UNIVERSITY OF MINNESOTA
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Department of Geography
University of Minnesota
Minneapolis, Minnesota
USA 55455
email: stgeorge@umn.edu
telephone: 612.625.0805

Mr. Terry Sargeant
Chair
Clean Environment Commission
Room 305 - 155 Carlton Street
Winnipeg MB RC3 3H8

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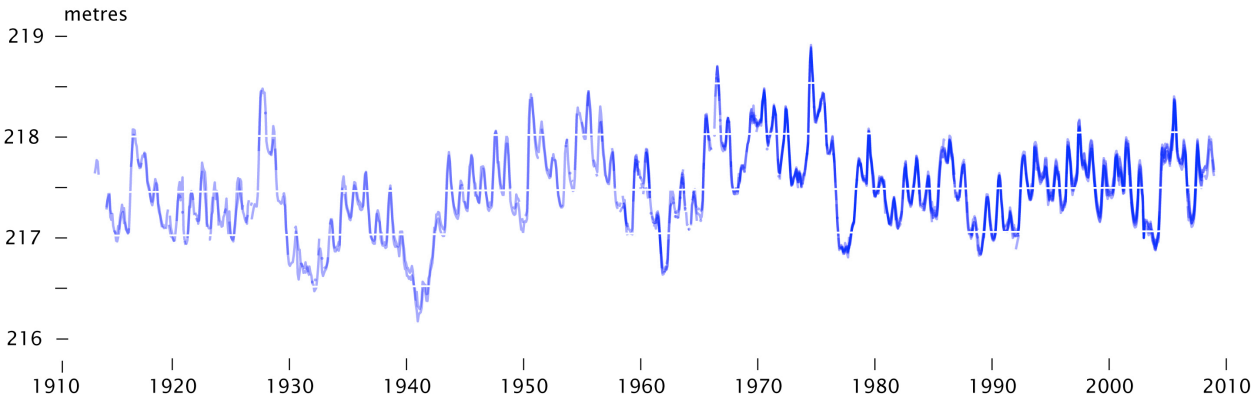
Dear Mr. Sargeant,

I was very interested to learn that the Clean Environment Commission plans to hold a public review of the regulation of Lake Winnipeg's water levels. As a scientist who is studying the hydrology and environmental history of the lake and its watershed, I thought a few of the lessons I've learned so far might be helpful to your deliberations.

To introduce myself, I'm an Assistant Professor of Geography at the University of Minnesota in Minneapolis. My background is in the earth sciences, and most of my research has dealt with climate change across the northern Great Plains of Canada and the United States. I am a paleoclimatologist, which means that I study 'old climates' (or, more accurately, past climates) using evidence from tree rings, lake sediments and other natural archives. If we can understand how (and, more importantly, why) our climate changed in the past, we should be able to make better forecasts of what the future may have in store. Before joining the faculty at Minnesota, I was employed as a research scientist by the Geological Survey of Canada. I'm also a former Manitoban, having grown up in Winnipeg and taken my B.Sc. degree at the University of Winnipeg.

Lake Winnipeg is the most significant element of the hydrological system that ties the Canadian Prairies together, but there's still a lot about the lake that is poorly understood. To my knowledge, the most recent summary of historical changes in Lake Winnipeg's water level was published in the early 1970s. That analysis is now more than three decades out of date, and that makes it hard to sort out whether the changes we've seen recently are really unusual. Earlier this year, my colleague Dr. Grant Ferguson (Associate Professor and Chair, Department of Earth Sciences, St. Francis Xavier University) and I started a project aimed at clarifying the recent hydrological history of Lake Winnipeg ('recent' meaning the last century and a bit earlier). That work has really just begun, but we are able to make a few basic observations about water levels in Lake Winnipeg by drawing on the results of prior studies.

First, Lake Winnipeg has some of the longest water level records in Canada, and these data provide an excellent starting point to understand the lake's long-term behavior. Direct measurements of the level of Lake Winnipeg stretch back almost one hundred years. The earliest observations began at Winnipeg Beach as early as 1913 and today there are eight active gauges operating on the lake. As illustrated by the graphic below, these data give us the deep perspective that is absolutely critical to understand how Lake Winnipeg has changed over the last century.



The present, uncorrected record of lake-level fluctuations for Lake Winnipeg. The shading of the line varies depending the number of lake gauges contributing to the estimate, ranging from one gauge (light blue) to nine (dark blue). These data are the best indicator of changes in Lake Winnipeg hydrology we have, but they're also tough to interpret because they reflect the combined influence of hydrology, geology and regulation.

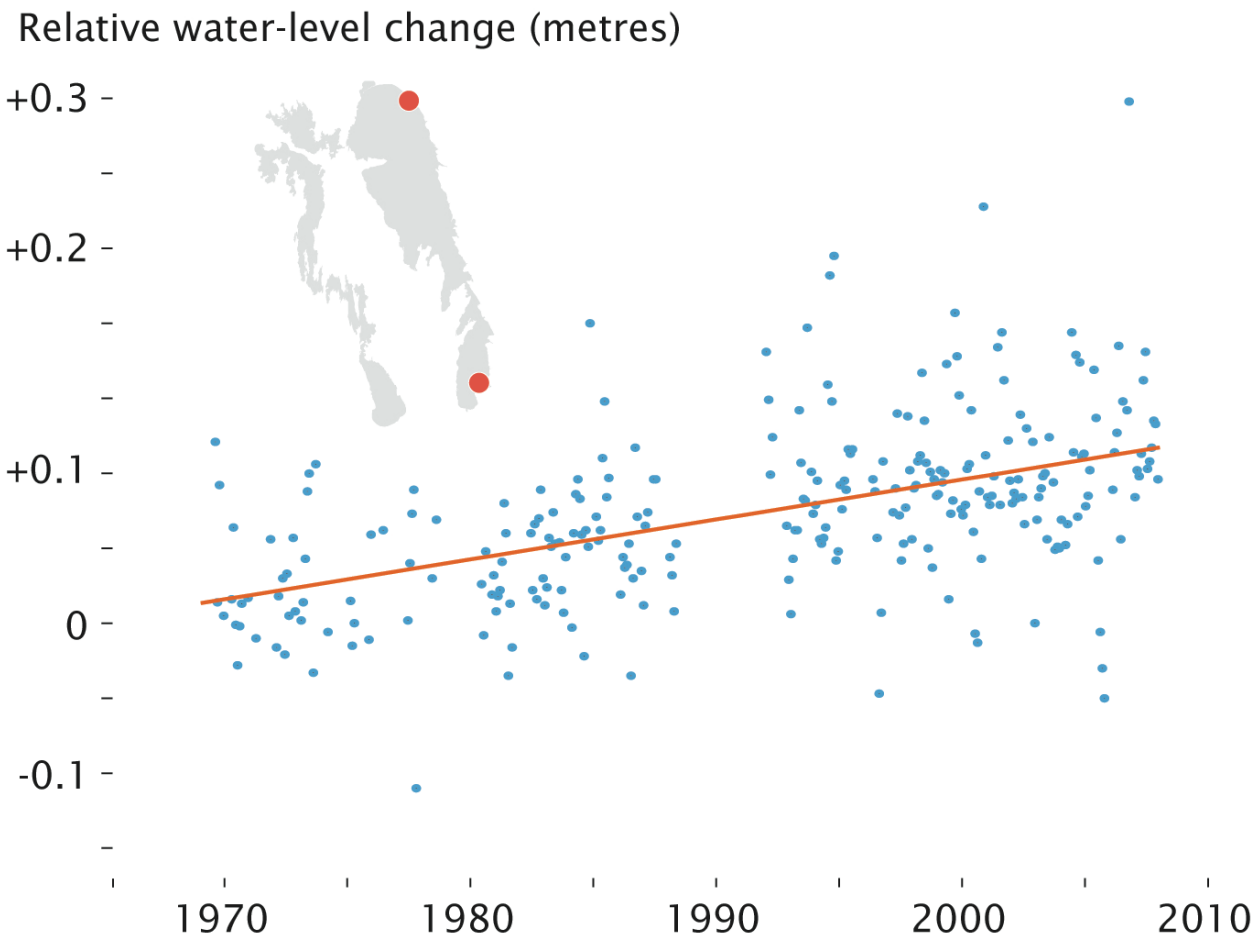
These data are freely available through the website operated by the Water Survey of Canada (http://www.wsc.ec.gc.ca/applications/H2O/index-eng.cfm). I hope that one of the outcomes of your review will to inform Manitobans about the important work done by the Water Survey on Lake Winnipeg. I also hope that you are able to show people how they can access these records for themselves. If we're able to understand how the lake has changed in the past, we'd be better positioned to have an informed discussion of the impact of regulation (and other factors) on the level of Lake Winnipeg.

Second, the water level record for Lake Winnipeg reflects the combined influence of climatic, geological and human factors. If Lake Winnipeg was a simple lake, its water level would be dictated by three main factors: (1) the amount of water flowing into the lake from its tributaries, (2) the amount of water leaving at its outlet and (3) losses due to evaporation at the lake's surface and seepage into groundwater. Unfortunately, Lake Winnipeg is not a simple lake, and its water level also influenced by the effects of regulation and geology.

Since 1976, the level of Lake Winnipeg has been controlled by two dams and three diversion channels located downstream, near its outlet to the Nelson River. The operational goal of these facilities is to increase outflow from the lake during fall and winter so that dams on the Nelson can satisfy the increased seasonal demand for electricity. They also act to reduce the amplitude of the annual cycle in Lake Winnipeg's water level, meaning that the lake is less variable from one season to the next than it would be under natural conditions.

Hydrology and regulation are the two most obvious controls of Lake Winnipeg, but there is one additional factor that, despite being slow and subtle, still has a detectable impact on the lake's water level: Lake Winnipeg's basin is rising. The basin is rising because this part of North America is still responding to the removal of the surface load associated with the most recent glaciation. Because the weight of the ice is no longer pressing down on the earth's surface, central Manitoba is slowly 'rebounding' and is gradually getting higher. The rate of this rebound is really slow, somewhere around 0-2 mm/yr at the south end of the lake and around 4-5 mm/yr at its north end. That may seem like a small change, but over a century the higher rates add up to an increase of almost half a meter in elevation.

If we look over the long term, the effects of these geological changes can be seen directly in the water level records. Because the lake's north basin is rising more rapidly than its south basin, lake levels measured at gauges in the south are rising relative to gauges in the north (see illustration below). As a result, any attempts to sort out how the level of Lake Winnipeg has varied due to hydrological factors or the effects of regulation must also account for the changes in the elevation of the lake basin due to rebound.



The effects of isostatic rebound are obvious if you take the difference between lake level measured at gauges at the northern and southern ends of Lake Winnipeg. In this example, comparing observations made at Mission Point (the northern circle) and Victoria Beach (the southern circle) shows that lake levels at the two sites were approximately equal at the start of 1970s. Since then, more rapid uplift at the lake's northern end has caused water levels at Victoria Beach to slowly rise relative to levels at Mission Point. Overall, the long-term trend (illustrated by the orange line) shows a 0.1-meter increase in 40 years.

Water level is both the most fundamental and best observed aspect of the Lake Winnipeg system, but understanding how and why the level of the lake rises and falls is an ongoing scientific challenge. If we're going to answer that challenge, we'll need to include contributions from several disciplines across the earth sciences, including hydrology, climatology, geophysics, hydrological engineering and water policy. It's not a simple problem.

Before I conclude, I must emphasize that most of my comments are based on research conducted by other scientists. At the end of this letter, I've included the citations for a pair of scientific papers that I've found very helpful while learning about the dynamic nature of Lake Winnipeg. I'm sure that you, and your colleagues, would find them relevant to the mandate of your review.

I hope that some of these ideas are relevant to the issues that will be considered by the Clean Environment Commission.

Yours sincerely.

Scott St. George, Ph.D.

Key references

Penner F. and Swedlo, A. 1974. Lake Winnipeg shoreline erosion, sand movement, and ice effects study; The hydrologic, hydraulic and geomorphic studies, technical report appendix 2, v. 1-B, Water Resources Branch, Department of Mines, Resources and Environmental Management.

Tackman, G.E., Bills, B.G., James, T.S. and Currey, D.R. 1999. Lake-gauge evidence for regional postglacial tilting in southern Manitoba. *Bulletin of the Geological Society of America* **111**, 1684-1699.