National Vector Data Change Management

Edition 4.0

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REVISION HISTORY

Date	**Edition**	**Description**
March 2006	1.0	Original version.
April 2007	2.0	NRNv2 updates.
January 2009	3.0	Updates to accommodate a broader range of themes.
November 2010	4.0	Addition of Municipal Boundaries change procedures.

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ABBREVIATIONS

AL	Aboriginal Lands
ID	Identifier
MUNI	Municipal Boundaries
NID	National Identifier
NHN	National Hydrographic Network
NRCan	Natural Resources Canada
NRN	National Road Network
NVD	National Vector Data
UUID	Universal Unique Identifier

TERMS AND DEFINITIONS

National Identifier (NID)

Unique national identifier attributed to each NVD object. Each NID is a 32 lower case character string (without blanks) representing a UUID generated at random.

National Vector Data (NVD)

The NVD is intended to be the best vector representation of interest phenomena that is broadly available across Canada. Changes occur when a more up-to-date or more accurate representation than the previous one becomes available. The National Road Network (NRN), the National Hydrographic Network (NHN), and the Municipal Boundaries (MUNI) are examples of NVD.

Object

Information technology model of a real world phenomenon.

Unique Universal Identifier (UUID)

Unique identifier within a universe defined in an application domain. UUIDs are those proposed by the *ISO 19118:2005 standard: Geographic information – Encoding*. They are represented by a 32-character hexadecimal string.

The definition and method used for the generation of a UUID is defined in the *National Vector Data: Identification Rules* document available on the GeoBase portal (http://www.geobase.ca).

1 BACKGROUND

This documentation is intended for National Vector Data (NVD) users and providers on GeoBase and aims at describing and standardizing data maintenance.

The NVD is intended to be the best vector representation of interest phenomena that is broadly available across Canada. These are vector data layers with common characteristics (such as a unique and permanent identifier for each of its basic constituent and the possibility to update data by numerous stakeholders) and therefore share the same data specifications.

NVD present the possibility to be updated on a regular basis by various actors. To allow this, we use update mechanisms among NVD partners. These mechanisms are founded on change management principles established on two basic concepts:

- Identification rules for objects composing NVD
- Change management rules for the data.

The **identification rules** for NVD are presented in the *National Vector Data: Identification Rules* document available on the GeoBase portal (http://www.geobase.ca) while the **change management rules** are presented in the current document.

Objects are information technology models of real world phenomena. If the real world phenomenon of interest is considered to be a geographic entity, then the term feature is typically used to describe the model of the entity. In other words, a feature is a type of object.

2 INTRODUCTION

Many projects (or the literature) deal with update management and time modelling [see References 1, 2, 3]. The NVD change management model herein was developed in cooperation with the Centre for Research in Geomatics (CRG) at Laval University [see Reference 4] and has been defined to be consistent with the terminology used by the Open Geospatial Consortium.

Change management rules allow to characterize the evolution of features in order to identify any changes that may have occurred between two versions of a feature, whether successive or not. The discrepancies observed between two versions are referred to as the differential[1]. In the context of the NVD, the purpose of change management is to facilitate synchronization of databases from various producing partners and customers based on current national views (see Figure 1: Evolution of the database in time).

The change management process must also make it possible to reconstitute the dataset as it was on a previous date. Depending upon the particular change management strategy used (as discussed below), the process may allow for time travel through the dataset, such that the state of individual features in the dataset can be ascertained at arbitrary times.

[1] The differential corresponds to the set of differences observed between two landmarks of the territory [see reference 4].

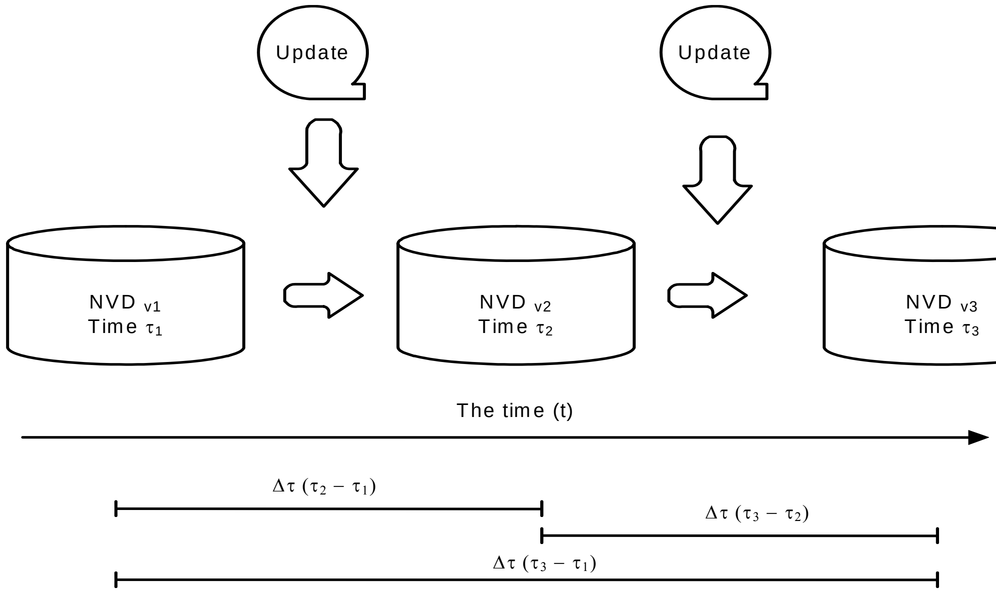

Figure 1: Evolution of the database in time

In this document, we will present the life cycle of an object (in other words, what a change is) as well as the types of effect on objects and we will provide examples of changes for each NVD product that can go through updating.

3 OBJECT LIFE CYCLE

The NVD is intended to be the best vector representation of interest phenomena that is broadly available across Canada. Changes occur when a more up-to-date or more accurate representation than the previous one becomes available.

The effects on NVD data are established based on the previous representation. Data life cycle is therefore limited by two events. The cycle always begins with an "addition" (assignment of a new NID) and ends with "retirement". Between these two events, geometric or descriptive modification or confirmation of the previous state can occur, while maintaining the same NID. Data with the effects "addition," "geometric or descriptive modification", and "confirmation" are said to be ***active*** (or current) features. Features with the effect "retirement" are said to be ***non active*** (historical) data.

4 EFFECT TYPES ON OBJECTS

Various kinds of updates are recognized based on the *effect* of the update on the data. (These are analogous to transaction types in the database world.) Effects affect either the existence or the evolution of an object and can be classified as follows:

Addition (Existence)

When a new object has no geometric counterpart in the NVD, a new feature is *added*, which has a new NID.

Retirement (Existence)

When a feature no longer represents an entity, the feature is *retired*. The feature is removed from the current data while maintaining its NID.

Modification (Evolution)

A feature is said to be *modified* if one or more of its descriptive attributes or its geometric representation is changed. In this case the initial NID is preserved, as the new version will have the same NID value as the version it replaces. Two types of modification are possible.

Descriptive Modification

A descriptive modification occurs if one version of a feature is replaced by a second version with the same NID but with one or more differences in attribute values. For example, the surface of a specific road may have changed from “unpaved” to “paved”.

Geometric Modification

A geometric modification occurs if one version of a feature is replaced by a second version with the same NID but with a change in the object’s geometric representation.

Four types of geometric modification are currently defined within the NVD. Each has a certain level of complexity. In comparing two representations (old and new), the following change management methods are recognized:

- **First Method**

  Comparing the vertices of an old and a new version of an object. If any vertex is different positionally, or if any vertex has been added or removed, the old representation of the object is retired and a new representation added. The new version has a new NID and no explicit reference to the original version is retained. Using this method means that **there is no tracking of geometric modifications**, making time travel through the data difficult or almost impossible.

- **Second Method**

  Comparing the locations of the old and the new junctions. Two junctions always bound a network linear element. Any modification along a linear element (geometric representation) may occur between its junctions. These are treated as geometric modifications where the NID is preserved. If, for whatever reason, one of the old junctions located at one end of the network linear element has changed, then this network linear element is retired and a new one added with a new NID.

- **Third Method**

  Comparing topological links of network linear elements. If the representation of the linear element junctions has maintained the same topological links (even if the junctions have moved and the network linear element geometry has been modified), then these changes are treated as a geometric modification and the network linear element and junctions maintain their respective NID.

- **Fourth Method**

  The fourth method is the most lenient. The geometric representation of a feature may be redefined in any way, but the feature itself is considered to continue and will retain the same NID. For example, the boundaries of an Aboriginal land or a municipality may be modified or extended. In this case the old version of the feature is replaced by the new version with the same NID.

  For any given NVD dataset, **only one method of geometric modification can apply**. It must be specified in the dataset metadata.

Confirmation (Evolution)

Addition, retirement, and modification all pertain to change. However, an entity may have been revisited, with no changes required to the description of its geometric or attribute properties. In such a case, there is *confirmation* of the existing description for the entity.

5 EXAMPLES OF CHANGE

5.1 National Road Network (NRN) Data

The following example is designed to illustrate NRN update management for better comprehension. Figure 2 : Example of Changes Following a NRN Updatebelow demonstrates the comparison between the original data and new data. In terms of geometry, a single Road Element (object 6) was added with respect to the original data. In terms of description, the type of surface of the Road Element (object 2) has changed from “unpaved” to “paved”.

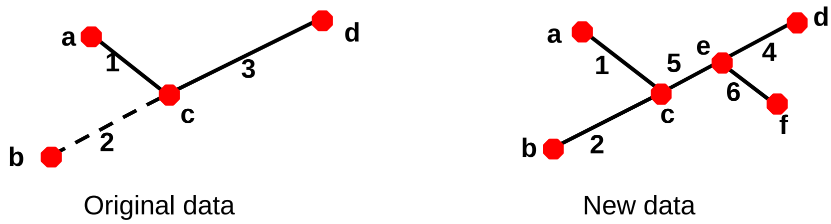

Figure 2 : Example of Changes Following a NRN Update

Table 1: NRN Updating Effectsshows the effects observed on objects after the NRN update.

Object	Explanation	Effect
3	No correspondence with a new object.	Retirement
4	No correspondence with an object in the original data; the arrival of object 6 changed the topological structure of the objects (and therefore the geometry).	Addition
5	No correspondence with an object in the original data; the arrival of object 6 changed the topological structure of the objects (and therefore the geometry).	Addition
6	No correspondence with an object in the original data; the feature was not represented.	Addition
e	No correspondence with an object in the original data.	Addition
f	No correspondence with an object in the original data.	Addition
2	Attribute value changed.	Descriptive modification
1	Geometry and attributes did not change.	Confirmation
a	Geometry and attributes did not change.	Confirmation
b	Geometry and attributes did not change.	Confirmation
c	Geometry and attributes did not change.	Confirmation
d	Geometry and attributes did not change.	Confirmation

Table 1: NRN Updating Effects

5.2 Aboriginal Lands (AL) Data

The following example describes change management for AL data. The AL data always uses the fourth method to manage all changes. The example illustrates the changes that occurred between the original AL dataset and the new AL dataset. The geometry of Indian Reserve A was not altered, but its name was changed. Indian Reserve B was confirmed to exist with the same geometry and description. Indian reserve C was abandoned. Lands were added to Indian Reserve D. Indian Reserve E was created. Table 2 explains the updating effects for each of the five AL objects.

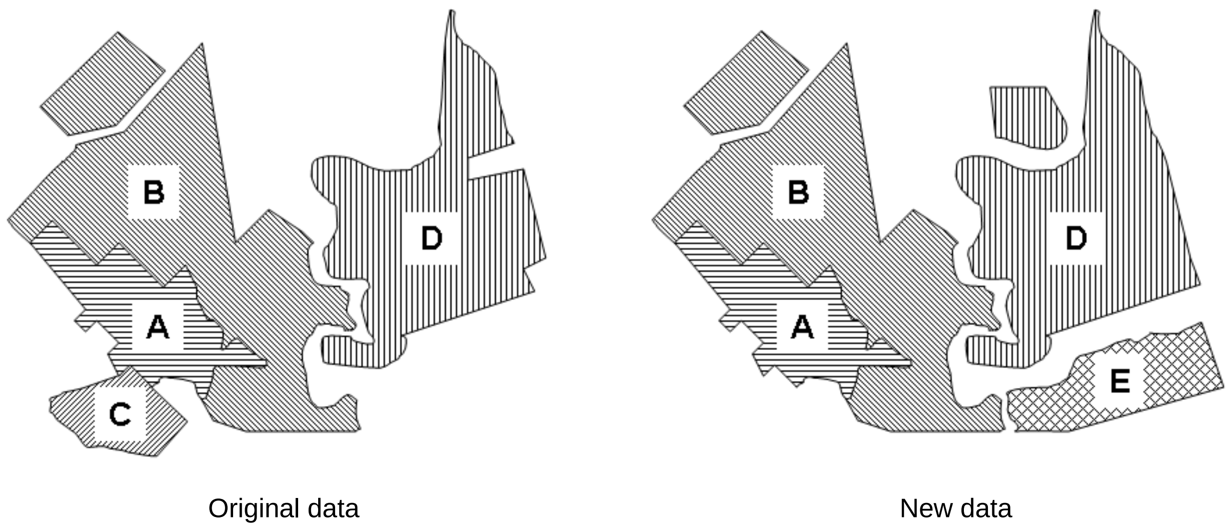

Figure 3: Example of Changes After an Update of AL Data

The table 2 shows the effects observed on objects following updating of AL features in this dataset.

Object	Explanation	Effect
A	Attribute value changed.	Modification
B	Geometry and attributes did not change.	Confirmation
C	No correspondence with an object in the new dataset.	Retirement
D	Geometry was changed.	Modification
E	No correspondence with an object in the original dataset.	Addition

Table 2: AL Data Updating Effects

5.3 Municipal Boundaries (MUNI) Data

The examples in this section describe change management for MUNI data (municipalities, upper municipalities, and municipal regional areas). The MUNI data always uses the fourth method to manage all changes.

Given the MUNI data is divided into hierarchical levels, change management will be illustrated in two steps: 1) change management for municipalities (lower level of the hierarchy); 2) change management for corresponding upper municipalities (intermediate level of the hierarchy). Change management for municipal regional areas (higher level of the hierarchy) is performed in a similar manner than that for upper municipalities.

5.3.1 Municipalities

Figure 4 illustrates the changes that occurred between the original MUNI dataset and the new MUNI dataset for the municipality hierarchy level.

In Figure 4, objects A through E are municipalities. The geometry of Municipality A was not altered, but its name was changed. Municipality B was confirmed to exist with the same geometry and description. Municipality C was annexed by an adjacent municipality (not shown). Lands were added to Municipality D. Municipality E was created.

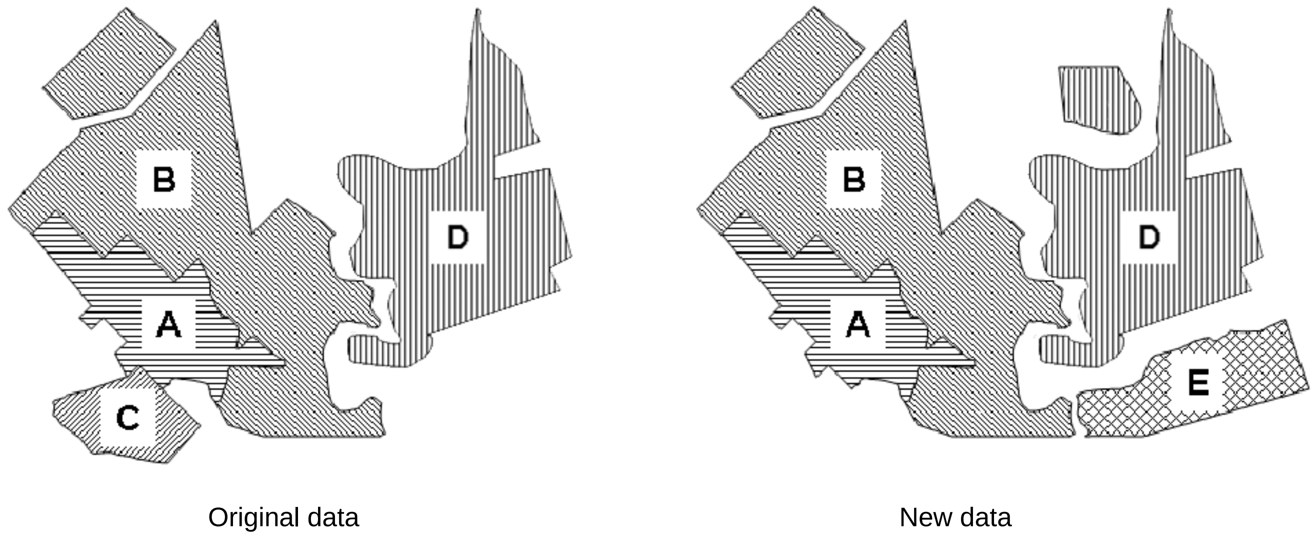

Figure 4: Example of Changes Following an Update of Municipal Boundaries (Municipality Hierarchy Level)

Table 3 shows the effects observed on objects (municipalities) following updating of MUNI in this dataset.

Object	Explanation	Effect
A	Attribute value changed.	Modification
B	Geometry and attributes did not change.	Confirmation
C	No correspondence with an object in the new dataset.	Retirement
D	Geometry was changed.	Modification
E	A new municipality is formed. It has no correspondence with an object in the original dataset.	Addition

Table 3: Updating Effects on Data for Municipalities

5.3.2 Upper Municipalities

Figure 5 illustrates the changes that occurred between the original MUNI dataset and the new MUNI dataset for the upper municipality hierarchy level.

In Figure 5, municipal feature F is the Upper Municipality that is comprised of Municipalities A, B, and C from Figure 4. In the original data, the Municipality D is not included in an upper municipality. After Municipality C is amalgamated to another upper municipality (not shown), the resulting Upper Municipality F has a smaller area than the previous one and contains only two Municipalities (A and B). Municipal feature G, an Upper Municipality, is defined for the first time. It consists of the redefined Municipality D and a new Municipality, municipal feature E.

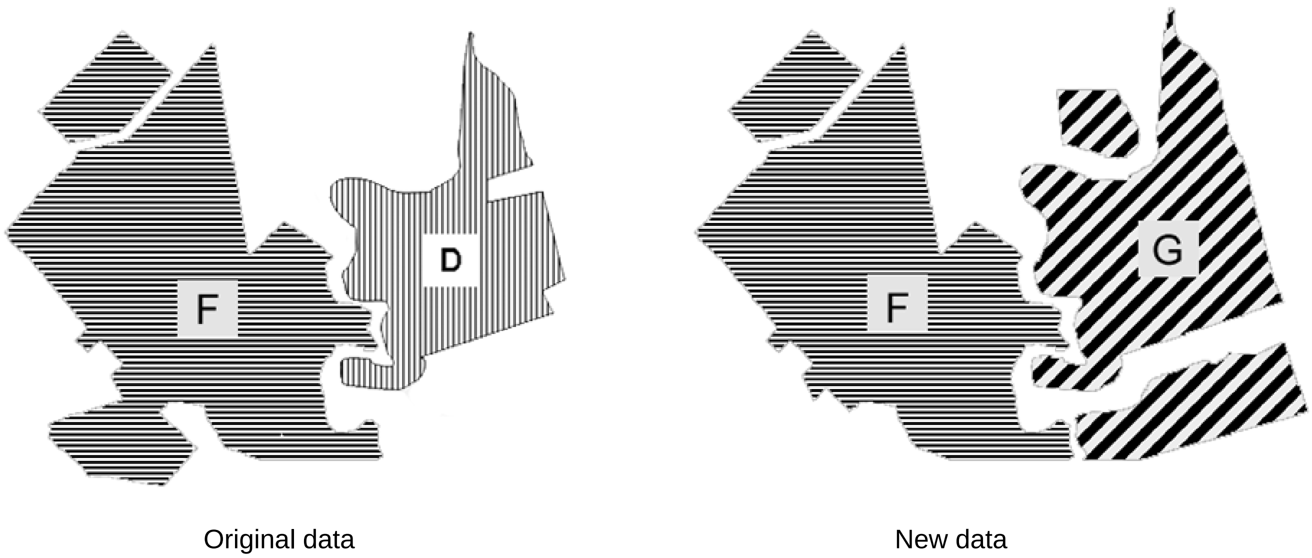

Figure 5: Example of Change Management for Corresponding Upper Municipalities

The following table shows the effects observed on objects (upper municipalities) following updating of Municipal Boundaries in this dataset.

Object	Explanation	Effect
F	Municipality C is removed from the Upper Municipality F, and thus the geometry of Upper Municipality F changes.	Modification
G	A new upper municipality is defined, consisting of Municipality D and Municipality E.	Addition

Table 4: Updating Effects on Data for Upper Municipalities

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