

# Gimli Storm Water Quality Assessment 2008 Report

Produced by the East Interlake Conservation District in  
partnership with the Rural Municipality of Gimli





## Executive Summary

The East Interlake Conservation District partnered with the Rural Municipality of Gimli to conduct an assessment of the Gimli's urban storm water drains. The purpose of the project was to investigate the quality of storm water from an urban environment (Gimli) and determine what, if any, pollutants are entering Lake Winnipeg. With an understanding of what is currently entering Lake Winnipeg, the EICD and the R.M. of Gimli will be better positioned to take appropriate mitigative measures.

The study was designed to capture spring snowmelt, a summer, and a late fall storm event. Four drains were selected for analysis and sampled on April 10<sup>th</sup>, July 31<sup>st</sup> and October 9<sup>th</sup>, 2008. Water from each storm system was analyzed for 65 different parameters. Of these water quality indicators, guidelines upon which comparisons could be made were found for 36. When summarizing all test sites and times, the water quality assessment for the four drains was based on 324 parameters. In total, 59 parameters did not meet associated guidelines (18.2%).

When examining each drain on an individual basis it was found that the storm drain system exiting at the Viking statue failed the highest number of tests; followed by the systems exiting at the Library, the Concession Stand, and Loni Beach respectively. In terms of drains that pose the highest risk to human health, the two storm drain systems that have their outflow on the public beach are of highest concern. These two systems, referred to as the 'Concession' and 'Library', showed bacteria levels well above recommended guidelines for recreational water use and direct contact with this outflow could result in illness, particularly gastrointestinal.

Of all the parameters for which guidelines were available, bacteria concentrations are of greatest concern. The October sampling of the storm drain in Loni Beach was seen to have *E. coli* concentrations 70 times greater than what a municipal wastewater treatment system can legally release to surface waters.

Based on the findings of this study, the East Interlake Conservation District has provided several recommended actions which are primarily focused on public education and improved awareness. The EICD will continue to work the R.M. of Gimli to implement programs aimed at improving the storm water quality and monitor urban runoff.



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## Introduction

In February 2008, the East Interlake Conservation District Board member William Barlow, made the District aware of Gimli's desire to determine the quality of their urban storm water runoff and if it would negatively affect Lake Winnipeg. It was felt that this project would fall within the mandate of the District and the East Interlake Conservation District (EICD) agreed to implement an urban storm water monitoring plan in partnership with the R.M. of Gimli. The primary goal of sampling urban storm water in Gimli was to determine the general quality of the water entering Lake Winnipeg from the urban area, the town, of Gimli. With this information the R.M. of Gimli and the EICD would be better positioned to make informed decisions regarding the urban water quality programming needs of Gimli as well as the other urban centres within the EICD.

## Study Site

Four storm water drains were selected for testing within the R.M. of Gimli. Each drain was selected in consultation with Councillor Barlow based on his knowledge of the approximate catchment of the storm water system. The four drainage systems are identified by their outlet point and were named the Viking, the Library, the Concession, and the Loni Beach systems (Figure 1). At the time of selection it was believed these four storm water systems drained a largely urban catchment.

The Viking drain outlet is located south west of the Viking statue at the southern end of 2<sup>nd</sup> Avenue in Gimli. This outlet enters directly into Lake Winnipeg and can be subject to backflow when the lake levels are high. The outlet is situated amongst hydrophytic vegetation.

The Library and Concession systems both have outlets on Gimli's main public beach. The Library drain outlet is situated east of the public library and the Concession drain outlet is situated north of Gimli beach's concession stand. All storm water flow from the system is released approximately 10 m from the lake's edge and allowed to flow in an open sand channel to the lake. The elevation of each outlet culvert is sufficiently high that at time of sampling water from the lake was not observed flowing into the storm water culvert; although, ponding of water below the culvert was observed, particularly at the 'Concession' site.

The final sampling location was the Loni Beach site. This location differed from the other three sites in that it is exclusively a surface drainage system as opposed to the curb and gutter style of the other three systems. Immediately upstream of the sampling site, the drain resembles a small natural creek with dense vegetation. This drain is surrounded on all sides by residential development. All samples collected in the Loni Beach drain were taken approximately 30 m from the lake. No back flow from the lake was seen at this site. An artesian well is located approximately 3 m downstream of the sampling location but is not believed to have impacted the samples.



Figure 1: Study site locations



## Methods

Samples were collected at the downstream end of the storm water culvert. All samples were labelled and immediately placed in a cooler to maintain appropriate sample temperature. A chain of custody was completed and delivered to the laboratory with the samples on the same day as collection.

All drain samples, with the exception of the spring bacteria samples, were analyzed at CanTest Ltd., an accredited laboratory commonly used by the EICD and the Province of Manitoba for water quality testing. The specific CanTest analysis requested was Test #101 without pesticides. This test was selected as it provides analysis for a variety of metals and conventional parameters such as pH, dissolved oxygen, nutrients and suspended solids. In addition to Test #101 (no pesticides), CanTest also analyzed for two types of bacteria, total coliforms and *E. coli* using membrane filtration for the mid-summer and fall samples, ALS Laboratory Group was utilized for the bacteria analysis of the April 10<sup>th</sup> samples.

The EICD attempted to collect runoff samples representative of the seasonal variation within one year. To accomplish this, samples from a spring snowmelt, a mid-summer storm and a late fall rain event were targeted. Exact dates could not be predetermined as sample times were weather dependant. The EICD captured samples only if a number of conditions were met which included:

- Rain/snowmelt event of sufficient magnitude to produce storm water flow at all the sampling locations
- Runoff event occurred at appropriate time (i.e. snowmelt, mid-summer, late fall)
- EICD staff were able to capture the initial flush of storm water (i.e. event occurred during the day)
- Runoff event was relatively isolated in time and not in the later stages of series of storms that may have 'washed' the catchment
- Lake Winnipeg water levels were low enough to allow storm water flow out of drainage system (of particular concern at the Viking Statue sampling site)

All water samples were collected within one hour of each other and all possible attempts were made to capture the beginning of the runoff event. Due to the difficulty in capturing the initial flow of snowmelt, the EICD attempted to sample at the peak runoff time. This was determined by studying the Icelandic River discharge at Riverton over the past several years and through local observations.

For analysis of the data, the EICD compiled water quality guidelines from three sources as no one set of guidelines were found that could be applied in this situation. The guidelines were derived from the *Manitoba Water Quality Standards, Objectives and Guidelines*, the *Guidelines for Canadian*

*Recreational Water Quality* and the *United States Environmental Protection Agency*. When selecting which guideline to apply, the Manitoba recommendations were given the highest priority then the recreational guidelines and finally the US EPA guidelines for chronic exposure. When multiple guidelines were available for a parameter (i.e. guidelines for drinking water, irrigation water, aquatic life, municipal wastewater, recreation) the most appropriate guideline, as determined by EICD staff, was applied. For some parameters the most appropriate guideline was not available and the guideline selected was done so as a point of reference and not as a target to be achieved (i.e. drinking water quality guidelines). This approach was selected so as to maximize points of reference and to protect the health of people that frequently use the waters around the runoff discharge points. In total, 65 separate parameters were tested for using Test #101 (no pesticides) and the bacteria testing. Of these 65 parameters, guidelines were found for 36.

## Results

EICD personnel captured storm water runoff on April 10<sup>th</sup>, July 31<sup>st</sup> and October 9<sup>th</sup>, 2008. On April 10<sup>th</sup> the Gimli Industrial Park temperature hit a high of +7.9°C which was warm enough to cause snowmelt runoff in the urban drainage system. On July 31<sup>st</sup> and October 9<sup>th</sup> the weather station at the Gimli Industrial Park received 5.0 mm and 4.0 mm of rain respectively.

Upon submission of all water samples results were electronically sent to the EICD office. Results were then compiled into a single database for further analysis of the data. Due to a change in labs after the spring 2008 tests, the total number of bacteria was not able to be determined for the July 31<sup>st</sup> samples as no end-point for the bacteria was found. This resulted in four water samples, collected in the summer of 2008, having the same reading of >2419 MPN/100mL<sup>i</sup> which was the maximum detection limit of the bacteria analysis utilized. Unfortunately, bacteria samples are time sensitive and must be analyzed within 48 hours so the samples were not viable for retesting. This issue was corrected for the fall sampling and any future sampling that will be conducted by the EICD.

### Bacteria

Based on the results, the biggest area of concern is in regards to bacteria levels in the water. When applying the same standards that a municipal wastewater treatment system must achieve prior to releasing effluent (*Escherichia coli* <200 MPN/100mL), 9 of the 12 samples failed (75%). The Loni Beach sample taken on October 9<sup>th</sup>, 2008 had a count of 14,000 MPN/100mL, 70 times higher than the *E. coli* count at which a municipality can release effluent from their treatment plant or lagoon. The sample taken at the concession stand drain had a count of 8,000 MPN/100mL, 40 times higher than the municipal wastewater limit. Based on research conducted by Health Canada, approximately 25 out

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<sup>i</sup> MPN/100mL = Most probable number (of coliforms) per 100 mL of water



of 1000 people exposed to water with *E. coli* counts of 8,000 MPN/100mL will develop a gastrointestinal illness (Health and Welfare Canada, 1992). As *E. coli* are only found in warm-blooded animal feces, these results are indicative of fecal contamination within the catchment, animal and/or human.

The second type of bacteria analyzed for were total coliforms. No recreational use limit for total coliforms is available in Canada but a limit of 1,000 MPN/100mL is the guideline for irrigation water. Based on this limit, all four drains failed each time they were sampled. Total coliforms are not as dangerous to human health as *E. coli*, and have a much wider variety of environmental sources. However, counts as high as 110,000 MPN/100mL, as seen at the storm drain behind the Gimli Public Library are of concern, particularly as it runs directly across a public beach. In Loni Beach the total coliform count was 50,000 MPN/100mL in October.

Generally, the highest bacteria counts were found during the October sampling. Given this information and the fact that all summer bacteria counts exceeded the detection limit of 2419 MPN/100mL, one may speculate that the summer results were likely quite high given that the cooler temperatures of October would hinder the proliferation of bacteria and the catchment is more intensively used during the summer months. Given the location of these drains in proximity to a heavily used recreational area, they would pose a health risk to beach users, particularly in the immediate outflow area.

Monitoring of the beach as a whole is conducted by Manitoba Water Stewardship who measures bacteria densities (as *E. coli*) at Gimli Beach Monday through Friday during the recreational season and posts the results at <http://www.manitoba.ca/waterstewardship/quality>. Bacteria densities are compared to the recreational water quality guideline of 200 colony forming units per 100 mL. Between May 7<sup>th</sup> and September 21<sup>st</sup>, 2008, densities of *E. coli* exceeded the recreational water quality guideline six times, prompting warning notices to be posted. An examination of Water Stewardships data shows that *E. coli* exceeded recreational water quality guidelines on July 30<sup>th</sup>, the day before the EICD conducted summer monitoring on the storm drains (July 31<sup>st</sup>, 2008) but did not ever exceed guidelines on the day of, or immediately after, the times when EICD sampled the runoff.

## **Nutrients**

Nitrogen and phosphorus were also measured in the storm drains. In all but two samples tested, concentrations of phosphorus were below the 1 mg/L total phosphorus goal applied to the Gimli Wastewater Treatment plant. However, when applying nutrient guidelines developed by the US EPA specifically for the Northern Great Plains (0.076 mg/L for P and 2.18 mg/L for N), 17 of 25 samples failed (70%), the majority of which were because phosphorous concentrations exceeded ambient surface water guidelines.

## Metals

Of the 38 metals tested, 21 had some type of guideline upon which to compare the results. Only 3 of the 21 (14%) were found to exceed guidelines (iron, manganese and zinc) and only during the spring snowmelt sample. The guidelines selected to apply to these metals were from Manitoba and were intended for use in relation to protection of aquatic life (iron and zinc) or irrigation (manganese). Based on these initial results, metal contamination does not appear to be of great concern within Gimli's storm water system.

## Other

The only other parameters to fail were total suspended solids, turbidity and dissolved oxygen. The storm water drains behind the Viking statue and Public Library both consistently had more suspended sediment in the water than the Manitoba Tier 1 Water Quality Standard for municipal effluent and were typically more turbid than the *Canadian Guidelines for Recreation Water Quality* guidelines. For the storm drain outflow behind the Viking statue, this may be due to its location in amongst aquatic vegetation and its susceptibility to wave action. The remaining two storm water drains did not meet the Manitoba Tier 2 Water Quality Objective for dissolved oxygen in the summer.

## Relative Quality

Based exclusively on the number of parameters that did not meet guidelines and not taking into account the degree to which guidelines were exceeded, the quality of the water leaving Loni Beach drain was found to be the best, followed by the drain at the concession stand, then the drain at the library and finally the drain at the Viking statue. In terms of the drains the pose the highest threat to human health, the two storm drains flowing onto Gimli Beach are the most hazardous as they have the highest potential for direct human contact. In examining bacteria exclusively, the Loni Beach drain has significantly more of the potentially hazardous *E. coli* than any other drain which indicates that there is a larger source of fecal material in Loni Beach from which these bacteria are being derived than in other parts of Gimli's urban environment.

## Recommendations

Although one year's data is not sufficient to base major policy recommendations upon, it was the goal of this project to use the findings to help direct general urban initiatives to promote watershed and human health. In recognition of this, the following is a list of possible initiatives to be undertaken by the EICD or other watershed stakeholders.

1. Educational campaign to reduce bacteria sources
  - a. Improper, defective or unmaintained septic systems
  - b. Pet wastes (i.e. "Scoop the Poop!")
2. Educational campaign regarding household use of fertilizers
3. Painting of fish along the storm water system as part of a public awareness campaign
4. Provision of pet waste bags and receptacles in parks and public spaces
5. Expansion of the existing sewer system to include all homes in the urban area of Gimli
6. Signs to note areas of potential bacteria hazard at the storm drain outflows, particularly at the two beach drains
7. Create a storm drain system map and delineate the associated catchment
8. Survey of drain system to identify any obvious sources of bacteria
9. Inspection of storm drains during dry times to detect any non-storm flows
10. Establishment of a 'hotline' for citizen's to report any illegal dumping or suspicious activity
11. Continued testing so as to capture summer bacteria levels and nutrient concentrations in the catchments

## Data

The following tables list the results from all 65 parameters that were tested. Any red parameters are ones that have failed to meet the selected water quality guideline.

### Spring Samples

Sample ID		Viking	Library	Concession	Loni Beach
CANTEST ID		804110004	804110005	804110006	804110007
Date Sampled		04/10/2008	04/10/2008	04/10/2008	04/10/2008
Parameter	Units				
<b>Conventional Parameters</b>					
Temperature	°C	3	3	3	3
Hardness (Total) CaCO <sub>3</sub>	mg/L	378	133	104	82
Total Dissolved Solids	mg/L	292	228	187	193
Total Suspended Solids	mg/L	188	53	9	5
Dissolved Chloride Cl	mg/L	71.4	57.8	25	20.3
Nitrate and Nitrite N	mg/L	0.42	0.24	0.21	0.14
Dissolved Sulphate SO <sub>4</sub>	mg/L	9.88	5.86	10.6	8.75
Total Organic Carbon C	mg/L	16	12	14	29
Total Inorganic Carbon C	mg/L	29	26	24	19
Total Carbon C	mg/L	45	38	38	47
Ammonia Nitrogen N	mg/L	0.46	0.3	0.08	0.72
Total Kjeldahl Nitrogen N	mg/L	1.3	1	2.9	1.8
Total Nitrogen N	mg/L	1.72	1.24	3.11	1.94
Total Phosphorus P	mg/L as P	1.74	0.616	0.467	0.386
Total Particulate Phosphorus P	mg/L as P	1.14	0.199	0.07	0.074
Total Soluble Phosphorus P	mg/L as P	0.602	0.417	0.397	0.312
<b>Metals Analysis</b>					
Total Aluminum Al	mg/L	2.43	0.49	0.15	0.08
Total Antimony Sb	mg/L	0.0006	0.0006	0.0005	0.0005
Total Arsenic As	mg/L	0.0027	0.0014	0.0011	0.0013
Total Barium Ba	mg/L	0.075	0.031	0.026	0.018
Total Beryllium Be	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Bismuth Bi	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Boron B	mg/L	0.05	0.04	0.06	0.03
Total Cadmium Cd	mg/L	0.00022	< 0.00004	< 0.00004	< 0.00004
Total Calcium Ca	mg/L	90.3	29.8	17.3	13.5
Total Chromium Cr	mg/L	0.0066	0.0015	0.0004	0.0003
Total Cobalt Co	mg/L	0.01	0.0005	< 0.0002	0.0003
Total Copper Cu	mg/L	0.015	0.0053	0.0034	0.0053
Total Iron Fe	mg/L	4.93	0.64	0.17	0.09
Total Lead Pb	mg/L	0.012	0.0025	0.0005	0.0003
Total Lithium Li	mg/L	0.021	0.012	0.011	0.019
Total Magnesium Mg	mg/L	36.8	14.2	14.8	11.7
Total Manganese Mn	mg/L	0.315	0.037	0.02	0.035
Total Molybdenum Mo	mg/L	0.001	0.0009	0.001	0.001
Total Nickel Ni	mg/L	0.017	0.002	0.001	0.0014
Total Phosphorus P	mg/L	1.38	0.66	0.48	1.97
Total Potassium K	mg/L	10.7	8.31	8.91	17.2

Sample ID		Viking	Library	Concession	Loni Beach
Total Rubidium Rb	mg/L	0.0069	0.0029	0.0048	0.0072
Total Selenium Se	mg/L	0.0005	< 0.0002	< 0.0002	< 0.0002
Total Silicon Si	mg/L	5.44	3.54	3.05	3.41
Total Silver Ag	mg/L	0.00007	< 0.00005	< 0.00005	< 0.00005
Total Sodium Na	mg/L	37.2	30.6	13.7	8.3
Total Strontium Sr	mg/L	0.11	0.061	0.06	0.039
Total Tellurium Te	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Thallium Tl	mg/L	0.00006	< 0.00002	< 0.00002	< 0.00002
Total Thorium Th	mg/L	0.0002	< 0.0001	< 0.0001	< 0.0001
Total Tin Sn	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Titanium Ti	mg/L	0.112	0.025	0.0076	0.0045
Total Uranium U	mg/L	0.0012	0.0009	0.002	0.0007
Total Cesium Cs	mg/L	0.0002	< 0.0001	< 0.0001	< 0.0001
Total Vanadium V	mg/L	0.0089	0.002	0.001	0.002
Total Zinc Zn	mg/L	0.078	0.23	0.054	0.029
Total Zirconium Zr	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Dissolved Aluminum Al	mg/L	0.03	0.027	0.01	0.012
<b>Conventional Parameters-Winnipeg Laboratory-</b>					
pH, Laboratory	pH units	7.69	7.67	7.67	7.42
Conductivity	uS/cm	465	406	304	260
True Color	CU	110	86	90	175
Turbidity	NTU	147	48.4	7.2	3
Total Alkalinity CaCO <sub>3</sub>	mg/L	170	116	102	83
Bicarbonate Alkalinity HCO <sub>3</sub>	mg/L	207	142	124	101
Carbonate Alkalinity CO <sub>3</sub>	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Dissolved Oxygen, Winkler	mg/L	7.8	8	8	5
<b>Microbiological Analysis</b>					
Total Coliform	MPN/100mL	9300	2300	4300	2300
E. coli	MPN/100mL	23	9	210	23

## Summer Samples

Sample ID		Viking	Library	Concession	Loni Beach
CANTEST ID		807310273	807310274	807310275	807310276
Date Sampled		07/31/2008	07/31/2008	07/31/2008	07/31/2008
Parameter	Units				
<b>Conventional Parameters</b>					
Temperature	°C	19	19	19	19
Hardness (Total) CaCO <sub>3</sub>	mg/L	327	253	481	387
Total Dissolved Solids	mg/L	131	123	550	447
Total Suspended Solids	mg/L	381	253	16	20
Dissolved Chloride Cl	mg/L	28.9	25.5	64	34.9
Nitrate and Nitrite N	mg/L	0.31	0.31	0.09	0.09
Dissolved Sulphate SO <sub>4</sub>	mg/L	9.12	9.49	52.8	63.2
Total Organic Carbon C	mg/L	7.8	6.6	21	35
Total Inorganic Carbon C	mg/L	17	17	90	73
Total Carbon C	mg/L	25	23	110	108
Ammonia Nitrogen N	mg/L	0.32	0.33	0.15	0.2
Total Kjeldahl Nitrogen N	mg/L	2.7	2.1	2.1	3.6
Total Nitrogen N	mg/L	3.01	2.41	2.19	3.69
Total Phosphorus P	mg/L as P	0.644	0.404	0.257	1.55
Total Particulate Phosphorus P	mg/L as P	0.591	0.363	0.11	0.3
Total Soluble Phosphorus P	mg/L as P	0.053	0.041	0.147	1.25
<b>Metals Analysis</b>					
Total Aluminum Al	mg/L	3.86	2.14	0.2	0.45
Total Antimony Sb	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Arsenic As	mg/L	0.002	0.001	0.002	0.002
Total Barium Ba	mg/L	0.06	0.035	0.06	0.053
Total Beryllium Be	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Bismuth Bi	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Boron B	mg/L	0.09	0.06	0.24	0.1
Total Cadmium Cd	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Calcium Ca	mg/L	65.9	51.7	63.2	57.1
Total Chromium Cr	mg/L	0.012	0.007	0.001	0.001
Total Cobalt Co	mg/L	0.002	0.001	< 0.001	< 0.001
Total Copper Cu	mg/L	0.017	0.011	0.004	0.003
Total Iron Fe	mg/L	4.83	2.79	0.38	0.76
Total Lead Pb	mg/L	0.018	0.011	0.002	0.001
Total Lithium Li	mg/L	0.055	0.03	0.048	0.036
Total Magnesium Mg	mg/L	39.5	30	78.4	59.4
Total Manganese Mn	mg/L	0.15	0.094	0.038	0.18
Total Molybdenum Mo	mg/L	0.0007	0.0007	0.0007	< 0.0005
Total Nickel Ni	mg/L	0.007	0.004	0.002	0.003
Total Phosphorus P	mg/L	0.4	0.3	0.2	1.5
Total Potassium K	mg/L	2.9	2.4	3.9	14
Total Rubidium Rb	mg/L	0.009	0.005	0.002	0.006
Total Selenium Se	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Silicon Si	mg/L	7.52	4.58	6.34	10.6
Total Silver Ag	mg/L	< 0.00025	< 0.00025	< 0.00025	< 0.00025



Sample ID		Viking	Library	Concession	Loni Beach
Total Sodium Na	mg/L	11.1	11.7	46	32.4
Total Strontium Sr	mg/L				
Total Tellurium Te	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Thallium Tl	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Thorium Th	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Tin Sn	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total Titanium Ti	mg/L	0.14	0.079	0.009	0.018
Total Uranium U	mg/L	0.0007	0.0008	0.0075	0.0026
Total Cesium Cs	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Vanadium V	mg/L	0.01	0.006	0.002	0.002
Total Zinc Zn	mg/L	0.087	0.24	0.11	0.03
Total Zirconium Zr	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Dissolved Aluminum Al	mg/L	0.059	0.037	0.02	0.035
<b>Conventional Parameters-Winnipeg Laboratory-</b>					
pH, Laboratory	pH units	8.24	7.86	7.91	7.67
Conductivity	uS/cm	201	206	995	817
True Color	CU	35	38	106	175
Turbidity	NTU	228	163	13.7	17.6
Total Alkalinity CaCO <sub>3</sub>	mg/L	105	82	405	322
Bicarbonate Alkalinity HCO <sub>3</sub>	mg/L	128	100	494	393
Carbonate Alkalinity CO <sub>3</sub>	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Dissolved Oxygen, Winkler	mg/L	7.2	6.3	3.8	1.9
<b>Microbiological Analysis</b>					
Total Coliform	MPN/100mL	>2419	>2419	>2419	>2419
E. coli	MPN/100mL	>2419	>2419	>2419	>2419

## Fall Samples

Sample ID		Viking	Library	Concession	Loni Beach
CANTEST ID		810100140	810100156	810100157	810100158
Date Sampled		10/09/2008	10/09/2008	10/09/2008	10/09/2008
Parameter	Units				
<b>Conventional Parameters</b>					
Temperature	°C	3	3	3	3
Hardness (Total) CaCO <sub>3</sub>	mg/L	168	113	551	358
Total Dissolved Solids	mg/L	232	167	724	627
Total Suspended Solids	mg/L	46	64	5	6
Dissolved Chloride Cl	mg/L	31.8	23.6	79.4	89.4
Nitrate and Nitrite N	mg/L	0.29	0.18	0.03	< 0.01
Dissolved Sulphate SO <sub>4</sub>	mg/L	15.1	15.5	80.4	137
Total Organic Carbon C	mg/L	14	11	25	29
Total Inorganic Carbon C	mg/L	36	31	129	80
Total Carbon C	mg/L	49	42	154	108
Ammonia Nitrogen N	mg/L	0.09	0.06	0.03	0.05
Total Kjeldahl Nitrogen N	mg/L	0.8	0.8	1.1	1.2
Total Nitrogen N	mg/L	1.09	0.98	1.13	1.2
Total Phosphorus P	mg/L as P	0.236	0.226	0.085	0.359
Total Particulate Phosphorus P	mg/L as P	0.149	0.144	0.011	0.077
Total Soluble Phosphorus P	mg/L as P	0.087	0.082	0.074	0.282
<b>Metals Analysis</b>					
Total Aluminum Al	mg/L	0.13	0.16	0.024	0.017
Total Antimony Sb	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Arsenic As	mg/L	< 0.0002	< 0.0002	< 0.0002	0.0004
Total Barium Ba	mg/L	0.0072	0.0048	0.012	0.01
Total Beryllium Be	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Bismuth Bi	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Boron B	mg/L	0.12	0.06	0.27	0.09
Total Cadmium Cd	mg/L	< 0.00004	< 0.00004	< 0.00004	< 0.00004
Total Calcium Ca	mg/L	30.9	21.9	65.8	52.5
Total Chromium Cr	mg/L	0.0004	0.0006	< 0.0002	< 0.0002
Total Cobalt Co	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Copper Cu	mg/L	0.0014	0.0013	0.0005	0.0006
Total Iron Fe	mg/L	0.2	0.2	0.05	0.05
Total Lead Pb	mg/L	0.0006	0.0006	< 0.0002	< 0.0002
Total Lithium Li	mg/L	0.0064	0.0056	0.012	0.0062
Total Magnesium Mg	mg/L	22	14.2	93.8	55
Total Manganese Mn	mg/L	0.011	0.0067	0.0015	0.025
Total Molybdenum Mo	mg/L	0.0002	< 0.0001	< 0.0001	< 0.0001
Total Nickel Ni	mg/L	0.0005	0.0005	0.0004	0.0004
Total Phosphorus P	mg/L	0.04	0.04	< 0.03	0.08
Total Potassium K	mg/L	1.07	0.71	1.18	1.54
Total Rubidium Rb	mg/L	0.0006	0.0006	0.0006	0.0006
Total Selenium Se	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Silicon Si	mg/L	3.21	2.4	4.98	4.28
Total Silver Ag	mg/L	< 0.00005	< 0.00005	< 0.00005	< 0.00005

Sample ID		Viking	Library	Concession	Loni Beach
Total Sodium Na	mg/L	21.7	10.9	56.7	36.4
Total Strontium Sr	mg/L	0.098	0.049	0.35	0.18
Total Tellurium Te	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Thallium Tl	mg/L	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Total Thorium Th	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Tin Sn	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Total Titanium Ti	mg/L	0.0063	0.0071	0.0014	0.0009
Total Uranium U	mg/L	0.0004	0.0002	0.0019	0.0013
Total Cesium Cs	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Total Vanadium V	mg/L	0.0006	0.0006	0.0004	0.0003
Total Zinc Zn	mg/L	0.01	0.02	0.024	0.02
Total Zirconium Zr	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
Dissolved Aluminum Al	mg/L	0.002	0.011	0.013	0.004
<b>Conventional Parameters-Winnipeg Laboratory-</b>					
pH, Laboratory	pH units	7.68	7.53	8.06	7.77
Conductivity	uS/cm	401	256	1220	825
True Color	CU	55	58	86	85
Turbidity	NTU	52	58.6	5.1	5.8
Total Alkalinity CaCO <sub>3</sub>	mg/L	149	90.2	506	284
Bicarbonate Alkalinity HCO <sub>3</sub>	mg/L	182	110	617	347
Carbonate Alkalinity CO <sub>3</sub>	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Hydroxide Alkalinity OH	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Dissolved Oxygen, Winkler	mg/L	7.5	7.3	4.6	4.1
<b>Microbiological Analysis</b>					
Total Coliform (Confirmed)	MPN/100mL	24000	110000	8000	50000
E. Coli	MPN/100mL	1300	500	8000	14000

### Guidelines Used in Analysis

Sample ID		Viking	Library	Concession	Loni Beach	Guideline Source
Temperature	°C	<30	<30	<30	<30	Canadian Recreational Use
Hardness (Total) CaCO <sub>3</sub>	mg/L					
Total Dissolved Solids	mg/L	<1000	<1000	<1000	<1000	Tier 2 – Irrigation Water
Total Suspended Solids	mg/L	<30	<30	<30	<30	Tier 1 - Municipal Wastewater Discharge
Dissolved Chloride Cl	mg/L	<100	<100	<100	<100	Tier 3 - Irrigation Water
Nitrate and Nitrite N	mg/L	<10	<10	<10	<10	Tier 2 - Drinking Water
Dissolved Sulphate SO <sub>4</sub>	mg/L					
Total Organic Carbon C	mg/L					
Total Inorganic Carbon C	mg/L					
Total Carbon C	mg/L					
Ammonia Nitrogen N	mg/L	<14.94	<19.01	<7.50	<12.80	Tier 2 – Protection of Aquatic Life
Total Kjeldahl Nitrogen N	mg/L					
Total Nitrogen N	mg/L	<2.18	<2.18	<2.18	<2.18	US EPA - Protection of Aquatic Life
Total Phosphorus P	mg/L as P	<0.076	<0.076	<0.076	<0.076	US EPA - Protection of Aquatic Life
Total Particulate Phosphorus P	mg/L as P					
Total Soluble Phosphorus P	mg/L as P					
Total Aluminum Al	mg/L					
Total Antimony Sb	mg/L					
Total Arsenic As	mg/L	<0.15	<0.15	<0.15	<0.15	US EPA - Protection of Aquatic Life
Total Barium Ba	mg/L	<1	<1	<1	<1	Tier 3 - Drinking Water
Total Beryllium Be	mg/L					
Total Bismuth Bi	mg/L					
Total Boron B	mg/L	<6	<6	<6	<6	Tier 3 - Irrigation Water
Total Cadmium Cd	mg/L	<0.01	<0.01	<0.03	<0.02	Tier 2 – Protection of Aquatic Life
Total Calcium Ca	mg/L	<1000	<1000	<1000	<1000	Tier 3 - Livestock
Total Chromium Cr	mg/L	<0.05	<0.05	<0.05	<0.05	Tier 3 - Drinking Water
Total Cobalt Co	mg/L	<0.05	<0.05	<0.05	<0.05	Tier 3 - Irrigation Water
Total Copper Cu	mg/L	<0.02	<0.02	<0.07	<0.05	Tier 2 – Protection of Aquatic Life
Total Iron Fe	mg/L	<0.30	<0.30	<0.30	<0.30	Tier 3 - Protection of Aquatic Life
Total Lead Pb	mg/L	<0.16	<0.10	<0.72	<0.41	Tier 2 – Protection of Aquatic Life

Sample ID		Viking	Library	Concession	Loni Beach	Guideline Source
Total Lithium Li	mg/L	<2.50	<2.50	<2.50	<2.50	Tier 3 - Irrigation Water
Total Magnesium Mg	mg/L					
Total Manganese Mn	mg/L	<0.2	<0.2	<0.2	<0.2	Tier 3 - Irrigation Water
Total Molybdenum Mo	mg/L	<0.073	<0.073	<0.073	<0.073	Tier 3 - Protection of Aquatic Life
Total Nickel Ni	** mg/L	<0.73	<0.52	<1.99	<1.38	Tier 2 – Protection of Aquatic Life
Total Phosphorus P	mg/L					
Total Potassium K	mg/L					
Total Rubidium Rb	mg/L					
Total Selenium Se	mg/L	<0.001	<0.001	<0.001	<0.001	Tier 3 - Protection of Aquatic Life
Total Silicon Si	mg/L					
Total Silver Ag	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	Tier 3 - Protection of Aquatic Life
Total Sodium Na	mg/L	<200	<200	<200	<200	Tier 3 - Drinking Water
Total Strontium Sr	mg/L					
Total Tellurium Te	mg/L					
Total Thallium Tl	mg/L	<0.0008	<0.0008	<0.0008	<0.0008	Tier 3 - Protection of Aquatic Life
Total Thorium Th	mg/L					
Total Tin Sn	mg/L					
Total Titanium Ti	mg/L					
Total Uranium U	mg/L	<0.01	<0.01	<0.01	<0.01	Tier 3 - Irrigation Water
Total Cesium Cs	mg/L					
Total Vanadium V	mg/L	<0.1	<0.1	<0.1	<0.1	Tier 3 - Irrigation Water
Total Zinc Zn	** mg/L	<0.19	<0.13	<0.51	<0.35	Tier 2 – Protection of Aquatic Life
Total Zirconium Zr	mg/L					
Dissolved Aluminum Al	mg/L					
pH, Laboratory	pH units	6.5 - 9	6.5 - 9	6.5 - 9	6.5 - 9	Tier 3 - Protection of Aquatic Life
Conductivity	uS/cm	<1500	<1500	<1500	<1500	Tier 2 - Irrigation Water
True Color	CU	<15	<15	<15	<15	Tier 3 - Drinking Water
Turbidity	NTU	<50	<50	<50	<50	Canadian Recreational Use
Total Alkalinity CaCO3	mg/L					
Bicarbonate Alkalinity HCO3	mg/L					
Carbonate Alkalinity CO3	mg/L					
Hydroxide Alkalinity OH	mg/L					

Sample ID		Viking	Library	Concession	Loni Beach	Guideline Source
Dissolved Oxygen, Winkler ***	mg/L	>3	>3	>3	>3	Tier 2 - - Protection of Aquatic Life
Total Coliform (Confirmed)	MPN/100mL	<1000	<1000	<1000	<1000	Tier 3 - Irrigation Water
E. Coli	MPN/100mL	<200	<200	<200	<200	Tier 2 – Recreational Use

Guidelines shown here are based on the water conditions during the October 9<sup>th</sup>, 2008 sample period.

- \* Actual guideline is dependant on the pH of the sampled water
- \*\* Actual guideline is dependant on the hardness of the sampled water
- \*\*\* Actual guideline is dependant on the temperature of the sampled water

## Guideline Sources

Health Canada, *Guidelines for Canadian Recreational Water Quality*, (1992). Part I [http://www.hc-sc.gc.ca/ewh-semt/alt\\_formats/hecs-sesc/pdf/pubs/water-eau/guide\\_water-1992-1-guide\\_eau-eng.pdf](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/water-eau/guide_water-1992-1-guide_eau-eng.pdf) and Part II [http://www.hc-sc.gc.ca/ewh-semt/alt\\_formats/hecs-sesc/pdf/pubs/water-eau/guide\\_water-1992-2-guide\\_eau-eng.pdf](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/water-eau/guide_water-1992-2-guide_eau-eng.pdf) accessed on 23-Jan-09.

Manitoba Conservation, D. Williamson, *Manitoba Water Quality Standards, Objectives and Guidelines – Final Draft: November 22, 2002 for additional review and comment*. Report 2002-11, 86 pgs. [http://www.gov.mb.ca/waterstewardship/water\\_quality/quality/mwqsog\\_2002.pdf](http://www.gov.mb.ca/waterstewardship/water_quality/quality/mwqsog_2002.pdf) accessed on 23-Jan-09.

United States Environmental Protection Agency, *Current National Recommended Water Quality Criteria* <http://www.epa.gov/waterscience/criteria/wqctable/index.html> accessed on 23-Jan-09.

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