D R A F T - 6/6/2005

APPENDIX ?: MASS BALANCES

1. INTRODUCTION

The development and structure of a mass-balance modeling framework for Onondaga Lake is described in previous lake monitoring reports (Ecologic, 2003). The framework facilitates computation and analysis of mass balances for nutrients and other water-quality components using hydrologic and water quality data collected in the Lake and its tributaries since 1986. Results provide a basis for:

(1) Estimating the magnitude and precision of loads from each source;
(2) Assessing long-term trends in load and inflow concentration from each source and source category (point, nonpoint, total);
(3) Evaluating the adequacy of the monitoring program, based upon the precision of loads computed from concentration and flow data;
(4) Developing and periodic updating of an empirical nutrient loading model that predicts eutrophication-related water quality conditions (as measured by nutrient concentrations, chlorophyll-a, algal bloom frequency, transparency, and hypolimnetic oxygen depletion) as a function of yearly nutrient loads, inflows, and lake morphometry (Ecologic, 2001).
(5) Developing simple input/output models for other constituents; and
(6) Developing data summaries to support integration and interpretation of monitoring results in each yearly AMP report.

This appendix updates the mass-balance framework to include 2003 and 2004 data. Recent mass balances for key water quality components are summarized. Long-term trends in total loads (point, nonpoint), inflow concentrations, and outflow concentrations are documented.

2. REFINEMENTS TO MASS-BALANCE FRAMEWORK

The mass-balance framework has been integrated with the AMP's Long-term Database (Figure 1). The database supplies yearly flows and loads for monitored tributaries. A separate workbook (MASSBAL.XLS) performs lake mass-balance calculations and supplies output in various formats, including those shown below. This workbook also computes total nitrogen loads & balances based upon nitrite, nitrate, and TKN results.

3. LONG-TERM TRENDS

Yearly variations in precipitation and lake inflow volume are summarized in Figure 2. Over the 1990-2004 period, yearly runoff from the Onondaga Lake watershed varied from 31 to 75 cm and was strongly correlated with precipitation ($r^2 = 0.85$). The strength of this correlation suggests that year-to-year variations in the lake water budget can be simulated using a simple rainfall/runoff model. Runoff was 63 cm in 2004, as compared with a 15-year mean of 51 cm.

The following figures show trends in each water quality component over the 1990-2004 period:

Figure 3	Total Inflow & Outflow Concentrations
Figure 4	Total Inflow & Outflow Loads
Figure 5	Total NonPoint & Total Metro Loads

Ten-year (1995-2004) trends in concentration and load for each mass-balance term and water quality component are summarized in Table 1. Trends are tested using a linear regression of flow-weighted-mean concentration or load against year. Trend slopes that are significantly different from zero ($p < .10$ for a two-tailed hypothesis or $p < 0.05$ for a one-tailed hypothesis) are listed. A ten-year rolling window has been consistently used for trend analysis in yearly AMP reports. With a longer period, results would be strongly influenced by historical data that are not representative of current conditions with respect to municipal and industrial wastewater inputs. With a shorter period, results would be increasingly influenced by short-term variations in hydrology and other random factors.

For total inflows, decreasing trends in concentration and/or load are indicated for BOD, calcium, ammonia nitrogen, Kjeldahl nitrogen, nitrite nitrogen, total nitrogen, total & filtered organic carbon, and total phosphorus. An increasing trend in nitrate nitrogen load reflects increased nitrification of the Metro effluent. Trends in nutrient species and BOD generally mimic those detected in the Metro discharge. For the lake outflow (12 foot samples considered most representative), significant decreasing trends in concentration and/or load are indicated for BOD, calcium, chloride, ammonia nitrogen, total Kjeldahl nitrogen, nitrite nitrogen, total nitrogen, soluble reactive phosphorus, and total phosphorus. Outflow trends are generally consistent with inflow trends and improving water quality conditions resulting primarily from Metro improvements over the 1995-2004 period. The phosphorus decreases occurred primarily between 1995 and 1998. After that, lake inflow and outflow loads were relatively stable.

4. MASS BALANCES

Five-year average (2000-2004) mass balances for the following constituents are summarized in the following tables:

Table 2	Chloride
Table 3	Total Phosphorus
Table 4	Soluble Reactive Phosphorus
Table 5	Total Nitrogen
Table 6	Ammonia Nitrogen

Since chloride is expected to be conservative, the chloride balance provides a basis for testing the accuracy and completeness of the data and methods used to develop the mass balances. Outflow loads computed from 12-foot outlet samples exceeded inflow loads by 7% ± 2% or 13,738 ± 4,062 metric tons/year in 200-2004 (Table 2). Excess loads (outflow-inflow) in chloride and sodium load were fairly consistent from year to year (Figure 4). These may be attributed to application of road deicing salts in ungauged portions of the watershed, salt springs contributing directly to the lake, and/or over-estimation of lake outflow volumes.

Direct monitoring of lake outflows by the USGS provides a basis for comparison with the lake water budget estimates (Walker, 2005). Figure 6 compares provisional measurements with computed net outflows for October 2003 – December 2004. On the average, the USGS net outflows differed from the computed values by -0.4 to +6.4%, depending upon subtle differences in how the measured net outflows are computed from raw data. Further analysis using final USGS data is recommended. Agreement with preliminary data tends to validate the computed water budgets and mass balances derived from them.

Theoretically, it would be possible to include reverse flow as a term in the lake mass balances by using the USGS measured flows and Outlet 2 foot samples. Such estimates would be highly uncertain, however, because the extent to which the reverse flow actually enters the open Lake (vs. just the outlet canal) is unknown.

5 . REFERENCES

Ecologic, LLC et al., “Onondaga Lake Monitoring Program, 2000 Annual Report”, prepared for Onondaga County, New York, November 2001.

Ecologic, LLC et al., “Onondaga Lake Monitoring Program, 2003 Annual Report”, prepared for Onondaga County, New York, 2004.

Walker, W.W., Lake Advisors Meeting Presentation, March 2005.

Mass Balance Appendix

List of Figures

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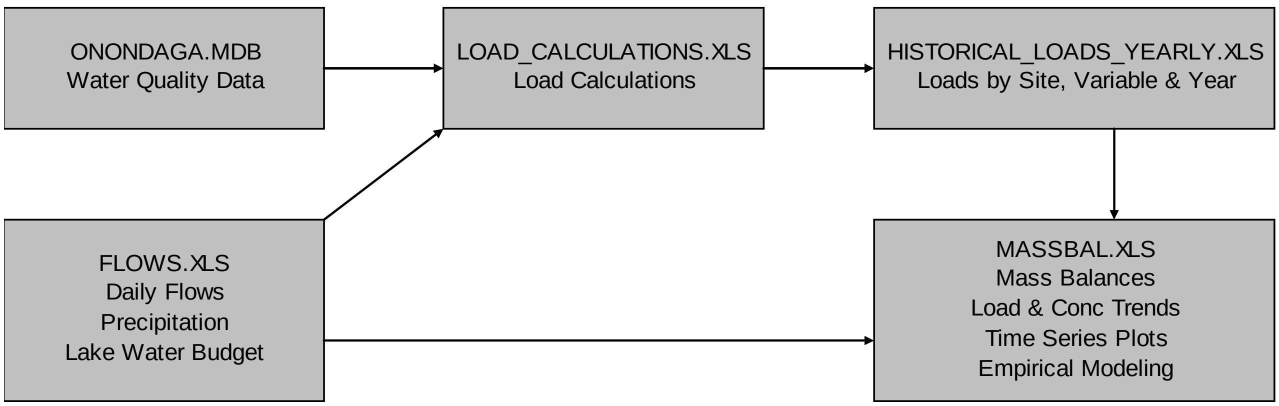
Figure 1

Mass Balance Compuations Integrated with Long-Term Database



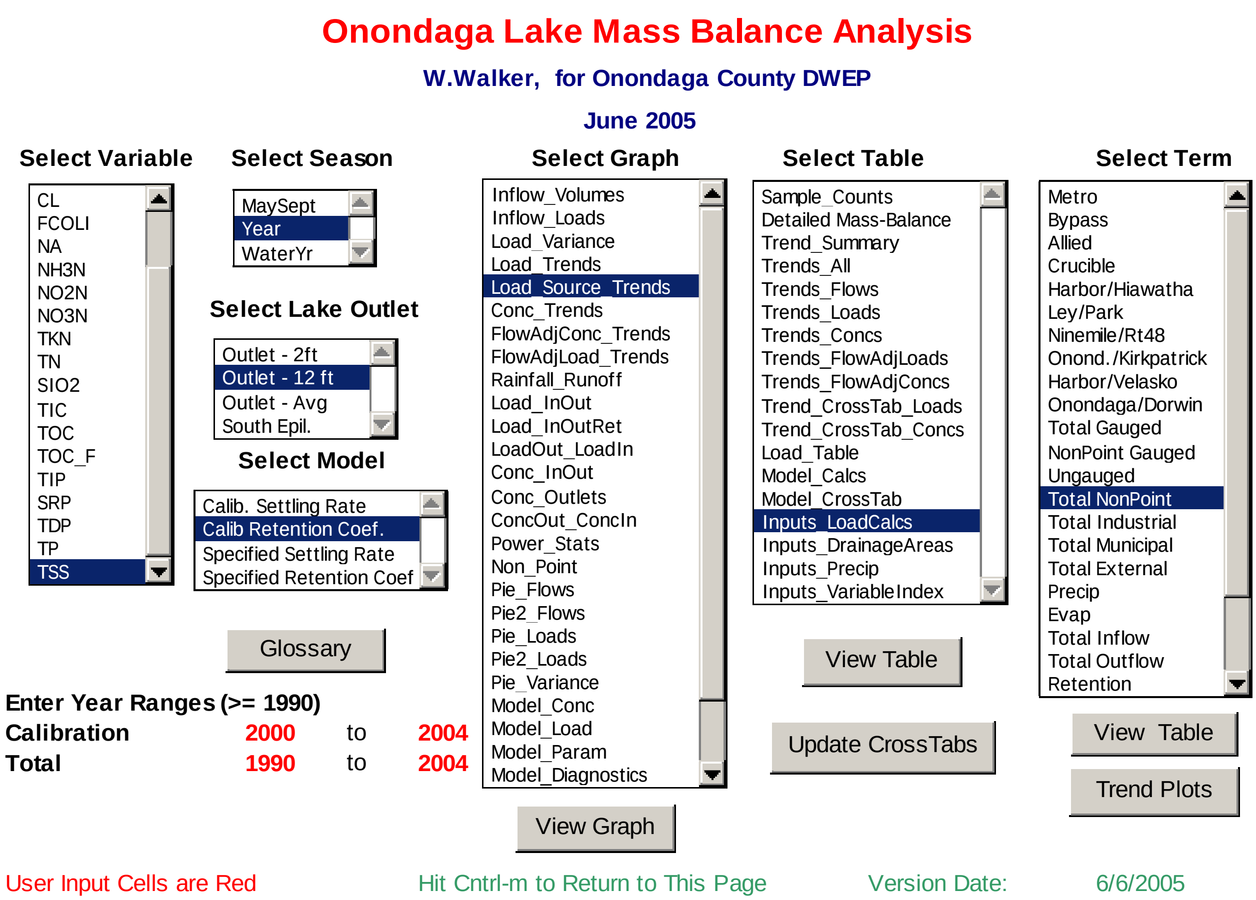


Figure 2
Precipitation, Runoff, & Lake Inflow Volumes

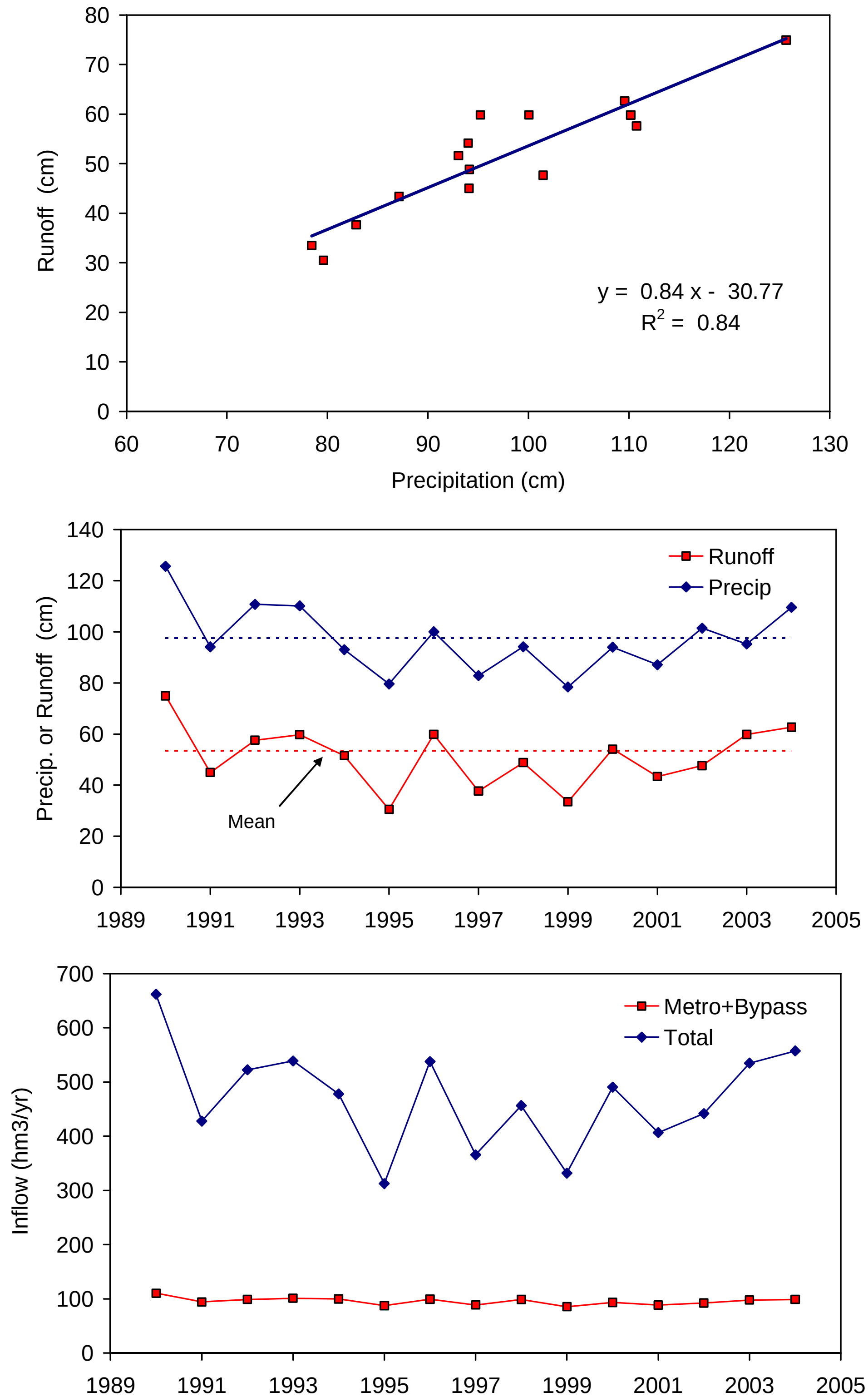


Figure 3
Long-Term Trends in Total Inflow & Outflow Concentrations

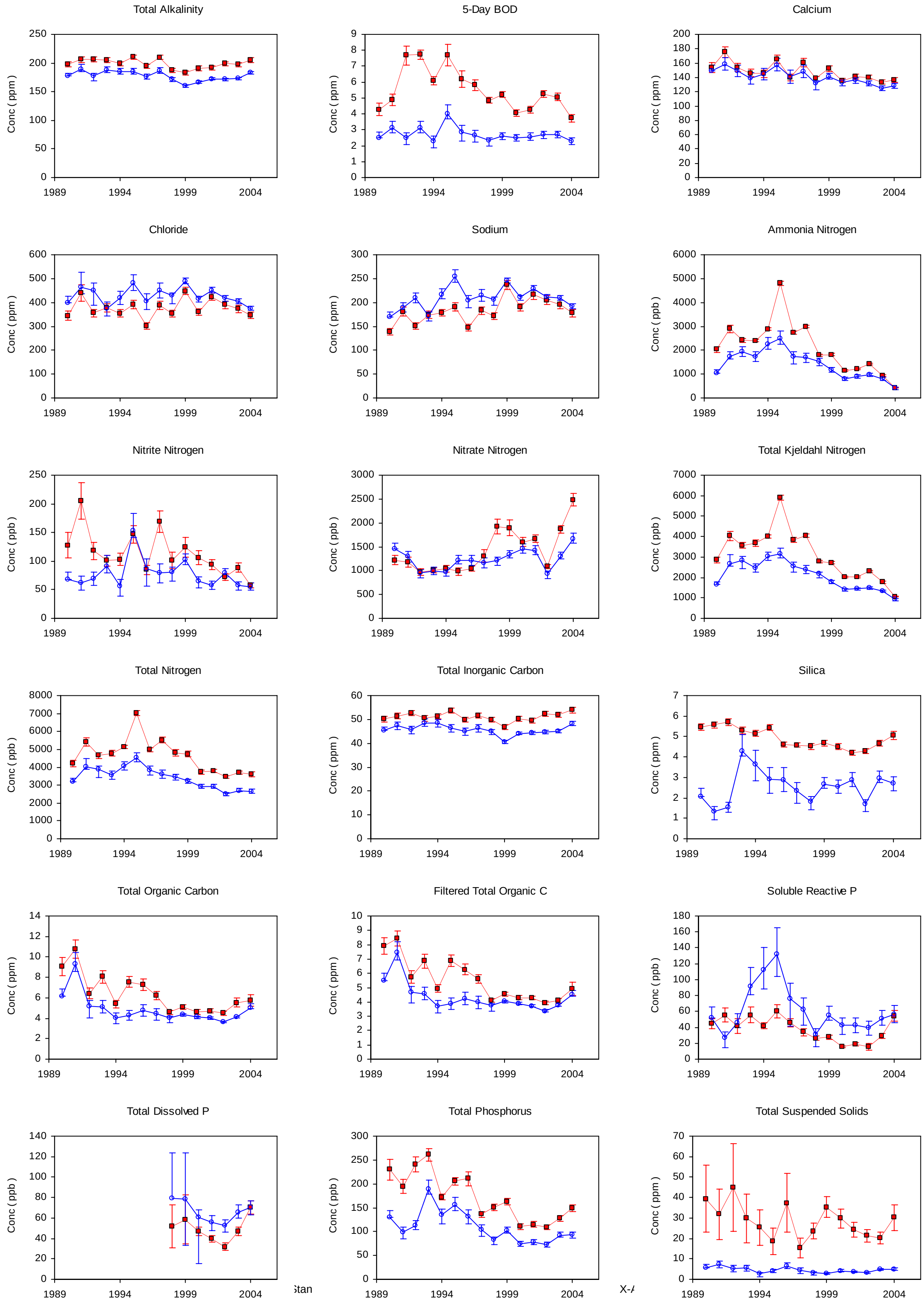


Figure 4
Long-Term Trends in Total Inflow & Outflow Loads

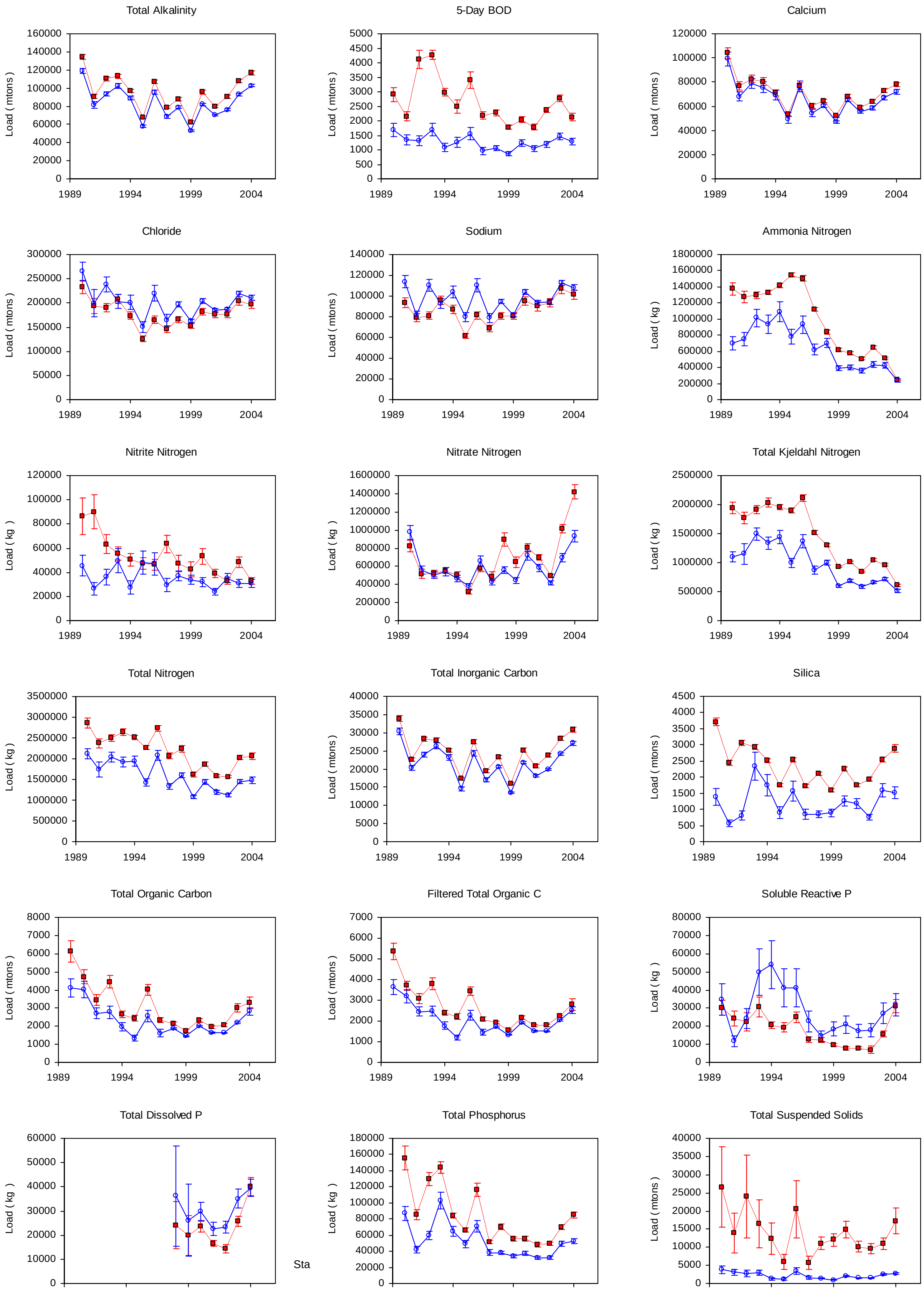


Figure 5
Long-Term Trends in NonPoint & Metro Loads

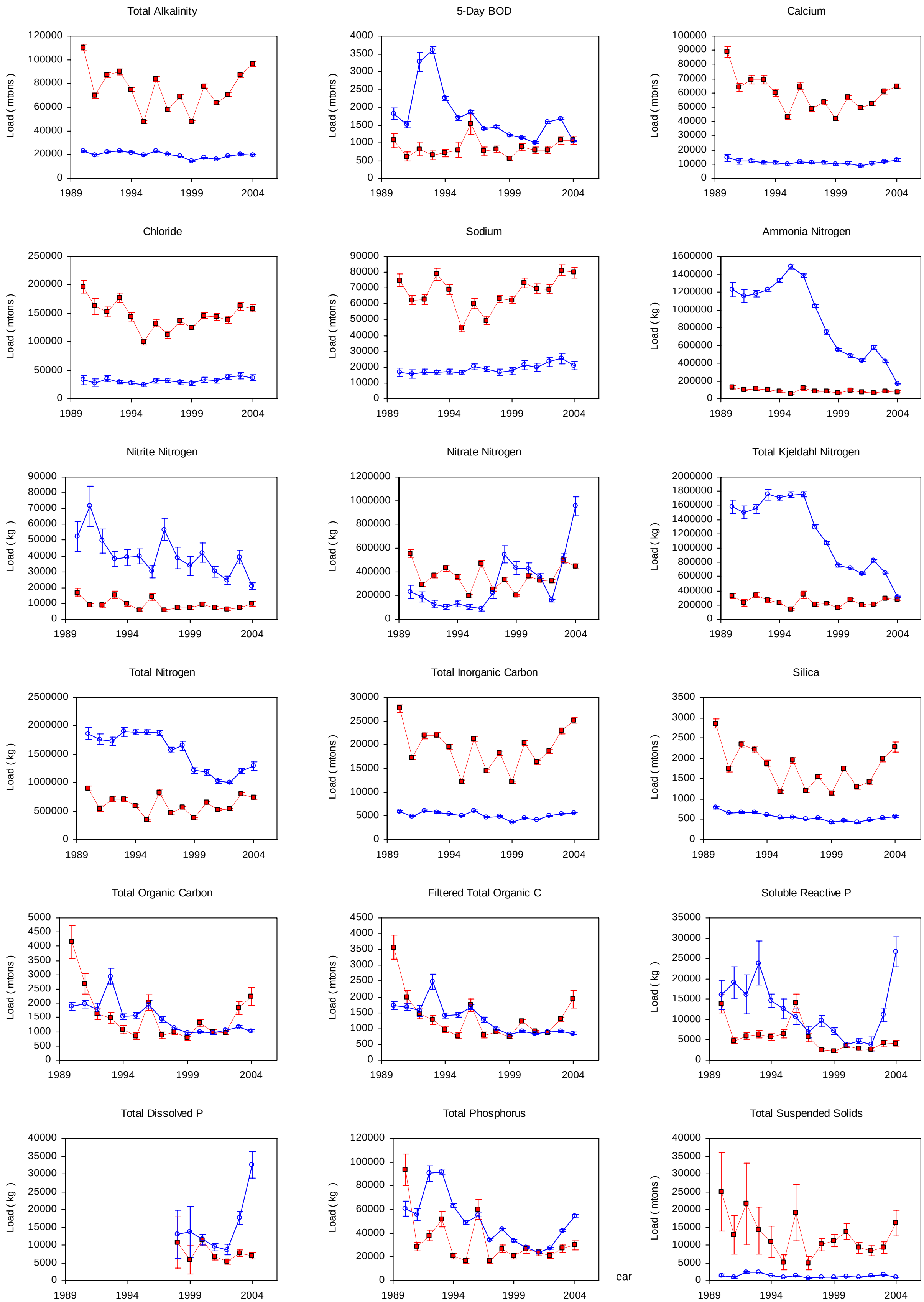
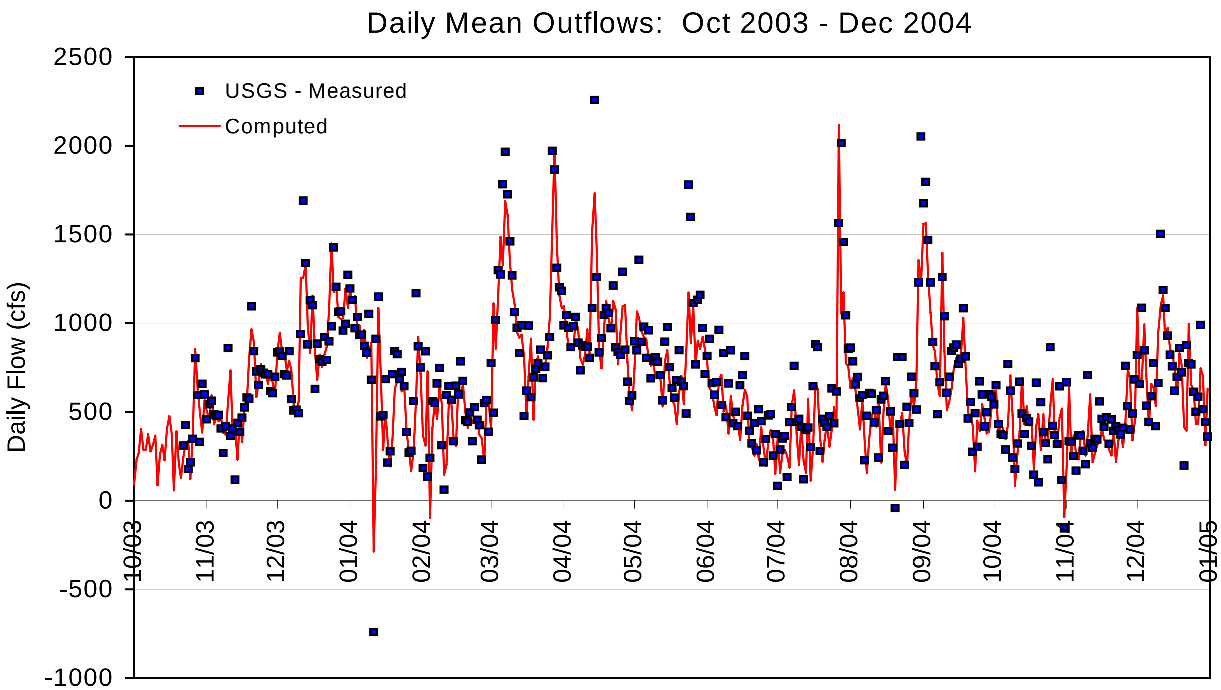


Figure 6
Comparison of USGS Measured Outflows with Water Budget Estimates



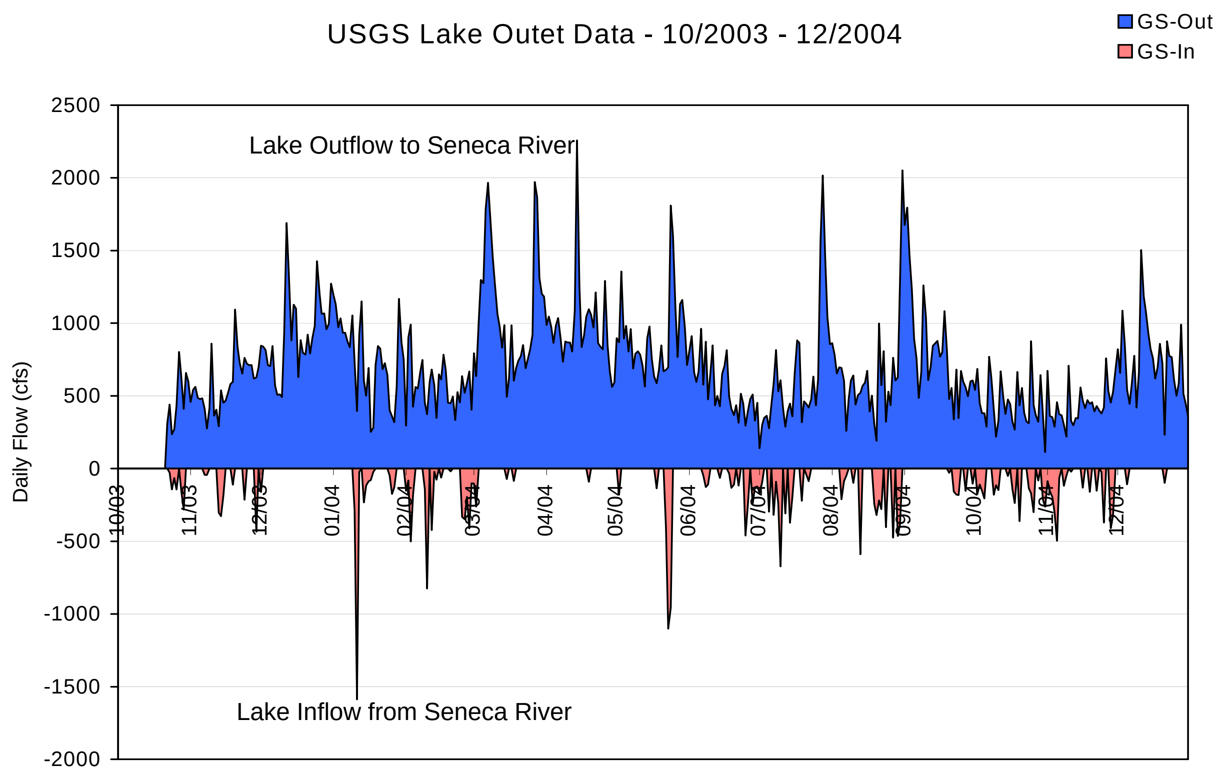


Table 1: 10-Year Trends in Load & Flow-Wtd-Mean Concentration

Load Trends (% / yr) **Period: 1995 to 2004**

Term	ALK	BOD5	CA	CL	NA	NH3N	NO2N	NO3N	TKN	TN	SIO2	TIC	TOC	TOC_F	SRP	TP	TSS
Metro				4%	3%	-18%		16%	-15%	-7%			-6%	-7%			
Bypass								14%					-16%	-17%			
Allied	14%		12%	16%	16%			15%				13%					21%
Crucible		-6%					-15%	-14%		-11%			-6%	-6%			
Harbor/Hiawatha	6%		4%	7%	8%			8%		7%		6%				7%	
Ley/Park	4%	-17%	4%	5%	5%							5%					
Ninemile/Rt48		8%										5%	11%	8%			
Onond./Kirkpatrick	5%		4%	8%	8%				6%			5%			-19%		
Harbor/Velasko	6%	11%	4%	7%	8%			8%	7%	8%	5%	6%	10%	10%			
Onondaga/Dorwin	5%	9%		4%	4%				8%			5%					
Total Gauged				4%	5%	-17%	-4%	11%	-12%	-4%		4%					
NonPoint Gauged	5%			4%	6%							5%					
Ungauged	5%			4%	6%							5%					
Total NonPoint	5%			4%	6%							5%					
Total Industrial								-5%								7%	
Total Municipal				4%	3%	-18%		16%	-15%	-6%			-6%	-7%			
Total Inflow				4%	5%	-16%	-4%	10%	-12%	-3%		4%					
Total Outflow						-12%	-5%	6%	-8%								
Retention	5%			-14%	-21%	-25%		28%	-18%	-5%		5%		-20%	-11%		
Outlet2		4%		3%	4%	-9%		6%	-6%								8%
Outlet12						-12%	-5%	6%	-8%								

Concentration Trends (% / yr) **Period: 1995 to 2004**

Term	ALK	BOD5	CA	CL	NA	NH3N	NO2N	NO3N	TKN	TN	SIO2	TIC	TOC	TOC_F	SRP	TP	TSS
Metro		-4%		3%	3%	-19%	-6%	15%	-16%	-7%			-6%	-7%			
Bypass		-7%	-6%			-10%	10%	10%	-9%	-7%		-3%	-16%	-17%	-17%	-9%	-4%
Allied		-3%	-3%			-19%	-10%		-12%	-5%	-6%		-4%	-4%	-8%	-5%	10%
Crucible	2%		3%	5%		6%	-10%	-11%		-7%	5%	3%			13%	10%	
Harbor/Hiawatha					2%	-8%	-6%	2%		2%							
Ley/Park		-20%				-10%	-7%			-6%		1%	-5%	-6%	-14%		
Ninemile/Rt48		3%	-4%	-6%	-5%	-4%	-5%						6%	3%	-13%		
Onond./Kirkpatrick															-22%		
Harbor/Velasko		5%	-2%			-9%	-8%	2%		2%	-2%						
Onondaga/Dorwin		5%				-10%			4%						-22%		
Total Gauged		-6%	-2%			-20%	-8%	7%	-15%	-7%			-4%	-5%		-6%	
NonPoint Gauged		-5%	-3%			-5%	-4%								-17%		
Ungauged		-5%	-3%			-5%	-4%								-17%		
Total NonPoint		-5%	-3%			-5%	-4%								-17%		
Total Industrial	2%		2%	5%	4%						4%	3%			10%	8%	
Total Municipal		-4%		3%	3%	-19%		15%	-15%	-7%			-7%	-8%			
Total Inflow		-6%	-2%			-20%	-8%	7%	-15%	-7%			-4%	-5%		-6%	
Total Outflow		-4%	-2%	-2%		-15%	-9%		-12%	-6%					-10%	-6%	
Outlet2			-1%			-12%	-7%		-9%	-4%						-5%	5%
Outlet12		-4%	-2%	-2%		-15%	-9%		-12%	-6%					-10%	-6%	

Trends Significant at $p < .10$ (2-tailed hypothesis), based upon linear regression of yearly values

Table 2: Chloride Balance for 2000-2004

Variable: **Chloride** **Average for Years:** **2000** **thru** **2004** **Season: Year**

						Percent of Total Inflow				Drain.		Export
	Flow	Load	Std Error	Conc	RSE	Sampl	Flow	Load	Error	Area	Runoff	mtons/
Term	**10^6 m3**	**mtons**	**mtons**	**ppm**	**%**	**per yr**	**%**	**%**	**%**	**km2**	**cm**	**km2**
Metro Effluent	91.85	35106	2038	382	6%	33	18%	19%	37%			
Metro Bypass	2.21	956	176	432	18%	4	0%	1%	0%			
East Flume	0.65	314	15	484	5%	27	0%	0%	0%			
Crucible	2.43	1000	19	411	2%	27	0%	1%	0%			
Harbor Brook	10.06	2712	196	270	7%	30	2%	1%	0%	31.4	32.1	86.5
Ley Creek	40.21	13559	1418	337	10%	31	8%	7%	18%	66.1	60.8	205.1
Ninemile Creek	146.98	53012	846	361	2%	29	30%	28%	6%	298.1	49.3	177.8
Onondaga Creek	167.12	71031	1600	425	2%	33	34%	38%	23%	285.1	58.6	249.1
Nonpoint Gauged	364.37	140314	2308	385	2%	123	73%	75%	48%	680.7	53.5	206.1
Nonpoint Ungauged	24.82	9557	1294	385	14%	0	5%	5%	15%	46.4	53.5	206.1
NonPoint Total	389.19	149871	2646	385	2%	123	78%	80%	63%	727.0	53.5	206.1
Industrial	3.08	1314	24	426	2%	54	1%	1%	0%			
Municipal	94.07	36062	2046	383	6%	37	19%	19%	37%			
Total External	486.34	187247	3345	385	2%	214	98%	100%	100%	727.0	66.9	257.5
Precipitation	11.41	11	1	1	9%	0	2%	0%	0%	11.7	97.5	1.0
Total Inflow	497.74	187258	3345	376	2%	214	100%	100%	100%	738.7	67.4	253.5
Evaporation	8.86						2%			11.7	75.7	
Outflow	488.89	200996	2304	411	1%		98%	107%	47%	738.7	66.2	272.1
Retention	0.00	-13738	4062		30%		0%	-7%				
Alternative Estimates of Lake Output												
Outlet 12 Feet	488.89	200996	2304	411	1%	26	98%	107%	47%	738.7	66.2	272.1
Outlet 2 Feet	488.89	175253	4532	358	3%	26	98%	94%	184%	738.7	66.2	237.2
Upstream/Downstream Contrast- Harbor Brook												
Upstream - Velasko	9.43	2151	73	228	3%	30	2%	1%	0%	27.0	35.0	79.8
Downstream - Hiawatha	10.06	2712	196	270	7%	30	2%	1%	0%	31.4	32.1	86.5
Local Inflow	0.63	561	209	896	37%		0%	0%	0%	4.4	14.2	127.4
Upstream/Downstream Contrast - Onondaga Creek												
Upstream - Dorwin	130.12	15339	291	118	2%	33	26%	8%	1%	229.4	56.7	66.9
Downstream - Kirkpatrick	167.12	71031	1600	425	2%	33	34%	38%	23%	285.1	58.6	249.1
Local Inflow	37.00	55692	1627	1505	3%		7%	30%	24%	55.7	66.4	999.3

Lake Overflow Rate 41.79 m/yr Calib. Settling Rate -2.9 m/yr RSE % = Relative Std. Error of Load & Inflow Conc. Estimates

Lake Residence Time 0.26 years Calib. Retention Coef. -7% Error % = Percent of Variance in Total Inflow Load Estimate

Table 3: Total Phosphorus Balance for 2000-2004

Variable: **Total Phosphorus** **Average for Years:** 2000 thru 2004 **Season:** Year

Term	Flow 10^6 m3	Load kg	Std Error kg	Conc ppb	RSE %	Sampl per yr	Percent of Total Inflow Flow %	Load %	Error %	Drain. Area km2	Runoff cm	Export kg / km2
Metro Effluent	91.85	32709	354	356	1%	363	18%	53%	7%			
Metro Bypass	2.21	2396	78	1082	3%	46	0%	4%	0%			
East Flume	0.65	105	7	162	6%	27	0%	0%	0%			
Crucible	2.43	313	10	129	3%	27	0%	1%	0%			
Harbor Brook	10.06	811	112	81	14%	30	2%	1%	1%	31.4	32.1	25.9
Ley Creek	40.21	3834	430	95	11%	31	8%	6%	10%	66.1	60.8	58.0
Ninemile Creek	146.98	8377	494	57	6%	29	30%	14%	13%	298.1	49.3	28.1
Onondaga Creek	167.12	10945	1131	65	10%	33	34%	18%	67%	285.1	58.6	38.4
Nonpoint Gauged	364.37	23966	1312	66	5%	123	73%	39%	90%	680.7	53.5	35.2
Nonpoint Ungauged	24.82	1632	238	66	15%	0	5%	3%	3%	46.4	53.5	35.2
NonPoint Total	389.19	25599	1333	66	5%	123	78%	42%	93%	727.0	53.5	35.2
Industrial	3.08	418	12	136	3%	54	1%	1%	0%			
Municipal	94.07	35105	362	373	1%	409	19%	57%	7%			
Total External	486.34	61122	1382	126	2%	587	98%	99%	100%	727.0	66.9	84.1
Precipitation	11.41	342	31	30	9%	0	2%	1%	0%	11.7	97.5	29.2
Total Inflow	497.74	61464	1382	123	2%	587	100%	100%	100%	738.7	67.4	83.2
Evaporation	8.86						2%			11.7	75.7	
Outflow	488.89	40586	1199	83	3%		98%	66%	75%	738.7	66.2	54.9
Retention	0.00	20878	1830		9%		0%	34%				
Alternative Estimates of Lake Output												
Outlet 12 Feet	488.89	40586	1199	83	3%	26	98%	66%	75%	738.7	66.2	54.9
Outlet 2 Feet	488.89	38318	1221	78	3%	26	98%	62%	78%	738.7	66.2	51.9
Upstream/Downstream Contrast- Harbor Brook												
Upstream - Velasko	9.43	398	144	42	36%	30	2%	1%	1%	27.0	35.0	14.8
Downstream - Hiawatha	10.06	811	112	81	14%	30	2%	1%	1%	31.4	32.1	25.9
Local Inflow	0.63	413	182	659	44%		0%	1%	2%	4.4	14.2	93.7
Upstream/Downstream Contrast - Onondaga Creek												
Upstream - Dorwin	130.12	7942	980	61	12%	33	26%	13%	50%	229.4	56.7	34.6
Downstream - Kirkpatrick	167.12	10945	1131	65	10%	33	34%	18%	67%	285.1	58.6	38.4
Local Inflow	37.00	3002	1497	81	50%		7%	5%	117%	55.7	66.4	53.9

Lake Overflow Rate 41.79 m/yr — Calib. Settling Rate 21.5 m/yr — RSE % = Relative Std. Error of Load & Inflow Conc. Estimates

Lake Residence Time 0.26 years — Calib. Retention Coef. 34% — Error % = Percent of Variance in Total Inflow Load Estimate

Table 4: Soluble Reactive P Balance for 2000-2004

Variable: **Soluble Reactive P** | **Average for Years:** **2000** **thru** **2004** | **Season: Year**

Term	Flow 10^6 m3	Load kg	Std Error kg	Conc ppb	RSE %	Sampl per yr	Percent of Total Inflow: Flow %	Percent of Total Inflow: Load %	Percent of Total Inflow: Error %	Drain. Area km2	Runoff cm	Export kg / km2
Metro Effluent	91.85	9552	794	104	8%	29	18%	69%	75%			
Metro Bypass	2.21	509	391	230	77%	4	0%	4%	18%			
East Flume	0.65	47	5	73	11%	27	0%	0%	0%			
Crucible	2.43	123	6	51	5%	27	0%	1%	0%			
Harbor Brook	10.06	255	34	25	13%	30	2%	2%	0%	31.4	32.1	8.1
Ley Creek	40.21	657	38	16	6%	31	8%	5%	0%	66.1	60.8	9.9
Ninemile Creek	146.98	1108	149	8	13%	29	30%	8%	3%	298.1	49.3	3.7
Onondaga Creek	167.12	1253	174	7	14%	33	34%	9%	4%	285.1	58.6	4.4
Nonpoint Gauged	364.37	3272	235	9	7%	123	73%	24%	7%	680.7	53.5	4.8
Nonpoint Ungauged	24.82	223	34	9	15%	0	5%	2%	0%	46.4	53.5	4.8
NonPoint Total	389.19	3495	237	9	7%	123	78%	25%	7%	727.0	53.5	4.8
Industrial	3.08	171	8	55	5%	54	1%	1%	0%			
Municipal	94.07	10061	885	107	9%	33	19%	72%	93%			
Total External	486.34	13727	917	28	7%	210	98%	99%	100%	727.0	66.9	18.9
Precipitation	11.41	171	15	15	9%	0	2%	1%	0%	11.7	97.5	14.6
Total Inflow	497.74	13898	917	28	7%	210	100%	100%	100%	738.7	67.4	18.8
Evaporation	8.86						2%			11.7	75.7	
Outflow	488.89	22992	2216	47	10%		98%	165%	584%	738.7	66.2	31.1
Retention	0.00	-9094	2398		26%		0%	-65%				
Alternative Estimates of Lake Output												
Outlet 12 Feet	488.89	22992	2216	47	10%	26	98%	165%	584%	738.7	66.2	31.1
Outlet 2 Feet	488.89	19879	1294	41	7%	26	98%	143%	199%	738.7	66.2	26.9
Upstream/Downstream Contrast- Harbor Brook												
Upstream - Velasko	9.43	76	14	8	19%	30	2%	1%	0%	27.0	35.0	2.8
Downstream - Hiawatha	10.06	255	34	25	13%	30	2%	2%	0%	31.4	32.1	8.1
Local Inflow	0.63	179	37	286	21%		0%	1%	0%	4.4	14.2	40.6
Upstream/Downstream Contrast - Onondaga Creek												
Upstream - Dorwin	130.12	554	86	4	16%	33	26%	4%	1%	229.4	56.7	2.4
Downstream - Kirkpatrick	167.12	1253	174	7	14%	33	34%	9%	4%	285.1	58.6	4.4
Local Inflow	37.00	699	195	19	28%		7%	5%	5%	55.7	66.4	12.5

Lake Overflow Rate	41.79 m/yr	Calib. Settling Rate	-16.5 m/yr	RSE % = Relative Std. Error of Load & Inflow Conc. Estimates
Lake Residence Time	0.26 years	Calib. Retention Coef.	-65%	Error % = Percent of Variance in Total Inflow Load Estimate

Table 5: Total Nitrogen Balance for 2000-2004

Variable: **Total Nitrogen** **Average for Years: 2000 thru 2004** **Season: Year**

Term	Flow 10^6 m3	Load kg	Std Error kg	Conc ppb	RSE %	Sampl per yr	Percent of Total Inflow: Flow %	Percent of Total Inflow: Load %	Error %	Drain. Area km2	Runoff cm	Export kg/ km2
Metro Effluent	91.85	1113752	21271	12125	2%	72	18%	61%	76%			
Metro Bypass	2.21	28642	1140	12939	4%	4	0%	2%	0%			
East Flume	0.65	4048	114	6249	3%	27	0%	0%	0%			
Crucible	2.43	3663	162	1506	4%	27	0%	0%	0%			
Harbor Brook	10.06	21434	733	2131	3%	27	2%	1%	0%	31.4	32.1	683.4
Ley Creek	40.21	58350	2731	1451	5%	26	8%	3%	1%	66.1	60.8	882.8
Ninemile Creek	146.98	262289	7079	1784	3%	26	30%	14%	8%	298.1	49.3	879.9
Onondaga Creek	167.12	266582	6935	1595	3%	27	34%	15%	8%	285.1	58.6	934.9
Nonpoint Gauged	364.37	608654	10306	1670	2%	107	73%	33%	18%	680.7	53.5	894.2
Nonpoint Ungauged	24.82	41457	5682	1670	14%	0	5%	2%	5%	46.4	53.5	894.2
NonPoint Total	389.19	650111	11768	1670	2%	107	78%	36%	23%	727.0	53.5	894.2
Industrial	3.08	7711	198	2503	3%	53	1%	0%	0%			
Municipal	94.07	1142394	21301	12144	2%	76	19%	63%	76%			
Total External	486.34	1800216	24337	3702	1%	236	98%	99%	99%	727.0	66.9	2476.1
Precipitation	11.41	21670	1944	1900	9%	0	2%	1%	1%	11.7	97.5	1852.1
Total Inflow	497.74	1821886	24414	3660	1%	236	100%	100%	100%	738.7	67.4	2466.2
Evaporation	8.86						2%			11.7	75.7	
Outflow	488.89	1335770	24683	2732	2%		98%	73%	102%	738.7	66.2	1808.2
Retention	0.00	486115	34718		7%		0%	27%				
Alternative Estimates of Lake Output												
Outlet 12 Feet	488.89	1335770	24683	2732	2%	25	98%	73%	102%	738.7	66.2	1808.2
Outlet 2 Feet	488.89	1230299	26156	2517	2%	25	98%	68%	115%	738.7	66.2	1665.4
Upstream/Downstream Contrast- Harbor Brook												
Upstream - Velasko	9.43	20254	1031	2147	5%	27	2%	1%	0%	27.0	35.0	751.3
Downstream - Hiawatha	10.06	21434	733	2131	3%	27	2%	1%	0%	31.4	32.1	683.4
Local Inflow	0.63	1180	1265	1884	107%		0%	0%	0%	4.4	14.2	267.7
Upstream/Downstream Contrast - Onondaga Creek												
Upstream - Dorwin	130.12	200556	6531	1541	3%	27	26%	11%	7%	229.4	56.7	874.3
Downstream - Kirkpatrick	167.12	266582	6935	1595	3%	27	34%	15%	8%	285.1	58.6	934.9
Local Inflow	37.00	66026	9526	1785	14%		7%	4%	15%	55.7	66.4	1184.7

Lake Overflow Rate	41.79 m/yr	Calib. Settling Rate	15.2 m/yr
Lake Residence Time	0.26 years	Calib. Retention Coef.	27%

RSE % = Relative Std. Error of Load & Inflow Conc. Estimates
Error % = Percent of Variance in Total Inflow Load Estimate

Table 6: Ammonia Nitrogen Balance for 2000-2004

Variable: Ammonia Nitrogen **Average for Years:** 2000 thru 2004 **Season:** Year

Term	Flow 10^6 m3	Load kg	Std Error kg	Conc ppb	RSE %	Sampl per yr	Percent of Total Inflow Flow %	Percent of Total Inflow Load %	Percent of Total Inflow Error %	Drain. Area km2	Runoff cm	Export kg/km2
Metro Effluent	91.85	402462	5939	4382	1%	363	18%	81%	60%			
Metro Bypass	2.21	13619	748	6153	5%	46	0%	3%	1%			
East Flume	0.65	400	21	618	5%	27	0%	0%	0%			
Crucible	2.43	433	83	178	19%	27	0%	0%	0%			
Harbor Brook	10.06	1134	107	113	9%	27	2%	0%	0%	31.4	32.1	36.1
Ley Creek	40.21	14132	952	351	7%	27	8%	3%	2%	66.1	60.8	213.8
Ninemile Creek	146.98	40725	4528	277	11%	26	30%	8%	35%	298.1	49.3	136.6
Onondaga Creek	167.12	18206	1129	109	6%	27	34%	4%	2%	285.1	58.6	63.8
Nonpoint Gauged	364.37	74197	4763	204	6%	107	73%	15%	38%	680.7	53.5	109.0
Nonpoint Ungauged	24.82	5054	756	204	15%	0	5%	1%	1%	46.4	53.5	109.0
NonPoint Total	389.19	79250	4823	204	6%	107	78%	16%	39%	727.0	53.5	109.0
Industrial	3.08	833	85	270	10%	54	1%	0%	0%			
Municipal	94.07	416081	5986	4423	1%	409	19%	84%	61%			
Total External	486.34	496164	7688	1020	2%	571	98%	100%	100%	727.0	66.9	682.4
Precipitation	11.41	1141	102	100	9%	0	2%	0%	0%	11.7	97.5	97.5
Total Inflow	497.74	497304	7688	999	2%	571	100%	100%	100%	738.7	67.4	673.2
Evaporation	8.86						2%			11.7	75.7	
Outflow	488.89	371713	13731	760	4%		98%	75%	319%	738.7	66.2	503.2
Retention	0.00	125591	15737		13%		0%	25%				
Alternative Estimates of Lake Output												
Outlet 12 Feet	488.89	371713	13731	760	4%	26	98%	75%	319%	738.7	66.2	503.2
Outlet 2 Feet	488.89	322068	13923	659	4%	26	98%	65%	328%	738.7	66.2	436.0
Upstream/Downstream Contrast- Harbor Brook												
Upstream - Velasko	9.43	611	51	65	8%	27	2%	0%	0%	27.0	35.0	22.7
Downstream - Hiawatha	10.06	1134	107	113	9%	27	2%	0%	0%	31.4	32.1	36.1
Local Inflow	0.63	523	118	835	23%		0%	0%	0%	4.4	14.2	118.6
Upstream/Downstream Contrast - Onondaga Creek												
Upstream - Dorwin	130.12	8440	424	65	5%	27	26%	2%	0%	229.4	56.7	36.8
Downstream - Kirkpatrick	167.12	18206	1129	109	6%	27	34%	4%	2%	285.1	58.6	63.8
Local Inflow	37.00	9766	1206	264	12%		7%	2%	2%	55.7	66.4	175.2

Lake Overflow Rate	41.79 m/yr	Calib. Settling Rate	14.1 m/yr	RSE % = Relative Std. Error of Load & Inflow Conc. Estimates
Lake Residence Time	0.26 years	Calib. Retention Coef.	25%	Error % = Percent of Variance in Total Inflow Load Estimate