PART TWO

DATA WAREHOUSE ARCHITECTURE

CHAPTER 2

TABULAR DATA ARCHITECTURE

This chapter provides an overview of the data associated with fishery and aquatic resource management. Due to the complexity and variety of information, the data is grouped into broad categories or subjects for presentation purposes only. Key words which reflect the data within the data warehouse are highlighted in bold italic font.

THE BUSINESS

The data architecture of the New Brunswick Aquatic Data Warehouse is based on the four primary functions within natural resource management:

- Resource managers must take inventory of the resource they are managing. Although maps can provide a general inventory of water resources, field surveys are required to quantify and qualify stream and lake characteristics and fish populations.

- Based on resource availability and its regeneration potential, the resource can be allocated for use or consumption. New Brunswick allocates fishery resources through a variety of angling permits, plus two other unique methods - Crown reserves and angling leases.

- Other impacts or uses of aquatic resources are also monitored and regulated, such as watercourse alterations and pollution controls. Land use activities in particular can have significant impact on fish and the aquatic environment. Land based data complements the information within the Aquatic Data Warehouse but are not described in this document.

- Management plans are developed to allow sustainable use of the resources. Management tools can include regulations, habitat protection and improvement, fish stocking, and public information and education.

DATA SUBJECTS

There are six categories or subjects of data within the Aquatic Data Warehouse which support the above business functions: Water Resource Inventory, Fish Populations, Fishery Harvest, Aquatic Disturbances, Management Activities, and Watercourse Recreation. Each subject is briefly described as follows:

- ***Water Resource Inventory*** - inventory of the Province's lakes, streams and eventually wetlands. Through field surveys, bodies of water are further defined by their physical, chemical and biological attributes. For instance, the Canada/New Brunswick Recreational Fisheries Agreement funded community groups to survey more than 2000 kilometres of the New Brunswick streams, thus collecting vast quantities of habitat, fish population and angler harvest information.

- ***Fish Population Assessments*** - the identification of fish species or fish

assemblages within a water body, plus any assessment data quantifying fish populations. Fish population assessment techniques include electrofishing and direct and indirect counting of migrating fish at trapping facilities.

< ***Fishery Harvest*** - recreational fishing and commercial harvest statistics, plus socio-economic data associated with New Brunswick's recreational fisheries.

< ***Aquatic Disturbances*** - watercourse alterations, potential pollution sources and actual pollution events that impact aquatic resources.

< ***Management Activities*** - a history of management activities, plus recommendations for future actions. Management activities include regulating waters, stocking fish, or limiting human activity near special waterways, such as drinking water supplies.

< ***Watercourse Recreation*** - the identification of angling pools and open Crown angling waters, plus the classification of stream stretches with respect to canoeing difficulty.

Although the data is presented as distinct groupings, it is all inter-related as illustrated in Figure 2. The water inventory component is the "backbone" of the architecture with all information relating to a specific water body or a section thereof. The following sections describe each of the subjects in more detail.

WATER RESOURCE INVENTORY

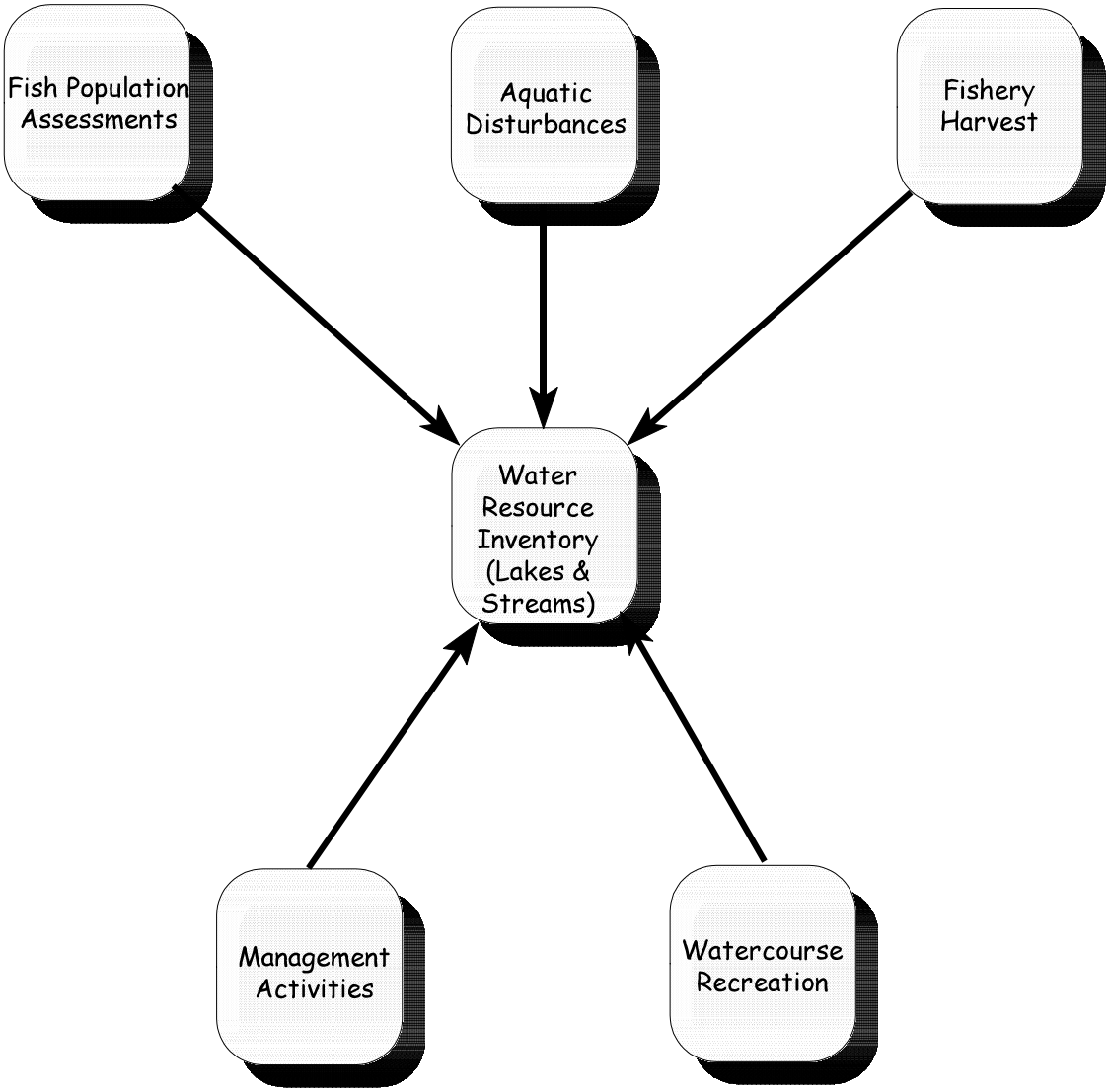
The ***Water Resource Inventory*** is an inventory of all lakes, streams, and eventually wetlands within New Brunswick. Each lake and stream is assigned a unique identifier or number, plus appropriate drainage system codes. New Brunswick has adopted a five level hierarchal ***drainage system*** with the first level representing the twelve major drainage basins/composites which flow into the Gulf of St. Lawrence and Bay of Fundy. Each basin is then divided into composites and 5th order or higher streams using Strahler's stream ordering methodology (see below). Each drainage unit is then further subdivided until it no longer contains units meeting the minimum order/size criteria - 4th order with a drainage area greater than 100 km^2. Please refer to the **Drainage System** and **Water Resource Inventory** chapters for information on drainage units and lake and stream numbering. Appendix A contains a listing of New Brunswick's drainage units.

In addition, streams are classified within the stream network hierarchy. This is called ***stream order*** classification; the number and order of streams that flow together to create larger streams determine a stream's order. Source streams as identified on 1:10:000 scale maps are considered 1st order. When two 1st order streams join, a 2nd order stream is created. If two 2nd order streams join, a 3rd order stream is created and so on as described by Strahler.

The term "reach" is often used to describe each section within a stream with a unique order. Larger streams will consist of multiple sections with increasingly higher orders, while small headwater streams will be a single order throughout its length.

Streams can be further decomposed into ***habitat units*** if stream habitat surveys are performed. The basis for defining a habitat unit is the geomorphic composition of the area which can be most easily defined by the flow of the stream, whether it is fast water or slow water. There are twenty-two classifications of fast and slow water. In addition, other types of information are collected, such as substrate composition, channel type, stream width and depth, presence of undercut banks and overhanging vegetation, temperatures, flows, and stream disturbances (natural and manmade). Habitat units may also be used to define estuarial waters, although their characteristics are quite different from freshwater habitat.

Figure 2. Diagram of the subject level data model for the New Brunswick Aquatic Data Warehouse. All data relates to a specific lake or stream, or section thereof.



Prior to a stream survey, ***reconnaissance stream surveys*** are often performed to help prioritize areas for detailed stream surveys. Reconnaissance sites are established at stream access points within a reach (order) and basic information is collected, such as stream type, wet and full channel width, substrate composition, embeddedness and water temperature.

Lakes are uniquely identified within the water inventory, however, they are not divided into sections and their physical attributes are not similar to streams. ***Lake assessments*** generally collect the following types of information: description of shoreline including vegetation, substrate types and adjacent human activities; depth measurements; chemistry and temperature profiles; fish population assessments and tributary surveys.

Fish productivity is partially determined by the ***water chemistry*** of the lake or stream. Water samples from reconnaissance site are field tested for pH, alkalinity, total calcium and total phosphorous. Samples from larger streams (fourth or fifth order) are often returned to the lab for complete chemical analysis (anion-cation balance), which includes approximately 30 inorganic parameters.

FISH POPULATIONS

One or more ***fish species*** or populations may reside within a lake or stream. Within a particular species of fish, there may be several strains which are generally characterized by their stream or lake origin, or by their migratory behaviour (e.g. late run, early run, anadromous, landlocked, or resident).

There are several types of assessment techniques which assist in estimating fish population sizes. Within streams, both juvenile and older fish populations can be estimated through ***electrofishing***. The electrofishing results are used in mathematical formulas to determine the total population and population density within the surveyed area. Population age classes can be defined using length frequency distributions. Length can also be used with fish density to calculate habitat carrying capacity using percent habitat saturation index.

For older fish, population strength can be estimated by partial or complete ***fish migration counts*** at trap net sites and counting/containment barrier fences. In addition, ***spawning fish or redd counts*** can indicate the number of spawning adults and can forecast the next year's juvenile populations.

FISHERY HARVEST

New Brunswick anglers purchase one of two types of fishing permits which govern the species they are able to angle for and keep. Atlantic salmon angling requires a salmon licence allowing the angler to catch any fish species. For individuals solely interested in non-salmonid species, a general angling permit is available. In addition to fishing open waters, anglers may apply for ***Crown reserves***; their limited rods per day provide quality angling experiences. Crown reserves are issued on a lottery basis and are categorized as regular Crown reserves (2-3 days; 2-4 rods/day), daily Crown reserves (1 day, 2-4 rods/day), or hook and release waters.

The Province also authorizes nineteen 10 year term ***angling leases***; these are allocated through public auction. Again the number of rods are limited and the lessee is responsible for operational costs, including warden patrols.

To monitor recreational fishing harvest, a variety of creel census and survey methods are employed. ***Angler catch and effort*** statistics can be gathered for an individual lake or stream, a stream section, or a river system or watershed involving multiple lakes and streams. Provincial fishery agencies conduct an annual mail and/or telephone survey for Atlantic salmon angling effort and harvest, as well as a general recreational fishing survey every five years. In addition to gathering catch and effort statistics on all fish species, the quinquennial survey provides information on the

social and economic values of recreational fishing. For more localized angling information, voluntary and stratified creel census and sporting camp log books are utilized to assess angling catch and effort. In all cases, the repository maintains overall statistics on predefined time intervals, rather than capturing individual angler success.

Fisheries and Oceans Canada maintains annual ***commercial and native harvest*** statistics for the following species in estuarial waters: striped bass, gaspereau, American eel, smelt and Atlantic salmon. Annual research assessment reports document harvest information gathered by Fisheries and Oceans.

International commercial harvest statistics for Atlantic salmon are prepared by the North Atlantic Salmon Working Group of the International Council for the Exploration of the Seas (ICES). The statistics are the result of questions to ICES posed by the North Atlantic Salmon Conservation Organization (NASCO). These statistics, which are the only source of historical information, may be used to examine trends in stock abundance for each Atlantic salmon producing country. Prior to 1995, methods used to collect catch statistics varied by country, producing areas of incompatibility. NASCO has since adopted a minimum standard for catch statistics. Nevertheless, ICES has established a time series harvest/stock return database for nearly 1000 North American and European rivers to help track the relative abundance of Atlantic salmon.

MANAGEMENT ACTIVITIES

Management activities encompass past and present management activities, plus recommendations for future actions. ***Management recommendations and activities*** for a specific lake or stream are generally developed/performed to mitigate a known problem. Fishery management problems might include overfishing of a specific age class, public angling is restricted, limited fish habitat or unrestricted gear is causing over-exploitation.

Fishery managers generally have four tools available to them to improve or protect fish and fish habitat: regulations, stocking, habitat protection or restoration, and public education and information. To protect fish stocks, ***angling regulations*** are established to restrict gear and set bag limits, size limits, and season lengths. Regulations sometimes only apply to certain segments of a stream.

To restore the fishery resource, provincial and federal agencies have been involved in habitat protection/restoration and ***fish stocking*** programs for many years. Stocking may introduce or regenerate a fish species. Alternatively, it may support "put and take", as well as "put, grow and take" fisheries designed for waters where sufficient natural reproduction is not possible to support a sport fishery.

From a water resource perspective, management activities include restricted land use within a watershed or within lake or stream buffers.