

## Digital Tax Mapping – Present and Future

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**Digital Tax Mapping**

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WV GIS Technical Center

## WV GIS Technical Center

- **Mission** - To provide focus, direction and leadership to users of geographic information systems (GIS), digital mapping and remote sensing within the State of West Virginia
- The West Virginia GIS Technical Center (WVGISTC) is the designated clearinghouse for statewide GIS data, developer of core base layers, and contributing author to state GIS plans

## Outline – Digital Tax Mapping

- *What is GIS?*
- *GIS Benefits and Applications*
- *What constitutes a digital tax mapping system?*
- *GIS tax map conversion steps*
- *Components of a tax GIS*
- *Future Directions*

Contributions: State Tax Office (GIS Unit) and Mountain CAD

## Focus: Surface Land Ownership

**The cadastral parcel and ownership rights**

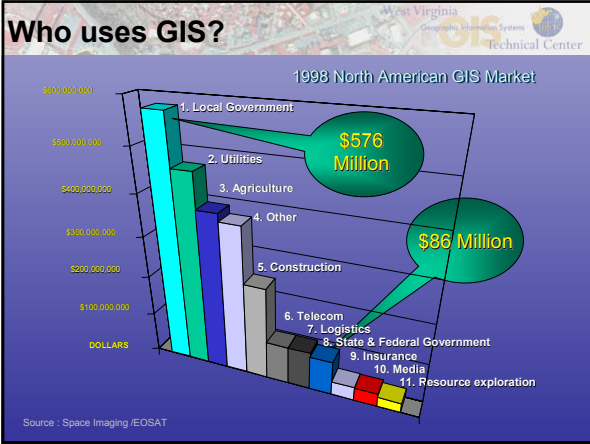
Source: Land Administration (Peter Dale and John McLaughlin)

## What is GIS ?

- GIS = Geographic Information System
- In its simplest form: A computer system capable of holding and using data describing places on the earth's surface.
- A computerized system for the capture, storage, management, analysis, and display of digital maps, images, and related databases about geographic features. The five components of GIS are pictured below:

## What is GIS ?

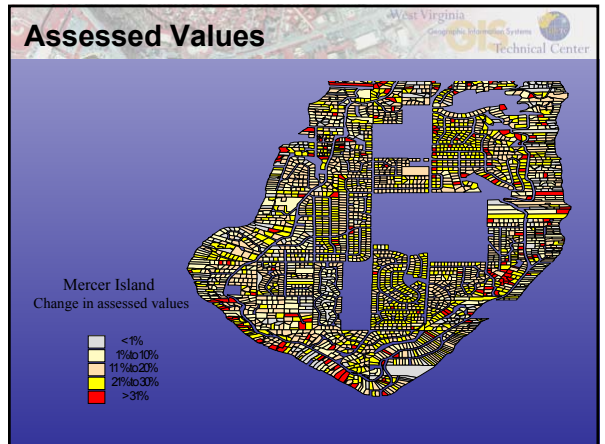
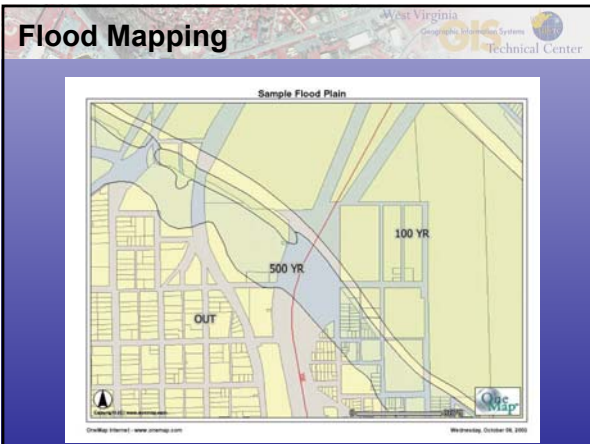
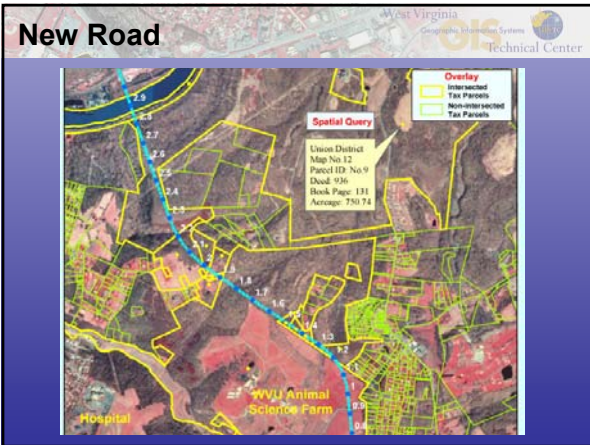
- A geographic information system (GIS) links locational (spatial) and database (tabular) information and enables a person to visualize patterns, relationships, and trends.
- This process gives an entirely new perspective to data analysis that cannot be seen in a table or list format.



## Applications

*Land records information needed for a variety of applications*

- Zoning
- Planning
- Public Works
- Police
- Assessors
- Permitting
- Public Utilities
- Boundaries
- Economic Development



## Public Works

Information for 500 E CITRUS AV

April 06/15/2012 09:45:11 50000 NEW'S CONCRETE ASSESSORS/LANDS Location: 455 Desktop: 8-2

Show Selected Address  
 Show City Parcels  
 City Improvement Projects  
 Properties within System Boundaries  
 Show Selected Project  
 Info about

500 E CITRUS AV  
 Completion: 05/20/09  
 Contract: City Street

Back to City Projects Home

## What Constitutes a GIS Tax Map?

- Composed of thematic layers, referenced to a common coordinate system (i.e., State Plane, UTM, Lat./Long.)
- Linked to external databases (e.g. CAMA)
- Has topology (i.e. mathematically closed polygons)
- Seamless (countywide)
- A digital reference, not a legal record

## Related data layers

Structures  
Boundaries  
Streets  
**Parcels**  
Land Use  
Environmental Considerations

• Data is organized by layers, coverages or themes (synonymous concepts), with each theme representing a common feature.  
 • Layers are integrated using explicit location on the earth's surface, thus geographical location is the organizing principal.

"The Real World"

## Same Geographic Space

Table of Contents shows 3 layers

2 Layers displayed – They match!

All three match in space

## Linked to Assessment Database

A GIS links locational (spatial) and database (tabular) information

Tax Parcel Record: Anytown, West Virginia	
Parcel Number:	1
Owner:	Mr. John Sebastian Doe
Address:	3087 Apia Mellifera Road
Address:	Anytown, WV 20855
Phone:	1-304-555-7674
Acreage:	116
Assessed Value:	220,000
Mineral Rights:	No
Zoning Classification:	Single Family Residential (R1)
Tax District:	Trap Hill District
District Number:	12
Map Number:	21

Spatial Information

Tabular Information

Database links to parcels via: (1) parcel identifier or (2) standardized address

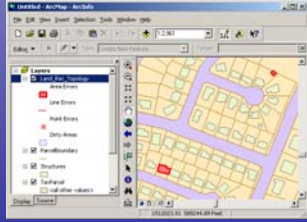

## GIS = Parcel Features + Database

- GIS are a combination of **geographic** data and **attribute** data
  - Parcel polygons are the **spatial features**
  - CAMA records are the **attributes**
- GIS allow two key types of functionality
  - **Point** at a graphic feature and **retrieve** attributes
  - **Query** attributes and **see graphic result** of query on a map

Parcel ID	Parcel No.	Owner	Address	Assessed Value	Area	Acres	County	City	Zip
100-2872	100-2872	JOHN SEBASTIAN DOE	3087 APIA MELLIFERA ROAD	220000	116	1.66	PUTNAM	ANYTOWN	20855
100-2873	100-2873	JOHN SEBASTIAN DOE	3087 APIA MELLIFERA ROAD	220000	116	1.66	PUTNAM	ANYTOWN	20855
100-2874	100-2874	JOHN SEBASTIAN DOE	3087 APIA MELLIFERA ROAD	220000	116	1.66	PUTNAM	ANYTOWN	20855


## Topology (spatial relationships)

- How to model spatial relationships
  - Parcels cannot overlap one another
  - Building footprints must not overlap parcels
  - Parcel lines cannot have dangles

*Error / Validation Checks*

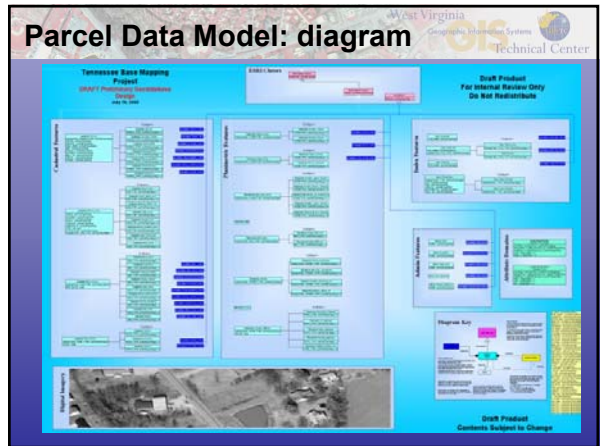
## Topology – Define Relationships



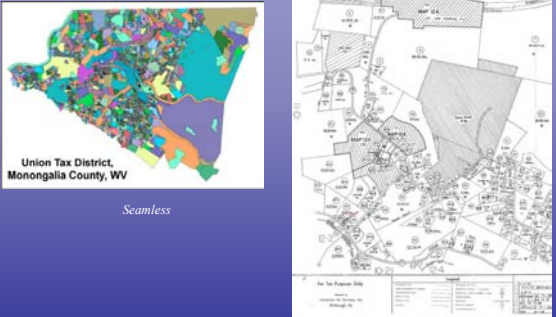
*Define Spatial Relationships*

## Parcel Data Model: table

Entity	Related to	Spatial Type
<b>Land Base Data Sets</b>		
Parcel Boundary	Parcel ID (CAMA)	Area or line
Parcel ID	Parcel Boundary	Text
Lot Numbers		Text
Interior lot / tract lines	Parcel Boundary	Line
Ownership	Parcel ID (CAMA)	Table
Landmark		Text or line
Dimensions (acres)	Parcel ID (CAMA)	Text
Dimensions (meters and bounds)		Text
Parcel Photograph	Parcel ID	Image
Structures	Parcel Boundary	Area or point
Address	Parcel ID (CAMA) / Structure Address	Location
Parcel Index Grid		Area or Line
Political Boundaries	Parcel Boundary	Area
Corporation Boundaries	Parcel Boundary	Area
<b>Reference Data Sets</b>		
Roads		Area or line
Water Bodies		Area or line
Political Boundaries		Area or line
Aerial Photos		Image
Satellite Images		Image
Topographic Maps		Image
Geographic Names	Referenced features	Text
Flood hazards		Area or line
Right of Way Dimensions	Referenced features	Text



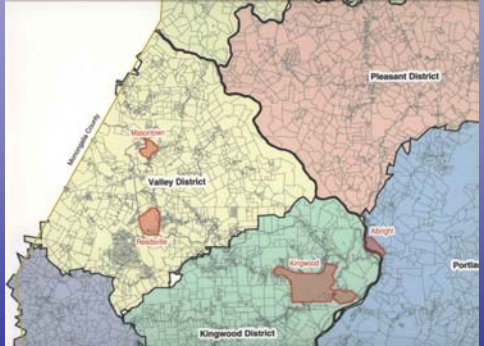
## Seamless



*Seamless*

*Not Seamless*

## Seamless - countywide



*Seamless between rural districts and corporations*


## Digital Reference

- A digital landbase is a digitized **reference** to the legal cadastre, specifically, a reference to the **source documents** that describe the intent of the on-ground cadastre
- A digital landbase is not the official cadastre of record – only a reference to it. A digital landbase does **not define** land tenure boundaries.
- Example: Assessor's Parcel Map used for taxation. These maps should not be used as the basis for engineering and construction which **determines** the location of built features ("fixed works")


## GIS Tax Map Conversion Steps

- **Approaches for parcel data automation**
  - Automation of hard copy \$2 - \$6+ /parcel
  - Conversion of CAD data \$2 - \$6+ /parcel
  - Parcel deed research (COGO) \$15 - \$20/parcel
- **Hybrid Approach**
  - Use GIS to identify problematic parcels that might require deed research
    - Polygons with no matching CAMA records
    - CAMA records with no matching polygons
    - Wide variance between measured area and CAMA area
    - Splits required after digital conversion
  - Perhaps:
    - 70%-80% of parcels @ \$2 - \$6/parcel
    - 20%-30% of parcels @ \$15 - \$20


Source: Applied Geographics, Inc.



## Digital Conversion - Geology



Hand drawn geologic features on USGS 1:24,000-scale topographic map

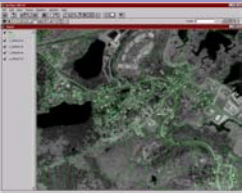


Geologic map digital conversion

## Conversion of Hardcopy Maps

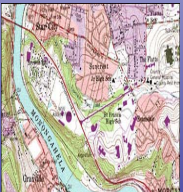


- **Scan existing maps**
  - Georeference scans to a base map
    - Control points: street intersections, bldg. corners
- **Heads-up digitize linework**
  - Parcels
  - ROW/easement
  - Dimension annotation (extra \$)
  - Index grid
- Make "adjustments" to enhance fit to base map
  - Performed during automation
  - Or later, as a separate project
- Create topology
- Label parcels with their ID number (e.g. Map and Lot) Link to CAMA database
- Obtain "dump" from CAMA in DBF, MDB or ASCII
- Database "table join" using ID number as primary key
- Produce checkplots
- Integrate parcel related features with other reference base layers
- Create electronic map book of "pretty maps."

Source: Applied Geographics, Inc.



## Select Base Layers


*A base map is needed to establish a coordinate system, accuracy and ability to overlay with other layers*

TOPOGRAPHIC MAPS	CIR AERIAL PHOTOS	AERIAL PHOTOS
		
Scale: 1:24,000 1" = 2,000 ft.	Scale: 1:12,000 1" = 1,000 ft.	Scale: 1:4800 1" = 400 ft.
Date: avg. map 23 yrs. old	Date: 1996-97	Date: Spring 2003

## Heads-Up Digitizing / Data Integration

- **Parcel Related Features**
  - Geo-Referenced Tax Map
  - Digitized Parcel Lines
  - Parcel IDs
  - Interior Lot Lines and IDs
  - Land Hooks and Buildings
  - Parcel Dimensions
- **Reference Datasets**
  - Road and Water Layers
  - Aerial Photography

*Integration (spatial compatibility) of data layers is more difficult if compiled from different sources or assembled at varying time intervals*



## Parcel Line Work Adjustments

- Can be a highly “interpretive” and subjective process
- Try to make parcels and reference layers look “logically consistent”
- If the fit between parcels and base map is really bad, a need for deed research may be implied



## CAMA Reconciliation Process

- Process to determine how well CAMA matches polygons
  - 99% match rates are possible
  - Known problems with “exempt” properties
- “Combined” lots can pose issues
  - Two parcels, one CAMA record
- Condos pose an issue
- Most issues are resolved during the checkplot review process



Source: Applied Geographics, Inc.

Parcels with FAILED PID link

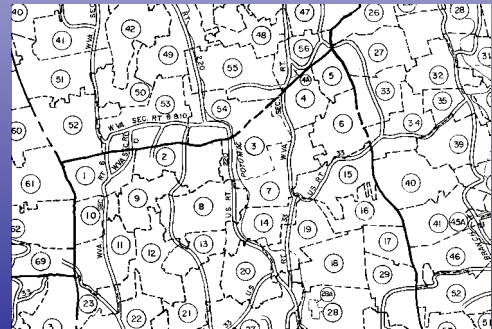
## Map Tile Reference System

Must covert grid system to a GIS format

Primary map tiles	Nested Grid	True Grid	Modified Grid	Random
Orientation true north	Y	Y	Y	N
Uniform tile size	Y	Y	N	N
100 scale nested within 400 scale	Y	N	N	N

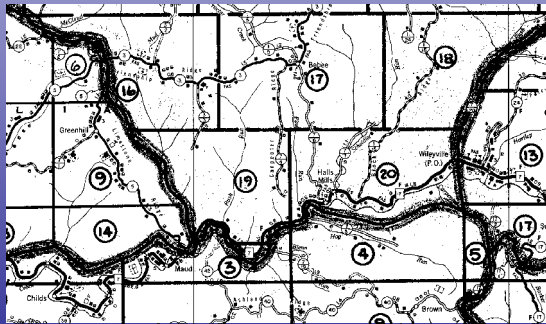
**Map Tile Reference System:** The parcel reference system for each county is subdivided into rural tax districts and corporations, which are further subdivided into map tiles / map sheets. The type of parcel reference system is determined by the primary map scale (usually 1”=400’ scale) configuration for rural maps and its relationship to urban areas (usually 1”=100’ scale).

## Random Grid – Pendleton County



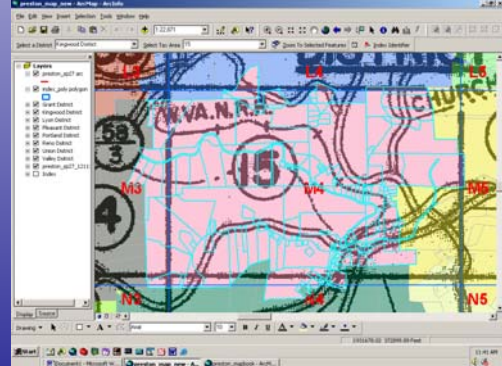
Random Orientation, No uniform tile size, No nesting of 100’ and 400’ scale maps

## Modified Grid - Wetzel County

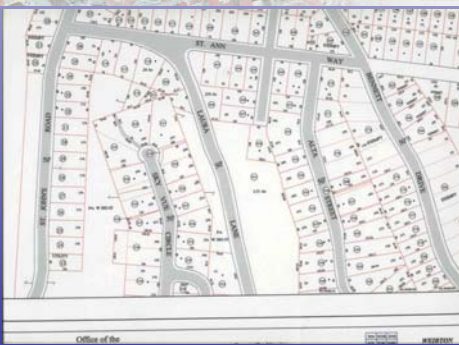


True North Orientation, No uniform tile size, No nesting of 100’ and 400’ scale maps

## Electronic Map Books – using indexes



## Map Products – Pretty Maps

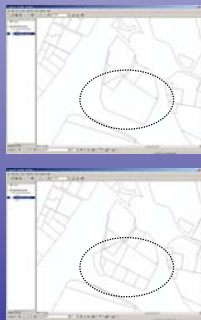


- Visually appealing cartographic product
- Print-ready electronic versions

## Internet Applications

## Maintenance

- Plan maintenance strategy before digital conversion
- Can be done in-house, or out-sourced
- Diligence and Staff Responsibility required
  - It's more fun to make maps than update data
- Adjust "business process" workflow
  - Update data instead of maps
  - Can be done continually, not just annually
  - Coordinate with Planning/Building Departments
    - New sub-divisions
    - Base map changes (new buildings, etc.)



Source: Applied Geographics, Inc.

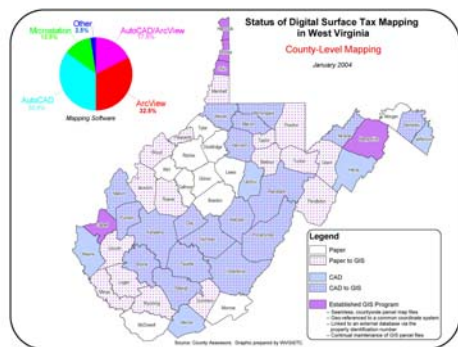
## Challenges – digital conversion

- Maintaining two systems (manual and digital)
- Expense
- Time
- Technical Issues
- Organizational Issues



- Sharing resources and expenses with other entities can minimize redundancy, ensure interoperability, and maximize benefits.
- Conduct pilots to resolve critical issues.

## WV Digital Tax Mapping Status



## Components of a Tax GIS

- A working GIS integrates these key components:
  - hardware
  - software
  - data
  - people
  - methods



# Hardware

The hardware is the computer and peripherals on which the GIS operates



## Traditional Mapping



MAP



TYPEWRITER



MANUAL DRAFTING TOOLS

## Computer Mapping



COMPUTER



PLOTTER



GPS



CD-ROM

# Software

GIS software provides the functions and tools users need to store analyze, and display geographical information. It includes the assessment database software.

- Multiple software vendors
- Family or suite of software products necessary to have complete GIS functionality (i.e., ESRI: ArcView, ArcEditor, ArcInfo)
- Adequate training and technical support

# Data

An important component of GIS is complete, current, and accurate data.

## Raster



Digital Raster Graphic (DRG)  
Digital Topographic Map

## Image



Digital Ortho Quarter Quad  
Aerial Photography

A form of GIS data structure that quantizes space into an array of grid of uniformly shaped cells (pixels), each of which represents a limited, but defined, amount of the earth's surface.

## Vector



Digital Line Graph (DLG)  
Hydrographic features



County boundaries with  
linked data

A graphic data structure that represents the points, lines, and areas of geographical space by exact X and Y coordinates.

# WV Spatial Data Infrastructure

Access to \$50 million dollars worth of spatial data



Armories



Railroads



Pipelines



Sewer Treatment Plants



Rural Tax Districts



Police Towers

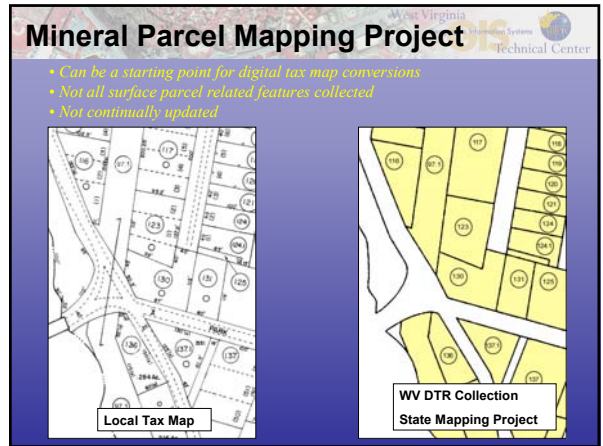
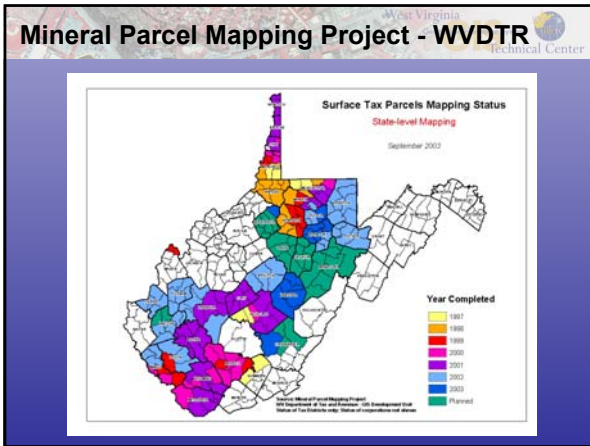
# WV Addressing & Mapping Layers (\$15 million value)



# Digital Flood Layers







## People

GIS technology is clearly of limited value without people to manage the system and to develop plans for applying it.

- **County Level**
  - Political Champion (i.e., Assessor, County Commissioners)
  - Tax Mapper (technically proficient)
- **State Level**
  - Political Champion (State Tax Office, Tax Commission)
  - Application Experts (Standards, Training, Education)
- **Private Sector**
  - Reputable Vendors
    - Specialize in tax map applications and customization
    - Training and technical support

**People**

## Methods

Methods, plans, specifications, standards, and business rules describing how technology is applied

- **Plans (integrate with other state IT plans)**
  - Digital Tax Map Plan (proposed). What is the vision?
  - Interrelate with other state plans
    - The National Map State Business Plan (2003)
    - WVGISTC Strategic Plan (2003)
    - Addressing and Management Maintenance Plan (in progress)
    - All Hazard Mitigation Plan (in progress)
    - Flood Map Modernization State Business Plan (proposed)
    - State GIS Plan (in progress)
    - State IT plans
- **Procedures (for digital tax maps)**
  - *Statewide Procedures for the Manual Maintenance of Surface Tax Maps*, Title-Series 189-04
  - *Tax Map Sales* Title-Series 189-05

**Vision**

## Methods (cont.)

New business rules are needed for compiling and sharing GIS tax data with other government agencies.

**Statewide Configuration Concept**

**Govt. Agencies Needing Access**

- Office of Emergency Services
- Development Office
- Redistricting Office
- Division of Highways

## Future Directions

- **Digital Tax Guidelines (Report)**
  - Elaborate on information in this presentation
  - Definitions, Procedures, Policies, Organization Roles, Benefits
  - Preston County as pilot
- **Organizational Roles**
  - **Property Valuation Commission (PVC)**
    - Overarching body (authority)
    - Approve digital tax guidelines
    - Update existing regulations to include digital mapping procedures
    - Establish new business rules / organizational role
  - **Tax Advisory Committee**
    - Develop digital tax guidelines
    - Interface with other strategic plans
    - Present and obtain feedback from tax geospatial community
    - Consult with private sector
    - Proposed Members
      - (WVU GIS Technical Center, Tax and Revenue, WV GIS Coordinator, 3 Assessors)

## WVGISTC's Role?

- **Assist with Digital Tax Guidelines Report**
  - Standards
  - Specifications
  - Procedures
- **Assist with editing of tax map regulations**
  - Authority
  - Policies
- **Training and Outreach**
- **Applied Research**
- **Repository of digital tax files for state government**

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