

NEW BRUNSWICK'S WATER BODY INVENTORY

NB Aquatic Data Warehouse, Canadian Rivers Institute

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OVERVIEW: The water resource inventory is the foundation of the NB Aquatic Data Warehouse. It contains basic information on all of New Brunswick's lakes and streams, including stream order, stream permanency, and tidal influence, plus the lake or stream into which each body of water flows into. In the case of coastal streams, the name of the receiving bay or cove is noted. In addition, lake and stream dimensions, such as total length, surface area or maximum depth, are captured if available.

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 twelve major drainage basins. Each basin is then divided into composites and 5th order or higher streams, according to Strahler's (1952) stream ordering method. 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 km². Please refer to **New Brunswick's Drainage System** document for details.

The water resource inventory is based on the Service New Brunswick's (SNB) 1:10,000 scale hydrographic data. The base was developed in the early 1980's through interpretation of spring and late fall aerial photographs. As such, the digital data represents high water conditions.

The water resource inventory exists as a tabular database and as a series of point layers which can be viewed or plotted with GIS. Three point layers were created; two are used for labeling water body ID's and water body names, while the third layer identifies the location of order change along streams (Figure 1).

DATA SOURCES: The water resource inventory was developed by the NB Aquatic Data Warehouse in 1997. Service New Brunswick's hydrographic data was the primary source for developing the inventory; NR Canada's National Topographic Series 1:50,000 maps were used as a cross reference. The NB Gazetteer was referenced for official water body names.

Additional attributes for some of the primary lakes and streams were acquired through GIS measurements, such as stream length, lake area and perimeter. Lake surveys, performed by the New

Figure 1. Water inventory numbering technique used by the NB Aquatic Data Warehouse.



METHODOLOGY: Within GIS, a stream is represented by many segments rather than a single line. That is, the line is segmented or broken each time a tributary joins a stream. Ideally, the water body ID should be attached to each stream or lake segment so one could ask the computer system to display a specific body of water. Due to the extended effort of this exercise and limited resources, an alternate method was employed. Point files were digitized for labeling water body ID's and water body names. Secondly, locations of stream order change were also digitized (Figure 1). This approach allows the information to be viewed or plotted with the lakes and streams.

The water resource inventory is based on the following rules:

Numbering Lakes and Streams

All streams and any lake 10 acres or larger, named or unnamed, are given a unique number or water body ID. Lakes less than 10 acres are numbered if they have an official name or have been surveyed. Should a small unnumbered lake require an ID in the future, it can be easily added to the inventory.

Working within a drainage basin, the bodies of water are numbered sequentially in a clockwise direction. As each ID is assigned, the following information is input into a water inventory data file: unique water body ID number, water body name, highest stream order (see *Stream Order* below), intermittent indicator, tidal influence indicator, and the name and number of the stream or lake to which the water body flows. If the stream flows into the ocean, the name of the cove or bay is recorded, but no number is assigned to the receiving water.

A point layer was created for labeling the water body ID beside each lake and stream (Figure 1). Larger streams generally required several points along their length to clearly indicate their path.

Rules or guidelines used for numbering lakes and streams are summarized below:

- ▶ Streams and lakes are numbered as they are encountered while moving clockwise through the stream network. If a stream or lake has tributaries, it is numbered first then its tributaries.
- ▶ All named lakes are included in the inventory, regardless of size. All unnamed lakes are measured. If a lake is 10 acres or larger, it is included in the inventory. Each of these lakes is checked on the National Topographic Series (NTS) 1:50,000 maps to see if it is actually a lake or a wetland area (this is not always distinguishable in the Service New Brunswick data). If it is a lake, it is assigned a unique water body ID number.
- ▶ If a lake is numbered, inflows are assigned different IDs than the outflows. Otherwise the lake is considered a part of the stream and does not affect the numbering scheme. There are a few exceptions to this rule where named streams flow through named lakes (e.g. South Branch Renous River); this is accepted only when the stream's path is clearly defined on the NTS 1:50,000 topographic maps.

- ▶ If a lake is smaller than 10 acres, it is considered an in-stream lake and the inflow and outflow are given the same number. If there is more than one inflow, the stream course has to be determined.
- ▶ To determine the source of a stream, the 1:50,000 NTS map is referenced. In the event the stream source is not clearly marked on the NTS map and there are two or more possible sources, the longest stream is selected as the stream source. If there is a lake with the same name as the stream, it is considered to be the source (e.g. Trout Lake is the source of Trout Brook).
- ▶ If a named stream forks into two named branches (e.g. North and South Branches Renous River), the forks represent the end (or source) of the main stream. Each branch is assigned a unique stream ID different from the main stream ID.
- ▶ Bogans and dead waters, even if named, are not included in the inventory as they are considered a part of the main stream. However, any streams flowing into bogans or dead waters are numbered.
- ▶ When a main stream flows through a wetland, there are often numerous tiny streams flowing in and around the main stream (e.g. South Branch Southwest Miramichi River). Only source streams are assigned numbers, i.e. those entering the wetland.
- ▶ Only one ID is assigned to streams that split.

Naming Lakes and Streams

Only names found on the NTS 1:50,000 topographic maps are used. These names were later verified within the *Gazetteer of Canada: New Brunswick* published by the Canadian Permanent Committee on Geographical Names, Canada Center for Mapping, Natural Resources Canada. Although the major streams and lakes have names, many of the smaller brooks and ponds do not.

Three names are maintained for each lake and stream - official name, abbreviated name and alternate name. The alternate name may be a local name which is not in the Gazetteer or it can be a name found in the Gazetteer, but has been superseded by a more recent official name.

The abbreviated name should be used on reports and maps or where space is limited. Only stream names containing "Branch" were shortened. For example, the abbreviated name for "Lower North Branch Little Southwest Miramichi River" is "Lwr N Br LSW Miramichi River". Where no adjustments have been made, the abbreviated name contains the full length official name. The alternate name represents common or local names.

Water Body Complexes

There are instances where the official name refers to more than one body of water. For example, the name "Twin Lakes" refers to two adjacent lakes within the Miramichi drainage. Since it is desirable for the inventory to track every distinct body of water, each lake is assigned a unique number while their official names are the same (Twin Lakes). However, both records reference a water body complex to

indicate both lakes belong to the “Twin Lakes” complex. In addition, the abbreviated name notes the relative position of each lake, for instance “Twin Lakes (East)”. Each water body complex is assigned a unique number.

Drainage System Codes

Each lake and stream is assigned to a series of drainage system codes to reflect its position within the drainage basin. Please refer to **New Brunswick’s Drainage System** document for details on how drainage boundaries are defined.

Stream Order

Strahler's ordering system was utilized for identifying stream order. In this system, the number and order of streams that flow together to create a larger stream determine a stream's order. Source streams, which have no tributaries, 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. Larger streams will have sections with different orders, while small headwater streams will be a single order throughout their entire length.

Stream order was recorded in the GIS by digitizing the locations along streams where order changed. Larger streams that consist of multiple stream orders along its length have stream order change points at the confluence of an equal or higher ordered stream. The following are rules used for applying stream order:

- ▶ Stream order does not change within estuarial waters, that is, stream order is used for classifying freshwater streams only.
- ▶ If a stream of higher order (a tributary) enters a stream of lower order (the main stream), the main stream increases its order to the order of the tributary.
- ▶ If two or more streams of the same order enter a lake, the order of the outlet stream increases by one (e.g. if there are two 1st order inflows, the outflow is 2nd order). If there are two or more inflows to a lake, but only one has a higher order, the order of the outflow remains the same (e.g. if there are two 2nd order and one 3rd order inflows, the outflow is 3rd order).
- ▶ If two named streams join to form a third stream which has a different name, the latter does not have a 1st order section. Instead the stream's beginning order will be equal to or higher than the merging branches. The North Branch Renous River joining the South Branch Renous River to form the Renous River is an example.
- ▶ When order changes along a stream, it always occurs at the confluence of another stream.

Stream Permanency

During the development of the Service New Brunswick's hydrographic base, the digitized lines were assigned codes to indicate the type of hydrographic feature. For instance, the codes include lakes, double line (≥ 10 m wide and have right and left banks) and single line (< 10 m wide) permanent streams, and single line intermittent streams. Hydrographic maps are generally plotted with different colors to illustrate the various water feature codes. In many cases, streams begin as intermittent single lines then change to permanent single lines. A stream is only recorded as intermittent if its entire length is coded as intermittent. Appendix A contains Service New Brunswick's codes for water features.

Tidal Influence

Within the hydrographic base, portions of streams below the head of tide are coded as coastal. If a stream contains a coastal portion, or flows into the coastal portion of another stream, it is coded as having tidal influence.

DATA FILES:

Tabular Data

There are four tables within the water resource inventory. One is the master table which maintains the list of all bodies of water. The second maintains the names of water body complexes where a single official name refers to multiple features, such as "Twin Lakes" and "Kennedy Lakes". Two additional tables maintain attributes that are specific to lakes and streams, respectively. The water resource inventory table only includes fields of information that are common to all types of water bodies.

Spatial Data

Service New Brunswick's hydrographic data is the basis of the water resource inventory. In addition, there are three point layers to support the inventory: water body IDs, water body names and stream order.

In addition, route systems were created for primary lakes and streams within each basin. Route systems allow linear referencing of data along streams, that is, data can be stored in river miles or meters.

REFERENCES:

Strahler, A. N. 1952. Hypsometric (area-altitude) analysis of erosional topography. Bull. Geol. Soc. Am. 63: 1117-1142.

APPENDIX A

Service New Brunswick's

Hydrographic Feature Codes

WATER FEATURE CODE (FCODE)	DESCRIPTION
WACA	Canal
WACA04	Canal Abandoned
WADI	Ditch
WADI05	Ditch Indefinite
WACO10	Coastline (left)
WACO20	Coastline (right)
WACOIS	Coastal Island
WALK10	Lake (left)
WALK20	Lake (right)
WALKIS	Lake Island
WARS10	Reservoir (left)
WARS20	Reservoir (right)
WARVDL	River Double Line
WARVDL10	River Double Line (left)
WARVDL20	River Double Line (right)
WARVDL15	River Double Line Indefinite (left)
WARVDL25	River Double Line Indefinite (right)
WARVIS10	River Island (left)
WARVIS20	River Island (right)
WARVIS15	River Island Indefinite (left)
WARVIS25	River Island Indefinite (right)
WARVLK10	River Lake (left)
WARVLK20	River Lake (right)
WARVIS	River Island
WASL	River Single Line
WASL05	River Single Line Indefinite
WARVSP	River Split
WARVSP05	River Split Indefinite