TxDOT GIS Deliverable Standards

GIS Data and Applications Committee

November 2024

Texas Department of Transportation

Contents

Introduction

This document includes instructions for TxDOT consultants submitting data deliverables to TxDOT.

General Guidance

This document provides general guidance for the creation, delivery, and utilization of geospatial data and products within TxDOT. Adherence to these standards ensures data consistency, quality, and interoperability, supporting effective decision-making and resource management.

It is highly recommended that consultants meet with TxDOT staff ahead of any data collection or production in order to ensure full compliance with this standard in a way that meets the needs of the agency.

This standard applies to spatial data in all formats, including:

- GIS
- CAD
- Imagery
- Tabular Data
- Code and Programming Data
- Web maps and Applications

Data Transfer and Ownership

All digital deliverables should be packaged and delivered in a secure, organized manner, using a format specified by TxDOT for the project.

- The consultant will transfer ownership of all digital deliverables to TxDOT upon final acceptance of the project.
- The consultant will provide TxDOT with access to all data and information necessary to maintain and update GIS products after delivery.

GIS Deliverables

All geospatial data deliverables must adhere to established TxDOT standards for data formats, coordinate systems, and metadata. (Add relevant links to documents that specify said formats, coordinate systems, and metadata) Recipients of geospatial data should conduct rigorous quality control checks to ensure data accuracy and completeness. Timely communication and feedback between data providers and recipients are critical for resolving data-related issues and improving future deliveries. Please remember consultant contracts are time sensitive.

TxDOT Account Access

To access and utilize agency GIS systems and create GIS deliverables, consultants must submit a formal request for an agency account. The request should outline the specific GIS tools and resources required to fulfill job responsibilities. Upon approval, users will be granted appropriate access privileges and provided necessary training to uphold TxDOT publishing standards.

Please refer to the **Data Integration Companion Guide** for TxDOT Account Access request procedures and data deliverable integration processes.

The TxDOT Data Integration Companion Guide includes:

- TxDOT Consultant Access Request Form
- Example ArcPro Project and Map Files: .aprx, .mapx
- Example ArcPro Packages: .ppkx

Digital Deliverables

Digital deliverables require specific standards and guidelines for the creation, format, and delivery of GIS products. These standards ensure consistency, quality, and interoperability of GIS data products within the agency's broader data management framework. By adhering to these standards, we aim to optimize data sharing, analysis, and decision-making processes.

The following sections will detail requirements for data formats, coordinate systems, metadata, quality control, and delivery methods. Additionally, specific guidelines will be provided for the creation and delivery of common GIS deliverables such as web maps, applications, and story maps.

ESRI ArcGIS Deliverables

Consultants are required to deliver all GIS products in a digital format compatible with TxDOT's geospatial environment. Specific digital deliverables shall include, but are not limited to:

- Web Maps
- Web Applications

- Story Maps
- Geodatabases
- Shapefiles
- Raster Data
- Metadata

Code and Resource Deliverables

Delivery, management, and sharing of code, scripts, queries, and other programing resources used in the development of agency digital products include, but are not limited to:

- Code Repositories: All code for agency digital products shall be managed in a centralized code repository. Access to TxDOT's Git Hub can be requested via:
  - TPP_GIS@txdot.gov for TPP Git Hub Repository
  - GIS@txdot.gov for GIM GeoLab
- Version Control: All code must be version controlled to track changes and facilitate collaboration.
- Code Templates: Standardized code templates shall be provided for common development tasks to ensure consistency and efficiency.
- Code Documentation: All code must be adequately commented to explain its purpose, functionality, and usage.
- Code Reviews. Code reviews shall be conducted to ensure quality, adherence to standards and best practices.
- Code Sharing: Mechanisms for sharing code snippets, queries, and other reusable code components shall be established (e.g., internal code libraries, knowledge bases) on a project-by-project basis.
- Intellectual Property: All code developed for agency digital products is the property of TxDOT and subject to copyright protection.

Data and Metadata Standards

Adherence to standardized data formats, coordinate systems, and attribute structures ensures data consistency and interoperability across the agency. Comprehensive metadata accompanying datasets provides essential information for understanding, locating, and using data effectively.

Geospatial Data Formats

All geospatial data submitted to TxDOT must adhere to the following format standards:

- Vector Data: Comma-Separated Values (.CSV), File Geodatabase (.gdb), and GeoJSON are the preferred formats. Other vector formats may be considered on a case-by-case basis with prior approval.
- Raster Data: TIFF, GeoTIFF, Image (img), or SID. Other raster formats may be considered on a case-by-case basis.

- ArcPro Data: Geodatabases (.gdb), Layer Files (.lyrx), Toolboxes (.tbx), Packages (.ppkx, .mmpl), Scene Layers (.slpk) Tile Packages (.tpk)
- CAD Data: Please see TxDOT Surveyors Tool Kit and TxDOT Digital Delivery Specifications
- Code and Resource Data: Programming code (Python, JavaScript, C#, etc), notebooks (annotated), configuration files, scripts, libraries, modules

Coordinate Systems and Projections

All spatially enabled files must include spatial reference information for accurate spatial analysis and data integration within the agency. Adherence to these standards assures seamless data sharing and compatibility across different departments and projects.

- Coordinate Systems
    a. A coordinate system must be defined
    b. The coordinate system definition must be embedded or associated with the file
    c. Must use a common coordinate system definition (no local systems)
        i. TxDOT standard coordinate system is preferred: NAD_1983_Texas Statewide_Mapping_System
        ii. WGS84 Web Mercator is preferred for ArcGIS Online environments.
    d. All submitted data must use the same coordinate system unless the project needs dictate otherwise and the TxDOT staff is aware.
    e. Tabular data must include latitude and longitude fields in decimal degrees (WGS84)

Metadata Standards

Comprehensive metadata must be provided for all geospatial datasets submitted to TxDOT. Metadata must adhere to the TxDOT Metadata Standards attached as Appendix A with a minimum of the following:

- Dataset identification information (Title, Abstract, Purpose, Keywords)
- Data quality information (accuracy, precision, lineage, constraints)
- Spatial reference information (coordinate system, projection, extent)
- Entity and attribute information (attribute definitions, domains, relationships)
- Data sources with attribution
- Distribution information (format, size, access constraints)
- Metadata contact information
- User instructions
- Data dictionary
- Clear and concise documentation for all digital deliverables

Attribute Standards

Standardized attribute naming conventions, data types, and units enhance data clarity and compatibility within TxDOT. Adhering to attribute standards facilitates data analysis, integration, and the creation of accurate and reliable information products.

Mapping Templates

TPP Division regularly uses mapping templates for most map requests, and many of our map products conform to the general style set forth in the templates. Two example templates are available at the TxDOT GIS Users Site. (add link) These templates are provided as an optional method for building map products. They are not required. If the TxDOT map templates are used, some changes will need to be made:

- **Marginal Information** : Date, Creator, Attribution, Sources, Copyright, Title. Subject to map purpose.
- **Source Layers:** The map templates are designed to work with many of the datasets published by TxDOT and available on the TxDOT Open Data Portal.
- Some layers will not be needed for all map products and should be removed accordingly.
- **Map Series:** Ensure that if there are multiple maps showing the same background or area of interest, all maps elements are consistent including Font, map element placement, labeling, etc., If the only thing changing between maps in a series is the subject. all other mapping elements should be identical.
- Multiple maps that are not in a series, but are being made for a single deliverable, should all have the same marginal information, style, formatting, font, color schemes etc. This is especially important when there are multiple contractors working on a single deliverable.
- **Spacing:** Header and Footer items are evenly spaced from the edges and the border.
- **Spelling:** All labels, title and legend items are spelled correctly.
- **Labeling:** Ensure that all major roadways and map subjects are labeled appropriately.
- Audience: Consider the audience and the format the maps will be viewed in. If the map is going to be part of a smaller inset in a larger page of text, then the map should not contain lots of labels in small font, or highly detailed analysis.
- Image Scaling: In general, maps should be made to the appropriate size given the requirements of the map's purpose. If you are scaling a map up or down by more than 50% to make it fit on a page for a document, then the map needs to be edited to fit the context it is being displayed in.
- **Legend:** Ensure that the legend colors and text match the subject data and purpose of the map.

Authoritative Data Sources

Identifying and prioritizing authoritative data sources is essential for maintaining data quality and accuracy with TxDOT. Guidelines for accessing, utilizing, and updating these data sources will ensure consistency and reliability across all agency projects.

1. TxDOT Open Data Portal

   The TxDOT Open Data Portal is the agency's platform for exploring and downloading official TxDOT GIS datasets. The portal allows users to view datasets on a map, filter data using queries, and download data in various formats. Please reference this

platform for all official TxDOT asset, boundary, infrastructure, and traffic data as well as planning, performance, and project information.

TxDOT Open Data Portal

2. GIS Data Dictionary
   The TxDOT Data Dictionary provides a comprehensive interface for understanding commonly used terms, field names, and abbreviations used in TxDOT datasets. Information areas included are: Owner, Projection, Layer Count, Item ID, Fields, Hyperlink to Dataset, Hyperlink to Rest Service, Hyperlink to Open Data Portal Location.

   TxDOT GIS Data Dictionary

   A comprehensive attribute data dictionary must be provided for each dataset, describing each field, its data type, units, and any relevant codes or values.

Division Schemas

GIS data schemas are available for the following divisions:

- Right of Way: Parcel Submissions

For Local Government Entities

Local government entities are encouraged to provide road network updates to TxDOT for the purpose of inclusion in our network and ultimately for reporting to the Federal Highway Administration. Updates to our database must pass rigorous data quality checks. Preparing your data properly will facilitate the loading of your roads into our network.

Please contact us before proceeding with these updates, so that we may coordinate on the best practices for sharing your data.

Contact Info:TPP-GIS@txdot.gov 512-486-5052

Below is a list of considerations for preparing data, including the kinds of data quality checks that must pass before the data can be loaded into our system.

- Schema: we can provide you with a schema into which to load your data, which will facilitate and expedite the process.
- Attributes: common errors in attributes, such as misspellings, missing or repeated road name suffixes (Main St St), improper abbreviations etc. must be addressed before we can import your data.
- Ensuring that your data does not contain these sorts of errors will facilitate the process. We may be able to provide validation tools to check for these before submitting your data.

- Any translations between TxDOT's four linear referencing methods should be processed with the Enterprise Linear Referencing Service API:[TxDOT eLRS]

    - Below is a list of example fields (these are not the exact field names: we will provide an empty dataset to you with the proper schema):
    - Street Name (fully concatenated, e.g. N. 21st St)
    - Prefix (e.g. N.)
    - Name/Number (e.g. 21st)
    - Suffix (e.g. St.)
    - Ownership (e.g. state, local, or private)
    - Paved/Unpaved
    - Pavement Type
    - Number of Lanes
    - Direction (e.g. one-way or two-way)
    - Geometry: there are several geometry errors that will cause errors upon loading. Below are some considerations for preparing your data.
    - The network should not contain curves, excessive dangles, self-intersecting lines (lollipops), etc.
    - Routes should be dissolved rather than broken at attribute changes and/or intersections.
    - Tools: we may be able to provide some tools for preparing your data, which will speed up the process of validating and loading into our system. Please contact us before proceeding so that we can discuss a strategy that will be most efficient.

Linear Referencing Data

Linear Referencing Data

- Source geometric layer used for referencing must be documented. If source layer is not TxDOT Roadways, source input layer must be included.
- Required fields
    - Route in TxDOT Format (i.e. IH0035-KG, FM0235, 123AA1234, 123456)
    - From Measure and to measure in miles to the thousandth (0.000)
    - Any attributes being placed on the line work

RTE_NM *	FRM_DFO	TO_DFO	SPD_MAX	NUM_LANES
US0290-KG	14.499	14.508	75	2
US0290-KG	14.508	14.536	75	4
US0290-KG	14.536	14.65	75	3

[TxDOT Enterprise Linear Referencing System]

Appendix A:

Versioning

Date	Comments
3/28/2014	Created
7/21/2014	Updated to include a link to the TxDOT Survey Manual
8/15/2014	Updated to include information on Linear Reference Data and Updated Map Deliverables
5/5/2015	Updated to include Metadata SOP
1/24/2016	Update to include ArcGIS version requirements and added discussion of the use of map packages
3/2/2016	Updated to add guidelines for local government agencies submitting local street data
10/1/2016	Updated to add guidelines for local government agencies submitting local street data
4/17/2019	Updated to adding Mapping Guidelines and general editing and cleanup
1/20/2023	Updated to include current guidelines, standards, and requirements
8/5/2024	Updated to include new agency branding template, data transfer guidance, digital deliverable standards, and updated metadata standards
11/6/2024	Revised to include committee comments and revisions