Under the

Canadian Support Project for the Senegalese National Geomatics Plan

Statement of Work for the Priority Geospatial Database and Web Access Services

Prepared by:

Natural Resources Canada

In Collaboration with
The Priority Geospatial Database Group of the Senegalese Inter-institutional Geomatics Consultation and Co-ordination Group (GICC)

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Acronyms

CIDA: Canadian International Development Agency

ADIE: Senegal National Informatics Agency

ANAT: Senegal National Land Use Planning Agency

DB: Database

DTGC: Directorate of Geographic and Mapping Products

GICC: Inter-institutional Geomatics Consultation and Co-ordination Group

SWG: Senegalese working group

GI: Geographic information

SGDI: Senegalese geospatial data infrastructure

JICA: Japan International Cooperation Agency

KML : Keyhole markup language

DEM: Digital elevation model

NGP: National Geomatics Plan

NRCan: Natural Resources Canada

GIS: Geographic information system

SRTM: Shuttle Radar Topography Mission

SOW: Statement of work

UUID: Universal unique identifier

XML : Extensible markup language

Glossary

Administrator: Person who manages the operating parameters of a system.

Attribute: Property or characteristics relating to a feature and bearing a name.

Dataset: Physical grouping of data for a specific collection based on a specific clipping.

Geographic coordinates: Values expressing the longitude and latitude of a point.

Geographic data: Data about spatial entities and their relationships, in a geomatics application.

Geographic footprint (bounding box): Normally invisible rectangle that encloses a graphic object and that may appear when this graphic object is selected.

Geomatics: The discipline of managing geographic data, using related sciences and technologies for their acquisition, storage, processing and distribution.

Geospatial data: Data about spatial entities and their relationships, in a geomatics application.

Geospatial information: Information deduced from geographic data.

Metadata: Data about the nature of certain other data that allows them to be used appropriately.

Metadata template: Pattern used to guide metadata creation**.**

Neatline: Theoretical boundary of a dataset.

Producer: Person or organization that produces geospatial data.

Raster data: Representation of one or more geographic features using an image that can be positioned on the Earth.

User: Person who consults the Geo-Portal by searching and downloading (as needed) geospatial data.

Vector data: Set of geometric elements (points, lines, polygons) representing a geographic feature that can be located on the Earth.

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1 Title

Establishment of a priority geospatial database and of a Web-based system for accessing these data.

2 GENERAL PRESENTATION

2.1 BACKGROUND AND RATIONALE

Following a number of meetings and discussions between Senegal and Canada about how to support Senegal's efforts to implement a geomatics program, a memorandum of agreement was signed between the two countries in August 2008. This was followed by the signing of an administrative agreement between the Canadian International Development Agency (CIDA) and Natural Resources Canada (NRCan) in January 2009, confirming Canadian support for the development of a National Geomatics Plan (NGP) specific to the Senegalese context.

The requirements were identified during a start-up mission in March 2009. This two-week mission enabled a team of geomatics experts from NRCan, working with a number of Senegalese stakeholders, to prepare an implementation plan for the Canadian Support Project for the Senegalese National Geomatics Plan, which will meet the needs of Senegal. Canada, acting through its geomatics experts in government and in the private and academic sectors, is pleased to support Senegal's geomatics initiative. The standardization, management and access to geospatial data is an important part of this plan.

By providing funding assistance and expertise, Canada's goal is to help Senegal increase its geomatics expertise in support of the country's development. It is important for Senegal to be directly involved in all activities carried out under the support project for the Senegalese NGP, through its geomatics industry , its government departments (URBANISME, MEF, MEPN,…), and its educational and other institutions with an interest in geomatics. Through future calls for tender, proposals that foster linkages with Senegal and its institutions will receive favourable consideration for this criterion.

Like any project supported by CIDA, this project includes an Equality between Women and Men (EWM) component. The main objective of developing an equality strategy EMW in the field of geomatics is to ensure that Senegalese women:

- Actively participate in the NGP and receive an equitable share of the project resources;
- Also benefit from the development of geomatics in Senegal and play an active role in this development.

The Senegalese organizations with which we met demonstrated a genuine desire to participate in the National Geomatics Plan and showed a keen interest in geomatics. The establishment of the priority geospatial database and of a Web-based system for accessing these data is a first step toward establishing a Senegalese geospatial data infrastructure (SGDI), which will give the Senegalese geomatics community easier access to standardized geospatial data.

It should be noted that French is the official language in Senegal and is used by the government, educational institutions, the media and the business community. That is why all documents from the Senegalese party are in French and will not be translated for the purposes of this SOW.

The main partners of the Canadian Support Project for the Senegalese NGP are:

In Senegal

The Inter-institutional Geomatics Consultation and Co-ordination Group (GICC)

This project involves a large number of Senegalese stakeholders. Together, the Canadian and Senegalese officials responsible for the project decided that management and communications would be better served if a Senegalese organization were set up to effectively represent all the Senegalese partners. This is also a first step toward attaining the strategic objectives and underlying principles that are driving development of the NGP, namely co-operation for the mutual benefit of all the partners. The GICC will serve as the official representative of the Senegalese partners and will be directly involved in the initiative. In its current configuration, the GICC includes representatives of departments and organizations that are involved primarily in land use management, natural resources, the environment, health and education.

The GICC is responsible for:

- Establishing and implementing a National Geomatics Plan;
- Making decisions related to all geomatics issues in Senegal;
- Making decisions regarding all legislation and regulations documents related to geomatics;
- Making decisions concerning standards applicable to geomatics;
- Forming working groups to help meet the priorities identified, and approving the composition of each working group and designating a chairperson;
- Validating the proposals formulated by the various working groups.

Senegal National Land Use Planning Agency (ANAT)

The ANAT is responsible for implementing Senegalese government policy on mapping. This agency is tasked with carrying out and overseeing cartographic and topographic work on Senegalese territory. Its functions include archiving and disseminating map products, both analog and digital, aerial photographs and geodetic control points. Its mandate also includes studying and delimiting national borders. In addition to carrying out these government-mandated activities, the ANAT also carries out all specific operations: scanning of documents, orthophotographs, GPS points, plans, surveys, thematic maps, and exploitation of satellite images.

Senegal National Informatics Agency (ADIE)

The ADIE's role within the Senegalese government is to carry out and promote, in co-ordination with the various government departments and agencies, and local communities, a range of activities that will enable the government to establish a coherent system for processing and disseminating information that meets international standards in terms of quality, security, performance and availability. The ADIE is involved in developing the Senegalese government's electronic strategy, commonly referred to as "e-government."

Senegal Ecological Monitoring Centre (CSE)

The CSE's mandate is to collect, input, process, analyze and disseminate data and information on Senegal's territory and natural resources using spatial technologies in order to provide a foundation for sustainable management of resources. Through the skills and expertise it has acquired, the CSE plays an important role at the national and subregional levels. The CSE is active in a variety of disciplines, primarily the environment, remote sensing, databases, mapping and the collection of socio-economic data.

In Canada

NRCan, the Canadian Support Agency (CSA)

The Earth Sciences Sector (ESS) of NRCan is the CSA and will serve as the lead agency for Canada's contribution to this project.

NRCan is responsible for accepting the deliverables and payments, on the recommendation of the GICC.

NRCan has a representative in Dakar, who will remain on site up to December 31 2014 and will work in close collaboration with the Executive Committee of the GICC, NRCan's main partner in this project. This NRCan representative will report directly to the Project Director based in Ottawa and will be in Dakar when the first contracts with private geomatics sector are initiated. He/she will be responsible mainly for:

- Assisting the working groups in the various phases of activity development;
- Monitoring the development of activities;
- Preparing, in conjunction with the experts, the statement of work for the calls for tender;
- Validating the quality and compliance of the deliverables;
- Supporting the start-up of activities;
- Acting as a liaison between the contractor and Senegalese clients; in the event of a dispute between the contractor and Senegalese clients, as the technical authority's representative, he/she may be called on to recommend in favour of one party or the other if conciliation is not possible.
- Co-ordinating the various activities to ensure adherence to the planned resources, schedules and the critical path of the entire Canadian Support Project.

The Canadian International Development Agency (CIDA)

CIDA's primary mandate is to ensure the successful implementation of the project, and any decision in this regard will be made in co-operation with the other members of the joint committee.

CIDA is responsible for:

- Providing follow-up/monitoring of the project as a whole to ensure that the objectives are achieved;
- Co-chairing meetings of the joint committee;
- Making sure that the requisite evaluations and audits are performed;
- Monitoring and evaluating the development work carried out in Senegal with Canadian aid.

Joint committee

As part of the Canadian Support Project for the NGP, a joint committee has been established to provide liaison between Senegalese and Canadian officials. The committee's primary goal is to ensure the project's success through ongoing and open dialogue between the parties.

The joint committee has decision-making authority and is chaired on a rotating basis by CIDA and a representative of the Office of the President of Senegal. The committee includes representatives of the Senegalese Administration, CIDA, the Executive Secretariat of the GICC and NRCan. The committee may also retain the services of experts whose skills and abilities are useful for successful implementation of the project.

The committee has responsibility for approving the project goals and objectives, the project implementation guidelines, the annual reports and implementation plans as well as the associated budgets. In addition, the committee will make any decisions it feels are warranted to carry out the project. The committee will meet at least once a year or any time it is necessary to ensure the success of the project.

Competent Senegalese officials

To assist in determining the requirements for the establishment of the priority geospatial database and of a website for accessing these data, the GICC has set up the working group on the priority geospatial database. This working group includes representatives of the GICC as well as one or two NRCan representatives.

3 General objective

The purpose of this statement of work (SOW) is to establish a system for managing and distributing normalized geospatial data that will provide the Senegalese geomatics community with easy access to high-quality, diversified geospatial information.

3.1 Specific objectives

Establishing an interoperable geospatial data distribution system will require attaining the following specific objectives:

- Development of national standards for the priority geospatial data collections; these national standards will be based on international geomatics standards;
- Standardization of the priority geospatial data in order to comply with international standards;
- Development of a priority geospatial database to store the vector data, orthoimages and digital elevation models;
- Development of Web access services for the priority geospatial data, orthoimages and digital elevation models;
- Deployment of the system at the ANAT and at the ADIE;
- Training of personnel so that the Senegalese party can assume management of the system.

4 Feature catalogues

This section describes the work to be performed in order to develop the feature catalogues for the priority vector data.

4.1 Background

Feature catalogues are an important foundation of modern vector geospatial data. They are used throughout the life cycle of geospatial information (GI) (development, production, management and use). The feature catalogues describe vector data in terms of geometric primitives and feature and attribute classes. These feature catalogues will be developed from current vector GI and the relevant available documentation. The feature catalogues thus developed will be used directly for implementation of the following sections of this SOW. For production (section 5), the catalogues will be used as a framework for standardizing vector data. For the database (section 6), the catalogues will serve as a conceptual model for implementing the physical model. These catalogues will also make it possible to consolidate inventories of heterogeneous data in order to create a homogeneous national standard for vector GI. Finally, the cataloguing standard used is part of the ISO 19100 family of geomatics standards.

4.2 Creating the feature catalogues

The catalogues are used to describe the features of a vector data collection (vector product). Vector data describe discrete geographic phenomena. The spatial characteristics of a geographic phenomenon are represented by geometric primitives (points, lines and surfaces), the nature of the geographic phenomenon by classes, and the other characteristics of the geographic phenomenon by attributes.

This section contains the instructions and concepts to be followed (list of feature classes, organization by theme, harmonization of catalogues, catalogue format, etc.) to create the feature catalogues for the

various vector collections covered by this SOW. It is essential that the contractor properly understand these instructions in order to incorporate them when creating the various feature catalogues.

The feature catalogues must comply with ISO standard 19110 “Methodology for feature cataloguing.”

A different feature catalogue must be produced for each of the following three vector collections (products). **Deliverable: 1**

- 1:1,000,000 data collection
- 1:200,000 data collection
- 1:50,000 data collection

4.2.1 Organization by theme and specific code

Features or feature classes must be grouped by theme (hydrography, vegetation…). This grouping provides a natural organization by classing together features of a similar nature. The names of the themes must be significant. There should be approximately 10 themes. The contractor must use the concepts of classes and subclasses provided in the cataloguing standard to describe the organization of the themes in each catalogue.

The contractor must also develop a structure of specific codes; specific codes are unique codes assigned to the various combinations of fixed domain attributes for a specific class. The specific code must incorporate or maintain a logical link to the class and to the theme.

4.2.2 Feature catalogue harmonization

The feature catalogues for the various data collections must be harmonized and integrated with each other semantically (the names of the feature classes, the names of the attributes and the attribute domains).

The following are a few examples and tips to illustrate the concept of *catalogue harmonization* used in this SOW:

- For equivalent topographic entities, the semantics used (names of feature classes, definitions of feature classes, names of attributes, definitions of attributes, attribute domains, data types…) must be identical/consistent across the various data collections.
- The 1:50,000 data collection is the source data collection from which the catalogues for the other collections are normally derived. When possible, the attributes and attribute domains of the 1:200,000 and 1:1,000,000 collections should therefore usually be a subset of those found in the 1:50,000 collection.

If the contractor is unable to adhere to the concept of *feature catalogue harmonization* when creating the various catalogues, the contractor must submit the problem cases (section 11.8.3) to NRCan/GICC, together with proposed solutions and a recommendation with supporting justification. NRCan/GICC will then contact the contractor to validate the proposed solution or find another solution.

4.2.3 Minimum catalogue content

ISO standard 19110 “Methodology for feature cataloguing” describes a number of mandatory and optional fields/information. In the context of this SOW, the various feature catalogues must include (in addition to the mandatory information) the information described below:

- For each feature class:
    - Link to the theme with which the feature class is associated;
    - Short, precise class name;
    - Precise, unambiguous definition of the feature class;
    - List of the attributes associated with this feature;

- For each attribute:
  - Short, precise attribute name;
  - Precise, unambiguous definition of the attribute;
  - Type of domain that the attribute can take (fixed or variable);
  - For each fixed attribute:
    - Short, precise fixed attribute name;
    - Precise, unambiguous definition of the fixed attribute.

4.2.4 Catalogue management tool

The contractor must provide a tool for storing, editing and presenting the information contained in the feature catalogues **Deliverable: 2**. This tool must be able to run on a workstation running Microsoft Windows XP or a more recent version.

For example, the proposed tools can range from a Microsoft Word/Excel file to a Microsoft Word/Excel file using templates, to an application capable of managing an ISO 19110 standard compliant feature catalogue.

It is desirable that the tool ensure the consistency/integrity of the feature catalogues in relation to the ISO 19110 cataloguing standard “Methodology for feature cataloguing.”

4.2.5 Catalogue presentation

The catalogue management tool (4.2.4) must offer an electronic version of the catalogues in PDF format. It is desirable that the catalogue management tool be able to present the catalogue in HTML and/or XML format.

If the catalogue management tool presents the catalogues in HTML format, the HTML presentation must make the catalogue user-friendly, dynamic and adapted to Web rendering.

If the catalogue management tool presents the catalogues in XML format, it must conform to the ISO standard 19110 “Methodology for feature cataloguing - Amendment 1.”

4.2.6 Reference documentation

To develop the vector data catalogues, the contractor must use the various information sources made available on the FTP site (section 11.4). The following are a few examples of available documents:

- 1:50,000 topographic data: digital data, acquisition document, topographic maps, legend
- 1:200,000 topographic data: GeoConcept data, FreeHand files that were used for data capture, FreeHand files of representation (edited for mapping), GeoTIFF topographic maps, acquisition procedure, map legend
- 1:1,000,000 topographic data: FreeHand data, map in GeoTIFF format
- …

The above-mentioned documents are intended as an example; the contractor must analyze the content of the FTP site to determine the relevant documents for creating the feature catalogues.

4.2.7 Geometric representation

The authorized geometric primitives are Point, Line (“LineString”) and Polygon; their descriptions, characteristics and behaviours are described in ISO standard 19125-1: “Geographic information -- Simple feature access - Part 1: Common architecture.” The following geometric primitives: MultiPolygon, MultiLineString (“MultiLine”) and MultiPoint are not to be used in the feature catalogues, unless by agreement with NRCan/GICC. In the feature catalogue, each feature class is associated with one or more (maximum 3) geometric primitives.

4.2.8 Additional instructions

This section contains additional instructions for creating the feature catalogues.

4.2.8.1 Representation information

In the 1:200,000 topographic product, the toponyms representing locations and having a point type geometry were arbitrarily positioned for cartographic representation purposes rather than for analysis purposes. Their positions are offset relative to their true position (see Figure 1). During production (section 5), these toponyms will be moved to their true position; the toponym class must allow the representation position (x,y) to be retained as an attribute.

In the 1:200,000 topographic product, certain toponyms are written in “cartographic representation mode”; they can therefore be written in upper case (“DAKAR”) if the name is important, or with spaces (“L a c R o s e”) to facilitate map reading. The toponym model must allow both toponyms to be retained: first, the name of the standardized toponym (without spaces and following French capitalization rules); and second, the name of the toponym used for cartographic representation purposes.

All toponyms have an orientation in degrees for cartographic representation purposes. The toponym model must retain this angle value.

N.B.: If other map elements have similar representation characteristics, the contractor must catalogue the feature using a similar strategy.

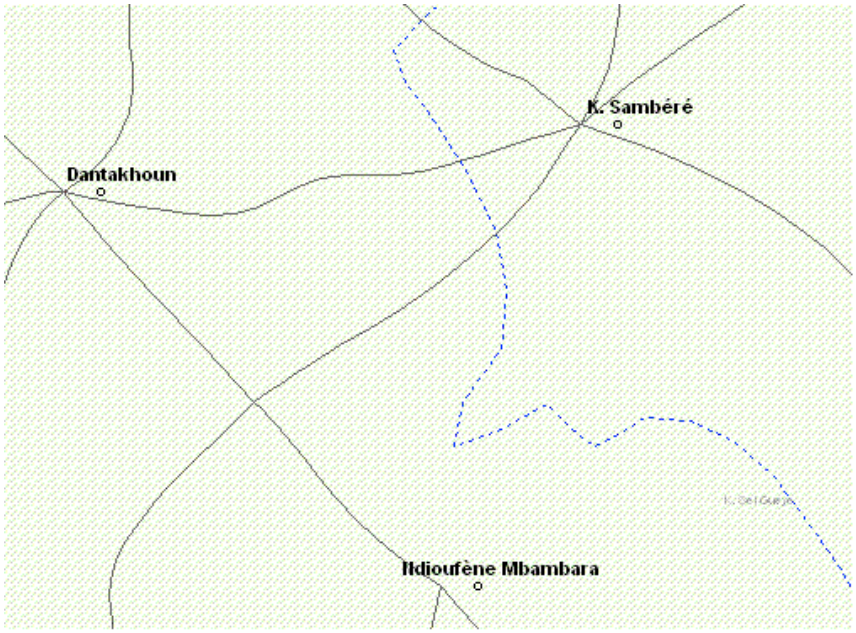


Figure 1 Toponym for cartographic representation

4.2.8.2 Distinction between lake, river and ocean

The feature catalogues must allow distinctions to be made between *lake* (same elevation surface), *river* (variable elevation surface) and *ocean* features.

In the catalogues, there is no requirement that the features be called *lake, river* and *ocean;* the contractor may use a different nomenclature or strategy in line with the semantics currently used in the various Senegalese data collections.

N.B.: This distinction (lake, river and ocean) will facilitate the subsequent creation of value-added derivatives, such as hydrographic networks and digital elevation models consistent with the hydrography.

4.2.8.3 Map elements excluded from the catalogues

All the types of map elements found in the various collections should have an entry in one of the feature catalogues. If the contractor does not wish to include a map feature in one of the feature catalogues, the contractor must explain why and obtain approval from the NRCan technical authority (section 11.8.3) before excluding it.

4.2.8.4 Neatline

Each data collection must have a *neatline* class. As a minimum, this class must have the following characteristics/attributes:

- A *polygon* type geometric representation;
- A *number* attribute: descriptor of the sheet in the Senegalese clipping system (section 5.3.5.6); e.g. ND-28-XXIII;
- A *name* attribute: word or group of words used to designate the dataset (e.g. Louga).

4.2.8.5 Common attribute

All the feature classes must have the following attributes:

- *Number:* descriptor of the sheet in the Senegalese clipping system (e.g. ND-28-XXIII). This attribute will be used to index the data in order to speed up feature searches in the geospatial database.
- *Specific code:* Specific code (section 4.2.1) of the topographic entity to be represented.
- *Country:* The country code (ISO 3166) of the country in which the topographic entity is to be represented.
- *Unique code:* Each feature must have a unique identifier. This identifier must be of the “UUID” (Universal Unique Identifier) type. The method for creating UUIDs is standardized according to ISO/IEC standard 9834-8:2008.

4.2.9 Production rules

The catalogues must also accommodate the various rules listed in the section describing the production work (section 5).

4.2.10 Other considerations

The feature catalogues are used in all phases of the planned work: data production, database development and reference documentation for Web distribution. Consequently, in addition to compliance with ISO standard 19110 and the various instructions provided above (harmonization, themes, …), the contractor must pay particular attention to the following aspects when creating the various catalogues:

- Quality of the French, in terms of both syntax and semantics;
- Explicit and appropriate nomenclature (class names, attribute names, …);
- Accuracy and precision of the definitions (class definitions, attribute definitions, …);
- Circular definitions are to be avoided, for example, a definition that uses the word to be defined within the definition (e.g. road: road on which vehicles can drive);
- Where applicable, use fixed attribute domains rather than variable or “free text” domains.

4.3 Meeting with the working group

Should the contractor have any questions about how to interpret and/or model the feature catalogues in relation to the Senegalese reality, the contractor is encouraged to use technical visits, planned in the meetings (section 11.12) or any other communication means to meet, discuss and resolve the problem cases with the competent Senegalese officials.

4.4 Modification of the feature catalogues

During production of topographic data (section 5), the contractor may find that the feature catalogues are incomplete or contain inconsistencies, preventing the contractor from properly performing the production work (e.g. inadequate definition, missing feature, missing attribute, incorrect value domain…). In such an eventuality, the contractor must revise/correct the feature catalogue(s) concerned and forward a new version of the feature catalogues to the NRCan/GICC technical authority.

5 Production of geospatial data

5.1 Background

For the production of geospatial data, the aim is to make available a series of geospatial data collections that can be accessed via Web access services (section 8) with the following characteristics:

- Maximize the use of current data: Preference is to be given to using data currently available in Senegal rather than acquiring new data;
- Diversified collections: The collections should include vector products at various scales as well as coverage products such as imagery or aerial photographs as well as digital elevation models;
- Homogeneous national coverage: Each product should cover the total surface area of the country (when this is possible);

In order to meet the above-mentioned characteristics, this section describes the various production activities that must be carried out on the geospatial data.

5.2 Type of production

In order to meet the characteristics for the provision of the desired geospatial data collections, the various production activities of this SOW are:

- Standardization of vector data: Using existing vector data, make modifications to the data in order to make them compliant with the feature catalogues (section 4) based on the scale of the data. This will require editing the data to be standardized in order to make them compliant with the catalogues and the various rules set out in this document.
- Standardization of SRTM data: Using SRTM data at 90 m resolution (section 5.4), make the modifications as requested in this document.

5.3 Standardization of vector data

Vector data represent discrete geographic phenomena. The spatial characteristics of a phenomenon are represented by a set of geometric primitives. The other characteristics of the phenomenon are represented by attributes.

In the context of this SOW, vector data consist of three (3) collections (1:1,000,000, 1:50,000 and 1:200,000). These three (3) collections are normatively interconnected. They are three topographic collections whose feature catalogues are harmonized and derived from each other using the feature catalogue with the largest scale, i.e. the 1:50,000 product (section 4.2.2).

These three collections were developed at different times and with different acquisition processes. The level of effort required to standardize them will therefore be different for each collection. In addition, it is important to point out that these various collections were originally compiled for cartographic

representation purposes, whereas the purpose of the present standardization work is to populate a position database.

5.3.1 Goals of the standardization process

This SOW outline the expectations of the GICC, and by extension of NRCan, in terms of a standardized database. It is important to bear in mind that the data to be standardized were generated by processes designed to produce representation data (maps) and that the expected deliverables will be applicable to position data, with the capacity to perform spatial and attribute analyses.

Ultimately, upon completion of the standardization process, the geospatial data will have the following characteristics:

- Accurately reflect the existing data (to be standardized);
- Reflect choices that favour position data over representation data;
- Be correlated and compliant with the new catalogues;
- Be structured in a manner to allow GIS users to make spatial and attribute analyses and support land use management.

5.3.2 Source material provided

For each collection to be standardized, NRCan/GICC will provide the data files, the data sources that were used for the data capture and the acquisition specifications when these documents are available. With few exceptions, all these files are available, according to the procedures explained in this document, on the following FTP site and its specific subdirectories: ftp://.../senegal/...

5.3.2.1 1:50,000 collection

The main acquisition source is ALOS satellite or stereo imagery. Fifty-four 1:50,000 datasets were captured along the Senegal River in UTM projection, zone 28.

5.3.2.1.1 Data format

The data available for the tender are samples in “shapefile” format with two preliminary datasets.

5.3.2.1.2 Orthoimages

For the 1:50,000 data collection, there is an orthoimage for each dataset in the collection. These orthoimages will be made available as a reference in order to resolve any inconsistencies that might occur during standardization.

5.3.2.1.3 FTP directories for the 1:50,000 data and sources

All the 1:50,000 data, the acquisition sources and the acquisition documents are available at the following FTP address: ftp://.../senegal/bd_50k/

5.3.2.2 1:200,000 collection

The main acquisition source is a collection of SPOT orthoimages georeferenced in UTM projection, zone 28, and the data are in this projection.

The 3D source for the acquisition of the contour lines and spot elevations is a 90-m resolution DEM derived from Astrium’s Reference3D product.

5.3.2.2.1 FreeHand files

The capture of the 1:200,000 data and map editing were done in the “FreeHand” format and are grouped into 27 datasets. Two series of files are available for each of the 27 datasets: one for data capture and one for map editing.

The data captured in this way are not organized as in a true “GIS” (Geographic information system). Consequently, all the “attribute” information is represented by annotations. However, the “layers” were used to group the data by data type. The document “Doc_Numerisation.PDF” will help the contractor better understand how the data were captured and the differences between these two series of files.

5.3.2.2.2 GeoConcept database

The data in FreeHand format were also exported with MapPublisher interface in MIF/MID to a database in GeoConcept format, version 5.5. This made it possible to better organize the data and associate the annotations with the geometry in the form of attributes. However, we cannot confirm either the exact procedure used to export the data or from which FreeHand MX file series the data were taken. Based on our observations, we must conclude that this database is imperfect for the following main reasons:

- Excessive data filtering was carried out, which degraded the data;
- Features at the dataset neatline were destroyed;
- Although the container appears to be complete (list of layers, attributes, etc.), NRCan cannot confirm that all the features are present (e.g. the linear features representing the “ferry” routes are missing);
- The association of annotations with attributes was not validated.

5.3.2.2.2.1 Data model

A data model in XML format (mod.xml) derived from this GeoConcept database is available under the “geoconcept” directory on the FTP site.

5.3.2.2.2.2 Export in MIF/MID

Since the “GeoConcept” format is not very widely used and since the data are in an old version of “GeoConcept,” NRCan exported the data in “MIF/MID.” One “MIF/MID” file per subclass was created for the data in the GeoConcept database.

Certain subclasses of data derived from the “GeoConcept” database are not to be standardized and the corresponding MIF/MID files are not available. These data correspond to the subclasses belonging to the “reseau_routier_tp” and “temp” classes.

5.3.2.2.3 Map in GeoTIFF format

A representation map in GeoTIFF format was created from the FreeHand files (from the “map editing” series).

5.3.2.2.4 Urban database (UDB)

Senegal has acquired topographic data at the 1:2,000 scale for seven cities. These data will be made available as a reference to correct or improve the continuity of the 1:200,000 road network map. They are not to be used to update the data or add data to the 1:200,000 collection. These data may not be used for purposes other than those specified in this document.

5.3.2.2.5 FTP directories of sources for the 1:200,000 collection

The following data are available on the FTP site:

- SPOT orthoimages: ftp://.../senegal/bd_200k/orthoimages_spot/
- 90-m resolution DEM: ftp://.../senegal/bd_200k/mne_90m/
- Map in GeoTIFF: ftp://.../senegal/bd_200k/cartes_geotiff/

- FreeHand files that were used for data capture: ftp://.../senegal/bd_200k/bd_freehand/
- FreeHand files that were used for map editing: ftp://.../senegal/bd_200k/cartes_freehand/
- GeoConcept database: ftp://.../senegal/bd_200k/geoconcept/
- Export in “MIF/MID” from the GeoConcept database: ftp://.../senegal/bd_200k/geoconcept/midmif/
- Acquisition specifications: ftp://.../senegal/bd_200k/documentation/
- UDB: ftp://.../senegal/bd_200k/bdu_2000/

5.3.2.3 1:1,000,000 collection

5.3.2.3.1 Vector data

The FreeHand data file for the 1/1 000 000 collection contains two boxes which are actually enlargements of the cities of Dakar and Saint-Louis. The data contained in these enlargements does not have to be recovered and are not part of data standardization.

The FreeHand data file for 1/1 000 000 contains a box showing an administrative map of Senegal. The data contained in this box do not have to be recovered and are not part of data standardization.

The following data are available on the FTP site: ftp://.../senegal/bd_1m/

- Number of datasets: 1
- Format: FreeHand
- Projection: WGS84, UTM28

5.3.2.3.2 Acquisition specifications

There are no acquisition specifications for the 1:1,000,000 collection. This collection is derived from the 1:200,000 collection.

5.3.2.3.3 Orthoimages

There are no orthoimages specific to the 1:1,000,000 data collection, but the orthoimages from the 1:200,000 collection can be used as a reference in order to resolve any inconsistencies that may arise during standardization.

5.3.2.3.4 1:200,000 collection

The 1:200,000 data may be used as a reference to correct any inconsistencies encountered during standardization.

5.3.3 Data preparation and selection of sources for standardization

NRCan did not make any particular observations concerning the data in the 1:50,000 and 1:1,000,000 collections, except that the data sources for the 1:1,000,000 collection (FreeHand format) will have to be georeferenced.

However, the situation for the 1:200,000 collection is different. Given how the data were acquired, in NRCan’s view, there is no clear reason to prefer one source over another.

The following are a few of the observations on the data made by NRCan:

- The data in the FreeHand files are not organized in the same way as in a GIS:
    - The georeference is not explicit;
    - The geometries do not contain attributes;
    - Linear data are represented by splines;
    - The geometries have an excessive number of vertices;
- The intermittent streams in GeoConcept were overfiltered and no longer accurately represent the terrain;

- Some road segments in the FreeHand files of the “capture” series and the GeoConcept database appear not to have been moved for cartographic representation purposes;
- There are missing or superfluous data in the GeoConcept database.
- GeoConcept data have in attributes, annotations which could facilitate the work.

For these reasons, the contractor will have to analyze the available sources and select the sources that it will use and the methodology for carrying out the standardization without losing sight of the standardization goals set out in section 5.3.1.

5.3.4 Content validation

Content validation does not imply that the contractor will have to validate all the features from the data sources, but that the contractor will have to take all the necessary steps to ensure that the data that have been standardized will meet the following criteria:

- All the features present in the initial data must be standardized;
- It is not necessary to conduct quality control to ensure that all the entities visible on the acquisition source were captured;
- The contractor will have to ensure that the features were properly correlated;
- The features may have initially been improperly coded, which will inevitably result in correlation errors;
- The contractor will have to ensure that all the features are coded correctly based on what they are intended to represent;
- Participate in a one-day workshop on the toponymy of Senegal. This workshop will be held during a technical visit of the contractor in Senegal. The GICC is responsible for the organization of this workshop.

5.3.4.1 Commission and omission

All the features present in the initial datasets must be standardized. Features should be added or deleted only for the purpose of resolving an inconsistency in the existing data or ensuring horizontal integration between datasets (see section 5.3.5.9)

5.3.4.2 Data from outside Senegal

All the collections contain data from outside Senegal. A minimal effort is required to obtain a consistent representation of these data with the data from Senegal. (See section 5.3.5.8 for additional instructions concerning data from outside Senegal.)

5.3.4.3 Variable attributes

Variable attributes are attributes whose value domain is not defined. The data to be standardized have this type of attribute. These data are present primarily in text form in the data to be standardized. The contractor must ensure that it retrieves all these texts or information corresponding to variable attributes and makes them compliant with the catalogue and structuring rules in section 5.3.5.2.2.

5.3.4.3.1 Elevation of spot elevations and contour lines

The elevation values of the spot elevations and contour lines must be validated. The DEM that was used to capture the contours in the 1:200,000 collection is the 3D source for carrying out this validation. There is no available 3D source for the 1:50,000 collection for this SOW. The contractor shall ensure that the elevations of the spot elevations and contours are consistent between the 1:50,000 and 1:200,000 collections.

5.3.5 Data structuring rules

The following sections describe the minimum rules that data of all the collections must comply. NRCan has not conducted a complete analysis of the data to be structured. The harmonized catalogues may lead to other structuring rules that will have to be applied to the data.

5.3.5.1 Geometric primitives

The geometric primitives used in this SOW are based on the ISO “simple feature” model [ISO/TC211, DIS-19125-1]. Three types of primitives are acceptable: *points, lines* and *polygons*.

Note that this concept applies only to the features that have a geometry and that any other type of data is not permitted.

All data must comply with the principles set out in the following document:
ftp://.../senegal/structuration/PrimitivesGeometriques.doc

5.3.5.1.1 FreeHand files

The files in FreeHand format contain geometries that may not be compliant with the geometric primitive rules. Conversion of the format may also cause geometry problems. This does not mean that these features will necessarily be destroyed. During initial preparation of the work environment by the contractor and when importing the data to be standardized, particular attention must be paid to this aspect in order to determine the appropriate action.

5.3.5.2 Correlation and attributes

All the features to be standardized must be correlated with a specific code in the new catalogue (section 4). The attributes and attribute values must also be transferred without any loss of information. Once the data have been correlated with the new catalogue, feature duplications will have to be eliminated.

5.3.5.2.1 Fixed attributes and specific codes

Each feature class has its own description of fixed attributes with defined values. Specific codes are derived from these fixed attributes. Integrity between the specific code, the class and the fixed attributes must be preserved during the correlation process and the standardization process must ensure that this integrity is fully maintained (correlation, validation, structuring).

5.3.5.2.2 Variable attributes

The data catalogues (section 4) identify the variable attributes for each class, and for each attribute, the type, and the domain of expected values.

The contractor must ensure that the values of the variable attributes are compliant with the catalogue requirements. For example, the “ELEVATION” attribute of the contour lines must contain only whole number values and the value domain must limit the values to those found in Senegal.

For the “character” attributes, the contractor must “clean up” the data so that they can be properly used. For example, all superfluous spaces must be eliminated. The type of encoding to be used is UTF-8.

5.3.5.2.3 UUID

Each feature must have a “UUID” (Universal Unique Identifier) attribute for each collection (1:50,000, 1:200,000 and 1:1,000,000).

No duplication of a UUID is permitted.

The method for creating UUIDs is standardized according to ISO/IEC standard 9834-8:2008. The UUID must be 36 characters long.

The following is an example of the form that UUIDs must take: 5b52390f-dd28-4417-9045-cb6be0c1b085

5.3.5.3 Consistency between collections: 1:50,000, 1:200,000 and 1:1,000,000

Each collection is the result of a different acquisition process. The geometry representing the topographic and anthropogenic entities will therefore obviously be distinct. However, the catalogue harmonization (section 4.2.2) and the data standardization work will ensure consistency between the 1:50,000, 1:200,000 and 1:1,000,000 collections in terms of attributes and attribute values.

5.3.5.4 Filtering

Depending on the sources selected by the contractor, filtering may be required (for example, if the FreeHand files are used). The filtering parameters must ensure accurate representation by removing as many vertices as possible. It is important to point out that the final data must be the most accurate representation possible of the terrain. The orthoimages are the reference sources for determining whether the data accurately represent the terrain.

5.3.5.5 Spatial relationships

There are typically several ways of spatially representing features in a geospatial database. Different ways of modeling the shape and location of the features in a database can be used. The spatial relationships describe how these features are located in relation to each other. By studying the relationships between these features, we can learn more about the real objects they represent. Spatial relationships representing the relative locations of two features of the same type or of different types must behave in a manner consistent with objects in the real world.

For example, it would not be logical to find the following in the database:

Two “lake” features one exactly above the other (prohibited duplication).
A lake overlapping another lake (overlap not permitted).
A road in a lake (overlap not permitted).
A bridge without a road (inconsistency).
A waterfall not connected to a watercourse (inconsistency).

Based on the harmonized catalogues of the 1:50,000, 1:200,000 and 1:1,000,000 collections, the contractor will have to compile a list of all the spatial relationships that describe the spatial behaviour of the features (of the same type and of different types) relative to each other and make the data conform to these relationships in order to ensure that the data in the database accurately represent reality.

5.3.5.5.1 Basic principles

The following basic principles will help the contractor to accurately define spatial relationships:

For features in the same theme:

- No duplication is permitted.
- Lines may not cross each other. They are broken at their intersections with a common vertex to form distinct segments.
- Polygons cannot be superimposed.
- Two lines or polygons of the same type that are in proximity (e.g. two linear watercourses) must form a single feature. The concept of proximity is relative to the type of entity.
- Vertical integration must be ensured between features. For example;
    - A point feature representing a bridge must be located on the vertex of a line type geometry representing a road.
    - An “elevation point” point feature cannot be superimposed on a “contour” line feature.

For features in different themes:

- The features must behave in a manner that is normal for their environment. For example;
  - An “isolated habitat” point feature cannot be located within a “water” polygon.
  - A savanna type vegetation polygon cannot be located within or superimposed on a “water” polygon.
  - A contour line cannot cross a “lake” type water body but can cross a “river” type water body.

5.3.5.6 Geometric definition of neatlines

The 1:50,000 and 1:200,000 collections are organized into datasets. This section provides the instructions for data clipping and naming of these datasets.

5.3.5.6.1 Clipping of the 1:1,000,000 collection

There is no dataset neatline to be used for the 1:1,000,000 collection. All the data must be delivered in a single dataset.

5.3.5.6.2 Clipping of the 1:200,000 collection

For the 1:200,000 collection, the extent of the datasets corresponds in geographic coordinates to 1 degree by 1 degree, and the coordinates of the vertices of the four corners correspond exactly to whole degrees. Figure 2 shows the clipping for the Saint-Louis dataset.

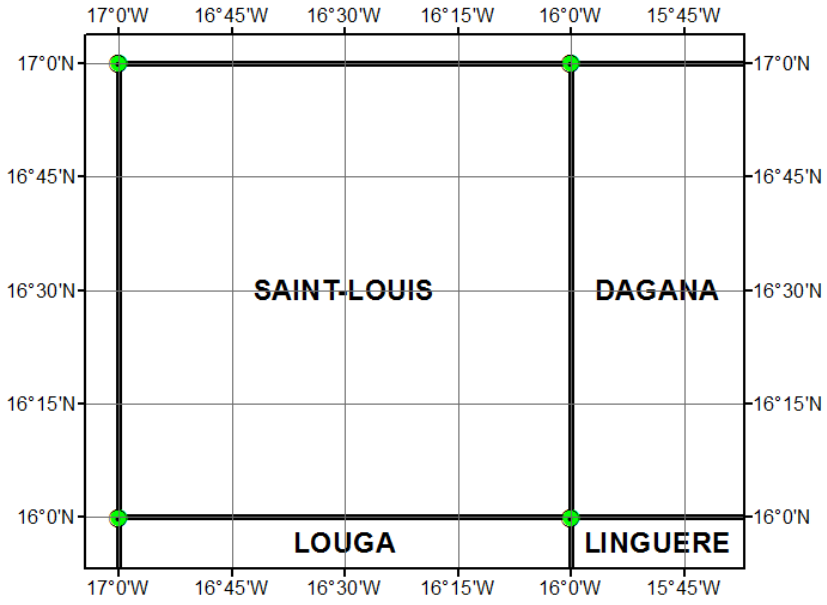


Figure 2 Clipping for the Saint-Louis dataset

5.3.5.6.2.1 Inflection points

In order to minimize deformation should it prove necessary to change the projection type, the dataset neatlines must have vertices or inflection points every five minutes (geographic coordinates) the length of the neatlines.

The geographic coordinates of the dataset neatlines must be expressed in metres, in the UTM projection, zone 28, and rounded to the nearest metre.

5.3.5.6.2.2 Sheet nomenclature

For Senegal, there are 27 datasets to be standardized, but the new definition of the dataset neatlines divides the data into 29 datasets. Figure 3 shows the previous clipping, while Figure 4 shows the new clipping and the nomenclature to be used.

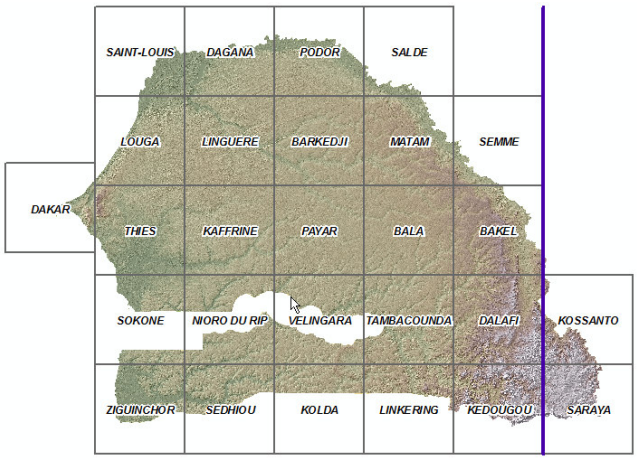


Figure 3 Previous clipping of the sheets in the 1:200,000 collection

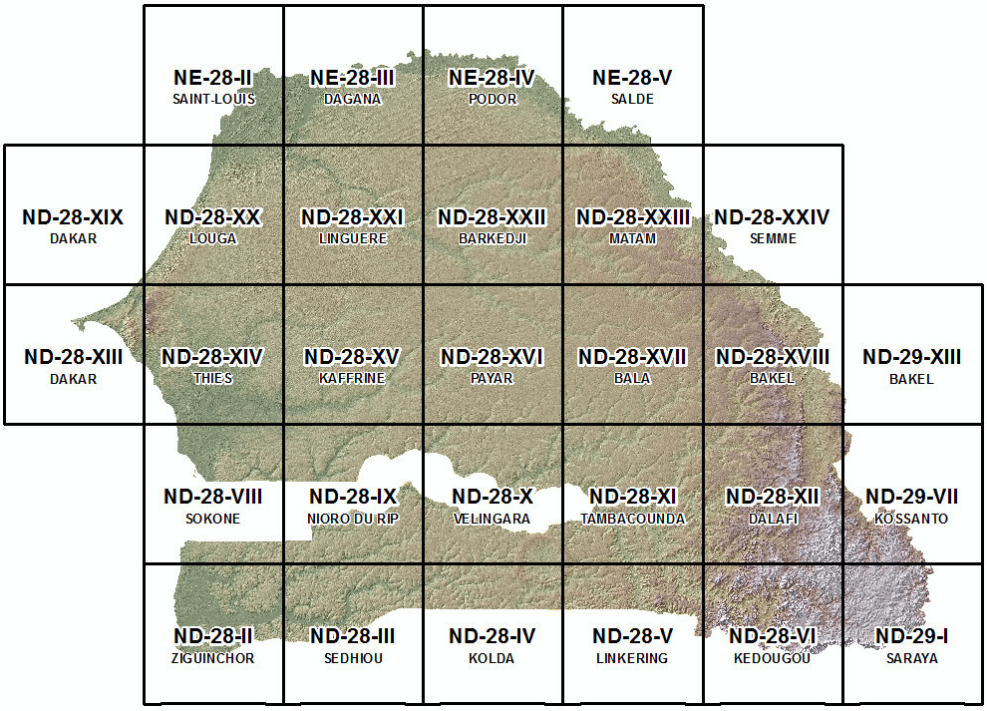


Figure 4 New clipping of the sheets in the 1:200,000 collection and nomenclature

The new clipping of the 1:200,000 collection forms a separate class of the catalogue and must be delivered with the standardized data.

The neatlines are represented by polygons and must have two attributes: the first for the sheet name and the second for the sheet number (e.g. THIES, ND-28-XIV). The format for the sheet name is upper case characters and the format for the sheet number is alphanumeric characters in upper case.

All the standardized features of all the datasets must have an attribute for the number of the sheet to which the feature belongs (e.g. ND-28-XIV).

The sheet numbers (e.g. ND-28-XIV) are composed of three series of characters separated by a dash.

5.3.5.6.3 Clipping of the 1:50,000 collection

For the 1:50,000 collection, the extent of the datasets corresponds to 15 minutes by 15 minutes (in geographic coordinates) and the coordinates of the vertices of the four corners correspond exactly to quarter degrees. Figure 5 shows the extent in geographic coordinates and the nomenclature of the 1:50,000 dataset.

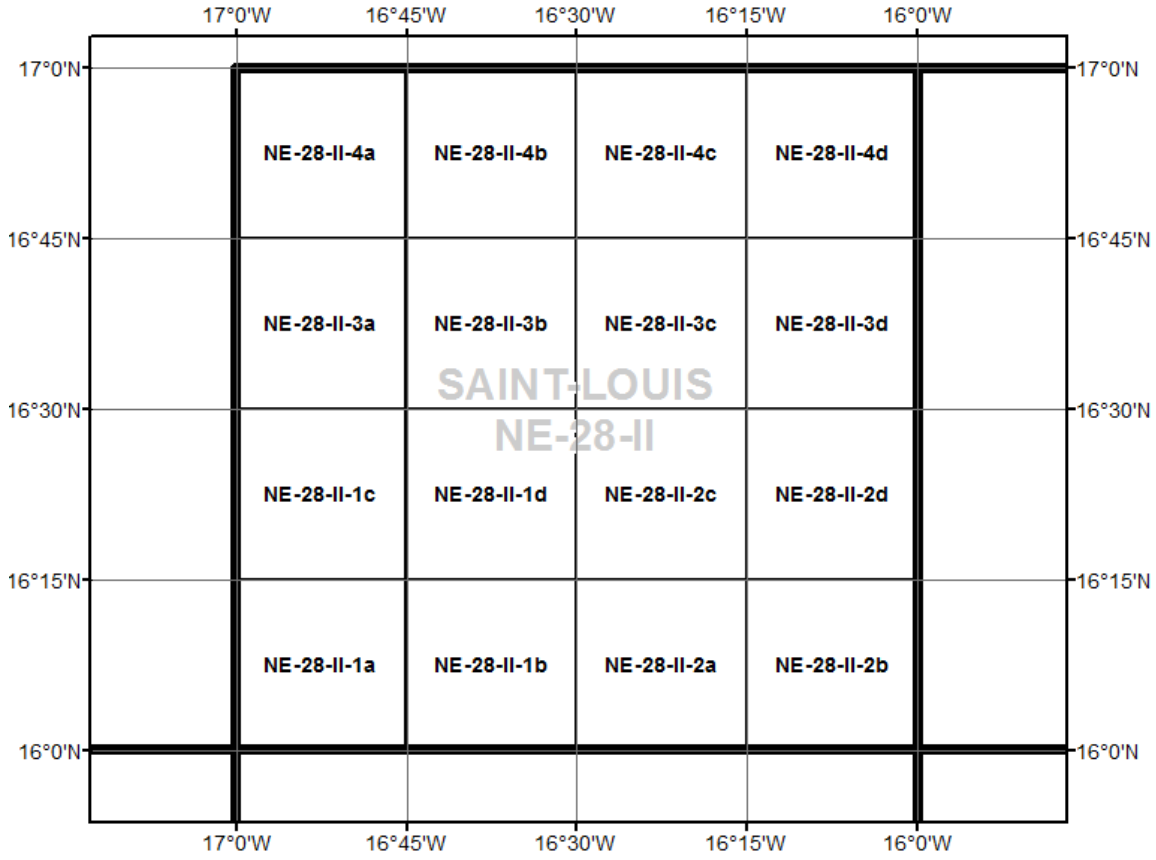


Figure 5 Extent of the datasets in the 1:50,000 collection

Methodology for naming datasets in the 1:50,000 collection:

Divide the 1:200,000 collection into four and number these four parts from 1 to 4 from bottom to top and from left to right.

Subdivide these four parts again into another four parts and add the letters a, b, c, d to the number established in the first step.

There are 54 datasets to be standardized in the 1:50,000 collection, and all the sheets covering all or part must be delivered in the database.

The neatlines are represented by polygons and must have two attributes: the first for the sheet name and the second for the sheet number (e.g. SAINT-LOUIS, NE-28-II-1a). The name of the sheets in the 1:50,000 collection corresponds to the name of the sheets in the 1:200,000 collection. The format for the sheet name is upper case characters.

All the standardized features of all the datasets must have an attribute for the number of the sheet to which the feature belongs (e.g. NE-28-II-1a).

The sheet numbers (e.g. NE-28-11-1a) are composed of four series of two characters separated by a dash.

5.3.5.6.3.1 Inflection points

In order to minimize deformation should it prove necessary to change the projection type, the dataset neatlines must have vertices or inflection points every five minutes (geographic coordinates) the length of the neatlines.

The geographic coordinates of the dataset neatlines must be expressed in metres, in the UTM projection, zone 28, and rounded to the nearest metre.

5.3.5.7 Data clipping

The action of data clipping means that all the features must be segmented to the neatlines. Figure 6 shows an example of data clipping.

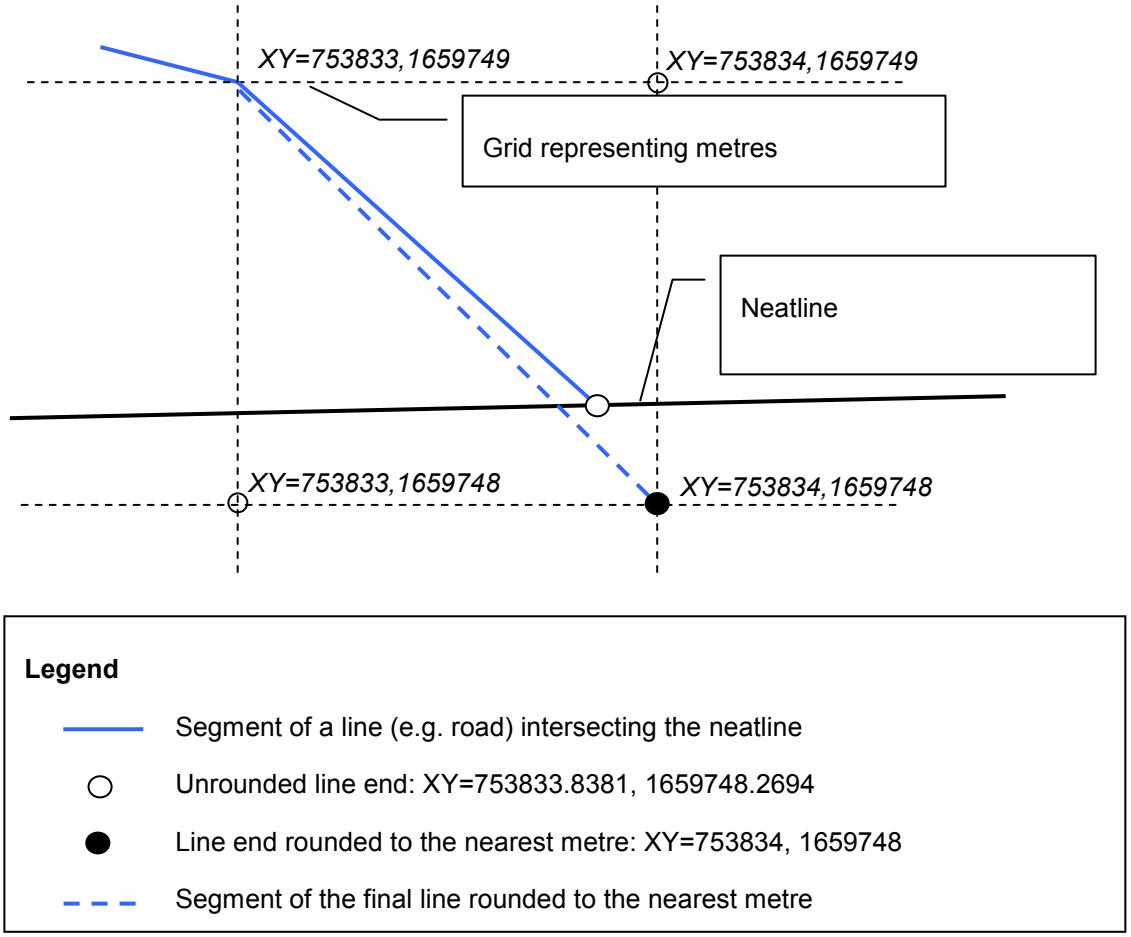


Figure 6 Data clipping

The coordinates of the features where they intersect with the neatline are rounded to the nearest whole value.

See the document “Decoupage.doc” for all the clipping instructions. This document is available at the following FTP address: ftp://.../senegal/structuration/Decoupage.doc

5.3.5.8 Clipping at the international boundary

All data from all collections must be segmented at the limit of the international boundary obtained from the 1:200,000 collection. No existing data, including data from outside Senegal, are to be destroyed, but they must be assigned the two-character code of the country from which they originated as attributes. The country codes are from ISO standard 3166 (http://www.iso.org/iso/fr/french_country_names_and_code_elements). Figure 7 shows the country code values to be used.

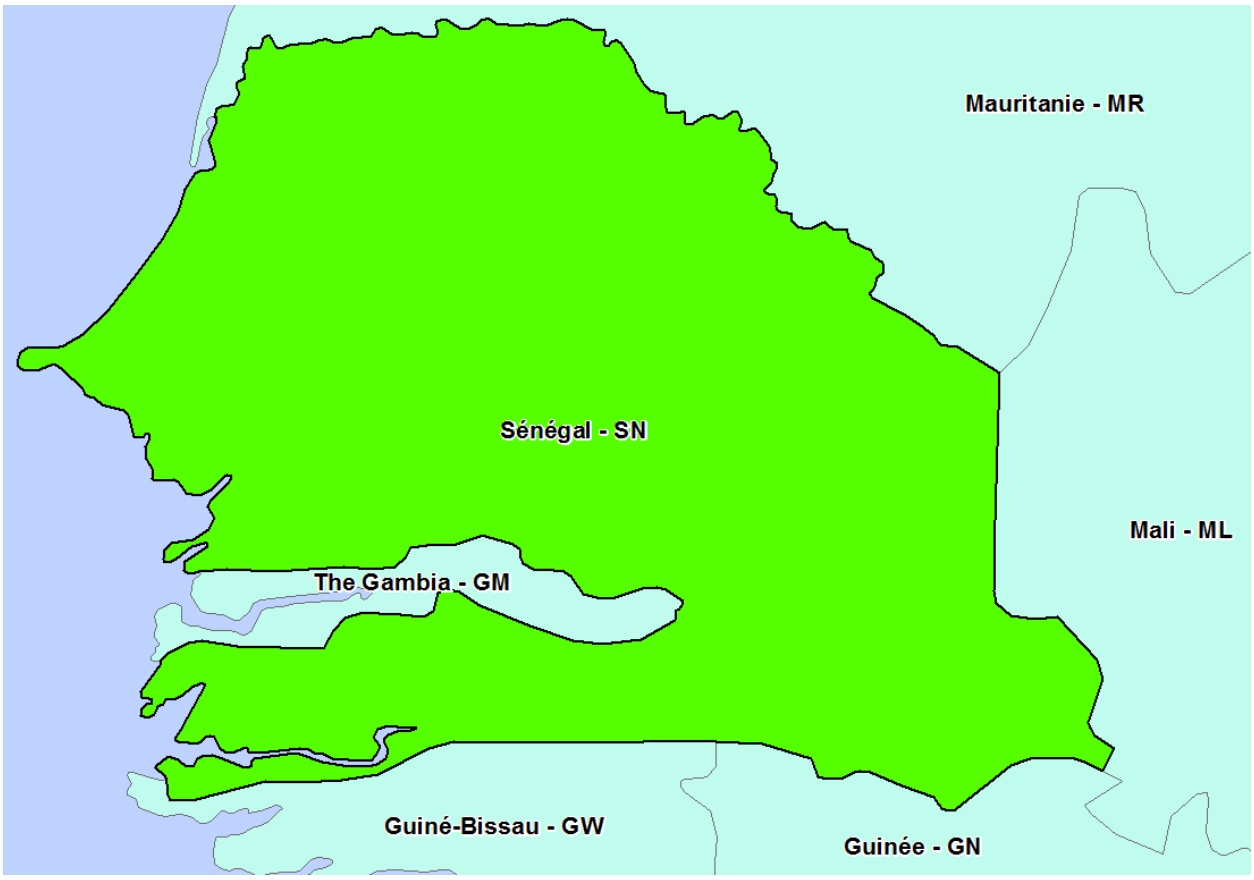


Figure 7 Country codes

5.3.5.9 Horizontal integration of datasets

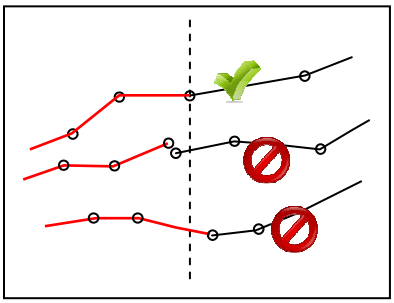
Horizontal integration is a process that ensures continuity of the data between the datasets. Horizontal integration must be performed on contiguous datasets. Horizontal integration is mandatory for all features in all datasets for the data from the 1:50,000 and 1:200,000 collections. This process must therefore be performed at all times. The specific code as well as the attribute values, like the hypsometric values of the contour lines, must also be identical.

5.3.5.9.1 Continuity between datasets

The geometric and attribute continuity of the features crossing the datasets must be validated and ensured.

Geometric continuity means that the coordinates of the last vertex of the line representing a road, for example, at the neatline will be the same for the line representing the same road in the adjacent dataset. For a polygon, this means that the coordinates forming the segment touching the neatline will be the same for the segment of the other polygon completing the entity in the adjacent dataset. See section 5.3.5.7 for additional information. Figure 8 shows some examples of feature continuity.

Continuity of a linear feature:



Continuity of a polygon:

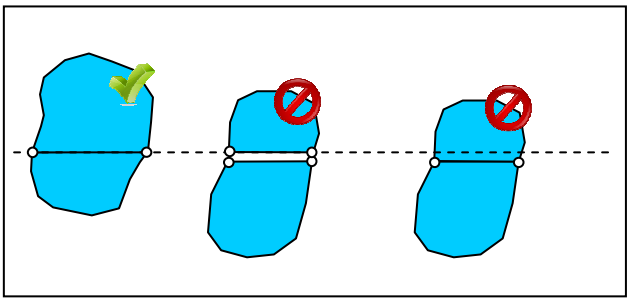


Figure 8 Example of feature continuity

The features that end at the neatline must be modified so that they are within the dataset if, in fact, they do not extend into the adjacent dataset; otherwise they must end exactly at the neatline if they extend into the adjacent dataset.

In the case of a linear feature representing an entity, such as a road, that extends over more than one dataset, its last vertex must connect perfectly with the neatline of the dataset and then be rounded to the nearest metre. In the case of a surface feature representing an entity that extends over more than one dataset, an edge of its polygon must coincide perfectly at the neatline and then be rounded to the nearest metre. See section 5.3.5.7 for more information concerning the clipping of features at neatlines.

The “attribute” continuity of a feature between two datasets may be broken by the attribute value of one or more attributes or by improper coding. This improper coding may be the result of an incorrect correlation or may be simply due to a coding error when this feature was initially coded.

Horizontal integration can be validated using orthoimages, the map in GeoTIFF and the context in order to determine the most appropriate solution. Figure 9 shows an example of data before and after horizontal integration.

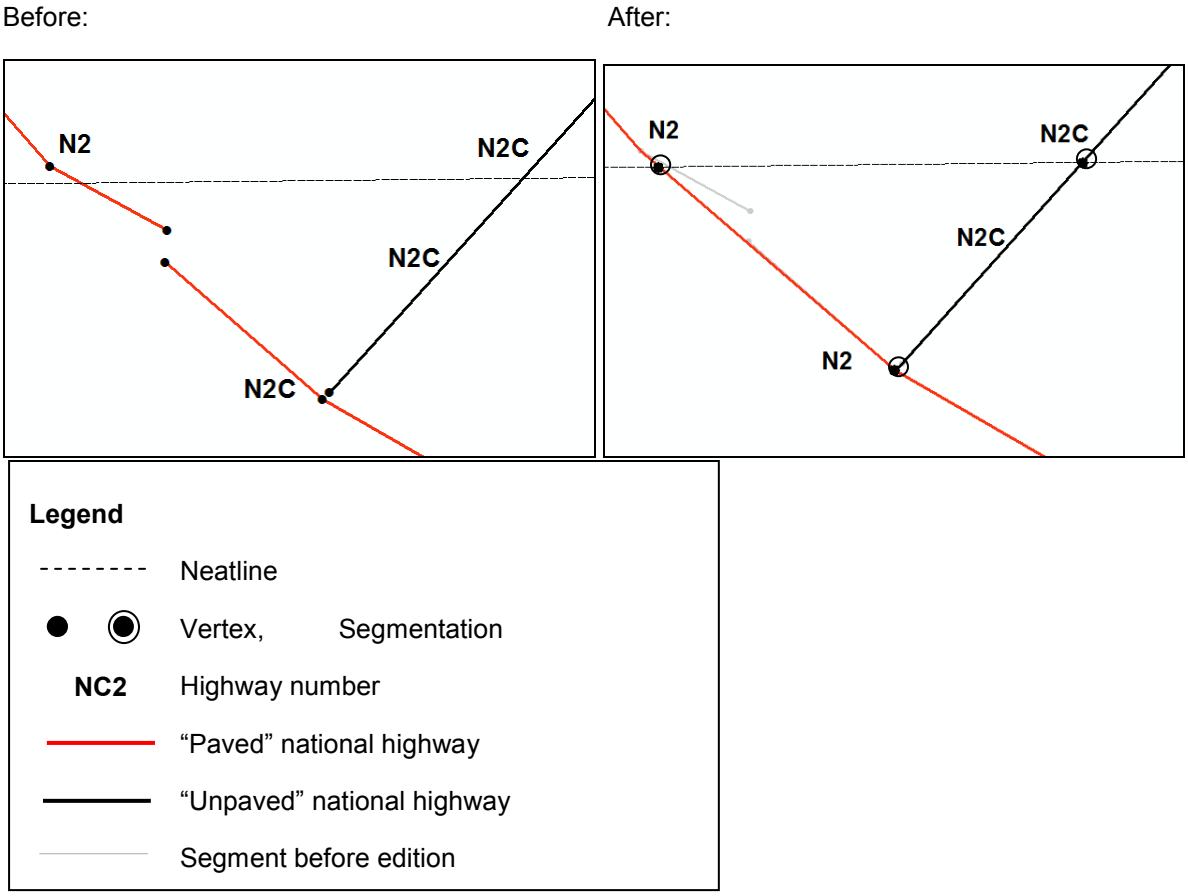


Figure 9 Example of horizontal integration

It is important that the final editing result accurately reflect the initial appearance of the features. To this end, determine the preferred segment to be modified and move the last vertex of this segment toward the last vertex of the other segment. Once this operation has been performed, clip the segment crossing the neatline at the exact location where there is an intersection, and finally, eliminate all superfluous segmentations. Then validate that the value attributes of the lines created in this way are the same, with the exception of the dataset identifier.

5.3.5.9.2 Data without continuity in the adjacent dataset

Horizontal integration must always be performed. If a feature is missing from one side of the datasets, the contractor must ensure first of all that the feature was not destroyed during the standardization process. For data from the 1:200,000 collection, additional validation on the map in GeoTIFF format must be performed. As a last resort, the contractor must use the orthoimages.

5.3.5.10 Contour lines and spot elevations

For all collections containing contour lines (1:50,000 and 1:200,000), the contractor must ensure that the data retrieved are consistent:

- Between contours
- Between spot elevations
- Between contours and spot elevations

- With the hydrography

When it's possible, horizontal integration (geometric and attribute) must be performed on all contours and datasets.

5.3.5.10.1 Contour lines and spot elevations for the 1:200,000 collection

The contractor must retrieve contour and spot elevation data whenever possible. The elevation values must be validated with the 90-m resolution DEM of the 1:200,000 collection.

N.B.: The elevation values of the contour lines in the GeoConcept database contain errors.

Horizontal integration of the contour lines is mandatory for the following types of contours:

- Standard contours
- Index contours
- Auxiliary contours

Section 5.3.5.9 provides all the instructions concerning horizontal integration.

5.3.5.10.1.1 Auxiliary contours

The auxiliary contours are incomplete. However, completing these contours and performing horizontal integration has been identified as an objective. The "capture" series of the FreeHand files contains a data layer called "ORO_Courbes Interc. (toutes)" which seems to be the raw result from the creation of contours from a DEM. The requirement is not to recover all these contours, but to complete the existing auxiliary contours from this layer and perform horizontal integration. Figure 10shows an example of auxiliary contours.

Existing auxiliary contours

"Raw" auxiliary contours of the capture series

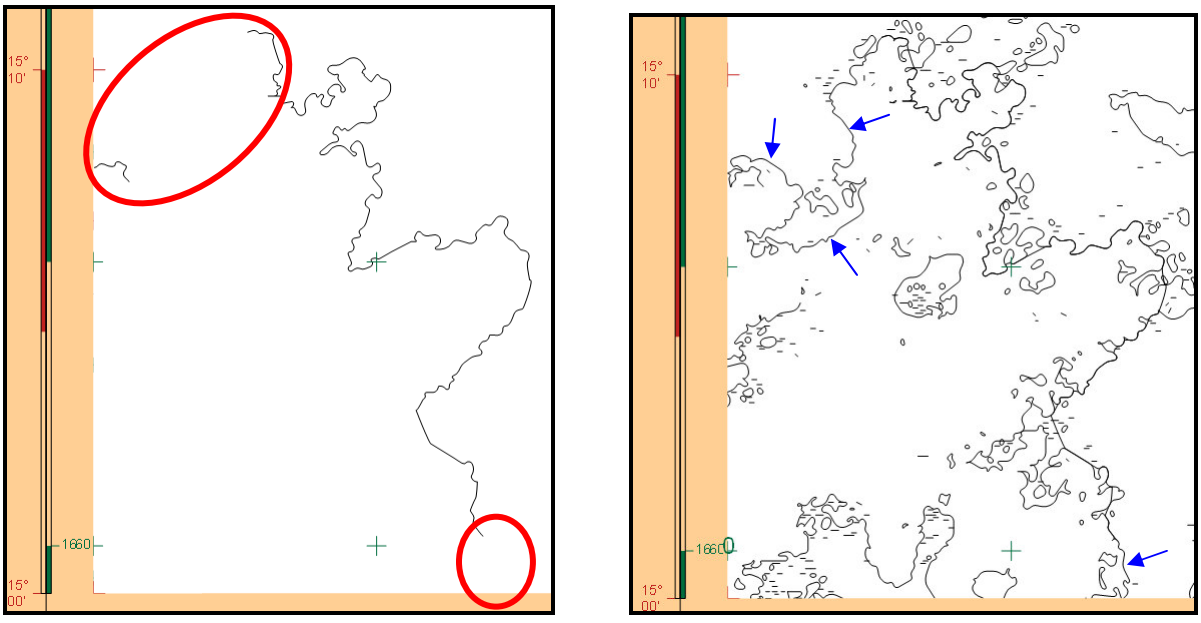


Figure 10 Example of auxiliary contours

Inside the red circles, a section of the auxiliary contour is missing.

The blue arrows show that these missing sections exist in the "capture" series of the FreeHand file.

5.3.5.11 Continuity of the road network

The road network is an important theme in the mapping of a country and in its use for land management purposes.

All available sources must be used in order to achieve a continuous and complete road network. The goal is not to update the data or add data to the 1:200,000 collection, but to complete the existing data.

To ensure insofar as possible that the roads form a connected road network, the standardization must meet the following expectations:

- Road numbering must be validated using the maps in GeoTIFF format (Figure 11):

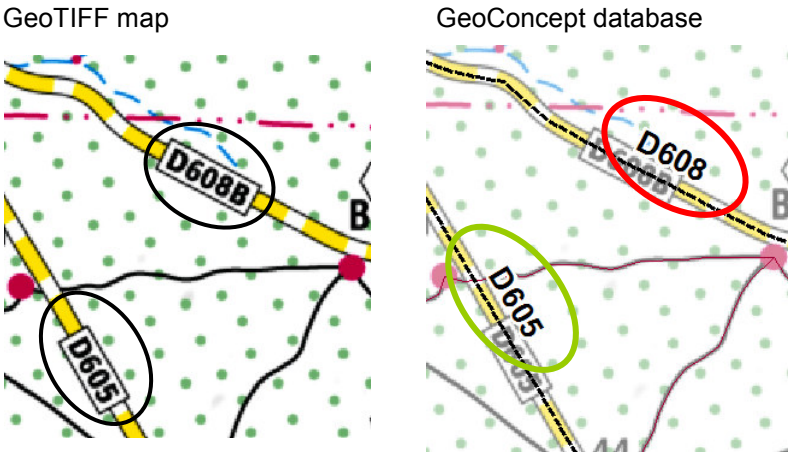


Figure 11 Road numbering

- Geometric and attribute continuity (specific code and road numbering) between and within datasets must be ensured on all datasets (Figure 12).

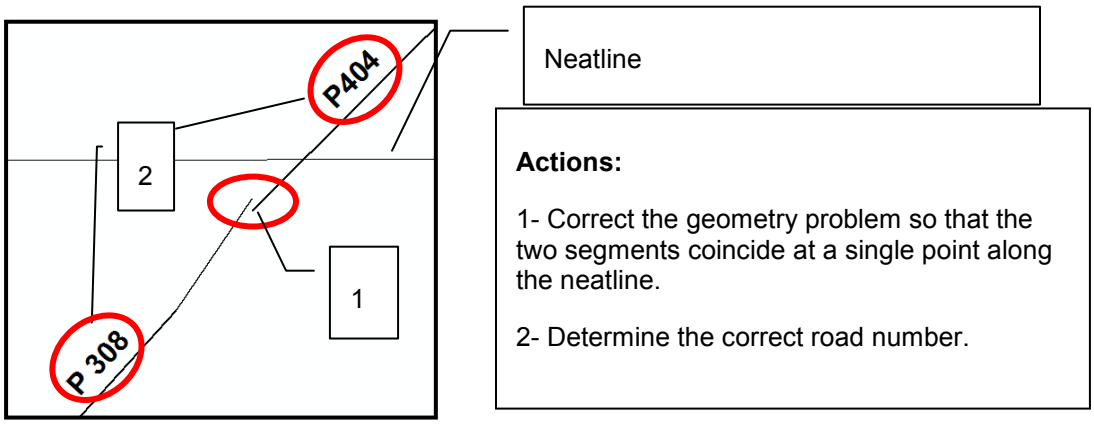


Figure 12 Geometric and attribute continuity

- "Ferry" features are an integral part of the network and can help to ensure the continuity of the road network. Ferries allow motor vehicles to cross major rivers. Ferries that connect a numbered road to an opposite shore must be assigned the road number as an attribute. The line representing the ferry must connect to the rest of the road network. However, since the ferry

feature, owing to its nature, is within a river, the roads will have to be modified in order to connect to the ferries. Figure 13 shows an example of a ferry.

A “ferry” linear feature represents traffic in both directions. Do not create a “ferry” segment to represent the outbound route and another for the return.

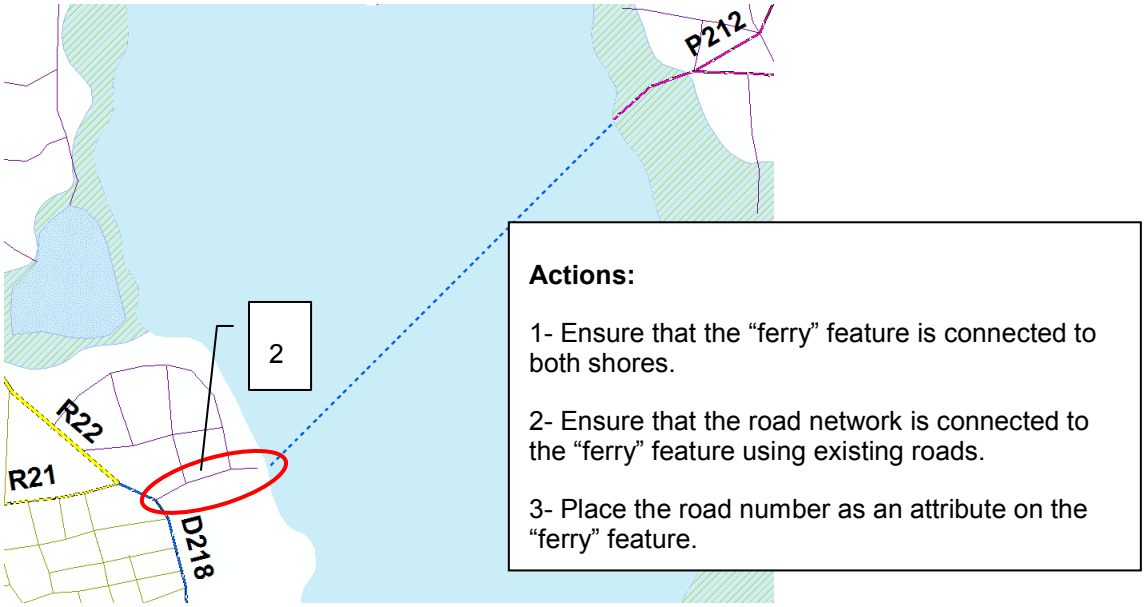


Figure 13 Example of a ferry

N.B.: On the example in Figure 13, there is no numbered road on the left shore leading to the ferry. The best action to take in this case is to recode the existing road segments using the same code as the road on the right shore leading to the ferry and ensure that it connects to the rest of the road network.

- A road segment must be capable of supporting several road numbers simultaneously. It is prohibited to duplicate the segment because there is more than one number (Figure 14).

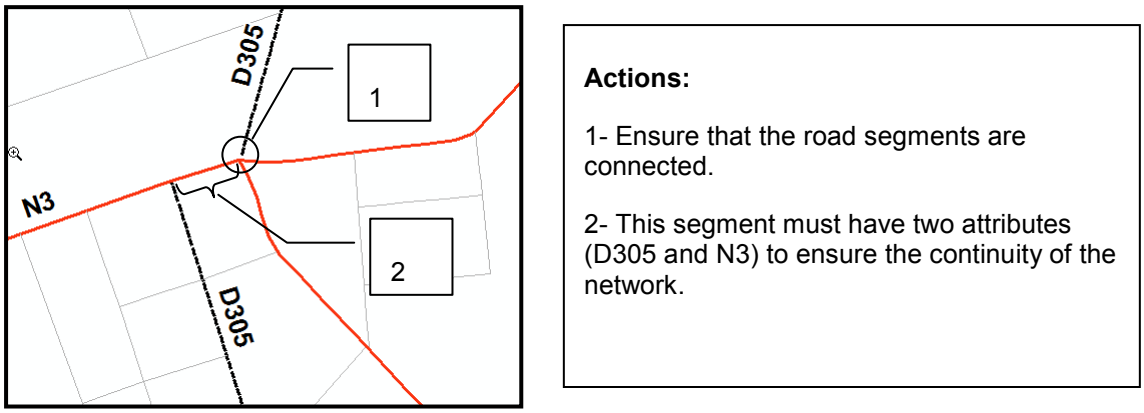


Figure 14 Numbered roads I

- Depending on the context, it may be obvious that one numbered road must essentially end at another numbered road (Figure 15).

Vector data Representation GeoTIIF

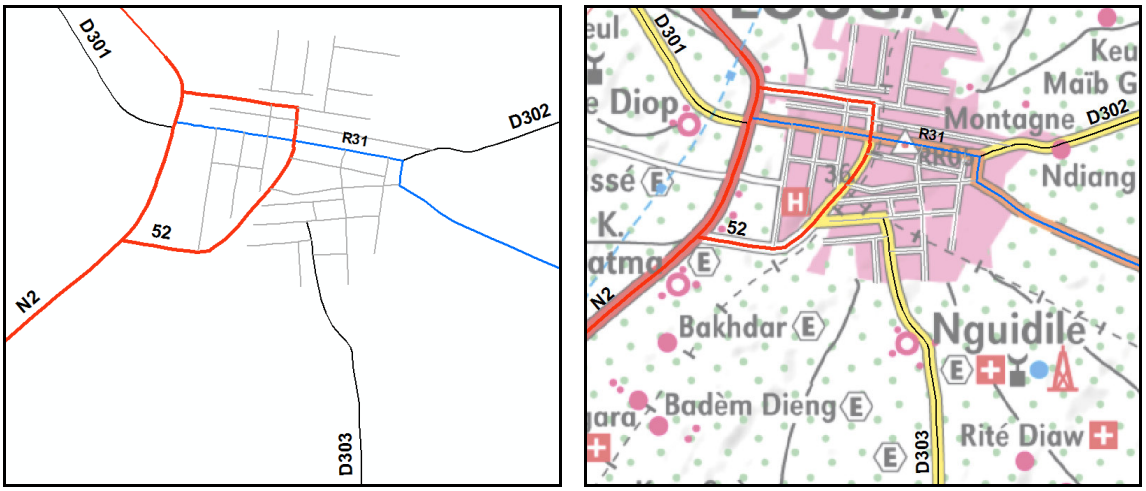


Figure 15 Numbered roads II

Actions:

1- According to the GeoTIFF map, Road 52 (present in GeoConcept) is not a numbered road. Recode these road segments to the appropriate code.

2- The departmental highway “D303” must connect to the national highway “N2,” as shown on the GeoTIFF map.

It is not necessary to apply these rules to unnumbered road types.

5.3.5.11.1 Isolated road

An isolated road is a road that does not connect to the rest of the road network. This concept applies to all road types (Figure 16).

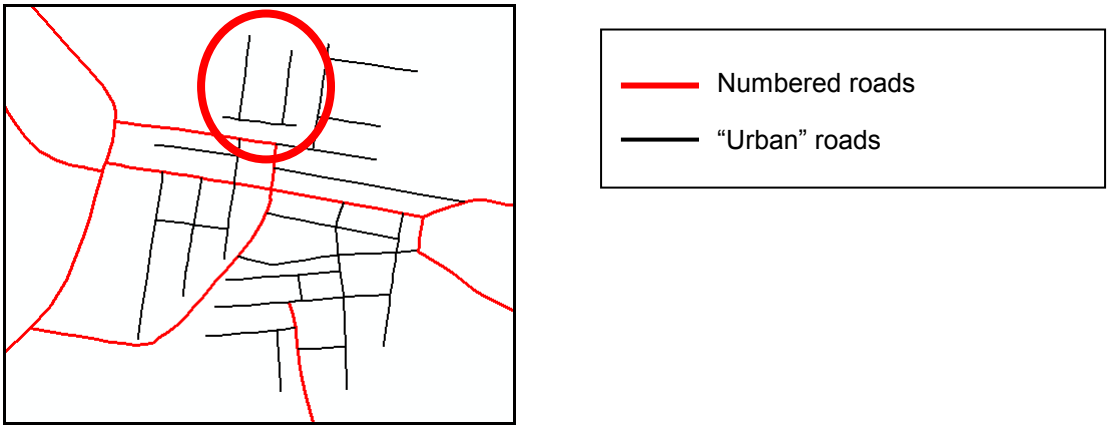


Figure 16 Isolated road

An “urban” road must necessarily connect to the numbered road network (Figure 17).

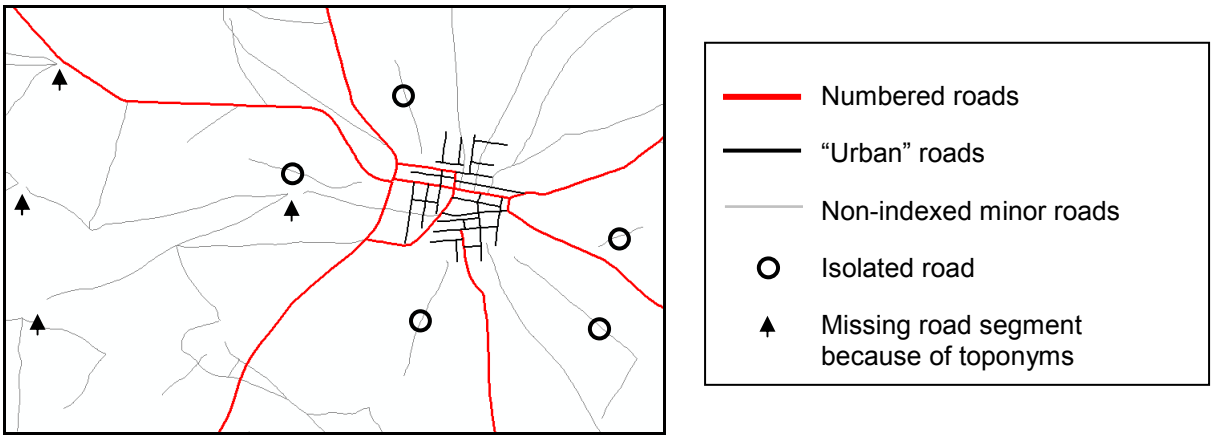


Figure 17 Urban roads

"Non-indexed minor roads" are very often isolated. The contractor must determine how the minor road must be connected, i.e. either to another minor road or to the numbered road network.

In addition, the minor roads were frequently segmented and disconnected in order to leave room for the symbols representing urban areas. Wherever possible, an effective solution must be found to correct all these deficiencies based on the situation.

5.3.5.11.2 Continuity of the road network and international boundary

With the exception of the territory of Gambia, the contractor is not required to ensure the continuity of the road network beyond the boundaries of the territory of Senegal.

However, the geography of Senegal requires special processing of the territory of Gambia in order to ensure continuity of the road network. Provided that the existing data permit, the contractor must ensure the continuity of the numbered roads that cross into Gambia (Figure 18).

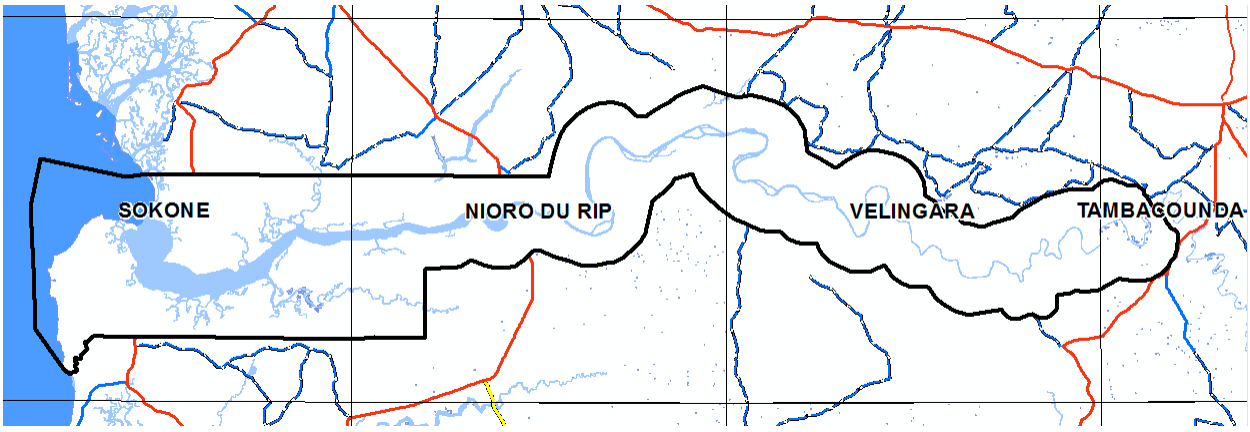


Figure 18 Road network of Gambia

5.3.5.11.3 Duplication

The road segments and ferry segments form the road network and no duplication of features is permitted. Overlapping of a ferry feature with a road feature is not permitted.

5.3.5.12 Hydrography

The hydrography is an important theme for the mapping of a country. Standardization of the hydrography includes:

- Distinguishing between lakes, rivers and oceans
- Improving geometric and attribute continuity

5.3.5.12.1 Distinguishing lakes, rivers and oceans

The catalogues make it possible to make a distinction between lakes, rivers and oceans. The catalogues do not limit water bodies to these three categories, but take them into consideration.

Generally, distinguishing water bodies into lakes, rivers and oceans is something that must first be done based on the geomorphologic context and secondly based on toponymic information.

Criteria for distinguishing lakes, rivers and oceans

Water body: ***Lake***

- Little or no current;
- Uniform elevation;
- No connection with an ocean;
- Presence of a lake toponym (without matching the criteria describing a river).

Water body: ***River***

- Fluvial system (presence of current);
- Presence of difference in elevation and entities associated with rivers (rapids, falls, shoals, contours);
- Long, slender shape;
- There is generally a significant change in width (bottleneck) at the intersection with another water body;
- Presence of a toponym of a flowing toponymic entity;
- Mouth approximately 200 m wide or less bordering an ocean.

Water body: ***Ocean***

- Marine entity where tides are present (can include areas of an intermittent nature);
- Uniform elevation, close or equal to mean sea level (0 m). This does not apply to the portions of water areas bordering an ocean whose mouth is approximately 200 m wide or less;
- Extends inland to a narrowing of approximately 200 m.

5.3.5.13 Toponomy

The existing data of the 1:50,000 and 1:200,000 collections have different types of toponyms in the form of textual annotations that identify topographic, location or administrative entities. These entities are represented in the existing data by point, line or polygon type features. The toponym annotations are positioned near the geometric features. In the existing data, there are no attribute associations between the annotations and the corresponding geometric features. Figure 19 shows examples of toponomy.

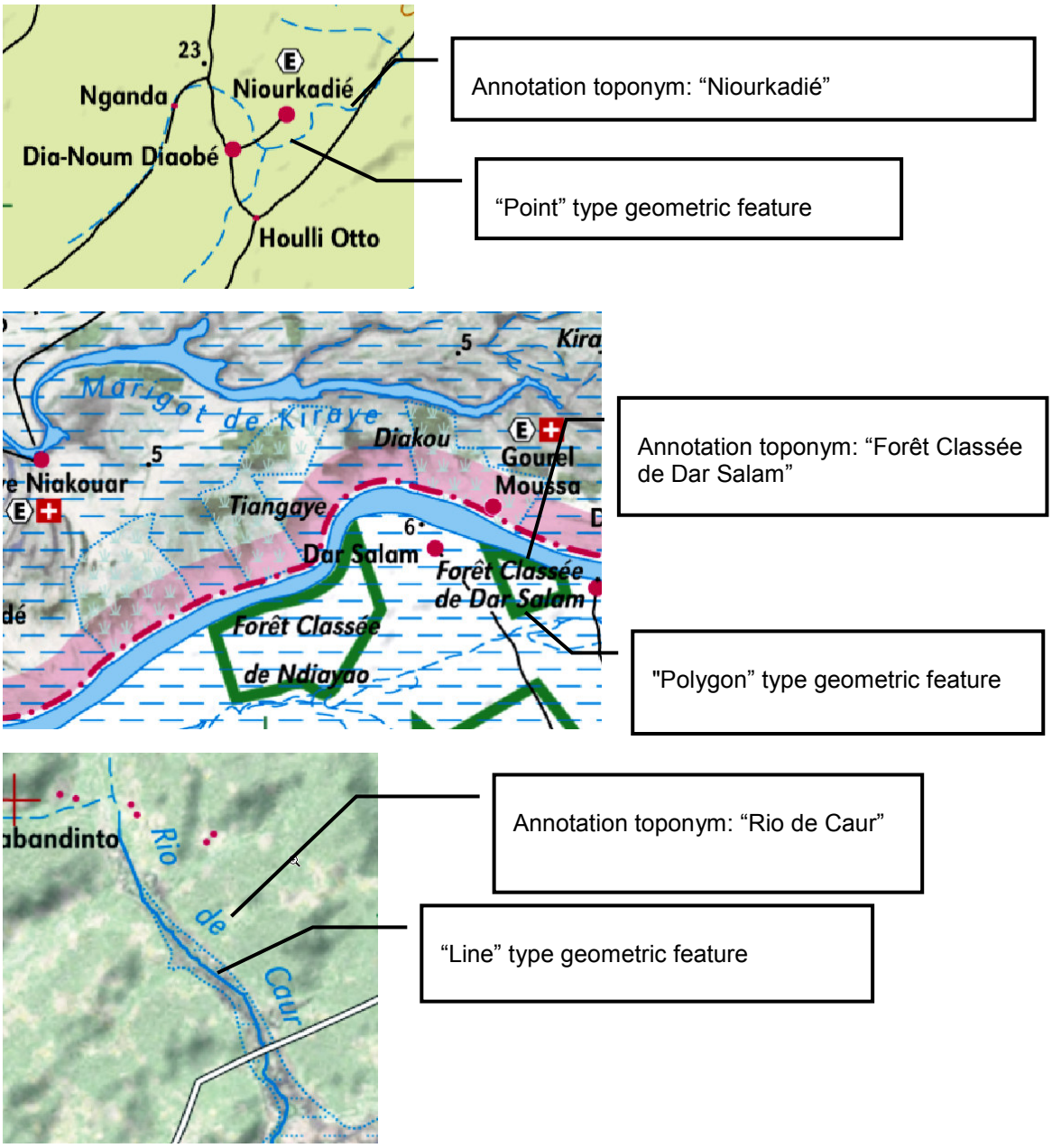


Figure 19 Examples of toponomy

5.3.5.13.1 Basic principles

Without knowing how the toponomy will be modeled in the catalogues, it is difficult to provide detailed instructions concerning its standardization. However, the following general rules must be followed:

- Toponyms (annotations) must be added as attributes to the geometric features; once these annotations become attributes, they will not be part of the catalogues;
- Point type geometric features that represent location entities (urban areas) must have as attributes the toponym of the location and must be connected to the road network by positioning the geometric point feature, either:
  - at the end of a road segment;
  - at the intersection of road segments; or

    - on a vertex of a road segment.
- Polygon type geometric features that represent administrative entities (e.g. city, town, village or park) must have as attributes the toponym of the administrative territory.
- When the polygon borders a topographic feature (e.g. a road or shoreline), the segment in common must coincide perfectly at the geometry of the topographic feature.
- During data structuring, the geometric features must not be moved except to respect the spatial relationships between features, which will be determined by the contractor.
- If the extent of a geometric feature does not fully correspond to that of a topographic feature (e.g. a river crossing a lake), the topographic feature must be split in order to clearly identify the extent of the geometric feature.

5.3.5.13.2 Toponym without topographic feature

Certain types of toponyms do not have topographic features in the data, for example named hills.

If the toponym cannot be associated with an existing topographic feature, the contractor must create a "point" type geometry and position the feature based on the context and the type of toponym by using the final product such as the map in GeoTIFF format. The position of the feature does not necessarily correspond to the exact location where the toponym is located.

The following are a few examples of toponyms without geometric features:

- Hill
- Historic or religious site
- Specific government centre

5.3.5.14 Type of feature positioned arbitrarily or without georeference

Some information is present only in the form of attributes or positioned arbitrarily only for cartographic representation purposes.

The contractor will have to model this information in the catalogue and determine how it will be represented.

If its geographic position cannot be determined, it is not permitted to create a feature to represent it.

For example, in the 1:200,000 collection, for each urban area, there is a list of available services (school, police, hospital, place of worship, etc.), but these services are positioned arbitrarily to facilitate cartographic representation. The catalogue must ensure that this information is associated with a feature type.

5.4 Standardization of the 90-m resolution SRTM DEM

The SRTM (Shuttle Radar Topography Mission) data at a resolution of 3 arc-seconds correspond to approximately 90 m on the ground. These data are free of charge and rights free. This DEM is the best option that provides a DEM comparable to the one that was used for the acquisition of the 1:200,000 dataset collection. This section provides instructions for standardizing these data.

5.4.1.1 Source material provided

The SRTM data are not provided by NRCan. The contractor must download the SRTM data itself.

5.4.1.1.1 90-m DEM of the 1:200,000 collection

This DEM is made available solely for reference and quality control purposes.

FTP directory: ftp://.../senegal/bd_200k/mne90m/

5.4.1.1.2 DEMs from the urban datasets (UDB)

For seven cities in Senegal, there are very dense contour lines and spot height coverage.

FTP directory: ftp://.../senegal/bdu_2000/data/

5.4.1.2 Assembling the tiles

The SRTM data are cut into tiles. The contractor must first download all the tiles relating to Senegal and assemble them in a single DEM.

5.4.1.3 Eliminating the “no data”

The SRTM data contain “no data” values. The contractor must replace the “no data” with elevation data. This value can be deduced by averaging the elevations around the “no data” area or by using the other available sources.

5.4.1.4 Replacing with UDB data

For seven cities in Senegal, there are very dense contour lines and spot height coverage. The contractor must produce a DEM from these data and include them in the SRTM data and make adjustments at the intersection of the data from the two sources.

5.4.1.5 Format and projection

The DEM to be produced must be in WGS84, in the UTM projection, zone 28 North.

5.5 Metadata

The contractor must produce metadata for each dataset according to the ISO 19115 profile. The following FTP site contains a template: ftp://.../senegal/metadonnees/ profil_senegalais_metadonnees.doc

5.6 Standardization methodology

The contractor must develop adequate methodologies adapted to the collections to be standardized and the requirements contained in this SOW.

5.7 Quality control (QC)

To achieve a satisfactory level of quality, the contractor must establish an appropriate data quality system that ensures the conformance of the requirements defined in this SOW.

5.8 Deliverables

Table 1 presents the various deliverables that the contractor must provide to the NRCan technical representative and the GICC. This table also indicates the number of datasets and the format in which the data must be delivered. The NRCan technical authority and the GICC reserve the right to inspect the data and to return all or part of the data if the content does not comply with this SOW.

For the 1:50,000 and 1:200,000 collections, since there are many datasets, the contractor shall provide, for these two collections, two adjacent datasets for inspection at the start of the production process. The purpose of this inspection is to allow the contractor to make adjustments to its production process as quickly as possible and ensure that the deliverables comply with this SOW. The deliverables must also include the metadata (section 8.5).

Collection	Deliverable	Number of datasets	Delivery format
1:1,000,000 topographic	**Deliverable: 3**	1	To be confirmed with NRCan
1:200,000 topographic	**Deliverable: 4**	29	To be confirmed with NRCan
1:50,000 topographic	**Deliverable: 5**	54	To be confirmed with NRCan
90-m DEM (SRTM)	**Deliverable: 6**	1	GeoTiff

Table 1 Collections to be delivered

6 Priority geospatial database

6.1 Background

The preceding stages of this SOW established a conceptual framework (definition of the catalogues) for the priority geospatial data of Senegal. This section moves from the conceptual framework to physical implementation of the database, which will centralize the priority data in order to support the Web services for accessing the priority geospatial data (section 8).

6.2 Technological architecture

This section describes the choice of hardware and software to be used to support the development, loading and operation of the priority geospatial database.

6.2.1 Hardware

The contractor must identify and propose the technical characteristics of the server that will host the priority geospatial database including: the type of server, the number of CPU, CPU speed, amount of RAM and the amount of hard disk storage. This proposal will then be validated by NRCan and the GICC.

The contractor will not have to acquire or draw up financial plans to acquire this server. The date of availability of the server will be decided on jointly by the contractor and the NRCan technical representative.

This server will be dedicated to supporting the priority geospatial database.

6.2.2 Operating system

The operating system of the database server is:

- The latest version of Windows Server 64-bit or Linux. It is desirable that the contractor use Linux.

The contractor will have to install the operating system and will have to configure the operating system in order to optimize performance of the geospatial database.

6.2.3 Application software

The priority geospatial database is loaded into the free database:

- PostGIS 2.0.3 for PostgreSQL 9.0-9.2 or a more recent stable version.

The contractor will have to install and configure the PostGIS database.

The choice of the PostGIS database is endorsed by the NGP: “The third service provides access to the data and metadata stored in the database. It is hosted by the PostGIS product. PostGIS adds support of geographic objects to the PostgreSQL database,” page 85, Deliverable 5 - Development of the NGP, January 2012.

Interactive processing of the geospatial data is performed with the software:

- ArcGIS for Desktop, Version 10.1, or a more recent stable version

The contractor will not have to acquire, but will have to install and configure, the ArcGIS for Desktop software.

The ESRI solution has been chosen in keeping with the decisions made by the NGP. See: Deliverable 5 – Development of the NGP, page 87, *“ESRI is the recommended solution for the development of the SGDI. ESRI is the dominant supplier in the geomatics field. It provides a complete range of products that meet all the needs. Expertise in using ESRI products is widespread around the world and in most of the Senegalese government departments and organizations. In addition, training programs are available for all levels of expertise.”*

Batch processing of the geospatial data is performed with the following software:

- Safe Software FME Desktop, Version 2013 or a more recent stable version.

The contractor must install and configure the FME Desktop software. The contractor will not have to acquire FME Desktop.

The choice of Safe Software FME Desktop is endorsed by the NGP. See “7.2.2, Table - Target Architecture Products, Loading of Geographic Data and Extraction of Geographic Data,” page 88, Deliverable 5 - Development of the NGP, January 2012.

6.3 Development and loading

This section deals with the development and loading of the database.

6.3.1 Collections to be loaded

Table 2 presents the collections to be loaded into the database and the associated data type for each: vector or raster.

Collection	Deliverable	Vector	Raster	Clipping
1:50,000 topographic	**Deliverable: 7**	X		1:50,000
1:200,000 topographic		X		1:200,000
1:1,000,000 topographic	**Deliverable: 8**	X		1:1,000,000
90-m digital elevation model			X	1:1,000,000
National imagery	**Deliverable: 9**		X	1:50,000
30-m digital elevation model	**Deliverable: 10**		X	1:50,000

Table 2: Collections to be loaded

6.3.2 Conceptual model

For the vector collections, the feature catalogues developed in section 4 will serve as conceptual models.

6.3.3 Physical model

Using the conceptual models (section 6.3.2), the contractor must develop the physical model (tables and attributes) of the database for the various collections.

6.3.4 Reference system

The contractor must use the WGS 84, UTM zone 28 reference system and represent the data from zone 29 in zone 28. This strategy is the same as the one used to produce the geospatial data (section 5). Data are rounded to the nearest meter.

6.3.5 Data format

For the collections the contractor will standardize (section 5), the contractor can use any format for the transfer between the production of the datasets and the loading into the database. For the collections not covered by the contractor's production, these collections will be supplied in the following formats: ESRI shape file for vector data and GeoTIFF for raster/DEM data. The data will also be accompanied by their corresponding metadata.

6.3.6 Data indexing

Data indexing serves to speed up searches in the database. The database has two different types of indices: one-dimensional linear indices and two-dimensional spatial indices.

6.3.6.1 Indexed collections

Table 2 specifies the collections covered by the various indices.

6.3.6.2 Linear index

Linear indices are "conventional" non-spatial databases. The "number" (section 4.2.8.5) (dataset number) field that all vector classes have will be indexed in order to speed up searches on this field. If necessary, the contractor will have to index other fields in order to improve database efficiency. The datasets number is based on the Senegalese cartographic reference system (section 5.3.5.6).

6.3.6.3 Spatial index

Spatial indexing is a particular feature of spatial databases. The contractor shall create, parameterize and generate a spatial index in order to enhance the efficiency of spatial searches.

6.3.7 Security

This section describes the various profiles or necessary roles to ensure the security and integrity of the system. Each profile may be assigned to one or more persons and is accorded different privileges based on the tasks to be performed. The contractor must configure system security as described in this section.

6.3.7.1 System administrator

The “system administrator” profile is used to manage the server on which the geospatial database resides. The main tasks associated with this profile are as follows:

- Managing the server operating system
- Managing the hardware
- Adding, configuring and updating software
- Configuring the database management system
- Assuring high availability of the services
- …

6.3.7.2 Database administrator

The “database administrator” profile is used to manage the database. The main tasks associated with this profile are as follows:

- Managing the indices
- Optimizing performance, table space
- Adding or deleting data collections
- Managing changes made to the data models
- Managing DB users and privileges
- Stop and start the DB
- Develop backup and restoration procedures
- Assuring high availability of the services
- …

6.3.7.3 Data collections manager

The “data collections manager” profile is used to manage the database collections. The main tasks associated with this profile are as follows:

- Updating the datasets in a specific collection
- Correcting the datasets in a specific collection

6.3.7.4 Geospatial data users

The “geospatial data users” profile is used to access data in read-only mode. The main tasks associated with this profile are as follows:

- Reading the data in the various collections
- Conducting spatial and/or attribute searches in the various tables

6.3.8 Loading of data into the geospatial database

This section deals with loading of data into the geospatial database and managing loading errors.

6.3.8.1 Data to be loaded into the database

Table 2 presents the various collections that the contractor must load into the database. In addition, for each collection, the type of clipping that the collection must follow is indicated.

6.3.8.2 Correction of loading errors

There may be errors in the data or metadata that prevent the loading processes from functioning properly. The contractor must develop a methodology that manages the detection and correction of loading errors so that all the data and metadata can be properly loaded.

In the event of errors during loading:

- If the contractor was responsible for the standardization or production of these data and metadata, then the correction of these loading errors is the contractor's responsibility;
- If the contractor was not responsible for the standardization or production of these data and metadata, the contractor must describe the problem, develop one or more correction scenarios and contacts the NRCan (section 11.8.3) representative to discuss the situation and devise a solution.

Various error correction methods may be used and the extent of the corrections required may vary considerably. Types of errors may range from simple errors in geometry or attribute to more complex problems that require returning to the source documents. For each error, the contractor must determine the source of the problem and apply the proper strategy to correct it.

6.3.9 Coverage indices

Coverage indices are used to determine, for the various scales and the various collections, the availability of datasets on Senegalese territory. The contractor must propose a simple method for producing these various coverage indices.

7 Loading the data and metadata into the geoportal

7.1 Background

In addition to loading the collections into the database (section 6), the datasets of all the collections and the associated metadata must be loaded into the geoportal. The address and a user account for the geoportal will be provided to the contractor when the geoportal becomes available in November 2013.

The geoportal, which will be operational in November 2013, was developed from the ESRI Geoportal Server. It includes a fully functioning website with a set of application components that allow the recording, publication, discovery and use of standards-based metadata describing geographic datasets and/or services.

7.2 Metadata

The contractor must load the metadata (section 8.5) into the geoportal in order to enable the Senegalese geomatics community to discover these metadata. An XML ISO 19115 metadata file is associated with each of the datasets loaded into the database (section 6). The contractor must load the ISO 19115-compliant metadata into the geoportal for the collections listed in Table 3.

7.3 Data

The geoportal also offers the possibility of uploading the data in the form of compressed (zip) files. The contractor must upload the datasets into the geoportal in order to provide unrestricted access to the data to the entire Senegalese geomatics community. The contractor must upload each collection listed in Table 3 into the geoportal. Table 3 describes, for each collection, the formats in which the data must be uploaded. The vector data are uploaded in 2 formats (ESRI Shape and KML) in order to maximize their uses.

Collection	Deliverable	ESRI Shape	KML	GeoTIFF
1:50,000 topographic	**Deliverable: 11**	X	X	
1:200,000 topographic		X	X	
1:1,000,000 topographic	**Deliverable: 12**	X	X	
90-m digital elevation model				X
30-m digital elevation model	**Deliverable: 13**			X
National imagery	**Deliverable: 14**			X

Table 3 Collections to be loaded into the geoportal

8 Web services for accessing the data

8.1 Background

The preceding sections of this SOW described the requirements for structuring the geospatial data and storing them in the priority geospatial database. The purpose of this section is to make the geospatial data accessible to Senegalese users.

The modern way of making geospatial information available to users is to use a Web services server. Centralizing geospatial information in a server has the following advantages:

- Users all have access to the same geospatial information;
- Users always have access to the most up-to-date information;
- If a new collection is available, all users can benefit from it;
- Users do not have to regularly download and maintain a local infrastructure (servers, databases and software) to access the priority geospatial data.

8.2 Technological architecture

The technological architecture section outlines the hardware and software specifications for the server that is to support the Web access services.

8.2.1 Hardware

The contractor must identify and propose the technical characteristics of the server that will host the web services for accessing the data including: the type of server, the number of CPU, CPU speed, amount of RAM and the storage capacity. This proposal will then be validated by NRCan and the GICC.

This server will be dedicated to supporting the Web access services.

The contractor will not have to acquire or even draw up financial plans to acquire or arrange acquisition of this server by a third party. The date of availability of the server will be decided on jointly by the contractor and the NRCan technical representative.

8.2.2 Operating system

The operating system of the database server is:

- The latest version of Windows Server 64-bit or Linux. It is desirable that the contractor uses Linux.

The contractor will have to install the operating system and will have to configure the operating system in order to optimize performance of the Web services server.

8.2.3 Application software

The software supporting the Web access services will be:

- ArcGIS Server version 10.1 or a more recent stable version.

N.B.: The level of functionality of the server - Basic, Standard or Advanced - will be adjusted based on the type of service to be provided (section 8.4).

The ESRI solution has been chosen in keeping with the decisions made by the NGP. See: Deliverable 5 – Development of the NGP, page 87, *"ESRI is the recommended solution for the development of the SGDI. ESRI is the dominant supplier in the geomatics field. It provides a complete range of products that meet all the needs. Expertise in using ESRI products is widespread around the world and in most of the Senegalese government departments and organizations. In addition, training programs are available for all levels of expertise."*

8.3 Web access services

This section describes the 2 Web services for accessing the priority geospatial data that the contractor must implement using the ArcGIS Server software.

8.3.1 Web mapping service

The first Web service to be developed is a Web mapping service compatible with version 1.3 of the OGC Web Mapping Service (WMS) standard.

8.3.1.1 Information layer

The contractor must create 4 information layers. Table 4 below lists the layers to be developed. Each layer is associated with the various data collections on which it is based. The state of coverage (complete or partial) is indicated for each collection. A collection is complete if it covers the entire country. A collection is partial if it covers only part of the country.

Information layer	Deliverable	Collection	Coverage
Senegal topographic base map	**Deliverable: 15**	1:50,000 topographic	Partial
		1:200,000 topographic	Complete
		1:1,000,000 topographic	Complete
Elevation shading	**Deliverable: 16**	90-m digital elevation model	Complete
	Deliverable: 17	30-m digital elevation model	Partial
Elevation	**Deliverable: 18**	90-m digital elevation model	Complete
	Deliverable: 19	30-m digital elevation model	Partial
National imagery	**Deliverable: 20**	National imagery	Partial

Table 4 Layers of the on-line mapping service

The *Senegal topographic base map* layer must present the topographic data of Senegal in an on-line, dynamic, multi-scale context. During changes in scale, the contractor must use the appropriate mechanisms to ensure a natural transition between the various collections.

The *elevation shading* layer represents the relief of the territory using the shading technique. The contractor will use the conventional parameters: sun in the upper left at an altitude of 45°.

The *elevation* layer represents the relief of the territory using a palette of colours where each colour represents a given range of elevations.

The national imagery layer displays satellite images, which have a resolution of 2.5 m to 5m.

8.3.1.2 Scale range

Scale range refers to the minimum and maximum scale at which the Web mapping service can display an information layer. Each information layer has its own scale range. In determining the minimum scale, consideration must be given to the extent of the country and a strip outside the country. In determining the maximum scale, consideration must be given to the maximum scale of the collections that comprise the information layer (e.g. the *Senegal topographic base map* layer is composed of three collections and the maximum scale is 1:50,000). The on-line mapping service must prevent queries that are made outside the scale range by displaying instead the closest lower or upper limit.

During the analysis phase, the contractor shall propose a scale range scenario for each information layer (Table 4). Once approved by NRCan/GICC, the contractor must implement this scenario.

However, as a consequence of endeavouring to adhere to the scale range, the available collections (vector or raster) may contain too high a density of information features to be displayed at a given scale without compromising the usability or legibility of the map. In such cases, the contractor must create one or more “internal representation products.” This is termed cartographic generalization for the vector data and aggregates or pyramids for the raster products. It is important to note that these “internal representation products” will be used only for the Web mapping service, will not require a feature catalogue or metadata and will not be offered via the Web feature service (section 8.3.2).

8.3.1.3 Management of missing information

In a Web mapping context, digital data do not really have a scale. However, it is acknowledged that digital data must be displayed in a given range of scales in order to be useable (viewing data acquired at the 1:1,000,000 scale at the 1:50,000 scale is not very useful).

Not all the collections have complete coverage (Table 4). The contractor will have to manage this situation (partial coverage) by displaying a “Pas de données disponibles / No available data” frame when at a large scale, the user accesses a region where large-scale data are not available.

8.3.1.4 Web mapping symbology

Symbology refers to the appearance of the map features that are displayed (colours, line styles, fonts, …). The contractor must develop a symbology appropriate to the “on-line” nature of the Web mapping service and not attempt to reproduce the Senegalese mapping specifications. A “Web mapping symbology” will have softer colours and possibly less detailed content than the map. This reduced Web symbology facilitates data mashup. Data mashup is one of the significant advantages provided by on-line mapping services. The contractor may use as a model the website of the National Atlas of Canada (http://www.atlas.gc.ca/site/english/toporama/index.html) or websites such as Google Maps, Bing Maps… which have successfully implemented the concept of “Web mapping symbology.”

The contractor must develop for the on-line mapping service a “Web mapping symbology” as described above. The contractor will submit the first draft of its “Web mapping symbology” to the working group. Following receipt of the participants’ comments, the contractor may develop the final version.

8.3.1.5 Map caching and performance

Map caching is a method used to improve the performance of Web mapping services. When map caching is generated and stored on disks, it is much faster to access the map cache than having to regenerate each image from the data sources.

Once the Web mapping service has been developed, the contractor must analyze the performance of the service and provide a recommendation as to whether it is necessary to implement a map caching system. The contractor shall provide a recommendation to the NRCan technical representative with appropriate supporting arguments for or against using map caching. If use of map caching is deemed necessary, the contractor will then have to submit to NRCan/GICC an analysis of the map caching system to be developed (number of scales, content, projection,…) and a cost estimate for its development. NRCan/GICC may accept or reject this recommendation without having to provide its reasons.

8.3.2 Feature service

The second service to be developed is a feature service for querying the collections on line. Users must be able to submit queries and view the results of their spatial or attribute queries on the data. Users must be able to save the data or query results on their local workstation. The feature service is in read-only mode. Initially, this service will be used by the Senegalese departments and public organizations through clients such as ESRI ArcGIS Desktop.

8.3.2.1 Collections to be placed on line

The collections listed in Table 5 must be available via the on-line feature service:

Collection	Deliverable
1:50,000 topographic	**Deliverable: 21**
1:200,000 topographic	**Deliverable: 22**
1:1,000,000 topographic	
90-m digital elevation model	
30-m digital elevation model	**Deliverable: 23**
National imagery	**Deliverable: 24**

Table 5 Collections available via the Web feature service

8.3.2.2 Parameterization

The contractor must parameterize the Web feature service in order to provide an appropriate level of service. One of the goals of this parameterization is to prevent inappropriate queries from congesting the system to the point of reducing the overall level of performance expected of the Web feature service.

The following are some examples of inappropriate queries:

- Queries by novice users who do not understand the impact of their queries on the database (query covering too large an area for the requested scale, …);
- Queries from users containing an error (inattention or typo) that has a major impact on database performance.

8.3.2.3 Symbology

For the various collections, the contractor must provide a display symbology appropriate to the use context.

8.4 Type of service

The ArcGIS Server product provides a wide range of types of services for delivering geospatial data. The contractor will have to decide which ArcGIS Server services it wishes to use to implement the Web mapping service and the Web feature service. The contractor must select the services that meet the needs listed above, while incurring minimal licence costs. Once the types of services have been selected, the contractor will inform the NRCan technical representative so that NRCan can acquire the appropriate licence level - Basic, Standard or Advanced.

8.5 Metadata

The contractor must create ISO 19115-compliant metadata for the two data access services described earlier. The contractor must use the metadata template available on the FTP site: ftp://..senegal/metadonnees/profil_senegalais_metadonnees.doc

The contractor must record the metadata describing these two services in the following systems:

- The GéoSénégal geoportal; the address and a user account for the geoportal will be provided to the contractor when the geoportal becomes available in November 2013;
- The ArcGIS Server, which is used to record metadata to describe the services.

8.6 Performance and testing strategy

The proposed architecture was determined based on comparable architectures for comparable needs. Once the database server and the access services server are operational, load tests will have to be performed in order to estimate the number of queries per minute that the system can handle.

The contractor shall propose a testing strategy to the NRCan technical representative. A series of tests will be elaborated for this purpose and approved by NRCan before the implementation. Once the strategy has been approved by NRCan, the contractor may implement this testing strategy and submit the results to the NRCan technical representative. These results will determine whether there is a need to adjust the hardware configuration of the database server or the access services server.

8.7 Security

This section describes the various profiles or roles necessary to ensure the security and integrity of the server for the Web access services. Each role may be assigned to one or more individuals. Each profile has the privileges appropriate to the tasks to be performed. The contractor must configure the security of the system as described in this section.

8.7.1 System administrator

The “system administrator” profile is used to manage the server for the Web services. The main tasks associated with this profile are as follows:

- Managing the server operating system
- Managing the hardware
- Adding/updating software
- …

8.7.2 Web services administrator

The “Web services administrator” profile is used to manage the Web services. The main tasks associated with this profile are as follows:

- Adding/removing a service
- Parameterizing a service
- Optimizing services
- Start and stop the services
- …

8.7.3 Service users

The “service users” profile is used to access the services. Each service has a different level of security and access:

- Web mapping service: This service is offered without restriction. No identification will be necessary to use it;
- Web feature service: Authorization will be required (user name and password) to access this service. Initially, this service will be offered to Senegalese departments and public organizations only.

9 Deployment

Sections 6 and 7 described the database server and the server for the Web access services. This section describes the environments in which these servers will be physically deployed within the various

Senegalese government agencies as well as the work that the contractor must perform to successfully deploy these various servers.

9.1 Governance model for managing geospatial information

In Senegal, two different government agencies, the ANAT and the ADIE, share responsibility for the production and on-line distribution of geospatial information.

A governance model for the production and distribution of GI between the ANAT and the ADIE was developed. The purpose of this governance model is to make available to citizens and departments/ organizations quality, accurate and up-to-date GI. The deployment of the various servers presented in this section is in keeping with this GI governance model.

Figure 20 Governance model for the priority geospatial data" graphically illustrates this governance model. This figure describes the servers and the links between them. The following is a description of the various components of this figure:

Workshops: Identifies the various production units of the ANAT devoted to acquiring and updating basic geospatial data.

Produce: Action carried out in the various ANAT workshops to create or update GI in the *"workshop" databases.*

"Workshop" database: Identifies the database server(s) used by the ANAT to store the data generated by the various workshops.

"ANAT" priority geospatial database: Identifies the geospatial database server used by the ANAT to store the priority geospatial data. This database is an instantiation of the database described in section 6 of this SOW.

"ADIE" priority geospatial database: Identifies the geospatial database server used by the ADIE to distribute the priority geospatial data. This database is an instantiation of the database described in section 6 of this SOW.

Web services for accessing the geospatial data: Identifies the access website used by the Senegalese geomatics community to access priority geospatial data via Web services.

Geoportal access service: Identifies the server storing the ISO 19115 compliant metadata. Senegalese users can query the metadata stored in this server.

Query: Action allowing the Senegalese geomatics community to interrogate the geoportal to verify the presence of geospatial data corresponding to a given spatial area or to specific criteria (name, date…).

Download: Action of transferring metadata or geospatial data in file form from the geoportal to a local workstation via Internet protocols.

Synchronize: Action to update the *"ANAT" geospatial database* using the data produced in the workshops. The frequency of this activity varies depending on the level of production of the various workshops.

Access: Action of consuming priority geospatial data in the form of Web services (e.g. on-line mapping service).

Replicate: Action of shared responsibility between the ANAT and the ADIE; this action allows each of these two organizations to maintain an identical copy of the "priority geospatial database." For this activity, the ADIE is responsible for the connection and the ANAT is responsible for the content. The frequency of this activity must be determined under an agreement between the ANAT and the ADIE; it will also vary depending on the level of production of the various ANAT workshops.

Figure 20 covers three different groups of systems. The colours used in this figure help provide a better understanding of the systems to be developed in relation to the existing systems. Each colour has the following meaning:

Green: The items included in the green boxes refer to existing systems and actions operational at the ANAT. The contractor must simply develop the *synchronize* action which overlaps the green box and the yellow box.

Blue: The items in the blue boxes refer to the geoportal system.

Yellow: The items in the yellow box are those that are covered under the governance model.

In this model, each organization (ANAT and ADIE) is autonomous for all the processes for which it is responsible. The “replicate” activity is the only action of shared responsibility between the two agencies.

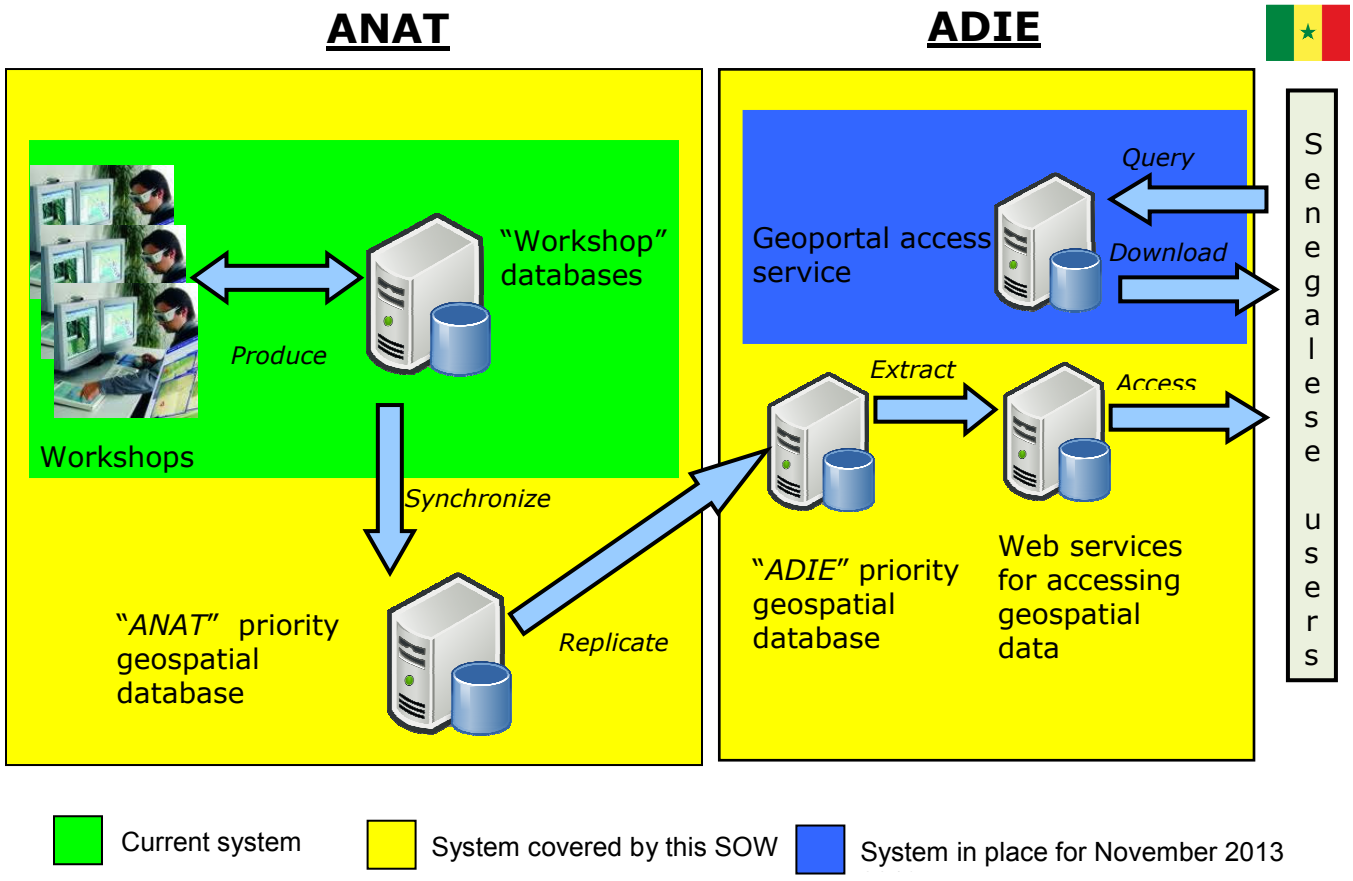


Figure 20 Governance model for the priority geospatial data

9.2 Deployment of the systems

This section describes the work that the contractor must perform in order to deploy the systems at the ANAT and at the ADIE **Deliverable: 25**.

9.2.1 Deployment at the ANAT

This section describes the work to be performed at the ANAT. The GICC will designate two (2) administrators (one primary and one alternate) at the ANAT who will be responsible for the management, operation and effective functioning of the "ANAT" priority geospatial database and of the *Synchronize* and *Replicate* actions.

9.2.1.1 "ANAT" priority geospatial database

The contractor must deploy a database server at the ANAT. This server must have the functions and the content presented in section 6. The ANAT is responsible for making a server available to the contractor at its facilities. The NRCan technical representative will provide the contractor with all the server features (hardware and software) as well as a system password and account in order to make the database operational.

9.2.1.2 Synchronize action

The contractor must develop a methodology for synchronizing at the ANAT the GI produced by the workshops and contained in the *"workshop" databases* with the *"ANAT" priority geospatial database.*

The synchronization methodology must take into account the following facts concerning the operations of the ANAT:

- Low production volume: The level of GI production that must be *synchronized* in the *"ANAT" priority geospatial database* is low. For the last seven years, the estimated volume is approximately 20 datasets per year. This number includes topographic data (1:50,000, 1:200,000 and 1:1,000,000), digital elevation models and orthoimages.
- International aid: Most of the GI produced at the ANAT is produced with the aid of international cooperation agencies.
- The ANAT uses a wide variety of software and hardware to produce the GI (Apple, Windows, ESRI, GeoConcept, FreeHand…) Most GI are produced by international cooperation agencies that do not coordinate the tools to be used. So, in order to simplify the synchronization between the ANAT "Workshop" databases and the ANAT Priority geospatial database, the contractor can assume that the GI residing in the ANAT "Workshop" databases will be in the following formats: ESRI shape file for vector data and GeoTIFF for raster/DEM data.

The synchronization methodology must meet the following criteria:

- Easy to use: The *synchronize* action will not be performed on a regular basis. The learning curve for this action must be fast and the level of complexity must be low so that the person who sporadically performs this task will not have to re-learn everything between 2 *synchronize* actions.
- Adaptable: Since most of the GI is produced by international cooperation agencies and since these agencies cannot guarantee the use of a common acquisition method, the *synchronize* action must be easily adaptable to various GIS platforms in order to supply data to the *"ANAT" priority geospatial database.*
- Robustness and sustainability: Since resources (human and financial) are limited, the methodology implemented will be used for many years. The synchronization methodology must therefore be capable of being used with minimum maintenance for many years.

It should be noted that synchronization methodology that rely extensively on "in-house software" that is often more difficult to maintain are to be avoided.

9.2.2 Deployment at the ADIE

This section describes the work to be performed at the ADIE. The GICC will designate two (2) administrators (one primary and one alternate) at the ADIE who will be responsible for the management,

operation and effective functioning of the *"ADIE" priority geospatial database*, the *Web service for accessing the geospatial data* and the *extract*, *access* and *replicate* actions.

9.2.2.1 "ADIE" priority geospatial database

The contractor must deploy at the ADIE a database server with the functionality and content presented in section 6. The ADIE is responsible for making a server available to the contractor at its facilities. The NRCan technical representative will provide the contractor with all the server features (hardware and software) as well as a system password and account in order to make the database operational.

9.2.2.2 Web service for accessing the geospatial data

The contractor must deploy at the ADIE a server for the Web access services with the functionality and the content as presented in section 8. The ADIE is responsible for making a server available to the contractor at its facilities. The NRCan technical representative will provide the contractor with all the server features (hardware and software) as well as a system password and account in order to make the database operational.

9.2.2.3 *Extract* and a*ccess* actions

During deployment of the servers for the *"ADIE" priority geospatial database* and the *Web services for accessing geospatial data*, the contractor must implement the *extract* and *access* actions as presented in sections 6 and 8, respectively.

9.2.3 Shared responsibility action (*replicate*)

The systems and actions presented in the preceding sections (9.2.1 and 9.2.2) are under the responsibility of a single agency, either the ANAT or the ADIE. The *replicate* action is the only action for which responsibility is shared, since it involves servers physically located in two different agencies (ANAT and ADIE). The contractor must develop a methodology that will allow the ANAT and the ADIE to *replicate* the GI from the *"ANAT" priority geospatial database* to the *"ADIE" priority geospatial database.*

The replication methodology must take the following facts into account:

- Low volume of transactions: The number of transactions that must be *replicated* between the *"ANAT"* and *"ADIE" priority geospatial databases* is low. For the last seven years, the estimated volume is approximately 20 datasets per year. This number includes topographic data (1:50,000, 1:200,000 and 1:1,000,000), digital elevation models and orthoimages.
- Different organizations: The ANAT and the ADIE are different organizations, located at different sites in Dakar and with different corporate cultures.

The replication methodology must meet the following criteria:

- Easy to use: The *replicate* action will not be performed on a regular basis. The learning curve for this action must be fast and the level of complexity must be low so that the person who sporadically performs this task will not have to re-learn everything between two *"replicate"* actions.
- Robustness and sustainability: Since resources (human and financial) are limited, the methodology implemented will be used for many years. The replication methodology must therefore be capable of being used with minimum maintenance for many years.

It should be noted that replication methodology that rely extensively on "in-house software" that is often more difficult to maintain are to be avoided.

9.2.4 GeoPortal loading

The contractor must develop a procedure to update the "GeoPortal access service" (Figure 20) for the newly produced data sets (data and metadata). The procedure should cover the data specified in section 7

9.3 System integration test

Once the systems are in place at the ANAT and at the ADIE, the contractor must prove that all the infrastructure developed to meet this SOW is functioning properly. These tests will be performed in Dakar, Senegal, in the presence of representatives of the contractor, the GICC and the NRCan technical authority. This section describes the actions that the contractor will have to take to prove that the infrastructure meets all the specifications set out in this SOW **Deliverable: 26**.

9.3.1 Testing the *synchronize* action

To test the *Synchronize* action, the contractor must be able to successfully synchronize a subset and all of the topographic data (Table 2). The topographic data to be synchronized will be identified by the NRCan technical representative. It must also be possible to perform the *synchronize* action again without any problems.

9.3.2 Testing the *replicate* action

To test the *Replicate* action, the contractor must be able to successfully replicate a subset and all of the topographic data (Table 2) from the *"ANAT" priority geospatial database* to the *"ADIE" priority geospatial database*. The topographic data subset will be identified by the NRCan technical representative. It must also be easy to perform the *replicate* action again without any problems.

9.3.3 Testing the Web data access service

The contractor must successfully pass the load tests on the *Web services for accessing geospatial data*. These load tests must correspond to the values identified in the "Performance and testing strategy" section (section 8.6). During the load test, the contractor must also ensure that the results of the various queries effectively correspond to the expected results.

9.3.4 Testing GeoPortal loading

The contractor must successfully complete the loading of the "GeoPortal access service". This test should correspond to the data specified in section "Loading the data and metadata in the Geoportal" (section 7). During the load test, the contractor must also ensure that the result matches the expected result.

9.4 Documentation

For each system deployed at the ANAT and at the ADIE, the contractor must provide system documentation and user documentation that will allow the staff at the ANAT and at the ADIE to support, operate, maintain and adapt these systems.

10 Training

The system covered by this SOW is complex. It includes several subsystems and requires mastery of several different technologies. Training is an essential component to ensure the transfer of knowledge that will enable the Senegalese party to truly appropriate this system and operate, adapt and upgrade it in the years to come. Hence, there is a training component for each of the elements developed in this SOW (sections 4 to 9).

10.1 Details concerning the training sessions

The sections below describe the types of training sessions that must be provided by the contractor. In order to maximize technology and knowledge transfer, the contractor shall include laboratories when the material to be taught lends itself to practical work. All the training sessions described in this section will take place in Dakar, Senegal.

10.1.1 Feature catalogues

This section describes the training sessions relating to the feature catalogues section (section 4).

10.1.1.1 ISO 19125-1 – Simple Feature Access

The purpose of this training is to train the participants on the important aspects of "Simple Feature Access." Emphasis will be placed on the concepts used to develop the catalogues covered by this SOW **Deliverable: 27**.

Duration: 3 hours

10.1.1.2 ISO-19110 Methodology for feature cataloguing

The purpose of this training is to train the participants on the vector data cataloguing standard. Emphasis will be placed on the concepts used to develop the catalogues covered by this SOW **Deliverable: 28**.

Duration: 3 hours

10.1.1.3 Catalogued Senegalese collections

The purpose of this training is to present the feature catalogues developed, their content (features, attributes), the concept of catalogue harmonization and the process used to develop these catalogues in relation to the reference documentation **Deliverable: 29**.

Duration: 4 hours

10.1.1.4 Catalogue management tools

The purpose of this training is to enable the participants who will be responsible for the feature catalogues to master the catalogue management tool so that they can make the necessary modifications to the various catalogues, such as adding/deleting/modifying feature classes and attributes **Deliverable: 30**.

Duration: 4 hours

10.1.2 Production

This section describes the training sessions relating to the section on the production of topographic data (section 5) .

10.1.2.1 Description of the production work

The purpose of this training is to provide participants with a description of the production work carried out on the priority geospatial data. The training must also cover the state of the data before and after production **Deliverable: 31**.

Duration: 4 hours

10.1.3 Priority geospatial database

This section describes the training relating to the section on the geospatial database (section 6).

10.1.3.1 Post GIS database - Users

The purpose of this basic training is to provide participants with an introduction to the Post GIS database **Deliverable: 32**.

Duration: 10 hours

10.1.3.2 FME Desktop software

The purpose of this basic training is to provide participants with an introduction to the FME Desktop software. Emphasis must be placed on the basic processing and the interaction with a PostGIS database and the ESRI products **Deliverable: 33**.

Duration: 12 hours

10.1.3.3 Post GIS database - Administration

The purpose of this basic training is to provide participants with an introduction to the administration of a Post GIS database. The training must describe the different profiles required to ensure the security and integrity of the database (section 6.3.7) **Deliverable: 34.**

Duration: 7 hours

10.1.3.4 Senegalese collections stored in the database

The purpose of this basic training is to familiarize participants with the physical model of the data and the structure of the information, data querying, data indexing, data clipping, security and the coverage index **Deliverable: 35**.

Duration: 4 hours

10.1.4 Web services for accessing geospatial data

This section describes the training relating to the section on Web services for accessing priority geospatial data (section 7).

10.1.4.1 ArcGIS Server - Users

The purpose of this training is to provide participants with an introduction to the ArcGIS Server software. Emphasis must be placed on the functions implemented for this SOW (section 8) **Deliverable: 36**.

Duration: 10 hours

10.1.4.2 ArcGIS Server – Administration and Security

The purpose of this training is to provide participants with an introduction to the “administration and security” aspects of the Arc GIS Server software (section 8) **Deliverable: 37**.

Duration: 7 hours

10.1.5 Deployment of the servers

This section describes the training relating to the section on deployment of the servers (section 9).

10.1.5.1 Deployment architecture

The purpose of this training is to explain in detail the architecture deployed to support the governance model for managing GI between the ANAT and the ADIE **Deliverable: 38**.

Duration: 5 hours

10.1.5.2 "Synchronize" action

The purpose of this training is to help participants master the methodology used to synchronize the GI produced by the workshops and contained in the *"workshop" databases* with the *"ANAT" priority geospatial database* (section 9.2.1.2). This training must include a laboratory component in which the participants will be asked to synchronize the *"ANAT" priority geospatial database* with various priority geospatial data **Deliverable: 39**.

Duration: 8 hours

10.1.5.3 "Replicate" action

The purpose of this training is to help participants master the methodology used at the ANAT and at the ADIE to *replicate* the GI from the *"ANAT" priority geospatial database* to the *"ADIE" priority geospatial database* (section 9.2.3). This training must include a laboratory component in which the participants will be asked to synchronize the *"ANAT" priority geospatial database* with various priority geospatial data **Deliverable: 40**.

Duration: 8 hours

10.1.5.4 Server ANAT: Operation and Maintenance

The purpose of this training is to help participants master the operation and maintenance of the server and software deployed at ANAT. At the end of the training each participant should be able to stop and start the servers and diagnose and repair potential daily problems. **Deliverable: 41**.

Duration: 5 hours

10.1.5.5 Server ADIE: Operation and Maintenance

The purpose of this training is to help participants master the operation and maintenance of the server and software deployed at ADIE. At the end of the training each participant should be able to stop and start the servers and diagnose and repair potential daily problems. **Deliverable: 42**.

Duration: 5 hours

10.2 Detailed syllabuses

Two months before each training session, the contractor shall provide the NRCan technical authority with the detailed syllabus for each session. The NRCan technical authority reserves the right to review the syllabuses and to request adjustments thereto in order to more effectively address the concerns of the Senegalese party in terms of technology and knowledge transfer. Once the contractor has received the requested adjustments, if necessary, the contractor shall consult with the NRCan technical authority to agree on the methods and approaches for incorporating the requested adjustments in the revised version of the syllabuses. The contractor shall then provide the training according to the revised version of the syllabus.

10.3 Duration of the training sessions and number of participants

An estimated duration is indicated for each training session to provide the contractor with guidance on the extent of the training to be provided. Within the estimated total time (section 10.2), the contractor may adjust and comment the duration of each training session and provide a new schedule when submitting the detailed syllabuses (section 10.2). The maximum number of participants for each training session will be 25.

10.4 Senegalese participation in this training

The GICC is responsible for selecting the participants for the training sessions and confirming their participation. The following facilities, goods and services will be provided by the Senegalese party for the purposes of this training:

- Salaries of the public servants participating in the training;
- Making the necessary logistical arrangements in Senegal for the training sessions. It is the responsibility of the Senegalese party to ensure, at all times, that the materials provided are functional and meet the stated needs.
- Premises with suitable lighting, air conditioning, generator and security measures to safeguard property; room that can accommodate 25 people equipped with desks, chairs, screen, conventional projector and projector for computer as well as a blackboard.
- For the training sessions that include laboratories, the facilities must include workstations (one person per workstation):
    - High-speed Internet connection for all the workstations;
    - PC workstations with the current version of Windows, Microsoft Office Suite;
    - The workstations must also have an up-to-date version of ArcGIS and FME Desktop.

10.5 Senegalese contribution to this training

There are a number of educational institutions and contractors in Senegal capable of providing training in geomatics. It is desirable that Senegalese resources are to be used to provide part of the training.

10.6 Pricing for training

The price quoted for the training (in Dakar, Senegal) must be a lump-sum price and must not be based on the number of participants per course.

10.7 Evaluation of the training sessions

NRCan reserves the right to ask participants to evaluate the form and/or content of the various training sessions. NRCan may use this evaluation for acceptance of this deliverable (section 11.10).

10.8 Training schedule

The contractor may plan its training schedule so as to minimize travel. However, the training schedule must be approved by the NRCan technical representative and by the GICC.

10.9 Profile of the trainers

Trainers must have mastered the geomatic technologies and application software for which they will provide training.

Trainers must adapt the training to the varying participant levels using dedicated teaching materials and interactive training methods.

10.10 Training material

The contractor will supply paper copy and digital copy of the training materials to each student.

11 Additional information

This section contains a series of information, comments, details and clarifications concerning this SOW and NRCan's intentions concerning performance of the work described in this SOW.

11.1 Consortium

Since this SOW deal with several aspects of geomatics (development of feature catalogues, production of GI, management of the geospatial database, dissemination of GI…), the contractor may enter into arrangements with other contractors (subcontractors) for the performance of this contract. It should be noted that NRCan will sign this contract with one and only one contractor. For NRCan, the signatory contractor retains full responsibility for the various deliverables to be provided under this SOW, regardless of whether the signatory contractor enters into arrangements with other contractors (subcontractors).

11.2 Implementation context

The context in which the work will be carried out involves a number of aspects which the contractor must take into account in its response. The following is a non-exhaustive list of these aspects:

- Working in Senegal requires some adaptation (e.g. distance from Canada, different work setting and culture, difference in the electrical power supply for equipment).
- The contractor must plan and take responsibility for all expenses and all logistical, financial and administrative aspects relating to the work and accommodation of its own human resources in Senegal. The NRCan representative in Dakar and the Embassy of Canada in Dakar are useful resources that may be consulted.
- Owing to the timetable and duration of the project, it is suggested that computer development work be minimized. The best approach would be to adapt off-the-shelf components.
- Since part of the work will be done in Senegal, local standards for access, security, hours of work and statutory holidays must be taken into consideration and adhered to.

11.3 Language of work

The language of work (spoken and written) in Senegal and with the Senegalese is French. All documents that are to remain in the possession of the Senegalese or that are to be consulted by the Senegalese must be in French. All presentations and meetings in Senegal or with the Senegalese must be held in French. The presentations, meetings and documents that are intended solely for NRCan may be in contractor's chosen language (English or French).

11.4 FTP site

The various technical documents required to meet this SOW are available at the following address: ftp://ftp.nrcan.gc.ca/pub/outgoing/Senegal/Cf91mdpdR/. The FTP file contains 4900 files.

11.5 ISO 19100 standards

If the contractor must procure ISO 19100 standards-related documents for performance of the work described by this SOW, these purchases shall be at the contractor's expense. In addition, the contractor must use the most recent versions of the ISO 19100 standards to perform the work.

11.6 Window for execution of the work

The work may begin the day the contract with NRCan is signed and must be completed by December 31, 2014, with the exception of the final report (section 11.8.2), which must be submitted by February 28, 2015.

11.7 Number of datasets to be processed

Table 6 indicates the number of datasets to be processed for each collection. The contractor must use these numbers to estimate the scope of the work to be performed.

Collection	Number of datasets
1:1,000,000 topographic	1
1:200,000 topographic	29
1:50,000 topographic	54
90-m digital elevation model	1
30-m digital elevation model	To be determined
National imagery	To be determined

Table 6 Number of data sets to be processed

11.8 Interaction with Natural Resources Canada

NRCan is the technical and administrative (contracting) authority for this project. At the time the contract is signed, NRCan will designate a technical representative and an administrative representative. The contractor shall report to this staff on the project progress and for any project-related questions.

In order to ensure effective project monitoring, the contractor must provide NRCan with *progress reports* (section 11.8.1) and a *final report* (section 11.8.2). In the event of problems during implementation of the project, the contractor must provide NRCan with a *problem report* (section 11.8.3).

11.8.1 Progress reports

The contractor must submit a monthly progress report to NRCan. This report must include as a minimum:

- A summary of the phases completed, the progress made, and the status of the project and of the deliverable(s) provided during the evaluated period;
- Confirmation as to whether the project statement of work was adhered to;
- Confirmation as to whether the project schedule deadline was met;
- Any aspects of the project that require improvement;
- Any other information that the contractor considers relevant to effectively carry out the contract.

In all cases, failure to meet targets (timetable, deliverable, other…) must be justified and described in the report.

11.8.2 Final report

The contractor must submit a final report within two months after project completion **Deliverable: 43**. This report must include, but is not limited to, the following:

- A general description of the project and its goal;
- A summary of the deliverables and results;
- Analysis and identification of the project's benefits and impacts;
- Recommendations for follow-up actions;
- Any other information the contractor considers relevant.

11.8.3 Problem report

It is imperative that the contractor informs NRCan when the contractor believes that it has encountered or will encounter problems that will change the content or deadline of one or more deliverables. Problems must be identified by means of a written report e-mailed to the NRCan technical authority. A problem report must include the following information:

- Identification of the deliverable(s) concerned;
- Description of the obstacle encountered or the problem to be solved;
- Description of the efforts devoted to solving the problem;
- The level of risk and the impact on the progress of work and the deliverables;
- Suggestions and, if possible, a recommendation to remedy the situation;
- A timeline indicating when the project will be affected (i.e. impact on the deadlines and deliverables) if the situation is not corrected;
- Any other information the contractor considers useful for identifying and resolving the problem.

On receipt of a *problem report*, NRCan will promptly contact the contractor in order to devise a solution and, if necessary, review the deliverables. NRCan will provide the contractor with written confirmation of the solution before it is to be implemented.

11.9 Synthesis of the deliverables

The contractor must provide a synthesis of the deliverables describing the various aspects of the work performed under this SOW **Deliverable: 44**. The synthesis of the deliverables must be in Microsoft PowerPoint format and must summarize the work performed, the results, and covering each of the following items:

- Creation of the feature catalogues (section 4)
- Production of topographic data (section 5)
- Topographic database (section 6)
- Web access services (section 8)
- Implementation of the governance model (section 9)
- Training (section 10)

11.10 Acceptance of deliverables

The contractor shall provide the deliverables in accordance with the project work plan. The NRCan technical authority is responsible for accepting each deliverable. The acceptance period for a deliverable may be up to six weeks.

In order to be accepted, a deliverable must:

- Be operational and meet the specifications described in this SOW for this deliverable;
- Be to NRCan's complete satisfaction.

11.11 Payment schedule

Payments shall be made based on acceptance of the various deliverables. Table 7 below indicates the payments that will be made by NRCan based on acceptance of the various deliverables in relation to the contract cost.

Deliverables	Description	Percentage	Total percentage
1, 2	Catalogues and catalogue management tools	5	5
3	Standardization of the 1:1,000,000 collection	5	10
4	Standardization of the 1:200,000 collection	15	25
6	Production of the SRTM DEM	5	30
8,12	Loading of the collections in the DB and geoportal	15	45
15, 16, 18, 22	Web access services	10	55
25, 26	System deployment	10	65
29, 30, 31, 35, 38, 39, 40, 41, 42	Training	15	80
43, 44	Final report and supplementary documentation	20	100

Table 7 Payments based on mandatory deliverables

11.12 Meetings

A project of this magnitude requires excellent coordination between the various stakeholders. Accordingly, the following meetings must be planned at a minimum (if necessary, NRCan reserves the right to plan and organize other meetings):

- A start-up meeting between the tender and NRCan in Canada in the office of NRCan in Sherbrooke (QC). The date will be decided jointly by the tender and NRCan. This start-up meeting in Canada should be held within the month following signing of the contract. The purpose of this meeting will be to analyse critical factors, review the different roles and responsibilities, communication mechanisms between the stakeholders and to clarify contract elements
- A start-up meeting in Dakar, Senegal, between the tender, NRCan and the Senegalese officials. The purpose of this meeting will be to present the solutions, the technologies, the deadlines for the deliverables, the schedule of meetings, etc. This start-up meeting in Senegal should be held within the two months following the signing of the contract;
- Before starting production, the tender must schedule a meeting with the NRCan technical representative in the office of NRCan in Sherbrooke (QC) during which the tender will present his/her production and quality control methodologies;
- A closing meeting in Dakar, Senegal, between the tender, NRCan and the Senegalese officials to present the final project results. The tender will also have to lead a workshop for the official launch of the priority geospatial database and Web access services.

- Active participation in the “Second National Geomatics Day” in Dakar (date to be determined). This participation involves: formal presentation, manning a booth and demonstrating use of the database and Web access services. This activity last one day.
- In addition to the two above-mentioned meetings in Dakar, Senegal, the tender must plan at least two other technical visits during the project, no more than four months apart. The purpose of these technical visits is: first, to present the completed deliverables; second, to present the overall progress of the project; third, to present the prototypes of the solutions for comments; and, fourth, to maintain contact with the Senegalese officials.
- All the technical visits in Dakar must be coordinated with the NRCan technical representative in order to ensure the availability of all stakeholders.

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