GeoBase – National Hydro Network

Canadian Hydrographic and National Surveyors Conference

7 May 2008

www.rncan.gc.ca

Ressources naturelles Canada | Natural Resources Canada

Canada

Objective

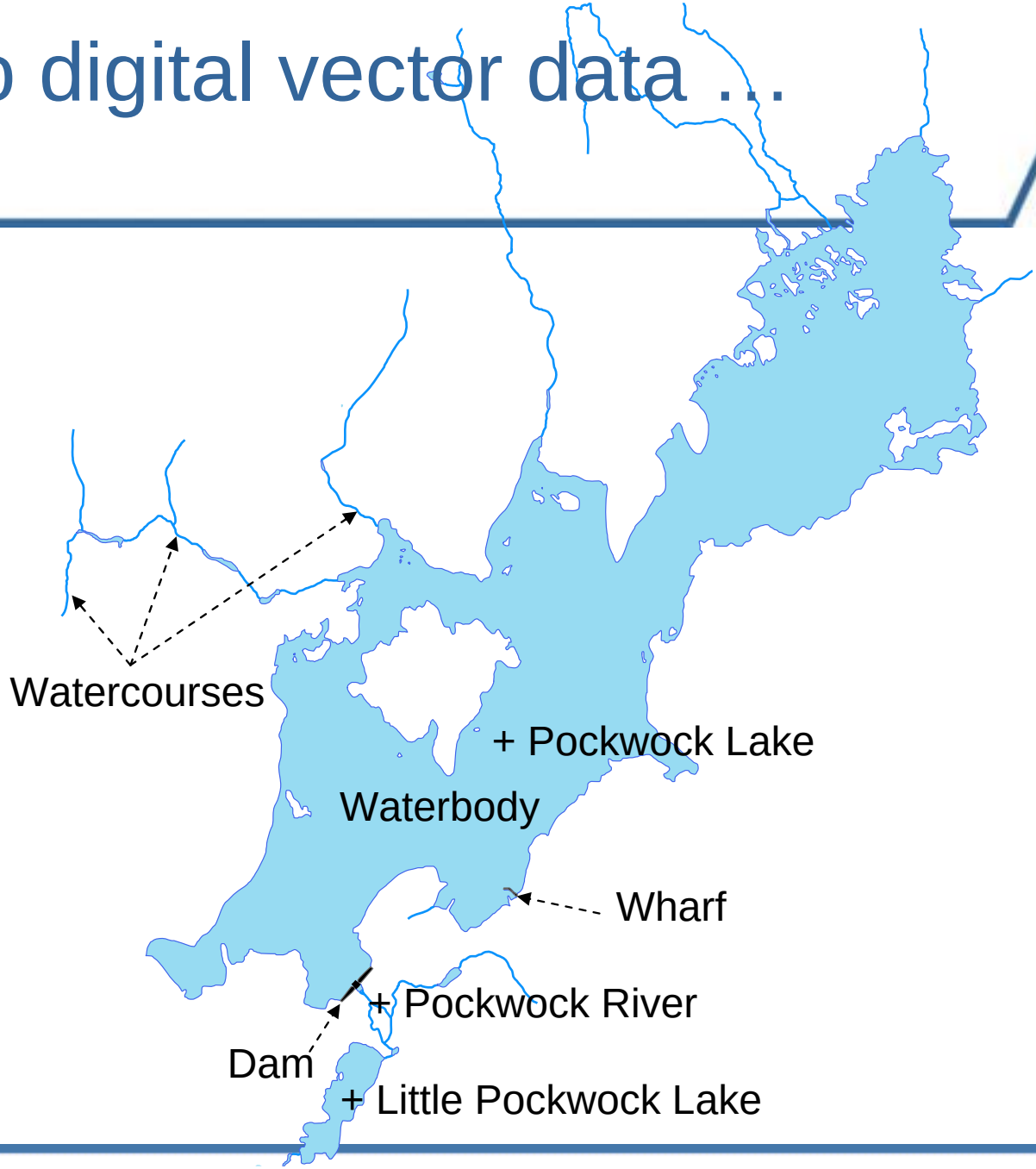
- Awareness
  - What the NHN is about (what and what for)
  - How it is being built
  - Where it is at
  - What the challenges and next steps are
  - How to get in touch if there is interest

Canada's base hydro data

- Canada's geospatial foundation for water-related information
- A national set of base data, representing the inland surface waters of Canada – not bathymetry
- From a graphical representation to an intelligent network organised in «drainage areas», suitable for network analysis and modeling for decision making
- Built from the best available data in Canada through the GeoBase initiative

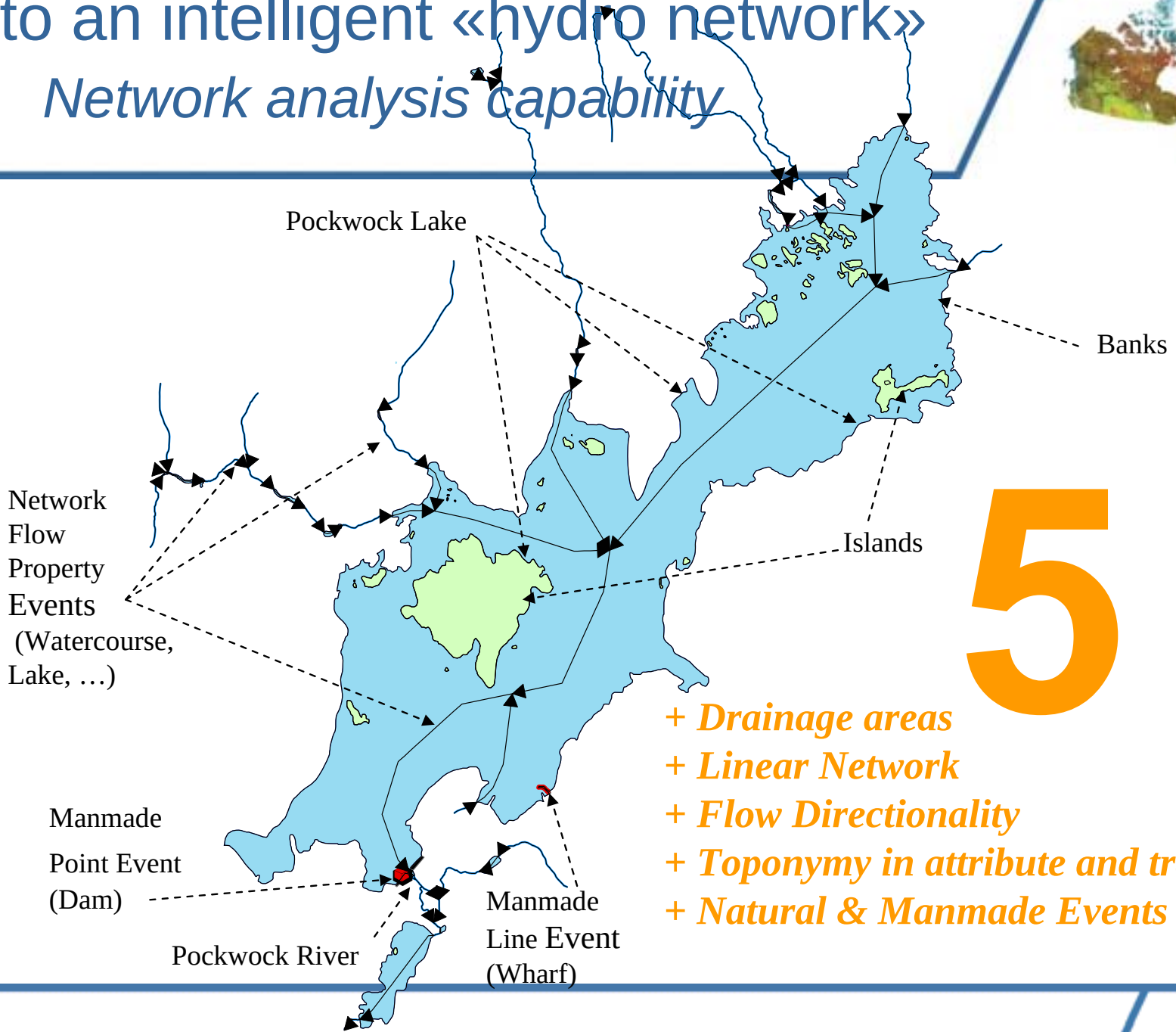
From base maps ...

… to digital vector data …



… to an intelligent «hydro network»

Network analysis capability



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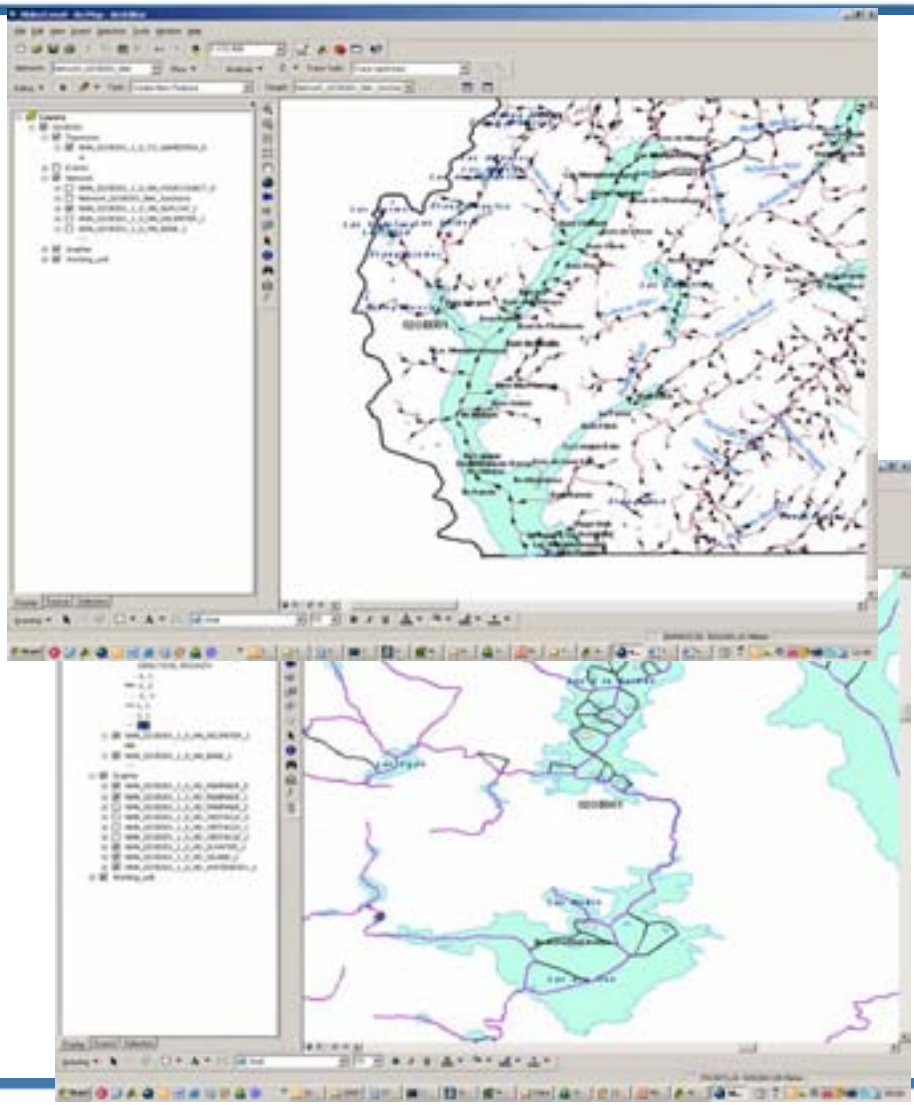
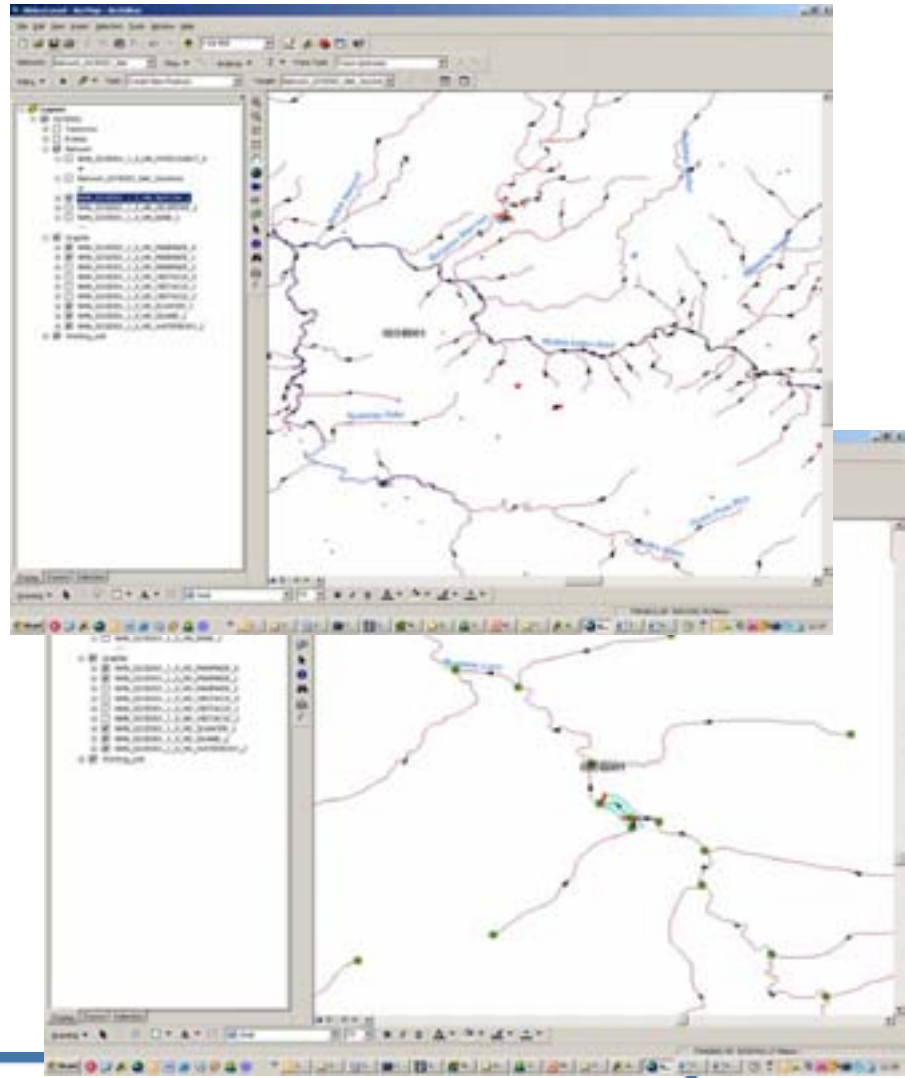
+ Drainage areas
+ Linear Network
+ Flow Directionality
+ Toponymy in attribute and traversals
+ Natural & Manmade Events - LRS

A look at NHN Data

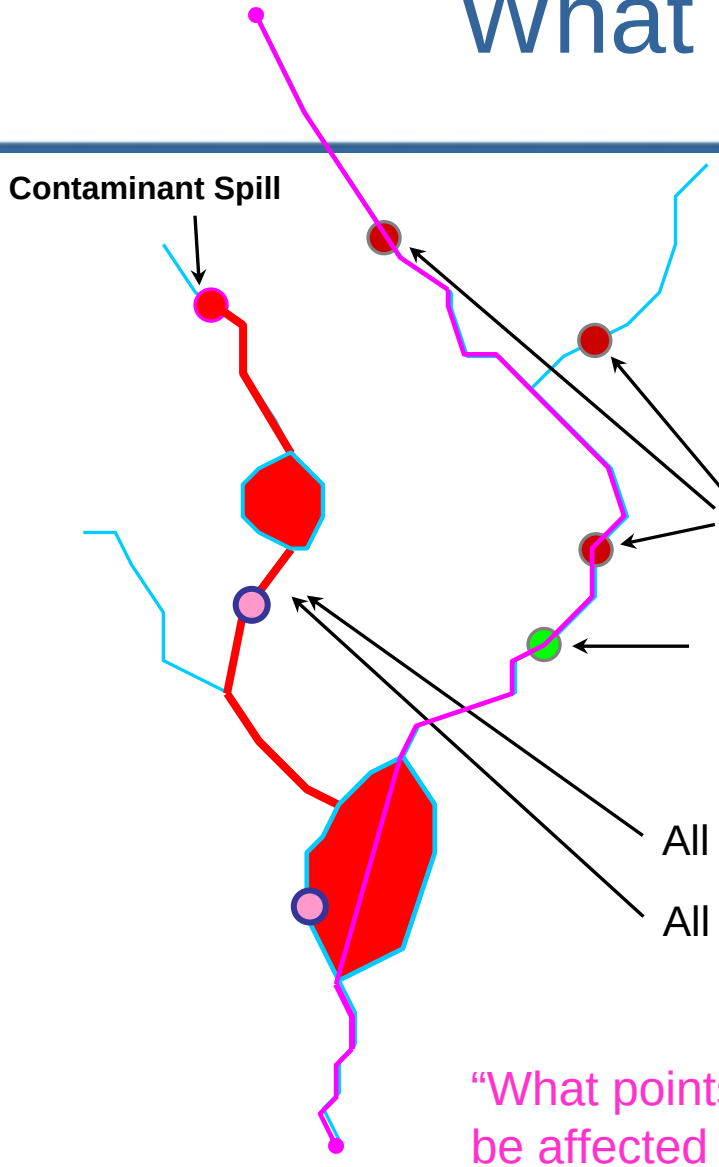




NHN Product Overview

- In a nutshell the NHN is:
  - A linear Network of hydro centerlines with water flow directionality.
  - A collection of hydrographic phenomena (ex. lakes, rivers and islands) linked to the «hydro network».
  - A collection of events (rapids, falls, dams, wharfs, etc.) associated to the «hydro network».
  - A collection of toponyms attributed to hydro features.
  - Metadata.

What if?



Network properties can be used to construct queries about effects of events on the network

"Given that the contaminant spill will disperse over 800m, what water features will be affected?"

These points of diversion are upstream of this point.

"What points of diversion are upstream from a new, proposed point of diversion."

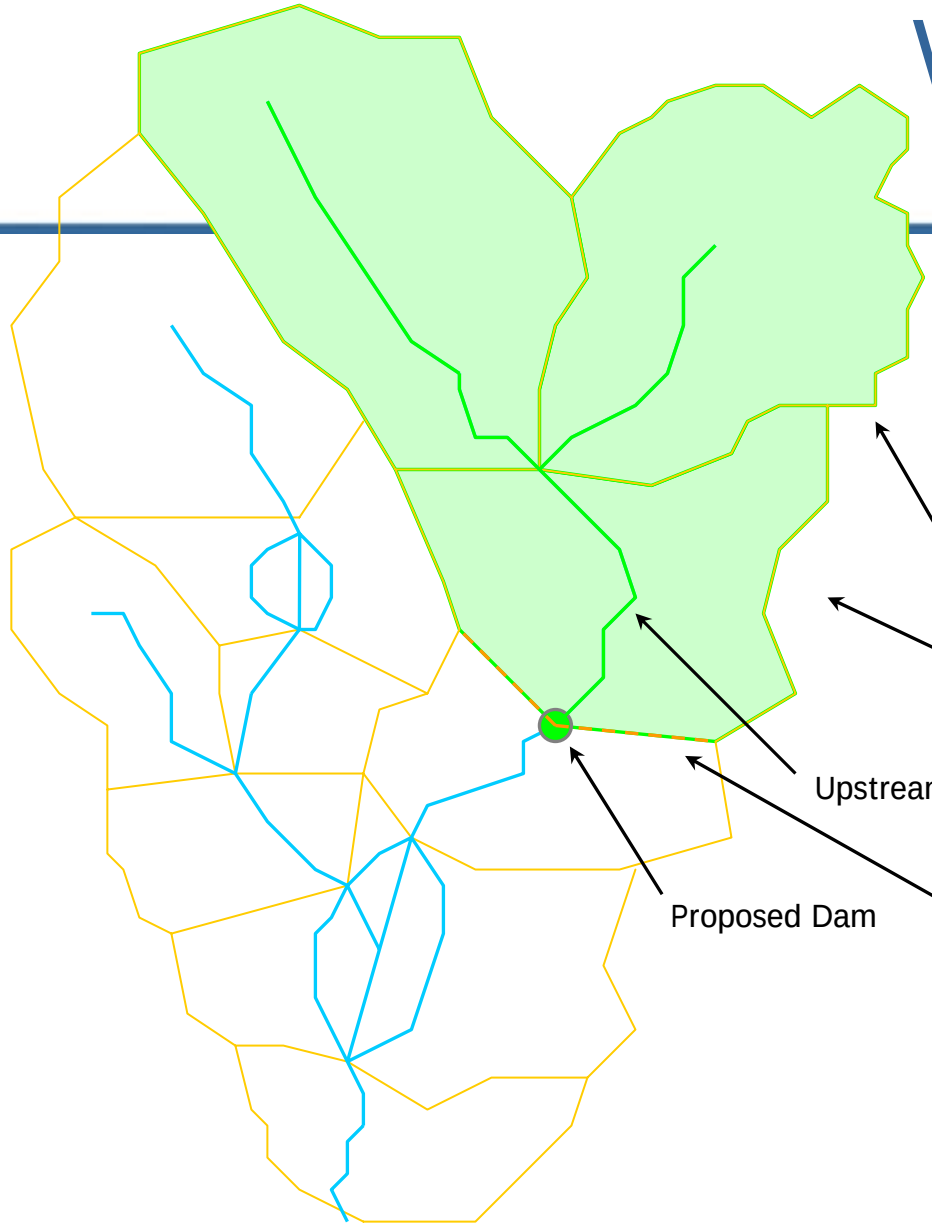
All affected water features.

All segments downstream to a max of 800m.

"Where is Smith River?"

"What points of diversion in the Smith River watershed may be affected by the contaminant spill?"

What if?



"What is the catchment area for a proposed micro-hydro facility?"

Upstream Catchments

Complete catchment area

Upstream Segments

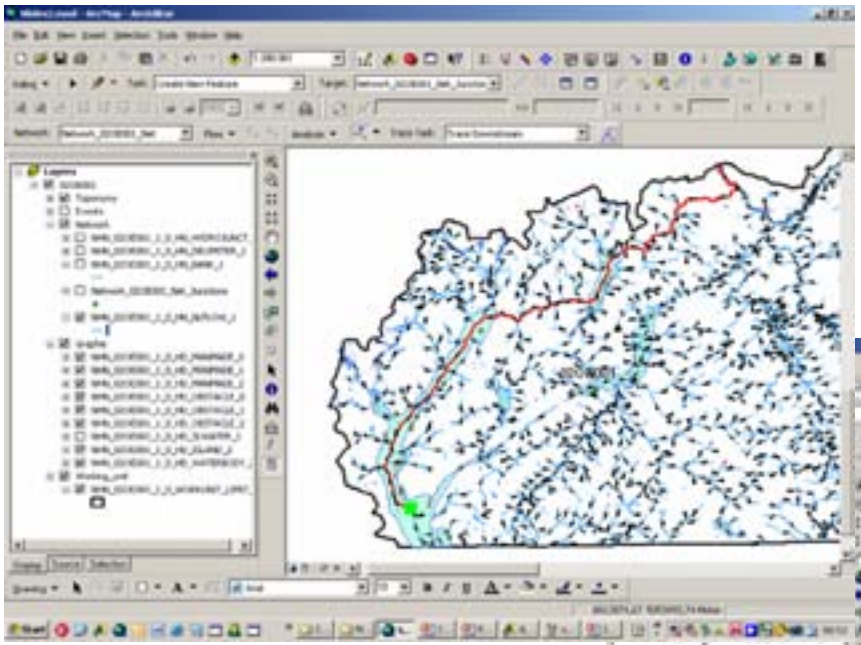
Proposed Dam

Build divide lines from diversion point using an elevation model

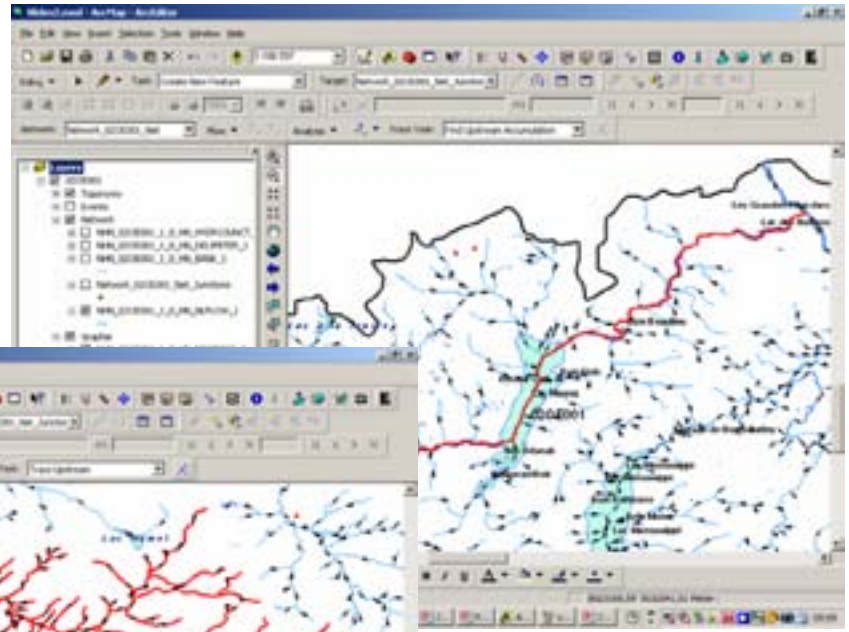
Tying upstream properties and drainage areas together allows queries which calculate aggregate drainage area.

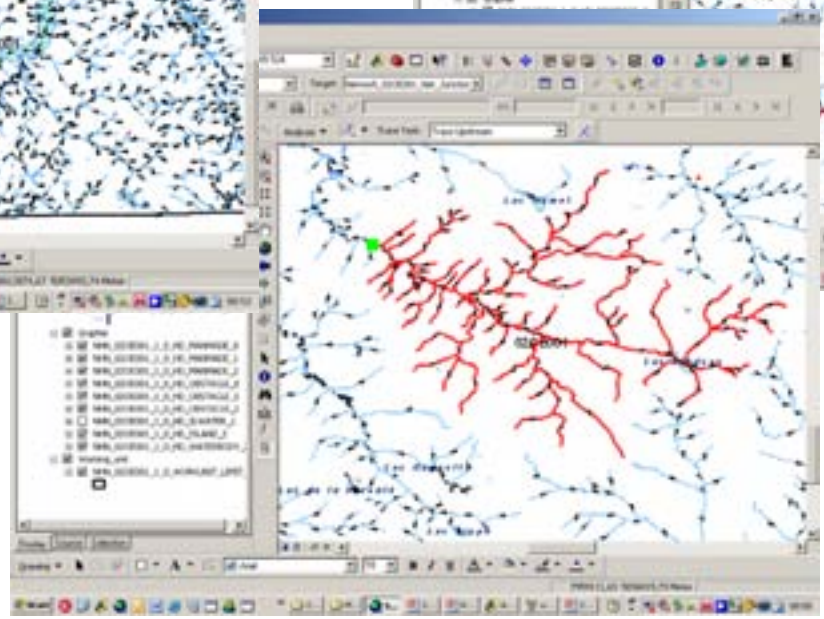
Navigating the network?

Downstream tracing



Attribute query on toponym

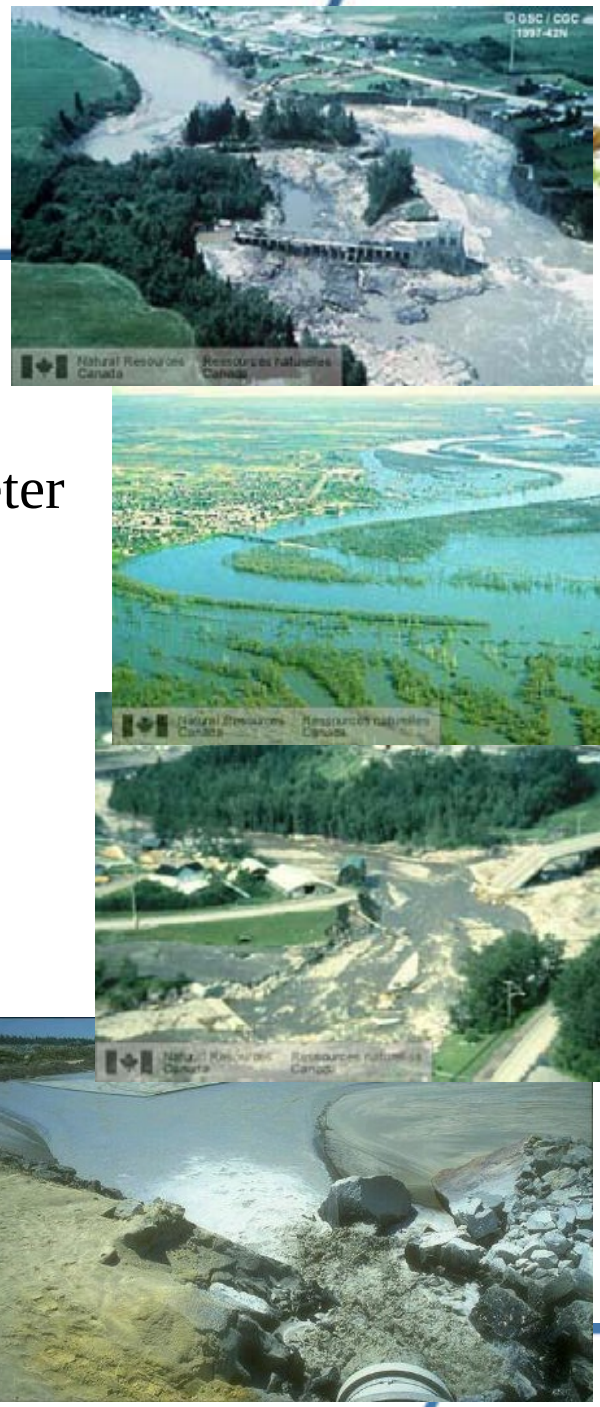




Upstream tracing

What if?

- … a dam collapses
- … a flood raises the level of water by one meter
- … a new land use creates additional run offs
- … a landslide change the location of a waterbody effluent
- … a change in a paper mill process off-loads new types of substance
- … a power plant needs more water
- …



A national governance issue

Proper consideration of the water issue is critical to sustainable activities and development:

- Environment
- Agriculture
- Forestry
- Fishing
- Natural habitats
- Climate Change
- Health

- Safety and security
- Hydro electricity
- Oil
- Mining
- Industrial processes
- Leisure and Tourism
- Etc.

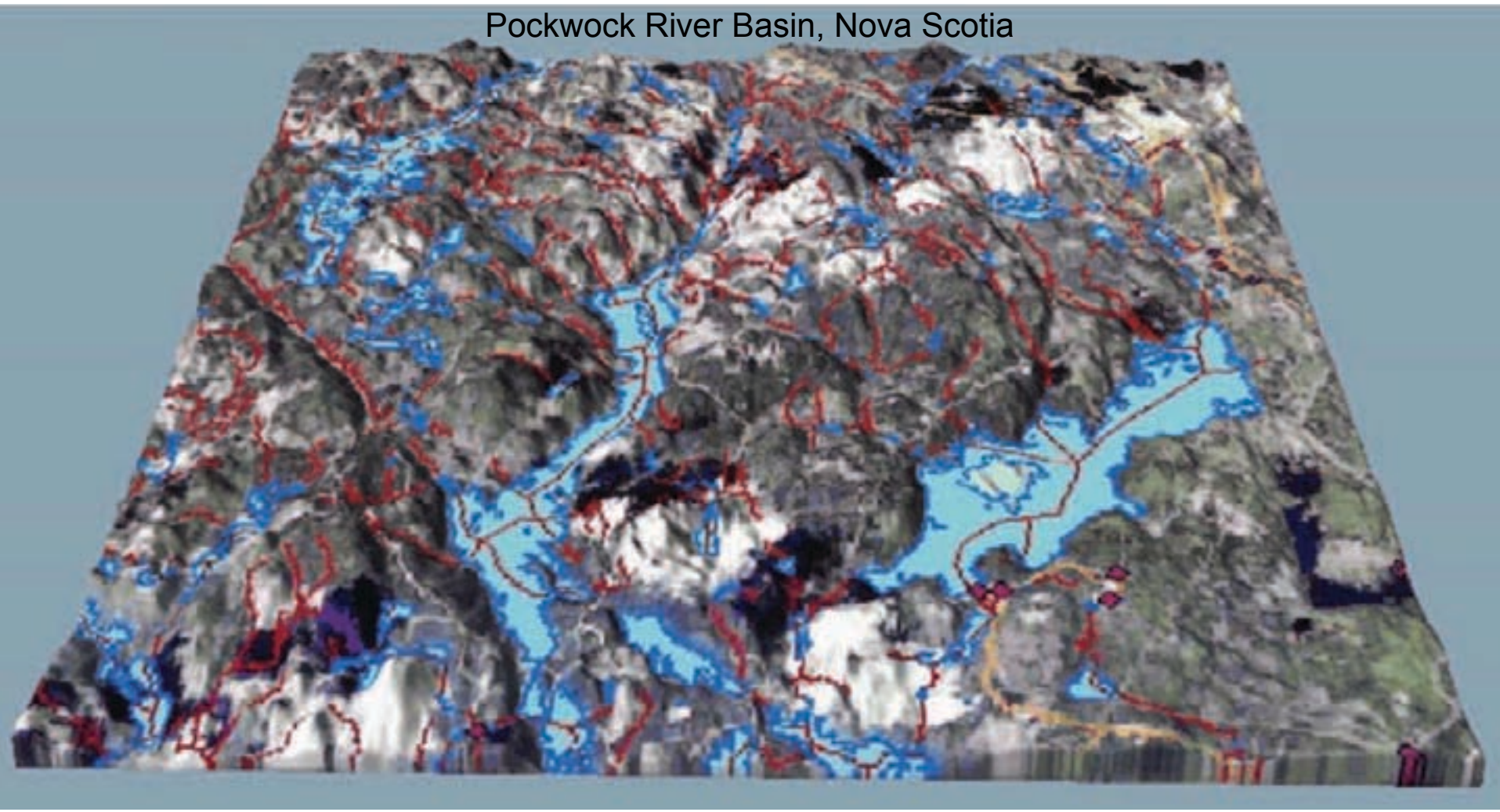
NHN – Part of GeoBase

- Canadian Council on Geomatics
- National base geospatial data initiative
- Federal and Provincial / Territorial collaborative initiative
  - *National coverage*
  - *Unique*
    - One data, collected once, the closest to source
    - From the best data available
  - *Quality*
    - Consistent: to National Standards
    - Accurate: precise
    - Current : up-to-date
  - *Sustainable*
  - *Freely accessible* through a national portal www.GeoBase.ca

NHN – Part of GeoBase

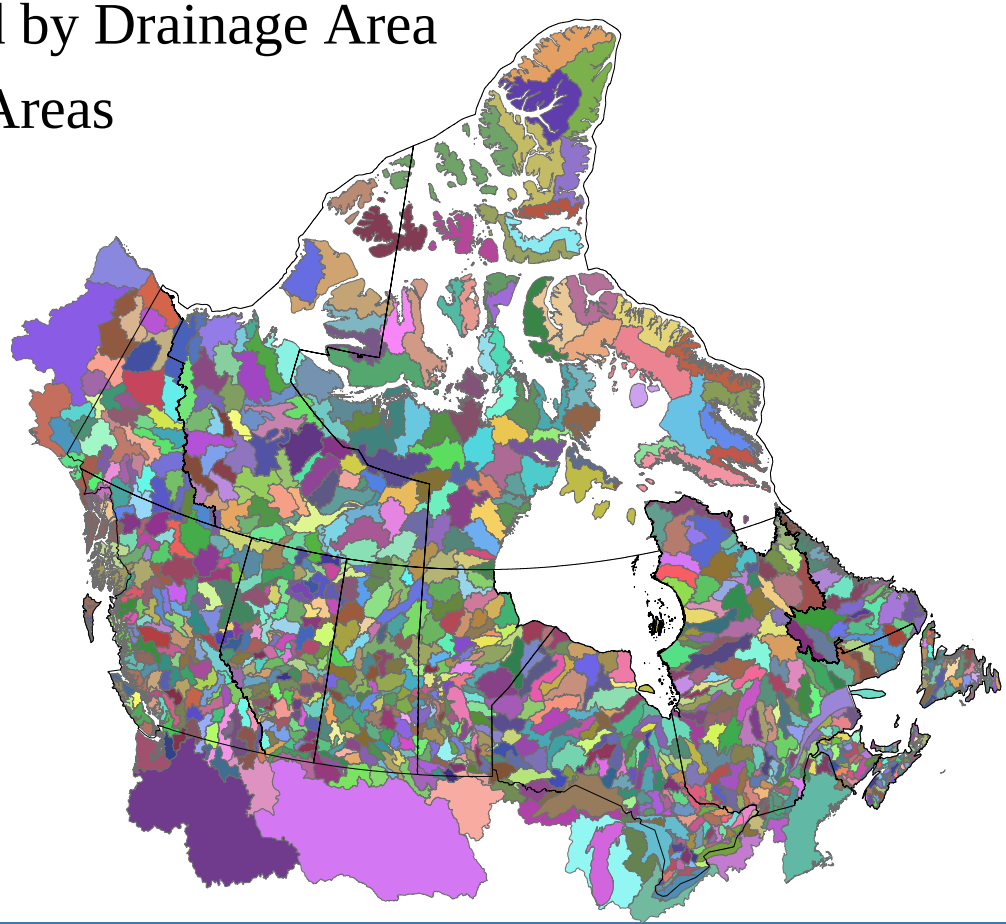
- Existing GeoBase themes
  - Canadian Digital Elevation Data (CDED)
  - Ortho-images and Control Points (GeoBase Data Alignment Layer) – Landsat 7 and SPOT
  - National Road Network (NRNv1)
  - Geographical Names of Canada (toponymy)
  - Administrative Boundaries
  - Canadian Geodetic Network
- New themes approved in June 2007
  - National Hydro Network
  - Addition of Street Names and Address ranges to the NRN
- Others to follow
  - Land Cover
  - Administrative boundaries
  - Critical infrastructure

Integrated to the GeoBase framework



NHN Work Units

- From Mapping Tiles to Drainage Area – watershed
- Organized, created and managed by Drainage Area
- Canada = 1150 NHN Drainage Areas

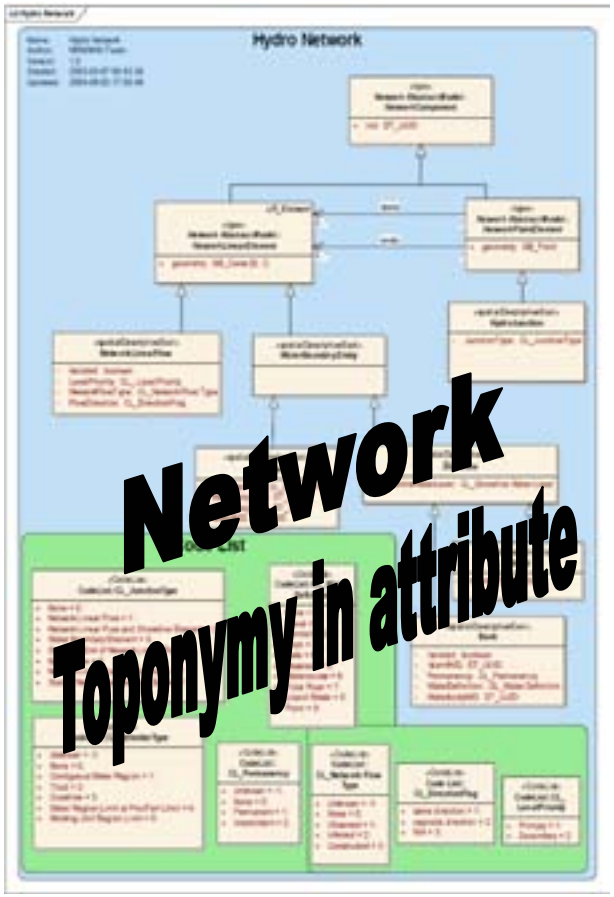


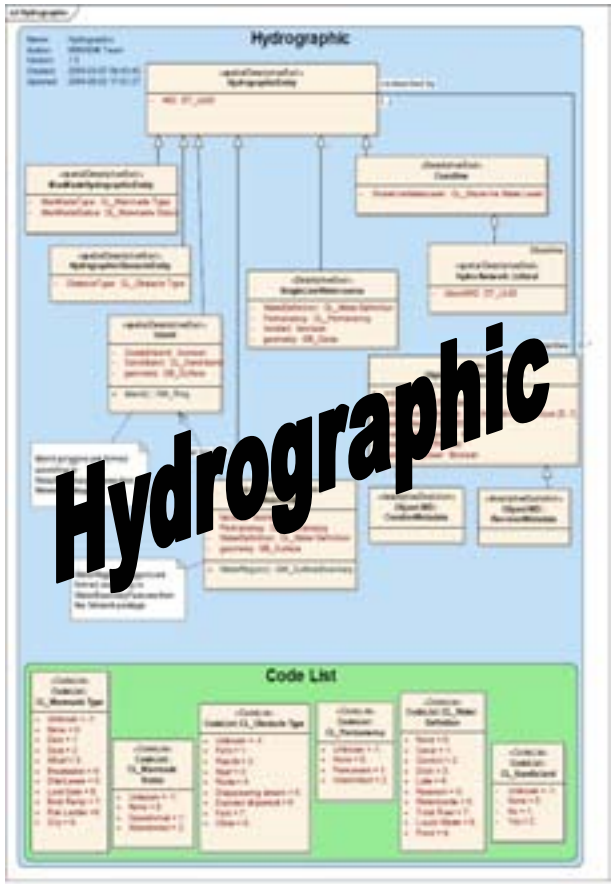
Built to a National Standard

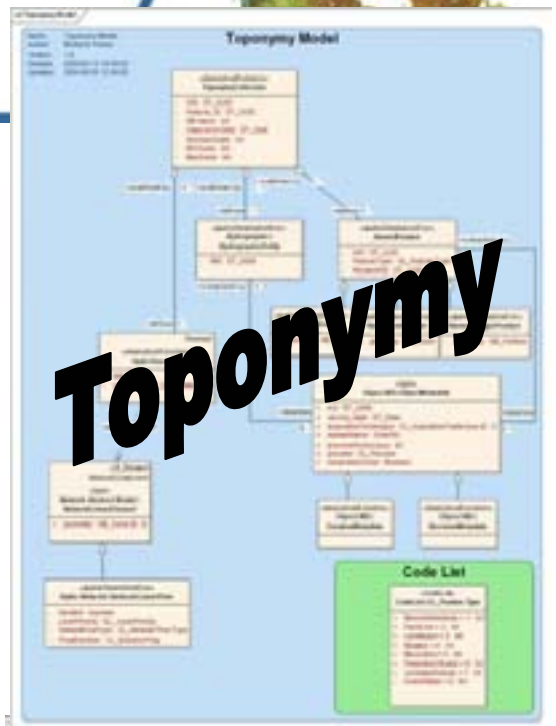
- Broad consensus
  - 2 years development – national consultative process
- CCOG adoption of the «*NHN*, *Canada*, *Level 1*, *Edition 1.0*» Standard in August 2004
- Expandable
  - New innovative Standard based on internationally recognized standards and technologies – ISO and OGC
  - Strong scientific and technical foundation
  - Data Model, Product Specifications and Data Catalog

    http://www.geobase.ca/geobase/en/news/nhn.html

NHN Standard – Data Model







http://www.geobase.ca/geobase/en/news/nhn.html

NHN Standard – Product Specs

TABLE OF CONTENTS

3 Geospatial Characteristics

3.1 Spatial representation type

The NHNC1 is feature-based (or vector) data. Geometric representation details can be found in "*National Vector Data – Geometric Representation and Integrity Constraints*"[4].

3.2 Spatial representation

While the NHNC1 has no explicit topology, it does ensure that the network data are free from any spatial inconsistencies such as overshoots and undershoots. To ensure compliance with the Open GIS Consortium (OGC) specifications concerning spatial relationships for all Simple Features Specifications (SFS), the NHNC1 will comprise two-dimensional planimetric (x,y) data. When available, the height information will be provided without changing the geometry types and associated rules. Therefore, the NHNC1 2D planimetric data (x,y) and optionally a 1D height component (H) with all spatial relationships defined in two-dimensional space.

3.3 Coverage and continuity

NHNC1 data are seamless within datasets and form a continuous network over the Canadian landmass. Segmentation only occurs at National, Provincial, and Territorial limits (called Data Set Boundaries).

3.4 Data segmentation

Network Linear Elements form the geometric structure of the Hydro Network. In accordance with the LRS model, these elements may be segmented for two reasons only:

- Intersection at the same level[3] with another Network Linear Element
- Intersection at National, Provincial, or Territorial boundaries

http://www.geobase.ca/geobase/en/news/nhn.html

NHN Standard – Data Catalog

Example: The « Network Linear Flow » feature class

Network Linear Flow

Definition	Linear spatial representation that traces the movement of water in a one-dimensional flow.
Attribute(s)	Flow Direction, Isolated, Level Priority, Network Flow Type, NID
Association	inherits from Network Linear Element
	is described by 1,1 Object Metadata
Package	Hydro Network

Spatial Integrity Constraints

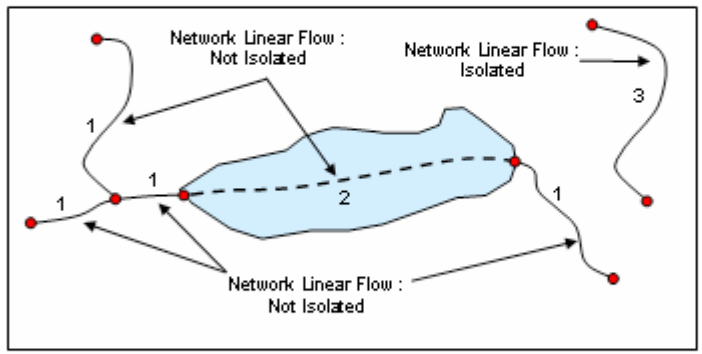
Network Linear Flow	Relation	Object	Geo	Cardinality
Network Linear Flow: Not-Isolated	Touches tangent	Network Linear Element	•	
And				
Network Linear Flow	Touches	Hydro Junction	•	2,2
And				
Network Linear Flow : Isolated	Disjoint	Network Linear Flow Observed	•	
Or				
Network Linear Flow : Isolated	Disjoint	Delimiter*	•	

* Delimiter type 1,2,3.

Representation

The line that represents a Network Linear Flow allows continuity of the waterway in the linear network. The location of the Network Linear Flow is the approximate centerline of the associated waterbody. The definition of a Network Linear Flow inside a waterbody is arbitrary. The network can flow on either or both sides of an island. When adjacent permanent and non-permanent polygons of water occur, the Network Linear Flow considers the entire area as a single water polygon through which continuity must be assured.

Rule for direction: the ordering of vertices must respect a downstream flow direction.



Hydro Junction

1. Network Linear Flow : Observed, Not Isolated
2. Network Linear Flow : Inferred, Not Isolated
3. Network Linear Flow : Observed, Isolated

http://www.geobase.ca/geobase/en/news/nhn.html

Built in phases – Completeness Levels

- Integrate an updating phase to the NHN process
- Streamline the data production process
  - Simplify the contract work
  - Automate
- Facilitate the implication of the partners – data and capacity
- Provide users with interim NHN sub-products during construction

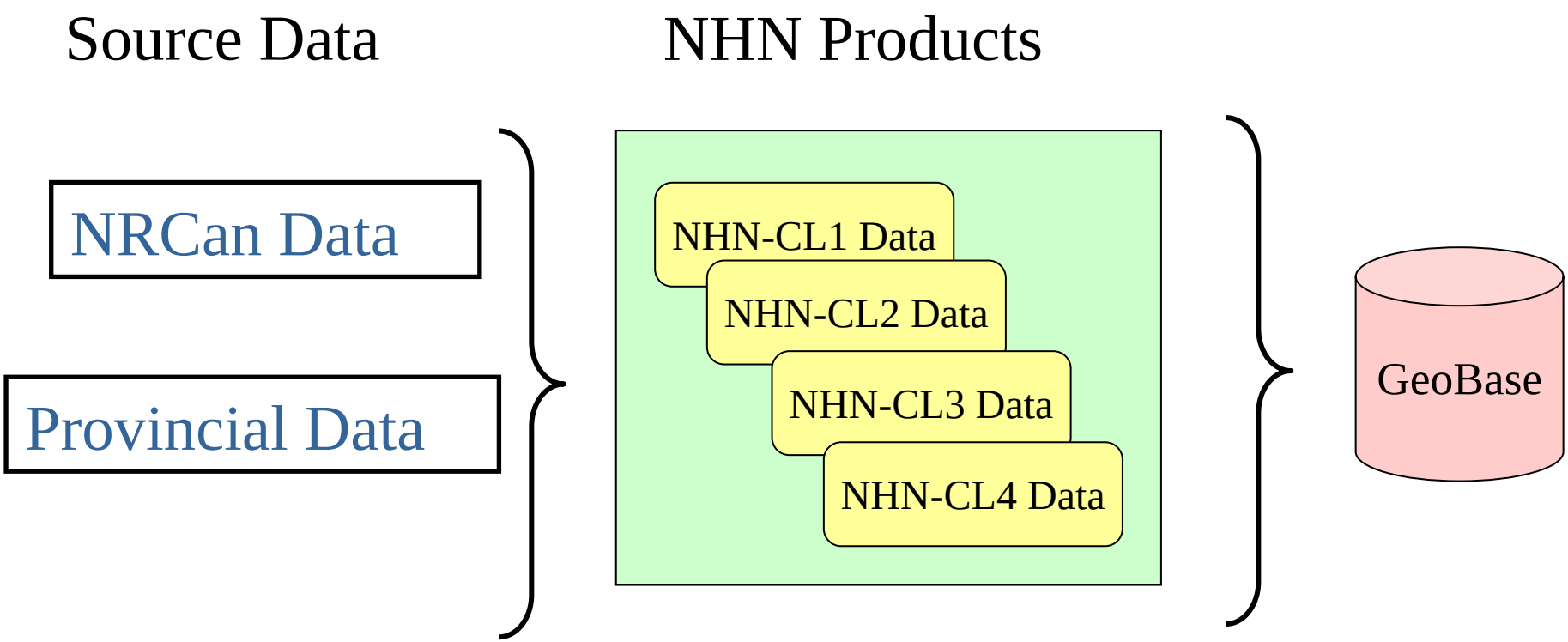
- Built through iterations
  - 4 possible Completeness Levels

NHN Completeness Levels

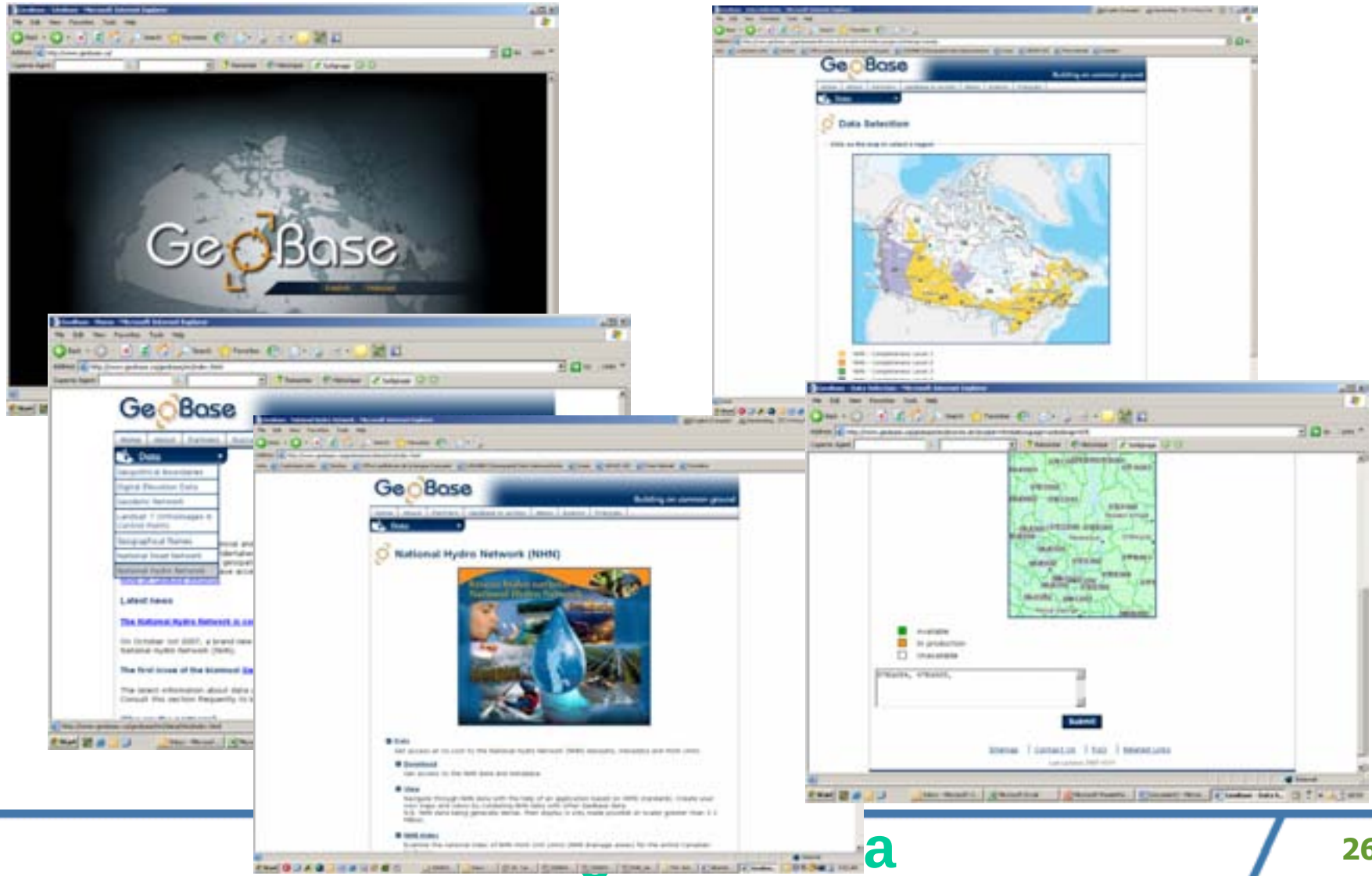
NTDB or Provincial Base Data

NHN-CL1 **NETWORK**	**Network, entity toponymy (70%) and directionality (90%)**	*Automated process*	**National Coverage 2008**
NHN-CL2 **WATERBODY**	**Closed waterbodies Network stability**	*Addition of delimiters*	**2009 – 2010**
NHN-CL3 **CONTINUITY**	**Data continuity, full directionality, full entity toponymy**	*Structuring/Updating*	**2008 – …**
	Base update		
NHN-CL4 **TOPONYMY**	**Virtual and updated toponymy**	*Toponymy Complement*	**TBD**

NHN Completeness Levels

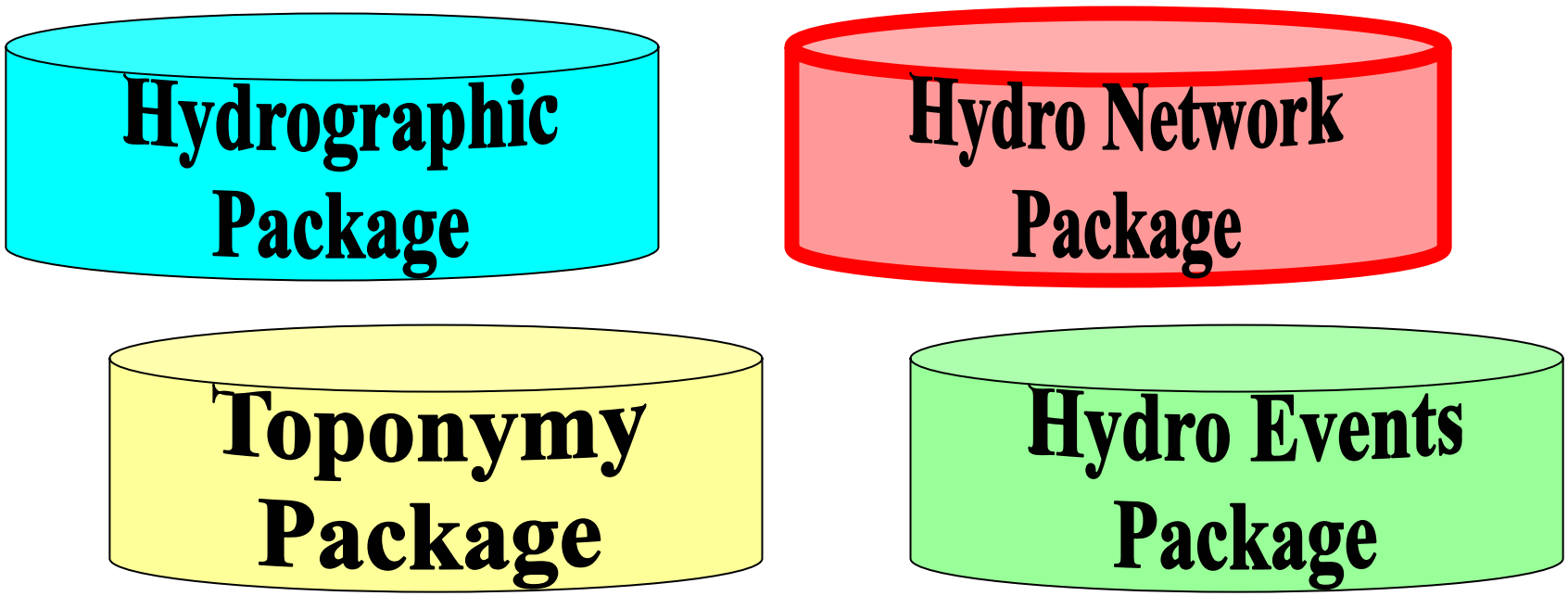


NHN Data on the GeoBase Portal



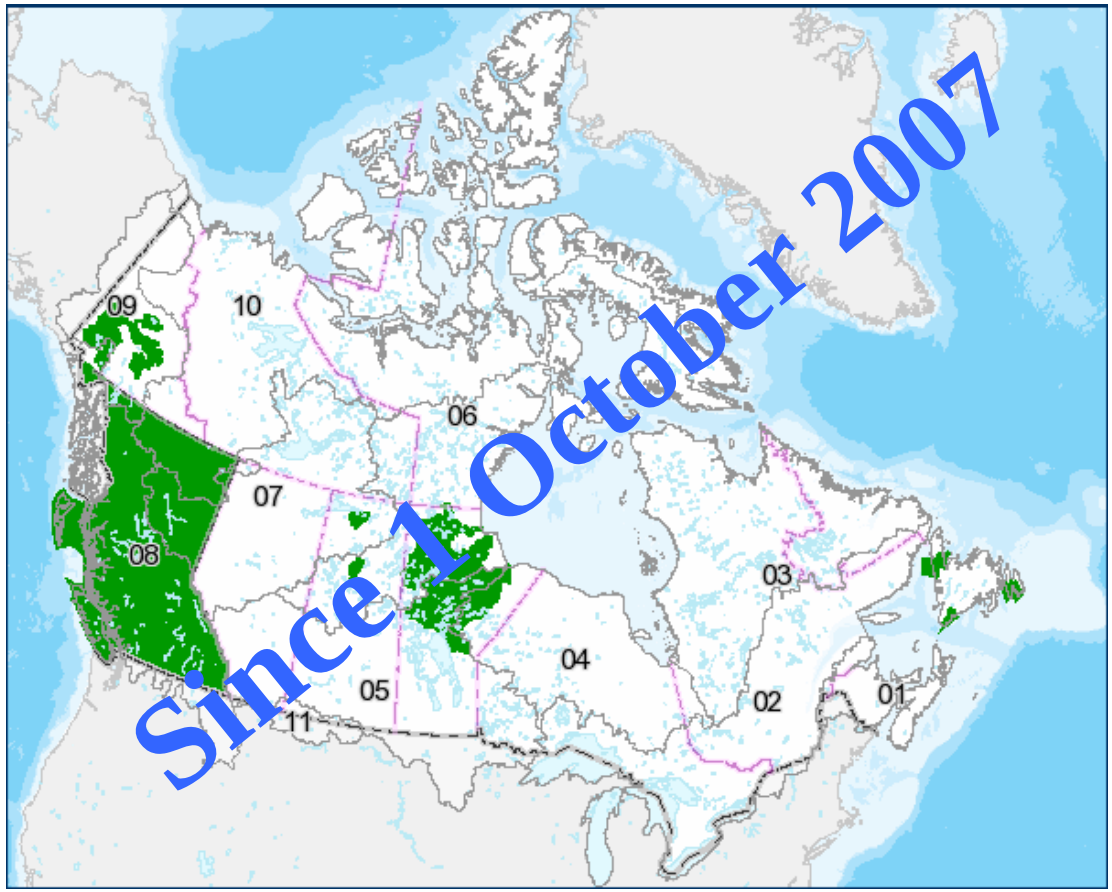
Overview of the NHN Product

- NHN Data:
  - Distributed by NHN Work Units – Drainage Areas
  - Each Work Unit is divided into 4 packages:



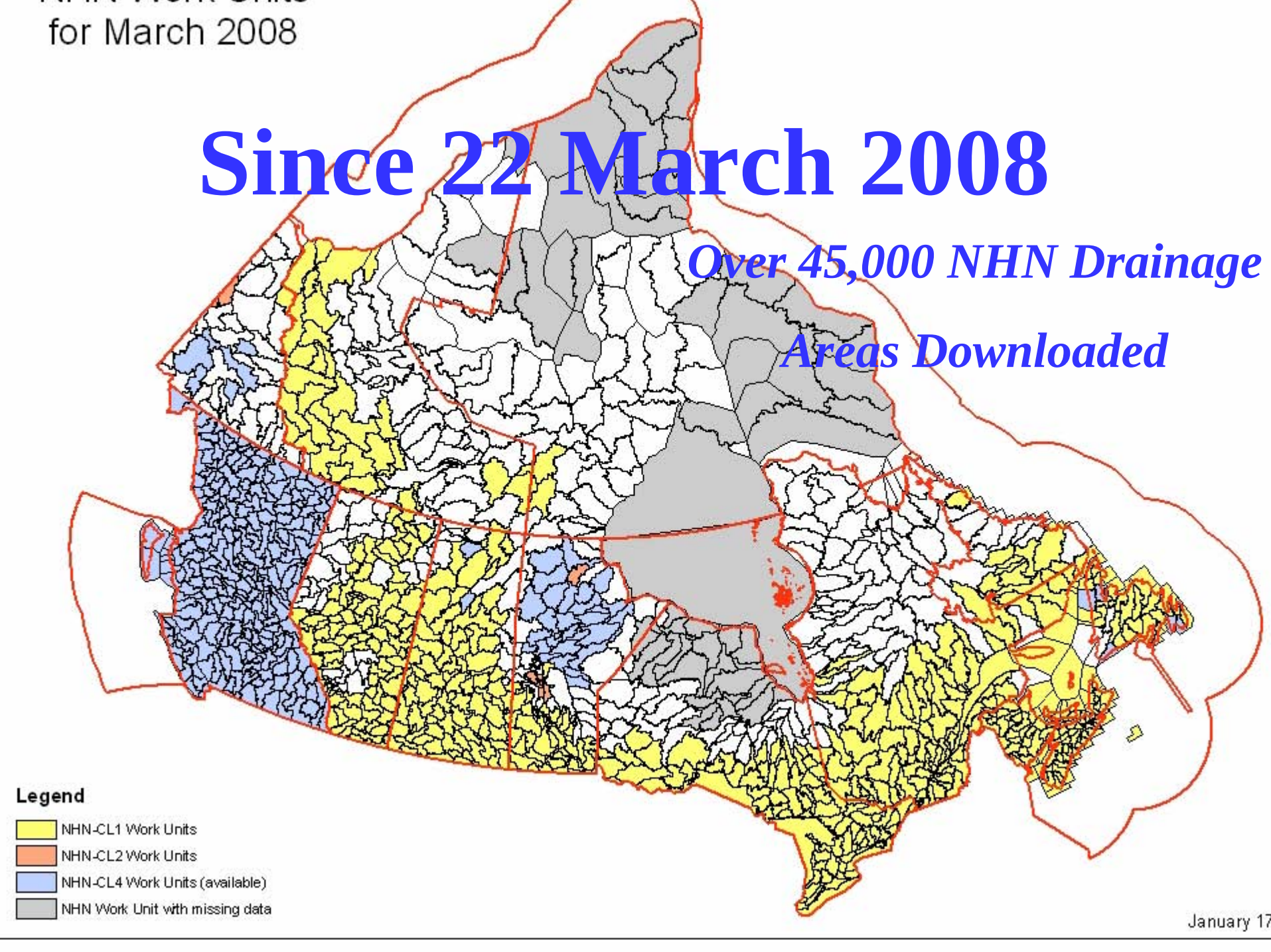
NHN Data on the GeoBase Portal

287 NHN-CL4 in GML, Shape and KML



NHN Data on the GeoBase Portal

KML (Google Earth)


for March 2008
Since 22 March 2008
Over 45,000 NHN Drainage Areas Downloaded
Legend
NHN-CL1 Work Units
NHN-CL2 Work Units
NHN-CL4 Work Units (available)
NHN Work Unit with missing data
January 17

A collaborative effort

- National Standard – 2004
- Implementation strategy – 2008
- GeoConnections Funding – 1,2M$ – 2007
- Agreements to date: BC, NS, YK, MB, ON and QC
- Provincial data into the NHN:
  - 2007 – BC
  - 2008 – Hybrid Model methodology, MB et QC
  - 2009 – MB et QC
  - 2010 – NS, ON, PEI
  - …. – NFL, NB, AB
- Canada-USA-IJC NHN-NHD Data harmonization project
  - 2008 – IJC Pembina Pilot Project and NHN-NHD / methodology
  - 2009 – NHN-NHD data harmonization

Put the NHN data to work

- International Joint Commission – Canada / US Data Harmonisation Project
- Fisheries and Oceans – IFISH / American Eel Pilote Project
- COGESAF – gestion du bassin versant de la Rivière Saint-François
- IACG National Drainage Area Framework
- ACZISC – COIN Atlantic Program
- EC/STC National Geographic Database
- Environment Canada hydrologic and hydraulic modeling

NRCan Drivers

- Objectvives on freshwater
  - Information and understanding for better decision making
  - S&T to minimize the impact of the Natural Resources Sector on ecosystems and water quality
- Stems from national mapping responsibility
  - Federal lead agency on the CCOG
  - National lead agency on GeoBase
- National Hydro Network Project
  - Around $3M per year
  - Programs reviewed every 3 years – 31 March 2011

NHN Contacts

- Earth Sciences Sector (ESS) – ADM, Mark Corey
- ESS Contribution to GeoBase Program – Éric Loubier
- National Hydro Network Project – Yves Belzile
  - Around $3M per year
  - Programs reviewed every 3 years – 31 March 2011

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Centre for Topographic Information in Sherbrooke
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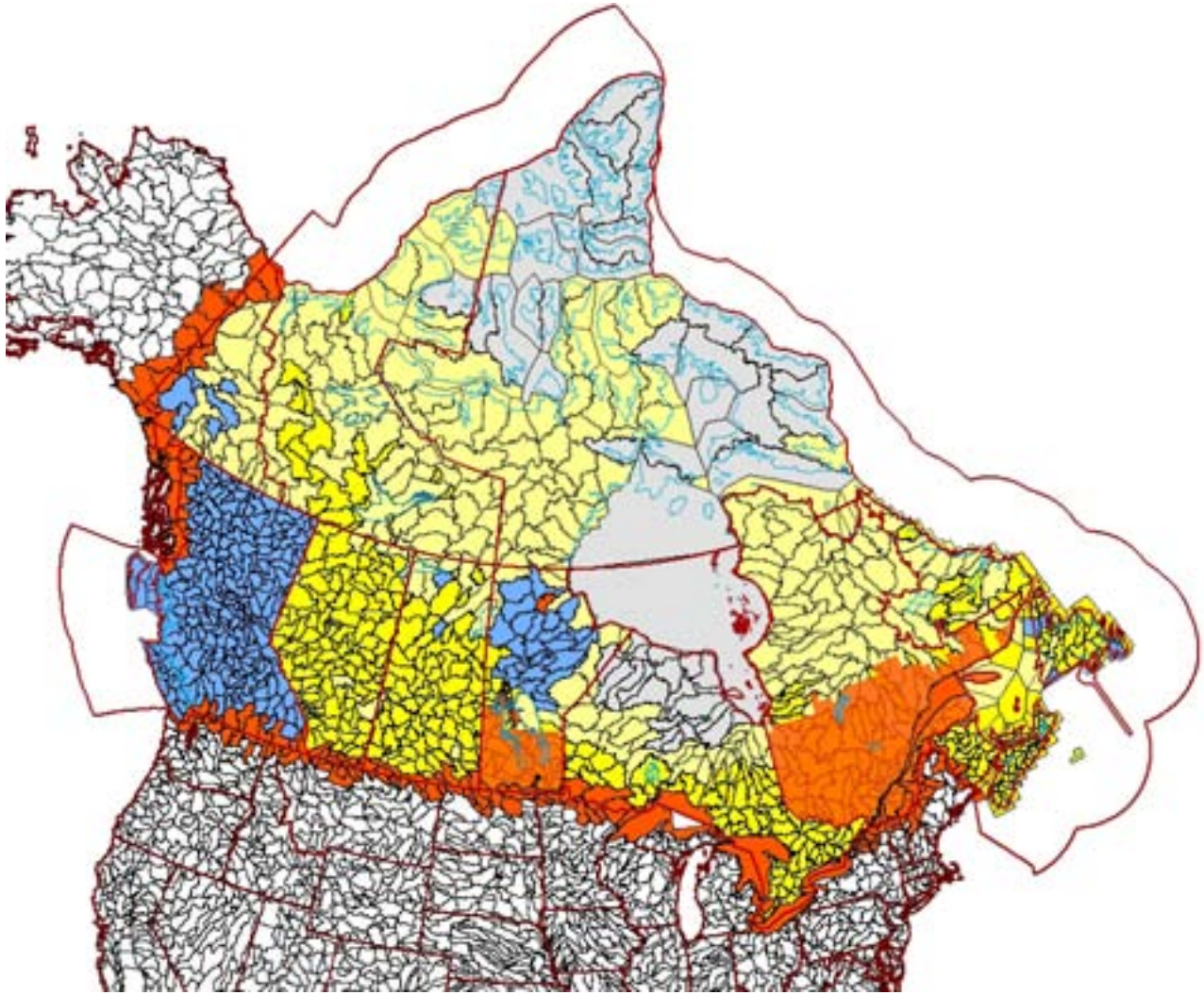
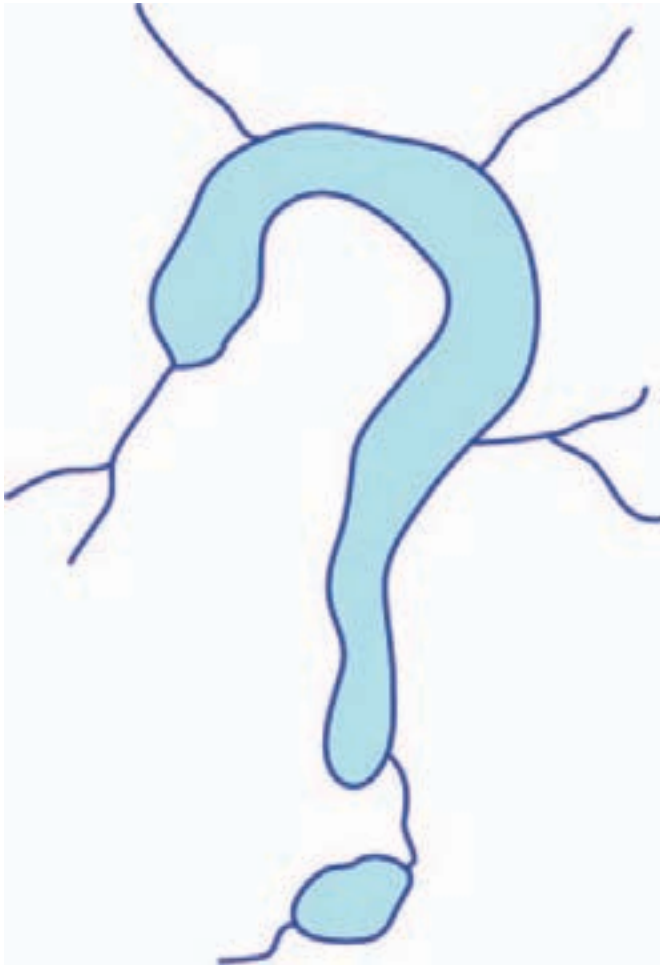
ybelzile@nrcan.gc.ca

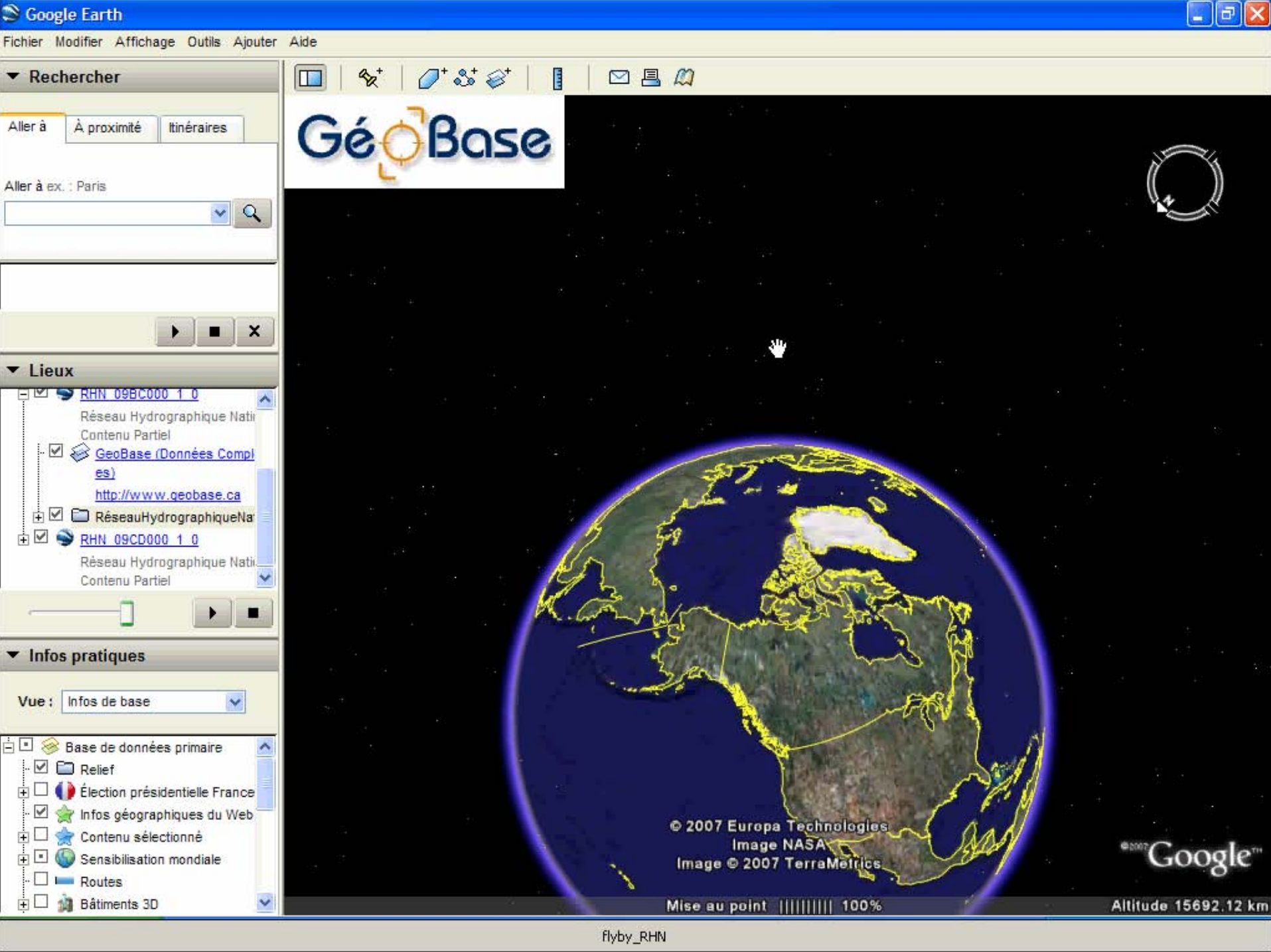
NHN Summary

- NHN is hydrography + drainage area + linear network + flow direction + toponyms + LRS events (5)
- NHN enables network analysis on surface waters
- To a National Standard
- Available freely on GeoBase
- *First national coverage in 2008*
- *Replacement by better provincial and updated data has started*
- *From basic to full NHN over the years through Completeness Levels*
- *Harmonization with USA dataset is being organized*
- *Deliberate efforts to put the NHN data to work*

Foreseeable future ~ 2 years






Google Earth
Fichier Modifier Affichage Outils Ajouter Aide
Rechercher
Aller à
À proximité
Itinéraires
Aller à ex. : Paris
Lieux
RHN_09BC000_1_0
Réseau Hydrographique Nati
Contenu Partiel
GeoBase (Données Compl
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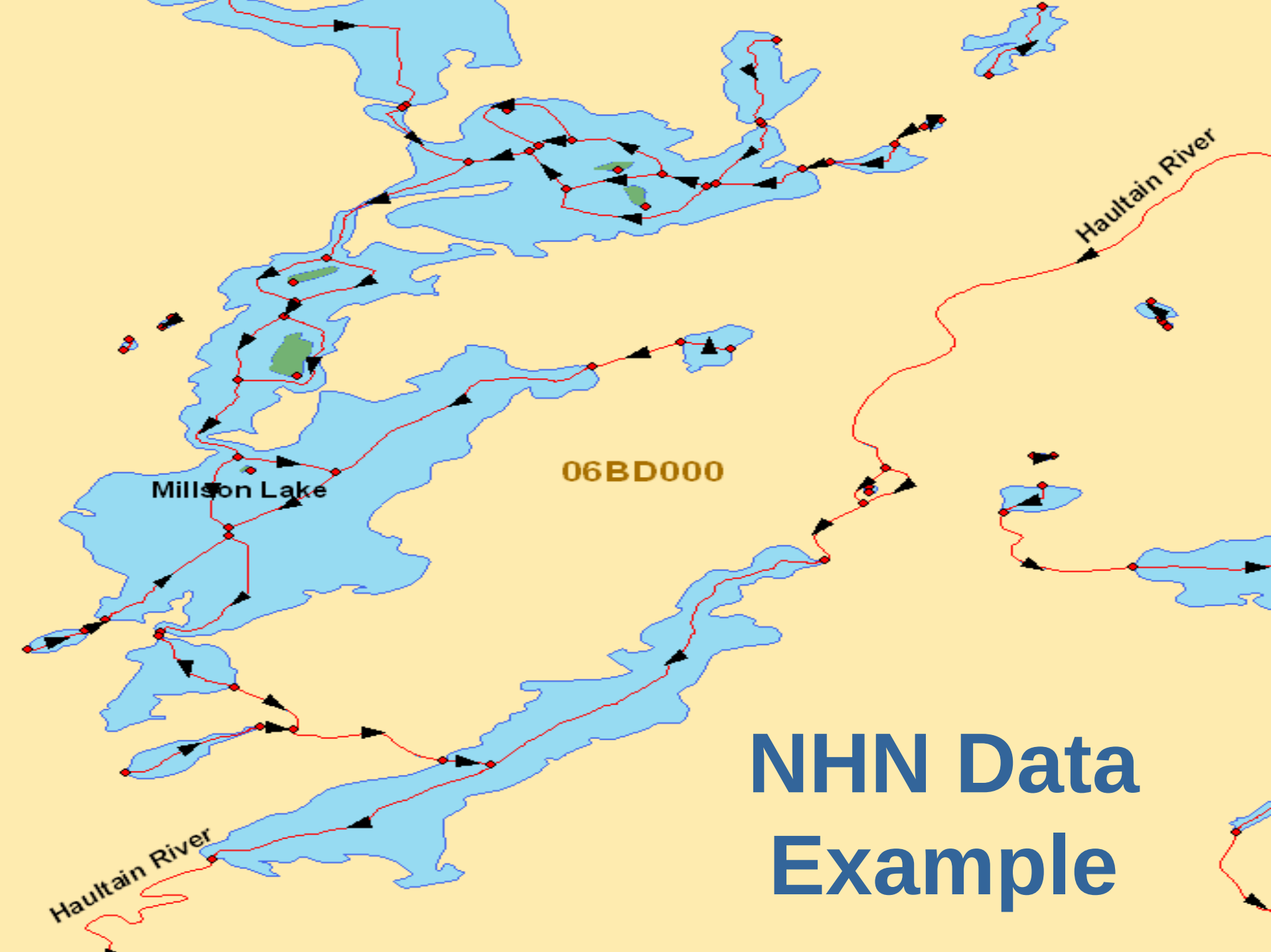
http://www.geobase.ca
RéseauHydrographiqueNa
RHN_09CD000_1_0
Réseau Hydrographique Nati
Contenu Partiel
Infos pratiques
Vue : Infos de base
Base de données primaire
Relief
Élection présidentielle France
Infos géographiques du Web
Contenu sélectionné
Sensibilisation mondiale
Routes
Bâtiments 3D
GéoBase
© 2007 Europa Technologies
Image NASA
Image © 2007 TerraMetrics
Google
Mise au point 100%
Altitude 15692.12 km
flyby_RHN



NHN Data Example

What if?


What if…?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1997-42E


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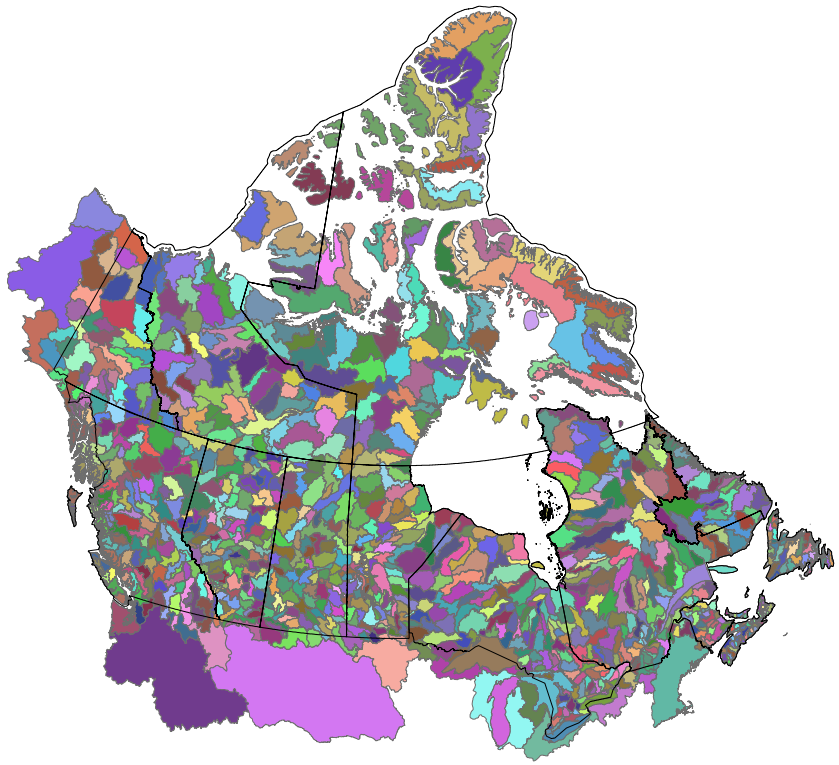
1997-42N
Natural Resources Canada
Ressources naturelles Canada

National Coverage - Watersheds

Water Survey of Canada

Sub-sub-drainage areas



1151 NHN work units

Overview of the NHN Product

- Data Distribution Formats:
  - NHN data distributed by NHN Work Unit or drainage area
  - Data & metadata files in both English and French
  - NHN distribution formats:
    - GML (ASCII)
    - SHAPE™
  - NHN subset distribution format (a view):
    - KMZ™ (compressed KML™ for Google Earth™)