Final Report – FGDC CAP Grant Category 7

(Demonstration of Geospatial Data Partnerships across Local, State, Tribal, and Federal Government)

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Agreement Number: G10AC00235

Project Title: Taking It to the Next Level: NCStreetMap 2.0
Local to State Transformational Data Exchange

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Executive Summary

This project focused on creating a solution to the challenges of sharing transportation data between local, regional, and state organizations. The fundamental problem is the ability of local government spatial data stewards to maintain their framework transportation data in their native formats (designed to meet their business needs), while also sharing the data with State and Federal Agencies who need data in a common format to aggregate contributions from many producers into seamless statewide and national products. The Eastern Carolina Council, the NC Department of Transportation, the Eastern Band of Cherokee Indians, and the NC Working Group for Roads and Transportation (WGRT) have partnered with The Carbon Project to develop a cloud-based solution that involves a master schema for road centerlines, defined by the NC Community Street Centerline Data Exchange Standard, and an open data platform that enables local data stewards to upload and translate their street centerline data into a common data model. Street centerline data from over 80 counties in North Carolina has been uploaded into the deployed Carbon 'Transformer'.

Project Narrative

Project Background

North Carolina has a long and successful history of geospatial collaboration between many different levels of government. This project is a continuation of that ongoing commitment to partnership and data sharing. The success is due in no small part to the organized governance structure established within the state. The NC Geographic Information Coordination Council (GICC) is the primary governance body for geospatial matters and is established by legislation. The State Mapping Advisory Committee (SMAC) is the arm of the GICC that sets data and mapping standards and coordinates statewide data collection and funding efforts. The SMAC commissioned the Working Group for Roads and Transportation (WGRT) in 2006. The WGRT is composed of domain experts and interested members from all levels of government who create or depend on transportation data. The WGRT is the GICC's official spatial data coordination mechanism for framework transportation data in North Carolina. The WGRT Technical Review Team met regularly with the developer through web-based meetings and conference calls to review and comment on the development of the transformer and the creation of the master centerline schema. As the Principal Investigator and WGRT co-chair, the Eastern Carolina Council (ECC) oversaw the project and the contracted developer on behalf of a larger project team composed of the Eastern Band of Cherokee Indians (EBCI), the NC Department of Transportation (NCDOT), the WGRT members, and the participating local data stewards.

Technical Overview

This project developed, deployed, and operationalized an open data platform for exchanging transportation data between local, regional, and state organizations and translating this data into a seamless statewide 'Roads' layer. The deployed capability was developed using The Carbon Project's new cloud-based interoperability platform which supports uploading, transforming, streaming, and synchronizing geospatial data from many organizations using open data and services standards from regional organizations, states, the FGDC, and the Open Geospatial Consortium (OGC). At the end of the reporting period, data from over 80 counties has been uploaded into the deployed Carbon 'Transformer'. As deployed on the Azure Cloud, the Carbon Transformer supports an engaged community across North Carolina for translating local street centerline data into a common data model and services (Figure 1).

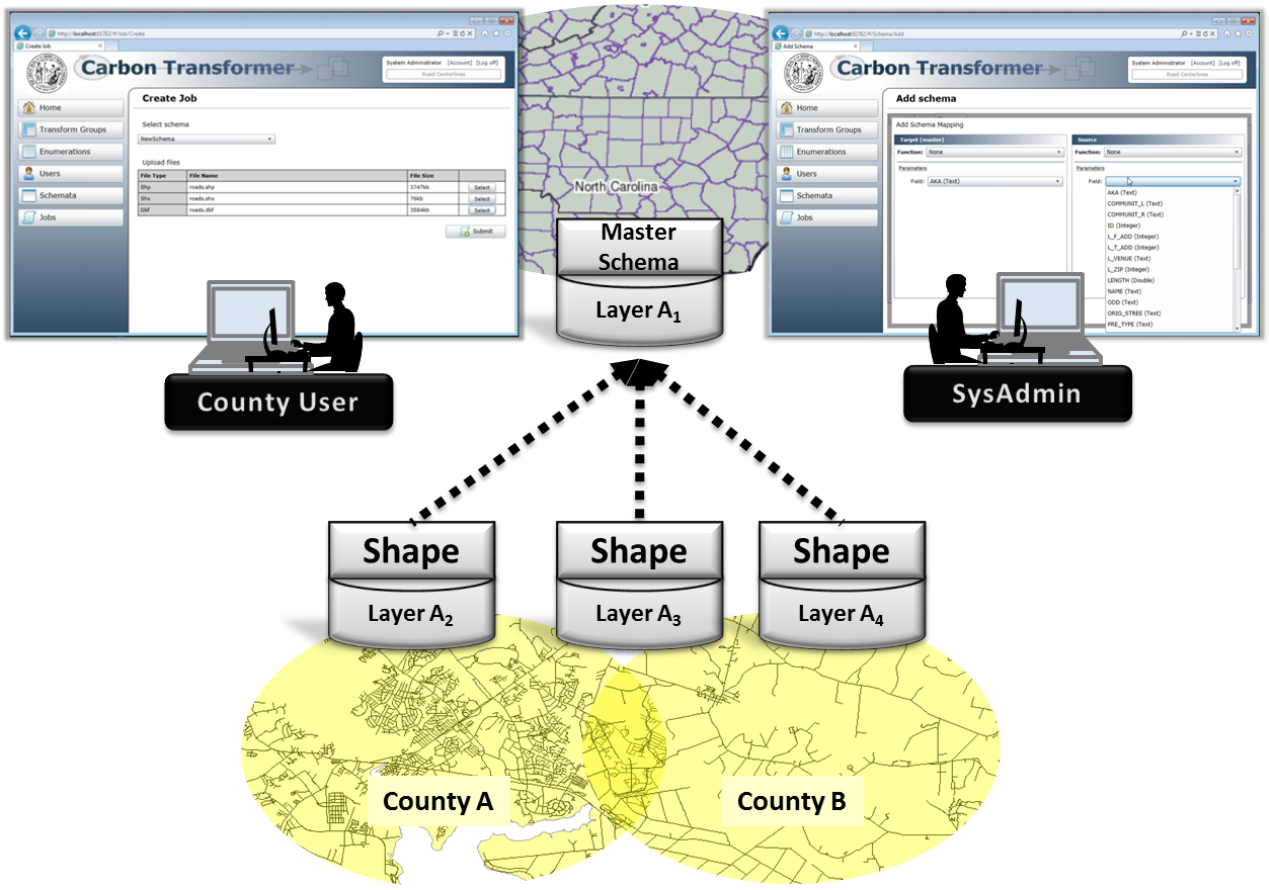

Figure 1 – This project developed, deployed, and operationalized an open data platform for exchanging transportation data between local, regional, and state organizations and translating this data into a seamless statewide 'Roads' layer.

To achieve its objectives the project leveraged a 'Master Schema' for Road Centerlines in North Carolina. The Master Schema was defined by mandatory elements in the draft 'NC Community Street Centerline Data Exchange Standard'. This Master Schema was deployed on the Carbon Transformer and used to create a translation target for Shapefiles uploaded by members of the WGRT Technical Review Team. Roads data from North Carolina counties was then mapped to Master Schema for Roads. Examples some of the more than 80 county schema mappings in the deployed system are shown in Figure 2.

The schema mappings used in this project are part of the 'Road Centerline' Transform Group (shown in the upper right corner of Figure 2). It is important to note that the Carbon Transformer also supports the addition of new Transform Groups. Using this Transform Groups approach new target schemas, such as Parcels or other data, may be added to the Carbon Transformer to support development of additional seamless data sets.

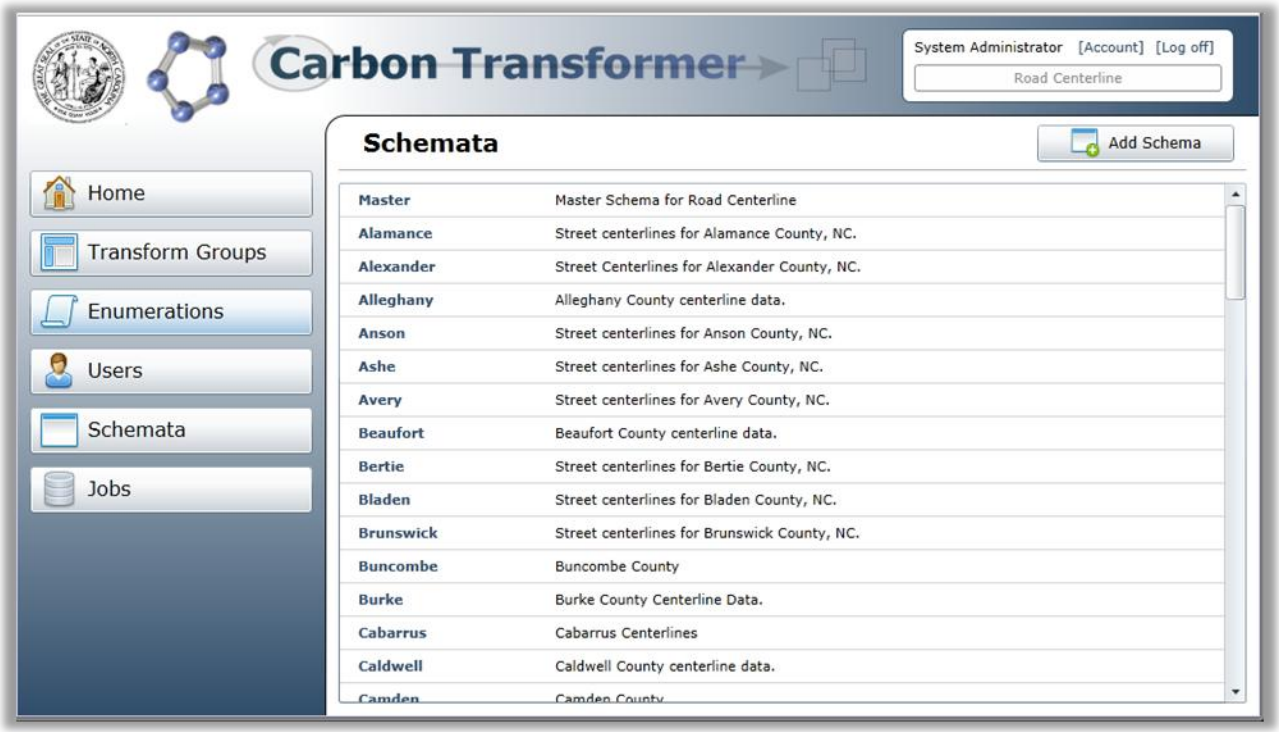

Figure 2 – Using the Carbon Transformer the project mapped and translated over 80 counties of Roads data to the Master Schema for North Carolina. Completed transformations in the 'Roads Centerline' group are shown above in the deployed Carbon Transformer.

Use Case for Counties

Using the Transformer, Counties or other members of the Technical Review Team were able to select a transformation, upload Shapefiles, and then translate the Shapefiles to the Road Centerlines Master Schema for the state.

The Use Case for a County User is summarized in Figure 3 below.

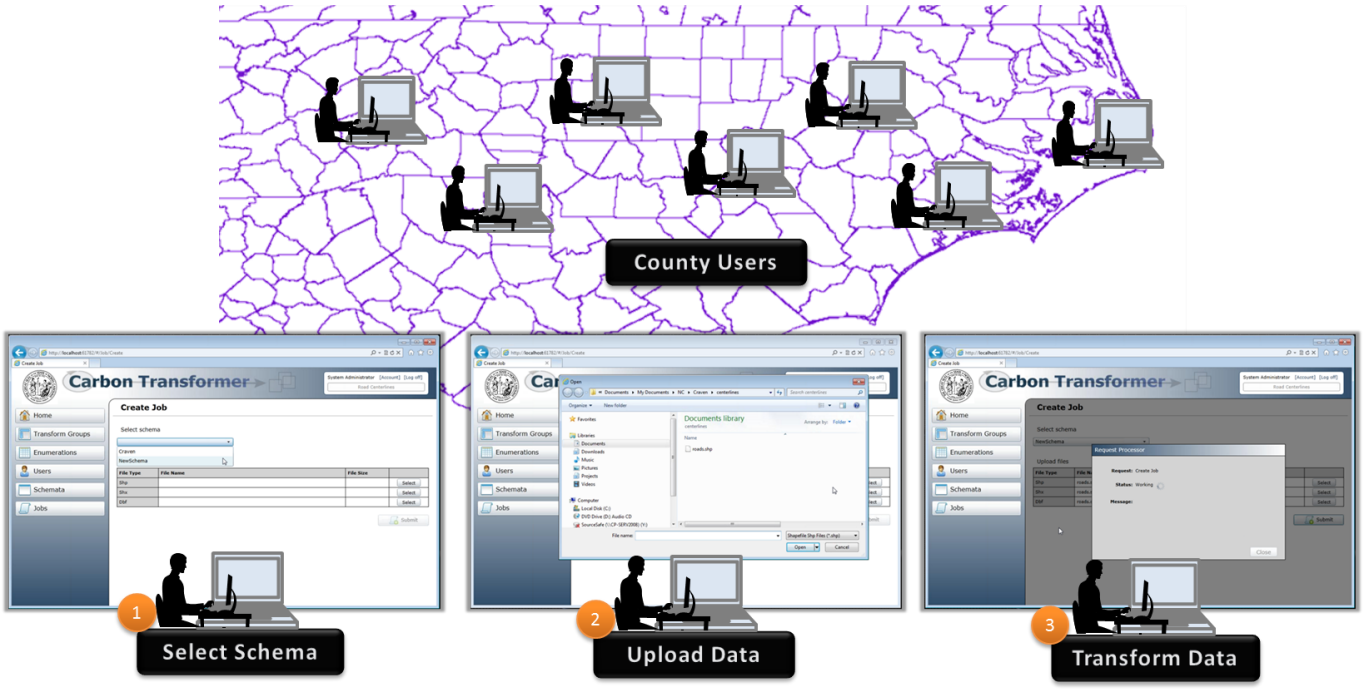

Figure 3 – Using the Transformer County Users were able to easily select a transformation, upload Shapefiles and then translate their local data to the Road Centerlines Master Schema for the state

At this point most users were completed with their work. The Carbon Transformer handled the processing and output their Roads data in the Master Schema, as defined by Mandatory elements in the draft 'NC Community Street Centerline Data Exchange Standard'.

During the project over 100 such translation 'Jobs' were completed for more than 80 counties throughout North Carolina. An example of some of the translation 'Jobs' for Craven, Onslow, Cleveland, Lincoln, Pamlico, Nash, and other counties completed between November 2012 to January 2013 are shown in Figure 4.

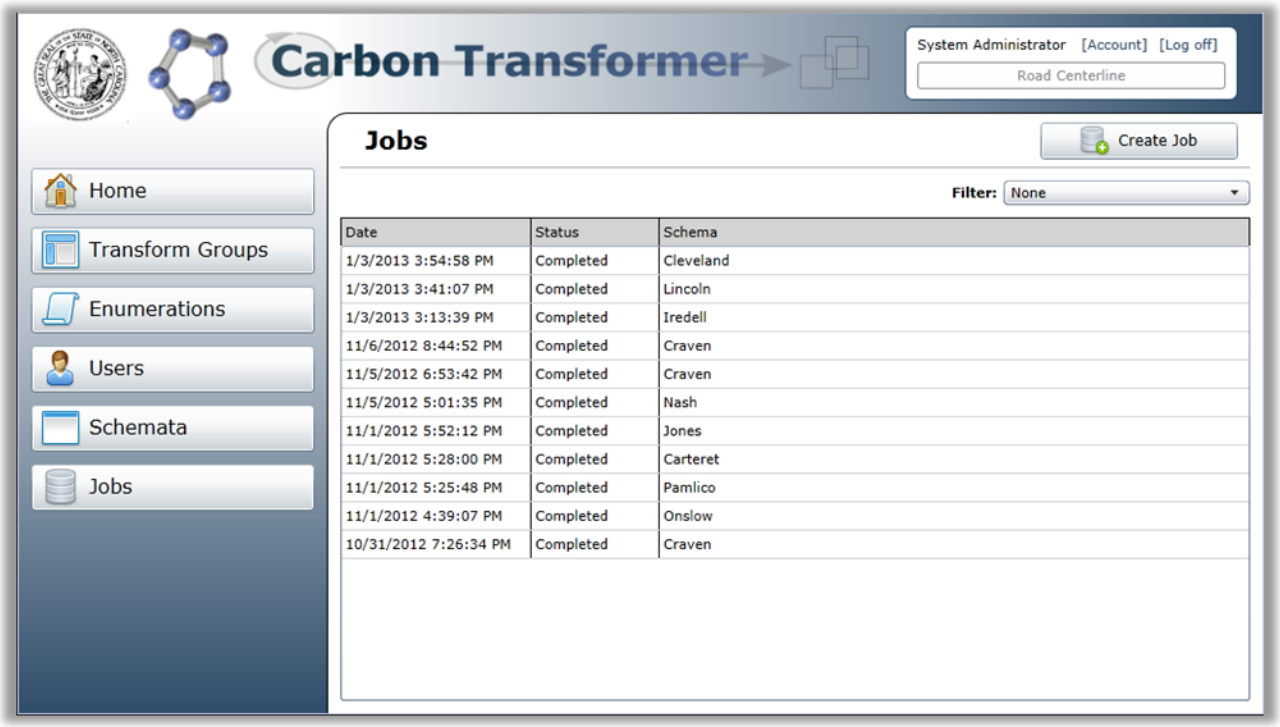

Figure 4 - During the project over a 100 translation 'Jobs' were completed for more than 80 counties across North Carolina.

Use Case for Adding and Editing Schema Mappings

The Carbon Transformer web service also provided spatial data stewards with a set of tools to map, also called 'crosswalk', selected data elements from their local Shapefile data formats to a Master schema and create new Transformations. Once this mapping was completed the transformation was saved and made available for use by County Users – who just needed to upload their data as discussed in the previous Use Case. Examples of Adding and Editing a Schema Mapping are summarized in Figures 5 and 6 below. As shown, after uploading their data users were able to map their local 'Source' data models (shown on the right) to the 'Target' Master Schema (shown on the left).

During the project the Technical Review Team and developers met regularly to discuss the user needs and system requirements in regards to the master schema and the mapping tools. The Schema Mapping tools in the Carbon Transformer were iteratively enhanced based on feedback from the Technical Review Team. Examples of such enhancements include color coding of Required, Completed, and Default Roads data attributes to aid in mappings (Figure 6). In addition, support for Functions was included. A Function is a method to execute a specialized action on a field. For example, the left Function may take two parameters - the Target Field and the Length. When applied, this Function returns the left 'X' most characters from the Target field and maps that to the local Source.

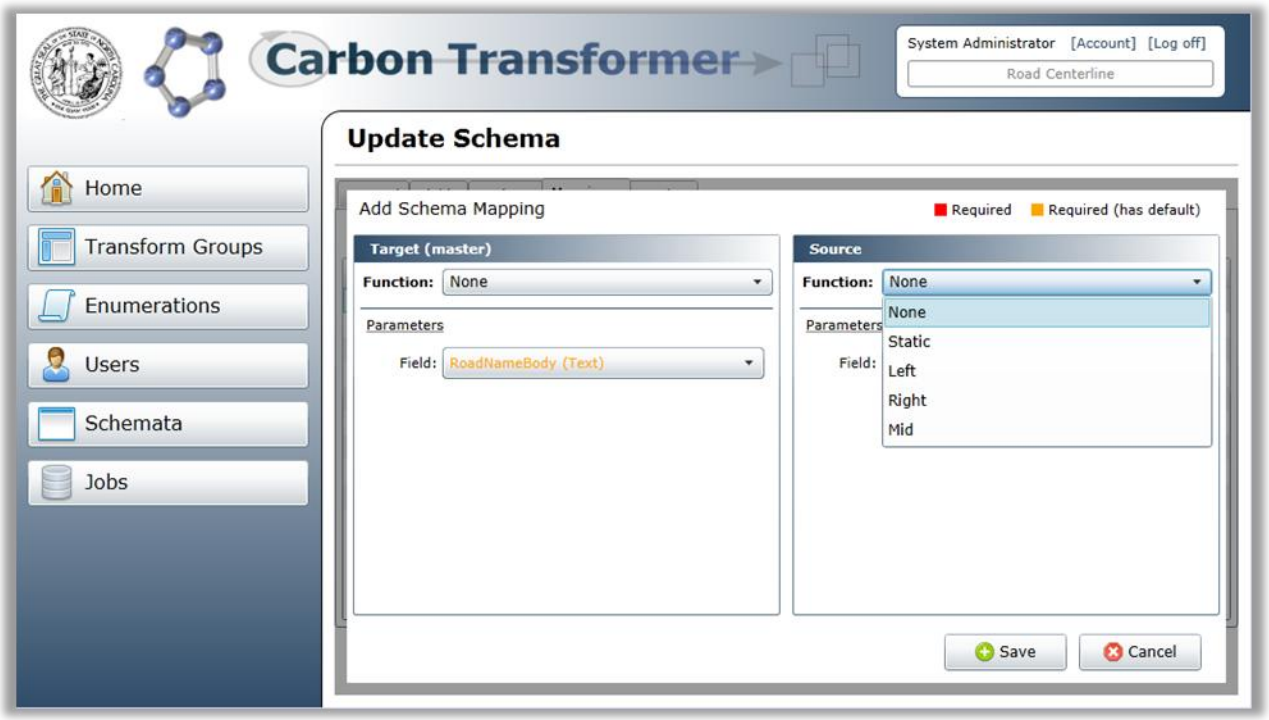

Figure 5 – Adding a Schema Mapping. The RoadNameBody Field is shown in the Target Schema on the left. To complete the mapping user selects the appropriate Field in the Source data and applies any required Functions.

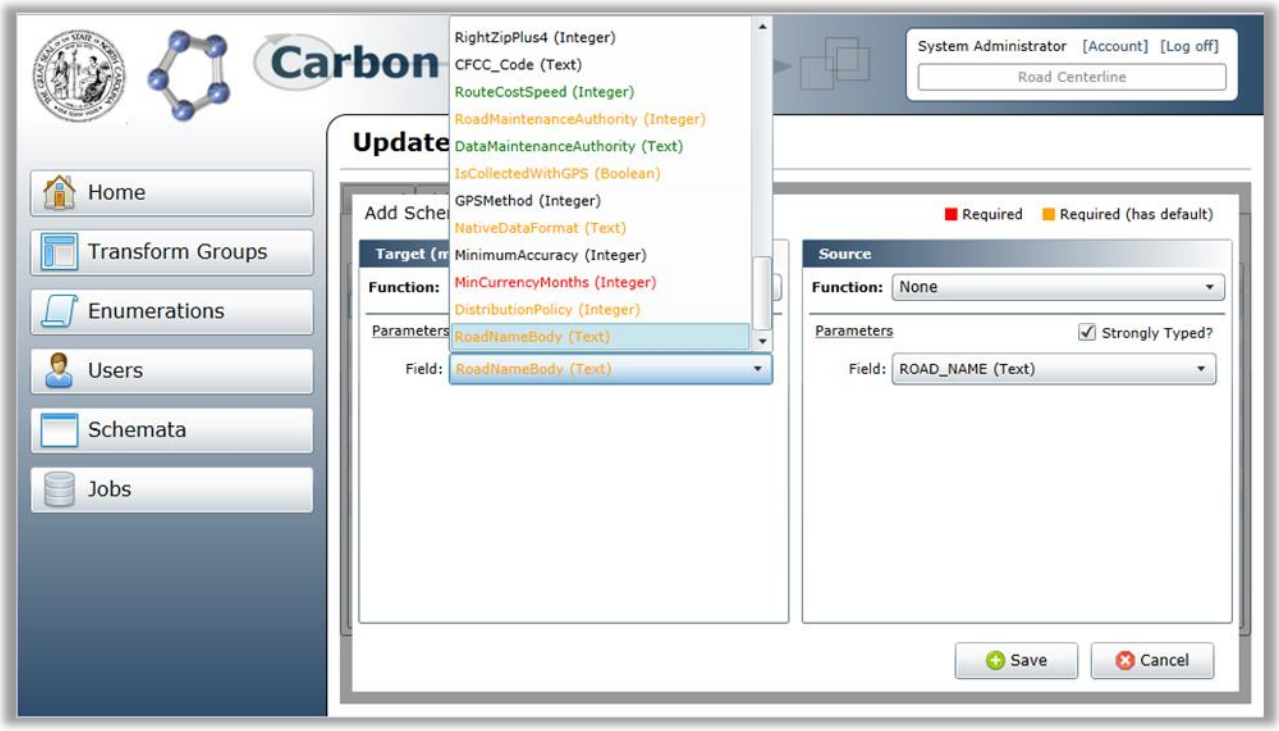

Figure 6 - Editing a Schema Mapping. The RoadNameBody Field in the Target Schema is shown on the left and the ROAD_NAME Field is shown in Source on the right. Color coding helps users keep track of the mappings.

Once mappings are completed they are saved in the Road Centerline Transform Group and available for Users, who then simply select the Transform and upload their data. Examples of a completed and saved Transform for Avery County are shown in Figures 7-9 below.

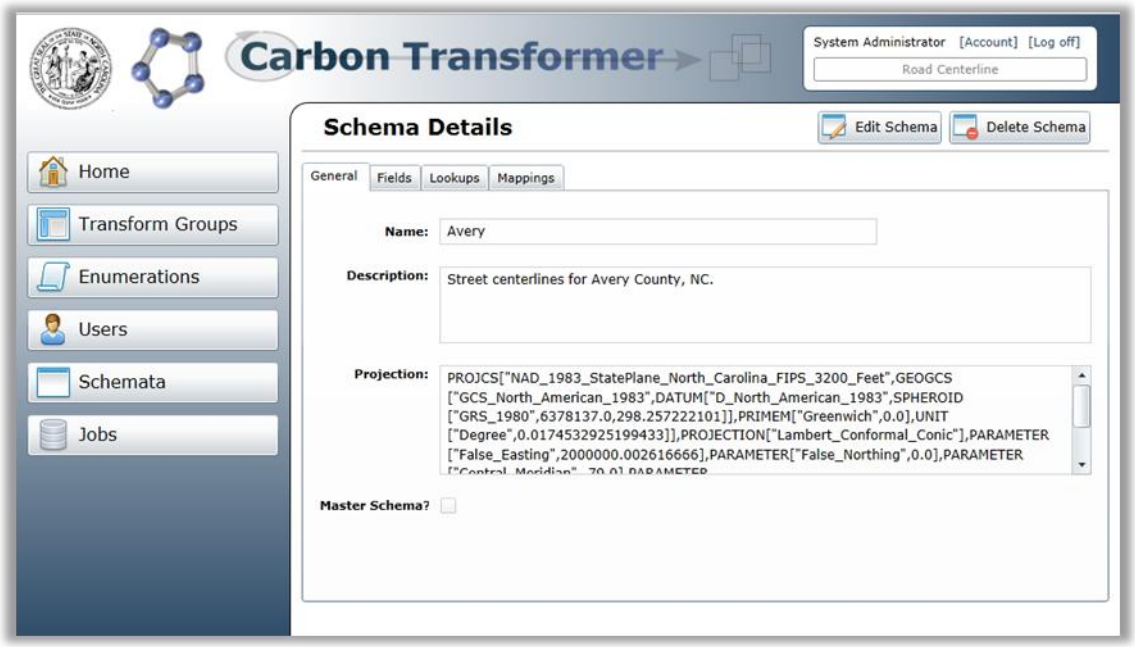

Figure 7 – Overview of the Avery County schema mapping.

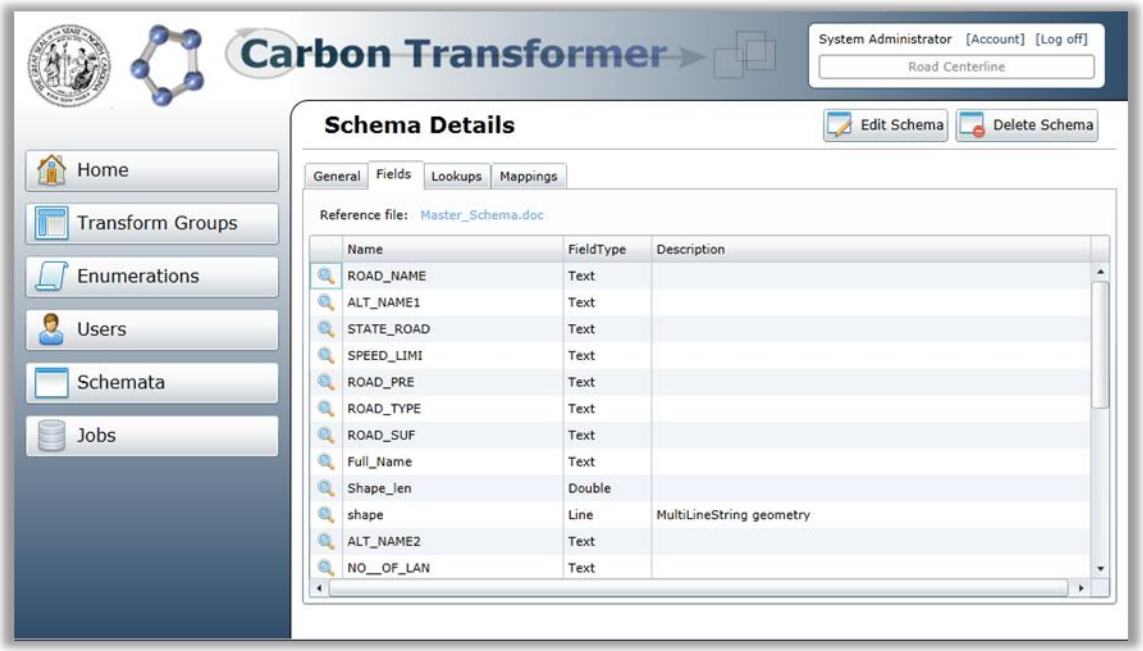

Figure 8 – Fields in the Avery County schema mapping.

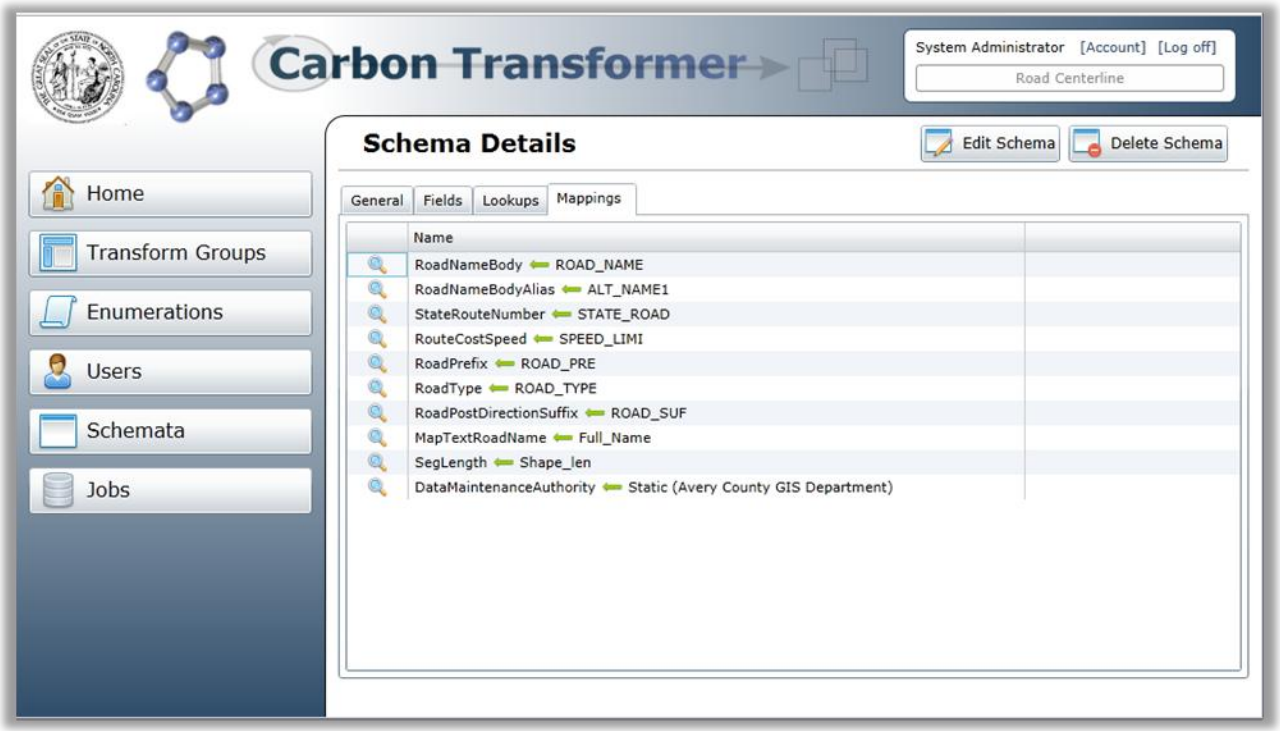

Figure 9 – Mappings completed for Avery County. The Target (Master Schema for NC) Fields are shown on the left and the Source (Local Data for Avery County) Fields are shown on the right.

It should be noted that the Carbon Transformer also includes many advanced functions to support enumerations on Roads data, for example Lookups. A Lookup is a way to map non-enumerated values to enumerated values. For instance, the enumeration for 'One-Way Direction' might have a value of 'Bidirectional', and the local (source) schema might have the text of 'BI' in the data. Lookups allow users to map the text of 'BI' to 'Bidirectional', and save this mapping so it may be used automatically.

System and Group Administration Tools

The Carbon Transformer supports three major roles in the system - *Users, System Admin, and Transform Group Admin.* Examples of the tools for the '*User*' role and some of the functions for the '*System Admin*' role were shown in the two previous Use Cases. In addition, the Carbon Transformer also supports powerful Administrative tools to manage a federated network where many counties are uploading and transforming a variety of data. Major sets of Admin tools for the Carbon Transformer include:

- **Transform Groups** - Help Administrators manage groups of related geospatial data and are logical containers for Schemata, Users, Enumerations and Jobs. The schema mappings used in this project are part of the 'Road Centerline' Transform Group, but the Carbon Transformer can also support other Transform Groups, such as Parcels or other data.
- **Enumerations** - Help manage the fields in a schema and include a list of values that you can restrict a field to. The Enumeration menu item allows Users to Create, Update, and Delete Enumerations.
- **Users** - Users can be assigned the roles of System Admin, Transform Group Admin, or a User. If assigned a role of User, specific schemata can be assigned to the user.
- **Schemata** - Helps manage the transform schema. In the schemata sections there exists a Master Schema and then as many other schemata as you want. As you create other schemata, you need to define how they map to the master schemata. The mapping process allows for straight 1 to 1 mappings, some built in functions, and static values. Custom logic can be added as well.
- **Jobs** - The jobs sections allows Users to upload a Shapefile. Once uploaded a job gets created, a separate worked thread gets created that transforms the file (based on the mappings) and puts it on the cloud for retrieval. Jobs may also be output to the Carbon WFS Plus+ for deployment as Geography Markup Language (GML) data streams.

Examples of these major sets of Administrative tools in the Carbon Transformer are shown below (Figures 10-12).

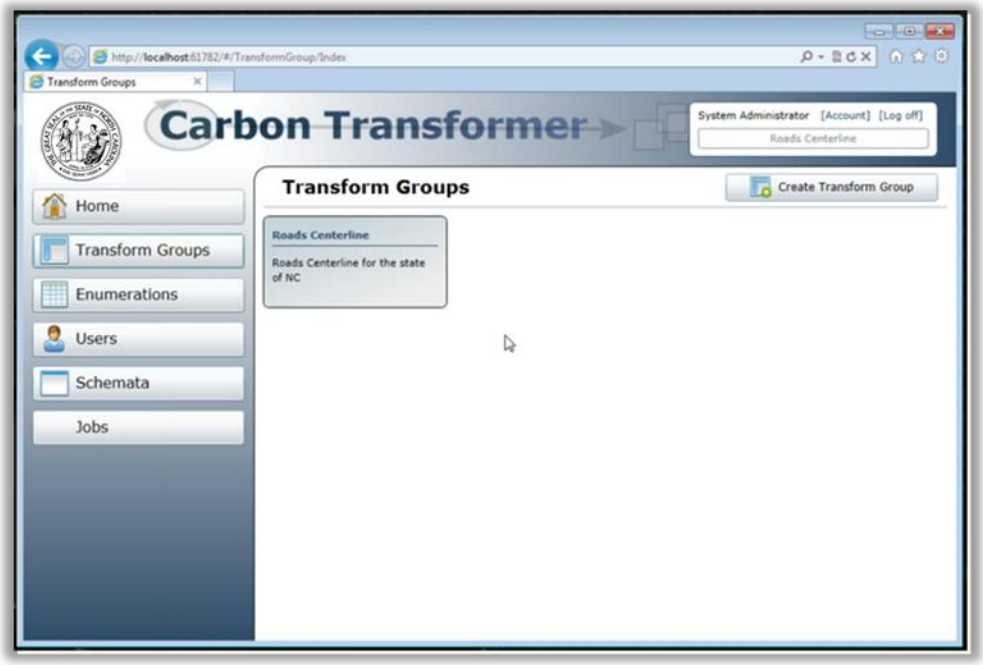

Figure 10 – Transform Groups help Administrators manage groups of related geospatial data, and the Transformer can support many groups such as Road Centerlines, Parcels, etc.

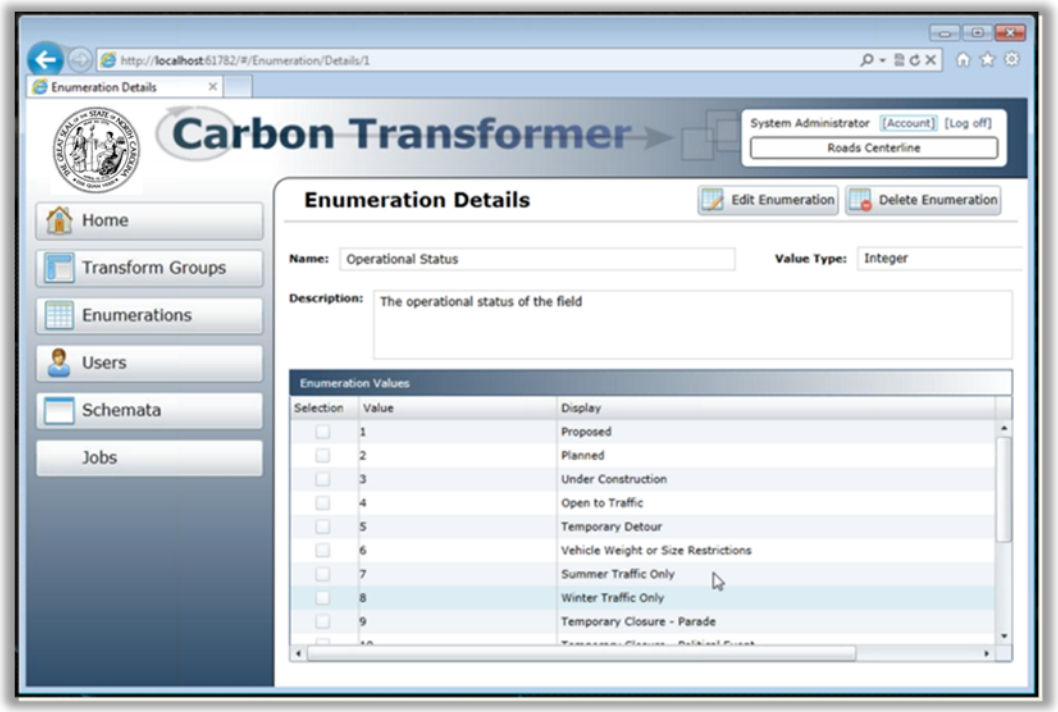

Figure 11 – Enumerations help manage the fields in a schema.

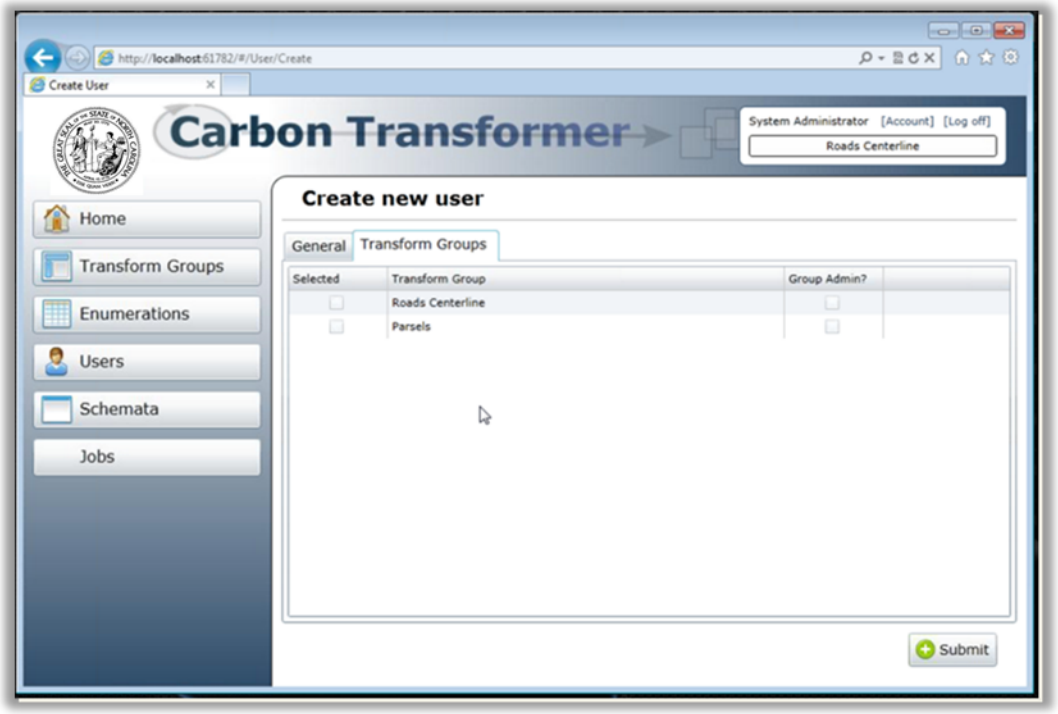

Figure 12 – Users may be assigned multiple roles, and assigned to specific Transform Groups.

Future Potential

The capabilities described in this section are now operationally deployed and providing an open data platform for exchanging transportation data between over 80 local, regional and state organizations and translating this data into a seamless statewide 'Roads' layer. In the future, this capability may support the transformation of other types of geospatial data including Parcels, and the exchange of geospatial data with US federal organizations (Figure 13).

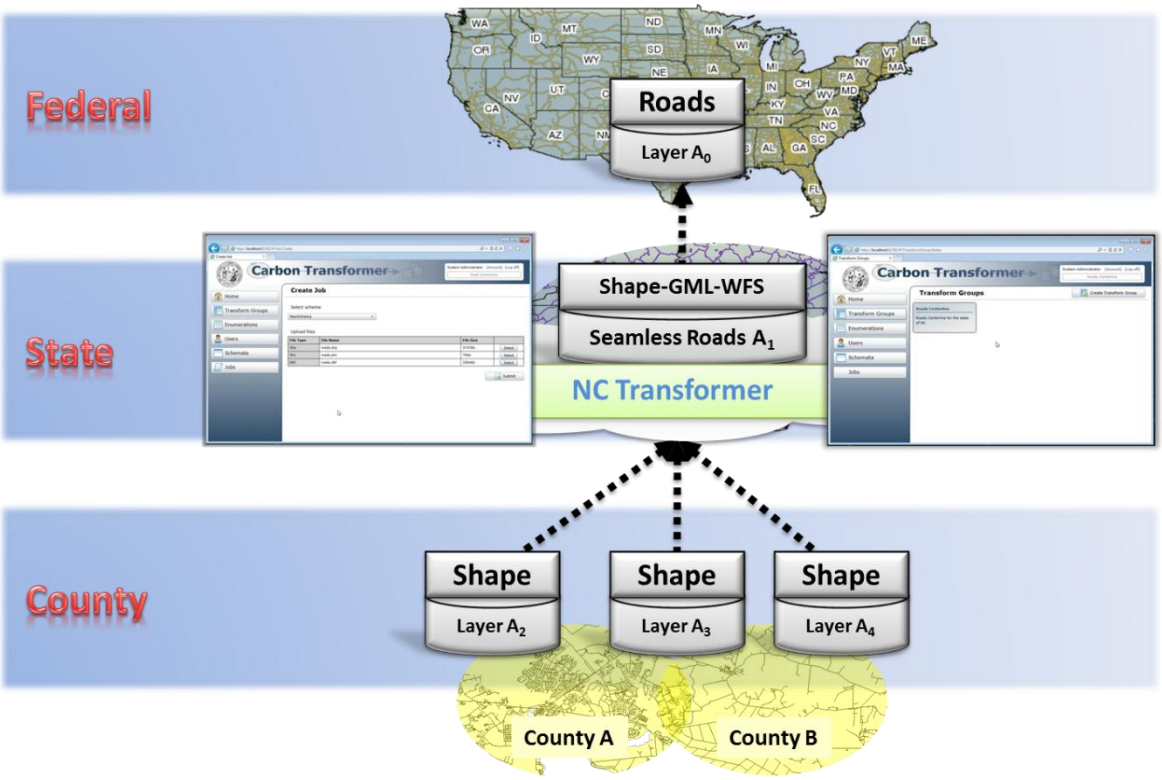

Figure 13 - In the future, the cloud-based Carbon Transformer capability may support the translation of other types of geospatial data including Parcels, and the exchange of geospatial data with US federal organizations

Project Narrative

Implementation & Long-term Sustainment Plan

The WGRT Technical Review Team initially uploaded and transformed centerline data for 25 counties as a beta test (Figure 14). Upon successful completion of the Carbon Transformer beta testing, the WGRT Technical Review Team revised the project Implementation Plan. It was originally suggested that local data stewards from each of the 100 counties in North Carolina would be encouraged to upload their data quarterly and maintain their data element mapping, 'crosswalks'. The WGRT TRT agreed that without a formal agreement or incentive this voluntary effort would eventually decline like previous data sharing efforts in the past. A revised two-part implementation plan was developed.

The WGRT TRT agreed that while the Carbon Transformer has a simple and intuitive interface the lack of familiarity with the master schema and the data elements in the NC Community Street Centerline Data Exchange Standard would prove too difficult and intimidating to local data stewards. WGRT TRT members possess a thorough understanding of the data elements, attribute values, and other properties of the master schema and a comprehensive understanding of the functionality of the Carbon Transformer including the use of Functions and Lookups. The strategy was revised so that WGRT TRT members would be responsible for creating the initial 'crosswalk' and working with local data stewards to proof and verify that the crosswalks were correct. This put the burden of the most difficult part of the process on the people who know the schema best and it led to uploading and transforming data from over 80 counties in two months (Figure 15).

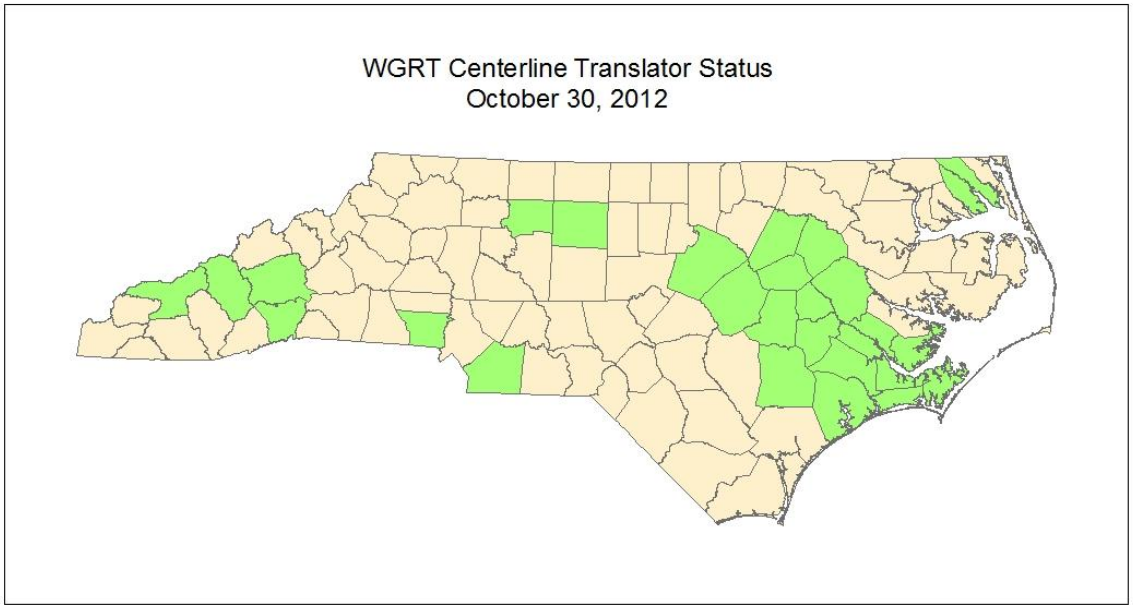

Figure 14 – The WGRT Technical Review Team successfully uploaded and transformed street centerline data from 25 counties as part of the project beta testing.

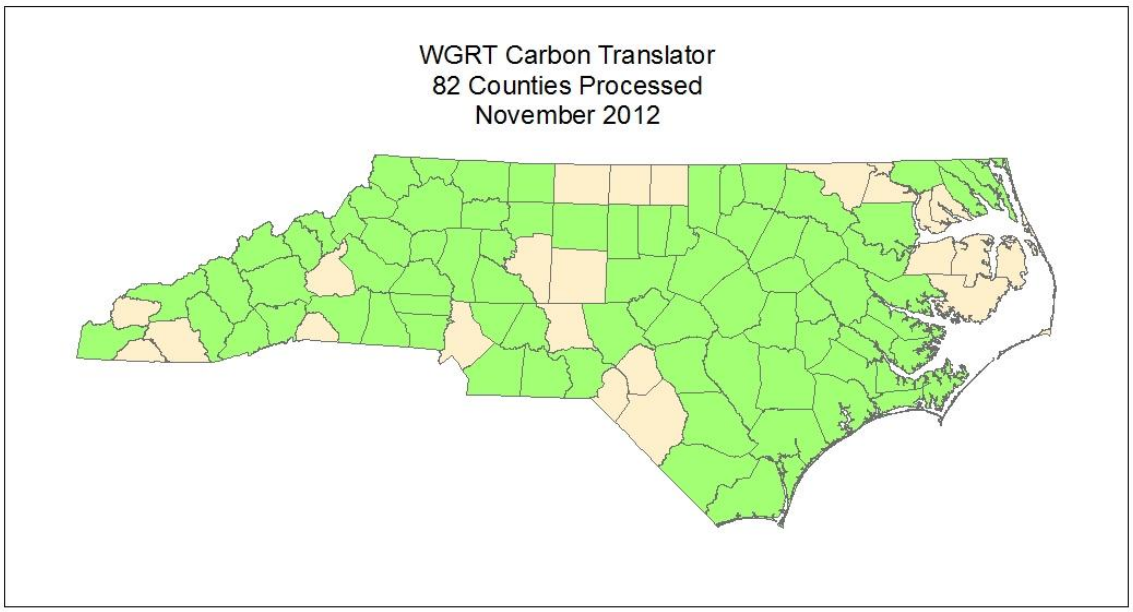

Figure 15 – Within the first two months of live operation the WGRT Technical Review Team successfully uploaded and transformed street centerline data from over 80 counties.

The second part of the strategy was to reduce the number of users in the system. With over 100 local data stewards in the system, it was agreed that staff turnover and other issues with local staff would eventually create an unreliable system. The strategy was to reduce the number of users from over 100 to 25. North Carolina like all states has Metropolitan Planning Organizations (MPOs) that coordinate transportation planning for the urban areas of the state. North Carolina was one of the first states to establish Rural Planning Organizations (RPOs) to coordinate transportation planning for the nonurban areas. It was suggested that the twenty RPOs in North Carolina along with the larger MPOs could take on the responsibility of uploading their counties' data and maintaining their assigned 'crosswalks'. A map of the RPOs and MPOs in North Carolina is shown in Figure 16.

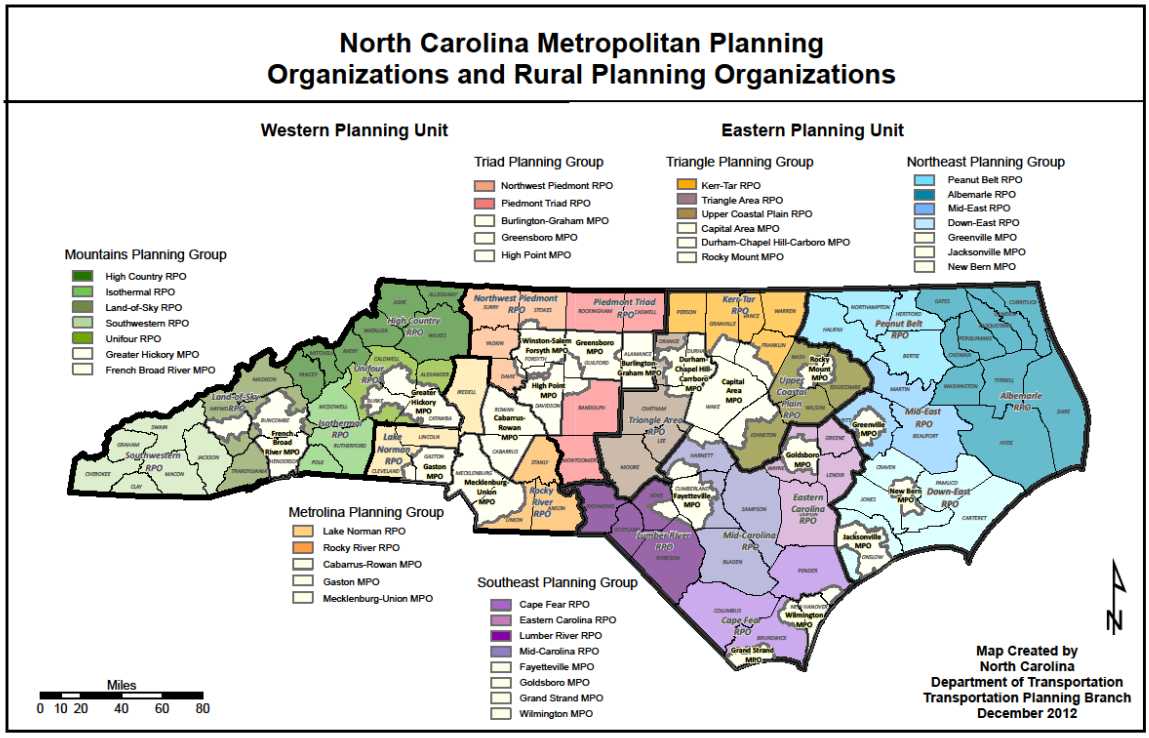

Figure 16 – The twenty RPOs in the state and five of the larger MPOs present a realistic solution to the problem of long-term sustainment.

The WGRT and the NCDOT are working with the RPOs and the larger MPOs to establish formal agreements requiring each RPO and MPO to upload their counties' data on a quarterly basis and serve as the custodian for their respective crosswalks. Each RPO and MPO has in-house GIS expertise, existing relationships with their local data stewards, and is a direct beneficiary of the statewide roads layer that will be produced from this effort. Furthermore, each planning organization must submit quarterly reports to NCDOT outlining the work items completed during the previous quarter. It has been suggested that NCDOT require each RPO and MPO to add the responsibility of quarterly centerline uploads to their annual work programs.

Next Steps

Vertical integration of street centerline data has been the goal of all past and current WGRT activities. While this project primarily focused on the local to state portion of the overall data integration effort, the work and effort in this project as well as the Carbon Transformer will aid NCDOT in publishing a seamless NC street centerline dataset for USGS to incorporate into The National Map. The WGRT has taken great effort to include the necessary element properties to comply with the FGDC Framework Transportation Schema definition of a "Road Segment" feature (see Appendix A). It is expected that revisions will be made to the master centerline schema and NC Community Street Centerline Data Exchange Standard as NCDOT further identifies the specific requirements for incorporating local centerlines into a seamless statewide layer.

In addition to completing the state to national portion of the vertical integration of street centerlines, the next steps for this effort are to partner with the NC Working Group for Seamless Parcels to incorporate cadastral and land use data as a separate transformation group in the Carbon Transformer. This project was originally designed and proposed as a joint effort between the two working groups but extenuating circumstances and budget issues with the WGSP's grant resulted in too many delays and eventually the WGRT had to pursue the development of a transformer independently. It is anticipated that the efforts of the WGSP will build off of this project and enhancements will be made to the Carbon Transformer such as automation of uploading, email notifications, and improved metadata documentation.

The WGRT and its members will continue to promote the vertical integration of street centerlines through workshops and conference presentations. In addition to giving regular reports and updates to the GICC and the SMAS, over the three year life of this project the WGRT has made multiple presentations to URISA, the NC Arc Users Group, the NC Property Mappers Association, the NC GIS Conference, the NC Association of Metropolitan Planning Organizations (NCAMPO), the NC Association of Rural Planning Organizations (NCARPO), the NC Section Institute of Traffic Engineers (NCSITE), and the Institute for Transportation Research and Education at North Carolina State University (ITRE). The WGRT co-chairs have also given presentations at the NC Public Transportation Association Conference and provided updates to the NC E911 Board. These presentations report on the progress of the project and the efforts of the WGRT and have been helpful in encouraging the counties and other data providers to adopt the standard and create and maintain the suggested attributes. The WGRT co-chairs are scheduled to present the completed CAP Project and Carbon Transformer at the 2013 NC GIS Conference in February and expect to have all 100 counties uploaded for that presentation.

Element Name	Data Type	NC WGRT Element Obligation	FGDC Equivalent Obligation	Default Values, Domain Values or Business Rules	Element Description
Note: The first 15 data elements in this data dictionary represent the minimum set of mandatory element properties necessary to transform NC local government street centerline data into a GML Simple Features format that complies with the FGDC Framework Transportation Schema definition of a "Road Segment" feature. Although most of these properties are not collected by local government data providers, they may be auto-populated with default values during the data transformation process.					
Shape	Simple 2D Linestring Feature	**Mandatory**	Mandatory	Depending on the native file format and software package used, enforcing these types of spatial relationship, or topological rules, upon street centerline features is highly desirable. • Must be a Single Part Feature • Must Not Have Dangles • Must Not Overlap Other Lines • Must Not Intersect Other Lines • Must Not Self-Intersect • Must Not Intersect Or Touch Interior	A valid 2D linestring simple feature, conforming to The ISO 19107 Geometry model - a special curve that consists of a single segment with linear interpolation, defined by two or more coordinate tuples, with linear interpolation between them. An complete technical definition and description may be found at: http://schemas.liquid-technologies.com/OpenGis/gml/3.1.1/LineStringSegment1.html Note: The spatial relationship rules listed at left are geared specifically towards data producers who maintain their centerline data in an ESRI "geodatabase" format. For those who maintain their data in other GIS formats, including ESRI "shapefiles", the concept of topology may or may not exist, or may differ widely in its implementation rules.

					http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Topology_rules
Source Metadata	Any valid URI	**Optional**	Optional	If the data provider elects to provide a URI pointing to a metadata file they maintain on a publicly accessible website, they should ensure that the URI is permanent / persistent.	A valid URI pointing to a metadata file containing structured or unstructured text as defined by the community of practice. Theoretically, this value would be the same for each road segment in a dataset produced by a single entity, and therefore could be auto-populated, en masse, during the data transformation process.
UID	Character String (40)	**Mandatory *** This is auto-generated during the transformation process and serves as the "id" attribute of the GML RoadSeg object	Mandatory	Without business meaning. Not Null GUID = a globally unique, 16-byte (128-bit) number, expressed as a text string representing a sequence of hexidecimal digits.	This is an auto-generated identifier that is unique to a *particular instance of a data transfer* from a local data producer. This is not the official permanent identifier for the street segment / line string that the local data provider assigns and maintains in the source dataset.
LastGeomEditDate	DateTime	**Mandatory *** If the data provider	Mandatory	Not Null Default/flag value = **January 1, 1900**	This date identifies when the last edits to a feature's spatial geometry occurred, or the original creation date, if there have been no later

		collects this information, it is mandatory to include.		If the creation date or last geometry edit date of a feature is not known by the data provider, the default value will be used, and this field can be populated with the default value, en masse, during the data transformation process.	edits. The "flag value'" is intended to provide an easy mechanism for local data providers to be able to fulfill the mandatory nature of this element in the FGDC Framework roads schema if they do not maintain this information on their source data.
LastPropertyEditDate	DateTime	**Mandatory *** If the data provider collects this information, it is mandatory to include.	N/A	Not Null Default/flag value = **January 1, 1900** If the local data provider does not maintain and track this information in their source data, this element can be populated with the default value, en masse, during the data transformation process.	This date identifies when the last edits to a feature's database attributes occurred, or the original population date, if there have been no later edits. Although the FGDC Framework roads schema does not distinguish between edit dates for feature geometry vs database attributes, this will better enable the tracking of some types of changes over time.
IsAnchor Section	Boolean	**Mandatory *** If the data provider collects this information, it is mandatory to include.	Mandatory	Not Null Default Value = False If the local data provider does not maintain element, it can be populated with the default value, en masse, during the data transformation process.	Is the road segment an "anchor section" in the local dataset. An anchor section is a section of road between two known and recoverable locations. They determine the official length of a road segment and where the section starts and ends. Their function is to support the collection of data by

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>providing an "all distances measured on this piece of road shall add up to this length" checksum.</td></tr>
<tr><td>Operational Status</td><td>Positive Integer</td><td>Mandatory *

If the data provider collects this information, it is mandatory to include.</td><td>Mandatory</td><td>Not Null
Default value = 17

Valid Domain Value List:
<table><tr><th>OpStatus_ID</th><th>OpStatus_Val</th></tr><tr><td>1</td><td>Proposed</td></tr><tr><td>2</td><td>Planned</td></tr><tr><td>3</td><td>Under Construction</td></tr><tr><td>4</td><td>Open to Traffic</td></tr><tr><td>5</td><td>Temporary Detour</td></tr><tr><td>6</td><td>Vehicle Weight or Size Restrictions</td></tr><tr><td>7</td><td>Summer Traffic Only</td></tr><tr><td>8</td><td>Winter Traffic Only</td></tr><tr><td>9</td><td>Temporary Closure – Parade</td></tr></table></td><td>The "Operational Status" of the road segment, as defined in the local data provider's source dataset, at the time of the data transfer. If this information is not maintained by the local data provider, the default value can be applied, en masse, to all of the features in the dataset during the data transformation process.
<table><tr><th>OpStatus_ID</th><th>OpStatus_Val</th></tr><tr><td>10</td><td>Temporary Closure - Political Event</td></tr><tr><td>11</td><td>Temporary Closure - Natural Hazard</td></tr><tr><td>12</td><td>Temporary Closure - Hazard</td></tr><tr><td>13</td><td>Closed</td></tr><tr><td>14</td><td>Private</td></tr><tr><td>15</td><td>Restricted</td></tr><tr><td>16</td><td>Abandoned</td></tr><tr><td>17</td><td>Not Provided</td></tr></table></td></tr>
<tr><td>Field Length</td><td>Double</td><td>Mandatory *

If the data provider</td><td>Mandatory</td><td>Not Null

Default Value = 0.0</td><td>Length of the road segment, as determined in the field. If the value of the "isAnchorSection" property = True, then this is the official</td></tr>
</table>

<table>
<tr><td></td><td></td><td>collects this information, it is mandatory to include.</td><td></td><td>If the data provider does not maintain this information, the default value will be used, and can be auto-populated en masse during the data transformation process.</td><td>length of the segment in an LRS. This will often differ from the "SegLength", especially in areas with hilly terrain. The calculated length is a 2 dimensional value and will not take elevation differences along the lengths of a road segment into account.</td></tr>
<tr><td>FieldLength_UOM</td><td>Positive Integer</td><td>Mandatory *

If the data provider collects this information, it is mandatory to include.</td><td>Mandatory</td><td>Not Null

Default Value = 5

Valid Domain Value List:
<table><tr><th>FLUOM_ID</th><th>FLen_UOM</th></tr><tr><td>1</td><td>US Survey Feet</td></tr><tr><td>2</td><td>Miles</td></tr><tr><td>3</td><td>Meters</td></tr><tr><td>4</td><td>Kilometers</td></tr><tr><td>5</td><td>Unspecified</td></tr></table></td><td>This indicates the units of measure that are associated with the numeric value of the "FieldLength" property.

If the value of "FieldLength" = 0.0, The value of this attribute must be set to the default value of 5.

If the data provider does not maintain "FieldLength" the default value for this property can also be auto-populated en masse during the data transformation process.</td></tr>
<tr><td>SegLength</td><td>Double</td><td>Mandatory *</td><td>Mandatory</td><td>Not Null

Length is auto-populated from the GIS layer itself.</td><td>This is the length of the road segment, as it exists in the GIS dataset. This is a 2D length.</td></tr>
<tr><td>SegLength_UOM</td><td>Positive Integer</td><td>Mandatory *

If the data provider collects this information,</td><td>Mandatory</td><td>Not Null

Default Value = the native units of the source dataset, as defined by its Coordinate System. This</td><td>This indicates the units of measure that are associated with the numeric value of the "SegLength" property.

Although none of the local centerline data providers in NC are known to</td></tr>
</table>

<table>
<tr><td></td><td></td><td>it is mandatory to include.</td><td></td><td>will be auto-populated during the data transformation process.

Valid Domain Value List:<table><tr><th>SLUOM_ID</th><th>SLen_UOM</th></tr><tr><td>1</td><td>US Survey Feet</td></tr><tr><td>2</td><td>Miles</td></tr><tr><td>3</td><td>Meters</td></tr><tr><td>4</td><td>Kilometers</td></tr><tr><td>5</td><td>Decimal Degrees</td></tr></table></td><td>store their source data this way, data defined in a geographic coordinate system is displayed as if a decimal degree is a linear unit of measure. This does not provide uniform values across the surface of the globe, and therefore is not an appropriate CRS to be used with street centerline data if accurate road segment lengths are required.</td></tr>
<tr><td>StartPointX</td><td>Double</td><td>Mandatory *</td><td>Mandatory</td><td>Not Null

This value is auto-populated and is simply the value of the X coordinate of the segment's start point as it exists in the source data file.</td><td>This field is intended to provide an easy mechanism for local data providers to be able to transform their data to a GML simple features format that very closely meets the FGDC Framework Roads schema, which contains 2 mandatory complex GML point objects representing the start and end points of the road segment.</td></tr>
<tr><td>StartPointY</td><td>Double</td><td>Mandatory *</td><td>Mandatory</td><td>Not Null
Default = auto-populated</td><td>Same purpose as StartPointX</td></tr>
<tr><td>EndPointX</td><td>Double</td><td>Mandatory *</td><td>Mandatory</td><td>Not Null
Default = auto-populated</td><td>Same purpose as StartPointX</td></tr>
<tr><td>EndPointY</td><td>Double</td><td>Mandatory *</td><td>Mandatory</td><td>Not Null
Default = auto-populated</td><td>Same purpose as StartPointX</td></tr>
</table>

This marks the start of the 42 data elements that are specific to the *Proposed DRAFT* 2009 NC Community Street Centerline Data Exchange Standard, as defined by the NC Working Group for Roads and Transportation and recommended for approval by the NC Geographic Information Coordinating Council and its SMAC, SGUC, LGC, and FIC subcommittees.

Note: This is intended *only* as a common data *exchange* schema, and local street centerline data providers are *not* required to begin maintaining all of these elements in their source centerline datasets. The fields in the data dictionary below that have been identified as *mandatory* or *conditional* have been classified that way because they are the elements that have been identified as necessary to either fully or substantially support the following:

- **Ability to identify the original data producer, at the feature level, once a local street centerline dataset has been aggregated with datasets from other local producers into a composite product.**
- **Ability to provide appropriate road name and highway number labeling capabilities on maps.**
- **Ability to support address geocoding and reverse geocoding operations.**
- **Ability to support network routing/tracing and service area analysis operations.**
- **Ability to identify, at the feature level, the "public" data sharing conditions the data steward attaches to their street centerlines – once data from many local producers has been aggregated into a composite.**
- **Accomplish the first step in the larger process of aggregating local centerline data and integrating it with State Route centerline data from NCDOT; and then making the composite product into a statewide linear referencing system (LRS) that local data providers can also begin to attach their event based information to (pavement condition, speed limit, et.)**

Element Name	Data Type	NC WGRT Element Obligation	FGDC Equivalent Obligation	Default Values, Domain Values or Business Rules	Element Description
SegID	Long Integer	**Mandatory**	Optional -as an "extended	Not <NULL>	This is the permanent, unique ID assigned to each street segment

			attribute" property	Must be > 0	feature in the local dataset, as defined by the Data Authority.
StreetID	Long Integer	**Conditional** – required only if the data provider maintains this information	Optional -as an "extended attribute" Property	Can be <NULL> only if the data provider does not maintain this information. Otherwise, must be > 0	This is the permanent, unique ID assigned to each street feature (composed of one or more segments) in the local dataset, as defined by the Data Authority. Conditional means that this data element is only required to be populated in the exchange dataset if the local data provider maintains unique Street Identifiers in addition to the unique Segment Identifiers.
RouteID	Long Integer	**Conditional** – required only if the data provider maintains this information	Optional -as an "extended attribute" Property	Can be <NULL> only if the data provider does not maintain this information. Otherwise, must be > 0	This is the permanent, unique ID assigned to each route feature (composed of one or more streets) in the local dataset, as defined by the Data Authority. Conditional means that this data element is only required to be populated in the exchange dataset if the local data provider maintains unique Route Identifiers in addition to the unique Street Identifiers.
IsOneWay	Boolean	**Conditional** – required only if the data provider	Optional -as an "extended attribute" Property	Can be <NULL> *only* if provider *does not* maintain one-way flow information.	This indicates whether the directional flow of traffic on the road segment is one-way.

<table>
<tr><td></td><td></td><td>maintains this information</td><td></td><td>If the data provider does maintain one-way traffic flow information, must be either True or False.</td><td>This information is intended to be used with routing applications.</td></tr>
<tr><td>OneWayDir</td><td>Positive Integer</td><td>Conditional

– required only if the data provider maintains this information</td><td>Optional -as an "extended attribute" Property</td><td>Can be <NULL> only if the data provider does not maintain one-way road segment information.

Valid Domain Values:

<table><tr><th>OWDir_ID</th><th>OWDir_Val</th></tr><tr><td>1</td><td>From-To</td></tr><tr><td>2</td><td>To-From</td></tr><tr><td>3</td><td>Two-Way</td></tr><tr><td>4</td><td>Exclude</td></tr></table>
If the value of "IsOneWay" = True, the value of this field may be either "From-To" or "To-From, or "Exclude"

If the value of "IsOneWay" = False, the value of this field may be either "Two-Way" or "Exclude".</td><td>This is intended to be used with network routing applications. It indicates the direction of traffic flow along the road segment.

The start and end points of the segment reflect which terminus of the segment was digitized first when the feature was initially created.

The value "From-To" means the direction of the one-way traffic flow is FROM the start point of the segment TO the end point of the segment.

The value "To-From" means the direction of the one-way traffic flow is FROM the end point of the segment TO the start point of the segment.

The value "Two-Way" indicates bi-directional traffic on the segment.

The value "Exclude" means that a segment should not be used in a routing application (such as e911), regardless of its direction of travel.</td></tr>
</table>

IsSplitGradeSeparated	Boolean	**Mandatory *** It is intended that this element be populated, en masse, during the data transformation process	Optional -as an "extended attribute" Property	Not <NULL> Default = False	This is intended to be used with network routing applications. It indicates whether a local data provider employs the best practice of splitting all street centerlines at overpasses and other multi-level interchanges so that a grade separation/elevation indicator can be applied to the end of each segment. A few NC counties do not split their centerlines at locations where there are multiple levels of roadway.
ToGradeLevel	Integer	**Conditional** – Non-Null values required only if provider splits CLs at grade separation. If the data provider does not maintain this info, this property can be auto-populated	Optional -as an "extended attribute" Property	Can be <NULL> only if the value of the element IsSplitGradeSeparated = False Default = 0 If a segment's **start** point is "at grade", meaning the segment represents a non-elevated stretch of roadway, it is considered to be at elevation level (0). If the **start** point of a segment is below grade in a sunken underpass or tunnel situation, it would be at elevation level (-1).	This is intended to be used with network routing applications. If street centerlines are split at all overpasses and other multi-level interchanges, this value indicates the level of grade separation or elevation that exists at the **start** point of the road segment. There can be multiple levels of elevation above grade level (0) in complicated highway interchanges (levels 1,2, 3, etc.) If data provider splits centerlines, but does encode the elevation level, the default value of 0 will be used.
FromGradeLevel	Integer	**Conditional** –	Optional -as an "extended	Can be <NULL> only if the value of the element	This is intended to be used with network routing applications.

<table>
<tr><td></td><td></td><td>Non-Null values required only if provider splits CLs at grade separation. If the data provider does not maintain this info, this property can be auto-populated with the default value.</td><td>attribute" Property</td><td>IsSplitGradeSeparated = False

Default = 0

If a segment's end point is "at grade", meaning the segment represents a non-elevated stretch of roadway, it is considered to be at elevation level (0). If the end point of a segment is below grade in a sunken underpass or tunnel situation, it would be at elevation level (-1).</td><td>If street centerlines are split at all overpasses and other multi-level interchanges, this value indicates the level of grade separation or elevation that exists at the end point of the road segment. There can be multiple levels of elevation above grade level (0) in complicated highway interchanges (levels 1,2, 3, etc.)

If data provider splits centerlines, but does encode the elevation level, the default value of 0 will be used.</td></tr>
<tr><td>ServiceClass</td><td>Positive Integer</td><td>Mandatory *

If the data provider does not maintain this info, it is intended that this element be populated, en masse, with the default value during the data transformation process</td><td>Optional -as an "extended attribute" Property</td><td>Not <NULL>

Default = 99
Valid Domain Values:

<table>
<tr><th>ServiceClass_ID</th><th>ServiceClass_value</th></tr>
<tr><td>1</td><td>Interstate</td></tr>
<tr><td>2</td><td>US Hwy</td></tr>
<tr><td>3</td><td>NC Hwy</td></tr>
<tr><td>4</td><td>Seconday Hwy</td></tr>
<tr><td>5</td><td>County Rd</td></tr>
<tr><td>6</td><td>Local Rd</td></tr>
<tr><td>7</td><td>Tribal Rd</td></tr>
<tr><td>8</td><td>Ramp</td></tr>
</table>
</td><td>The class or system of a road, according to the character of service it are intended to provide.

<table>
<tr><th>ServiceClass_ID</th><th>ServiceClass_value</th></tr>
<tr><td>9</td><td>Service Rd</td></tr>
<tr><td>10</td><td>4WD Trail</td></tr>
<tr><td>11</td><td>Logging / Fire Rd</td></tr>
<tr><td>12</td><td>Driveway</td></tr>
<tr><td>13</td><td>Park Rd</td></tr>
<tr><td>14</td><td>Military Rd</td></tr>
<tr><td>15</td><td>Private Rd</td></tr>
<tr><td>16</td><td>Other</td></tr>
<tr><td>99</td><td>Unclassified</td></tr>
</table>
</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

HighOrderRouteNumber	Positive Integer	**Conditional** – required only if the data provider maintains route numbers on the Primary Highway Routes in their linework and the road segment is part of a Primary Highway Route	Optional -as an "extended attribute" Property	Must be <NULL> if route numbers are not maintained. Must be <NULL> if route numbers are maintained, but this segment is *not* part of a Primary Highway Route. Otherwise, must be a positive integer reflecting the most important route number running on that segment. ex. If both I-85 and I-40 run on the same segment, 85 would be the correct value for this element.	This is to support map labeling. If route numbers are maintained AND a road segment is part of a Primary Highway Route (Interstate, US, or NC) this element will be populated with (only) the numeric portion of the Highway Route Number. In situations where multiple Primary Highway Routes run coincident on the same road segment, the number of the route with the most important status (Interstate, then US, then NC) will be used. If multiple Primary Highway routes of equal importance levels run on the same segment, the largest of those route numbers will be used.
StateRoute Number	Positive Integer	**Conditional** – required only if the provider maintains SR numbers in their linework and the segment is on a Secondary Route	Optional -as an "extended attribute" Property	Must be <NULL> if SR numbers are not maintained. Must be <NULL> if SR numbers are maintained, but this segment is *not* part of a State Secondary Highway Route. Otherwise, the value must be a number >= 1,000 and <= 50,000	This is to support map labeling. If a road segment is part of a State Secondary Highway Route, this is the (typically) 4-digit SR number assigned by the NC DOT. These SR numbers are unique only within a county. There will quite often be a State Secondary Highway Route with the same 4-digit number in a different county.

<table>
<tr>
<td>RouteClass Modifier</td>
<td>Positive Integer</td>
<td>Conditional

– required only if the provider maintains this kind of information on their linework and the segment is on a Primary Highway Route</td>
<td>Optional -as an "extended attribute" Property</td>
<td>Must be <NULL> if this information is not maintained.

Must be <NULL> if this info is maintained, but this segment is not part of a Primary Highway Route.

If a segment is on a Primary Highway Route and the data provider maintains this information, this is the valid domain of values:

<table>
<tr><th>RteMod_ID</th><th>RteMod_Value</th></tr>
<tr><td>1</td><td>Alternate Route</td></tr>
<tr><td>2</td><td>Business Route</td></tr>
<tr><td>3</td><td>Bypass Route</td></tr>
<tr><td>4</td><td>Emergency Route</td></tr>
<tr><td>5</td><td>Evacuation Route</td></tr>
<tr><td>6</td><td>Temporary Detour Route</td></tr>
<tr><td>7</td><td>Connector Route</td></tr>
<tr><td>8</td><td>Spur Route</td></tr>
<tr><td>9</td><td>Loop Route</td></tr>
<tr><td>10</td><td>Toll Route</td></tr>
</table>
</td>
<td>This element is intended to support proper automatic labeling of Primary Highway Routes that have a modifier such as Alternate or Business as part of their official designation.

This element is from the "GIS for the Nation" data model.

Note: If multiple Primary Highway Routes run concurrently on the same road segment, the Route Class Modifier assigned to the segment must be the modifier correctly associated with the DominantHighwayNumber.

For example:

If a road segment has both US 70 Bypass and NC 50 Alternate running coincidently on it, the correct RouteClassModifier value would be 3 rather than 1, because the US Route is dominant over the NC Route.

If a segment has US 19E and US 64 coincident on it, the correct value would be 99 (or None) rather than 14 (E) because 64 is a higher route number than 19.

*Note: We may need to rearrange these code values to align with whatever is currently used in the</td>
</tr>
</table>

				11 Scenic Route 12 Truck Route 13 Bus Route 14 East or E 15 West or W 16 North or N 17 South or S 18 Old 99 None	DOT universe file.
MapTextRouteName	Character String (10)	**Conditional** – required only if the provider maintains route number information on their linework and the segment is on a Primary or Secondary Highway Route Business Rules for this are rather complex.	Optional -as an "extended attribute" Property	If the segment is not part of a Primary or Secondary Highway Route (ServiceClass 1-4) –OR— this information is not maintained, the value must be <NULL> If it is an Interstate Route, the first text part = "I - " If it a US Route, the first text part is "US - " If it an NC Route, the first text part is "NC - " If it a Secondary Route, the first text part is "SR " If it is a Primary Route the second text part is the	This is to support route labeling This is a concatenation of several text strings, which are determined based on the values of other elements. (ServiceClass, Route ClassModifier, Dominant HighwayNumber, and StateRouteNumber). If it is a Primary Route and RouteClassModifier = 3, the third part = " Byp". If it is a Primary Route and RouteClassModifier = 14, the third text part = " E". If it is a Primary Route and RouteClassModifier = 15, the third text part = " W".

				DominantHighwayNumber If it is an SR Route, the second text part is the "StateRouteNumber" If it is a Primary Route and RouteClassModifier = 1, the third part = " A". If it is a Primary Route and RouteClassModifier = 2, the third part = " Bus".	If it is a Primary Route and RouteClassModifier = 16, the third text part = " N". If it is a Primary Route and RouteClassModifier = 17, the third text part = " S". If it is a Primary Route -–and-- if RouteClassModifier in (4-13,18,99) there is no third text part. If it is an SR Route, there is no third text part.
MapTextRoadName	Character String (75)	**Mandatory *** It is intended that this element be populated, en masse, during the data transformation process.	Optional -as an "extended attribute" Property	Not <NULL> The value will be a concatenated string using this formula: Proper(Trim(RoadPrefix & " " & RoadNameBody & " " & RoadType & " " & RoadPostDirectionSuffix)) *Note: even if the RoadNameBody was empty in the source dataset, the data transformation process will substitute the default "Unnamed Rd" into the RoadNameBody	This is intended to support Road Name labeling on maps. This string should be formatted in mixed-case. It is a concatenation of the various street name parts, separated by spaces and is auto-populated. The use of the Trim() function serves to eliminate any leading or trailing spaces if RoadPrefix or RoadPostDirectionalSuffix have null values. Proper() or its equivalent, depending on what scripting language is used in the data transformation tool, provides mixed case format w/ the first letter of each word capitalized

				element, so this element will never be <NULL>	and the rest lower case.
RoadPrefix	Character String (2)	**Optional**	Optional -as an "extended attribute" Property	<NULL> is allowed. Valid domain values are: "N", "E", "S", "W", "NE", "SE" "SW", "NW"	This element is a 'road name part' and supports labeling, geocoding and routing. It is a primary descriptor for geographic direction that may appear at the beginning of a road name.
RoadPrefix Alias	Character String (2)	**Optional**	Optional -as an "extended attribute" Property	<NULL> is allowed. Valid domain values are: "N", "E", "S", "W", "NE", "SE" "SW", "NW"	This element is a 'road name part' and supports labeling, geocoding and routing. It is a secondary, or alias, descriptor for geographic direction that may appear at the beginning of the road name.
RoadName Body	Character String (50)	**Mandatory ***	Optional -as an "extended attribute" Property	Not <NULL> If there is no officially designated name, the default value = "**Unnamed**" and will be auto-populated.	This element is a 'road name part' and supports labeling, geocoding and routing. This is the officially designated road name, as determined by the data provider authority.
RoadName BodyAlias	Character String (50)	**Optional**	Optional -as an "extended attribute"	<NULL> is allowed.	This element is a 'road name part' and supports labeling, geocoding and routing.

			Property		This is a commonly used road name that is not the officially designated name - an alias road name.
RoadType	Character String (4)	**Mandatory ***	Optional -as an "extended attribute" Property	Not <NULL> Valid Domain Values are only those in the standard NENA list. If RoadNameBody is not populated, or this field is not populated, the default value = " Rd" and will be auto-populated.	This element is a 'road name part' and supports labeling, geocoding and routing. This is the officially designated road type, as determined by the data provider authority.
RoadTypeAlias	Character String (4)	**Optional**	Optional -as an "extended attribute" Property	<NULL> is allowed. Valid domain values are only those in the list used by National Emergency Number Assoc. (NENA)	This element is a 'road name part' and supports labeling, geocoding and routing. This is a secondary, or alias, street type designation.
RoadPostDirectionSuffix	Character String (2)	**Optional**	Optional -as an "extended attribute" Property	<NULL> is allowed. Valid domain values are: "N", "E", "S", "W", "NE", "SE" "SW", "NW"	This element is a 'road name part' and supports labeling, geocoding and routing. A primary descriptor for geographic direction that appears at the end of the road name.

RoadPostDirectionSuffixAlias	Character String (2)	**Optional**	Optional -as an "extended attribute" Property	<NULL> is allowed. Valid domain values are: "N", "E", "S", "W", "NE", "SE" "SW", "NW"	This element is a 'road name part' and supports labeling, geocoding and routing. A secondary, or alias, descriptor for geographic direction that appears at the end of the road name.
LeftLowAddress	Integer (8)	**Conditional** - Required if the data provider maintains this information	Optional -as an "extended attribute" Property	<NULL> is allowed Otherwise, must be > 0	This element supports geocoding This is the lowest house number on the left side of the street when facing in the direction of ascending house numbers.
LeftHighAddress	Integer (8)	**Conditional** - Required if the data provider maintains this information	Optional -as an "extended attribute" Property	<NULL> is allowed Otherwise, must be > 0	This element supports geocoding This is the highest house number on the left side of the street when facing in the direction of ascending house numbers.
RightLowAddress	Integer (8)	**Conditional** - Required if the data provider maintains this information	Optional -as an "extended attribute" Property	<NULL> is allowed Otherwise, must be > 0	This element supports geocoding This is the lowest house number on the right side of the street when facing in the direction of ascending house numbers.
RightHighAddress	Integer (8)	**Conditional** - Required if	Optional -as an "extended	<NULL> is allowed	This element supports geocoding

		the data provider maintains this information	attribute" Property	Otherwise, must be > 0	This is the lowest house number on the right side of the street when facing in the direction of ascending house numbers
LeftZip	Integer (5)	**Conditional** - Required if the data provider maintains this information	Optional -as an "extended attribute" Property	<NULL> is allowed Otherwise, must be > 0 and a valid NC Zip Code number, as determined by the USPS.	This element supports geocoding The five-digit zip code on the left side of the street when facing in the direction of ascending house numbers. Note: there are no public domain (that are current and accurate) zip code boundary files that can be distributed with the data transformation tool to automatically populate this field. The local data stewarda will need to provide this information.
RightZip	Integer (5)	**Conditional** - Required if the data provider maintains this information	Optional -as an "extended attribute" Property	<NULL> is allowed Otherwise, must be > 0 and a valid NC Zip Code number, as determined by the USPS.	This element supports geocoding The five-digit zip code on the right side of the street when facing in the direction of ascending house numbers.
LeftZipPlus 4	Integer (4)	**Conditional** - Required if	Optional -as an "extended	<NULL> is allowed	This element supports geocoding

		the data provider maintains this information	attribute" Property	Otherwise, must be > 0 and a valid NC Zip+4 code, as determined by the USPS.	The additional four digits of the zip code on the left side of the street when facing in the direction of ascending house numbers.
RightZipPlus4	Integer (4)	**Conditional** - Required if the data provider maintains this information	Optional -as an "extended attribute" Property	<NULL> is allowed Otherwise, must be > 0 and a valid NC Zip+4 code, as determined by the USPS.	This element supports geocoding The additional four digits of the zip code on the right side of the street when facing in the direction of ascending house numbers.
MapTextRouteName	Character String (10)	**Conditional** – required only if the provider maintains route number information on their linework and the segment is on a Primary or Secondary Highway Route Business Rules for this are rather	Optional -as an "extended attribute" Property	If the segment is not part of a Primary or Secondary Highway Route (ServiceClass 1-4) –OR— this information is not maintained, the value must be <NULL> If it is an Interstate Route, the first text part = "I - " If it a US Route, the first text part is "US - " If it an NC Route, the first text part is "NC - " If it a Secondary Route, the first text part is "SR "	This is to support route labeling This is a concatenation of several text strings, which are determined based on the values of other elements. (ServiceClass, Route ClassModifier, Dominant HighwayNumber, and StateRouteNumber). If it is a Primary Route and RouteClassModifier = 3, the third part = " Byp". If it is a Primary Route and RouteClassModifier = 14, the third text part = " E". If it is a Primary Route and

		complex.		If it is a Primary Route the second text part is the DominantHighwayNumber If it is an SR Route, the second text part is the "StateRouteNumber" If it is a Primary Route and RouteClassModifier = 1, the third part = " A". If it is a Primary Route and RouteClassModifier = 2, the third part = " Bus".	RouteClassModifier = 15, the third text part = " W". If it is a Primary Route and RouteClassModifier = 16, the third text part = " N". If it is a Primary Route and RouteClassModifier = 17, the third text part = " S". If it is a Primary Route -–and-- if RouteClassModifier in (4-13,18,99) there is no third text part. If it is an SR Route, there is no third text part.
MapTextRoadName	Character String (75)	**Mandatory *** It is intended that this element be populated, en masse, during the data transformation process.	Optional -as an "extended attribute" Property	Not <NULL> The value will be a concatenated string using this formula: Proper(Trim(RoadPrefix & " " & RoadNameBody & " " & RoadType & " " & RoadPostDirectionSuffix)) *Note: even if the RoadNameBody was empty in the source dataset, the data transformation process will substitute the	This is intended to support Road Name labeling on maps. This string should be formatted in mixed-case. It is a concatenation of the various street name parts, separated by spaces and is auto-populated. The use of the Trim() function serves to eliminate any leading or trailing spaces if RoadPrefix or RoadPostDirectionalSuffix have null values. Proper() or its equivalent, depending on what scripting language is used in the data transformation tool,

				default "Unnamed Rd" into the RoadNameBody element, so this element will never be <NULL>	provides mixed case format w/ the first letter of each word capitalized and the rest lower case.
InPriorityUrbanArea	Boolean	**Mandatory *** It is intended that this element will be populated, en masse, at the time of data transformation, using the 2000 Census Urbanized Area Boundaries for NC	Optional -as an "extended attribute" Property	No <NULLS> Note: Urbanized Area Boundaries for NC, will need to be distributed with the data transformation tool in order to auto-populate this element. This function will need the ability for the data provider to supply 2010 Census Urbanized Area Boundaries, when they become available.	This element supports the efforts of the USGS & the US Census Bureau to prioritize integrating local data in important urbanized areas into a National Map Transportation layer product. This indicates if the road segment is within one of the USGS's "Urban Priority Areas", as defined by "area3" or "cluster4" as delineated by the 2000 Census. Road Segments crossing a boundary would be classified as In or Out according to which side claimed the greatest length of roadway.
CFCC_Code	Character String (3)	**Mandatory *** This will be auto-populated if the data provider does not know or maintain this type of information.	Optional -as an "extended attribute" Property	Not <NULL> Default = "X00", or " Not yet classified" Valid Domain Values: Must be a valid Census CFCC Code. If anything other than "X00" is used, the first character must be "A", as this is the prefix for all types of road features.	This element supports the efforts of the USGS & the US Census to more easily integrate local data into the Tiger product. It is the Census Bureau's Census Feature Class Code (CFCC), as used with TIGER data to provide information on the classification of a feature. It is recognized that most local data providers will not maintain this information, but is anticipated that

<table>
<tr><td></td><td></td><td></td><td></td><td>Refer to this official code list:

www.census.gov/geo/www/tiger/appendxe.asc</td><td>as local data is integrated with DOT centerlines at the State level, this element can become more accurately populated.</td></tr>
<tr><td>RouteCostSpeed</td><td>Integer(2)

* this assumes that no speed > 99 mph can be used.</td><td>Mandatory *

This will be auto-populated if the data provider does not know or maintain this information.</td><td>Optional -as an "extended attribute" Property</td><td>Can be <NULL>

Default Value = <NULL>

If not <NULL> must be >= 0</td><td>This element supports network routing functions.

This is not the posted speed limit - it is the "approximate travel speed" that is assigned to a road segment - specifically to help calculate the overall "Route Cost" (partially dependent on time) in network routing operations.</td></tr>
<tr><td>RoadMaintenance Authority</td><td>Integer (1)</td><td>Mandatory *

This can be auto-populated if the data provider does maintain this information as an attribute in their centerline data.</td><td>Optional -as an "extended attribute" Property</td><td>Not <NULL>
Valid Domain Values:

<table><tr><th>MaintAuthority_ID</th><th>MaintAuthority_Val</th></tr><tr><td>1</td><td>State</td></tr><tr><td>2</td><td>Municipal</td></tr><tr><td>3</td><td>County</td></tr><tr><td>4</td><td>Private</td></tr><tr><td>5</td><td>Federal</td></tr><tr><td>6</td><td>Tribal</td></tr><tr><td>7</td><td>Other</td></tr></table></td><td>This indicates what Type of Entity actually maintains the physical roadway, rather than the GIS data, as it may sometimes differ from the Entity that maintains the street centerline GIS dataset.</td></tr>
<tr><td>DataMaintenance Authority</td><td>Character String (50)</td><td>Mandatory *

This can be</td><td>Optional -as an "extended attribute"</td><td>Not <NULL></td><td>This is the full text name of the Entity that creates & maintains the source data.</td></tr>
</table>

<table>
<tr><td></td><td></td><td>auto-populated en masse.</td><td>Property</td><td></td><td>This element supports the ability to determine, at the feature level, who the provider is, when data from many local providers is aggregated into a regional or statewide dataset.</td></tr>
<tr><td>IsCollected WithGPS</td><td>Boolean</td><td>Mandatory *

This can be auto-populated data provider does maintain this information</td><td>Optional -as an "extended attribute" Property</td><td>Not <NULL>

Default = False</td><td>Indicates whether a street centerline has been collected in the field by driving the road and collecting the vehicle position with GPS.</td></tr>
<tr><td>GPSMethod</td><td>Integer (1)</td><td>Conditional – Required if the value of "IsCollectedWithGPS" = True</td><td>Optional -as an "extended attribute" Property</td><td>Must be <NULL> if "IsCollectedWithGPS" = False

Otherwise, Valid Domain =
<table><tr><th>GPSMethod_ID</th><th>GPSMethod_Value</th></tr><tr><td>1</td><td>Uncorrected Recreational / Navigational Grade (WAAS only)</td></tr><tr><td>2</td><td>Corrected Recreational / Navigational Grade</td></tr><tr><td>3</td><td>Uncorrected Mapping Grade (WAAS</td></tr></table></td><td>This element is intended to give the user an indication of the level of accuracy of centerline data collected using GPS Technology.

Common Recreational / Navigational Grade GPS Receivers include Garmin and Magellan. Only a few receivers of this class support the ability to differentially correct the GPS data, and accuracy varies widely, but is in the 10-30 m range. Many receivers in this class do have the ability to apply a less accurate method of correction using WAAS signals from the FAA system.

Mapping Grade GPS receivers include professional models such as those from Trimble, Geneq, Thales</td></tr>
</table>

				<table><tr><td></td><td>only)</td></tr><tr><td>4</td><td>Corrected Mapping Grade</td></tr><tr><td>5</td><td>Survey Grade</td></tr><tr><td>6</td><td>Unknown</td></tr></table>	that can get accuracies (corrected) of less than 5m. Higher end models can accomplish sub-foot. Survey Grade provides sub-centimeter accuracy and the data is always corrected. Not very likely to be used to collect centerlines.
NativeData Format	Character String (30)	**Mandatory** Every data provider *will* know this information. This element is intended to be populated en masse during the data transformation process	Optional -as an "extended attribute" Property	Not <NULL> Common spatial data format examples include: ESRI Shapefile, ESRI Coverage, ESRI File Geodatabase, ESRI Personal Geodatabase, ESRI Enterprise Geodatabase, AutoCad DWG or DXF, MapInfo MIF or TAB, Microstation DGN, Caliper CDF, Sungard/USI GeoBlocks	This element indicates the GIS or CAD data format that the source centerlines are maintained in by the data provider. Note: This *may* not be the same format input to the data transformation process. For proprietary formats that have no open translators, the source data may need to be converted to an intermediate format for which open translators do exist. And example of this is converting an ESRI File Geodatabase to an ESRI Shapefile format. This information provides some indication of the potential loss of un-translatable properties that may be present in the native data source.
NativeCRS	Integer (6)	**Mandatory** * This element	Optional -as an "extended attribute"	Not <NULL> Must be a valid EPGS code,	This is the native Coordinate Reference System (CRS) the source data is maintained in, represented

<table>
<tr><td></td><td></td><td>is intended to be populated en masse during the data transformation process</td><td>Property</td><td>and valid for NC data.

ex: NC State Plane, NAD83 Meters = 32119

NC State Plane, NAD83 US Survey Feet = 2264</td><td>with its EPSG code

The complete list of valid EPSG codes may be found at:

www.spatialreference.org</td></tr>
<tr><td>MinimumAccuracy</td><td>Integer (1)

If the data provider does not maintain this info at the feature level, this element is intended to be populated en masse during the data transformation process</td><td>Mandatory *

If the data provider does not maintain this info at the feature level, especially in datasets where features may have sources, data provider should test their data w/ the NSDDA methodology to determine its general accuracy.</td><td>Optional -as an "extended attribute" Property</td><td>Not <NULL>

Valid Domain Values:

<table><tr><th>MinAcc_ID</th><th>MinAcc_Val</th></tr><tr><td>1</td><td><= 4.68 m</td></tr><tr><td>2</td><td>4.69 m – 13.90 m</td></tr><tr><td>3</td><td>> 13.90 m</td></tr><tr><td>4</td><td>Unknown</td></tr></table>
Note: FGDC desires centerlines in the Priority Urban Areas that meet or exceed the 4.68 m horizontal accuracy level.

All other centerlines should meet or exceed the 13.90 m horizontal accuracy level.

The use of "Unknown" is strongly discouraged.</td><td>This is positional horizontal accuracy of the source centerline data, in units of meters.

This element supports the efforts of the USGS & FGDC to prioritize the integration of local and state centerline data into a National Map Transportation layer product.

For horizontal accuracies (95% confidence level), per USGS National Map Accuracy Standards:

4.68 m is commensurate with 1:4,800-scale mapping.

13.90 m is commensurate with 1:24,000-scale mapping.

For NSSDA test methodology information, refer to: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/index_html</td></tr>
</table>

MinCurrencyMonths	Integer (3)	**Mandatory *** If the data provider does not maintain a currency date at the feature level, then this element is intended to be populated en masse with a best estimate during the data transformation process	Optional -as an "extended attribute" Property	Not <NULL> Must be > 0 Units of measure for this element are "*number of months*" as a whole number. Data Providers *should* know how current their data is, so the option of an "Unknown" value is not warranted. The data provider is to enter their best estimate of the general currency level of their dataset, as a whole.	This element supports the efforts of the USGS & FGDC to prioritize the integration of local and state centerline data into a National Map Transportation layer product. The FGDC prefers currency to be within the last 2 years, or better. Estimated currency of the data at the date of service initiation; that is, the data served reflects the ground condition sometime during the two years prior to the sharing of the data to State or Federal integrators/aggregators. This element is included in the "GIS for the Nation" data model, which FGDC considers a "best practice".
DistributionPolicy	Integer (1)	**Mandatory *** This element is intended to be populated en masse during the data transformation process. Local Data Providers *should* know	Optional -as an "extended attribute" property	Not <NULL> Valid Domain Values:	This element supports the efforts of the USGS & FGDC to more easily manage the integration of local and state centerline data into a National Map Transportation layer product. This element is included in the "GIS for the Nation" data model, which FGDC considers a "best practice". However, that model has 20 different distribution policy types, which is a bit excessive for NC. This

		what their data distribution policy is, so therefore a value of "Unknown" is not included.			is a consolidated version with 9 different distribution policy types. Policy #1 is the least restrictive. Policies #2-#7 are increasing in their restrictiveness. Policy #8 is the most restrictive. Policy #9 is a catch-all for policies that may exist which bear no resemblance to any of the Policies listed in #1 - #8.

DistPol_ID	DistPol_Val	DistPol_ID	DistPol_Val	DistPol_ID	DistPol_Val
1	Everyone can have free access to the data, and can do whatever they want to with the data.	4	Only Gov Agency, NGO and Other Public Institution Employees may have free access to and use of the data. They may not resell it, use it to create other commercial products, or redistribute it in *any* form. The Private Sector may have access to the data for their own internal use, for a reasonable cost recovery fee. The Private Sector may not resell the data, use it to create other commercial products, or redistribute it in *any* form.	7	Only Gov Agency Employees may have free access to and use of the data for their own internal purposes.. They may not resell the data, use it to create other derivative products, or redistribute it in *any* form.

2	Everyone may have free access to and use of the data for their own internal purposes. No one other than the data authority may resell the data, use it to create other derivative products, or redistribute it in *any* form.	5	Only Gov Agency, NGO and Other Public Institution Employees may have free access to and use of the data for their own internal purposes.. They may not resell the data, use it to create other derivative products, or redistribute it in *any* form. The Private Sector may have access to the data for a reasonable cost recovery fee. The Private Sector may not resell the data or redistribute it in its *native* form, but they may use it to create other commercial products if they add substantial value.	8	Only Gov Agency Employees may have free access to the data for their own internal purposes. They may not resell the data, use it to create other derivative products, or redistribute it in its *native* form. They *may* integrate it into other public domain datasets at the state or federal level, with permission of the data provider.
3	Everyone may have free access to and use of the data for their own internal purposes. No one other than the data authority may resell the data or redistribute it in its *native* form, but it may used to create other derivative products, if substantial value is added.	6	Only Gov Agency, NGO and Other Public Institution Employees may have free access to and use of the data for their own internal purposes. They may not resell it, use it to create other derivative products, or redistribute it in *any* form.	9	Other – there is a data distribution policy, but it non-standard and differs quite substantially from policy types 1-8.