

CONDUCTIVITY TEMPERATURE
COEFFICIENTS FOR THE GREAT LAKES

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WQB-OR

CONDUCTIVITY
TEMPERATURE COEFFICIENTS
FOR THE GREAT LAKES

BY

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HONOURS AGRICULTURE
SEMESTER FIVE

ENVIRONMENT CANADA
Burlington, Ontario

Fall 1989

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Dear Sir:

Re: Letter of Submittal

This past fall, from September 5 to December 29, I was employed by Environment Canada at the Canada Centre for Inland Waters, Burlington, Ontario. My immediate supervisor was M. Neilson of the Water Quality Branch, Ontario Region. While employed at Environment Canada my research project involved calculating temperature coefficients for water samples collected from lakes Ontario, Huron, Superior, and Georgian Bay. These correction factors will be used to normalize conductivity measurements to a standard 25°C when using a Radiometer CDM83 conductivity meter.

The aim of this report is to describe the lab procedures and necessary statistical analysis to determine these temperature coefficients and delineate the processes involved in operating the CDM83 conductivity meter. This report is written for a person with knowledge of water quality chemistry and a strong grasp of the chemical science field. As a result, most of the basic terms are not defined, but some terms may be described more so than might be deemed necessary by an experienced scientist.

I would like to thank M. Neilson for her guidance and cooperation.

Yours Sincerely,

Dee Johnson

Dee Johnson
Environment Canada, Canada Centre for Inland Waters,
Burlington Ontario
December 15, 1989.

University of Guelph

Fall Semester 1989

Conductivity
Temperature Coefficients
for the Great Lakes

by

Dee Johnson

for

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ABSTRACT

293 Water samples were taken from Lakes Ontario, Huron, Superior and Georgian Bay for this study. Conductivity readings were taken with a Radiometer CDM83 conductivity meter from 2 to 25°C for each sample. Temperature coefficients were calculated for use with the Radiometer CDM83 and averages were calculated to get lake temperature coefficients. Lake Superior was found to have a higher temperature coefficient than the other lakes tested.

The procedure was repeated with a randomly selected sample from each lake using the calculated temperature coefficients. The resulting conductivity readings were only off by approximately 2.00 microSiemens. This accuracy is acceptable for open water samples.

Two areas were found to have inconsistent temperature coefficients relative to their region. They were Hamilton Harbour and Black River, both found in Lake Ontario. Both of these inconsistencies are explained in the report.

INTRODUCTION

Specific conductivity is a measure of the ability of a solution to carry an electric current (Rosenthal and Kidder 1969). It is defined as the reciprocal of the resistance in ohms, and is measured in Siemens ($S=\text{ohm}^{-1}$). It is a non-specific measurement and all ions present in a solution contribute, unlike pH which is a measure of the H^+ concentration only.

Conductivity is a function of temperature variations. It is therefore necessary either to measure conductivity at a fixed reference temperature, which would be impractical at the accepted reference temperature of 25°C , or to compensate for the variability with a temperature coefficient. The temperature coefficient serves to correct the conductivity measured at the temperature *in situ* to the reference temperature (usually 25°C). The conductivity meter, with the proper temperature coefficient, will then read conductivity at the reference temperature regardless of the sample temperature.

The temperature variability during a given year in the Great Lakes region dictates the need for a temperature coefficient. This will allow normalized data to be recorded and discrepancies or errors to be recognized. Corrections and observations can then be performed immediately ensuring accurate data and samples.

Previous studies on temperature adjustments of conductivity in the Great Lakes resulted in the use of individual quadratic equations for each of the Great Lakes and Georgian Bay (Smith 1962, Rodgers 1962). In the field this meant a time consuming and tedious procedure to arrive at a normalized value for conductivity. The validity of other studies (Clemmens 1971), is suspect due to errors in statistical evaluation. Today, the CDM83 conductivity meter allows for the input of a previously calculated temperature coefficient which corrects any raw conductivity measurement to a given reference temperature. The purpose of this report is to calculate the specific conductivity temperature coefficient for lakes Ontario, Huron, Superior, and Georgian Bay applying the equation which the microprocessor of the CDM83 uses.

COLLECTION OF SAMPLES

All samples were collected during the spring cruises of 1989 by Technical Operations Division from onboard the CSS Limnos. At all stations (Figure 1, 2, 3, 4), water samples were collected by a rosette sampler for conductivity testing. All samples were collected at a one metre depth and stored in 250 ml polyethylene bottles until analyzed.

LABORATORY ANALYSIS

The samples were separated into three different sections, one section for each lake (Lake Huron and Georgian Bay were combined into one section). The samples were first agitated, then approximately 20 ml of each sample was poured into a 50 ml test tube (Pyrex, Canada). The test tube was rinsed with this water, which was then discarded, then 50 ml of the sample was poured into the test tube to be used for conductivity measurements. Every filled test tube was capped by a neoprene stopper (Fisher Scientific, #4), and placed in racks fitted on a water bath.

A Guildline 9734 Constant Temperature Bath was used in this study. Its temperature constant had a bias of -0.01°C . This was easily corrected by setting the desired temperature to 0.01°C lower than normal (ie. 2.00°C would be set at 1.99°C). The temperature was lowered in the bath to 2.0°C and conductivity readings were taken at two degree intervals up to and including 25°C . A Guildline 9535 Digital Thermometer (Ice bath check: 0.001°C accuracy) was used to check and compare the accuracies of the temperature sensors of the water bath and CDM83.

A Radiometer CDM83 conductivity meter (Figure 4) was used to perform the conductivity measurements. The conductivity probe was calibrated as per the operating manual guidelines and concur with previous calibrations and accuracy checks on the CDM83 (Peer and Cooper 1988). The reference temperature (rt) on the CDM83 was set at 25°C , the temperature coefficient percent (TC%) was set at 0.00, the auto range was used, and the temperature sensor (Radiometer T108 accuracy: 0.1°C) was utilized, but was negligible because of a TC% of zero.

At each conductivity measurement the conductivity probe was rinsed with a sample of the given lake water, dried off with a Kimwipe (Kimberley-Clark) towel and placed into the sample to get a conductivity reading. Distilled water was not used as a rinse because the chemical composition of distilled water differs greatly from that of the lake samples, and inconsistent conductivity readings would result. When measuring samples at lower temperatures (2 and 4°C) it was necessary to leave the probe in the sample for approximately one minute (due to the small volume of the sample) to allow the sample to equilibrate to the desired temperature.

After one run was completed each test tube was emptied and rinsed three times with hot tap water, and three times with distilled water. The test tubes were rinsed with approximately 20 ml of the new samples, the water was then discarded. The test tubes were then filled with about 50 ml of the sample and another run was performed on the new samples. A calibration check was performed on the CDM83 after each run, with no error observed between the three sections.

STATISTICAL ANALYSIS

For each sample there were twelve measurements, and for each of these measurements the following formula was employed to calculate the temperature coefficient:

$$K_{t_{ref}} = \frac{K}{1 + \alpha(t - t_{ref})}$$

Manipulated, this gives:

$$\alpha = \frac{K / K_{t_{ref}} - 1}{(t - t_{ref})}$$

Where:

$K_{t_{ref}}$ = conductivity at reference temperature (S/cm)

K = conductivity of sample (S/cm)

α = temperature coefficient

t = temperature of the sample ($^{\circ}$ C)

t_{ref} = reference temperature ($^{\circ}$ C)

The temperature coefficients which resulted from this equation were averaged for each station sampled. These values were then averaged to get a mean lake temperature coefficient. The standard deviation was also calculated at the lake level to measure the precision and accuracy of the measurements.

RESULTS

A total of 293 samples were tested, 98 from Lake Ontario, 82 from Lake Huron, 88 from Lake Superior, and 25 from Georgian Bay. The raw conductivity measurements for each lake can be found in Appendix 1.1 (Ontario), 1.2 (Huron), 1.3 (Superior), and 1.4 (Georgian Bay). The temperature coefficients calculated by the equation as well as the temperature coefficient station averages are presented in Appendix 2.1, 2.2, 2.3, and 2.4.

Table 1.1 shows the final lake temperature coefficients, their standard deviations, and the range of values when the Empirical Rule is used (+/- 2 standard deviations).

TABLE 1.1 Great Lakes temperature coefficients and their standard deviations.

LAKE	TEMPERATURE COEFFICIENT (%)	STANDARD DEVIATION (%)	+/- 2 STANDARD DEVIATIONS (%)	
ONTARIO	2.00	0.041	1.92	- 2.08
HURON	2.00	0.068	1.86	- 2.14
SUPERIOR	2.17	0.098	1.97	- 2.37
GEORGIAN BAY	1.99	0.075	1.84	- 2.14

The procedure outlined in the methods above was repeated to check the validity of the results obtained. One random sample was taken from each lake and run through the procedure. The results of the run are found in Tables 2.1, 2.2, 2.3, and 2.4. They show the actual raw conductivity reading taken at 25°C versus the corrected conductivity values using the corresponding temperature coefficients for each lake.

Table 2.1 Lake Ontario temperature-coefficient corrected conductivity versus measured conductivity at 25°C.

TEMP	CONDUCTIVITY CORRECTED WITH A TC% OF 2.00 (μ S)	ERROR (%)
2	334	0.00
4	333	0.30
6	333	0.30
8	332	0.50
10	333	0.30
12	333	0.30
14	333	0.30
16	333	0.30
18	333	0.30
20	333	0.30
22	334	0.00
25	334	0.00

Table 2.2 Lake Huron temperature-coefficient corrected conductivity versus measured conductivity at 25°C.

TEMP	CONDUCTIVITY CORRECTED WITH A TC% OF 2.00 (μS)	ERROR (%)
2	218	0.00
4	216	0.91
6	215	1.38
8	217	0.45
10	217	0.45
12	CONDUCTIVITY	0.91
14	AT 25°C = 218 μS	0.91
16	215	1.38
18	214	1.83
20	217	0.45
22	215	1.38
25	218	0.00

Table 2.3 Lake Superior temperature-coefficient corrected conductivity versus measured conductivity at 25°C

TEMP	CONDUCTIVITY CORRECTED WITH A TC% OF 2.17 (μS)	ERROR (%)
2	115.7	0.86
4	115.4	1.11
6	114.8	1.63
8	114.9	1.54
10	114.9	1.54
12	CONDUCTIVITY	1.80
14	AT 25°C = 116.7 μS	1.29
16	115.2	1.29
18	115.0	1.46
20	115.1	1.37
22	116.5	0.17
25	116.7	0.00

Table 2.4 Georgian Bay temperature-coefficient corrected conductivity versus conductivity measured at 25°C

TEMP	CONDUCTIVITY CORRECTED WITH A TC% OF 2.00 (uS)	ERROR (%)
2	185	1.60
4	186	1.06
6	186	1.06
8	186	1.06
10	186	1.06
12	CONDUCTIVITY	0.53
14	AT 25° = 188 uS	0.53
16	186	1.06
18	186	1.06
20	188	0.00
22	187	0.53
25	188	0.00

Only two areas in the Great Lakes were inconsistent with the results obtained. Both of these areas were found in Lake Ontario. They are Hamilton Harbour and the mouth of the Black River. The conductivities and the temperature coefficients of these areas are found in Tables 3.1 (Hamilton Harbour), and 3.2 (Black River).

Table 3.1 Conductivity values and their temperature coefficient for Hamilton Harbour:

TEMPERATURE	CONDUCTIVITY	
2	343	
4	356	
6	383	
8	401	
10	421	
12	441	TEMPERATURE
14	466	COEFFICIENT: 1.88
16	489	
18	512	
20	533	
22	549	
25	588	

Table 3.2 Conductivity values and their temperature coefficient for Black River

TEMPERATURE	CONDUCTIVITY	
	Stn 97	Stn 76
2	53.1	60.9
4	57.0	65.2
6	60.0	68.8
8	63.3	72.7
10	67.2	76.9
12	70.4	79.7
14	74.5	84.7
16	81.4	90.4
18	83.3	94.6
20	86.3	97.8
22	90.6	103.1
25	97.1	111.5

DISCUSSION

Lake Ontario, Lake Huron and Georgian Bay had a similar temperature coefficient of approximately 2.00, while Lake Superior had a temperature coefficient of 2.17. The difference between the temperature coefficients can be explained by the geology of the regions. In the St. Lawrence Lowlands, and the Great Lakes basin region (which encompasses Lakes Ontario, Huron and Georgian Bay) the water tends to be harder, resulting in a higher conductivity due to the availability of ions. This harder water gives a lower temperature coefficient. Conversely, the Canadian Shield (which encompasses Lake Superior), with its thin soil cover, the water tends to be soft with small amounts of dissolved solids. This soft water gives rise to a lower conductivity, and a higher temperature coefficient.

The results from the samples that were used as duplicates were within the given statistical parameters. The temperature coefficient used on the Georgian Bay sample was 2.00. This number was used instead of the calculated 1.99 because the error between the two numbers was below 0.50% or one microSiemen. The percentage error is lower in lakes Ontario and Huron, but this is only a result of the magnitude of their conductivities. All duplicates were corrected to within approximately two microSiemens of the measured conductivity at 25°C.

Hamilton Harbour has unusually high conductivity readings and a lower temperature coefficient due to the large amount effluent deposits and pollution. It is almost a closed system and therefore does not get the open water flow that other regions of the lakes experience. The Black River mouth has a lower conductivity and higher temperature coefficient because it is an inflowing river with a slightly different chemical composition. It should be noted that this lower conductivity only occurs at the mouth of the Black River (Stations 76 and 97). The water quickly mixes with that of Lake Ontario and becomes similar with the rest of the lake.

RECOMMENDATIONS

The temperature coefficients calculated should be used with the Radiometer CDM83 as follows:

	Temperature Coefficient
Lake Ontario	2.00
Lake Huron	2.00
Georgian Bay	2.00
Lake Superior	2.17
Hamilton Harbour	1.88
Black River N.Y.	2.13

A repeat of this study, on a smaller scale (8 random samples per lake taken at the same time as the regular spring cruises), should be performed annually. This would make sure the results from this study are correct and still relevant. It should take a maximum of three person days.

More samples should be taken from Hamilton Harbour and Black River, before these calculated numbers are used, to be sure of the relevance of these temperature coefficients. The resulting measurements and calculations from these samples will give more precise temperature coefficients, and will find out the specific differences between these regions and the rest of Lake Ontario. It should be noted that these further studies would only be justified if in depth research was being performed in these specific areas.

ACKNOWLEDGEMENTS

The author would like to thank Technical Operations and Ship Support Division for collecting the water samples; National Water Quality Laboratory (Guy Paquette) for splitting and labelling the samples. Thanks to Jacques Carrier for giving up the only large test tubes in the building. Special thanks to L.R. Peer and W.J. Cooper for their invaluable wisdom and technical expertise; to M. Neilson for her patient guidance and supervision, and to B. Harrison, G. Bruce, R. Dobos and V. Glumac for their constructive criticism.

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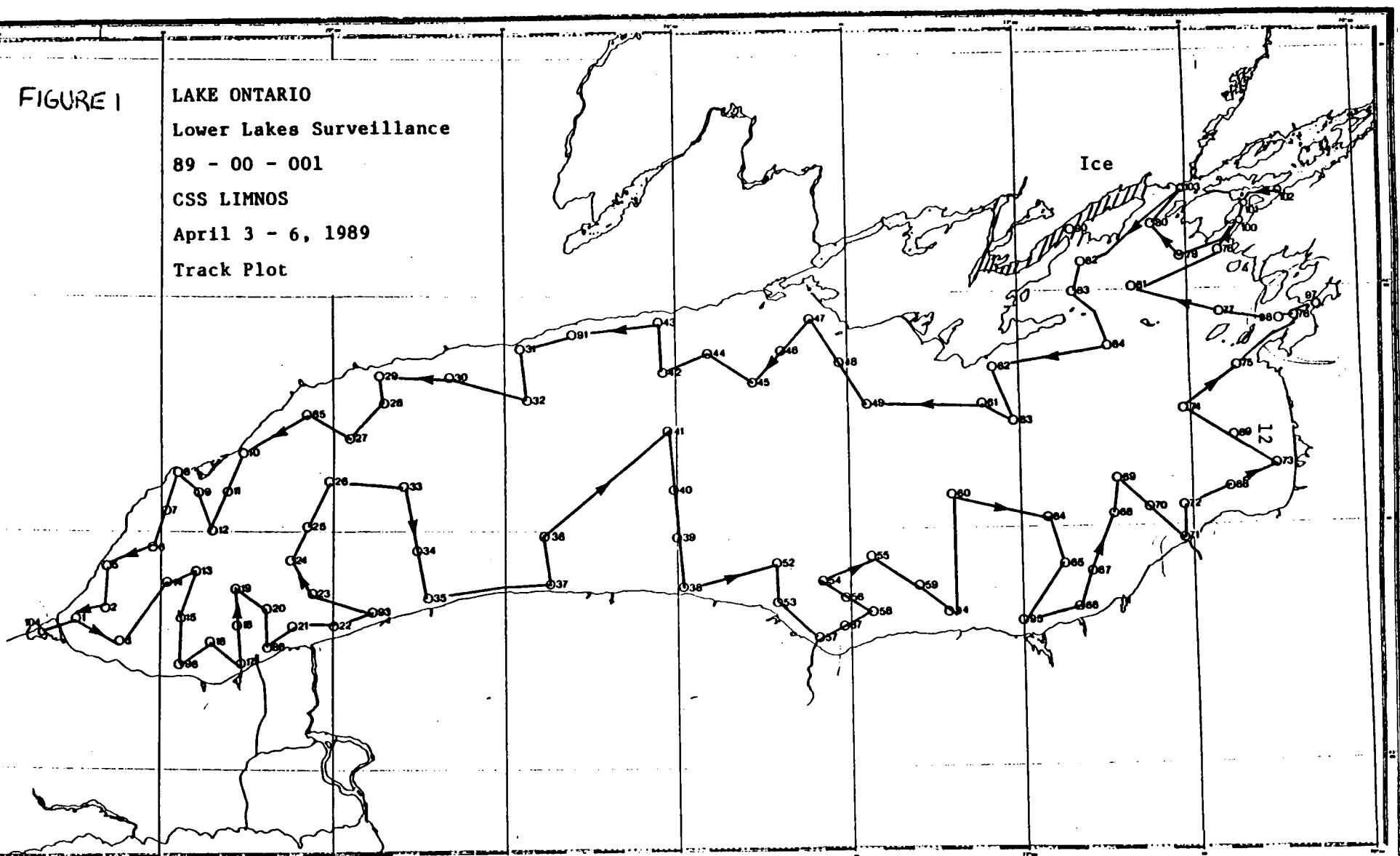
Peer, L.R. and Cooper, W.J. 1989. Calibration report for Radiometer CDM83 Conductivity Meter. Calibration Report. Canada Centre for Inland Waters.

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FIGURE 1

LAKE ONTARIO
Lower Lakes Surveillance
89 - 00 - 001
CSS LIMNOS
April 3 - 6, 1989
Track Plot



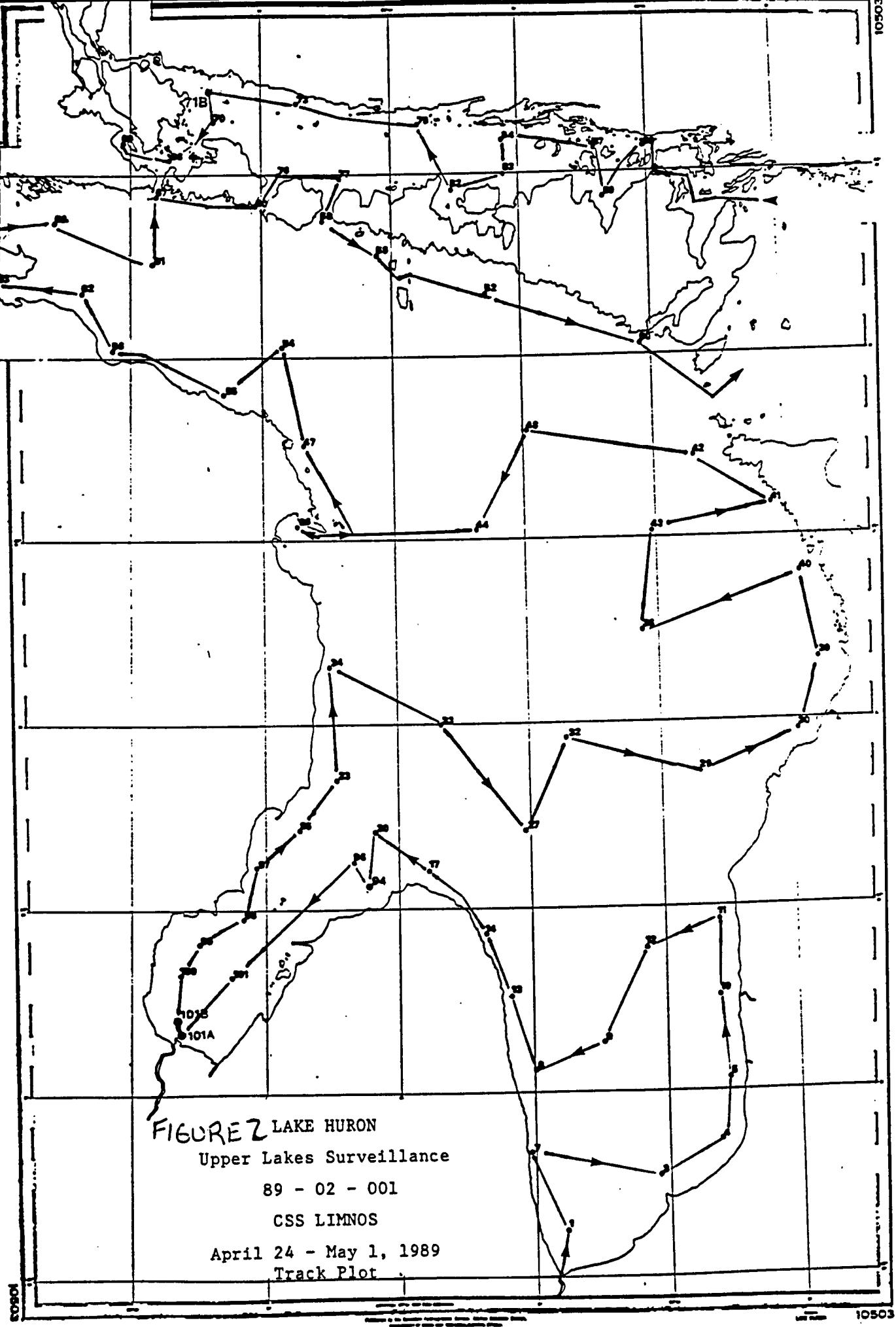


FIGURE 2 LAKE HURON
Upper Lakes Surveillance
89 - 02 - 001
CSS LIMNOS
April 24 - May 1, 1989
Track Plot

FIGURE 3 LAKE SUPERIOR

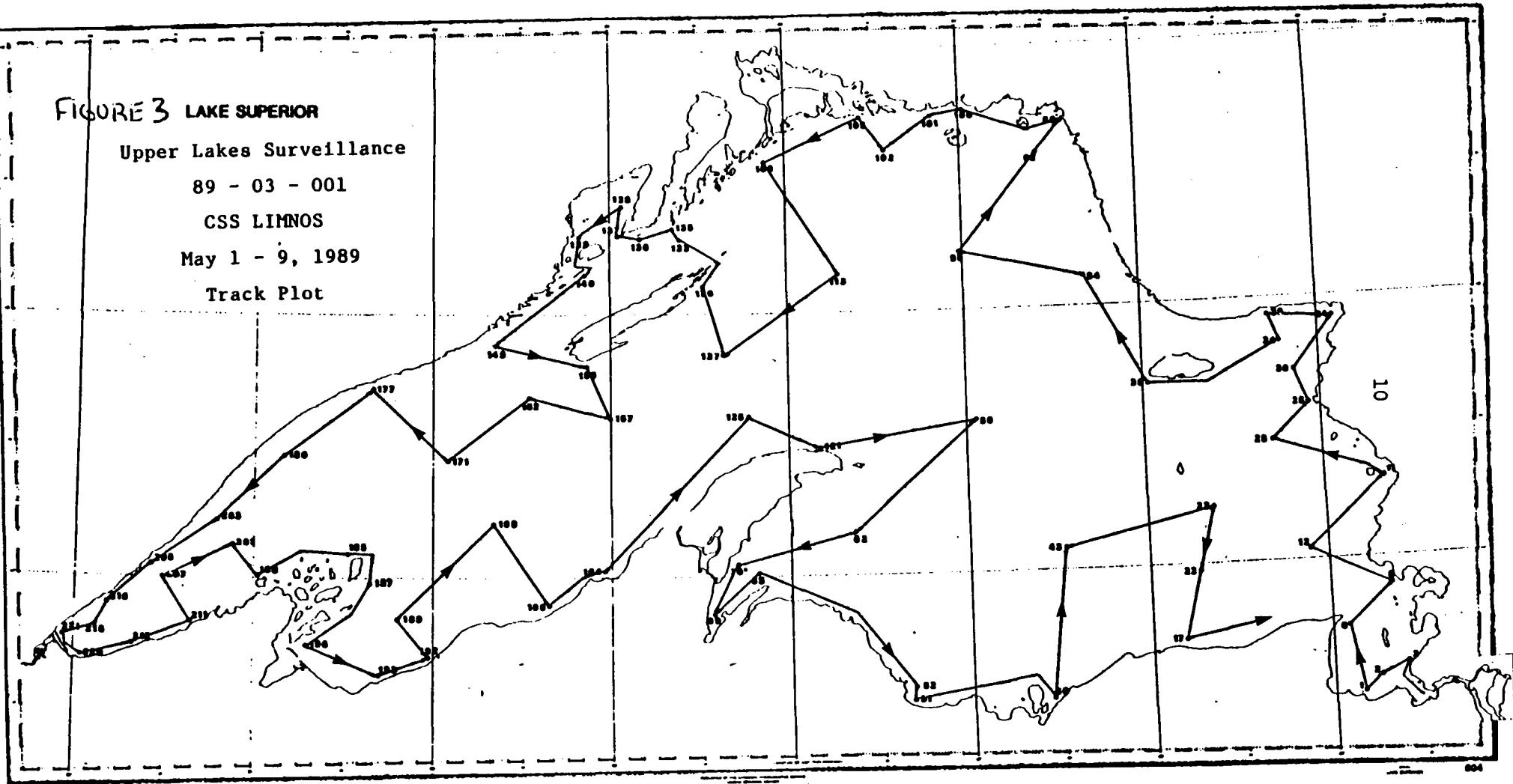
Upper Lakes Surveillance

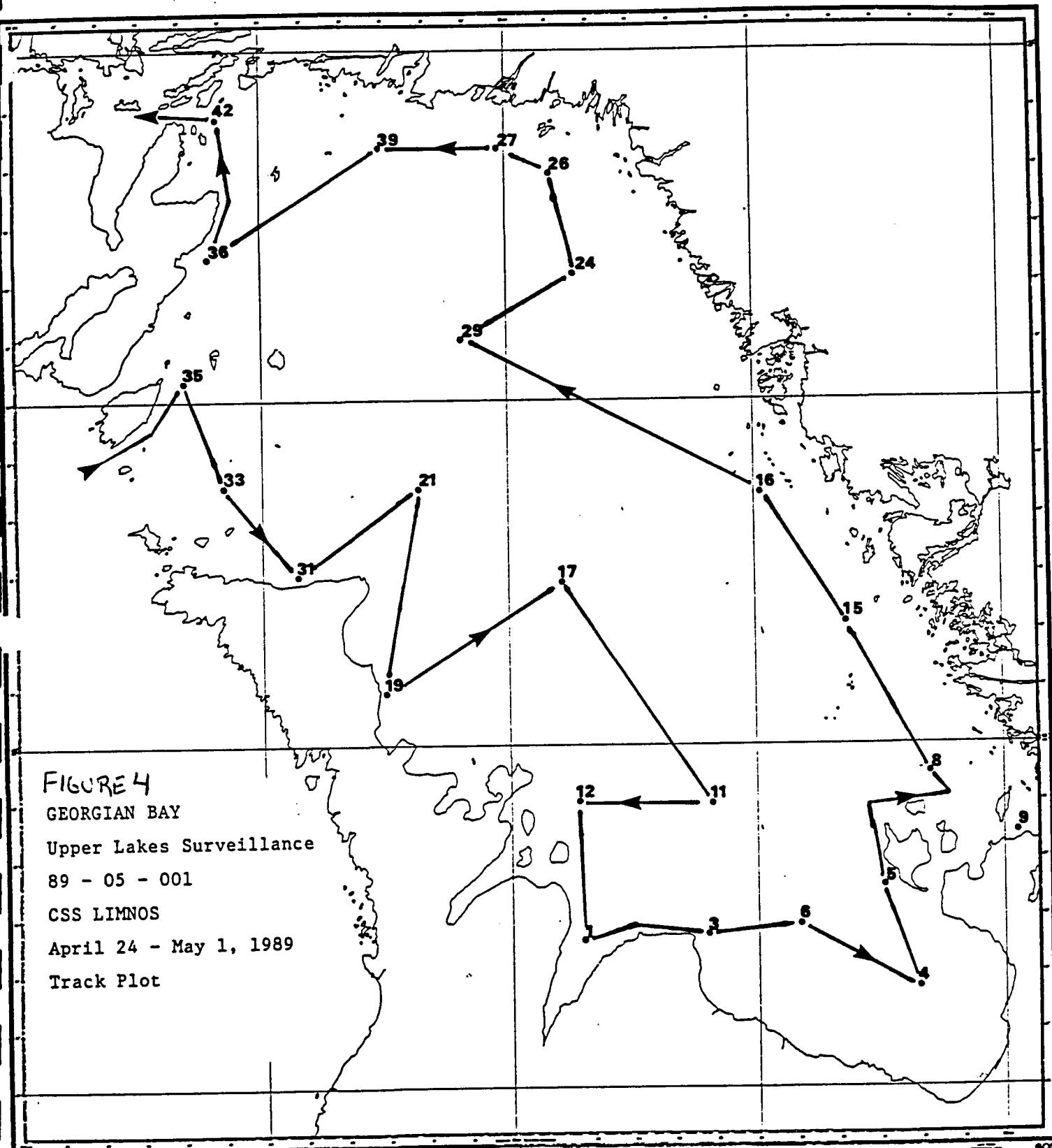
89 - 03 - 001

CSS LIMNOS

May 1 - 9, 1989

Track Plot





Appendix 1.1
Raw Conductivity for Lake Ontario

SAMPLE TEMPERATURE	1	2	3	5	6	7	8	9
2	184	181	182	184	183	181	180	179
4	194	188	194	192	190	191	193	189
6	206	202	205	205	199	204	205	199
8	217	214	218	216	214	215	219	211
10	231	226	229	229	226	228	229	223
12	241	241	240	241	237	239	243	237
14	255	252	254	254	252	252	254	248
16	268	265	268	269	266	268	269	263
18	281	278	280	282	281	282	283	276
20	293	292	292	296	295	295	297	289
22	303	306	305	309	310	308	311	302
25	322	326	325	329	330	328	331	322
SAMPLE TEMPERATURE	10	11	12	12	13	13	14	15
2	178	181	177	178	180	178	178	179
4	190	191	189	188	189	188	189	190
6	204	200	200	200	199	200	199	202
8	214	211	213	211	212	211	209	214
10	226	225	224	222	222	223	224	226
12	237	238	237	236	234	236	234	237
14	251	250	248	248	248	248	248	249
16	265	263	261	261	261	261	258	257
18	278	277	274	274	275	273	273	274
20	291	291	287	287	286	286	286	287
22	304	304	300	301	298	298	299	298
25	324	324	320	321	317	317	318	319

SAMPLE	30010 16	30011 17	30012 18	30015 19	30016 19	30017 20	30019 21	30020 22	30025 23	30026 24	30027 25	30030 26	30031 26	30123 27	30122 28	30121 29
TEMPERATURE																
2	177	182	179	178	178	179	162	161	175	176	178	177	176	178	178	178
4	189	194	191	189	190	190	171	172	189	188	189	188	190	190	188	189
6	200	204	201	199	200	200	181	183	200	200	200	199	200	200	200	201
8	211	214	214	210	210	210	192	193	211	210	212	209	212	211	212	213
10	224	228	225	220	221	223	202	203	223	222	223	220	224	222	224	226
12	236	240	236	231	234	235	213	214	235	235	235	233	235	232	235	237
14	247	252	249	243	247	247	223	226	248	247	248	245	248	248	249	251
16	262	265	261	255	258	259	237	237	259	258	259	255	259	262	264	264
18	274	279	274	267	270	274	248	249	272	273	272	267	273	275	277	278
20	287	292	288	279	285	286	259	260	285	283	284	278	285	288	290	290
22	300	303	301	292	298	299	271	272	297	296	297	292	297	301	303	304
25	319	323	320	310	317	319	288	289	316	314	315	311	317	321	323	324

SAMPLE	30120 30	30118 31	30119 32	30032 33	30033 34	30034 35	30038 36	30039 36	30035 37	30043 38	30042 39	30041 40	30040 41	30112 41	30115 42	30116 43
TEMPERATURE																
2	177	178	179	177	177	165	177	177	172	173	177	178	177	179	179	179
4	187	192	189	189	189	174	187	188	181	185	190	188	187	188	188	189
6	200	203	201	199	199	184	198	198	191	197	200	199	200	199	201	199
8	211	214	211	211	211	195	210	210	202	207	211	210	211	212	213	212
10	223	225	225	223	223	204	223	221	212	219	224	224	223	223	224	223
12	234	238	237	231	233	215	234	233	224	232	236	236	235	234	235	235
14	248	250	248	247	246	228	246	247	236	243	247	250	248	247	247	248
16	261	265	262	257	257	239	257	257	248	255	258	260	260	261	261	263
18	274	277	276	274	270	250	269	270	260	267	270	272	273	274	274	275
20	287	292	292	284	284	262	283	282	271	278	284	285	284	287	287	288
22	300	305	302	296	296	273	296	295	285	293	296	301	300	301	300	302
25	320	325	321	315	315	292	315	317	303	311	315	320	318	321	321	322

SAMPLE	30111 44	30110 45	30109 46	30108 47	30107 48	30106 49	30046 52	30047 52	30048 53	30055 54	30056 54	30057 55	30052 56	30049 57	30051 58	30058 59	
EMPERATURE																	
2	178	181	179	178	179	179	178	176	176	176	176	180	178	201	176	177	
4	188	192	192	188	189	189	189	189	187	189	189	189	189	211	188	190	
6	201	202	201	199	199	200	201	200	198	201	201	201	201	203	226	200	202
8	212	214	214	211	211	212	212	212	210	211	213	212	213	238	212	212	
10	224	226	224	224	223	223	223	224	224	223	225	224	224	249	222	225	
12	235	238	236	235	234	236	236	235	234	235	236	236	237	264	235	237	
14	248	250	248	247	247	249	249	248	248	249	250	247	250	276	248	247	
16	261	265	263	263	260	264	262	261	260	261	262	258	262	293	260	261	
18	272	278	276	276	273	277	271	273	273	271	270	273	272	306	272	275	
20	286	291	289	289	286	290	282	284	286	284	285	285	284	321	284	286	
22	300	304	302	302	300	304	296	295	297	298	296	295	300	335	295	297	
25	320	324	322	322	320	324	316	318	317	314	315	317	319	358	318	319	

SAMPLE	30060 60	30105 61	30103 62	30104 63	30063 64	30064 64	30065 65	30067 66	30070 67	30071 67	30072 68	30073 69	30074 70	30075 71	30078 72	30079 72
EMPERATURE																
2	180	179	178	177	177	176	178	178	177	176	176	181	176	179	180	176
4	188	189	190	187	189	189	189	189	189	189	187	190	191	192	190	190
6	200	199	200	201	200	201	201	200	201	200	200	200	201	204	202	202
8	210	215	213	213	210	211	211	212	213	211	211	212	212	215	212	212
10	222	229	224	223	222	223	224	223	224	223	224	224	224	227	225	224
12	234	238	235	237	235	233	235	234	234	236	234	235	235	239	235	236
14	246	249	247	250	247	247	249	248	247	249	247	249	249	253	248	246
16	260	264	263	264	259	258	261	261	259	262	261	262	261	264	259	259
18	271	278	276	277	274	270	273	273	271	274	272	273	273	279	272	274
20	284	291	289	290	285	284	284	285	283	284	283	284	284	290	284	286
22	299	305	303	303	296	299	299	297	297	300	299	298	296	302	296	299
25	316	325	323	323	318	316	317	317	316	318	315	316	316	321	316	319

SAMPLE	30081 73	30083 74	30086 75	30087 75	30089 76	30091 77	30093 78	30097 79	30098 80	30092 81	30100 82	30101 83	30102 84	30124 85	30018 86	30050 87
TEMPERATURE																
2	181	179	176	176	60.9	175	174	177	181	179	177	180	179	178	182	178
4	193	188	187	187	65.2	189	186	187	194	189	187	190	190	190	194	188
6	206	201	199	199	68.8	200	196	198	203	201	202	201	202	200	205	198
8	216	211	209	210	72.7	211	208	212	215	212	214	214	213	211	218	210
10	228	222	221	222	76.9	222	218	222	228	224	226	226	222	223	229	220
12	239	235	232	233	79.7	234	231	234	240	235	238	240	236	236	241	232
14	251	248	244	244	84.7	246	242	244	251	248	250	252	248	249	257	244
16	264	260	255	256	90.4	259	254	256	262	261	265	266	262	261	267	256
18	277	271	268	268	94.6	270	265	268	278	272	278	280	275	275	281	270
20	291	283	279	279	97.8	283	276	278	292	283	292	293	288	288	295	283
22	304	295	293	294	103.1	295	293	292	305	298	306	307	302	302	308	294
25	323	314	311	312	111.5	314	310	312	325	317	326	328	322	322	329	314

SAMPLE	30080 88	30082 89	30117 91	30023 93	30024 93	30059 94	30066 95	30009 96	30088 97	30090 98	30094 100	30095 101	30096 102	30099 103	30000 104
TEMPERATURE															
2	176	182	178	162	166	177	181	180	53.1	136	176	177	177	178	343
4	190	194	189	174	174	188	190	190	57	146	187	190	189	189	356
6	203	206	201	185	184	198	200	201	60	154	199	201	200	200	383
8	212	216	213	195	194	210	211	214	63.3	162	209	211	210	216	401
10	224	229	223	207	205	223	223	226	67.2	171	221	222	222	224	421
12	235	240	237	218	217	235	235	237	70.4	179	231	235	235	238	441
14	249	252	249	229	228	248	249	249	74.5	188	243	246	247	249	466
16	260	264	262	241	240	261	261	263	81.4	198	255	259	259	263	489
18	273	276	275	253	251	272	274	276	83.3	207	268	273	271	277	512
20	286	291	289	264	262	284	285	288	86.3	217	278	283	285	290	533
22	297	306	302	277	274	297	298	302	90.6	227	291	294	298	304	549
25	317	325	322	294	291	315	316	321	97.1	242	310	315	318	324	588

Appendix 1.2
Raw Conductivity for Lake Huron

TEMPERATURE	1	3	4	5	5	7	8	8
2	116.7	117.6	118.3	158	155	115.9	115.9	115.4
4	124.2	125.5	126.1	168	165	123.8	124	123.4
6	133	134	134	178	175	132	131	131
8	140	141	141	188	185	139	138	139
10	147	148	148	198	194	146	144	146
12	155	155	158	208	204	153	152	154
14	163	164	165	218	215	161	160	161
16	171	172	172	228	224	169	168	169
18	178	181	180	238	234	177	176	177
20	187	189	188	249	245	185	185	185
22	195	196	196	261	255	193	193	193
25	209	209	209	278	271	206	206	206
TEMPERATURE	9	10	11	12	13	13	14	20
2	115.8	131	120.7	117.1	116.2	120	117.6	115.9
4	123.4	140	126.7	125	123.8	128.7	125.5	123.8
6	131	149	135	132	131	139	134	132
8	140	159	142	140	138	144	141	139
10	147	166	150	148	146	151	148	146
12	154	174	156	156	154	160	153	153
14	162	182	161	162	161	167	161	163
16	169	190	169	170	169	175	171	172
18	177	200	178	177	177	184	179	180
20	185	208	186	186	186	193	188	188
22	193	217	194	194	194	202	196	196
25	206	231	206	207	207	215	208	209

TEMPERATURE	23	27	29	30	32	33	33	34
2	117.4	114.6	114.5	118.2	114.9	115.9	116	114.7
4	125.4	122.8	121.2	125.4	122.6	123	123.5	122.1
6	134	131	131	134	129.7	130	131	130
8	141	138	138	141	138	138	138	138
10	149	144	144	147	144	144	145	144
12	157	152	151	154	151	154	153	154
14	164	160	160	162	160	161	161	161
16	172	168	167	170	167	168	168	168
18	181	176	175	178	175	176	176	176
20	189	184	183	186	183	185	184	185
22	198	193	192	193	191	193	193	193
25	212	206	205	206	203	206	206	205
TEMPERATURE	36	38	39	39	39	39	40	41
2	136	114.7	116.5	117.9	116.9	118.4	119.1	118
4	145	122.6	124.7	125.5	125.4	125.6	127.4	125.3
6	154	131	133	135	134	134	136	133
8	162	138	140	141	141	141	143	141
10	171	144	148	148	148	148	150	148
12	180	152	155	155	155	156	158	155
14	188	160	163	163	162	164	166	163
16	196	168	171	171	171	172	174	171
18	207	176	179	179	180	180	180	180
20	217	184	187	187	188	188	188	188
22	226	193	196	196	196	197	197	197
25	242	205	209	209	209	211	211	211

TEMPERATURE	42	42	43	44	47	48	50	52
2	115.9	116.1	115.4	114.6	114.4	115.7	115.3	116.2
4	123.2	123.2	122.6	121.5	121.7	123.2	123.8	123.4
6	132	131	131	129.8	131	132	134	131
8	139	139	138	137	139	139	140	138
10	146	146	144	145	145	146	146	145
12	153	153	152	152	152	153	154	154
14	161	161	160	160	159	161	162	161
16	169	170	168	167	168	169	169	169
18	179	178	177	176	177	178	178	177
20	187	186	185	186	185	186	187	186
22	196	195	193	192	194	195	196	197
25	209	208	205	205	207	208	208	210
TEMPERATURE	52	54	54	55	56	58	59	60
2	114.7	113.4	113.7	113.1	114.9	105.5	115.2	98.7
4	123.4	119.2	118.7	120.9	120.5	111.6	123	104.5
6	129.9	126.9	127	127.7	130	118.1	129.4	111.5
8	138	136	137	135	139	124.3	138	117.5
10	144	142	143	142	145	133	145	123.3
12	153	148	149	149	152	140	152	128.1
14	161	154	156	155	160	147	160	136
16	169	165	165	165	168	154	168	144
18	177	173	173	173	175	161	177	151
20	186	182	181	181	183	169	186	158
22	195	190	190	189	192	177	194	165
25	208	203	203	201	205	189	208	177

TEMPERATURE

	60	61	62	63	64	64	65	66
2	99.1	111.1	113.1	125.5	134	134	116.7	112.2
4	105	118.3	120.6	134	142	142	124	123.4
6	112.3	126.7	128.8	142	150	151	133	127
8	117.8	132	135	151	159	159	141	134
10	123.6	139	145	159	167	168	147	140
12	131	145	150	167	175	176	154	148
14	137	154	159	175	183	185	164	156
16	144	162	167	183	192	195	171	164
18	149	170	175	192	204	204	180	171
20	157	177	183	201	211	213	188	179
22	165	186	191	210	220	223	197	188
25	177	199	204	225	235	238	212	201

TEMPERATURE

	67	68	69	70	71	73	76	77
2	59.3	63.3	54.8	70.5	58.4	87.7	97.3	101.2
4	63.4	67.3	57.7	74.4	62.1	92.6	102.5	107.5
6	68.4	71.1	61.3	78.7	66.1	97.9	109.9	114.3
8	71.3	75.3	64.6	83.1	69.8	103.5	115.2	118.8
10	75.2	79.9	68	88.3	73.5	109.7	121.2	127.1
12	79.4	84.3	73	93	78.1	115.4	128	134
14	83.4	89	76.9	98.2	82.4	121.9	134	140
16	87.8	94.1	81	103.4	86.3	127.3	141	147
18	93.3	98.8	85.1	108.5	90.1	134	150	155
20	97.2	103.9	90	114	94.3	141	157	163
22	101	108.8	94.8	119	98.9	148	163	170
25	108.8	116.2	101.7	127.8	105.8	158	174	181

TEMPERATURE

	79	82	83	84	84	87	88	89
2	88.5	98.1	98.3	93.8	93.2	97.3	96.2	98.7
4	93.4	103.8	103.2	98.8	98.6	103.7	103.7	104.9
6	98.7	109.9	110.3	104.9	105.7	109.6	110.4	111.2
8	104	116.1	116.4	111.2	110.8	116.2	116.7	118.2
10	111.1	123	123.2	118	117	122.5	122.9	124.8
12	117	130	130	124.5	123.5	130	131	132
14	124	138	137	132	129.8	137	138	139
16	131	143	143	139	138	145	146	147
18	137	153	153	146	145	152	153	154
20	146	165	159	153	152	159	160	161
22	152	170	167	160	160	167	168	170
25	163	180	178	170	170	178	179	181

TEMPERATURE

	94	94	95	96	97	98	98	99
2	119.3	119.6	118.7	117.3	121.2	139	139	150
4	128.5	128.2	127	125.2	130	149	148	160
6	137	136	136	134	139	157	157	169
8	144	144	143	141	146	166	166	178
10	153	152	150	148	153	175	174	187
12	160	159	157	156	161	184	182	197
14	167	167	166	164	169	193	192	208
16	175	174	174	172	177	202	201	217
18	183	182	182	180	185	213	210	228
20	191	191	190	188	193	222	219	237
22	201	200	198	196	200	231	228	248
25	214	213	212	210	214	246	244	264

TEMPERATURE

	100	101
2	149	160
4	159	171
6	169	181
8	178	191
10	187	200
12	197	210
14	206	219
16	216	228
18	227	238
20	237	249
22	247	259
25	264	279

TEMPERATURE

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Appendix 1.3
Raw Conductivity for Lake Superior

TEMPERATURE	1	2	3	6	8	8	11	12
2	57.4	55.7	54	54.6	54.7	54.2	54.3	54.1
4	61.7	59.5	57.3	59	58.8	57.9	57.5	57.9
6	65.8	63.9	61	61.9	62.7	62.7	61.7	61.4
8	70.1	68	65.4	66.1	66.8	66.7	65	65
10	75.4	73.2	69	70.5	71.4	71.4	68.6	69.1
12	80.2	77.8	72.9	74.6	75.7	75.4	72.7	73.2
14	84.9	82.6	77	79	79.9	80.1	76.5	77.1
16	89.6	86.6	81	83.3	83.9	84.5	80.7	81
18	94.8	91.5	86.4	87.6	88.4	89.3	85.3	85.5
20	99.3	96.4	90.6	92.5	93	93.6	89	89.7
22	104.4	101	94.4	97.4	97.7	98.6	93.8	94.2
25	112.2	107.7	100	103.7	104.6	105.9	100.4	101.4
TEMPERATURE	17	22	23	25	28	30	30	31
2	53.7	54.6	53.3	54.1	54.3	56.8	54.9	55.6
4	57.5	57.5	57.5	57.7	58.5	60.4	58.7	58.9
6	59.4	61.8	60.3	61.7	62.8	65	62.8	62.4
8	64.2	65	64.3	65.3	67	68.7	66.2	66.8
10	68.1	69.1	67.6	68.9	71.3	73.5	70.7	70.9
12	72.5	72.8	71.6	73	75.9	78	74.5	74.8
14	76.8	76.8	78.1	76.8	79.8	82.4	78.6	79.4
16	81.9	80.8	84.7	81.2	84.2	86.6	82.6	83.6
18	86.4	84.9	89.2	85.3	89	91.4	87.3	87.9
20	91.7	89.2	93.8	89.6	93.1	95.9	91.6	92.2
22	96.4	93.7	98.9	94.1	98.2	100.2	96.7	96.9
25	103.2	100.2	106.3	100.9	105.6	106.9	104	103.2

TEMPERATURE	34	35	39	43	50	50	51	52
2	54.8	55.3	54.1	52.8	53	54.7	53.5	54.7
4	58.1	59.1	58	56.5	56.6	57	56.9	57.2
6	62.7	62.2	61.7	60.2	59.1	60.3	60.6	60.8
8	66.7	66.9	65.7	63.3	63.4	64.1	65.7	65
10	70.8	71.1	69.5	67.6	67.2	68	68.8	68
12	75.1	74.9	73.2	71	71	71.7	70.8	72
14	79.2	79.2	77.4	76	75	75.4	75.3	76.3
16	85.2	83.2	81.9	81.3	80.3	80.7	80.5	82.3
18	89.9	87.5	86.3	85.8	84.2	85.1	84.6	86.4
20	93.8	91.7	90.4	90.6	88.6	89.7	89.3	90.6
22	98.7	96.1	94.7	95.4	93.1	94.4	93.4	95
25	105.4	102.6	102.1	102.1	99.4	101	99.5	101.4
TEMPERATURE	62	68	69	70	70	80	84	84
2	52.8	55.4	55.1	53.9	54.3	53.5	53.7	54
4	56.7	57.9	57.8	57.6	57.5	56.9	57.6	57.7
6	59.8	62	61	60.9	60.7	60.3	61.5	61.9
8	63.8	65.2	65.2	64.8	64.8	64	65.2	65.4
10	67.3	68.2	68.3	68.6	67.8	67.6	69.6	69.3
12	70.1	72.2	71.1	71.6	71.4	71	73.7	73.6
14	75	76.7	75.9	76.4	76.5	75.5	77.8	77.6
16	79.7	81.8	81.6	82.1	81.6	80.9	82.1	81.8
18	84.6	86.6	86	86.5	85.9	85	86.9	86.1
20	88.2	91.3	90.2	90.8	90.1	88.9	91.1	90.7
22	92.6	96	94.7	95.1	94.4	93.5	95.5	95.2
25	98.9	102.5	101.6	101.4	100.6	99.6	103.3	102.5

TEMPERATURE	89	92	95	100	101	101	102	105
2	55.1	54.3	54	54.5	55.6	54.7	54.6	53.2
4	58.9	57.9	58.7	58.4	59.5	57.8	58.4	57.1
6	62.7	61.7	61.9	62	63.3	61.4	62.3	60.5
8	66.5	65.6	65.6	65.3	66.7	64.6	66.2	65.2
10	70.4	69.7	69.8	69.5	69.5	68.6	70.3	68.5
12	74.7	73.7	73.9	73.6	74.8	73.3	74.3	71.9
14	78.6	77.9	78.2	77.6	79.3	77.1	78.7	76.4
16	82.8	82.3	82.4	81.8	83.3	83	82.4	81.9
18	87.2	86.3	87.1	86.2	87.7	87.9	87	86.1
20	91.4	90.5	91.4	90.3	92.1	92.6	91.1	90.8
22	95.8	94.7	95.7	94.4	96.2	97.3	95.3	95.6
25	102.7	101.6	103.7	101.1	102.7	103.8	101.8	102.3
TEMPERATURE	106	113	121	125	127	127	130	133
2	55.8	53.3	53.7	53.2	54.7	55.8	54.4	53.5
4	59.4	56.8	56.9	57	58.5	59.3	57.7	57.3
6	63.2	60.6	60.3	60.6	62.2	63.3	61.7	62.6
8	66.8	63.5	63.7	63.8	65.5	66.9	65.1	64.4
10	71	67.4	67.4	68.3	71	71.7	69.1	67.6
12	74.8	70.4	70.3	70.8	73.5	74.8	72.9	72.3
14	79.1	75.2	75.2	75.6	77.4	79	77.1	75.8
16	83.2	81.1	80	81.6	81.5	82.9	81.3	80.2
18	87.7	84.8	84.3	85.9	86	87.4	85.3	84.5
20	92.4	89	88.4	90.3	90.4	91.5	89.5	88.7
22	96	93.5	93.1	95.2	94.5	95.6	93.8	93.1
25	102.5	99.7	99.5	101.5	100.7	102.3	100.1	99.2

TEMPERATURE	135	136	137	137	138	139	140	149
2	54	54	54.3	54.3	55.6	56.9	55.6	53.1
4	57.6	56.7	57.4	58.5	59.2	60.2	58.9	57.6
6	61.6	62.3	61.3	62.2	62.9	64	63.1	60.4
8	64.5	64.8	65.5	66.7	65.6	68.4	66.5	63.6
10	68.1	68.2	68.9	69.8	70.3	71.6	70.4	67.8
12	71.4	71.5	73.1	72.9	75.5	75.3	74.1	71.8
14	75.7	76.2	77.6	77.5	79.1	79.6	78.3	79.9
16	81.2	81.7	83.1	83	84.4	85.3	82.7	81.3
18	85.8	85.6	87.9	87.1	88.7	89.6	86.8	85.7
20	90.2	90.3	91.9	91.4	93	94.3	91.1	90.1
22	94.5	94.5	96.6	96	97.7	99	95.6	94.8
25	101.3	101.1	103.4	102.4	104.1	105.5	102.1	101.2
TEMPERATURE	152	155	155	157	164	164	165	169
2	54.6	53.4	53.6	53.6	52.7	54.4	54.4	54.5
4	60.2	57.1	57.2	57.9	56.9	56.7	57.6	57.4
6	63.2	61.2	60.9	61.2	59.8	60.2	61.3	60.8
8	68.2	64.3	64	65.1	64.2	64	65.3	64.3
10	72.2	68.2	68.2	69.4	68.2	68.4	68.4	68.4
12	75.7	71.7	71.8	72.3	71	70.3	73.3	72.6
14	81.2	76.3	75.6	77.4	76.3	75.2	77.2	76.1
16	88.4	81.7	80.8	82.7	81.7	81	82.4	81.7
18	93.3	85.9	88.8	87.2	86.9	84.9	87.2	86.3
20	97.8	90.4	94.5	91.8	91.5	89.1	91.4	90.7
22	102.7	95.3	97.9	96.5	96.6	93.6	96.1	95.2
25	110	102.1	107.3	103.5	103.2	100.2	102.6	101.6

TEMPERATURE	171	177	180	180	185	187	189	192
2	53.6	53.3	58.2	53.6	56.4	53.5	52.6	54.3
4	59.4	58.5	63.2	57.6	58.7	57.2	56.8	57.6
6	62.8	62	66.5	61.4	62.4	61.6	59.7	61.2
8	68.6	66.9	70.7	64.9	66.1	64.4	63.8	65.1
10	70.8	70.2	75	69.1	69.5	68	68.1	68.7
12	74.7	74.1	78.9	72.5	73.3	71.6	70.8	71.6
14	79.3	78.5	83.6	76.6	78.2	76.4	75.1	76.5
16	85.9	85.3	91.9	82.9	84.5	81.8	80.1	81.5
18	90.9	90.1	96.8	87.2	90.1	86.7	84.5	85.6
20	95.6	95.1	101.5	91.6	95.1	91.1	88.9	90.1
22	100.9	100.6	106.6	96.3	100.2	95.7	94.7	95.3
25	109.6	108.1	116.4	102.9	107.3	102	99.9	101.4
TEMPERATURE	193	193	196	198	201	201	203	205
2	55.9	54.8	53.2	52.9	53.3	53.6	53.3	54.6
4	59.5	59.1	57.1	56.8	57.6	57.1	57	57.7
6	62.7	63.4	60.5	60.4	61.1	60.9	60.5	60.8
8	67.6	68.2	64.3	64.6	65.1	64.3	65.7	65.4
10	71.7	72	68.2	67.6	68.9	68.4	69.8	69.2
12	75	75.2	72	71.7	72.2	73.5	73.4	72.9
14	80.5	80.6	76.5	76.4	78	77.3	77.3	77.4
16	86.8	85.6	82	81.9	83.9	82.5	82.6	82.9
18	92.4	90	86.9	86.8	89.2	88	87.2	87
20	97.2	94.5	91.5	91.7	93.5	92.7	91.1	91.3
22	102.6	99.3	96.2	96.8	98.5	97.7	95.7	95.9
25	109.5	109.7	102.8	103.3	105.6	104.9	102.2	102.7

TEMPERATURE

	207	211	212	216	218	220	221	221
2	53.1	53.2	53.8	66.5	54.6	54.2	56.2	55
4	57.2	57.4	57.9	71.2	58.1	58.4	60.7	59.3
6	60.9	61.4	61.3	75.9	61.3	62	64.9	62.8
8	64.6	64.8	64.8	80.6	65.5	65.4	68.8	66.6
10	68.4	68.8	68.9	86.3	69.8	69.4	73	70.6
12	71.7	72.2	71.7	89.8	73.6	72.5	76.5	74.7
14	76.8	76.9	76.9	95.5	77.8	77	81	78.7
16	82.2	81.5	81.7	102	84.1	81.9	88	84.7
18	86.9	86	86.2	107.3	88.4	86.3	93.2	89.1
20	91.3	90.2	90.6	112.2	92.9	90.6	98	93.6
22	96	95	95.4	117.7	98	95.8	102.9	98.5
25	102.8	101.5	102.2	125.4	105.1	102.3	109.8	105.3

TEMPERATURE

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Appendix 1.4
Raw Conductivity for Georgian Bay

TEMPERATURE	1	3	3	4	5	6	8	11
2	108.7	108.5	108.5	108.5	108.9	109.3	106.2	108.5
4	115.1	115.1	115.4	115.3	115.9	115.8	112.3	114.7
6	121.6	122.5	122.4	122.4	122.4	122	122	121.7
8	131	131	129.6	131	129.4	131	126.2	129
10	137	137	136	137	136	137	133	136
12	143	143	144	143	143	144	139	143
14	151	151	151	150	150	152	146	150
16	158	159	159	158	158	160	154	157
18	165	166	166	166	166	167	162	164
20	173	175	173	174	174	174	169	172
22	180	183	180	181	182	181	175	180
25	191	194	191	192	193	192	188	191
TEMPERATURE	12	15	15	16	17	19	19	21
2	108.9	107.4	108.1	105.9	106.9	108.5	108.3	107.1
4	115.1	113.6	114.6	111.5	113.5	115.2	115.1	113.4
6	121.9	120	121	118.6	119.4	121.9	121.9	120.1
8	128.8	128.1	128.1	126.9	127.7	128.9	128.4	127.2
10	136	134	136	134	134	136	136	134
12	143	141	143	139	143	143	144	140
14	151	149	150	145	149	149	150	147
16	158	156	157	154	156	157	158	155
18	165	164	165	161	163	164	165	162
20	173	171	172	169	171	169	173	170
22	180	179	180	175	178	176	180	178
25	191	191	192	188	190	188	193	189

TEMPERATURE

	21	24	26	27	27	29	33	35
2	104.7	94.1	93.4	93.1	107.3	108.5	107.4	107.6
4	111.4	99	98.9	98.4	114	115.9	115.3	113.4
6	118.2	105.4	105	104.7	119	122.3	122.1	121.2
8	125	111.5	111.8	110.7	127.7	131	129	128.5
10	132	116.2	116.9	116.6	134	137	136	136
12	138	121.3	122.8	122.2	142	143	143	144
14	146	129.5	128.7	128.5	148	151	150	151
16	153	135	133	133	156	159	157	158
18	160	143	144	143	161	166	165	167
20	167	149	150	149	172	174	175	175
22	175	156	157	156	180	182	182	183
25	187	167	168	166	193	195	195	196

TEMPERATURE

	39	42
2	106.9	108.4
4	113.6	114.1
6	121.2	121.3
8	128.5	128.2
10	136	136
12	144	144
14	151	151
16	159	151
18	167	167
20	175	175
22	183	183
25	196	195

Appendix 2.1
Temperature Coefficients for Lake Ontario

	1	2	3	5	6	7	8	9
TEMPERATURE								
2	1.86	1.93	1.91	1.92	1.94	1.95	1.91	1.93
4	1.89	2.02	1.92	1.98	2.02	1.99	1.90	1.97
6	1.90	2.00	1.94	1.98	2.09	1.99	1.90	2.01
8	1.92	2.02	1.94	2.02	2.07	2.03	1.87	2.03
10	1.88	2.04	1.97	2.03	2.10	2.03	1.91	2.05
12	1.94	2.01	2.01	2.06	2.17	2.09	1.87	2.03
14	1.89	2.06	1.99	2.07	2.15	2.11	1.90	2.09
16	1.86	2.08	1.95	2.03	2.15	2.03	1.80	2.04
18	1.82	2.10	1.98	2.04	2.12	2.00	1.69	2.04
20	1.80	2.09	2.03	2.01	2.12	2.01	2.06	2.05
22	1.97	2.04	2.05	2.03	2.02	2.03	1.91	2.07
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.88	2.04	1.97	2.01	2.09	2.02	1.88	2.03
	10	11	12	12	13	14	15	16
TEMPERATURE								
2	1.96	1.92	1.94	1.91	1.91	1.91	1.94	1.90
4	1.97	1.95	1.95	1.95	1.92	1.93	1.94	1.90
6	1.95	2.01	1.97	1.95	1.96	1.93	1.96	1.94
8	2.00	2.05	1.97	1.98	2.00	1.94	1.99	1.99
10	2.02	2.04	2.00	1.99	1.96	1.94	1.99	1.96
12	2.07	2.04	2.00	1.98	2.01	1.98	2.00	1.98
14	2.05	2.08	2.05	2.00	1.98	1.99	2.05	2.00
16	2.02	2.09	2.05	2.10	2.00	2.16	1.99	2.00
18	2.03	2.07	2.05	2.02	1.94	2.02	2.02	1.95
20	2.04	2.04	2.06	2.01	1.96	2.01	2.01	1.92
22	2.06	2.06	2.08	1.99	2.10	2.19	1.99	2.06
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.01	2.03	2.01	1.99	1.98	2.00	1.99	1.96

TEMPERATURE	17	18	19	20	21	22	23	24
2	1.92	1.91	1.91	1.90	1.93	1.94	1.91	1.89
4	1.92	1.91	1.93	1.93	1.93	1.91	1.91	1.90
6	1.96	1.94	1.96	1.96	1.93	1.93	1.91	1.92
8	1.95	1.99	2.01	1.96	1.95	1.95	1.95	1.92
10	1.98	2.02	2.01	1.99	1.98	1.96	1.95	1.95
12	2.02	2.01	2.03	2.00	2.00	1.97	1.94	1.95
14	2.02	2.01	2.05	2.05	1.98	1.96	1.94	1.93
16	2.05	2.07	2.09	1.97	2.00	2.00	1.98	1.98
18	2.05	2.12	2.02	1.98	1.98	1.99	1.87	1.95
20	2.00	2.02	2.07	2.01	2.01	1.96	1.97	1.97
22	1.98	2.00	2.09	1.97	1.96	2.00	1.91	1.90
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.99	2.00	2.01	1.98	1.97	1.96	1.93	1.93
TEMPERATURE	25	26	27	28	29	30	31	32
2	1.93	1.94	1.95	1.96	1.94	1.97	1.92	1.90
4	1.91	1.94	1.99	1.98	1.98	1.95	1.96	1.90
6	1.94	1.98	2.00	2.00	1.97	1.98	1.97	1.94
8	1.95	2.02	2.02	2.02	2.00	2.01	2.02	1.94
10	1.96	2.06	2.04	2.02	2.02	2.05	1.99	1.95
12	1.99	2.13	2.10	2.07	2.07	2.06	2.01	2.05
14	1.98	2.07	2.08	2.05	2.05	2.10	2.07	1.96
16	2.03	2.04	2.03	2.06	2.05	2.05	2.04	2.05
18	1.98	2.05	2.03	2.03	2.05	2.11	2.00	1.86
20	2.02	2.06	2.04	2.10	2.06	2.03	1.81	1.97
22	2.10	2.08	2.06	2.06	2.08	2.05	1.97	2.01
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.98	2.03	2.03	2.03	2.03	2.03	1.98	1.96

TEMPERATURE	33	34	35	36	37	38	39	40
2	1.90	1.89	1.90	1.88	1.93	1.90	1.93	1.93
4	1.90	1.92	1.93	1.92	1.93	1.89	1.96	1.96
6	1.94	1.95	1.95	1.95	1.93	1.92	1.99	1.95
8	1.94	1.95	1.96	1.96	1.97	1.94	2.02	1.98
10	1.95	2.01	1.95	2.00	1.97	1.93	2.00	1.99
12	2.00	2.03	1.98	2.01	1.95	1.93	2.02	2.01
14	1.99	1.99	1.99	2.01	1.99	1.96	1.99	2.00
16	2.05	2.02	2.05	2.02	2.00	2.01	2.08	2.03
18	2.04	2.05	2.09	2.03	2.02	2.04	2.14	2.02
20	1.97	2.05	2.03	2.11	2.12	1.97	2.19	2.14
22	2.01	2.17	2.01	1.98	1.93	2.01	1.98	1.89
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.97	2.00	1.99	1.99	1.98	1.96	2.03	1.99
TEMPERATURE	41	42	43	44	45	46	47	48
2	1.92	1.92	1.93	1.92	1.93	1.94	1.92	1.95
4	1.97	1.97	1.96	1.94	1.92	1.98	1.95	1.98
6	2.00	1.97	1.96	1.98	1.98	2.01	1.99	2.01
8	2.00	1.98	1.99	2.00	1.97	2.03	2.00	2.03
10	2.04	2.01	2.00	2.02	2.03	2.03	2.02	2.08
12	2.08	2.06	2.04	2.04	2.05	2.08	2.07	2.09
14	2.10	2.10	2.05	2.08	2.09	2.12	2.07	2.10
16	2.08	2.08	2.05	2.02	2.04	2.04	2.08	2.06
18	2.09	2.09	2.14	2.03	2.04	2.04	2.10	2.07
20	2.12	2.12	2.13	2.04	2.05	2.05	2.13	2.10
22	2.08	2.18	2.08	2.06	2.07	2.07	2.08	2.06
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.04	2.04	2.03	2.01	2.02	2.04	2.04	2.05

TEMPERATURE	49	52	53	54	55	56	57	58
2	1.94	1.93	1.92	1.88	1.92	1.91	1.94	1.94
4	1.93	1.95	1.90	1.92	1.94	1.96	1.95	1.93
6	1.95	1.98	1.90	1.93	1.91	1.94	1.95	1.93
8	1.96	1.99	1.90	1.95	1.95	1.97	1.96	1.97
10	1.97	1.96	1.90	1.96	1.99	2.03	2.01	1.96
12	2.01	2.01	1.93	1.97	1.98	2.02	2.01	1.98
14	2.00	1.98	1.88	2.01	1.97	2.08	2.00	2.05
16	1.99	2.00	1.87	2.07	1.99	2.02	2.03	2.02
18	2.02	1.98	2.04	1.98	2.10	2.08	2.07	1.97
20	2.14	1.96	1.90	2.02	2.19	2.07	2.14	2.07
22	2.41	2.10	2.01	2.31	1.99	2.14	2.41	2.30
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.03	1.99	1.92	2.00	1.99	2.02	2.04	2.01
TEMPERATURE	59	60	61	62	63	64	65	66
2	1.87	1.95	1.95	1.97	1.93	1.91	1.91	1.94
4	1.93	1.99	1.96	2.01	1.91	1.92	1.92	1.93
6	1.93	2.04	2.00	1.99	1.92	1.93	1.94	1.95
8	1.97	1.99	2.00	2.00	1.95	1.97	1.95	1.98
10	1.98	1.97	2.04	2.06	1.96	1.96	1.98	1.99
12	2.00	2.06	2.10	2.05	2.02	1.99	2.01	1.98
14	2.01	2.13	2.14	2.05	1.99	1.95	1.98	1.97
16	1.97	2.09	2.06	2.03	2.04	1.96	1.96	1.96
18	2.03	2.07	2.08	2.03	2.08	1.98	1.98	1.98
20	2.03	2.09	2.11	2.04	2.03	2.08	2.02	2.14
22	1.79	2.05	2.06	2.06	1.79	1.89	2.10	1.89
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.96	2.04	2.05	2.03	1.97	1.96	1.98	1.97

	67	68	69	70	71	72	73	74
TEMPERATURE								
2	1.92	1.86	1.93	1.92	1.95	1.91	1.87	1.90
4	1.93	1.90	1.88	1.91	1.93	1.92	1.91	1.91
6	1.92	1.93	1.92	1.92	1.93	1.91	1.89	1.91
8	1.94	1.94	1.94	1.94	1.97	1.95	1.93	1.92
10	1.93	1.94	1.94	1.95	1.99	1.96	1.95	1.92
12	1.98	1.97	1.97	1.97	2.00	2.00	1.94	1.95
14	1.96	1.93	1.93	1.93	2.08	2.03	1.91	1.98
16	1.90	1.90	1.93	1.97	2.09	2.03	1.91	1.99
18	1.95	1.94	1.94	1.87	2.02	2.03	1.96	2.01
20	2.03	2.03	2.03	1.93	2.07	1.98	1.97	2.12
22	1.69	1.90	2.11	1.97	2.09	1.96	2.02	1.92
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.92	1.93	1.96	1.94	2.01	1.97	1.93	1.96
	75	76	77	78	79	80	81	82
TEMPERATURE								
2	1.97	1.92	1.91	1.88	1.93	1.89	1.99	1.96
4	1.98	1.90	1.90	1.91	1.92	1.92	2.03	2.00
6	2.02	1.91	1.94	1.92	1.98	1.93	2.00	2.04
8	2.05	1.93	1.94	1.89	1.99	1.95	2.02	2.04
10	2.07	1.95	1.98	1.92	1.99	1.96	2.04	2.07
12	2.19	1.96	1.96	1.92	2.01	1.99	2.08	2.06
14	2.19	1.97	1.99	1.98	2.07	1.98	2.12	2.11
16	2.10	1.95	2.01	1.99	2.15	1.96	2.08	2.10
18	2.17	2.00	2.07	2.01	2.07	2.03	2.10	2.09
20	2.46	1.97	2.19	2.18	2.03	2.15	2.09	2.13
22	2.51	2.02	1.83	2.14	2.05	2.00	2.04	2.13
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.15	1.95	1.97	1.98	2.02	1.98	2.05	2.07

TEMPERATURE	83	84	85	86	87	88	89	91
2	1.93	1.94	1.94	1.88	1.93	1.91	1.94	1.95
4	1.95	1.95	1.95	1.91	1.91	1.92	1.97	1.94
6	1.96	1.99	1.98	1.94	1.89	1.93	1.98	1.95
8	1.99	2.03	1.98	1.95	1.95	1.97	1.99	1.98
10	2.07	2.05	2.03	2.00	1.96	1.97	2.05	1.97
12	2.05	2.05	2.06	2.01	1.99	2.01	2.03	1.99
14	2.09	2.06	1.99	2.03	1.95	2.04	2.06	2.01
16	2.07	2.10	2.09	2.05	2.00	2.09	2.07	2.00
18	2.09	2.09	2.08	2.00	1.98	2.15	2.09	1.99
20	2.11	2.11	2.07	1.97	1.96	2.09	2.05	2.04
22	2.07	2.07	2.13	2.12	2.10	1.95	2.07	1.93
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.04	2.04	2.03	1.99	1.97	2.00	2.03	1.98
TEMPERATURE	92	93	94	95	96	98	100	101
2	1.90	1.86	1.91	1.97	1.90	1.88	1.90	1.93
4	1.92	1.90	1.94	1.97	1.89	1.89	1.89	1.93
6	1.95	1.93	1.97	2.01	1.91	1.88	1.90	1.95
8	1.96	1.95	1.96	2.05	1.94	1.92	1.94	2.00
10	1.95	1.96	1.97	2.05	1.96	1.91	1.97	2.01
12	1.95	1.97	2.01	2.12	2.00	1.96	1.95	2.01
14	1.93	1.93	2.04	2.12	2.03	1.96	1.99	2.03
16	1.90	1.93	2.01	1.80	2.02	1.97	1.98	2.06
18	1.95	1.90	2.00	2.03	2.07	1.94	1.90	2.11
20	1.97	1.96	2.06	2.22	2.07	2.06	2.03	2.08
22	1.90	1.90	1.97	2.23	2.07	2.04	2.22	2.10
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.94	1.93	1.99	2.05	1.99	1.95	1.97	2.02

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TEMPERATURE

2	1.96	1.81
4	1.98	1.88
6	2.01	1.83
8	1.96	1.87
10	2.06	1.89
12	2.04	1.92
14	2.10	1.89
16	2.09	1.87
18	2.07	1.85
20	2.10	1.87
22	2.06	2.21
25	0.00	0.00

AVERAGE 2.04 1.90

TEMPERATURE

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AVERAGE

Appendix 2.2
Temperature Coefficients for Lake Huron

TEMPERATURE	1	3	4	5	5	7	8	8
2	1.92	1.90	1.89	1.88	1.86	1.90	1.90	1.91
4	1.93	1.90	1.89	1.88	1.86	1.90	1.90	1.91
6	1.91	1.89	1.89	1.89	1.86	1.89	1.92	1.92
8	1.94	1.91	1.91	1.90	1.87	1.91	1.94	1.91
10	1.98	1.95	1.95	1.92	1.89	1.94	2.01	1.94
12	1.99	1.99	1.88	1.94	1.90	1.98	2.02	1.94
14	2.00	1.96	1.91	1.96	1.88	1.99	2.03	1.99
16	2.02	1.97	1.97	2.00	1.93	2.00	2.05	2.00
18	2.12	1.91	1.98	2.06	1.95	2.01	2.08	2.01
20	2.11	1.91	2.01	2.09	1.92	2.04	2.04	2.04
22	2.13	2.07	2.07	2.04	1.97	2.10	2.10	2.10
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.00	1.94	1.94	1.96	1.90	1.97	2.00	1.97
TEMPERATURE	9	10	11	12	13	13	14	20
2	1.90	1.88	1.80	1.89	1.91	1.92	1.89	1.94
4	1.91	1.88	1.83	1.89	1.91	1.91	1.89	1.94
6	1.92	1.87	1.81	1.91	1.93	1.86	1.87	1.94
8	1.88	1.83	1.83	1.90	1.96	1.94	1.89	1.97
10	1.91	1.88	1.81	1.90	1.96	1.98	1.92	2.01
12	1.94	1.90	1.87	1.90	1.97	1.97	2.03	2.06
14	1.94	1.93	1.99	1.98	2.02	2.03	2.05	2.00
16	2.00	1.97	2.00	1.99	2.04	2.07	1.98	1.97
18	2.01	1.92	1.94	2.07	2.07	2.06	1.99	1.98
20	2.04	1.99	1.94	2.03	2.03	2.05	1.92	2.01
22	2.10	2.02	1.94	2.09	2.09	2.02	1.92	2.07
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.96	1.91	1.89	1.96	1.99	1.98	1.94	1.99

TEMPERATURE	23	27	29	30	32	33	33	34
2	1.94	1.93	1.92	1.85	1.89	1.90	1.90	1.92
4	1.95	1.92	1.95	1.86	1.89	1.92	1.91	1.93
6	1.94	1.92	1.90	1.84	1.90	1.94	1.92	1.93
8	1.97	1.94	1.92	1.86	1.88	1.94	1.94	1.92
10	1.98	2.01	1.98	1.91	1.94	2.01	1.97	1.98
12	2.00	2.02	2.03	1.94	1.97	1.94	1.98	1.91
14	2.06	2.03	2.00	1.94	1.93	1.99	1.99	1.95
16	2.10	2.05	2.06	1.94	1.97	2.05	2.05	2.01
18	2.09	2.08	2.09	1.94	1.97	2.08	2.08	2.02
20	2.17	2.14	2.15	1.94	1.97	2.04	2.14	1.95
22	2.20	2.10	2.11	2.10	1.97	2.10	2.10	1.95
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.03	2.01	2.01	1.92	1.93	1.99	2.00	1.95
TEMPERATURE	36	38	39	39	39	39	40	41
2	1.90	1.92	1.92	1.90	1.92	1.91	1.89	1.92
4	1.91	1.91	1.92	1.90	1.90	1.93	1.89	1.93
6	1.91	1.90	1.91	1.86	1.89	1.92	1.87	1.95
8	1.94	1.92	1.94	1.91	1.91	1.95	1.90	1.95
10	1.96	1.98	1.95	1.95	1.95	1.99	1.93	1.99
12	1.97	1.99	1.99	1.99	1.99	2.01	1.93	2.04
14	2.03	2.00	2.00	2.00	2.04	2.02	1.94	2.07
16	2.11	2.01	2.02	2.02	2.02	2.05	1.95	2.11
18	2.07	2.02	2.05	2.05	1.98	2.10	2.10	2.10
20	2.07	2.05	2.11	2.11	2.01	2.18	2.18	2.18
22	2.20	1.95	2.07	2.07	2.07	2.21	2.21	2.21
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.01	1.97	1.99	1.98	1.97	2.02	1.98	2.04

	42	42	43	44	47	48	50	52
TEMPERATURE								
2	1.94	1.92	1.90	1.92	1.94	1.93	1.94	1.94
4	1.95	1.94	1.91	1.94	1.96	1.94	1.93	1.96
6	1.94	1.95	1.90	1.93	1.93	1.92	1.87	1.98
8	1.97	1.95	1.92	1.95	1.93	1.95	1.92	2.02
10	2.01	1.99	1.98	1.95	2.00	1.99	1.99	2.06
12	2.06	2.03	1.99	1.99	2.04	2.03	2.00	2.05
14	2.09	2.05	2.00	2.00	2.11	2.05	2.01	2.12
16	2.13	2.03	2.01	2.06	2.09	2.08	2.08	2.17
18	2.05	2.06	1.95	2.02	2.07	2.06	2.06	2.24
20	2.11	2.12	1.95	1.85	2.13	2.12	2.02	2.29
22	2.07	2.08	1.95	2.11	2.09	2.08	1.92	2.06
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.03	2.01	1.95	1.97	2.03	2.01	1.98	2.08
	52	54	54	55	56	58	59	60
TEMPERATURE								
2	1.95	1.92	1.91	1.90	1.91	1.92	1.94	1.92
4	1.94	1.97	1.98	1.90	1.96	1.95	1.95	1.95
6	1.98	1.97	1.97	1.92	1.93	1.97	1.99	1.95
8	1.98	1.94	1.91	1.93	1.89	2.01	1.98	1.98
10	2.05	2.00	1.97	1.96	1.95	1.98	2.02	2.02
12	2.03	2.08	2.05	1.99	1.99	1.99	2.07	2.13
14	2.05	2.19	2.10	2.08	2.00	2.02	2.10	2.11
16	2.08	2.08	2.08	1.99	2.01	2.06	2.14	2.07
18	2.13	2.11	2.11	1.99	2.09	2.12	2.13	2.10
20	2.12	2.07	2.17	1.99	2.15	2.12	2.12	2.15
22	2.08	2.13	2.13	1.99	2.11	2.12	2.24	2.26
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.04	2.04	2.04	1.97	2.00	2.02	2.06	2.06

	60	61	62	63	64	64	65	66
TEMPERATURE								
2	1.91	1.92	1.94	1.92	1.87	1.90	1.95	1.92
4	1.94	1.93	1.95	1.93	1.88	1.92	1.98	1.84
6	1.92	1.91	1.94	1.94	1.90	1.92	1.96	1.94
8	1.97	1.98	1.99	1.93	1.90	1.95	1.97	1.96
10	2.01	2.01	1.93	1.96	1.93	1.96	2.04	2.02
12	2.00	2.09	2.04	1.98	1.96	2.00	2.10	2.03
14	2.05	2.06	2.01	2.02	2.01	2.02	2.06	2.04
16	2.07	2.07	2.02	2.07	2.03	2.01	2.15	2.05
18	2.26	2.08	2.03	2.10	1.88	2.04	2.16	2.13
20	2.26	2.21	2.06	2.13	2.04	2.10	2.26	2.19
22	2.26	2.18	2.12	2.22	2.13	2.10	2.36	2.16
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.06	2.04	2.00	2.02	1.96	1.99	2.09	2.02
	67	68	69	70	71	73	76	77
TEMPERATURE								
2	1.98	1.98	2.01	1.95	1.95	1.93	1.92	1.92
4	1.99	2.00	2.06	1.99	1.97	1.97	1.96	1.93
6	1.95	2.04	2.09	2.02	1.97	2.00	1.94	1.94
8	2.03	2.07	2.15	2.06	2.00	2.03	1.99	2.02
10	2.06	2.08	2.21	2.06	2.04	2.04	2.02	1.99
12	2.08	2.11	2.17	2.09	2.01	2.07	2.03	2.00
14	2.12	2.13	2.22	2.11	2.01	2.08	2.09	2.06
16	2.14	2.11	2.26	2.12	2.05	2.16	2.11	2.09
18	2.04	2.14	2.33	2.16	2.12	2.17	1.97	2.05
20	2.13	2.12	2.30	2.16	2.17	2.15	1.95	1.99
22	2.39	2.12	2.26	2.30	2.17	2.11	2.11	2.03
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.08	2.08	2.19	2.09	2.04	2.07	2.01	2.00

TEMPERATURE	79	82	83	84	84	87	88	89
2	1.99	1.98	1.95	1.95	1.96	1.97	2.01	1.98
4	2.03	2.02	2.00	1.99	2.00	1.99	2.00	2.00
6	2.08	2.05	2.00	2.02	1.99	2.02	2.02	2.03
8	2.13	2.09	2.04	2.03	2.05	2.04	2.05	2.04
10	2.12	2.11	2.05	2.04	2.08	2.08	2.09	2.07
12	2.17	2.14	2.07	2.06	2.10	2.07	2.06	2.08
14	2.18	2.12	2.09	2.03	2.15	2.09	2.08	2.11
16	2.18	2.28	2.18	2.03	2.09	2.06	2.05	2.09
18	2.28	2.14	2.01	2.02	2.10	2.09	2.08	2.13
20	2.09	1.67	2.13	2.00	2.12	2.13	2.12	2.21
22	2.25	1.85	2.06	1.96	1.96	2.06	2.05	2.03
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.14	2.04	2.05	2.01	2.06	2.06	2.06	2.07
TEMPERATURE	94	94	95	96	97	98	98	99
2	1.92	1.91	1.91	1.92	1.89	1.89	1.87	1.88
4	1.90	1.90	1.91	1.92	1.87	1.88	1.87	1.88
6	1.89	1.90	1.89	1.90	1.84	1.90	1.88	1.89
8	1.92	1.91	1.91	1.93	1.87	1.91	1.88	1.92
10	1.90	1.91	1.95	1.97	1.90	1.92	1.91	1.94
12	1.94	1.95	2.00	1.98	1.91	1.94	1.95	1.95
14	2.00	1.96	1.97	1.99	1.91	1.96	1.94	1.93
16	2.02	2.03	1.99	2.01	1.92	1.99	1.96	1.98
18	2.07	2.08	2.02	2.04	1.94	1.92	1.99	1.95
20	2.15	2.07	2.08	2.10	1.96	1.95	2.05	2.05
22	2.02	2.03	2.20	2.22	2.18	2.03	2.19	2.02
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	1.98	1.97	1.98	2.00	1.93	1.94	1.95	1.94

100 101

TEMPERATURE

2	1.89	1.85
4	1.89	1.84
6	1.89	1.85
8	1.92	1.86
10	1.94	1.89
12	1.95	1.90
14	2.00	1.96
16	2.02	2.03
18	2.00	2.10
20	2.05	2.15
22	2.15	2.39
25	0.00	0.00

AVERAGE 1.97 1.98

TEMPERATURE

2
4
6
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14
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18
20
22
25

AVERAGE

Appendix 2.3
Temperature Coefficients for Lake Superior

TEMPERATURE	1	2	3	6	8	8	11	12
2	2.12	2.10	2.00	2.06	2.07	2.12	2.00	2.03
4	2.14	2.13	2.03	2.05	2.09	2.16	2.03	2.04
6	2.18	2.14	2.05	2.12	2.11	2.15	2.03	2.08
8	2.21	2.17	2.04	2.13	2.13	2.18	2.07	2.11
10	2.19	2.14	2.07	2.13	2.12	2.17	2.11	2.12
12	2.19	2.14	2.08	2.16	2.13	2.22	2.12	2.14
14	2.21	2.12	2.09	2.17	2.15	2.21	2.16	2.18
16	2.24	2.18	2.11	2.19	2.20	2.25	2.18	2.24
18	2.22	2.15	1.94	2.22	2.21	2.24	2.15	2.24
20	2.30	2.10	1.88	2.16	2.22	2.32	2.27	2.31
22	2.32	2.07	1.87	2.03	2.20	2.30	2.19	2.37
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.21	2.13	2.01	2.13	2.15	2.21	2.12	2.17
TEMPERATURE	17	22	23	25	28	30	30	31
2	2.09	1.98	2.17	2.02	2.11	2.04	2.05	2.01
4	2.11	2.03	2.19	2.04	2.12	2.07	2.07	2.04
6	2.23	2.02	2.28	2.04	2.13	2.06	2.09	2.08
8	2.22	2.07	2.32	2.08	2.15	2.10	2.14	2.07
10	2.27	2.07	2.43	2.11	2.17	2.08	2.13	2.09
12	2.29	2.10	2.51	2.13	2.16	2.08	2.18	2.12
14	2.33	2.12	2.41	2.17	2.22	2.08	2.22	2.10
16	2.29	2.15	2.26	2.17	2.25	2.11	2.29	2.11
18	2.33	2.18	2.30	2.21	2.25	2.07	2.29	2.12
20	2.23	2.20	2.35	2.24	2.37	2.06	2.38	2.13
22	2.20	2.16	2.32	2.25	2.34	2.09	2.34	2.03
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.23	2.10	2.32	2.13	2.21	2.08	2.20	2.08

TEMPERATURE	34	35	39	43	50	50	51	52
2	2.09	2.00	2.04	2.10	2.03	1.99	2.01	2.00
4	2.14	2.02	2.06	2.13	2.05	2.07	2.04	2.08
6	2.13	2.07	2.08	2.16	2.13	2.12	2.06	2.11
8	2.16	2.05	2.10	2.24	2.13	2.15	2.00	2.11
10	2.19	2.05	2.13	2.25	2.16	2.18	2.06	2.20
12	2.21	2.08	2.18	2.34	2.20	2.23	2.22	2.23
14	2.26	2.07	2.20	2.32	2.23	2.30	2.21	2.25
16	2.13	2.10	2.20	2.26	2.14	2.23	2.12	2.09
18	2.10	2.10	2.21	2.28	2.18	2.25	2.14	2.11
20	2.20	2.12	2.29	2.25	2.17	2.24	2.05	2.13
22	2.12	2.11	2.42	2.19	2.11	2.18	2.04	2.10
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.16	2.07	2.17	2.23	2.14	2.18	2.09	2.13
TEMPERATURE	62	68	69	70	70	80	84	84
2	2.03	2.00	1.99	2.04	2.00	2.01	2.09	2.06
4	2.03	2.07	2.05	2.06	2.04	2.04	2.11	2.08
6	2.08	2.08	2.10	2.10	2.09	2.08	2.13	2.08
8	2.09	2.14	2.11	2.12	2.09	2.10	2.17	2.13
10	2.13	2.23	2.19	2.16	2.17	2.14	2.17	2.16
12	2.24	2.27	2.31	2.26	2.23	2.21	2.20	2.17
14	2.20	2.29	2.30	2.24	2.18	2.20	2.24	2.21
16	2.16	2.24	2.19	2.11	2.10	2.09	2.28	2.24
18	2.07	2.22	2.19	2.10	2.09	2.09	2.27	2.29
20	2.16	2.19	2.24	2.09	2.09	2.15	2.36	2.30
22	2.12	2.11	2.26	2.07	2.05	2.04	2.52	2.37
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.12	2.17	2.18	2.12	2.10	2.10	2.23	2.19

Appendix 2.4
Temperature Coefficients for Georgian Bay

	1	3	3	4	5	6	8	11
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TEMPERATURE

2	1.87	1.92	1.88	1.89	1.89	1.87	1.89	1.88
4	1.89	1.94	1.88	1.90	1.90	1.89	1.92	1.90
6	1.91	1.94	1.89	1.91	1.93	1.92	1.85	1.91
8	1.85	1.91	1.89	1.87	1.94	1.87	1.93	1.91
10	1.88	1.96	1.92	1.91	1.97	1.91	1.95	1.92
12	1.93	2.02	1.89	1.96	1.99	1.92	2.00	1.93
14	1.90	2.01	1.90	1.99	2.03	1.89	2.03	1.95
16	1.92	2.00	1.86	1.97	2.01	1.85	2.01	1.98
18	1.94	2.06	1.87	1.93	2.00	1.86	1.98	2.02
20	1.88	1.96	1.88	1.88	1.97	1.88	2.02	1.99
22	1.92	1.89	1.92	1.91	1.90	1.91	2.30	1.92
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AVERAGE	1.90	1.96	1.89	1.92	1.96	1.89	1.99	1.94
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	12	15	15	16	17	19	19	21
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TEMPERATURE

2	1.87	1.90	1.90	1.90	1.90	1.84	1.91	1.88
4	1.89	1.93	1.92	1.94	1.92	1.84	1.92	1.90
6	1.90	1.96	1.95	1.94	1.96	1.85	1.94	1.92
8	1.92	1.94	1.96	1.91	1.93	1.85	1.97	1.92
10	1.92	1.99	1.94	1.91	1.96	1.84	1.97	1.94
12	1.93	2.01	1.96	2.00	1.90	1.84	1.95	1.99
14	1.90	2.00	1.99	2.08	1.96	1.89	2.03	2.02
16	1.92	2.04	2.03	2.01	1.99	1.83	2.01	2.00
18	1.94	2.02	2.01	2.05	2.03	1.82	2.07	2.04
20	1.88	2.09	2.08	2.02	2.00	2.02	2.07	2.01
22	1.92	2.09	2.08	2.30	2.11	2.13	2.25	1.94
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AVERAGE	1.91	2.00	1.98	2.01	1.97	1.89	2.01	1.96
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	21	24	26	27	27	29	33	35
TEMPERATURE								
2	1.91	1.90	1.93	1.91	1.93	1.93	1.95	1.96
4	1.93	1.94	1.96	1.94	1.95	1.93	1.95	2.01
6	1.94	1.94	1.97	1.94	2.02	1.96	1.97	2.01
8	1.95	1.95	1.97	1.96	1.99	1.93	1.99	2.03
10	1.96	2.03	2.03	1.98	2.04	1.98	2.02	2.04
12	2.02	2.11	2.07	2.03	2.03	2.05	2.05	2.04
14	1.99	2.04	2.13	2.05	2.12	2.05	2.10	2.09
16	2.02	2.13	2.31	2.21	2.13	2.05	2.17	2.15
18	2.06	2.05	2.04	1.98	2.37	2.12	2.20	2.11
20	2.14	2.16	2.14	2.05	2.18	2.15	2.05	2.14
22	2.14	2.20	2.18	2.01	2.25	2.22	2.22	2.21
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVERAGE	2.01	2.04	2.07	2.01	2.09	2.04	2.06	2.07
	39	42						
TEMPERATURE								
2	1.98	1.93						
4	2.00	1.98						
6	2.01	1.99						
8	2.03	2.02						
10	2.04	2.02						
12	2.04	2.01						
14	2.09	2.05						
16	2.10	2.51						
18	2.11	2.05						
20	2.14	2.05						
22	2.21	2.05						
25	0.00	0.00						
AVERAGE	2.07	2.06						

Appendix 3.1

CDM83 OPERATING INSTRUCTIONS

1. Plug in electrical cord. "AUTO RANGE" will be displayed, then a number will show up on the screen.
2. Check that the proper conductivity cell is connected (CDC104, CDC304). Connect the T108 temperature sensor if needed.
3. Press AUTORANGE
4. To calibrate the meter obtain a standard solution of known conductivity at a given temperature (follow the chart of NaCl solutions on pg. 19 of the operating manual).
5. Dip the conductivity cell in the solution. Repeat this to make sure all bubbles are out of the cell or incorrect calibration will result.
6. Find the correction factor on the conductivity cell (ie. +4.0% or -1.0%) and adjust the cell constant (CELL CONST.) until the conductivity reading corresponds with the correct standard value. Your meter is now calibrated.
7. If the temperature sensor is not used set the temperature coefficient (T.C.%) to 0.00, and set the adjusted temperature (t) to 0.00. Raw conductivity will be measured.
8. If the temperature sensor is used set the T.C.% to the desired value and adjust the reference temperature (tREF) to the appropriate value (usually 25°C).
9. When testing conductivity samples with the temperature sensor immerse both the sensor and the conductivity probe in the solution. Conductivity will automatically be measured at the reference temperature.
10. *When testing samples at very low temperatures (below 6°C) the readout will flash because the difference between the sample and reference temperatures is too great and the measurements will be less accurate. This is not a problem, continue measuring with the meter.