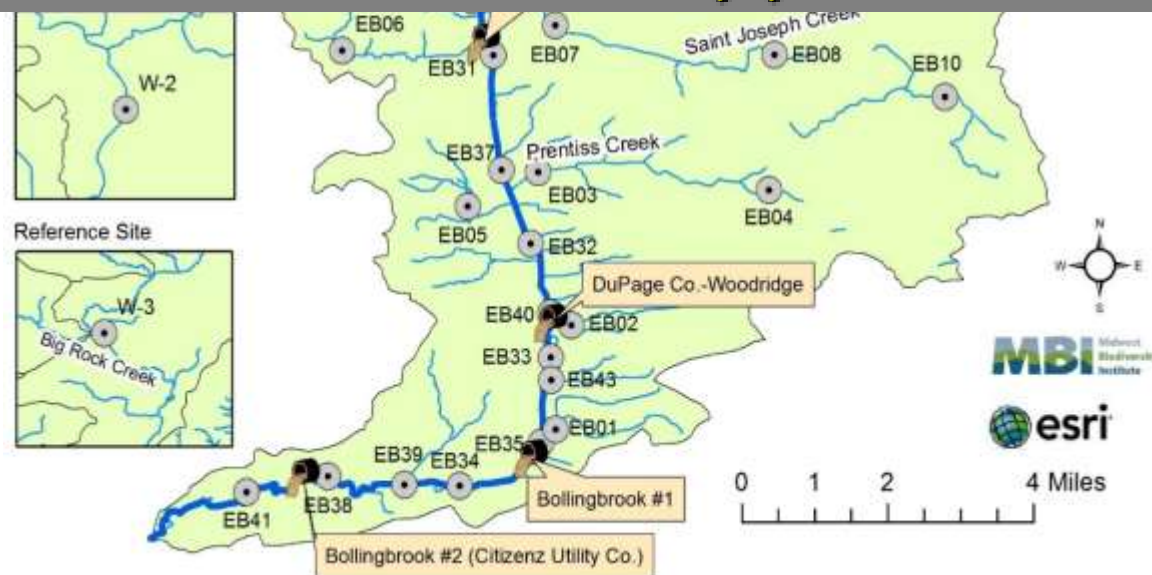
# **The Development of a Biological Assessment Plan for the DuPage and Salt Creek Watersheds**

**DuPage-Salt Creek Work Group  
March 7, 2006**

**Chris O. Yoder  
Center for Applied Bioassessment and Biocriteria  
Midwest Biodiversity Institute  
Columbus, OH**



*Spatial sampling design is critical for accurately detecting impairments and providing data at the same scale at which restoration is applied.*



# **E. Branch DuPage Bioassessment: 2014 Survey**

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- **21 mainstem, 16 tributary, & 2 reference sites sampled for fish, macroinvertebrates, and QHEI in 2014.**
- **Fish sampled with MBI methods – pulsed D.C. methods; 3 person crew.**
- **Macroinvertebrates sampled with IEPA methods.**
- **Water chemistry at all sites (37); sediment chemistry at 23 sites; continuous monitoring at 5 sites.**
- **Data analyzed using IEPA indices and either Illinois WQS or DRSCWG IPS thresholds.**
- **Stressor analysis accomplished to determine principal causes & sources of biological impairments.**

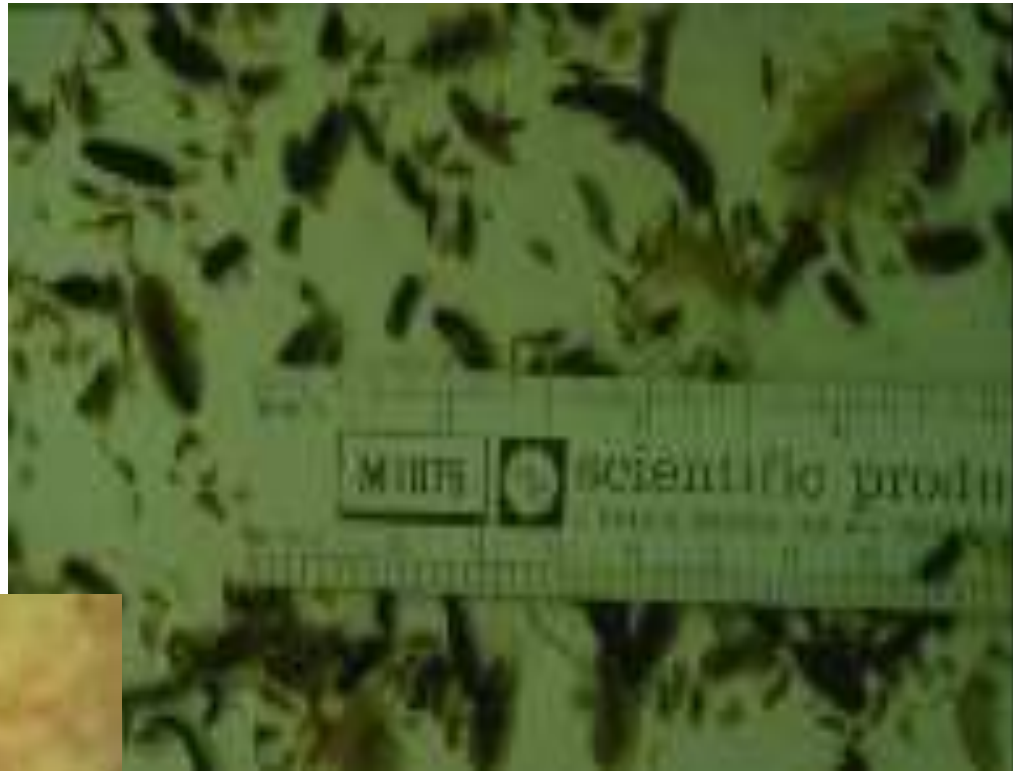


# What is a Bioassessment?

**Bioassessment is the essential implementation tool for a TALU based approach**

- *Reasonably available* tools and criteria exist to assess and evaluate this for all waterbody types.

**Invertebrate organisms contribute vital functions in an aquatic ecosystem including energy flow, conversion, and production.**

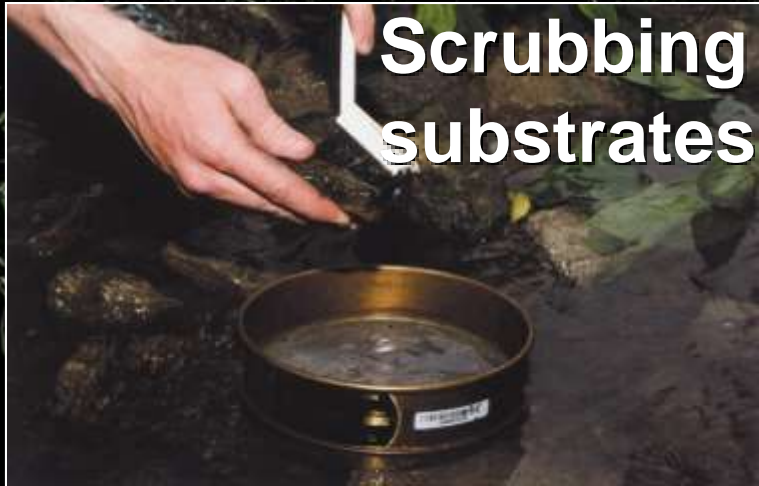


**This assemblage is the longest used indicator group. Numerous techniques and approaches have been developed.**

# Benthic Macroinvertebrates

## Active Sampling Methods Examples


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**Net-based methods  
(including kicks,  
dips, jabs, sweeps,  
& picks)**







**We followed IEPA methods  
for field collections & lab  
processing**



**Fish are a widely identifiable component of aquatic systems and are valued for their recreational uses.**

**Most species, however, are more obscure, and comprise the second most endangered group.**

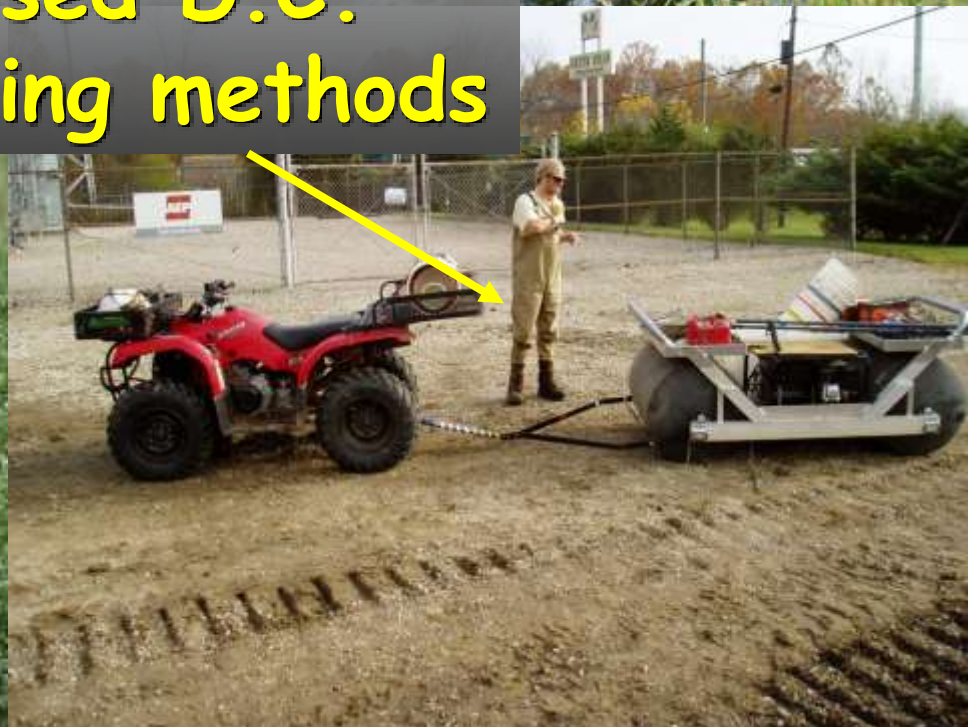




# Illinois DNR "electric seine"



## MBI pulsed D.C. electrofishing methods





# The Qualitative Habitat Evaluation Index (QHEI)

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## ***QHEI Includes Six Major Categories of Macrohabitat***

- Substrate - types, origin, quality, embeddedness
- Instream Cover – types and quantity
- Channel Quality – sinuosity, development, stability
- Riparian – width, quality, bank stability & quality
- Pool/Run/Riffle – depth, current types, embeddedness, morphology
- Gradient – local gradient (fall per unit distance)

*Source: The Qualitative Habitat Evaluation Index (Rankin 1989)*

# Illinois EPA Fish Index of Biotic Integrity

Table 3. Ten metrics selected for inclusion in revised Illinois IBIs. Metrics in **bold type** are new to Illinois IBIs; four others are slight variants of previous metrics.

Metric Name	Description
<i>Species-richness metrics</i>	
NFSH	Number of native fish species
NSUC	Number of native sucker species (i.e., in family Catostomidae)
NSUN	Number of native sunfish species (i.e., in family Centrarchidae)
INTOL	Number of native intolerant species
<b>NMIN</b>	<b>Number of native minnow species (i.e., in family Cyprinidae)</b>
<b>NBINV</b>	<b>Number of native benthic invertivore species</b>
<i>Trophic- or reproductive-structure metrics</i>	
<b>SBI</b>	<b>Proportion of individuals of species that are specialist benthic invertivores</b>
<b>GEN</b>	<b>Proportion of individuals of species that are generalist feeders</b>
<b>LIT0T</b>	<b>Proportion of individuals of species that are obligate coarse-mineral-substrate spawners and not "tolerant" (i.e., excludes creek chub and white sucker)</b>
<i>Tolerance metric</i>	
<b>PRTOL</b>	<b>Proportion of tolerant species</b>

# Illinois EPA IBI Narrative Evaluations

Prior IBI-score Range	Class	Description
51 - 60	A	Unique Aquatic Resource (Exceptional)
41 - 50	B	Good Aquatic Resource (Good)
31 - 40	C	Moderate Aquatic Resource (Fair)
21 - 30	D	Limited Aquatic Resource (Poor)
< 21	E	Restricted Aquatic Resource (Very Poor)

**General Use  
Attainment  
Threshold**





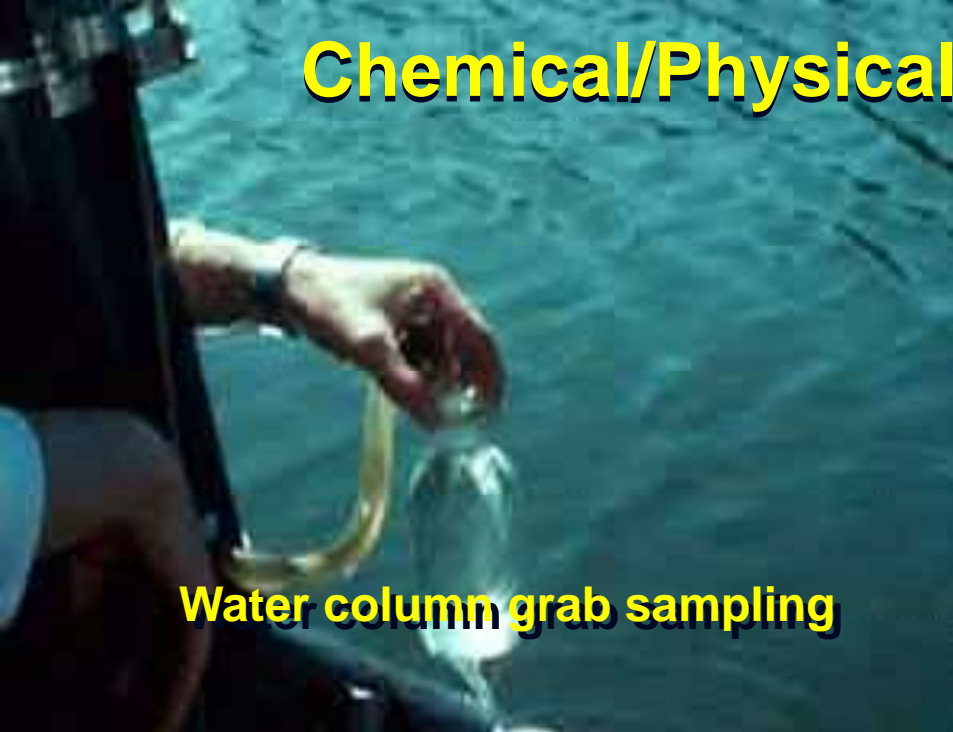
# Illinois EPA Macroinvertebrate Index of Biotic Integrity

<b>Metric</b>	<b>Response to Stress</b>	<b>Best Value</b>
Coleoptera taxa	Decrease	5
Ephemeroptera taxa	Decrease	10.2
Total Taxa	Decrease	46
Intolerant taxa	Decrease	9
MBI	Increase	4.9
Percent Scraper	Decrease	29.6
Percent EPT	Decrease	74

# Illinois EPA Macroinvertebrate IBI Narrative Ranges

Index Score			
Lower Boundary	Upper Boundary	Comparison to Reference	Narrative
73	<div>General Use Attainment Threshold</div>	95th percentile	Exceptional
52.7		75th percentile	Good
26.4		25th percentile (upper)	Fair
0		bisect 25th percentile (lower)	Poor

# Chemical/Physical Field Procedures



**Water column grab sampling**



**Depth integrated sampler**



**Automatic composite samplers**




**Time-of-travel dye injection**




# **Ohio EPA Chemical Effluent & Exposure Sampling Procedures**



**Whole Effluent Toxicity (WET) Testing is Performed Primarily on Effluents**



**Permitted Discharges are Sampled for a Variety of Chemicals - This Provides Data to Determine Pollutant Loads**



**Biochemical Markers (Biomarkers) are Useful for Discerning Problem Pollutants**



**Fish Tissue Analysis Reveals Bioaccumulative Pollutants and Risks to Human and Wildlife Health**

# Environmental Indicator

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**"... a measurable feature which singly or in combination provides managerially and scientifically useful evidence of ecosystem quality, or reliable evidence of trends in quality."**

# Types of Environmental Indicators: How Each is Used Makes a Difference

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1. **Stressor Indicators** (pollutant loadings, land use, habitat) – *best used to indicate impacts*
2. **Exposure Indicators** (e.g., chemical-specific, biomarkers, toxicity tests) – *best used to indicate risk of harm or undesirable changes*
3. **Response Indicators** (e.g., biological community condition) – *best used to indicate whole effects and as a performance end-point*

*Problems occur when indicators are used as surrogates outside their most appropriate role*



## Legend

-  WWTP Discharge
-  Sampling Site
-  Dams
-  Removed Dams
-  East Branch DuPage R.

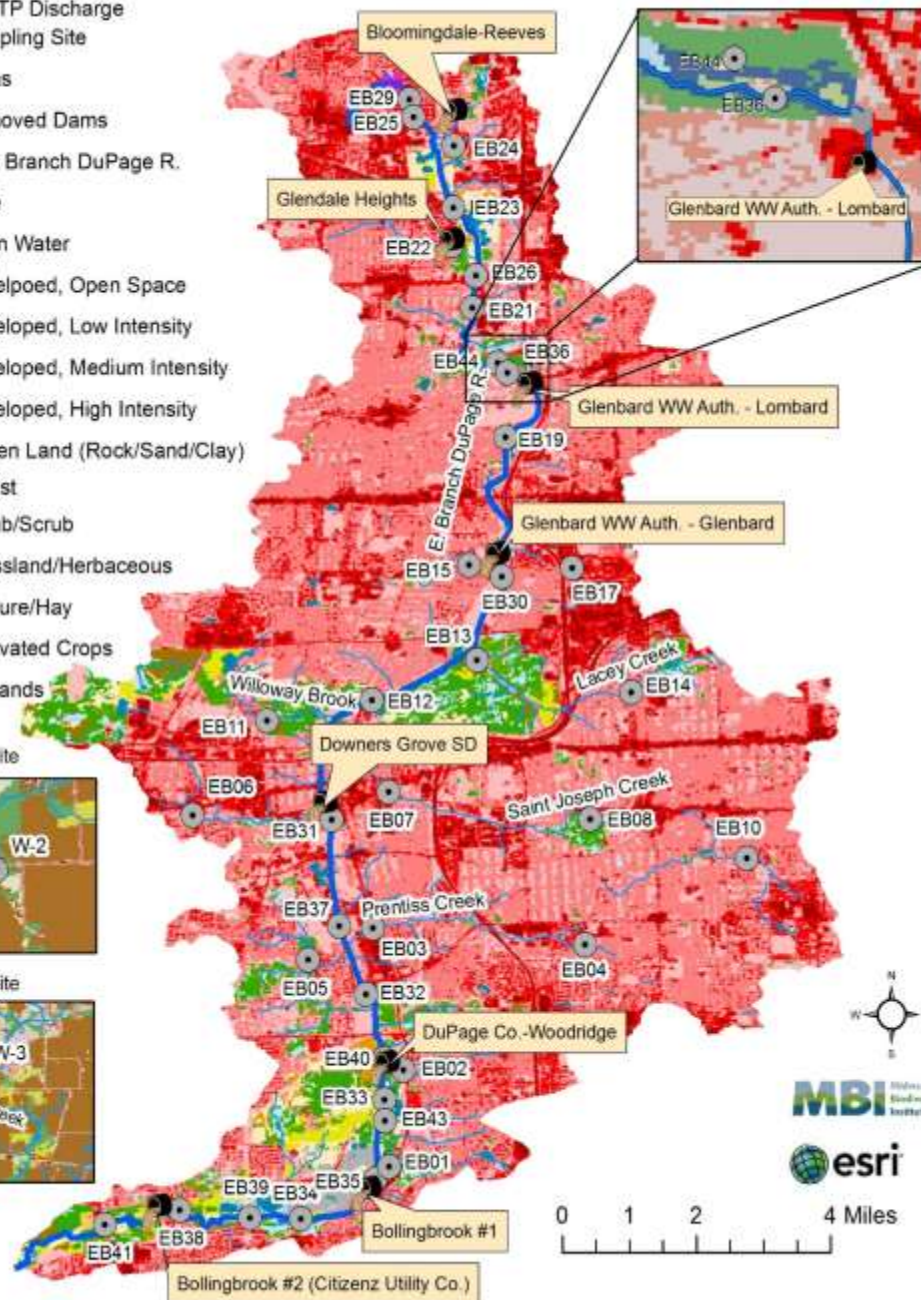
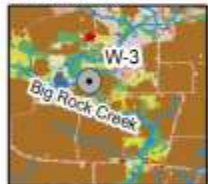
## Land Use

-  Open Water
-  Developed, Open Space
-  Developed, Low Intensity
-  Developed, Medium Intensity
-  Developed, High Intensity
-  Barren Land (Rock/Sand/Clay)
-  Forest
-  Shrub/Scrub
-  Grassland/Herbaceous
-  Pasture/Hay
-  Cultivated Crops
-  Wetlands

## Reference Site



## Reference Site



***The East Branch DuPage River watershed is urbanized and the mainstem is dominated by wastewater flows.***

# East Branch DuPage River – Status of Dams/Control Structures

Dam Name	Affected Waterway	River Mile	Impoundment Size (acres)	Impedes Fish Passage
a) West Lake Dam	East Branch	23.8	13	Y
d) Churchill Woods Dam <sup>a</sup> (modified and partially removed Feb. 2011)	East Branch	18.7	12	N
e) Mary knoll Gabion Weir	East Branch	16.8	None	N
g) Prentiss Creek flow-through Dam	Prentiss Cr. <sup>b</sup> /E. Branch	0.1/8.6	N/A	N

***Municipal wastewater treatment plants located in the E. Branch DuPage River study area***

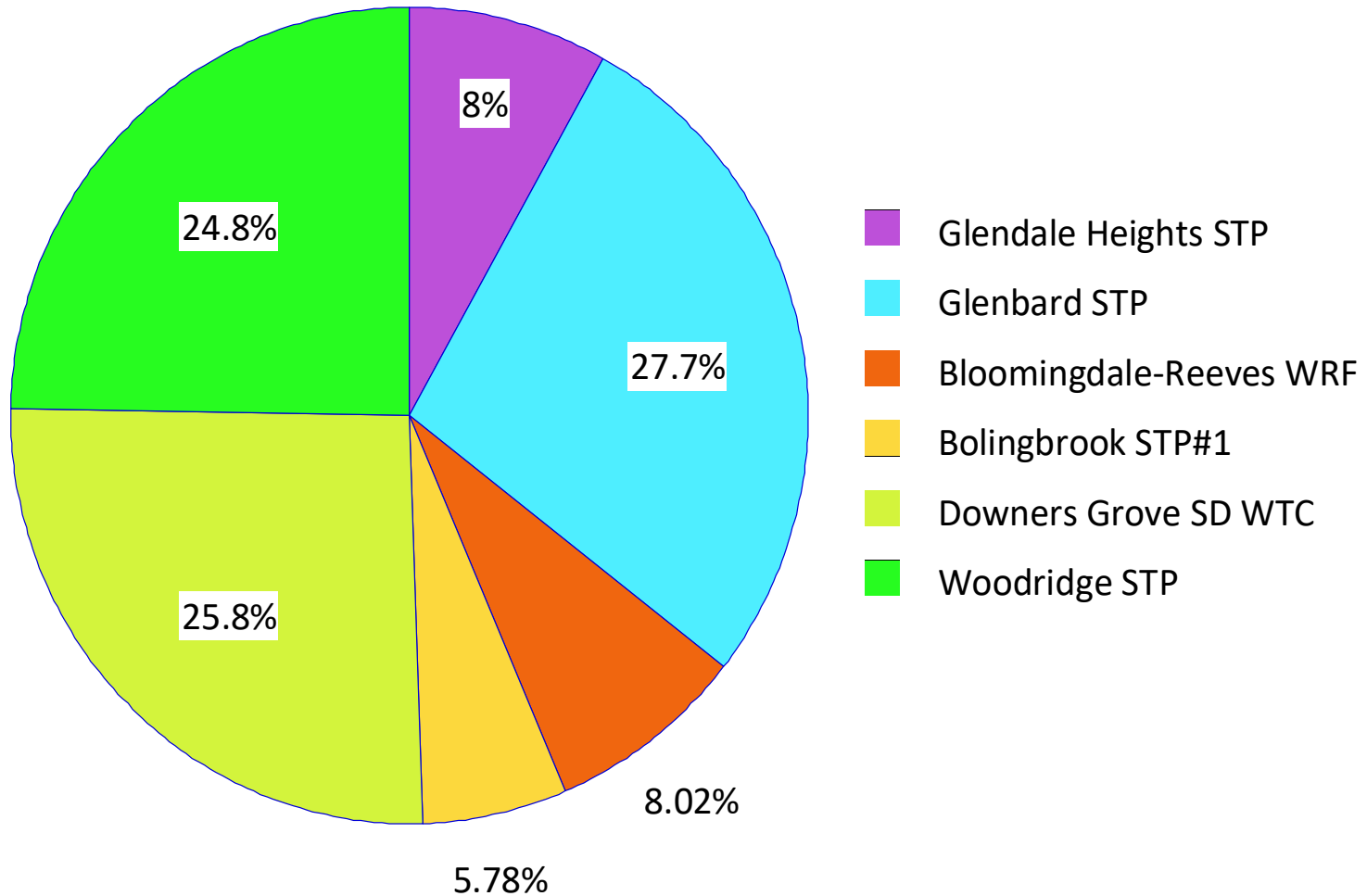
NPDES	Name	DAF	DMF	Receiving Stream (RM)	Long.	Lat.
IL0021130	Bloomington-Reeves	3.45	8.63	East Branch (23.3)	-88.0528	41.9375
IL0028967	Glendale Heights	5.26	10.52	Armitage Ditch (21.4,0.4)	-88.0534	41.9111
IL0022741	Glenbard WW Auth.-Lombard (CSO)	- <sup>2</sup>	58.0	East Branch (18.6)	-88.0367	41.8817
IL0021547	Glenbard WW Auth.-Glenbard	16.02	47.0	East Branch (15.9)	-88.0436	41.8469
IL0028380	Downers Grove SD	11	22.0	East Branch (11.35)	-88.0808	41.7961
IL0031844	DuPage Co.- Woodridge	12	28.6	East Branch (7.59)	-88.0675	41.7429
IL0032689	Bolingbrook #1	2.04	4.51	East Branch (5.66)	-88.0714	41.7172
IL0032735	Bolingbrook #2 (Citizens Utility)	3.0	7.5	East Branch (2.8)	-88.1167	41.7136

DAF = design average flow; DMF = design maximum flow

***WWTP effluent comprised 76% of river flow in September 2007 and reached 98% during a low flow period in September 2011.***

# Effluent Data from WWTPs

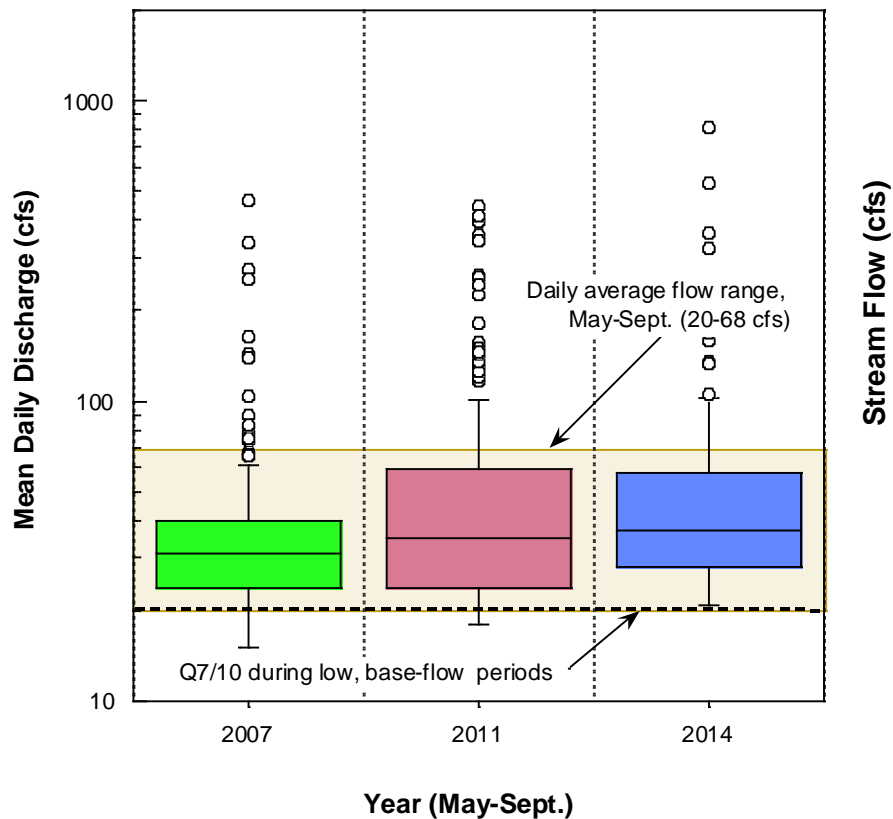
## Mean September Flow (MGD)



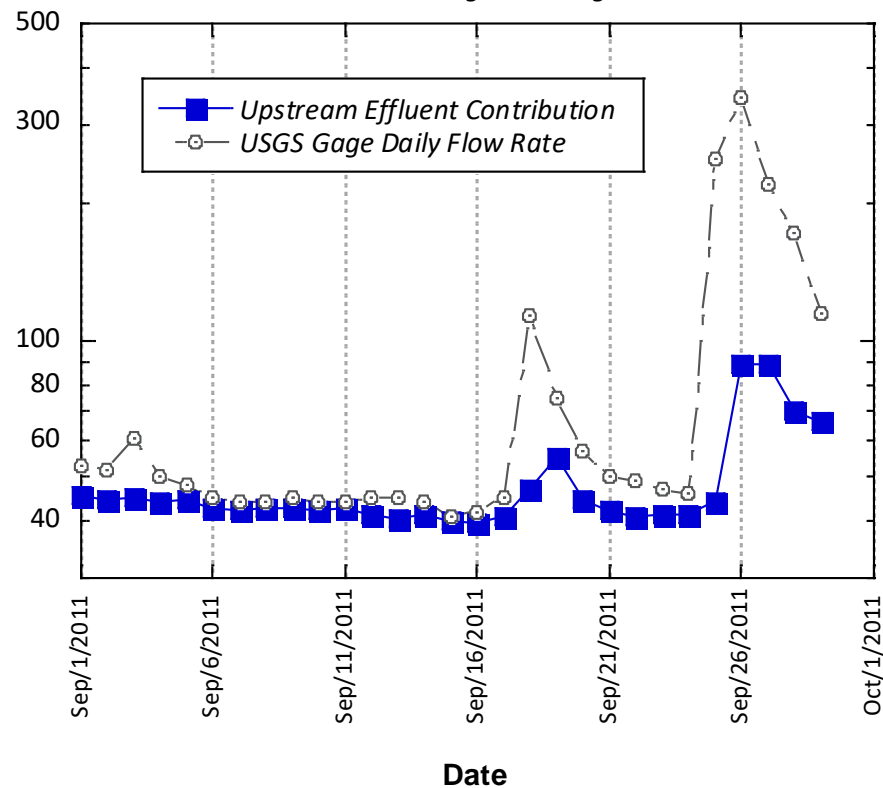


# East Branch DuPage River – River Flow Regime and %POTW Effluent

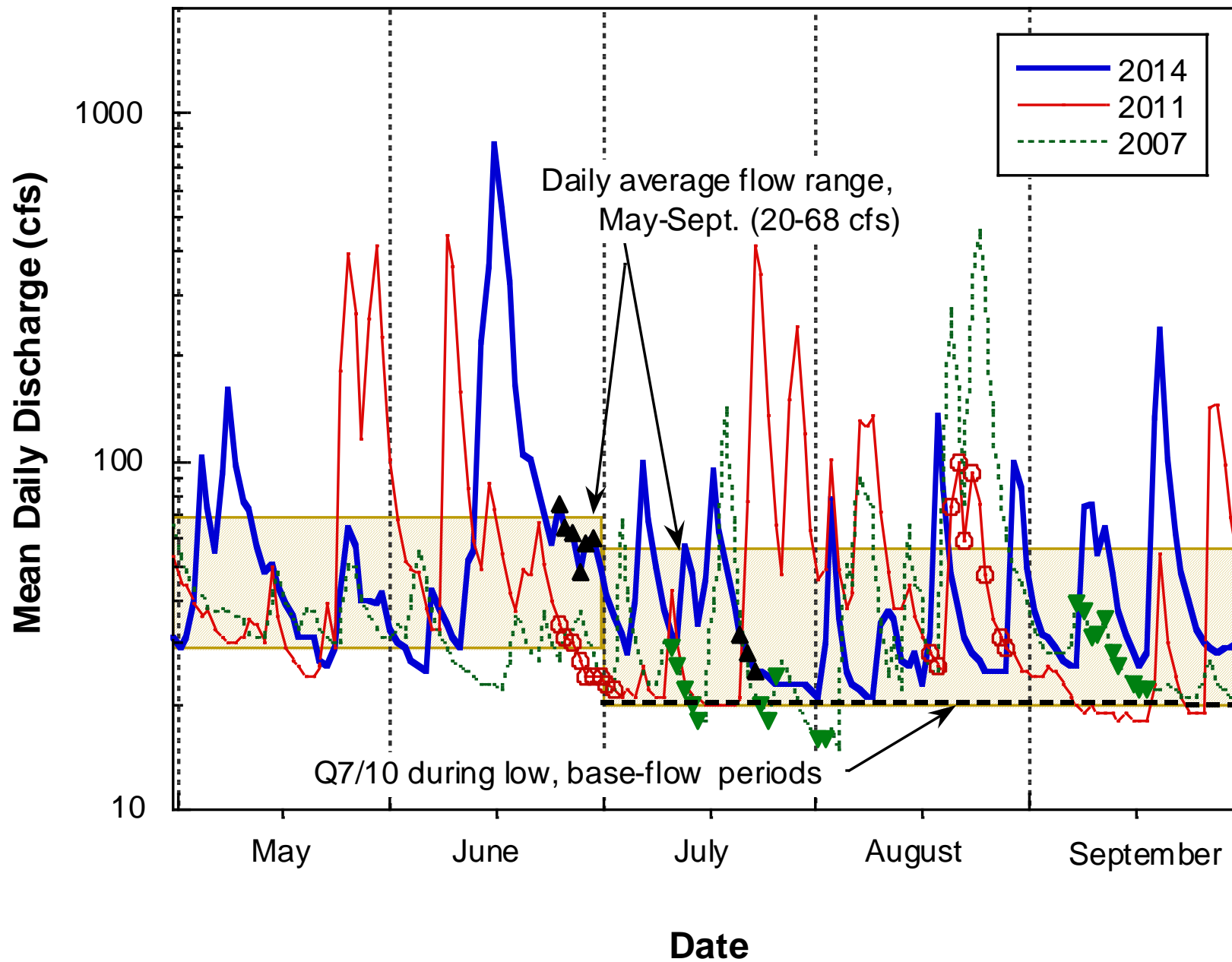
East Branch Dupage River at Downers Grove



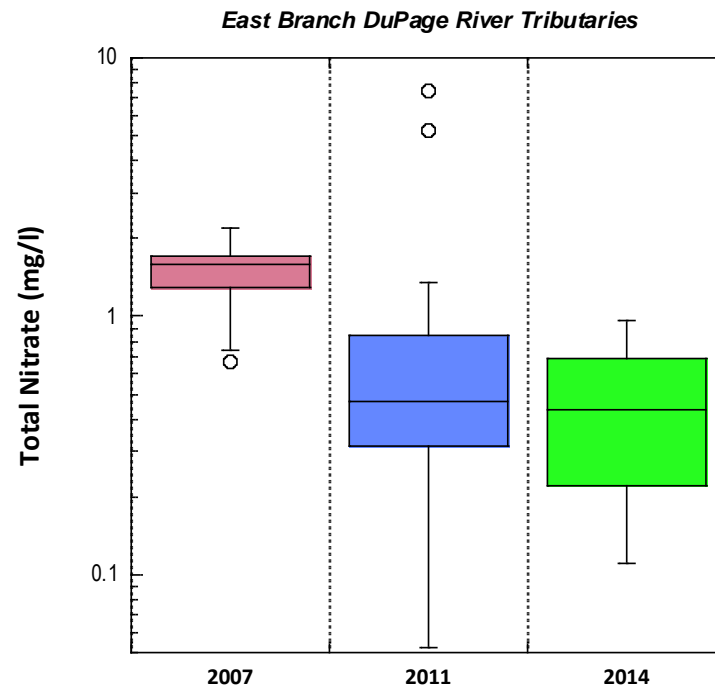
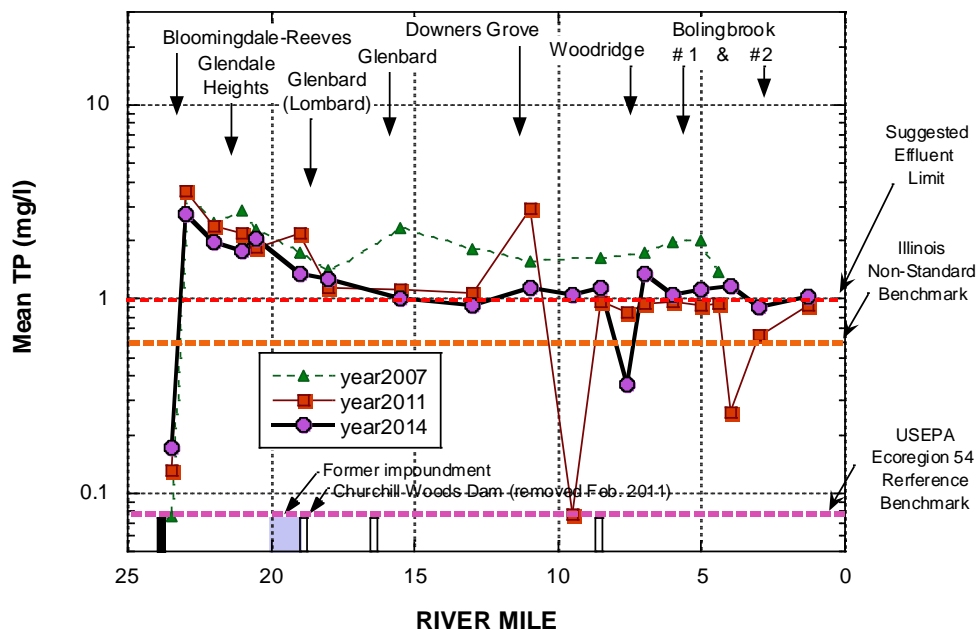
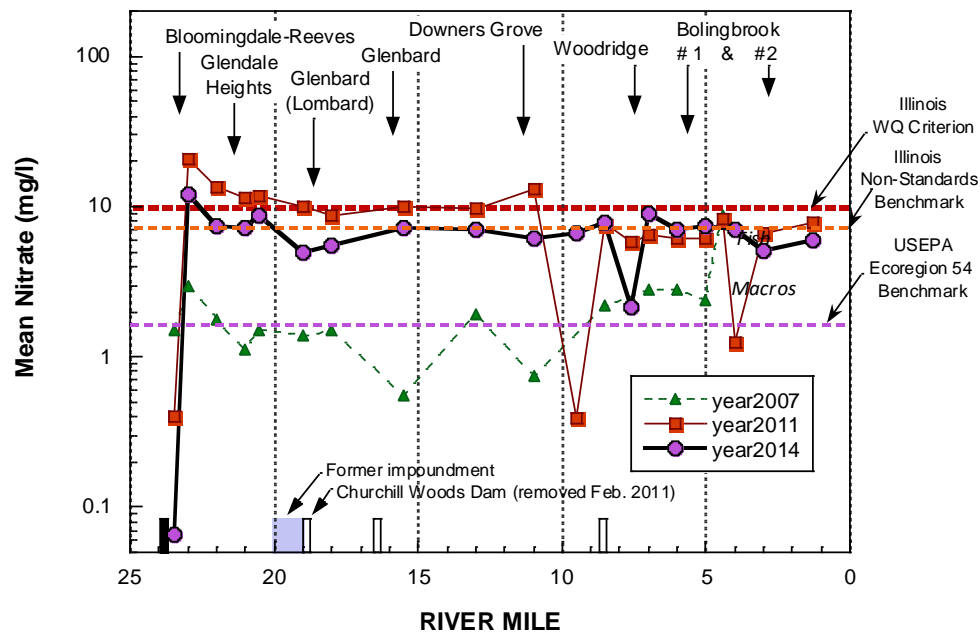
USGS Flow Gage at Bolingbrook



# East Branch Dupage River at Downers Grove



# ***E. Branch 2014 Chemical Water Quality***

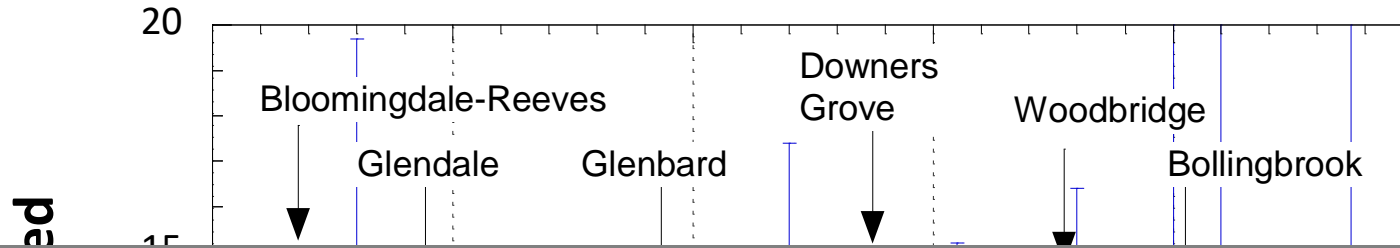




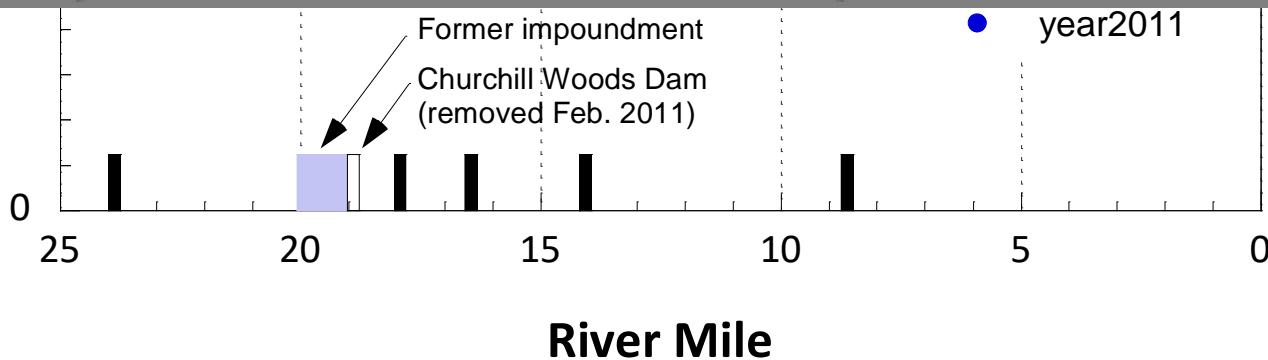
Site ID	Basin code	Stream Code	RM	D. Area (sq. mi.)	Ammonia <sup>1</sup> (mg/l)	Nitrate-N <sup>2,3,4</sup> (mg/l)	TKN <sup>5</sup> (mg/l)	Total Phosphorus <sup>6,7,8</sup> (mg/l)
<b>95-980 E. Branch DuPage River</b>								
EB29	95	980	23.5	2	0.05	0.03	1.16	0.17
EB29 Dup.	95	980	23.5	2	0.45	0.12	1.6	0.12
EB25	95	980	23.0	2	0.11	12.85	0.7	3.28
EB23	95	980	22.0	5	0.19	7.94	0.64	1.51
EB26	95	980	21.0	12	0.09	8.44	1	1.81
EB26 Dup.	95	980	21.0	12	0.16	4.3	1.35	1.17
EB21	95	980	20.5	14.2	0.08	8.82	1.03	2.05
EB36	95	980	19.0	16	0.17	4.73	1.47	1.44
EB19	95	980	18.0	18	0.34	5.52	1.23	1.14
EB30	95	980	15.5	27.2	0.13	7.42	1.04	1.04
EB12	95	980	13.0	50	0.05	7.57	0.52	0.96
EB31	95	980	11.0	58	0.08	4.74	0.74	0.92
EB37	95	980	9.5	60.1	0.05	7.69	0.46	1.12
EB32	95	980	8.5	61	0.08	6.24	0.3	0.94
EB32 Dup.	95	980	8.5	61	0.05	13.5	0.3	1.85
EB40	95	980	7.6	63	0.05	0.51	0.74	0.21
EB33	95	980	7.0	64	0.1	8.65	0.56	1.1
EB35	95	980	6.0	76.4	0.08	6.21	0.3	1.01
EB34	95	980	5.0	78	0.08	7.76	0.3	1.0
EB34 Dup.	95	980	5.0	78	0.05	7.9	0.3	1.03
EB34 duplicate	95	980	5.0	78	0.15	5.66	1.34	0.9
EB39	95	980	4.0	78	0.05	6.71	0.53	1.06
EB39 Duplicate	95	980	4.0	78	0.05	5.25	0.3	0.68
EB38	95	980	3.0	81	0.05	5.64	0.94	0.79
EB38 Dup.	95	980	3.0	81	0.11	2.55	0.3	0.44
EB41	95	980	1.3	85	0.05	5.86	0.55	0.8

Site ID	Location	Year	Date(s)	Parameter	Criterion	Form
EBAR (RM 23.0)	East Branch DuPage River	2012	July - 22	D.O.	<5.0 mg/l	Not to exceed
			Aug - 18	D.O.	<3.5 mg/l	Not to exceed
			Sep - 15	D.O.	<3.5 mg/l	Not to exceed
			Oct - 3	D.O.	<3.5 mg/l	Not to exceed
			8/ 1 - 8/23	D.O.	<4.0 mg/l	7-day Minimum
			8/31 - 10/14	D.O.	<4.0 mg/l	7-day Minimum
			7/15 - 7/31	D.O.	<6.0	7-day Average
		2013	June - 12	D.O.	<5.0 mg/l	Not to exceed
			July - 30	D.O.	<5.0 mg/l	Not to exceed
			Aug - 17	D.O.	<3.5 mg/l	Not to exceed
			Sep - 17	D.O.	<3.5 mg/l	Not to exceed
			8/ 2 - 9/25	D.O.	<4.0 mg/l	7-day Minimum
			6/23 - 7/30	D.O.	<6.0	7-day Average
			6/18 - 6/22	D.O.	<6.0	7-day Average
		2014	June - 26	D.O.	<5.0 mg/l	Not to exceed
			July - 25	D.O.	<5.0 mg/l	Not to exceed
			Aug - 6	D.O.	<3.5 mg/l	Not to exceed
			Sep - 1	D.O.	<3.5 mg/l	Not to exceed
			Oct - 3	D.O.	<3.5 mg/l	Not to exceed
			8/ 1 - 9/13	D.O.	<4.0 mg/l	7-day Minimum
			9/15 - 10/ 9	D.O.	<4.0 mg/l	7-day Minimum
			10/11 - 10/14	D.O.	<4.0 mg/l	7-day Minimum
			6/ 3 - 7/31	D.O.	<6.0	7-day Average

## E. Branch Daytime D.O. 2007 vs. 2011

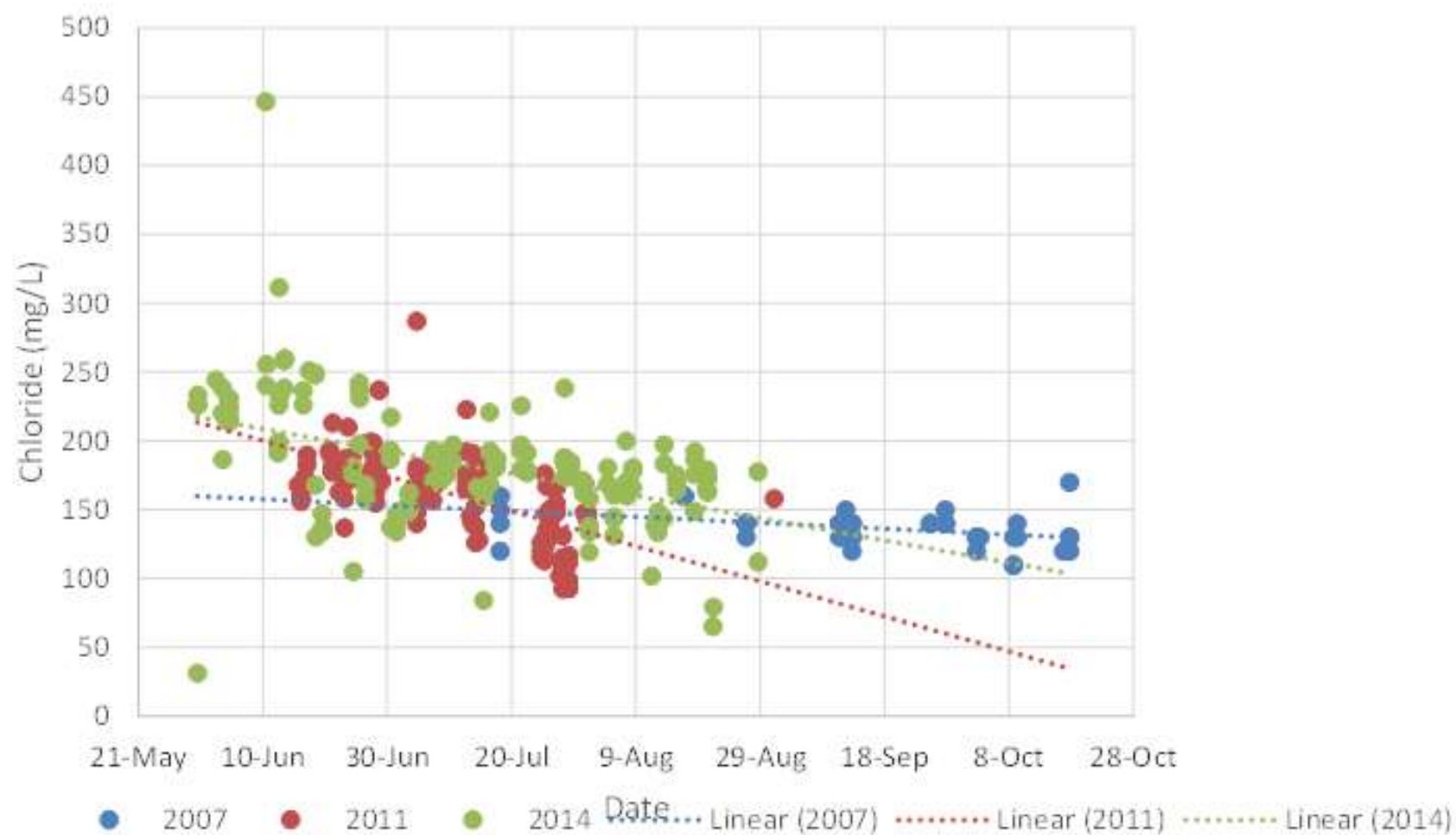


*The consequences of nutrient enrichment are frequently indirect affecting instream processes such as photosynthesis and respiration.*





## E Branch DuPage River Chloride Concentrations in the Summer Months



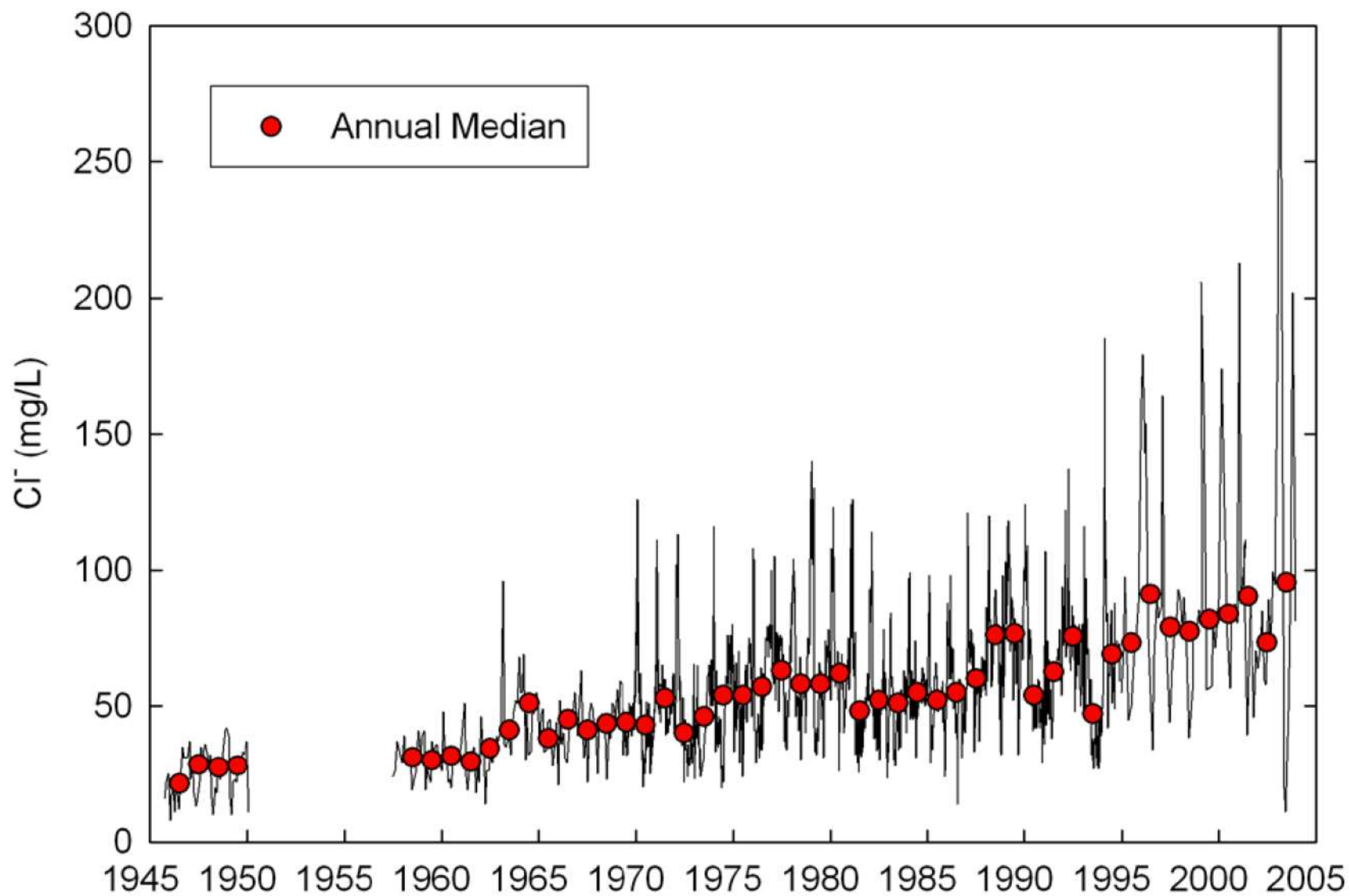
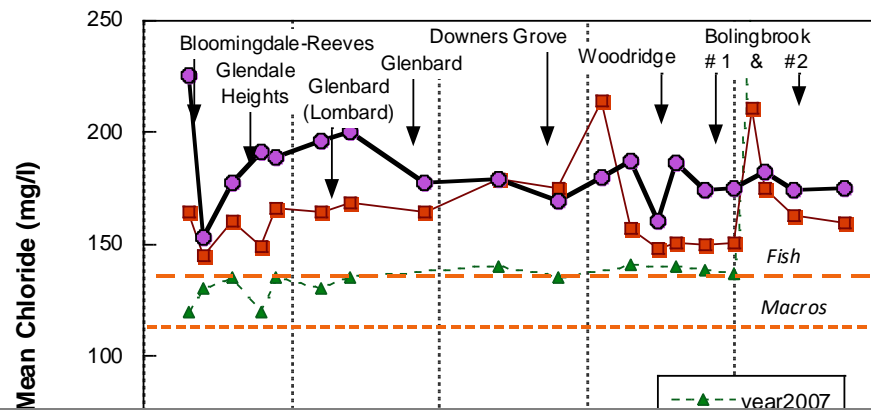
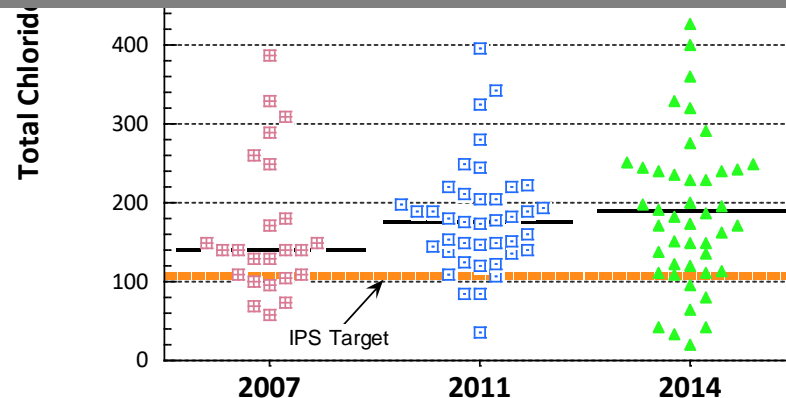


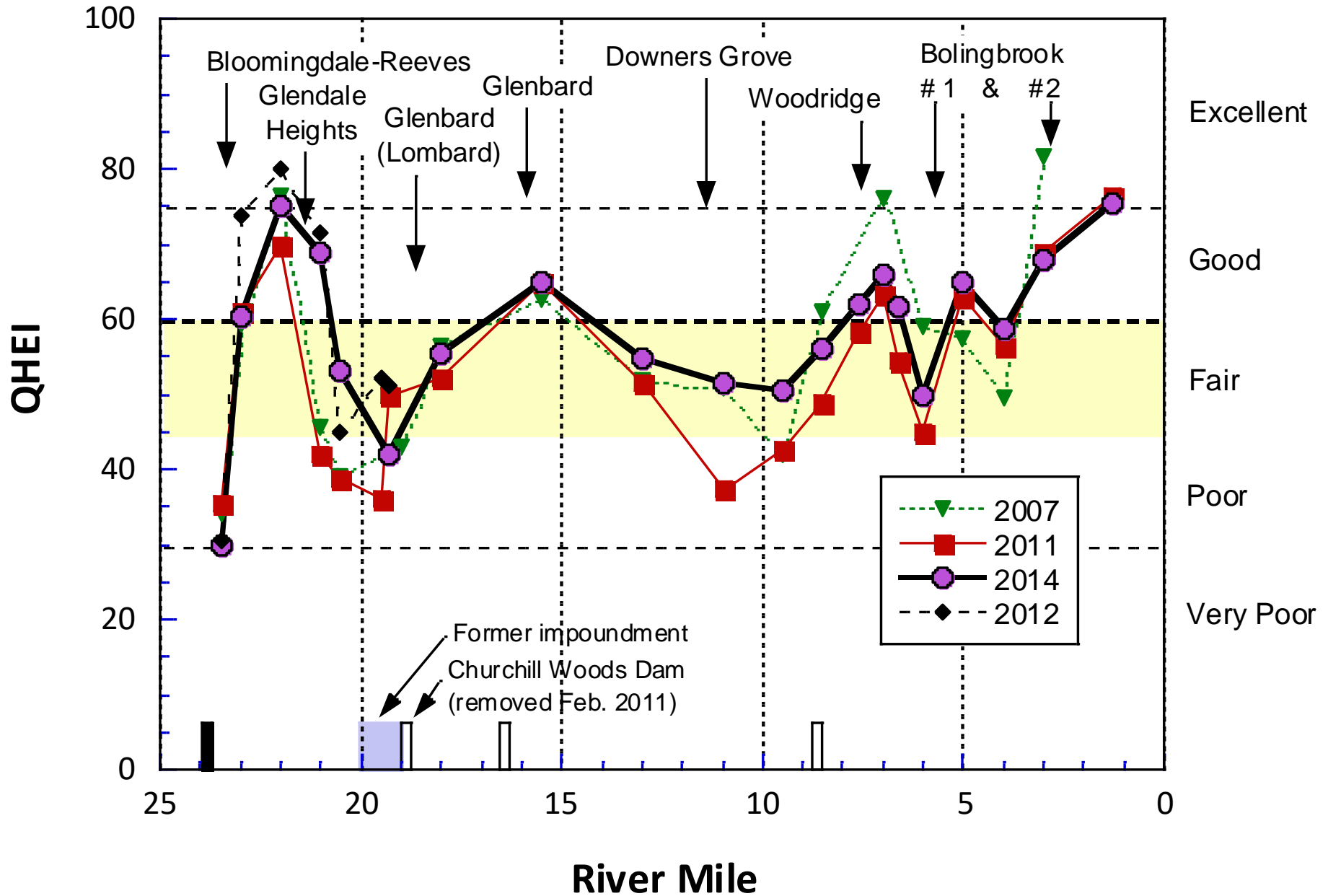
Figure 17. Chloride concentrations in Illinois River at Peoria. Data from ISWS and USGS.



*IPS derived thresholds were used in lieu of current IEPA WQS to judge effects to aquatic life. Chloride is an example of a parameter with an outdated criterion.*

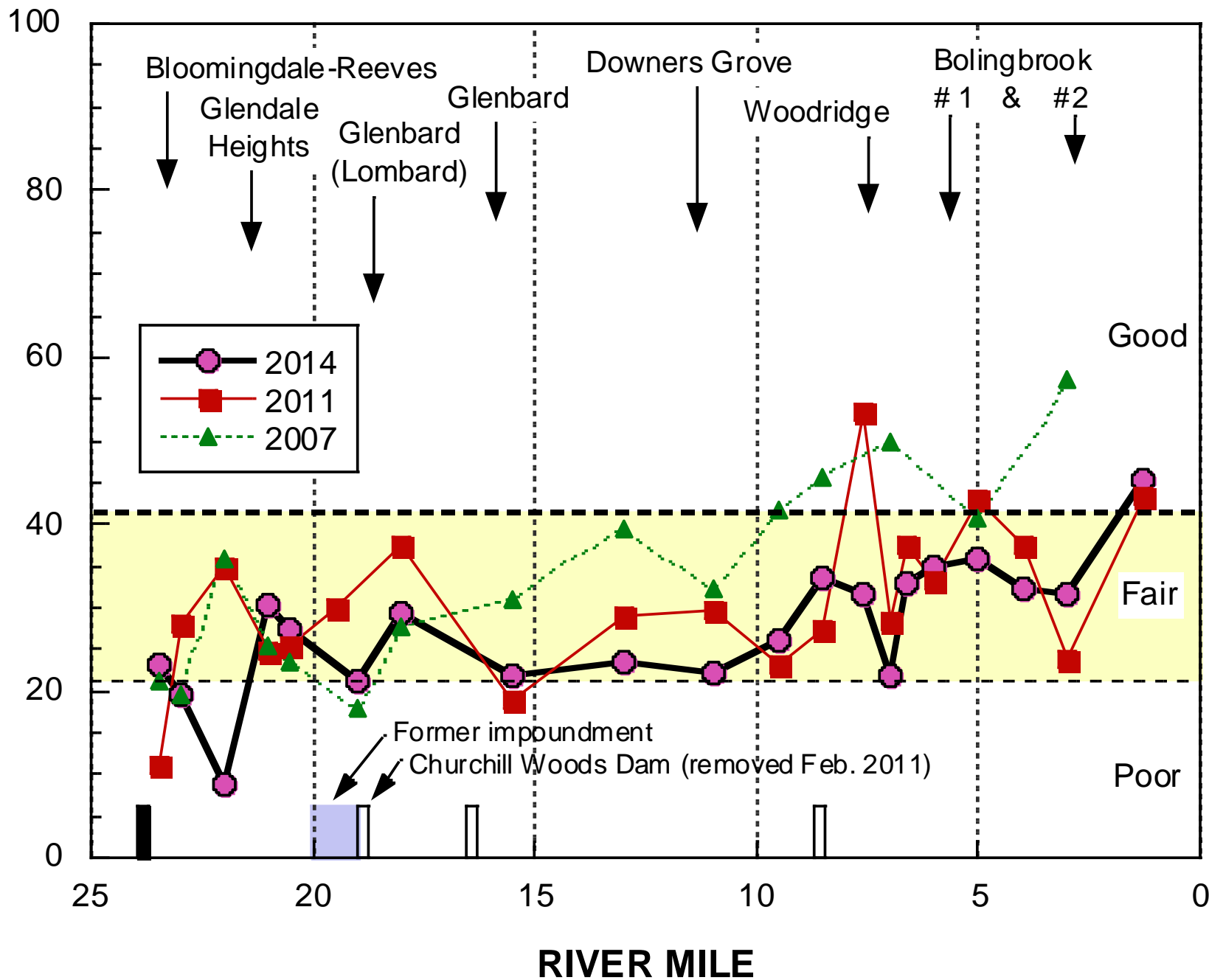


# East Branch DuPage River - Trends in QHEI

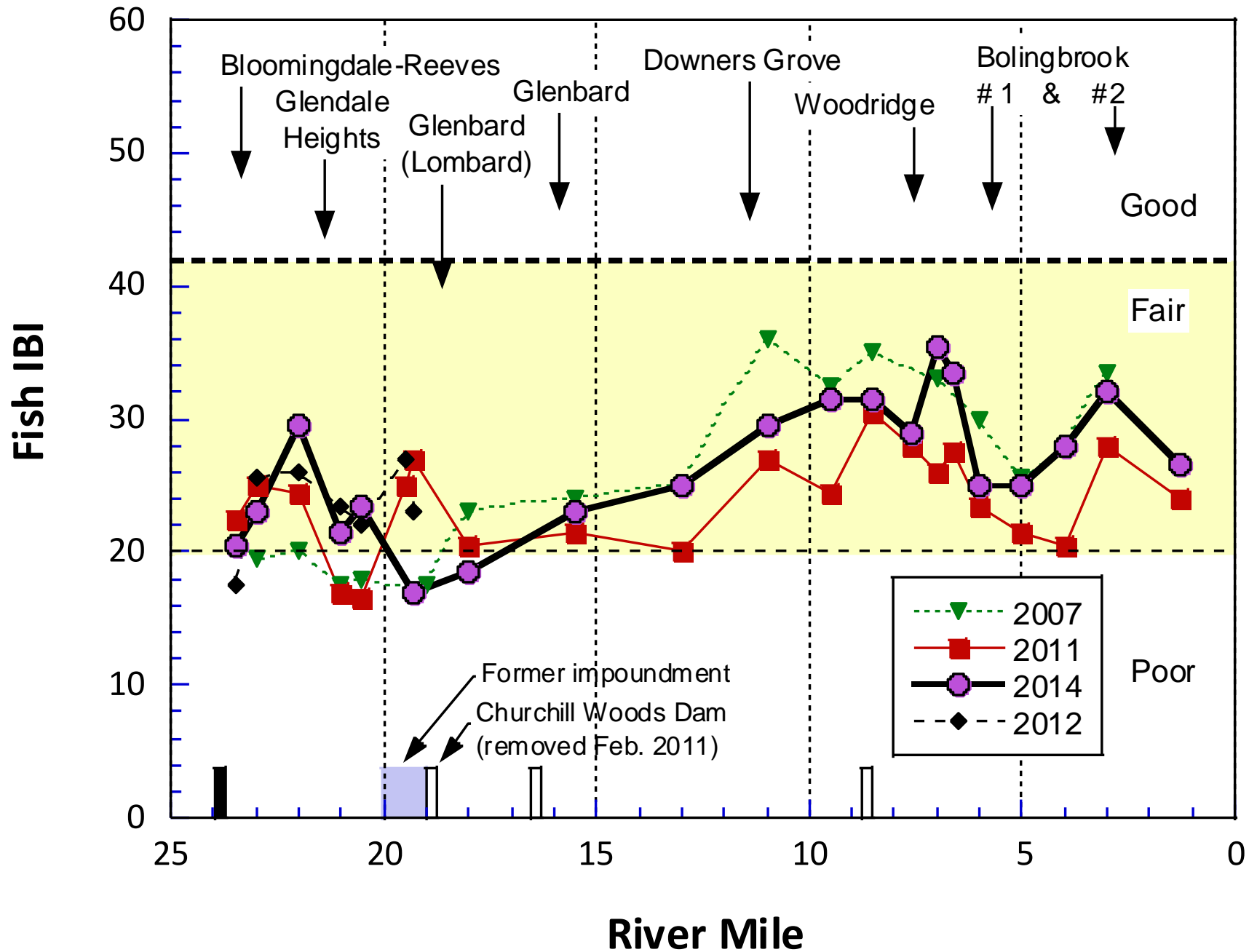




# Macroinvertebrate IBI



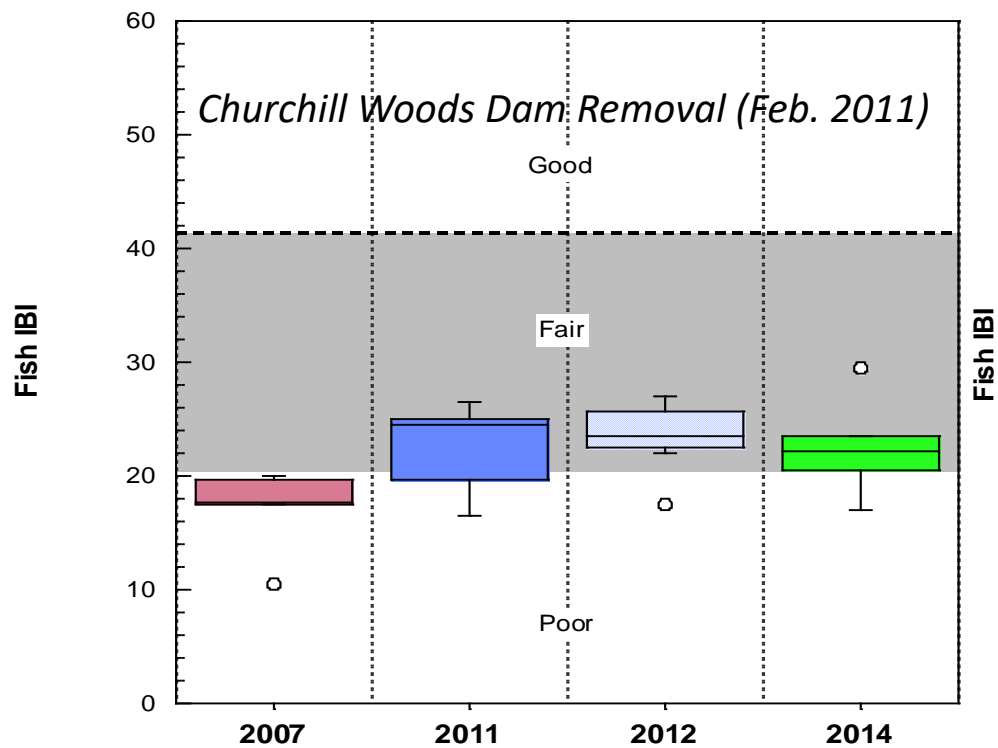
# East Branch DuPage River - Trends in Fish IBI



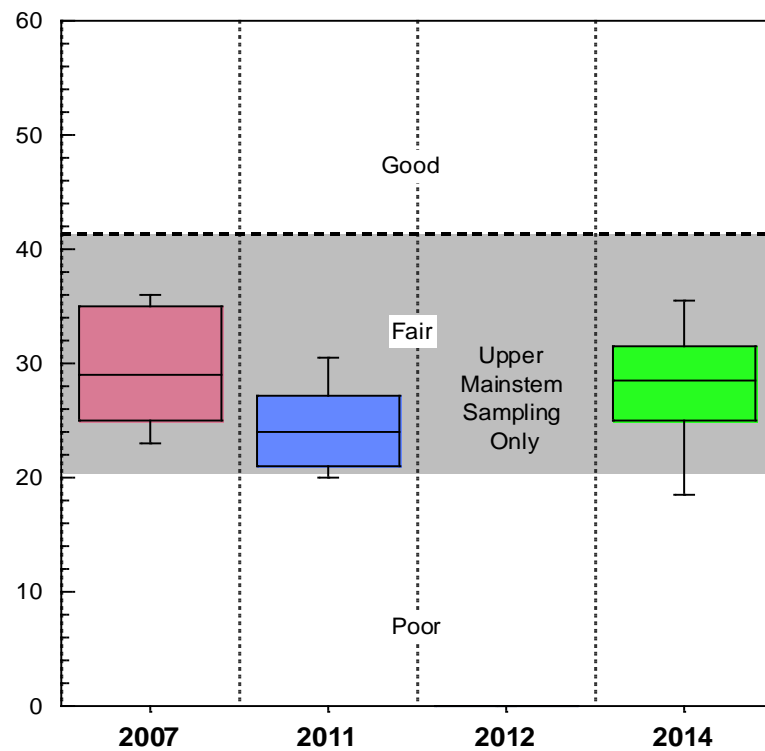
# Assessment of fish species pre- and post-Churchill Woods dam Removal (Feb. 2011)

Fish Species Collected Downstream and Not Upstream	Fish Species Collected Upstream Only After Dam Removal	Fish Species Collected Upstream Only Before Dam Removal
<i>golden redhorse</i>	<i>quillback carpsucker</i>	<i>western mosquitofish</i>
<i>shorthead redhorse</i>	<i>river carpsucker</i>	<i>central mudminnow</i>
<i>lake chubsucker</i>	<i>hornyhead chub</i>	
<i>striped shiner</i>	<i>blackstripe topminnow</i>	
<i>common shiner</i>	<i>channel catfish</i>	
<i>bullhead minnow</i>	<i>goldfish</i>	
<i>stonecat madtom</i>	<i>pumpkinseed</i>	
<i>tadpole madtom</i>	<i>johnny darter</i>	
<i>rock bass</i>		
<i>banded darter (2014)</i>		
<i>round goby (2014)</i>		

East Branch Dupage River  
Upper Mainstem



East Branch Dupage River  
Lower Mainstem





**Table 1.** Status of aquatic life use support for sites sampled in the E. Branch DuPage River study area in 2014.

SITE ID	River Mile	DA (sq. mi.)	fIBI	MIwb	mIBI	QHEI	Aquatic Life Use Attainment Status [Narrative]	MBI Associated Causes <sup>a</sup>	2011/12 fIBI	2011 mIBI
<b>95-980</b>	<b>E. Branch DuPage River Mainstem</b>									
EB29	23.50/23.50	2	20.5	na	23.2	30	Non [Fair]	TDS/Chloride, Org. Enrich., Habitat Alt., nutrients (TKN, NH <sub>3</sub> )	17.5 <sup>b</sup>	11.2
EB25	23.00/23.00	2	23.0	na	19.6	60.5	Non [Poor]	TDS/Chloride, D.O., <u>nutrients (P,N)</u> (Dst. Bloomingdale-Reeves WWTP)	25.5 <sup>b</sup>	27.9
EB23	22.00/22.00	5	29.5	na	8.9	75	Non [Poor]	TDS/Chloride, <u>nutrients (P,N,NH<sub>3</sub>)</u>	26.0 <sup>b</sup>	34.9
EB26	21.00/21.00	12	21.5	na	30.2	69	Non [Fair]	TDS/Chloride, TSS, <u>nutrients (P,N,TKN,NH<sub>3</sub>)</u> (Dst. Glendale WWTP)	23.5 <sup>b</sup>	24.8
EB21	20.50/20.50	14.2	23.5	na	27.3	53	Non [Fair]	TDS/Chloride, Habitat Alt., <u>nutrients (P,N, TKN)</u>	22.0 <sup>b</sup>	25.4
EB44	19.30/-	16	17.0	na	-	42	Non [Poor]	TDS/Chloride, TSS, Habitat Alt., D.O., <u>nutrients (P,N, TKN,NH<sub>3</sub>)</u> (no chem./causes match EB36)	23.0 <sup>b</sup>	30.1
EB36	-/19.00	-	-	na	21.3	-	(Non) [Fair]	TDS/Chloride, TSS, Habitat Alt., D.O., <u>nutrients (P,N, TKN,NH<sub>3</sub>)</u>	--	--
EB19	18.00/18.00	18	18.5	na	29.4	55.5	Non [Poor]	TDS/Chloride, Habitat Alt., <u>nutrients (P,N,TKN)</u> (Dst. Glenbard-Lombard WWTP)	20.5	37.5
EB30	15.50/15.50	27.2	23.0	5.73	21.7	65	Non [Fair]	TDS/Chloride, <u>nutrients (P,N,TKN)</u> (Dst.. Glenbard WWTP)	21.5	18.8
EB12	13.00/13.00	50	25.0	5.71	23.4	54.8	Non [Fair]	TDS/Chloride, Habitat Alt., D.O., nutrients (P,N)	20.0	29.0

## Legend

WWTP Discharge

### Attainment Status

Full - Good

Non - Fair & Good

Non - Fair

Non - Poor (any index)

Dams

Removed Dams

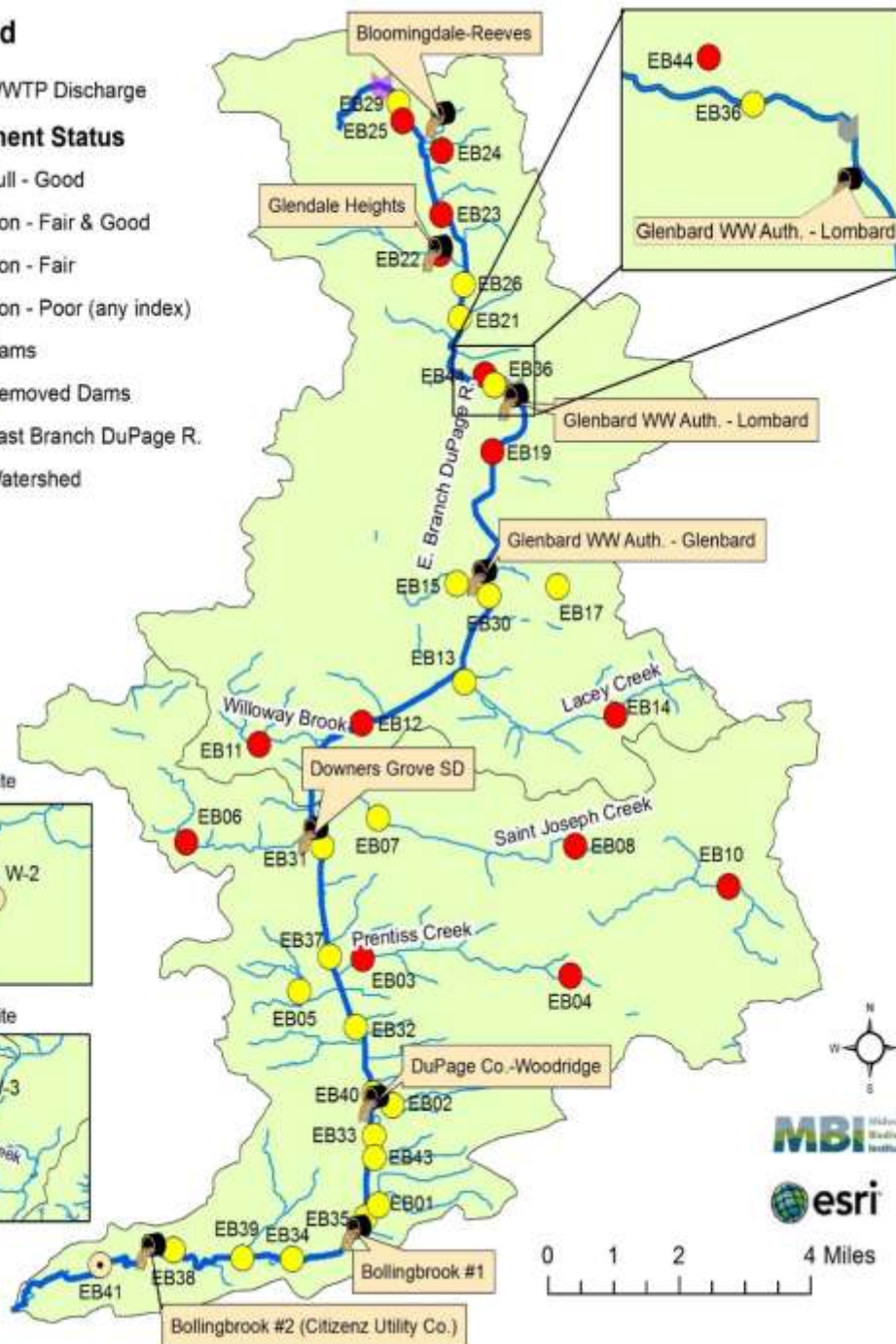
East Branch DuPage R.

Watershed

Reference Site



Reference Site



# *East Branch DuPage River Watershed Attainment Status 2014*

# **E. Branch DuPage Watershed: Major Observations**

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- **Incremental improvement in QHEI and fIBI following Churchill Woods dam removal.**
- **D.O. regime continued to exhibit wide nutrient related diel swings in 2014.**
- **Highly elevated nitrate-N highly in 2011 reduced in 2014 by flow dilution.**
- **Elevated nutrients primarily in mainstem.**
- **Elevated chlorides continued in 2014 watershed wide.**
- **Biological assemblages mostly fair-poor throughout watershed – multiple causes.**