North Carolina Department of Transportation (NCDOT)

Base Geospatial Standard

Date	Change Description	Approved By
12/03/2010	Initial document (version1.0)	GIS Implementation Team / GTAC
08/18/2011	Consistency with the GIS Data Policy Standard	GTAC
11/21/2011	Corrections and updates to referenced Standards	GIS Unit
07/06/2017	Major update to include new LRS standards (version 2.0)	GIS Unit

1. INTRODUCTION

Data Governance of a dataset refers to the operating discipline for managing data and information as a key enterprise asset. Key aspects of data governance include such topics as decision making authority (roles and responsibilities), compliance monitoring, policies and standards, data inventories, full lifecycle management, content management, records management (metadata), preservation (archiving), data quality, data classification (data model), data security and access, data risk management and data valuation. This standard is the first in a group of standards that defines data governance for the geospatial datasets within the NCDOT.

At a high level, the processes and standards described in this document refer to transportation features which have geographic locations and characteristics. As the NCDOT evolves to include geospatial data in its everyday processes, exchange of data is a natural consequence of that evolution. Indeed, it makes sense for the business to efficiently and effectively exchange information. However, data exchange without standards can lead to excessive amount of rework of GIS datasets, and also loss of critical information about the quality of that dataset (related to how it was developed and the accuracy and timeliness of that data). The set of standards, and processes referenced in them, ensures optimal use of business resources in the delivery of information to the business.

1.1. OBJECTIVE

The objective of this standard is to create a baseline for the development and documentation of all geospatial data used within normal NCDOT business work flows, utilized or shared with:

- Other business units
- Federal, state or local agencies
- The public

1.2. SCOPE AND APPLICABILITY

This standard defines geospatial data, minimally required elements, and backup and archival requirements for business-critical spatial datasets. The primary purpose of this part of the standard is to identify the necessary processes and standards to ensure quality and integrity of geospatial information to meet the needs of business operations within the NCDOT.

The Base Geospatial Standard integrates with the other NCDOT geospatial standards: GIS Metadata Content, Geospatial Data Publication, and Geospatial Data Collection & Acquisition. It is required that all initiatives or parts of the NCDOT organization that create/produce, maintain or acquire geospatial data for enterprise use within the NCDOT shall satisfy the requirements laid out in these standards.

2. CONFORMANCE

2.1. This standard is part of a group of standards which are required for all geospatial datasets within the NCDOT. Conformance to the group of standards includes conformance to the items listed in this base standard, and appropriate other parts for metadata, data model, data acquisition and/or data publication.

2.2. Conformance to this standard ensures that the spatial data used and maintained by the NCDOT delivers business value to the organization, that the data is able to be seamlessly integrated into other business datasets, that the information is maintained and timely in order to support strategic and tactical decisions, and that the data is consistently the best data available.

3. NORMATIVE REFERENCES

This standard is meant to work in conjunction with the following NCDOT spatial data standards https://connect.ncdot.gov/resources/gis/Pages/GIS-Standards.aspx

- NCDOT GIS Metadata Content Standard
- NCDOT Geospatial Data Publication Standard (forthcoming)
- NCDOT Geospatial Data Collection & Acquisition Standard (forthcoming)

This standard supplements the following North Carolina state standards (https://it.nc.gov/gicc-standards-and-best-practices)

- North American Vertical Datum of 1988
- State and Local Government Metadata Profile
- North Carolina Technical Specifications for Digital Orthophoto Base Mapping
- Content Elements for Statewide publication of core geospatial parcel data

This standard also addresses the topic of archiving of GIS datasets that is more fully explained at the following North Carolina Geographic Information Coordinating (GICC) site (https://it.nc.gov/preservation-and-long-term-access-geospatial-data)

3.1. STANDARDS DEVELOPMENT PROCESS

The process for development of this standard shall be in accordance with policies of the NCDOT GIS Unit.

3.2. MAINTENANCE AUTHORITY

3.2.1 **Level of responsibility:** The NCDOT GIS Unit is responsible for maintenance of this standard.

3.2.2 **Contact Information:** Address questions concerning this standard to:

GIS Help Desk, NCDOT GIS Unit
NC Dept of Transportation
4101 Capital Blvd,
Raleigh, NC 27604
Telephone: (919) 707-2165
gishelp@ncdot.gov

4. TERMS AND DEFINITIONS

4.1. METADATA

Metadata is information that describes the content, quality, condition, origin and other characteristics of data. Metadata for spatial data and services may describe and document its subject matter; how, when, where and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to an established standard.

4.2. DATA MODEL

A data model is a computer representation of the data used by the business, along with processes that the business performs. It includes such items as spatial representation of business objects (e.g., a road, imagery), attributes; integrity rules and relationships; cartographic portrayal; and metadata requirements. A common model governs how well software applications will perform using an organization's data.

4.3 VECTOR SPATIAL DATA

Vector data is a representation of the data in a geometric form, such as point, line or area, and referenced to a location on the earth. Most real-world objects (such as a landmark, a road or a lake) are represented as a vector.

4.4 RASTER SPATIAL DATA

Raster data is represented as a collection of grids with values, and referenced to a location on the earth. Most images are represented as raster.

4.5 LINEAR REFERENCED DATA

In linear referencing, location is given in terms of a known line feature and a position, or measure, along the feature. Currently there are two NCDOT supported referencing methods: (1) milepost along a unique route, (2) direction and distance offset from the intersection of two unique routes. Linear referencing is an intuitive way to associate multiple sets of attributes to portions of linear features.

4.6 REFERENCE SYSTEM

A system for identifying positions on the globe. This is often constructed with a grid that either refers to the earth's latitude and longitude (graticule), or a planar equivalent that divides grid lines by a fixed length from a predefined point of origin. It is common practice for coordinates to reference a location using either the latitude/longitude reference system or the North American Datum reference system.

4.7 ARCHIVING

The long term collection and maintenance of data snapshots retained permanently that can be utilized to help manage long term risk (i.e. regulatory/ legal requirements) while allowing ongoing access to authentic historical data for the purposes of analysis.

4.8 BACKUP

The capture of active datasets with the intention of providing a means to restore changing records that have been deleted or destroyed. The purpose of a backup is to manage short term risk and address disaster recovery. Typically, these snapshots are only retained for a few days or weeks before being overwritten by newer snapshots.

5. REQUIREMENTS

5.1. SPATIAL REFERENCE:

All enterprise spatial data shall be spatially referenced using the NCDOT standards listed below.

5.1.1. North American Datum 1983: The standard spatial reference for NCDOT vector and raster data is North American Datum 1983. Measurement units are in US Survey feet. The NCDOT's LRS is referenced to this common spatial reference.

5.1.2. Linear Reference Standard: Data related to the NCDOT's business operations should reference the road network utilizing the Roads and Highways Linear referencing System, approved integration processes, or the quarterly linework releases.

5.2. REPRESENTATION OF AUTHORATATIVE FEATURES:

All NCDOT enterprise spatial data shall be represented uniformly by the features outlined below.

5.2.1. Road network: The standard spatial representation for NCDOT's public road network is as a vector linear feature.

5.2.2. Road projects: The standard spatial representation for NCDOT's road projects are vector linear feature and point features. Feature layers include, CTP, Prioritization, and STIP.

5.2.3. Rail network: The standard spatial representation for NCDOT's rail network is a vector linear feature; along with road network intersections as point features.

5.2.4. Airports: The standard spatial representation for NCDOT's airport locations are point features and facilities boundaries.

5.2.5. Structures: The standard spatial representation for NCDOT structure locations are point features. Examples of this type of features are bridges, signs, and traffic signals.

5.2.6. Administrative Boundaries: The standard spatial representation for the administrative boundaries is as a vector area feature. Examples of this type of feature are municipal, county, state, and census boundaries.

5.3. REPRESENTATION OF CHARACTERISTICS:

The NCDOT represents characteristics referenced to roads as "events" in a database table. An event is any characteristic that can be located along a line using an accepted referencing method. Data can be located as either a point or a linear feature.

5.3.1. Point Feature: A point feature represents a discrete location on the surface of the earth. In order to reference it as an event along a road network, it will need to be located on or near the underlying spatial roads. GIS tools can be utilized to identify the referencing (e.g. route and milepost) values and then integrate the point data into the Linear Referencing System for sharing and storage requirements.

5.3.2. Linear Feature: A linear feature represents a line with discrete beginning and ending points. In order to reference it as an event along a road network, it will need to be located on or near the underlying spatial roads. GIS tools can be utilized to identify the referencing (e.g. route and milepost) values

and then integrate the linear data into the Linear Referencing System for sharing and storage requirements

5.4. DATA QUALITY

All enterprise spatial data shall include descriptions of the quality of data with respect to the items below. These descriptions shall be documented in the metadata for each spatial dataset.

5.4.1. POSITIONAL ACCURACY:

All enterprise spatial data shall have a known spatial accuracy. Positional accuracy is a statement of how closely the location of a feature represents a true position on the ground. An important component of positional accuracy is a statement of precision in which the exactness of the data is indicated.

5.4.2. ATTRIBUTE ACCURACY

Attributes are facts tied to the Earth's surface. Attribute accuracy is the closeness of attribute values to their true values. This applies to accuracy of continuous attributes such as elevation and accuracy of categorical attributes such as number of lanes or pavement type. An important component of attribute accuracy is a statement of precision in which the accuracy of the data is measured.

5.4.3. COMPLETENESS

Completeness is defined as the degree to which the features and their attributes represent all the instances of the entire dataset. Missing data (incompleteness) can affect logical consistency needed for correct processing and/or analysis of the data. A statement of completeness shall be documented in the metadata.

5.4.4. LOGICAL CONSISTENCY

A spatial dataset is logically consistent when it does not violate business rules and constraints for the dataset. Logical consistency is best expressed in the rules and constraints defined for a spatial data model. Data that meets rules and constraints (both spatial and non-spatial) can be used with a high level of confidence for business applications and analysis. Without consistency, additional time and effort will need to be expended to allow software to handle inconsistencies in ways that do not propagate or increase the errors. Logical consistency shall be documented in the metadata and reference the geospatial data model for the dataset.

5.4.5. LINEAGE

Lineage refers to the origin and processing history of a dataset. It includes the name of the organization that produced the data so that its policies, procedures and methods can be evaluated to see if they were biased in representing the surface of the Earth or its features. Lineage of the dataset shall be documented in the metadata.

5.5. METADATA

Metadata shall be accurate and complete, compliant to the NCDOT Metadata Content Standard for Geospatial Data. Ownership of the dataset shall be clearly identified within the metadata, as will any publication and use constraints. Acquisition method shall be identified in the metadata. Please see the NCDOT metadata content standard for instructions and guidance for geospatial metadata editing and compliance information. Contact the GIS Unit for information about training opportunities.

5.6. GEOSPATIAL DATA MODEL

Data models used as part of the development of the datasets will be delivered along with the dataset. Documentation of the data model will follow the NCDOT Geospatial Data Model Content Standard (forthcoming).

5.7. ACQUISITION

This method of acquisition and maintenance plan of datasets will follow requirements specified in the NCDOT Geospatial Data Acquisition Standard (forthcoming). This standard covers the following items:

5.7.1. Acceptable formats for development and acquisition of geospatial datasets.

5.7.2. Recommended sources for non-NCDOT data that may be of interest to the NCDOT business units.

5.7.3. Dependencies upon a dataset or any dependencies that a spatial dataset may have on other datasets will be clearly identified.

5.7.4. Identification of geospatial datasets critical for business operations

5.7.5. Identification of geospatial datasets as part of other applications, including documentation of workflow and dataflow for that application

5.8. PUBLICATION

Sharing of data will be in accordance with the specifications in the NCDOT Geospatial Data Publication Standard (forthcoming). The NCDOT is subject to all state laws regarding sharing of spatial datasets. This standard covers the following items:

5.8.1. Methods of publication

5.8.2. Formats for publication

5.8.3. Restrictions or requirements for internal or external sharing of the spatial datasets.

5.8.4. Requirements for publication of datasets as services to be consumed by web browsers.

5.9. LOCATION AND RECOVERABILITY

The physical location of the dataset will be identified, as well as documentation of any backup and restore procedures. Any spatial dataset considered critical to the business functions of NCDOT will be clearly identified and a backup and recovery plan verified and implemented to ensure that NCDOT meets its public obligations. In addition to backup and recovery, a plan for long term archiving should be included in the documentation associated with the dataset. (For more information on state activities related to the archiving of spatial datasets, please refer to the document in paragraph 3.0 above.) In lieu of an archival capability, backup datasets will be stored as archives, based on business needs and best practices. Geospatial datasets related to the road network will be backed up quarterly as part of the publication cycle.

6. BEST PRACTICES

Developers of spatial datasets within the NCDOT shall work closely with the NCDOT GIS unit to submit a draft of documentation and datasets for acceptance before final delivery.