

WWF-CANADA

FRESHWATER HEALTH ASSESSMENT

ST. JOHN RIVER WATERSHED



JUNE 2014

ST. JOHN RIVER HEALTH ASSESSMENT

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SUMMARY

OVERALL RIVER HEALTH SCORING

	Indicator	Sub-Basin			Basin	
		Upper	Central	Lower		
Overall River Health	Hydrology	Hydrology Health Category	Fair	Good	Good	Fair
		Hydrology Score	2	3	3	2
	Water Quality	Water Quality Health Category	Data Deficient	Good	Good	Good
		Water Quality Health Score	Data Deficient	3	3	3
	Benthic Macro-Invertebrates	Benthic Health Category	Very Good	Very Good	Very Good	Very Good
		Benthic Health Score	4	4	4	4
	Fish	Fish Health Category	Data Deficient	Data Deficient	Data Deficient	Data Deficient
		Fish Health Score	0	0	0	0
	Total Score		6	10	10	9
	Total Available Score		12	12	12	12
	Percentage of Maximum Score		50.0%	83.3%	83.3%	75.0%
	Overall Health Category		Data Deficient	Good	Good	Good

OVERALL DATA SUFFICIENCY SCORING

	Indicator	Sub-Basin			Basin	
		Upper	Central	Lower		
Overall River Health	Hydrology	Data Sufficiency Category	Partially Sufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
		Data Sufficiency Score	1	1	1	1
	Water Quality	Data Sufficiency Category	Insufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
		Data Sufficiency Score	0	1	1	1
	Benthic Macro-Invertebrates	Data Sufficiency Category	Partially Sufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
		Data Sufficiency Score	1	1	1	1
	Fish	Data Sufficiency Category	Insufficient	Insufficient	Insufficient	Insufficient
		Data Sufficiency Score	0	0	0	0
	Total Score		2	3	3	3
	Total Available Score		12	12	12	12
	Percentage of Maximum Score		16.7%	25.0%	25.0%	25.0%
	Overall Data Sufficiency Category		Insufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient

OVERALL HYDROLOGY RIVER HEALTH SCORING

				Upper	Central	Lower	Basin
Hydrology	Long-Term Trends in Monthly Flow	Average percentage change in median monthly flow, measured as the relative change in median monthly flow per year, reported as an average across studied stations and weighted by the median annual flow per station.	Period of Study	1930-2011	1951-2012	1962-2011	1930-2012
			Number of Stations	2	2	2	6
			Value	0.27	0.19	0.00	0.15
			Health Category	Good	Good	Very Good	Good
			Health Score	3	3	4	3
	Recent-Term Trends in Monthly Flow	Average percentage change in median monthly flow, measured as the relative change in median monthly flow per year, reported as an average across studied stations and weighted by the median annual flow per station.	Period of Study	1980-2012	1980-2012	1962-2012	1980-2012
			Number of Stations	3	6	4	13
			Value	0.26	0.06	0	0.09
			Health Category	Good	Very Good	Very Good	Very Good
			Health Score	3	4	4	4
	Long-Term Trends in Annual Flow	Average percentage change in median annual flow, reported as an average across studied stations and weighted by the median annual flow per station.	Period of Study	1930-2012	1951-2012	1962-2012	1941-2012
			Number of Stations	2	2	2	6
			Value	0.42	0	0.00	0.1
			Health Category	Good	Very Good	Very Good	Good
			Health Score	3	4	4	3
	Pre- vs. Post-Dam or Recent vs. Historical Analysis of Monthly Flow	Percentage of total months, for all stations analyzed, with significantly different variance in monthly flow pre- vs. post-dam operation or for historical vs. Recent time periods in undammed systems.	Period of Study	<=1926 - 1930 vs. 1930 - 2012	1951 - 1954 vs. 1955 - 1995	1962 - 1979 vs. 1980 - 2012	Various
			Number of Stations	1	1	2	4
			Value	66.7%	58.3%	62.5%	62.5%
			Health Category	Very Poor	Poor	Very Poor	Very Poor
			Health Score	0	1	0	0
Percentage change in median monthly flow pre-and post-dam or for historical vs. Recent time periods in undammed systems, averaged across studied stations by mean annual flow.		Period of Study	<=1926 - 1930 vs. 1930 - 2012	1951 - 1954 vs. 1955 - 1995	1962 - 1979 vs. 1980 - 2012	Various	
		Number of Stations	1	1	2	4	
		Value	21.5%	19.0%	17.1%	18.7%	
		Health Category	Good	Good	Good	Good	
		Health Score	3	3	3	3	
Hydrology Score	Total Score	12	15	15	13		
	Maximum Available Score	20	20	20	20		
	Percentage of Maximum Score	60.0%	75.0%	75.0%	65.0%		
	Hydrology Health Category	Fair	Good	Good	Fair		
	Hydrology Score	2	3	3	2		

Data Sufficiency Indicator	Sub-Basin			Basin
	Upper	Central	Lower	
Total number of sub-sub-basins	4	4	5	13
Total number of dams (>10m)	1	4	0	5
Year of earliest dam operation	1931	1951	-	1912
Year of earliest available continuous flow monitoring	1926	1918	1962	1962
Number of monitoring stations available for earliest, continuous flow monitoring	1	1	1	3
Number of sub-sub-basins with monitoring stations	1	1	1	3
Number of active monitoring stations on river downstream of dams	1	1	-	0
<i>Data Sufficiency Category</i>	Insufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
Year of long-term continuous flow monitoring	1930	1951	1962	1951
Number of monitoring stations available for continuous flow monitoring analysis	2	2	2	6
Number of sub-sub-basins with monitoring stations	2	2	2	6
Number of monitoring stations on river downstream of dams	1	1	-	2
<i>Data Sufficiency Category</i>	Moderately Sufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
Year of widespread, continuous flow monitoring	1980	1980	1980	1980
Number of monitoring stations available for continuous flow monitoring analysis	3	7	4	14
Number of sub-sub-basins with monitoring stations	2	4	4	10
Number of monitoring stations on river downstream of dams	1	1	-	2
<i>Data Sufficiency Category</i>	Partially Sufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
Overall Data Sufficiency Category	Partially Sufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
Data Sufficiency Score	1	1	1	1

MAP. RESULTS OF A SERIES OF TREND ANALYSES OF MEDIAN MONTHLY FLOW IN THE ST. JOHN RIVER BASIN.

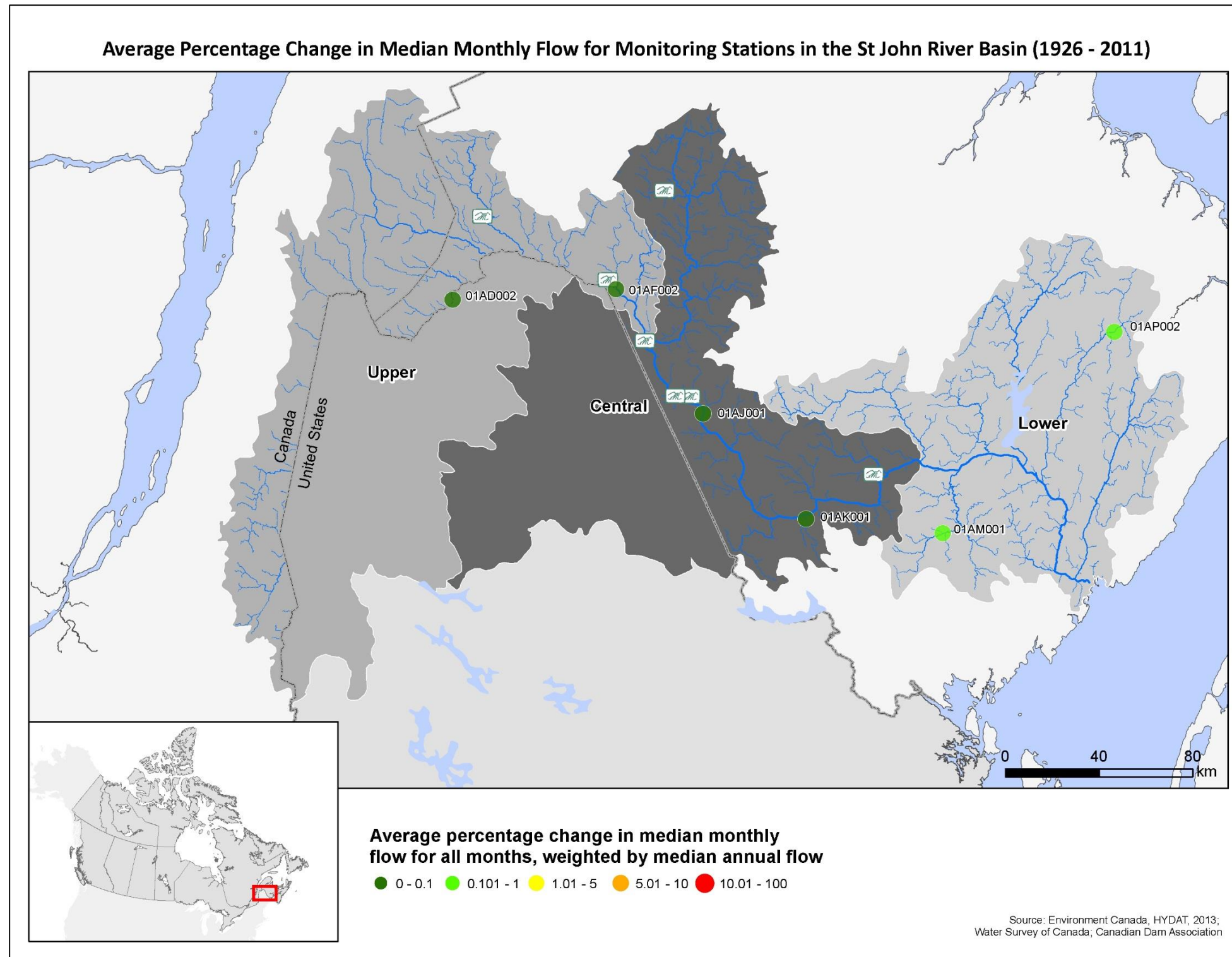


TABLE. RESULTS OF LONG-TERM TREND ANALYSES (1930 - 2011) FOR MEDIAN MONTHLY FLOW IN THE UPPER ST. JOHN RIVER SUB-BASIN.

Upper								
01AD002					01AF002			
Start Year for Analysis		1930			Start Year for Analysis		1930	
Median Annual Flow (m ³ /s)		140			Median Annual Flow (m ³ /s)		221	
Month	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*
October	0.32	0.46	173		0.31	0.67	260	
November	0.36	0.53	225		1.2	0.21	342	
December	0.69	0.27	150		1.5	0.00 **	246	0.61
January	0.32	0.06	90.59		1.1	3.75E-04 ***	158	0.69
February	0.37	0.01 **	69.88	0.53	0.78	9.54E-04 ***	130	0.60
March	0.64	1.56E-04 ***	81.04	0.79	0.75	0.01 **	162	0.46
April	3.8	0.01 **	536	0.71	5.2	0.03 *	826	0.63
May	-4.42	0.01 **	821	0.54	-4.99	0.03 *	1242	0.40
June	-1.25	0.00 **	261	0.48	-0.94	0.18	383	
July	-0.17	0.57	161		0.12	0.75	246	
August	0.00E+00	1.00	124		-0.19	0.56	204	
September	0.03	0.89	115		-0.37	0.30	179	
Average for all months, for each station	0.06		234	0.25	0.37		365	0.28
Average percentage change in median monthly flow for all months, weighted by median annual flow					0.27			

* Percentage change in median monthly flow is only calculated for months with a statistically significant trend over time. For months without a significant trend, a value of zero is assigned for calculation of the overall station score.

TABLE. RESULTS OF LONG-TERM TREND ANALYSES (1951 - 2012) FOR MEDIAN MONTHLY FLOW IN THE CENTRAL ST. JOHN RIVER SUB-BASIN.

Central								
01AJ001					01AK001			
Start Year for Analysis		1951			Start Year for Analysis		1951	
Median Annual Flow (m ³ /s)		377			Median Annual Flow (m ³ /s)		2.6	
Month	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*
October	2.9	0.21	438		0.01	0.12	2.29	
November	4.4	0.19	549		0.05	0.04 *	4.88	1.04
December	0.00E+00	1.00	417		-3.23E-04	0.97	5.21	
January	2.0	0.05 *	276	0.73	-0.01	0.35	3.13	
February	1.9	0.06	251		-0.02	0.02 *	2.96	0.76
March	0.81	0.51	278		0.01	0.28	3.55	
April	21.0	0.03 *	1377	1.53	-0.01	0.89	14.27	
May	-12.22	0.30	1986		-0.04	0.17	7.87	
June	0.44	0.87	601		0.00	0.84	3.09	
July	0.53	0.76	362		0.01	0.29	1.65	
August	1.3	0.38	323		0.00	0.43	1.17	
September	0.32	0.94	305		0.00	0.73	0.99	
Average for all months, for each station	1.95		597	0.19	2.99E-04		4.25	0.15
Average percentage change in median monthly flow for all months, weighted by median annual flow					0.19			

* Percentage change in median monthly flow is only calculated for months with a statistically significant trend over time. For months without a significant trend, a value of zero is assigned for calculation of the overall station score.

TABLE. RESULTS OF LONG-TERM TREND ANALYSES (1962 - 2010) FOR MEDIAN MONTHLY FLOW IN THE LOWER ST. JOHN RIVER SUB-BASIN.

Lower								
01AM001					01AP002			
Start Year for Analysis		1962			Start Year for Analysis		1962	
Median Annual Flow (m ³ /s)		6.2			Median Annual Flow (m ³ /s)		6.1	
Month	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*
October	0.00	0.95	4.97		0.02	0.72	7.19	
November	0.05	0.45	10.13		0.05	0.48	11.25	
December	0.00	0.97	9.87		0.00	0.96	9.63	
January	0.01	0.64	6.95		0.04	0.34	6.08	
February	-0.03	0.35	7.16		0.00	0.98	5.62	
March	0.14	0.10	11.96		0.15	0.08	10.86	
April	0.20	0.12	32.70		0.24	0.13	34.65	
May	-0.10	0.17	15.30		-0.13	0.07	15.75	
June	0.00	0.79	6.29		-0.02	0.39	5.96	
July	0.01	0.66	3.15		0.00	0.79	3.04	
August	-0.01	0.40	2.09		0.00	0.70	2.48	
September	-0.01	0.11	1.49		-0.01	0.60	2.37	
Average for all months, for each station	0.02		9.34	0.00E+00	0.03		9.57	0.00E+00
Average percentage change in median monthly flow for all months, weighted by median annual flow					0.00			

* Percentage change in median monthly flow is only calculated for months with a statistically significant trend over time. For months without a significant trend, a value of zero is assigned for calculation of the overall station score.

MAP. RESULTS OF A SERIES OF TREND ANALYSES OF MEDIAN MONTHLY FLOW IN THE ST. JOHN RIVER BASIN FOR THE PERIOD 1980 TO 2011.

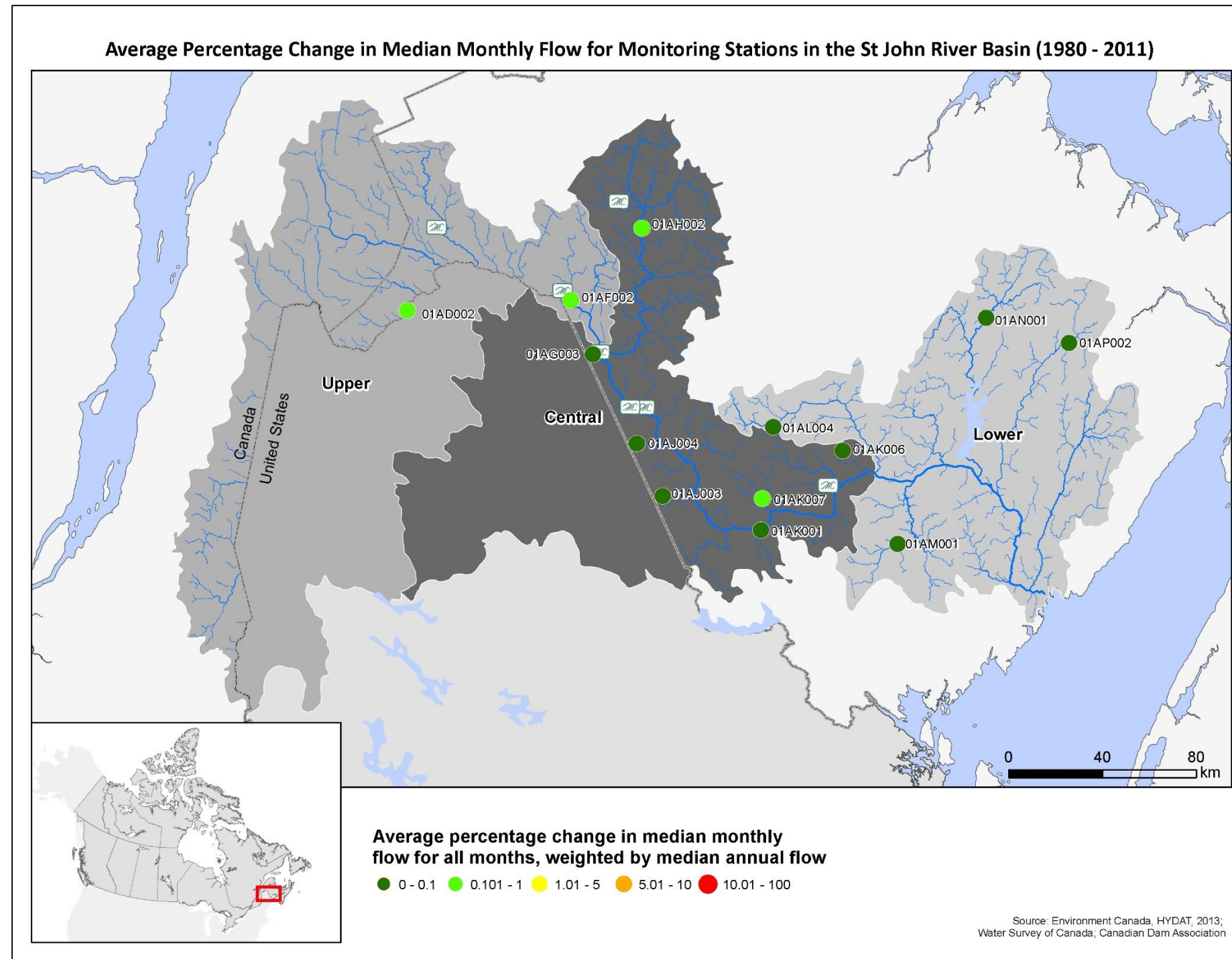


TABLE. RESULTS OF RECENT-TERM TREND ANALYSES FOR MEDIAN MONTHLY FLOW IN THE UPPER ST. JOHN RIVER SUB-BASIN.

Upper												
01AD002					01AD003				01AF002			
Start Year for Analysis		1980			Start Year for Analysis		1980		Start Year for Analysis		1980	
Median Annual Flow (m ³ /s)		155			Median Annual Flow (m ³ /s)		13.1		Median Annual Flow (m ³ /s)		241	
Month	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*
October	0.32	0.46	190		0.05	0.44	14.14		0.31	0.67	272	
November	0.36	0.53	252		0.11	0.20	21.42		1.2	0.21	381	
December	0.69	0.27	176		0.10	0.05 *	16.88	0.60	1.5	0.00 **	286	0.52
January	0.32	0.06	102		0.08	0.01 **	10.11	0.84	1.1	3.75E-04 ***	183	0.60
February	0.37	0.01 **	82.30	0.45	0.05	0.04 *	8.10	0.56	0.78	9.54E-04 ***	149	0.52
March	0.64	1.56E-04 ***	98.35	0.65	0.06	0.01 *	8.57	0.75	0.75	0.01 **	163	0.46
April	3.8	0.01 **	675	0.56	0.56	0.01 **	54.66	1.03	5.2	0.03 *	992	0.52
May	-4.42	0.01 **	625	0.71	-0.69	0.01 **	67.41	1.02	-4.99	0.03 *	982	0.51
June	-1.25	0.00 **	230	0.54	-0.15	0.01 **	20.32	0.72	-0.94	0.18	346	
July	-0.17	0.57	171		0.04	0.35	14.88		0.12	0.75	272	
August	0.00E+00	1.00	132		0.00	0.95	11.95		-0.19	0.56	217	
September	0.03	0.89	107		-0.04	0.36	7.84		-0.37	0.30	155	
Average for all months, for each station	0.06		237	0.24	0.02		21.36	0.46	0.37		367	0.26
Average percentage change in median monthly flow for all months, weighted by median annual flow					0.26							

* Percentage change in median monthly flow is only calculated for months with a statistically significant trend over time. For months without a significant trend, a value of zero is assigned for calculation of the overall station score.

TABLE. RESULTS OF RECENT-TERM TREND ANALYSES FOR MEDIAN MONTHLY FLOW IN THE MIDDLE-ST. JOHN SUB-BASIN.

Central																												
01AG003					01AH002				01AJ003				01AJ004				01AK001				01AK006				01AK007			
Start Year for Analysis		1980			Start Year for Analysis		1980		Start Year for Analysis		1980		Start Year for Analysis		1980		Start Year for Analysis		1980		Start Year for Analysis		1980		Start Year for Analysis		1980	
Median Annual Flow (m ³ /s)		59.7			Median Annual Flow (m ³ /s)		39.0		Median Annual Flow (m ³ /s)		12.2		Median Annual Flow (m ³ /s)		5.0		Median Annual Flow (m ³ /s)		2.6		Median Annual Flow (m ³ /s)		0.04		Median Annual Flow (m ³ /s)		1.9	
Month	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*
October	0.05	0.96	72.54		0.00E+00	0.93	28.44		0.05	0.77	13.48		0.01	0.83	5.39		0.03	0.39	2.49		2.50E-04	0.71	0.05		-0.01	0.87	2.52	
November	0.85	0.38	107		0.83	0.15	44.67		0.25	0.55	24.05		0.07	0.56	9.33		0.09	0.16	5.31		0.00	0.10	0.09		0.04	0.43	4.68	
December	0.60	0.39	79.06		0.48	0.32	49.17		0.20	0.37	19.67		0.12	0.25	8.44		0.05	0.22	4.98		5.24E-04	0.36	0.06		0.08	0.12	3.21	
January	0.65	0.10	48.12		0.42	0.24	49.44		0.20	0.07	10.97		0.07	0.12	4.59		0.04	0.15	2.54		2.40E-04	0.41	0.03		0.03	0.05 *	1.68	1.64
February	0.27	0.50	47.09		0.48	0.12	46.54		-0.01	0.96	9.50		0.01	0.81	4.09		0.00E+00	1.00	2.30		-5.26E-04	0.20	0.03		-0.01	0.73	1.33	
March	0.84	0.24	59.77		0.85	0.02 *	38.37	2.22	0.17	0.38	16.34		0.06	0.51	6.31		0.07	0.10	3.59		5.00E-04	0.35	0.06		0.05	0.31	3.36	
April	1.1	0.61	335		0.11	0.93	74.01		0.02	0.97	76.69		-0.15	0.54	29.67		-0.03	0.83	14.04		0.00	0.77	0.27		0.04	0.95	15.08	
May	-0.71	0.61	198		0.26	0.55	92.53		0.02	0.92	32.46		0.03	0.77	12.92		-0.01	0.74	6.70		-5.22E-04	0.55	0.10		-0.03	0.45	5.33	
June	0.25	0.57	68.93		0.16	0.66	42.44		0.11	0.43	12.35		0.03	0.39	5.33		-0.01	0.80	2.76		-5.56E-05	0.91	0.04		0.00	1.00	1.56	
July	0.63	0.15	45.40		0.13	0.50	31.46		0.11	0.22	8.37		0.04	0.20	3.44		0.00	0.88	1.73		3.33E-04	0.37	0.03		9.33E-04	0.91	1.05	
August	-0.39	0.32	37.20		0.08	0.72	26.49		-0.05	0.53	5.48		-0.03	0.35	2.31		-0.01	0.63	1.12		-3.75E-04	0.20	0.02		-0.01	0.45	0.60	
September	-0.58	0.10	32.33		-0.20	0.21	20.77		-0.04	0.43	4.52		-0.03	0.13	2.20		2.62E-04	0.96	0.78		-1.74E-04	0.35	0.01		0.00	0.45	0.59	
Average for all months, for each station	0.29		64.73	0.00E+00	0.30		45.36	0.18	0.09		19.49	0.00E+00	0.02		7.83	0.00E+00	0.02		4.03	0.00E+00	2.34E-04		0.07	0.00E+00	0.01		3.42	0.14
Average percentage change in median monthly flow for all months, weighted by median annual flow										0.06																		

* Percentage change in median monthly flow is only calculated for months with a statistically significant trend over time. For months without a significant trend, a value of zero is assigned for calculation of the overall station score.

TABLE. RESULTS OF RECENT-TERM TREND ANALYSES FOR MEDIAN MONTHLY FLOW IN THE LOWER-ST.JOHN RIVER SUB-BASIN.

Upper																
01AL004					01AM001				01AN002				01AP002			
Start Year for Analysis		1980			Start Year for Analysis		1980		Start Year for Analysis		1980		Start Year for Analysis		1980	
Median Annual Flow (m ³ /s)		0.0			Median Annual Flow (m ³ /s)		6.1		Median Annual Flow (m ³ /s)		10.5		Median Annual Flow (m ³ /s)		5.9	
Month	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*	Theil-Sen Slope	Mann-Kendall p-value	Average Median Monthly Flow	Average Percentage Change in Median Monthly Flow*
October	-4.50E-04	0.20	0.05		-0.01	0.79	4.82		-3.13E-04	0.99	10.12		0.01	0.88	6.87	
November	-4.72E-04	0.13	0.09		-0.02	0.34	10.34		0.01	0.94	18.80		0.01	0.62	11.28	
December	-3.13E-04	0.27	0.07		-0.02	0.51	9.77		-0.04	0.58	16.38		2.50E-04	0.99	9.82	
January	-2.32E-04	0.34	0.04		0.00	0.86	6.69		-0.03	0.59	9.51		0.02	0.61	6.07	
February	-3.33E-04	0.28	0.03		-3.65E-04	1.00	7.00		-0.02	0.75	8.24		0.01	0.71	6.18	
March	-3.33E-04	0.15	0.05		-0.02	0.55	12.40		-0.05	0.70	18.03		0.01	0.82	11.22	
April	-5.00E-04	0.20	0.26		-0.01	0.78	34.34		-0.04	0.65	61.45		0.02	0.39	36.84	
May	-2.78E-04	0.43	0.12		0.01	0.67	13.93		-0.01	0.85	27.58		0.03	0.34	12.98	
June	-2.69E-04	0.30	0.05		0.01	0.62	5.96		0.01	0.85	11.76		0.02	0.49	5.36	
July	-3.08E-04	0.37	0.03		0.01	0.82	3.46		0.03	0.66	7.25		0.02	0.50	2.76	
August	-3.21E-04	0.26	0.02		0.01	0.71	2.01		0.01	0.88	5.84		0.02	0.45	2.46	
September	-6.00E-04	0.07	0.02		0.00	0.97	1.34		0.01	0.89	4.91		0.01	0.73	2.27	
Average for all months, for each station	-3.67E-04		0.07	0.00E+00	0.00		9.34	0.00E+00	-0.01		16.65	0.00E+00	0.01		9.51	0.00E+00
Average percentage change in median monthly flow for all months, weighted by median annual flow					0.00											

* Percentage change in median monthly flow is only calculated for months with a statistically significant trend over time. For months without a significant trend, a value of zero is assigned for calculation of the overall station score.

TABLE. RESULTS OF LINEAR REGRESSION ANALYSES OF MEDIAN ANNUAL FLOW IN THE ST. JOHN RIVER FOR THE PERIOD, BY SUB-BASIN.

Sub-basin	Station	Start Year	Intercept	Intercept Standard Error	Intercept T-Test Statistic	Intercept T-Test p-value	Slope	Slope Standard Error	Slope T-Test Statistic	Slope T-Test p-value	Adjusted R-Squared	F-Test Statistic	F-Test p-value
Lower	01AM001	1962	4.8480	46.5958	0.1040	0.9176	0.0007	0.0235	0.0281	0.9777	-0.0213	0.0008	0.9777
	01AP002	1962	19.9623	47.4517	0.4207	0.6759	-0.0069	0.0239	-0.2887	0.7740	-0.0191	0.0834	0.7740
Central	01AJ001	1951	-1762.0464	2655.9588	-0.6634	0.5106	1.0841	1.3461	0.8053	0.42507	-0.0081	0.6485	0.4251
	01AK001	1918	-7.2224	8.4737	-0.8523	0.3962	0.0050	0.0043	1.1676	0.2460	0.0038	1.3632	0.2460
Upper	01AD002	1930	-965.5875	438.0946	-2.2041	0.0304 *	0.5612	0.2223	2.5245	0.0136	0.0622	6.3731	0.0136 *
	01AF002	1930	-1649.1842	616.7480	-2.6740	0.0091 **	0.9506	0.3130	3.0372	0.0032	0.0922	9.2249	0.0032 **

TABLE. RESULTS OF MANN-KENDALL NON-PARAMETRIC TREND ANALYSIS OF MEDIAN ANNUAL FLOW IN THE ST. JOHN RIVER, BY SUB-BASIN.

Sub-basin	Station	Start Year	Theil-Sen Slope	Mann-Kendall Test Statistic	Mann.Kendall Test p-value	Median Annual Flow (m ³ /s)	Average Percentage Change in Annual Flow	Weighted Average Percentage Change in Annual Flow Across Sub-Basin
Lower	01AM001	1962	0.0038	20	0.8699	6.16		0.00%
	01AP002	1962	0.0009	3	0.9867	6.11		
Central	01AJ001	1951	1.2710	121	0.2404	376.80		0.00%
	01AK001	1918	0.0090	644	0.0387 *	2.63	0.34%	
Upper	01AD002	1930	0.5750	588	0.0187 *	140.31	0.41%	0.42%
	01AF002	1930	0.9388	692	0.0057 **	220.86	0.43%	

TABLE. NON-PARAMETRIC COMPARISON OF VARIANCE IN MONTHLY FLOW PRE-AND POST-OPERATION OF THE GRAND FALLS DAM IN 1930 AT UPSTREAM STATION 01AD002 (ST. JOHN RIVER AT FORT KENT).

Station	Month	Pre-Dam				Post-Dam				Fligner-Killeen Test		Mann-Whitney Test		Percentage Change in Monthly Flow Between the Two Time Periods	Average Percentage Change Across Months	Median Annual Flow (m ³ /s)
		Start Year	Number of Year of Sampling	Median Monthly Flow (m ³ /s)	Median Absolute Deviation in Monthly Flow (m ³ /s)	Benchmark Year	Number of Year of Sampling	Median Monthly Flow (m ³ /s)	Median Absolute Deviation in Monthly Flow (m ³ /s)	Test Statistic	p-value	Test Statistic	p-value			
01AD002	October	1926	4	85.5	43.37	1930	82	123	101.26	22.9229	0.0000 ***	18999.5	0.0221 *	43.86%	21.32%	140.31
	November	1926	4	201	41.51	1930	82	204.5	154.93	6.5737	0.0103 *	27009.5	0.0924	1.74%		
	December	1926	4	176	151.37	1930	82	159	103.04	0.0625	0.8026	24718	0.5849	9.66%		
	January	1927	3	125	57.52	1930	82	93.05	45.59	0.0041	0.9492	24053.5	0.0003 ***	25.56%		
	February	1927	3	77.3	20.39	1930	82	62.3	33.66	4.6672	0.0307 *	18118	0.8153	19.40%		
	March	1927	3	47.15	8.82	1930	82	53.25	27.28	25.3854	0.0000 ***	12131	0.0013 **	12.94%		
	April	1927	3	109.5	47.00	1930	82	183	180.43	24.6001	0.0000 ***	13105	0.0080 **	67.12%		
	May	1927	3	1550	1219.44	1930	82	1130	652.34	7.4948	0.0062 **	19608.5	0.2748	27.10%		
	June	1927	3	616	178.65	1930	82	294	139.36	2.7584	0.0967	30391.5	0.0000 ***	52.27%		
	July	1927	3	195	125.28	1930	82	164	93.40	0.0736	0.7862	19135	0.4126	15.90%		
	August	1927	3	98.5	42.40	1930	82	104	70.79	5.0818	0.0242 *	19211.5	0.3879	5.58%		
September	1927	3	55.05	22.46	1930	82	84.8	67.01	30.5764	0.0000 ***	11922	0.0009 ***	54.04%			

FIGURE. MONTHLY FLOW PRE- AND POST- OPERATION OF THE GRAND FALLS DAM IN 1930 AT UPSTREAM STATION 01AD002 (ST. JOHN RIVER AT FORT KENT).

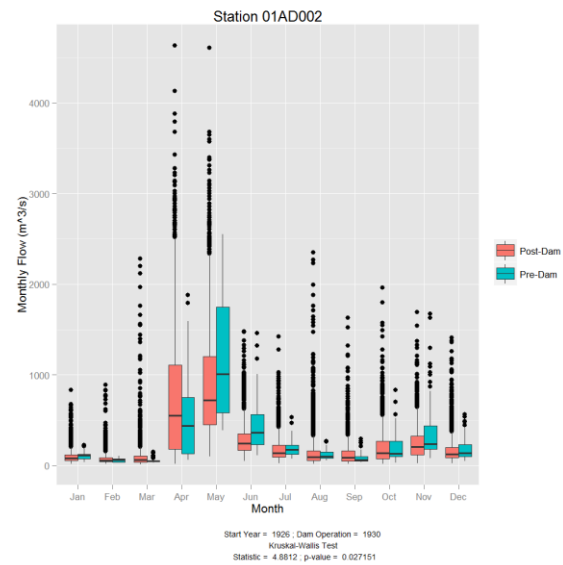


FIGURE. PERCENTAGE CHANGE IN MEDIAN MONTHLY FLOW PRE- AND POST- OPERATION OF THE GRAND FALLS DAM IN 1930 FOR UPSTREAM STATION 01AD002 (ST. JOHN RIVER AT FORT KENT).

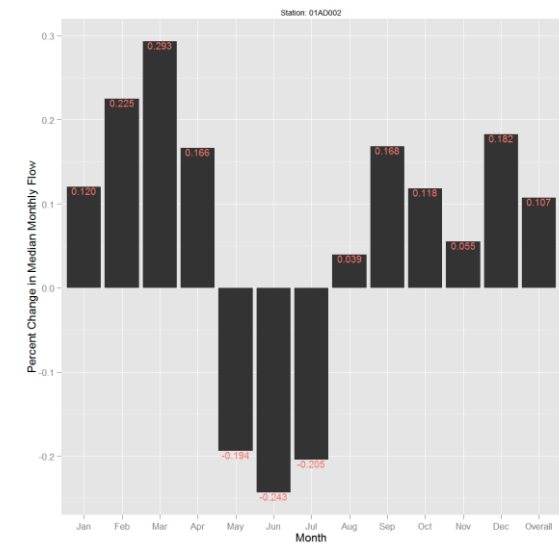


TABLE NON-PARAMETRIC COMPARISON OF VARIANCE IN MONTHLY FLOW PRE-AND POST-OPERATION OF THE BEECHWOOD DAM IN 1955 AT DOWNSTREAM STATION 01AJ001 (ST. JOHN RIVER NEAR EAST FLORENCEVILLE).

Station	Month	Start Year	Pre-Dam		Post-Dam		Fligner-Killeen Test		Mann-Whitney Test		Percentage Change in Monthly Flow Between the Two Time Periods	Average Percentage Change Across Months	Median Annual Flow (m ³ /s)			
			Number of Year of Sampling	Median Monthly Flow (m ³ /s)	Median Absolute Deviation in Monthly Flow (m ³ /s)	Benchmark Year	Number of Year of Sampling	Median Monthly Flow (m ³ /s)	Median Absolute Deviation in Monthly Flow (m ³ /s)	Test Statistic				p-value	Test Statistic	p-value
01AJ001	June	1951	4	544	391.41	1955	40	521	245.37	16.8825	0.0000 ***	71335.5	0.5483	4.23%	19.00%	140.31
	July	1951	4	335.5	262.42	1955	40	306	167.53	42.1844	0.0000 ***	87775.5	0.0092 **	8.79%		
	August	1951	4	235	201.11	1955	40	243	148.26	19.7142	0.0000 ***	71243.5	0.1778	3.40%		
	September	1951	4	157.5	147.67	1955	40	260.5	181.62	0.9783	0.3226	55518	0.0000 ***	65.40%		
	October	1951	4	269.5	255.60	1955	40	334	243.15	0.0115	0.9148	66962.5	0.0177 *	23.93%		
	November	1951	4	560.5	346.19	1955	40	453.5	327.65	0.0271	0.8692	72844	0.8322	19.09%		
	December	1951	4	549	209.79	1955	40	362	182.36	3.6880	0.0548	98397.5	0.0000 ***	34.06%		
	January	1952	3	209	45.96	1955	41	257	109.71	17.9051	0.0000 ***	47027	0.0010 ***	22.97%		
	February	1952	3	267	44.48	1955	41	215	102.30	32.2176	0.0000 ***	53282	0.2030	19.48%		
	March	1952	3	351	180.88	1955	41	224	142.33	1.0634	0.3025	83501	0.0000 ***	36.18%		
	April	1952	3	2115	1593.80	1955	40	1340	1168.29	3.8745	0.0490 *	64274.5	0.0026 **	36.64%		
	May	1952	3	1780	874.73	1955	40	1735	1074.89	14.0011	0.0002 ***	57348	0.9307	2.53%		

FIGURE. MONTHLY FLOW PRE- AND POST-OPERATION OF THE BEECHWOOD DAM IN 1955 AT DOWNSTREAM STATION 01AJ001 (ST. JOHN RIVER NEAR EAST FLORENCEVILLE).

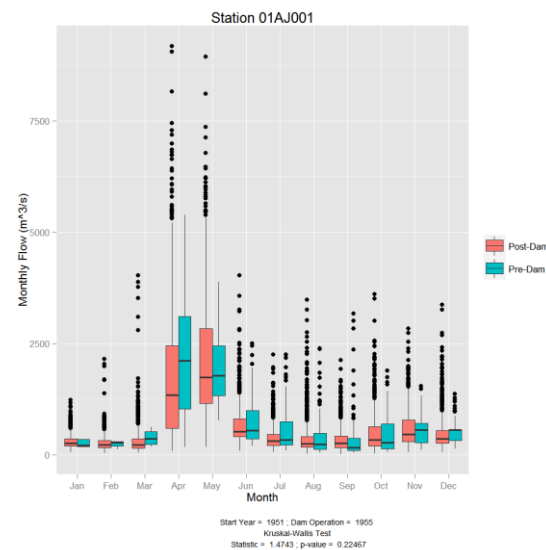


FIGURE. PERCENTAGE CHANGE IN MEDIAN MONTHLY FLOW PRE- AND POST- OPERATION OF THE BEECHWOOD DAM IN 1955 AT DOWNSTREAM STATION 01AJ001 (ST. JOHN RIVER NEAR EAST FLORENCEVILLE).

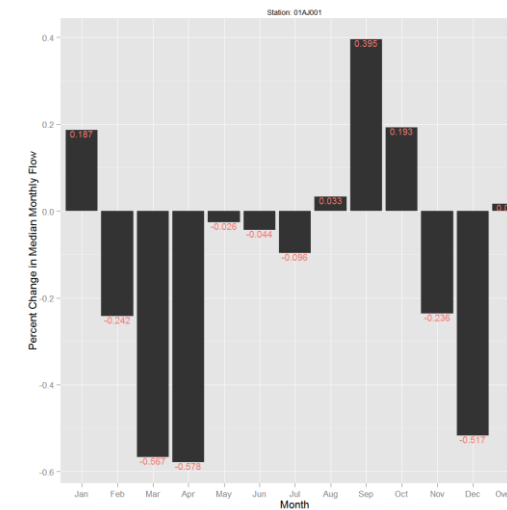


FIGURE. RESULTS OF COMPARISON OF MONTHLY FLOW (HISTORICAL VS. RECENT) FOR THE LOWER ST. JOHN RIVER BASIN.

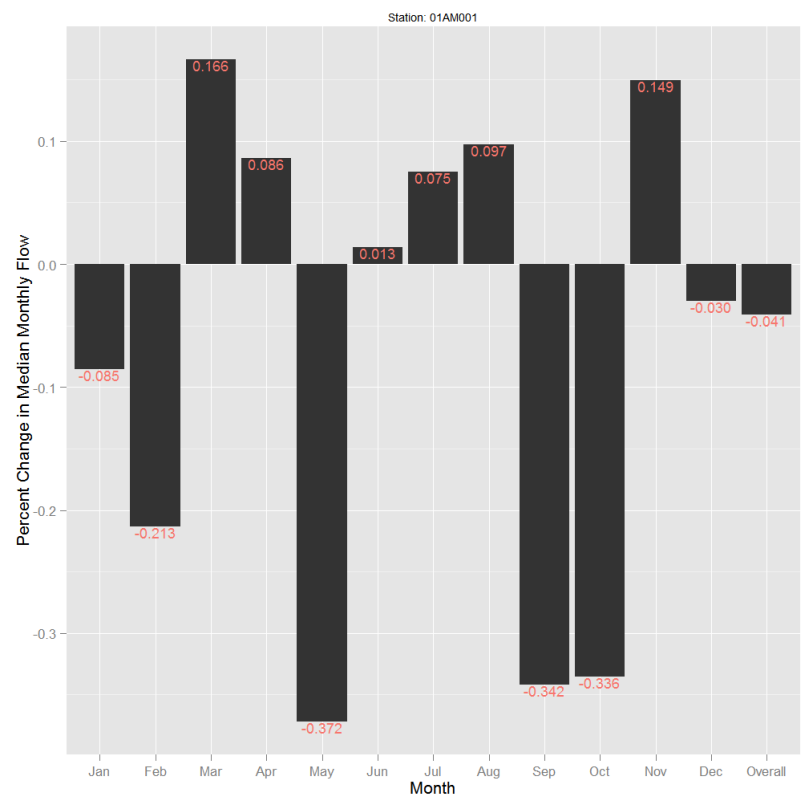
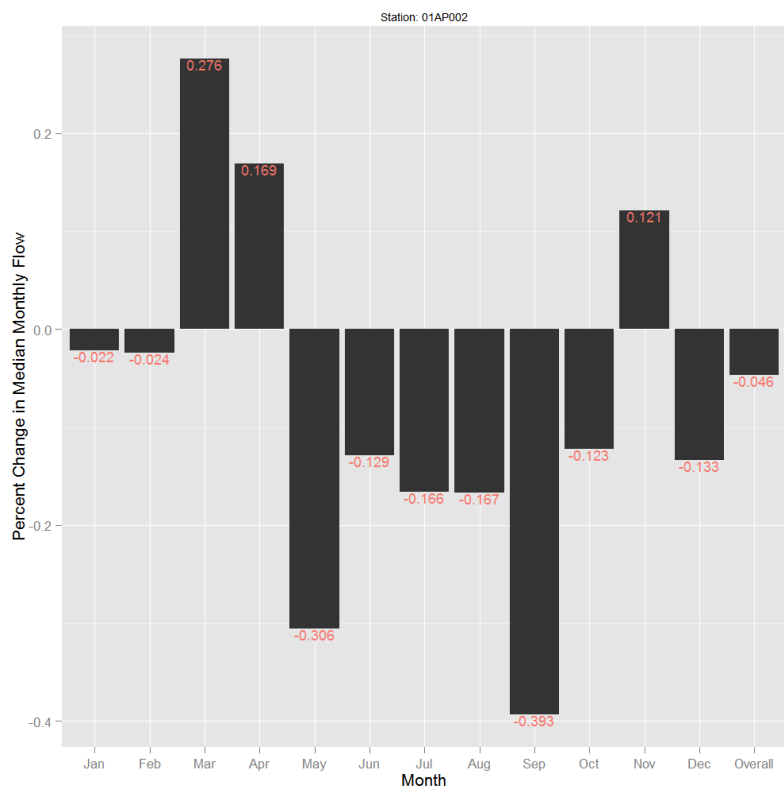


TABLE. NON-PARAMETRIC COMPARISON OF VARIANCE IN MONTHLY FLOW (HISTORICAL VS. RECENT) FOR THE LOWER ST. JOHN RIVER BASIN.

Station	Month	Historic			Recent			Fligner-Killeen		Mann-Whitney		Percentage Change in Monthly Flow Between the Two Time Periods	Average Percentage Change Across Months	Median Annual Flow (m ³ /s)	Weighted Average Percentage Change for Sub-basin
		Number of Years of Sampling	Median Monthly Flow (m ³ /s)	Median Absolute Deviation in Monthly Flow (m ³ /s)	Number of Years of Sampling	Median Monthly Flow (m ³ /s)	Median Absolute Deviation in Monthly Flow (m ³ /s)	Test Statistic	p-value	Test Statistic	p-value				
01AM001	October	20	4.63	4.72	29	2.66	3.20	16.9503	0.0000 ***	334923	0.0000 ***	42.55%	14.8%	6.16	17.07%
	November	20	9.2	8.55	29	9.805	8.98	1.3498	0.2453	252513	0.2887	6.58%			
	December	20	8.72	5.73	29	8.2	6.45	2.8977	0.0887	304955	0.0018 **	5.96%			
	January	19	6.23	3.44	29	6	5.14	28.4713	0.0000 ***	290315	0.0016 **	3.69%			
	February	19	5.52	4.40	29	4.6	3.51	12.7441	0.0004 ***	246348.5	0.0002 ***	16.67%			
	March	19	9.04	7.95	29	11	11.53	37.0726	0.0000 ***	240793	0.0031 **	21.68%			
	April	19	28.55	17.87	29	31.7	21.79	15.8283	0.0001 ***	220334.5	0.0003 ***	11.03%			
	May	19	15.7	10.26	29	12.2	8.05	19.6340	0.0000 ***	313539.5	0.0000 ***	22.29%			
	June	19	5.13	3.48	29	5.2	3.83	1.8717	0.1713	253404	0.4797	1.36%			
	July	19	2.31	1.82	29	2.16	1.73	2.0167	0.1556	264742.5	0.9988	6.49%			
	August	19	1.37	1.44	29	1.22	1.31	6.6040	0.0102 *	290348	0.0016 **	10.95%			
September	19	1.32	1.54	29	0.75	0.91	67.2055	0.0000 ***	295121.5	0.0000 ***	43.18%				
01AP002	October	20	6.685	7.57	30	4.9	5.54	19.0302	0.0000 ***	323016	0.0001 ***	26.70%	19.3%	6.11	17.07%
	November	20	9.74	7.72	30	10.2	8.61	1.5698	0.2102	263773.5	0.4487	4.72%			
	December	20	8.72	5.64	30	7.135	6.19	3.2876	0.0698	321987	0.0001 ***	18.18%			
	January	19	4.87	2.98	30	4.8	4.15	33.3947	0.0000 ***	278868	0.5497	1.44%			
	February	19	3.82	2.92	30	3.8	3.56	2.3199	0.1277	237092.5	0.1819	0.52%			
	March	19	7.99	8.17	30	10.2	11.42	32.0094	0.0000 ***	239581	0.0000 ***	27.66%			
	April	19	29.7	21.13	30	35.85	23.28	0.9143	0.3390	221839.5	0.0000 ***	20.71%			
	May	19	15.1	10.38	30	12.3	10.42	6.9415	0.0084 **	331473.5	0.0000 ***	18.54%			
	June	19	5.165	4.26	30	4.24	3.83	1.8650	0.1721	286449.5	0.0002 ***	17.91%			
	July	19	2.61	2.68	30	1.71	1.48	48.8532	0.0000 ***	309773	0.0000 ***	34.48%			
	August	19	1.98	2.16	30	1.285	1.27	19.9663	0.0000 ***	295525	0.0094 **	35.10%			
September	19	2.16	2.50	30	1.455	1.49	32.1435	0.0000 ***	276724.5	0.0108 *	32.64%				

WATER QUALITY

OVERALL WATER QUALITY HEALTH SCORING

	Indicator	Sub-Basin			Basin	
		Upper	Central	Lower	Value	
Water Quality	Exceedance of water quality guidelines for aquatic life Exceedance of water quality thresholds. Weighted average of exceedances of three thresholds: water quality guidelines, 90th percentile and 77th percentile. Expressed as a proportion of total measurements. Reported as a weighted average for the last five years. Significant Mann-Kendal time-series test to determine directional trend in proportion of exceedance of water quality	Year	2008	2008 - 2012	2008 - 2012	
		Number of Stations	3	11	50	64
		Value	0.23	0.24	0.22	0.23
		Water Quality Health Category	Data Deficient	Good	Good	Good
		Water Quality Health Score	Data Deficient	3	3	3
		Time Period	-	1984 - 2011	1971 - 2012	-
		Trend	-	None	Negative trend in proportion of exceedance	-

WATER QUALITY DATA SUFFICIENCY

	Data Sufficiency Indicator	Sub-Basin			Basin
		Upper	Central	Lower	
Water Quality	Total number of sub-sub-basins	4	4	5	13
	Year of earliest available monitoring	1971	1971	1971	1971
	Number of monitoring stations available for earliest monitoring	4	12	4	20
	Number of sub-sub-basins with earliest available monitoring stations	2	4	3	7
	Year of most recently available monitoring	2008	2012	2012	2012
	Number of monitoring stations available within last five years	1	11	50	61
	Number of sub-sub-basins within last five years	1	3	5	8
	Percentage of samples with at least 10 elements measured within last 5 years.	50%	77%	60%	57%
	Number of years of sampling in last 10 years	4	5	5	5
	Overall Data Sufficiency Category	Insufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
	Data Sufficiency Score	0	1	1	1

MAP. EXCEEDANCE OF WATER QUALITY THRESHOLDS IN THE ST. JOHN RIVER BASIN FOR THE FIVE MOST RECENT YEAR OF AVAILABLE MONITORING.

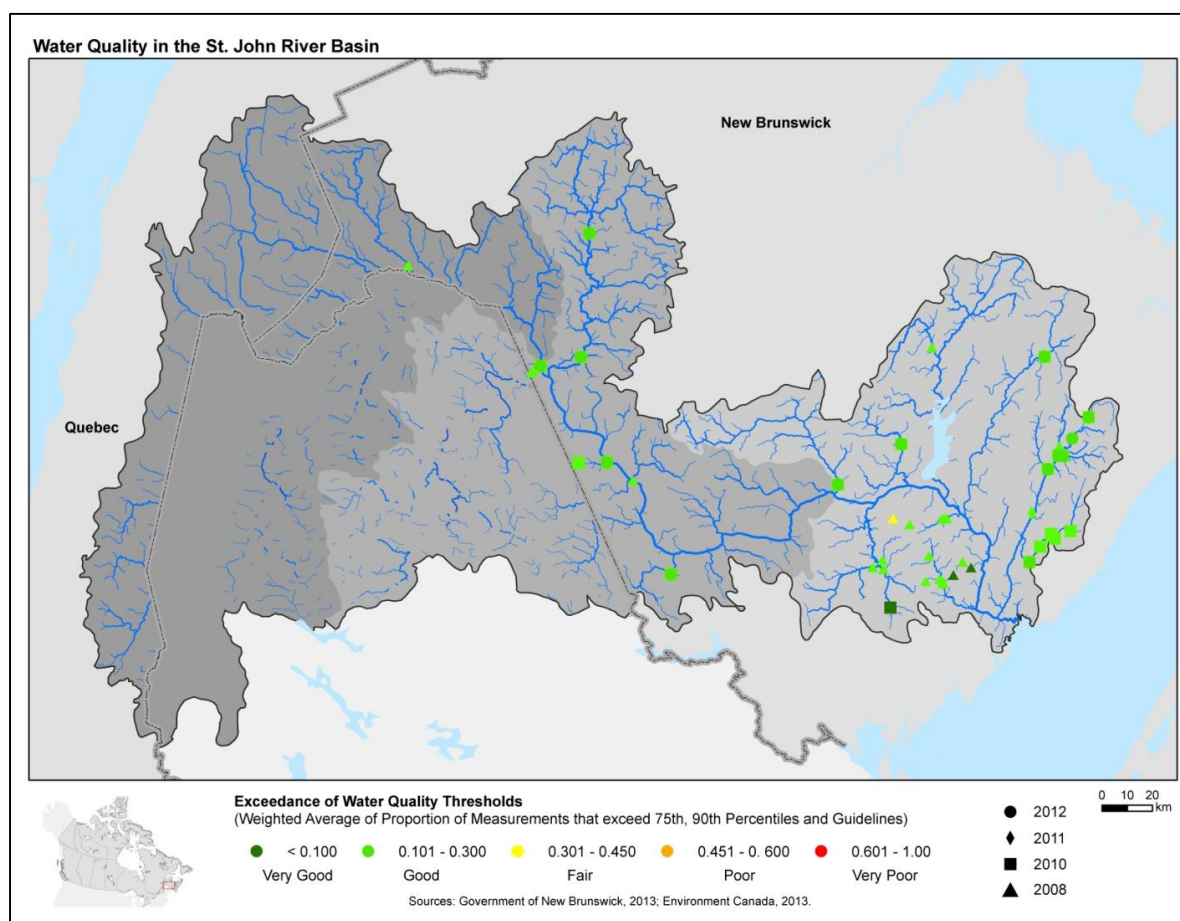


FIGURE. WATER QUALITY IN THE ST. JOHN RIVER BASIN BASED ON PROPORTION OF EXCEEDANCE OF THREE THRESHOLDS: PROVINCIAL WATER QUALITY GUIDELINES, 75TH PERCENTILE OF HISTORICAL DISTRIBUTION, AND 90TH PERCENTIEL OF HISTORICAL DISTRIBUTION. REPORTED BY SUB-BASIN AND DATA SOURCE.

Source	Sub-Basin	Year	Number of Contaminants Measured	Total Number of Sites	Number of Measurements	Total Number of Guidelines Exceedances	Proportion of Guideline Exceedance	Total Number of 90th Percentile Exceedances	Proportion of 90th Percentile Exceedance	Total Number of 75th Percentile Exceedances	Proportion of 75th Percentile Exceedance	Weighted Average Exceedance
New Brunswick Dept. Of Env.	St. John River Basin	2012	15	14	812	71	0.09	164	0.20	246	0.30	0.16
	Lower	2012	15	9	481	42	0.09	94	0.20	137	0.28	0.16
	Central	2012	15	5	331	29	0.09	70	0.21	109	0.33	0.17
New Brunswick Dept. Of Env.	St. John River Basin	2011	16	14	992	89	0.09	197	0.20	293	0.30	0.16
	Lower	2011	16	9	526	43	0.08	96	0.18	135	0.26	0.14
	Central	2011	15	5	466	46	0.10	101	0.22	158	0.34	0.18
New Brunswick Dept. Of Env. & Environment Canada	St. John River Basin	2010	18	19	1194	99	0.08	231	0.19	352	0.29	0.16
	Central	2010	18	6	500	43	0.09	102	0.20	159	0.32	0.16
Environment Canada	Central	2010	13	1	91	9	0.10	24	0.26	40	0.44	0.21
New Brunswick Dept. Of Env.	St. John River Basin	2010	16	18	1103	90	0.08	207	0.19	312	0.28	0.15
	Lower	2010	16	13	694	56	0.08	129	0.19	193	0.28	0.15
	Central	2010	15	5	409	34	0.08	78	0.19	119	0.29	0.15
New Brunswick Dept. Of Env. & Environment Canada	St. John River Basin	2008	18	40	1885	214	0.11	392	0.21	603	0.32	0.18
	Lower	2008	18	30	1320	156	0.12	266	0.20	386	0.29	0.18
	Central	2008	18	9	551	57	0.10	124	0.23	214	0.39	0.19
Environment Canada	St. John River Basin	2008	14	18	952	144	0.15	231	0.24	367	0.39	0.22
	Lower	2008	14	15	709	108	0.15	162	0.23	237	0.33	0.21
	Central	2008	14	3	243	36	0.15	69	0.28	130	0.53	0.26
New Brunswick Dept. Of Env.	St. John River Basin	2008	15	22	933	70	0.08	161	0.17	236	0.25	0.14
	Lower	2008	15	15	611	48	0.08	104	0.17	149	0.24	0.14
	Central	2008	15	6	308	21	0.07	55	0.18	84	0.27	0.14
	Upper	2008	14	1	14	1	0.07	2	0.14	3	0.21	0.12

FIGURE. ANALYSIS OF VARIANCE IN EXCEEDANCE OF WATER QUALITY THRESHOLDS OVER TIME FOR MONITORING STATIONS IN THE ST. JOHN RIVER BASIN, BY SUB-BASIN.

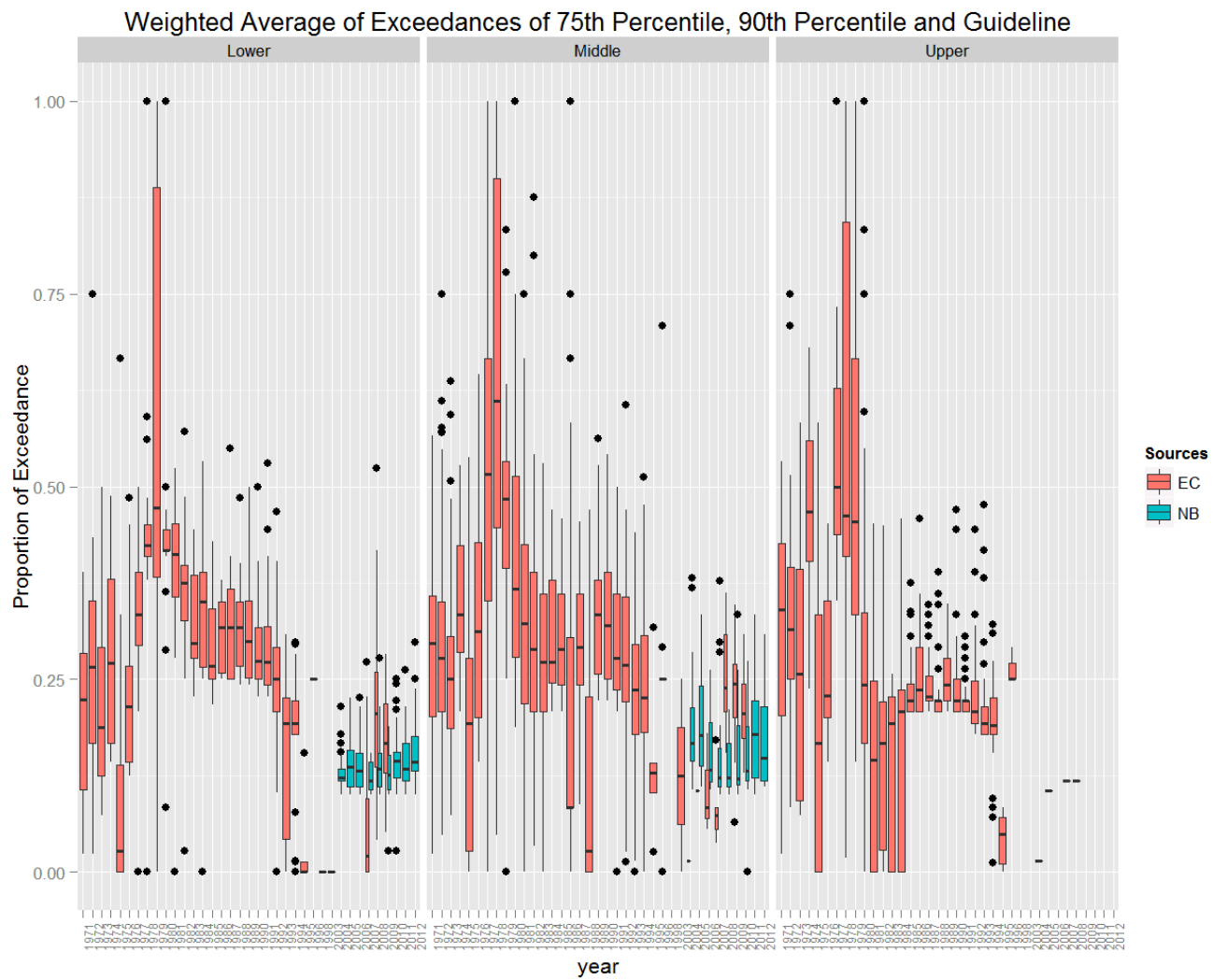
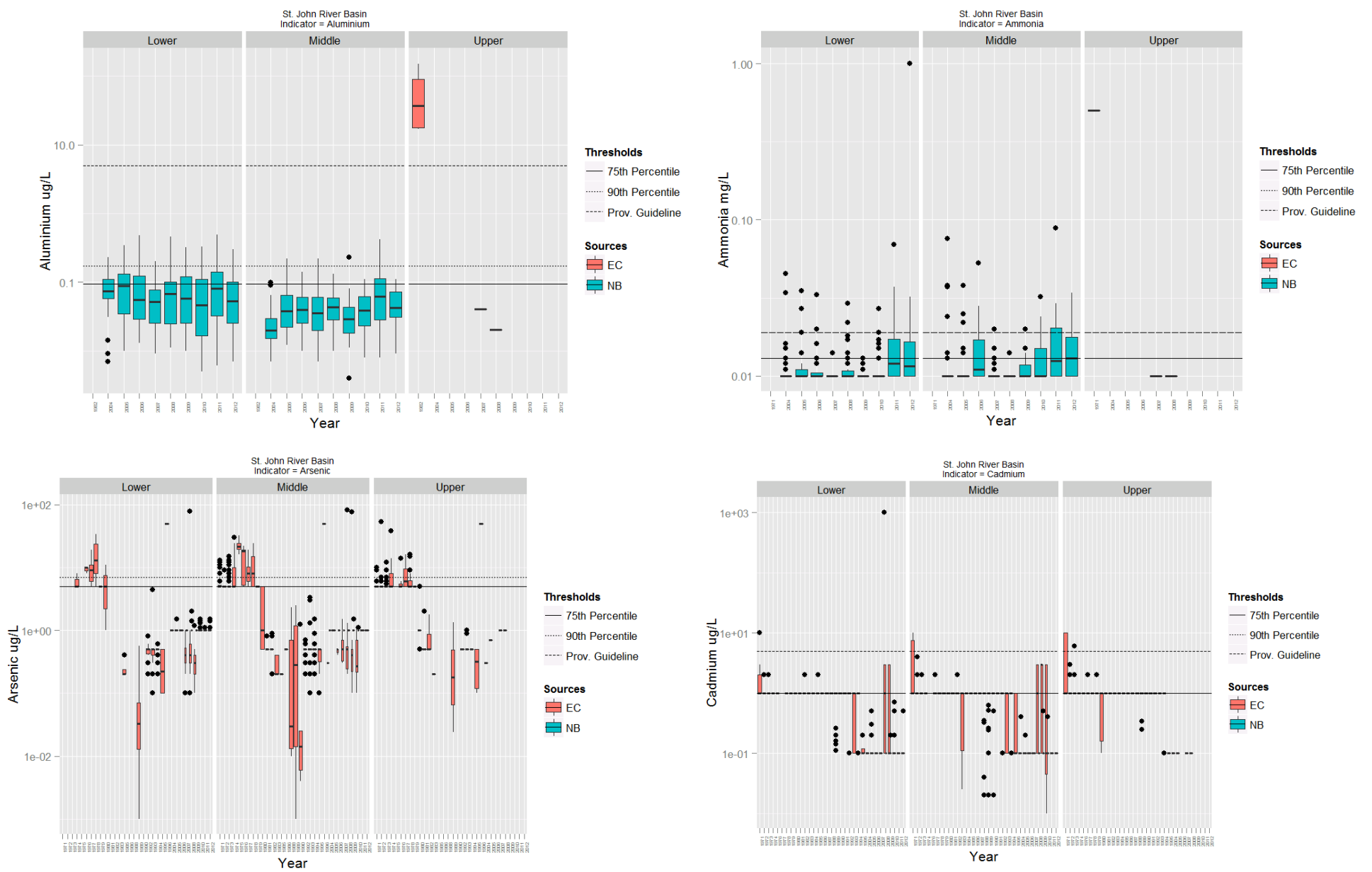
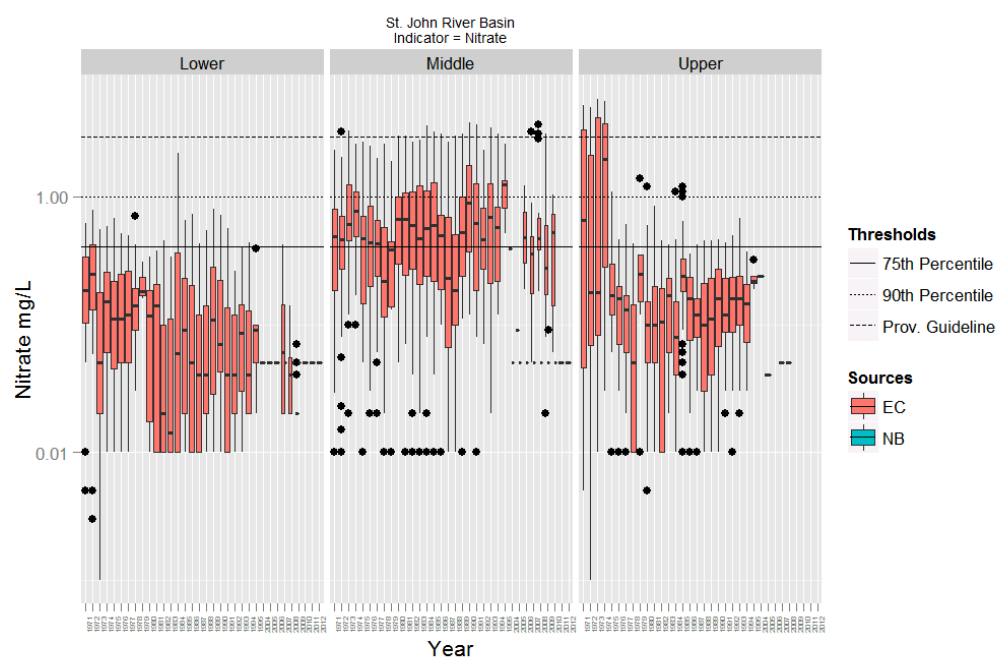
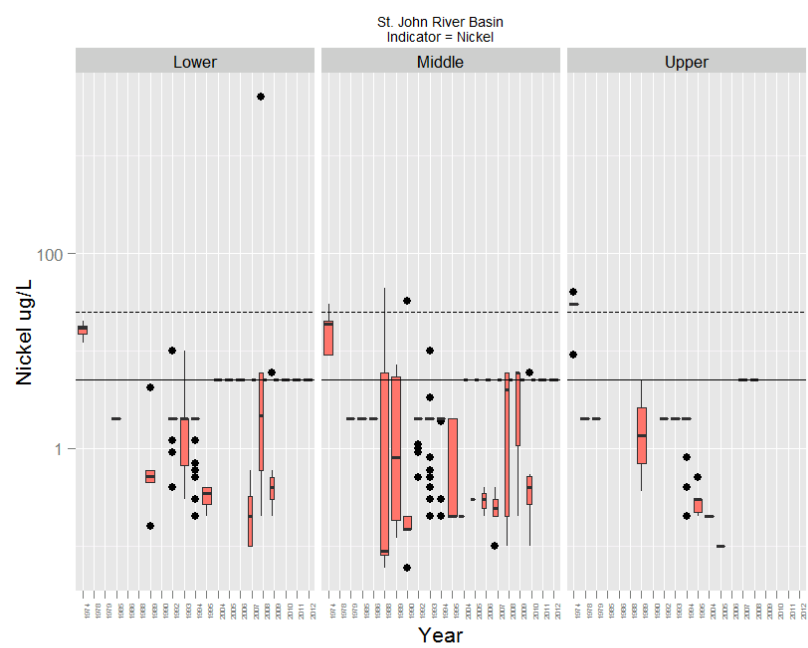
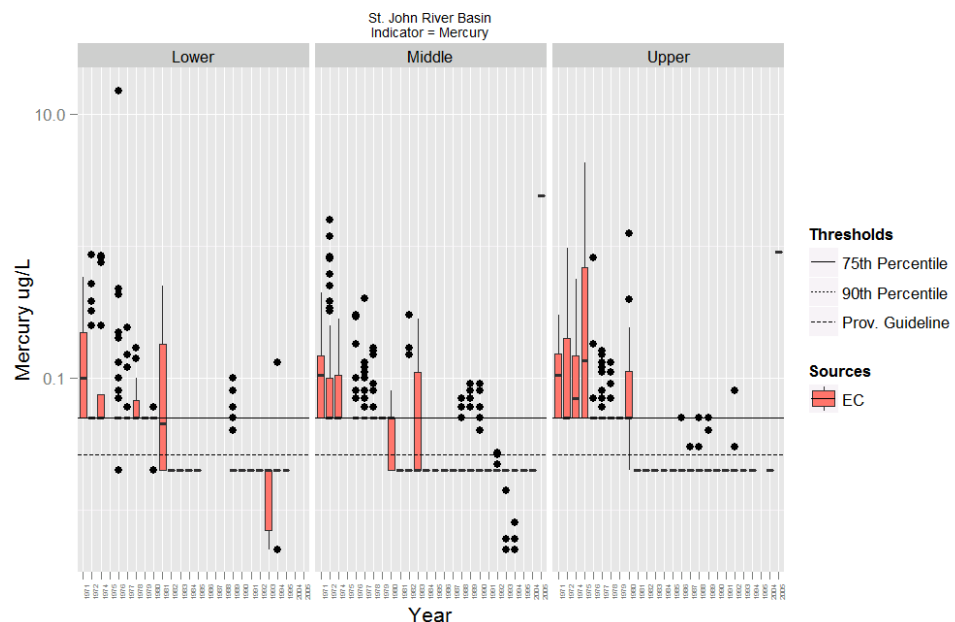
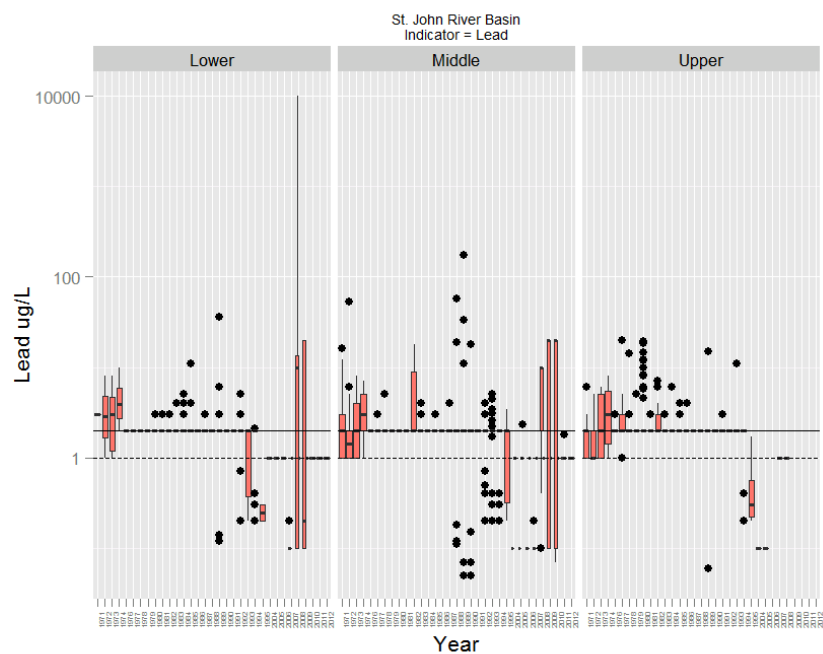
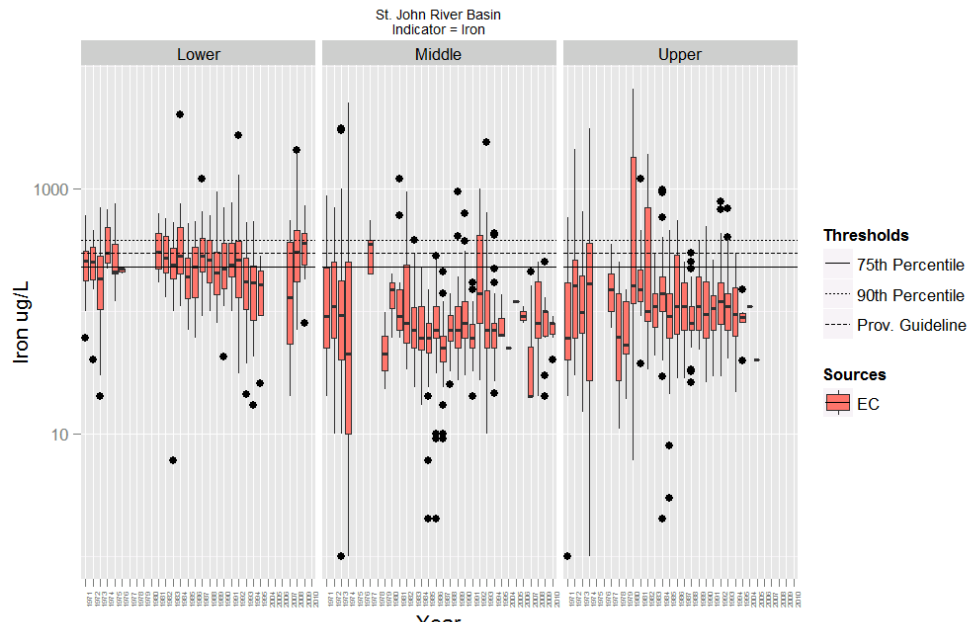
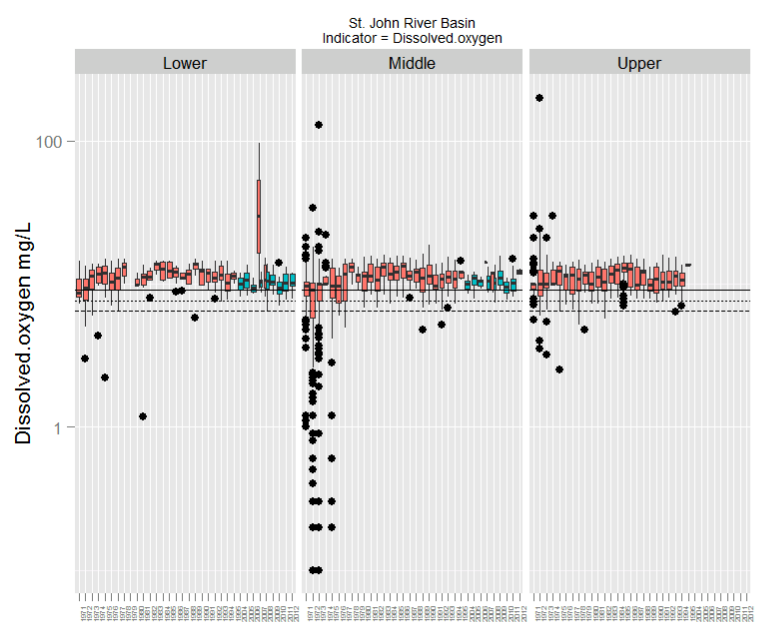
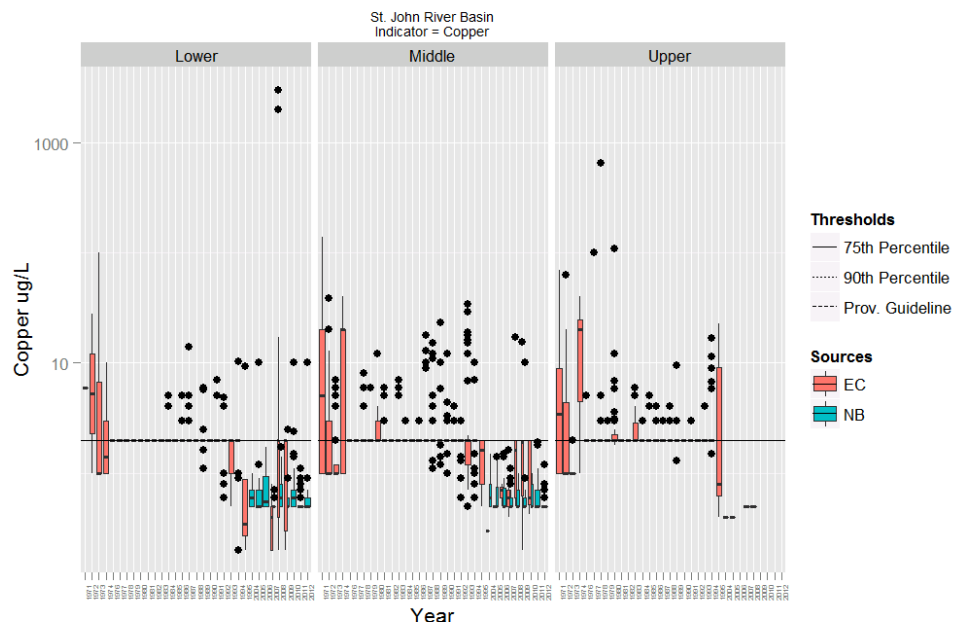
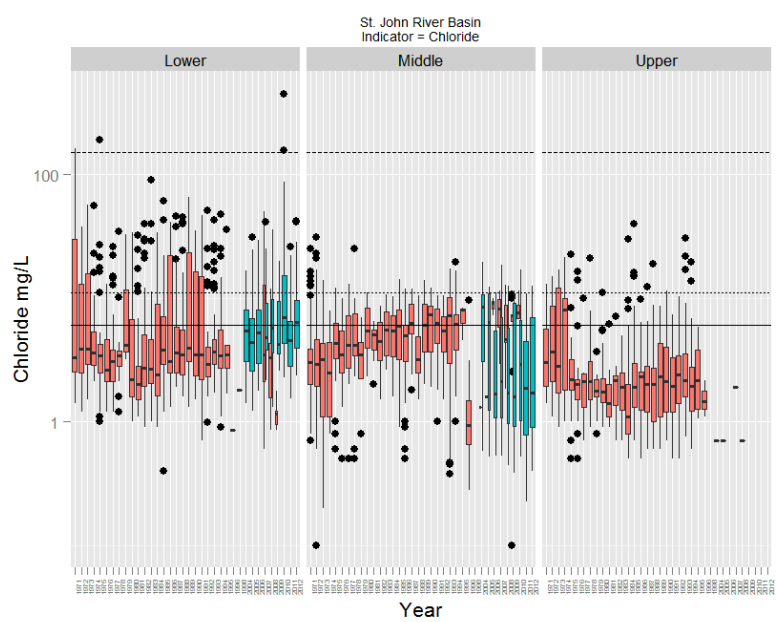


FIGURE. ANALYSIS OF VARIANCE IN EXCEEDANCE OF WATER QUALITY THRESHOLDS OVER TIME FOR MONITORING STATIONS IN THE ST. JOHN RIVER BASIN, BY CONTAMINANT.





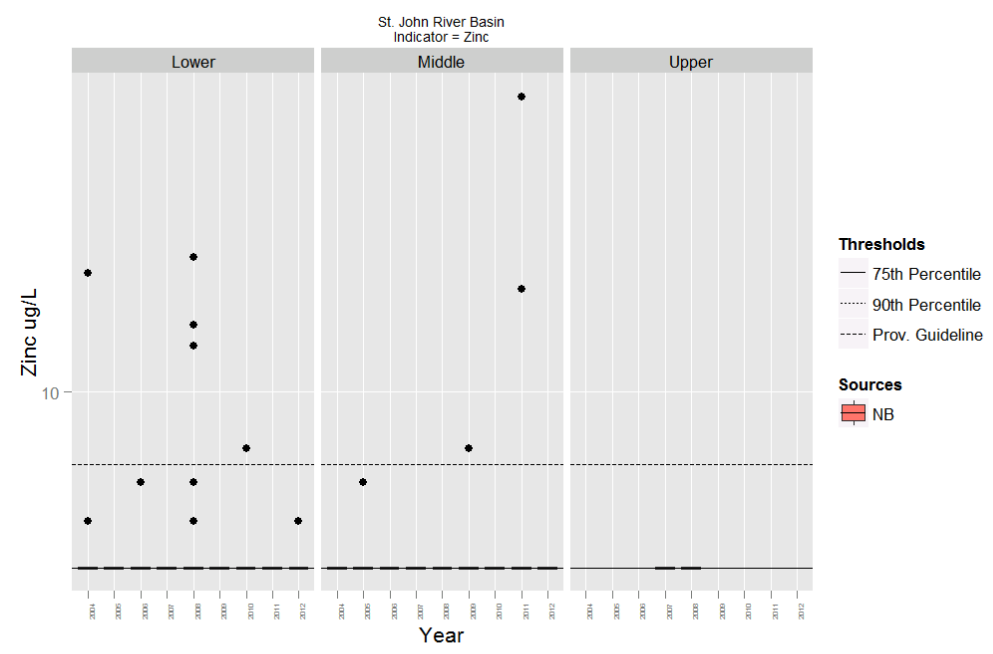
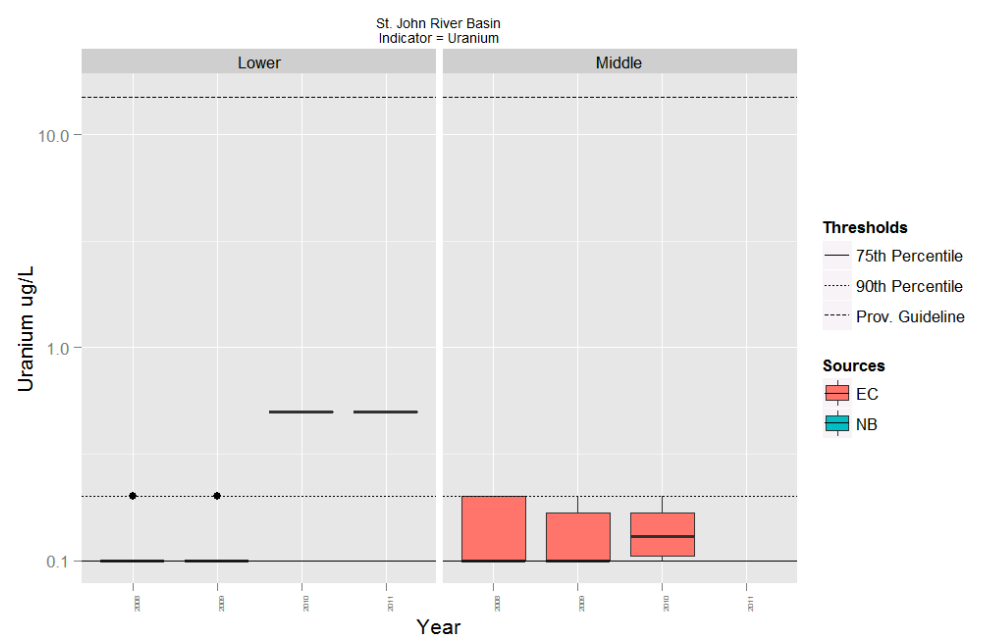
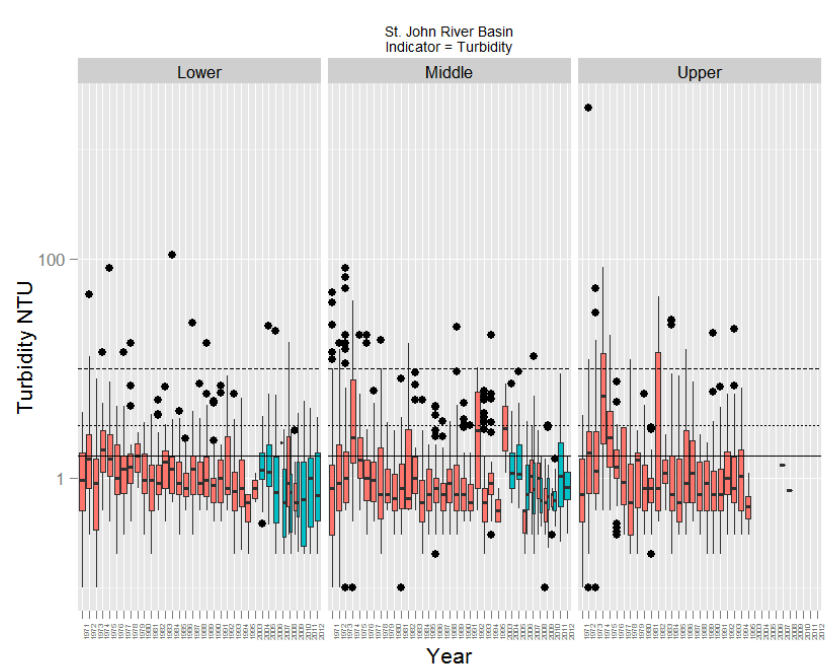
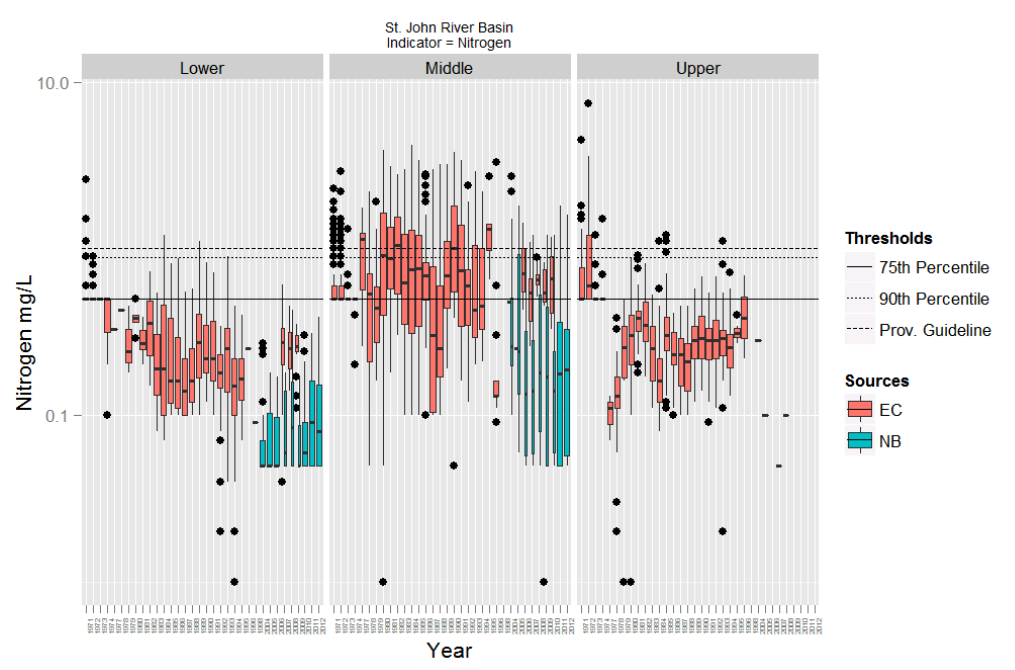
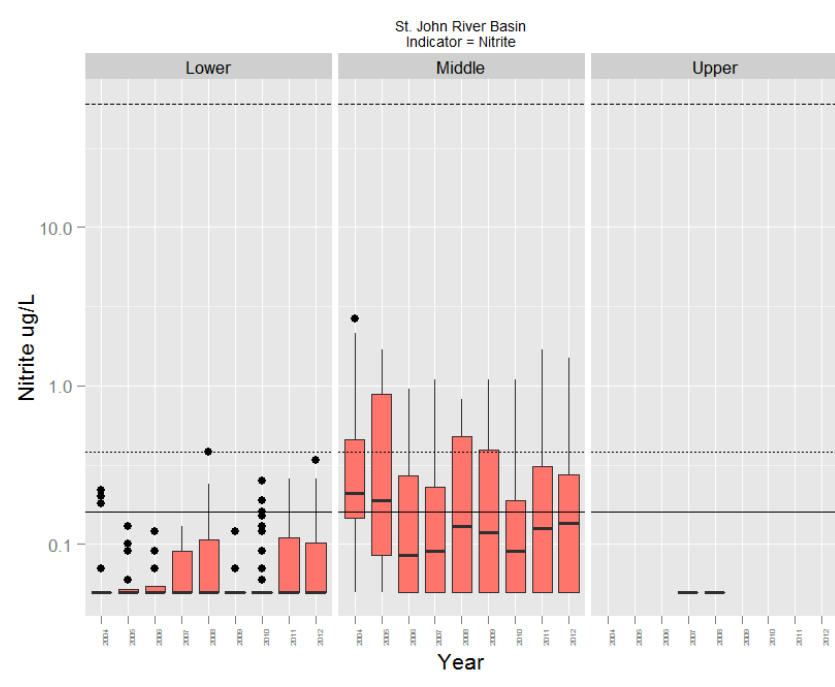


TABLE. RESULTS OF MANN-KENDALL NON-PARAMETRIC TREND ANALYSIS OF ANNUAL ADHERENCE TO WATER GUIDELINES OVER TIME FOR IN THE ST. JOHN RIVER BASIN, BY SUB-BASIN.

Data Source	Sub-Basin	Start Year	End Year	Number of Monitoring Stations	Theil-Sen Slope	Mann-Kendall Test Score	Mann-Kendall Test p-value
<i>Environment Canada</i>	Lower	1971	2009	78	-0.0036	-171	0.039 *
	Central	1971	2010	51	-0.0031	-220	0.011 *
	Upper	1971	2005	59	-0.0020	-74	0.299
	St. John Basin	1971	2010	188	-0.0038	-255	0.003 **
<i>Government of New Brunswick</i>	Lower	2004	2012	22	0.0018	13	0.208
	Central	2004	2012	12	-0.0005	-3	0.834
	Upper	2007	2008	2	NA	NA	NA
	St. John Basin	2004	2012	36	0.0007	7	0.525
<i>Environment Canada & Government of New Brunswick</i>	Lower	1971	2012	100	-0.0054	-315	0.001 ***
	Central	1971	2012	63	-0.0037	-243	0.009 **
	Upper	1971	2008	61	-0.0018	-76	0.345
	St. John Basin	1971	2012	224	-0.0043	-295	0.001 **

OVERALL FISH HEALTH SCORING

	Indicator	Sub-Basin			Basin		
		Upper	Central	Lower			
Fish	Change in Native Fish Species Richness	Period of Study	Data Deficient	Data Deficient	Data Deficient	Data Deficient	
		Number of Sites	None	None	None	None	
		Presence of statistically significant decline in number of total species observed per year.	Trend	Data Deficient	Data Deficient	Data Deficient	Data Deficient
		Presence of statistically significant decline in total species richness for the basin.	Trend	Data Deficient	Data Deficient	Data Deficient	Data Deficient
		Fish Health Category	Data Deficient	Data Deficient	Data Deficient	Data Deficient	
		Fish Health Score	0	0	0	0	

FISH DATA SUFFICIENCY

	Data Sufficiency Indicator	Sub-Basin			Basin
		Upper	Central	Lower	
Fish	Total number of sub-sub-basins	5	8	7	20
	Year of earliest available monitoring	0	0	0	0
	Number of sampling locations available for earliest monitoring	0	0	0	0
	Number of sub-sub-basins with earliest available sampling locations	0	0	0	0
	Earliest year of continuous monitoring	0	0	0	0
	Number of sampling locations available for first year of continuous monitoring	0	0	0	0
	Number of sub-sub-basins for first year of continuous monitoring	0	0	0	0
	Year of most recently available monitoring	0	0	0	0
	Number of sampling locations available for most recent monitoring	0	0	0	0
	Number of sub-sub-basins with most recent available monitoring	0	0	0	0
	Number of years of continuous monitoring	0	0	0	0
	Overall Data Sufficiency Category	Insufficient	Insufficient	Insufficient	Insufficient
	Data Sufficiency Score	0	0	0	0

OVERALL BENTHIC HEALTH SCORING

	Indicator		Sub-Basin			Basin	
			Upper	Central	Lower	Value	
	Benthic Macro-Invertebrates	Index of benthic community composition based on sensitivity to disturbance	Year	2007-2008	2004-2008	2006-2010	2007 - 2012
Number of Sites			2	15	22	39	
Value			4.16	3.87	3.68	3.84	
Benthic Health Category			Very Good	Very Good	Very Good	Very Good	
Benthic Health Score			4	4	4	4	
Significant Mann-Kendal time-series test to determine directional trend in HBI over			Time Period	-	2004-2008	2004-2010	2004-2010
Trend			-	None	None	None	

BENTHIC DATA SUFFICIENCY

	Data Sufficiency Indicator	Sub-Basin			Basin
		Upper	Central	Lower	
Benthic Macro-Invertebrates	Total number of sub-sub-basins	4	4	5	13
	Year of earliest available monitoring	2007	2004	2004	2004
	Number of monitoring stations available for earliest monitoring	1	7	9	16
	Number of sub-sub-basins with earliest available monitoring stations	1	2	3	5
	Year of most recently available monitoring	2008	2008	2010	2010
	Number of monitoring stations available within last five years	1	2	11	14
	Number of sub-sub-basins within last five years	1	2	3	6
	Number of years of sampling in last 10 years	2	5	4	5
	Overall Data Sufficiency Category	Partially Sufficient	Partially Sufficient	Partially Sufficient	Partially Sufficient
	Data Sufficiency Score	1	1	1	1

MAP. HILSENHOFF'S BIOTIC INDEX SCORES FOR BENTHIC MACRO-INVERTEBRATE COMMUNITIES IN THE ST. JOHN RIVER (2006 - 2010).

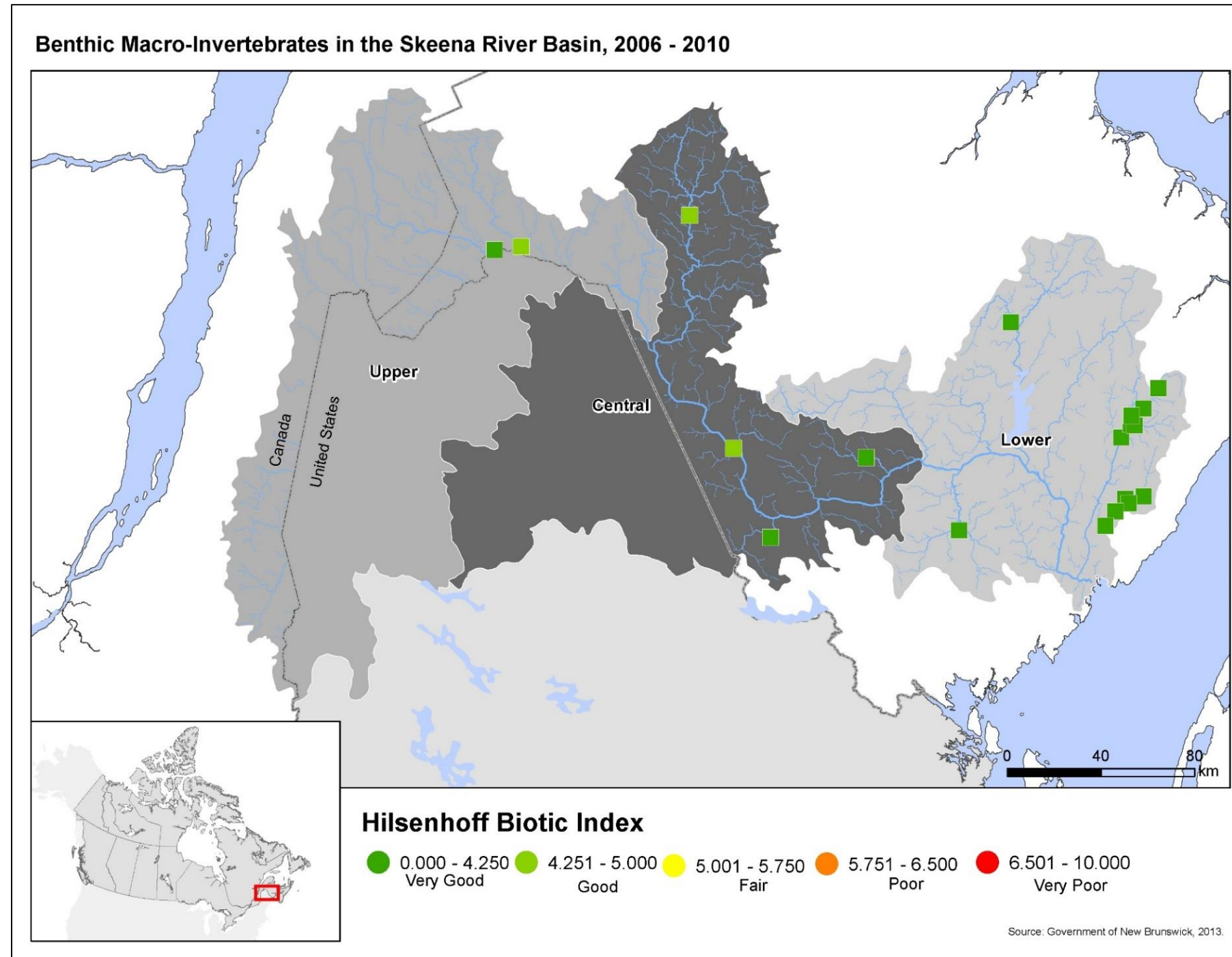


FIGURE. ANALYSIS OF VARIANCE FOR HILSENHOFF'S BIOTIC INDEX VALUES FOR BENTHIC MACRO-INVERTEBRATE COMMUNITIES SAMPLED IN THE ST. JOHN RIVER BASIN.

Sub-basin	Year	Number of Sites	HBI Value	5-Year Weighted Average
All	2010	1	3.88	3.84
	2008	13	3.84	
Lower	2010	1	3.88	3.68
	2008	10	3.65	
	2006	2	3.72	
	2004	9	3.87	
Central	2008	2	4.32	3.87
	2007	2	3.87	
	2006	1	4.12	
	2005	3	3.65	
	2004	7	3.79	
Upper	2008	1	4.75	4.16
	2007	1	3.56	

FIGURE. ANALYSIS OF VARIANCE FOR HILSENHOFF'S BIOTIC INDEX VALUES FOR BENTHIC MACRO-INVERTEBRATE COMMUNITIES SAMPLED IN THE ST. JOHN RIVER BASIN.

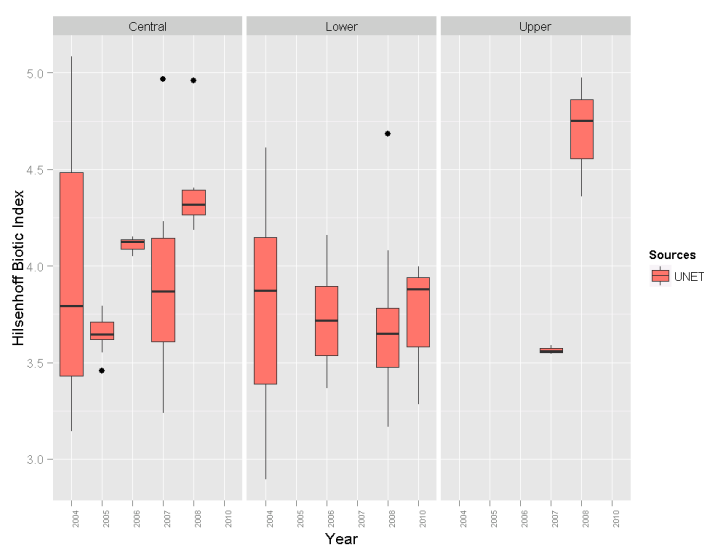


TABLE . RESULTS OF MANN-KENDALL NON-PARAMETRIC TREND ANALYSIS OF HILSENHOFF'S BIOTIC INDEX OVER TIME IN THE ST. JOHN RIVER BASIN, BY SUB-BASIN.

Sub-Basin	Start Year	End Year	Number of Sampling Sites	Theil-Sen Slope	Mann-Kendal Test Statistic	Mann-Kendal Test p-value
Lower	2004	2010	21	-0.02691	-6	0.436738
Central	2004	2008	12	0.157258	8	0.086411
Overall Basin	2004	2010	35	0.013207	2	0.879257

FIGURE. TREND ANALYSIS FOR HILSENHOFF'S BIOTIC INDEX VALUES FOR BENTHIC MACRO-INVERTEBRATE COMMUNITIES SAMPLED IN THE ST. JOHN BASIN.

