# Vermont Agency of Transportation
# Town Highway Maps - Purpose and Production

Policy & Planning - Mapping Unit
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**What is the purpose of the maps and why do they contain the information they do?**

The town highway maps (titled General Highway Map on the actual maps) are generated in response to requirements outlined in the Vermont State Statutes which specifically direct the Vermont Agency of Transportation that it will "provide each town with a map of all of the highways in that town together with the mileage of each class 1, 2, and 3 highway and such other information as the agency deems appropriate." [19 V.S.A. § 305(g)]

The maps and the information they contain are closely related to another product of the Agency, the Certificate of Highway Mileage. These certificates are the "sworn statements" referred to in State Statute:

> "Annually, on or before February 10, the selectboard shall file with the town clerk a sworn statement of the description and measurements of all class 1, 2, 3, and 4 town highways and trails then in existence ... " [19 V.S.A. § 305(b)]

By early January of each year, the Mapping Unit generates and mails a certificate for each town, city, village, unorganized town, and gore in the state. The mileage numbers contained in the certificate are the mileages on file with the Agency from the previous year's certificate. The municipalities are directed to return the certificates by February 20.
(An example of the certificate can be found on page 14-7 in the "Handbook for Local Officials" at http://www.aot.state.vt.us/maint/OrangeBook.htm. [2])

The town can report that either no changes occurred, or it can record on the certificate what changes occurred and include with the certificate supporting documentation describing the changes.

There are two key pieces of information contained in the certificate. The first is the mileage distribution of each highway class. This is essential for the formula for state aid distribution. [19 V.S.A. § 306]

The mileage information is reviewed and compiled, and then is forwarded to the Agency's Division of Finance and Administration. The result of this process is the distribution of about $25,000,000 in reimbursement funds to the towns based on the mileage information contained in the certificates. The amount of distribution ranges from about $1,800 for Buel's Gore to $260,000 for Burlington. [3]

The other key piece of information contained in the certificate is the documentation of the town highway changes. This documentation includes surveys, descriptions, sketch maps, selectboard meeting minutes, and certificates of completion and opening. These changes prompt the generation of a town highway map.

**How are the Maps Generated ?**

The maps are generated by the Mapping Unit of the Vermont Agency of Transportation. The software used is ESRI's ArcMap (with the ArcInfo license) and the Production Line Tool Set (PLTS, an ESRI extension product). [4]

The data layers are housed in ESRI ArcSDE [4] integrated with Microsoft SQL Server and are simultaneously accessed by the multiple users in the Mapping Unit. The data layers extend statewide and include the following:

| Data Layer | Type | Notes |
|---|---|---|
| airports | polys and points | |
| counties | polys and arcs | |
| conspub | polys | With contiguous entities dissolved, but split by town. |
| ferry routes | arcs | |
| nodetick_points | points | Road class division markers. |
| shields_arc | arcs | The arcs for the leaders of the highway shields. |
| shields_points | points | The points for the highway shields with Maplex labeling reading the route number from the RTNO attribute of the point. |
| railroads | arcs | Split by towns. |
| **rdsmall_arc** | arcs | The road centerline data layer. This is later exported as TransRoad_RDS and distributed by VCGI. |
| townindex | polys and arcs | A modified bndhash data layer. |
| transtruc | points | Structures: bridges and culverts |
| water | polys and arcs | A modified version of dlgsw |

| Annotation Layer | Reference Scale | Notes |
|---|---|---|
| boundary | 6,000 - 31,680 | The boundary annotation for each town. |
| FAU | 6,000 | The Federal Aid route identifier. Used in the city, village, and urban compact maps instead of displaying this data through Maplex labeling. |
| major | 31,680 | Identifies major features not covered by the other annotation layers. |
| mileage | 6,000 - 31,680 | The annotation for the official map AOT mileage. |
| roadnames | 6,000 | Contains road names used in city, village, and urban compact maps. |
| water | 31,680 | Names of water bodies. |
| major and water | 6,000 | This contains the annotation for both Major features and Water features. There are so few they were lumped together into one feature class. |

Prior to January 2005, the town highway maps were generated from workstation ArcInfo 7.x software. On February 2, 2005, the server running the program crashed and the Mapping Unit was faced with the choice of trying to resurrect the older technology or to take the opportunity to

advance to current technology. We chose to convert our mapping process over to ArcMap 8.x with SQL and SDE, and now, more recently, to 9.x.

Prior to the server crash, the data had been copied and stored on a network server, so we were able to resume using the existing data. We just needed to figure out how to generate the maps using current software.

ROAD CENTERLINE DATA LAYER

One of the first questions we had was: which road centerline data layer should we use? Two road centerline data layers were used when the maps were produced in ArcInfo 7.x. One was a "cartoon" layer in which the data was allowed to be spatially manipulated for cartographic reasons. The other road centerline data layer (rdsmall) was intended to be the spatially accurate layer. It was this other layer that was exported to VCGI and distributed as TransRoad_RDS.

The problem was that a disconnect occurred between the layers. The in-house focus was on the cartoon layer because the town highway maps were generated from this data layer. The spatial layer was considered an "also-ran" layer and did not receive the same level of attention as the cartoon layer. This resulted in some amount of double-entry of data. Because of the focus on the cartoon layer and the use of this layer for the production of the town highway maps, errors in rdsmall were not as readily noticed by the Mapping Unit.

We decided, as part of our conversion to current technology, to drop the use of the cartoon layer and to focus our effort on one road centerline layer (rdsmall). This has allowed us to focus on improving the quality of this data layer. By using this layer directly to generate the town highway maps, it has been easier for us to notice and fix errors and other problems. We are also working on improving its spatial accuracy.

Unfortunately, we are not able to completely avoid "cartooning" road features. There are instances in various towns where a strict use of the spatially accurate layer creates an unreadable map. In those cases, we have a layer of alternate geometry which contains only the specific arcs which need to be displayed in a non-spatially accurate (but more readable) way. We "undisplay" the spatially accurate arcs, and have the alternate road arcs draw instead.

PLTS

First, we tried the MPS Atlas feature of PLTS, but found the platform too unstable for our use. The key feature of MPS Atlas its ability to simultaneously produce many identical maps in which only the map extent is changed from sheet to sheet. MPS Atlas is similar to the Map Book Developer Sample, but is far more robust. Although, we try to produce a consistent set of maps from town to town, each map is not identical. The main differences between the maps are the mileage reports and the number of insets on the sheet. These differences force each of these town maps to become "unlinked" and the benefit of using MPS Atlas is diminished. Also, the response time of the MPS Atlas product was slowed considerably when trying to use an atlas size of 319 map sheets (our total number of town maps).

We ended up producing a separate mxd for each town, city, village, and urban compact. At the beginning of our process, we created a master town map and then spawned off a map for each town as it was needed.

Although we have found the MPS Atlas portion of the PLTS product unhelpful, the editing portion is extremely helpful. Its editing environment is designed for users who perform editing

tasks on more than a casual basis. An important feature for us of PLTS is its Dangle and Pseudo Node Renderer Tool. It is a critical tool for insuring connectivity of our road centerline network. ArcMap doesn't provide the ability to draw node errors like ArcEdit did, causing questions of arc connectivity. PLTS node renderer solves this.

MAPLEX

We looked into using the Maplex feature of 9.x, but it does not offer the amount of control for the labeling that we need. We have returned to relying heavily on annotation. Much of this annotation was converted out of the old coverages used in the ArcInfo 7.x application. Currently, the only feature set on which we use Maplex labeling is the bridge data layer, and we are considering changing over to using feature-linked annotation for this.

SCALE

Most of the town maps are produced at a scale of 1:31,680 (1 inch = 0.5 miles). A recurring debate we have in the Mapping Unit is whether we should open up the scale of the maps to something like 1:25,344 (1 inch = 0.4 miles). The resulting decision from these debates is that they should remain at 1:31,680. Remaining at this scale provides continuity with previous maps, and a consistency of product. Exceptions have been made for those maps for which a 1:31,680 scale map would require an excessive number of insets.

The maps for cities, villages, and urban compacts are generally at scales ranging from 1:3,168 (1 inch = 0.05 miles) to 1:6,336 (1 inch = 0.10 miles), but, there are exceptions for various cities and villages, as needed.

MUNICIPAL ENTITIES

Cities and villages represent distinct political entities. Urban compacts can be considered as "glorified insets". These are areas within towns that are not political subdivisions, but resemble cities or villages in their density of population and development. Their boundaries were defined by the Agency of Transportation. The Mapping Unit has these original descriptions on file.

DISTRIBUTION

Historically, the maps have been monochromatic. The Mapping Unit plans to continue this tradition. After a town's map has been approved by the Database Administrator as being "final", it is placed in the Unit's town file. This master print has been printed off a plotter. After this master plot is produced, the Unit still needs to produce one copy for each Transportation District and three copies for each town – one for to the town clerk, one for the road commissioner, and one for the selectboard.

Currently, the most efficient way to generate these copies is for the Mapping Unit to produce a tiff image of the map. This is stored on a shared network drive on the Agency's computer system. The Reprographics Department of the Agency of Transportation then accesses this image and prints the map using their industrial-strength, high-volume, large-size copier/printer.

In recent years, we have distributed, by paper copy, only the new maps we have created in response to the changes prompted by the year's mileage certificate. For example, in 2005, 50 towns reported changes, and the Unit generated and distributed 57 maps. In 2006, 55 towns reported changes, and the Unit produced 60 maps. Because of Act 178, the number of towns reporting changes in 2007 increased to 94, and we are currently working on producing 99 maps in response.

This means that in 2005, 228 paper copies had to be produced (4 x 57 maps). In 2006, 240 copies. In 2007, almost 400 paper copies will need to be produced. The most practical way to produce these copies is through the services of the Reprographics Department at the Agency and to keep the maps monochromatic.

There could be some debate about whether the process should go completely digital, but paper remains the most stable medium, and it remains important for the towns, districts, and the Agency to be able to maintain a current and historical record of the public highways in the towns of Vermont. Previously, the map copies were produced through the blueprint process. Even though we make the maps available through the Internet, this only transfers the generation of the paper copies to the towns who are less capable of generating the maps for their files as needed. It is more efficient to use the Agency's print production resources.

WEB PRODUCTION

The town highway maps for the most current production year are also available though the web at:
http://www.aot.state.vt.us/Planning/mapgis/town_maps1.htm

Although it is possible to generate a pdf of the town map directly from the ArcMap software, we generate pdfs from the tiff files which were produced for the Reprographics Department. We are able to produce smaller file sizes this way.

Some of town names in the drop down town list on the above-mentioned web page contain a note that they were generated in pdf. These maps are ones that were generated after January 2005. The road linework was generated directly from the rdsmall data layer (TransRoad_RDS). The town names without a (PDF) note, were created before January 2005. The road linework came out of the cartoon data layer.

GENERATION OF MILEAGE REPORTS

The mileage report summaries on the town highway maps are generated from the information contained in the AOTMILES field in TransRoad_RDS. Because of the limited functionality of the report writer in ArcMap, the reports are generated through MS Access. The MS Access report is published to MS Word and saved as a Rich Text Format (RTF) document. When the time comes to place the report on the map, it is inserted as a linked object onto the mxd map document. One thing to keep in mind during this process is that there is a vertical limit of 14 inches for the inserted object, this can affect the length and format of the report.

SUMMARY

The initial purpose of the Vermont Agency of Transportation's town highway maps is their use as inventory summary sheets as part of the Agency's town highway reimbursement program. However, there is broad interest in them and the distribution of the information contained in them ranges from paper copies, to digital images available through the web, to the raw digital data available through VCGI's Data Warehouse.

Shifting our production of these maps from a two-layer production (cartoon and rdsmall) system to a one-layer system (rdsmall) reduced our data maintenance load and helped us focus on improving the road centerline data layer distributed in its various forms to the Vermont GIS community.

REFERENCES AND OTHER RESOURCES

1. State of Vermont Legislature, "Vermont State Statutes Online Title 19." Accessed 10 May 2007. <http://www.leg.state.vt.us/statutes/chapters.cfm?Title=19>.

2. Vermont Agency of Transportation, "Handbook for Local Officials" (2007). Accessed 8 May 2007. <http://www.aot.state.vt.us/maint/Documents/book.pdf>.
Website: http://www.aot.state.vt.us/maint/OrangeBook.htm

3. Vermont Agency of Transportation - Finance and Administration
Current Rates of Reimbursement for the Town Highway Grant Program
(http://www.aot.state.vt.us/thgp/currentrates.asp)

Specific Reimbursement for Each Town
(http://www.aot.state.vt.us/finadmin/townlookup.htm)

4. ESRI = Environmental Systems Research Institute, http://www.esri.com
PLTS. http://www.esri.com/software/arcgis/extensions/plts
ArcSDE, http://www.esri.com/software/arcgis/arcsde

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