STATISTICAL NEEDS IN NATIONAL WATER QUALITY MONITORING PROGRAMS

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Abstract. The concept that a few well chosen, strategically placed, water quality stations can provide valuable scientific information to water managers is common to many countries. Historically within Canada, water quality regional networks (Great Lakes network, Prairie Provinces Water Board network, Long Range Transport of Airborne Pollutants network, etc.) have been successfully operating for many years. This paper will describe the difficulties associated with developing a national water quality network for a country the size of Canada. In particular, it will describe some of the statistical tools presently being used in regional networks which are suitable for a national network, and discuss the need to develop new statistical tools for environmental monitoring in the 1990's.

1. Introduction

Canada possesses abundant aquatic resources covering 7.6% of its surface (9% of the world's freshwater supply). However, despite the apparent abundance of water in Canada, several authors (Harvey, 1976; Johnson, 1980; Foster and Sewell, 1981) have repeatedly warned of the critical situation with respect to, not only the quantity, but also the quality of freshwater resources in Canada. There are several reasons for these concerns:

- 60% of Canada's freshwater drains north (Figure 1) while 90% of Canada's population can be found within 300 km of the Canada-United States border.
- Canadians use more than 2000 L of water per person per day, for domestic, commercial, agricultural and industrial purposes. This represents the second highest consumption rate in the world.
- At an average cost of $0.47 m⁻³, Canadians have one of the lowest costs for water in the world, approximately one half of that of the United States and one fifth that of European countries. As a result there is no financial incentive to conserve water.
- Many users of water (domestic, commercial, agricultural and industrial) return this water to the environment in a deteriorated state. As a result conflict between water users is increasing.

The Canadian government has accepted the concept of water quality conservation (e.g. maintaining the present aquatic ecosystem or an improved condition, so as not to eliminate future options for use). To achieve this concept, water managers have recognized the need for a scientifically sound measure of water demand (defined as the amount of water consumed plus the degree to which wastewater is degraded, Brooks and Peters, 1988). Only after an accurate measure of water demand is made will alternative
approaches to water demand management be developed, verified and implemented.

Within Canada, management of water resources is a provincial responsibility. However, the federal government has a mandate to show leadership on national issues. National assessment of water quality falls within the federal mandate. With the ever expanding list of man-made chemicals being introduced into the environment and the increased costs of monitoring these anthropogenically produced chemicals, a mandatory need for any national water quality network in Canada will be the close cooperation among the various agencies responsible for water. Areas requiring harmonization include network design, chemical analyses and data interpretation. Statistics plays an important role in all these aspects. The view that statistics are solely an end application, (e.g. for interpretation) will result in poor data interpretation and unresolved environmental issues.

The application of statistics to environmental assessments has dramatically increased in the last decade. The objective of this paper is to review presently used techniques for characterizing the quality of waters in Canada. This overview will provide the uniniated water manager with the salient areas within environmental assessment where statistical application plays a paramount role.

Before doing so, a brief review of three ‘Areas of Concern’ when dealing with large scale networks will be given. These ‘Areas of Concern’ are universal to all large networks and