Sharing GIS Data Models

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Introduction

In the open source software development model benefits are gained through the sharing and collaborative development of software source code. Oftentimes the sum of the benefits realized under this cooperative approach to software development is greater than the benefits resulting from the work of the individuals. Similar benefits can be realized from the collaborative design and sharing of GIS data models.

This is the first in a series of articles about the design and sharing of GIS data models. In this first article we will:

1) Define a GIS data model.

2) Describe the basic elements of a GIS data model.

3) Provide an example of one way to document and share information about a simple feature class.

4) Discuss two (2) example diagrams

used to document the simple feature types that make up a GIS data model.

The contents of this article are based, in part, on work I've completed while designing the sanitary sewer network GIS data model as part of my volunteer work for the Utility Working Group of CCVGPG (California Central Valley Geospatial Professionals Group). We will begin the meat of this article with a definition of a GIS data model.

Simple Definition of a GIS Data Model

Here is a simple definition of a GIS data model: A GIS data model is a blueprint for the implementation of a geographic information system (GIS).

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We might further expand on our definition by adding this statement: A GIS data model is typically focused on a single theme or problem domain.

Examples of problem domains include land parcels, addressing, forestry, geology, and public health.

The typical GIS data model includes a description of:

1) Structural elements of the data model.

2) Policies or procedures that are used to create, delete, and modify these structural elements.

Let's briefly consider a list of the structural elements that could be included in a GIS data model:

1) Simple Feature Types

2) Topology

3) Non Spatial Entities

4) Spatial Relationships

5) Non-Spatial Relationships

6) Layer Groups

Future articles in this series will further examine each of these structural elements of a GIS data model. In the first article we will consider the first item in the list, simple feature types, in more detail.

Simple Feature Classes

A simple feature is composed of a two

elements. The first element is a geometry representing the feature's shape and location. The second element is a set of attributes that capture non-spatial information about the feature. For example: You could represent a road feature using a linear geometry, an attribute that stores the road name, and an attribute that stores the road type.

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The type of geometry used to represent a feature, and the set of attributes common to all features of a single type, are typically defined in a feature schema or feature type. These simple feature types are the basic building block that forms the foundation of a GIS data model. All other data model elements related (directly or indirectly) to the simple feature types defined in the GIS data model.

Structural Elements of a GIS Data Model

- ○ Simple Feature Types
- ○ Topology
- ○ Non Spatial Entities
- ○ Spatial Relationships
- ○ Layer Groups

Documenting Simple Feature Types

How can simple feature types be documented in a GIS data model? A number of diagrams may be needed to document the simple feature types in a GIS data model these diagrams include the following:

1) An entity relationship diagram showing the relationship between simple feature types and other structural elements of the GIS data model.

2) A simple feature type attribute diagram, which provides information on the name, data type, and description of each attribute that stores non-spatial data about features of the feature type.

3) Policy diagrams that explain how the features of the feature type are created, destroyed, and modified.

4) Attribute domain diagrams that list valid values for attributes of the feature type.

5) Sub type diagrams that list valid attribute values for all features of a feature type that belong to a more specific sub type. (For example: You might require that all road features that represent state highways have a required set of attribute values.)

Examples

We provide examples of the first two (2) types of diagrams in this article. The examples are taken from the sanitary sewer network GIS data model being developed by the CCVGPG working group. Future articles in this series will provide examples of the other the

Simple Feature Type Diagram Attribute

- ○ Full Attribute Name
- ○ Attribute Name Abbreviation
- ○ Required Value?
- ○ Data Type
- ○ Unique?
- ○ Units
- ○ Domain
- ○ Default Value
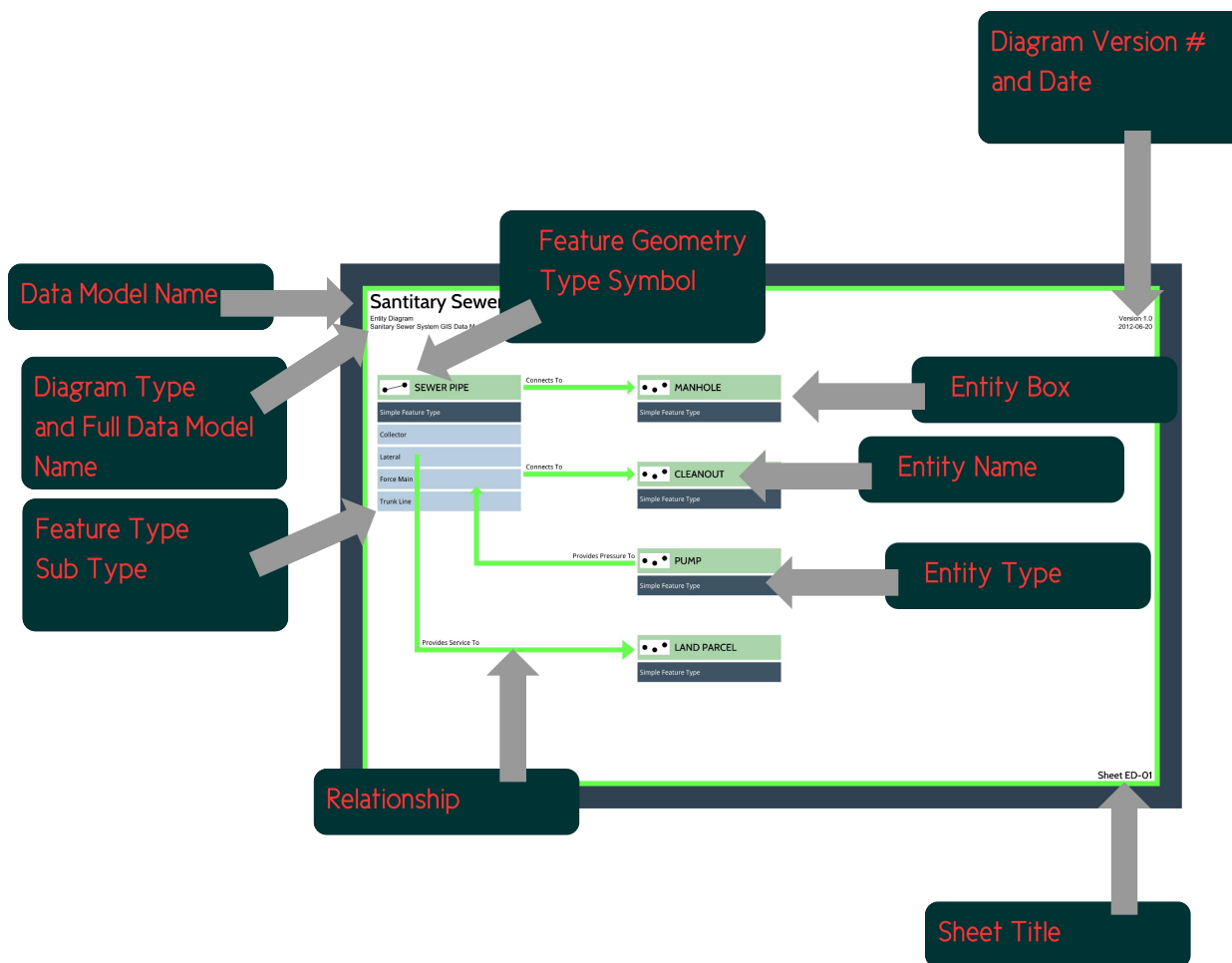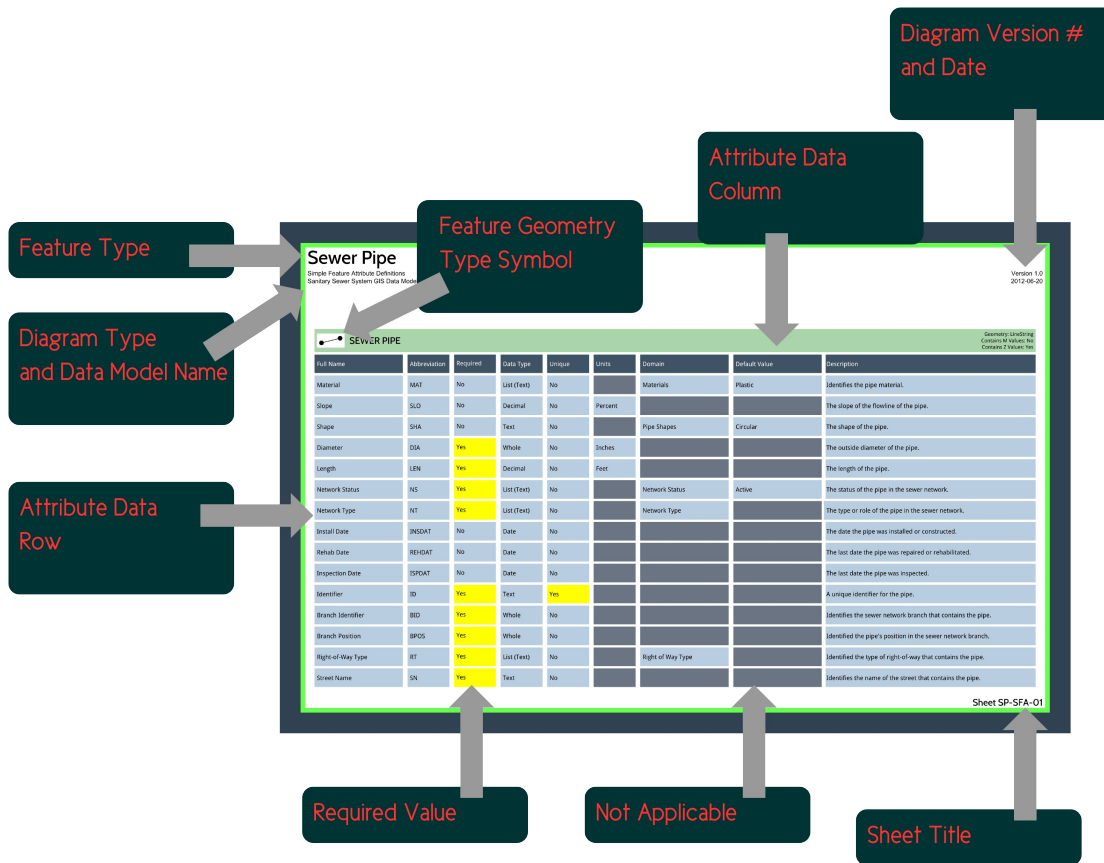
Annotated Entity Diagram

diagram types we listed in this article.

The Entity Relationship Diagram

The entity relationship diagram shows the simple feature types and non-spatial entities that make up the GIS data model as well as the relationships between them. It provides a simple "high-level" view of the GIS data model.

The entity relationship diagram has two (2) main components. The first component is an entity box. The second component is the relationship arrow. We will briefly describe each of these.

The entity box composed of three (3) types of smaller boxes or bars. The top bar shows the name of the entity, and if the entity is a simple feature type, the geometry type that

Annotated Simple Feature Type Attribute Diagram

is used to represent features of the type. The second bar shows the type of entity described by the box. This could be a simple feature type or a non-spatial entity.

The third bar shows all of the sub types of a simple feature type or a non-spatial entity.

The relationship arrow has only two (2) parts. The first is an arrow that shows the two elements of the GIS data model that are participating in the relationship. This could be a simple feature type, non-spatial entity, or a subtype of either. The second part of the relationship arrow is the name of the relationship.

The Simple Feature Type Attribute Diagram

The simple feature type attribute diagram describes the attributes of a

simple feature type in a standard way. A table is used to represent the simple feature type in the diagram. The first row of the table shows the geometry type of simple feature type and the feature name. It also indicates if the feature geometry contains elevation values or measure values (route stationing).

The remainder of the table contains data about the simple feature type attribute schema. For each attribute in the schema the following information is displayed:

1) The full name of the attribute.

2) The attribute name abbreviation.

3) If the attribute value is required.

4) The data type of the attribute value.

5) If the attribute value must be unique among features of the simple feature type.

6) The units of the attribute value.

7) The attribute value domain, if applicable. (A domain is a limited list of acceptable values.)

8) The default value for the attribute.

9) A description of the attribute.

Conclusion

In the next volume of the OSGeo Journal we will take a look at some of the other diagram types listed above. We'll also look at how the simple feature type attribute diagram can be represented as JSON and exchanged between GIS software for the automatic creation of GIS data model layers.