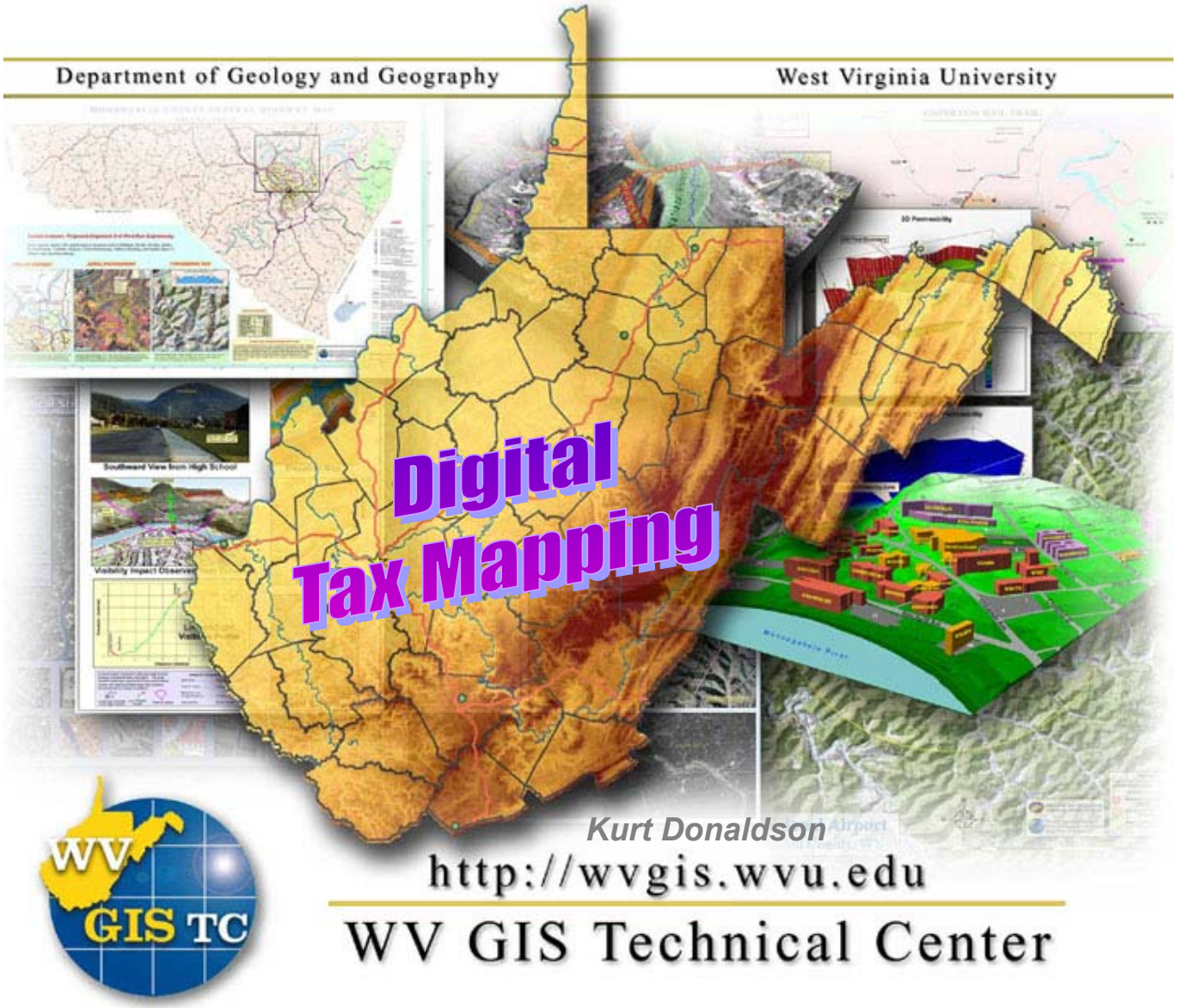
Digital Tax Mapping – Present and Future



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

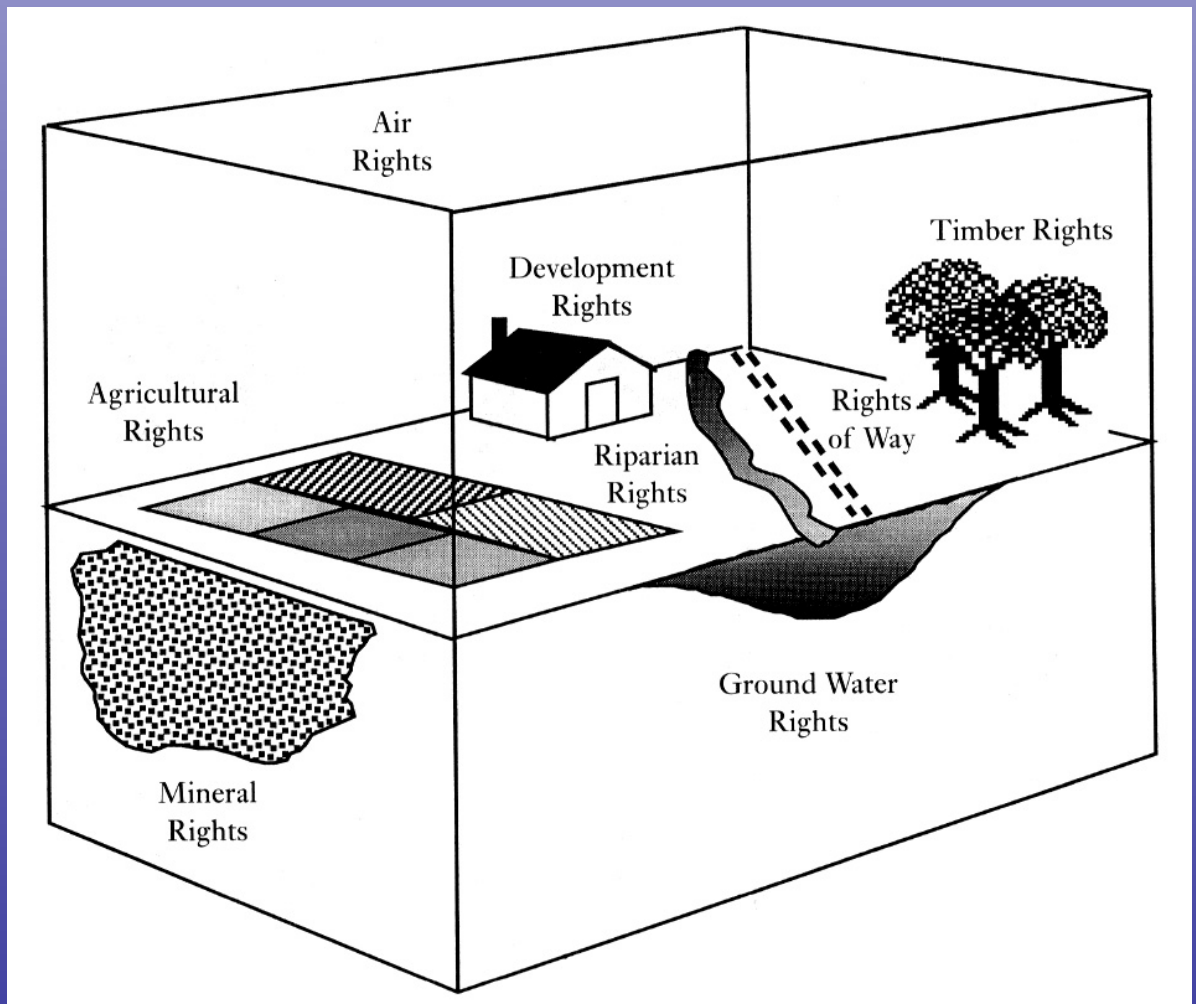
- The West Virginia GIS Technical Center (WVGISTC) is the designated clearinghouse for statewide GIS data, developer of core base layers, and contributing author to state GIS plans

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)

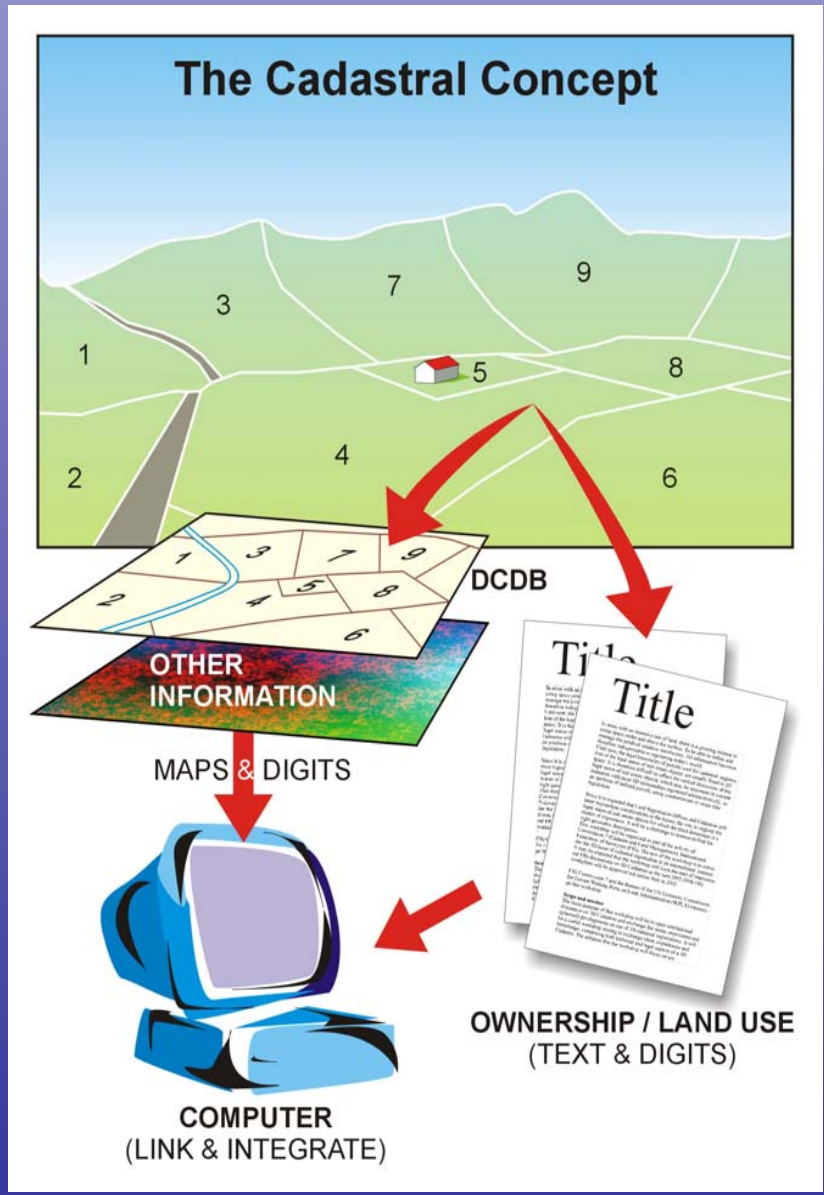
What is GIS ?

- GIS = Geographic Information System
- In its simplest form: A computer system capable of holding and using data describing places on the earths 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:

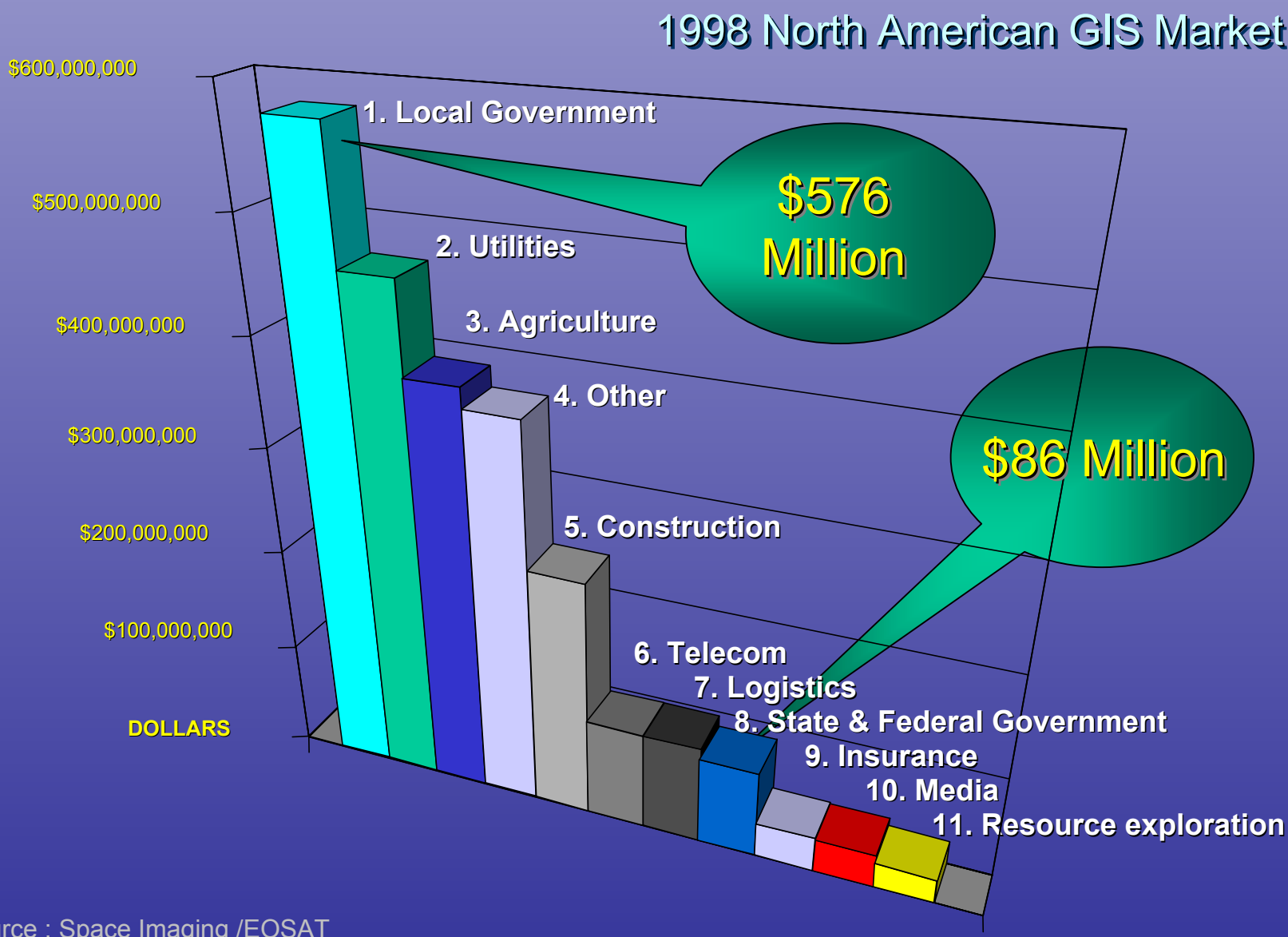
What is GIS ?

- 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.



Who uses GIS?



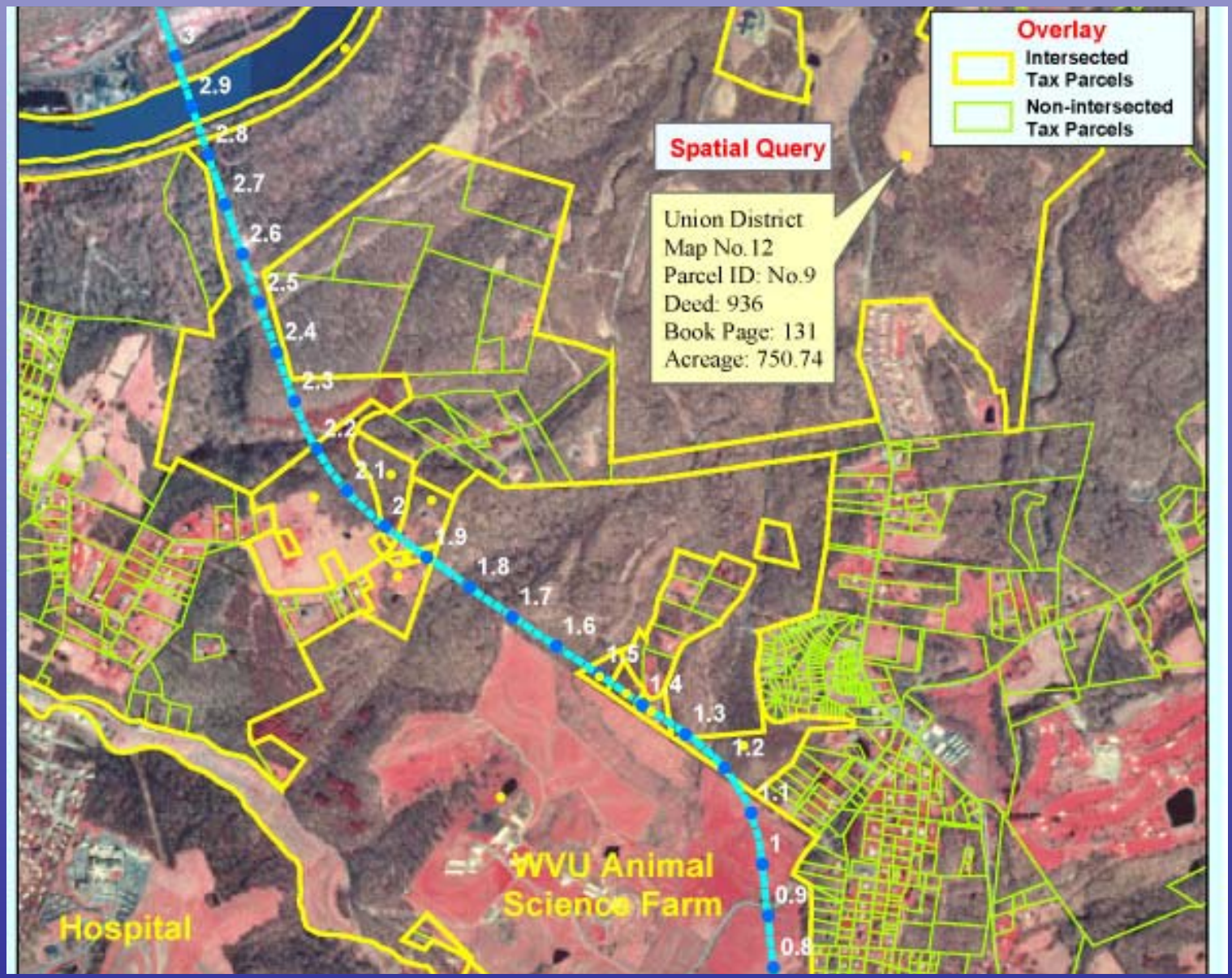
Source : Space Imaging /EOSAT

Applications

Land records information needed for a variety of applications

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

New Road


Overlay
Intersected Tax Parcels
Non-intersected Tax Parcels
Spatial Query
Union District
Map No.12
Parcel ID: No.9
Deed: 936
Book Page: 131
Acreage: 750.74
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
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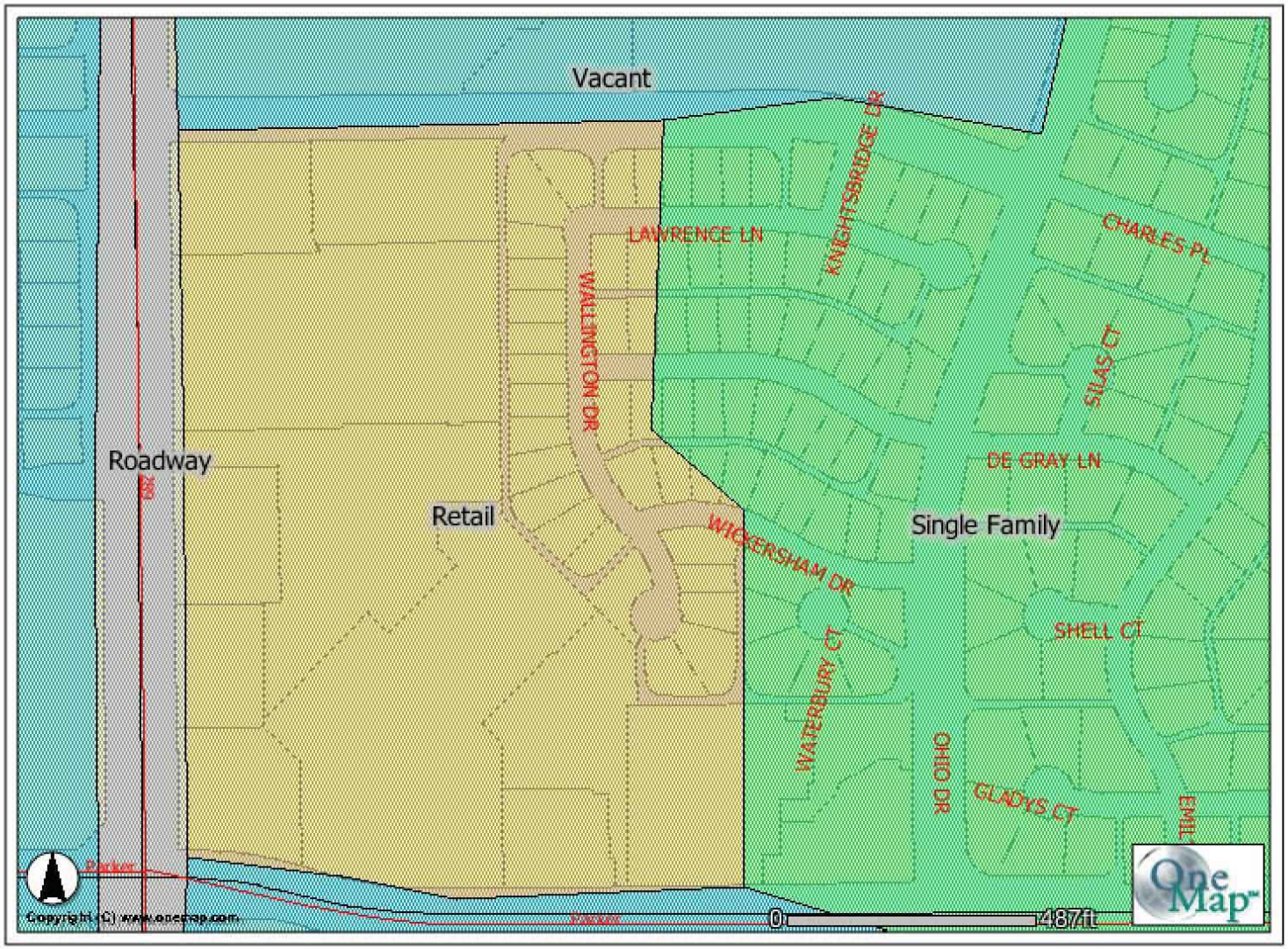
1.3
1.2
1.1
1
0.9
0.8
WVU Animal Science Farm
Hospital

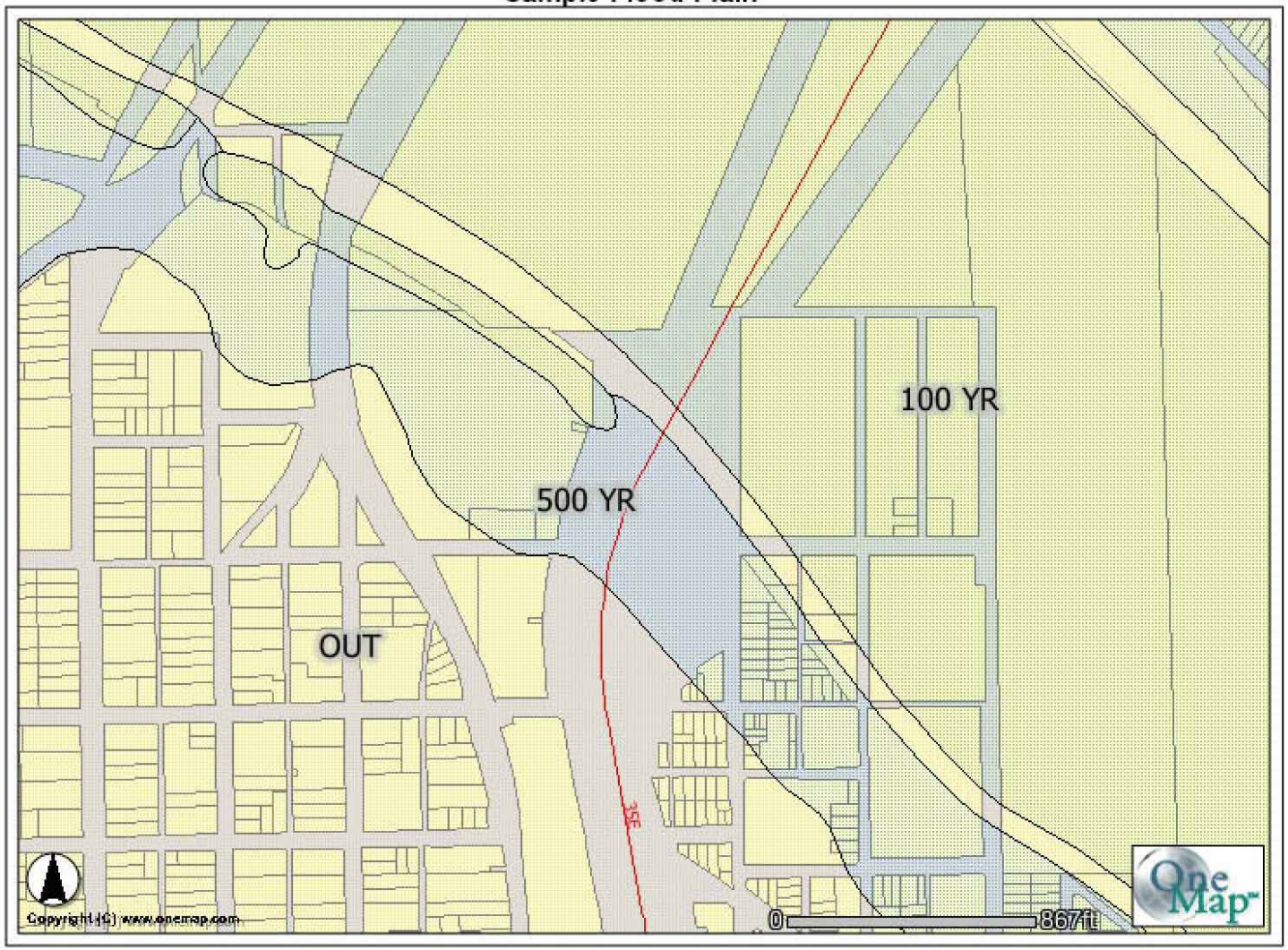
Zoning



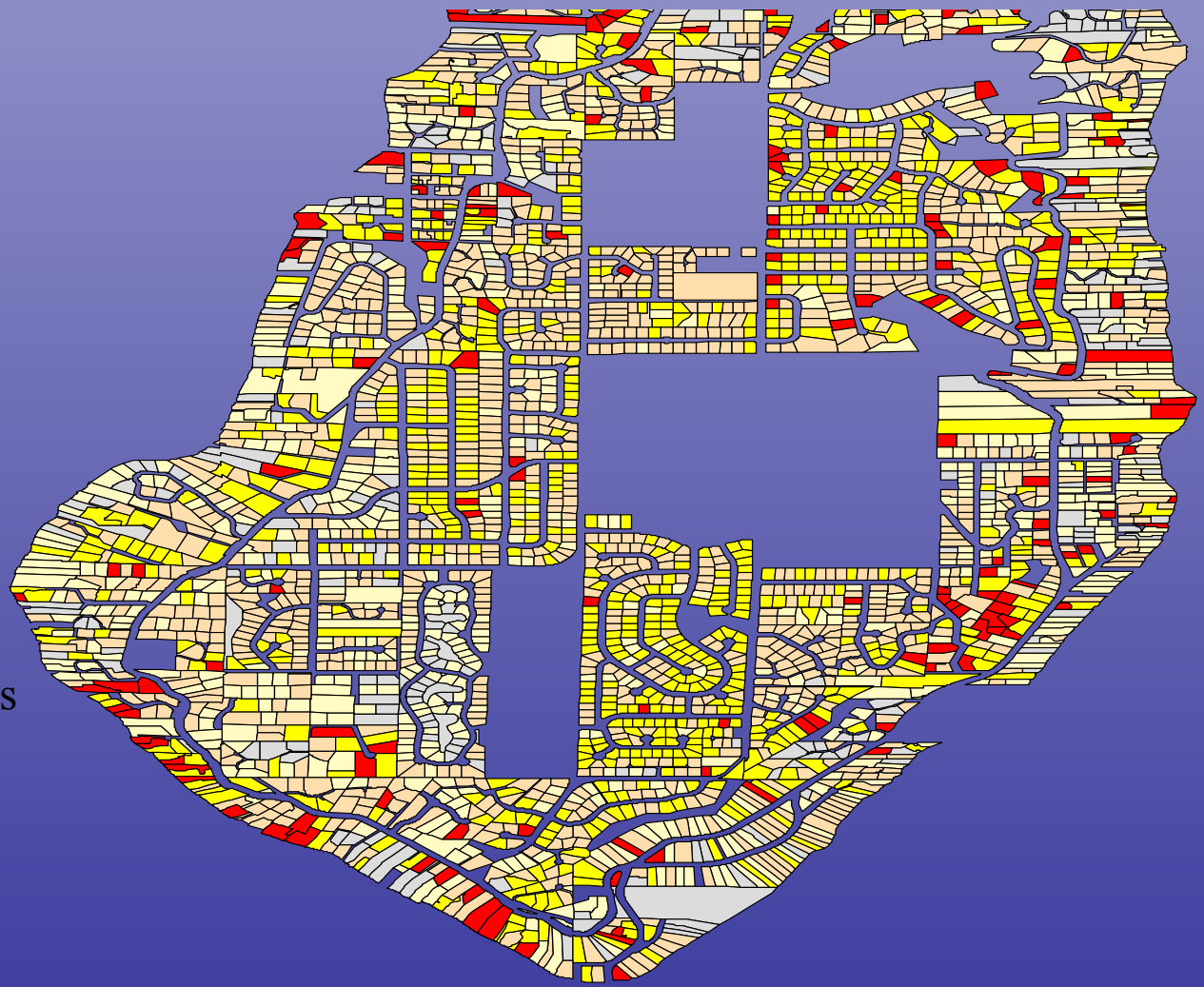
OneMap Internet - www.onemap.com

Wednesday, October 08, 2003

Flood Mapping



Assessed Values



Public Works

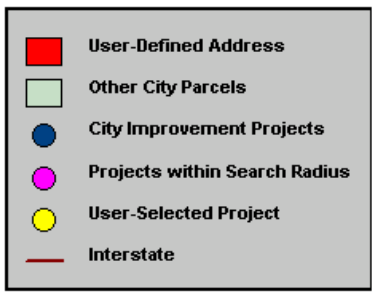
Netscape - [Parcel Information Page]

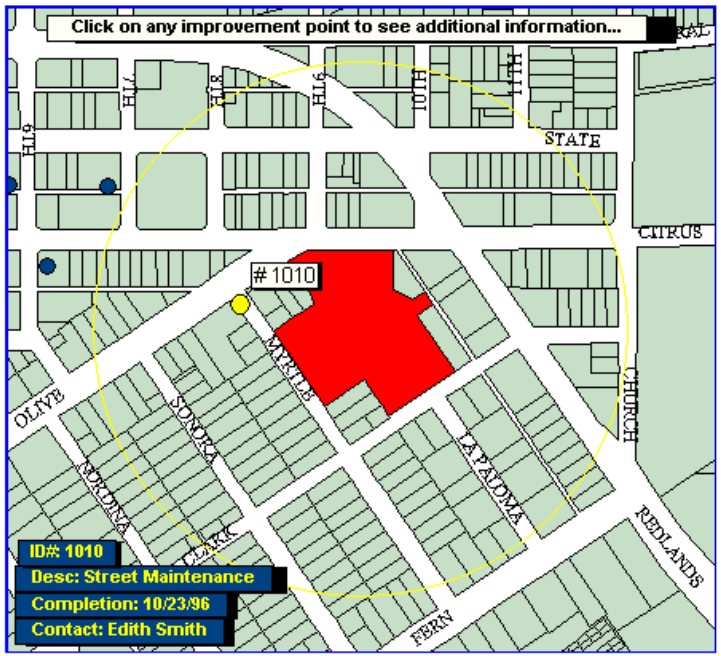
File Edit View Go Bookmarks Options Directory Window Help

Back Forward Home Reload Images Open Print Find Stop

Information for *500 E CITRUS AV*

Apn: **017134132** Owner: **YOUNG MEN'S CHRISTIAN ASSN/REDLANDS** Landuse: **451** Zoning: **R-2**





Back to City Projects Home

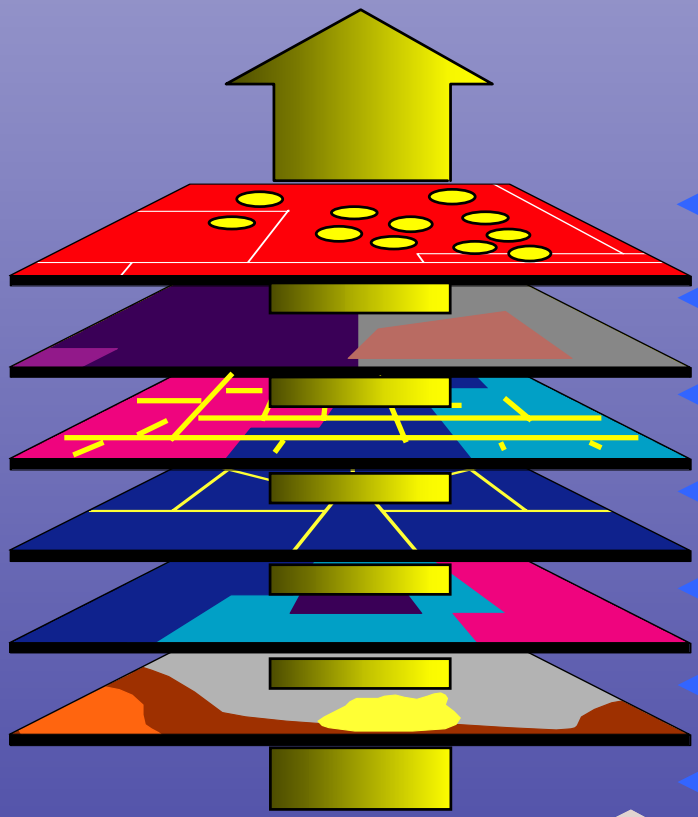
11K read

Start | Exploring - Graphics | Netscape - [Parcel... | Inbox - Microsoft Outlook | Microsoft Word | Microsoft PowerPoint - ... | 2:51 PM

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

"The Real World"

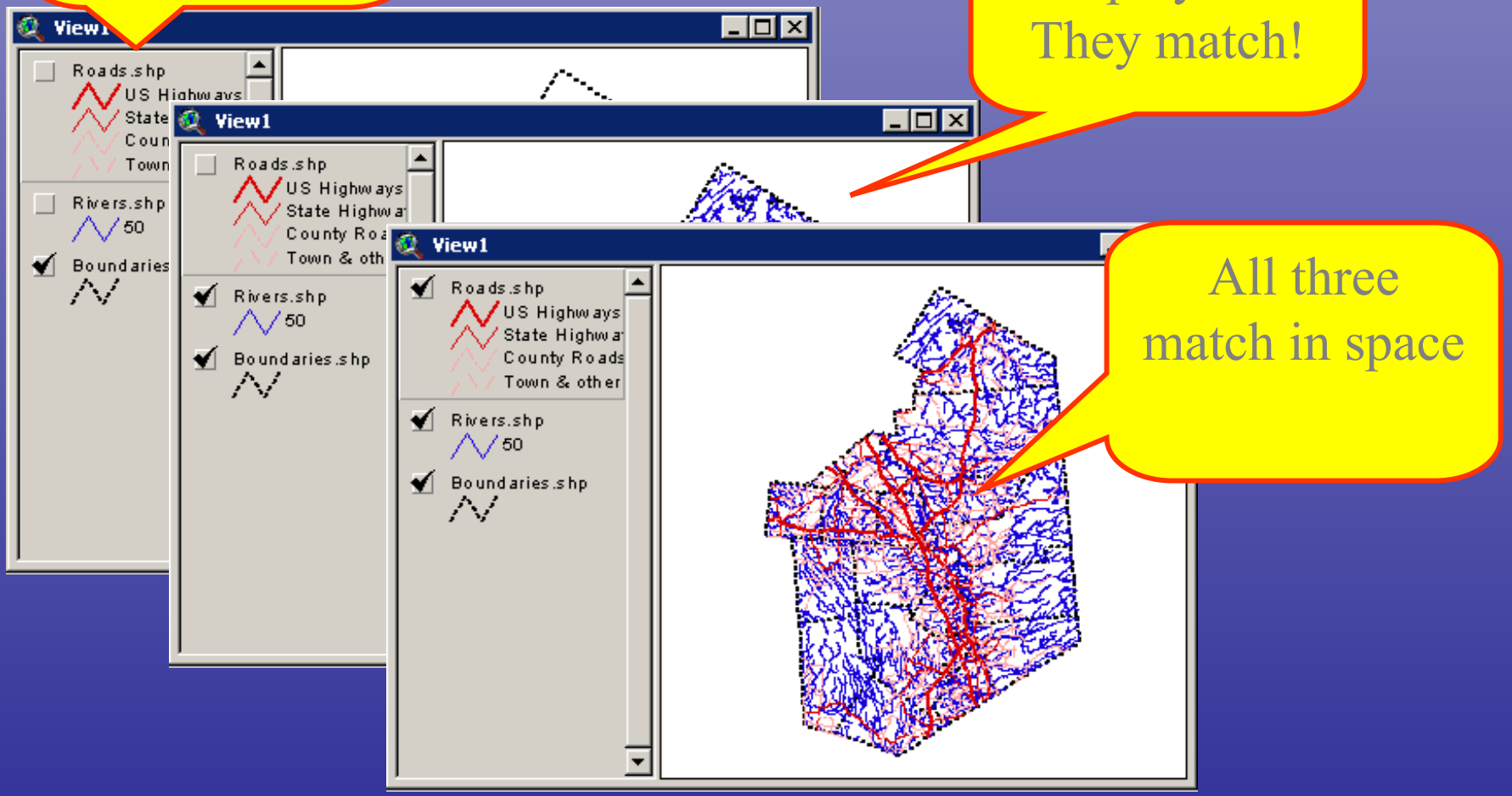
- Data is organized by layers, coverages or themes (synonomous concepts), *with each theme representing a common feature.*
- Layers are integrated using explicit location on the earth's surface, *thus geographical location is the organizing principal.*

Same Geographic Space

Table of Contents shows 3 layers

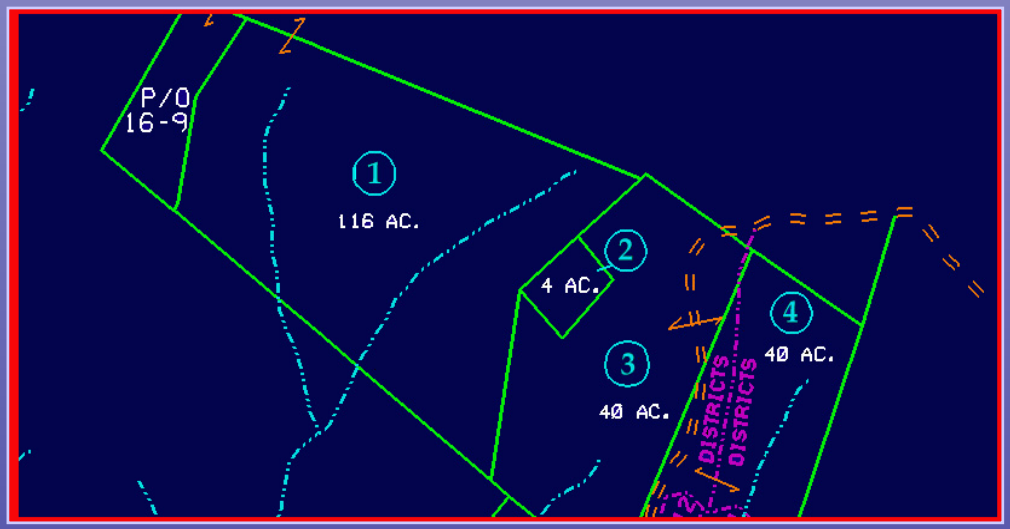
2 Layers displayed – They match!

All three match in space



Linked to Assessment Database

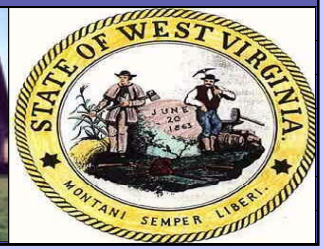
A GIS links locational (spatial) and database (tabular) information



Spatial Information

+

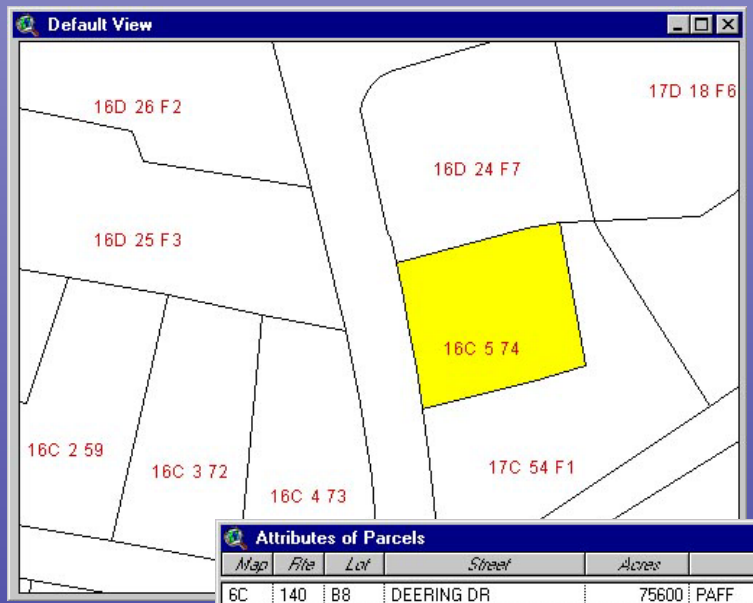
Tax Parcel Record:	Anytown, West Virginia
Parcel Number:	1
Owner:	Mr. John Sebastian Doe
Address:	3057 Apis Mellifera Road
Address:	Anytown, WV 20555
Phone:	1-304-555-7574
Acreage:	116
Appraised Value:	220,000
Mineral Rights:	No
Zoning Classification	Single Family Residential (R1)
Tax District:	Trap Hill District
District Number:	12
Map Number:	21



Tabular Information

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

GIS = Parcel Features + Database



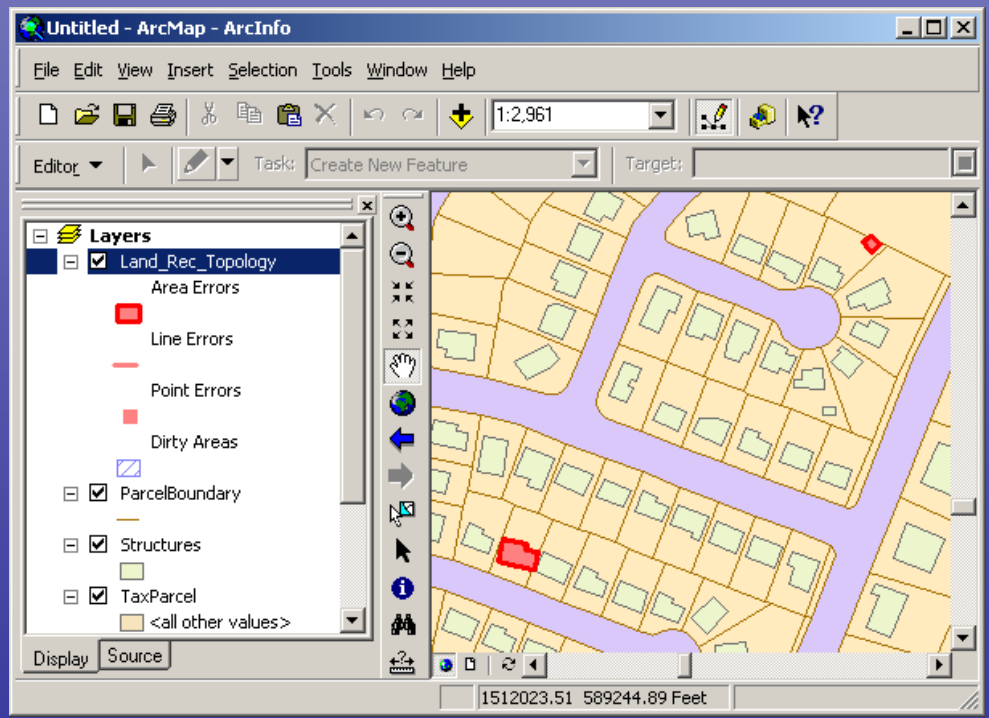
- GIS are a combination of **geographic** data and **attribute** data
  - Parcel polygons are the ***spatial features***
  - CAMA records are the ***attributes***
- GIS allow two key types of functionality
  - **Point** at a graphic feature and **retrieve attributes**
  - **Query** attributes and **see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

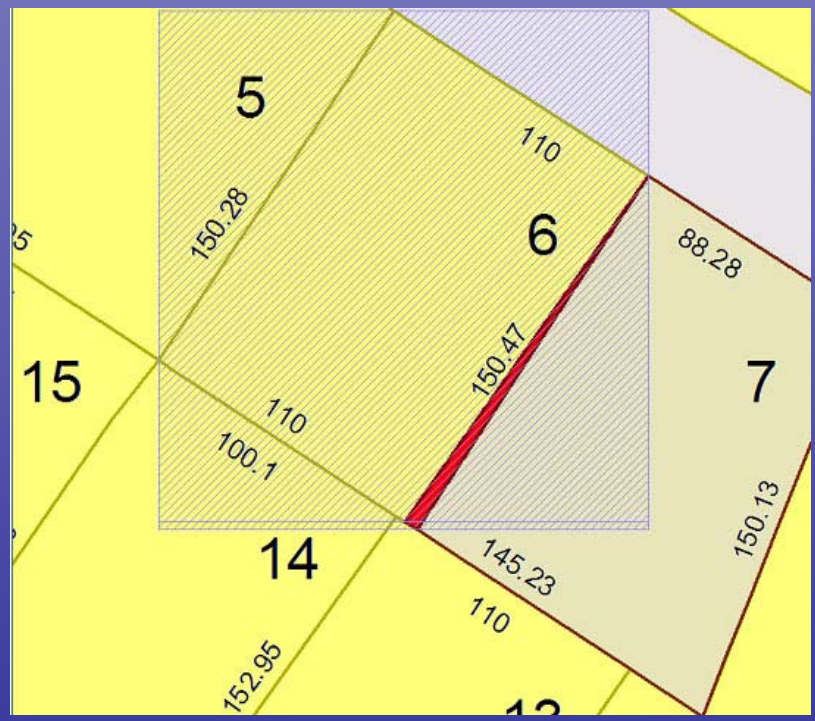
Attributes of Parcels

Map	Fite	Lot	Street	Acres	Lastname	Firstname	Loc_	Loc_street	
6C	140	B8	DEERING DR	75600	PAFF	ANDREW	50	DEERING	DR
6C	139	B7	DEERING DR	74700	KAZARIAN	ARMAND	60	DEERING	DR
10C	47	D135	VINEYARD AVE	190700	GRIFFIN	GENIE	220	VINEYARD	AVE
6C	138	B6	DEERING DR	74000	R A REAL ESTATE	TRUST		DEERING	DR
14C	64	D7	STAGE HARBOR RD	131500	ROBERT WILSON I	II TRUST		STAGE HARBOR	RD
17C	54	F1	QUASSON RD	240900	SWEENEY	ROBERT	4	SHORE	RD
6C	137	B5	DEERING DR	74000	ANDERSON	H RUSSELL/ET AL	82	DEERING	DR
15C	6	11	MILL POND RD	0	SMITH	ROY	64	MILL POND	RD
16C	5	74	SHORE RD	208200	NISSMAN	HARVEY	20	SHORE	RD
15C	8	8	MILL POND LN	0	YEAW	COLEMAN	27	MILL POND	LN
5C	52	B4	DEERING DR	75200	SHERIN	KEITH	98	DEERING	DR
16C	87	65	HOMESTEAD LANE EAST	0	FORGERON	EDWARD	19	HOMESTEAD LANE	EAS
9D	56	G3	YOUNGS FARM LN	248000	KELLEY	PAUL	27	YOUNGS FARM	LN
9C	52	M3A	BARNHILL MARSH	33500	HARRIS	JULIE		BARN HILL MARSH	
14C	8	3	STAGE HARBOR RD	0	NORMAN	EDWARD	180	STAGE HARBOR	RD
2C		1	MAIN ST	91300	TOWN OF CHATHAM	/ S.C. CEMETAR		MAIN	ST

Topology (spatial relationships)

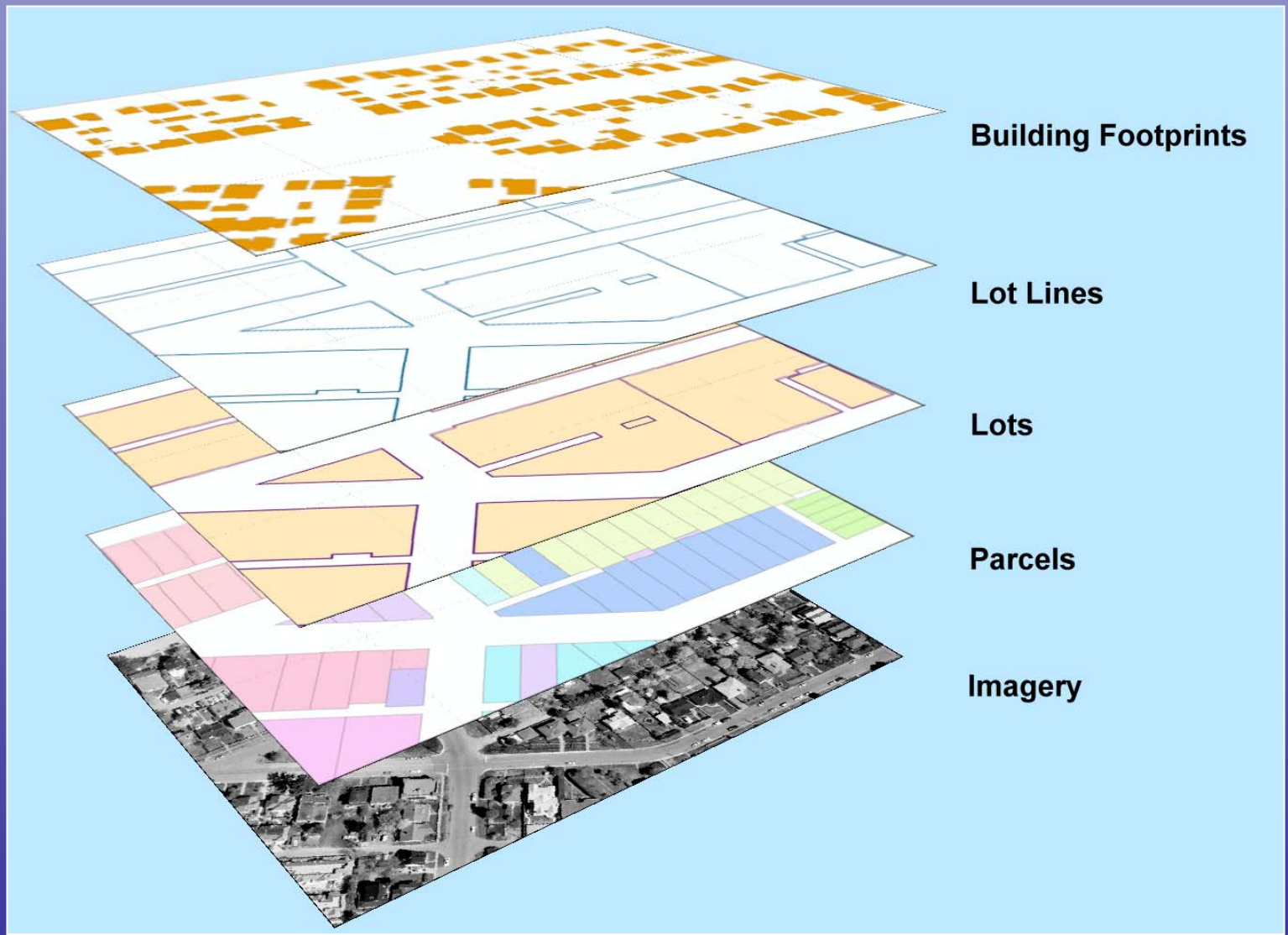
- How to model spatial relationships
  - Parcels cannot overlap one another
  - Building footprints must not overlap parcels
  - Parcel lines cannot have dangles





Error / Validation Checks

Topology – Define Relationships

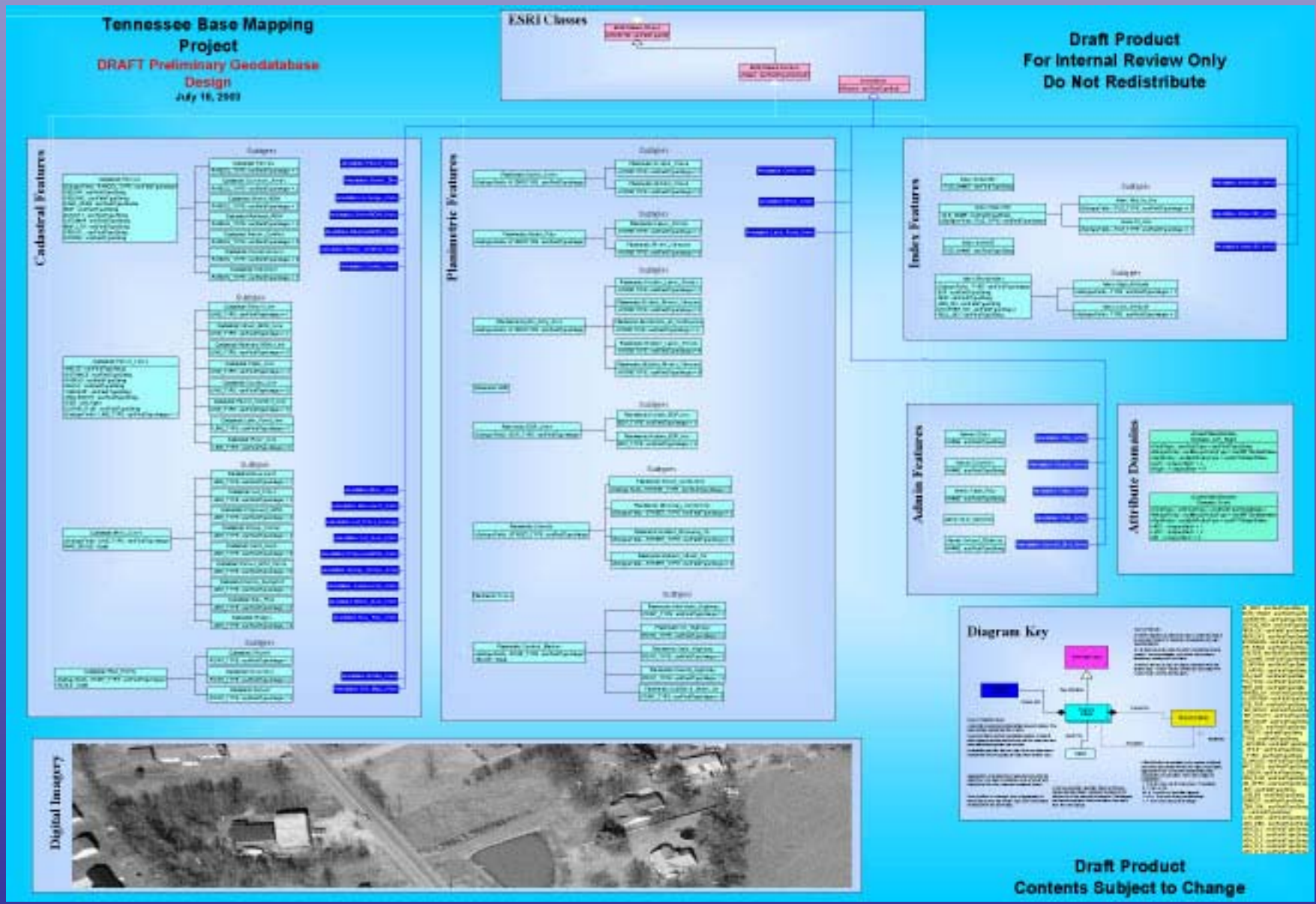


Define Spatial Relationships

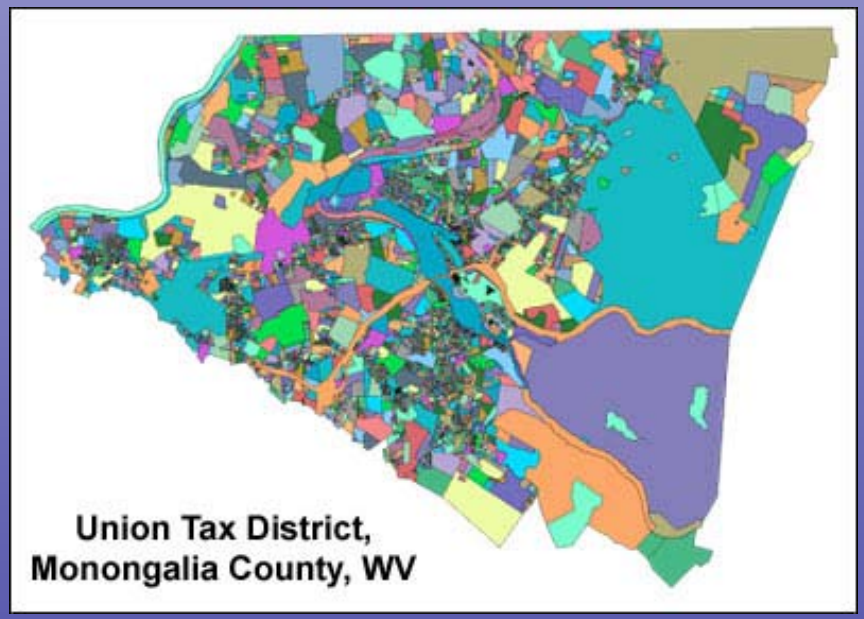
Parcel Data Model: table

Entity	Related to	Spatial Type
Land Base Data Sets		
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
Landhook		Text or line
Dimensions (acreage)	Parcel ID (CAMA)	Text
Dimensions (metes 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
District Boundaries	Parcel Boundary	Area
Corporation Boundaries	Parcel Boundary	Area
Reference Data Sets		
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

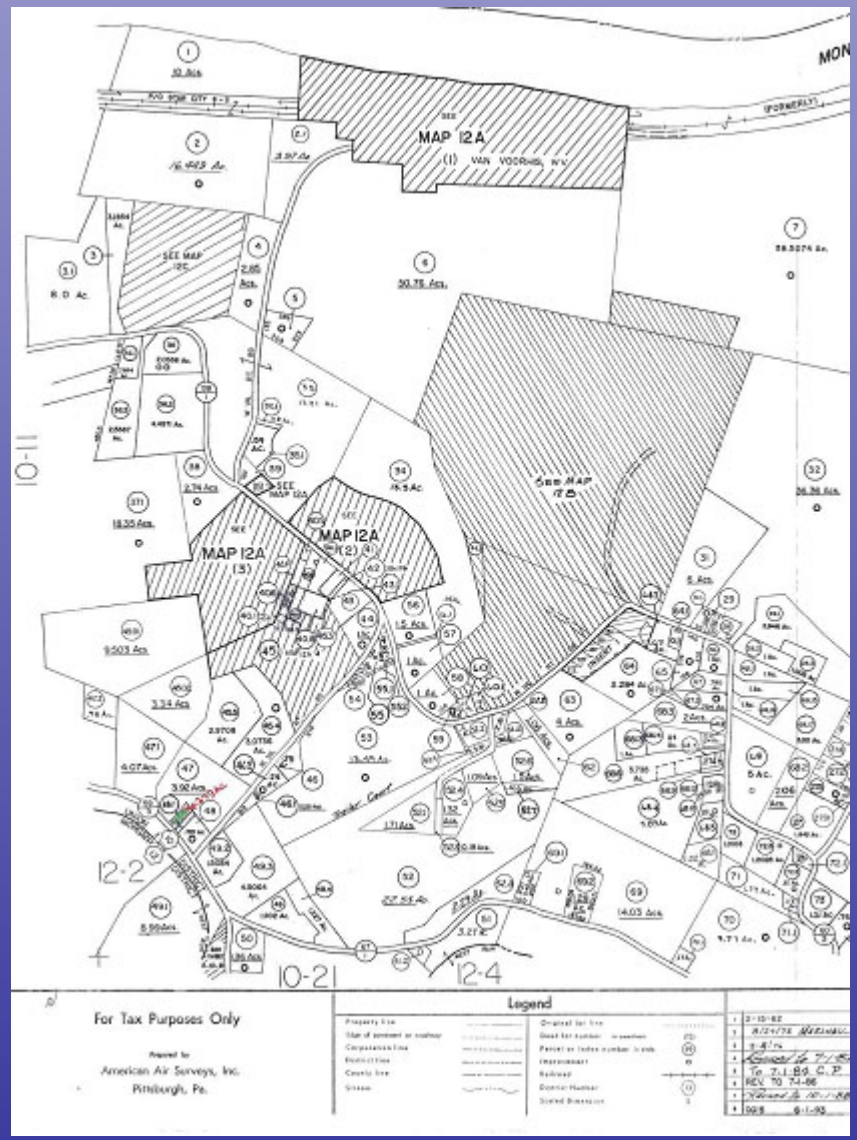
Parcel Data Model: diagram



Seamless

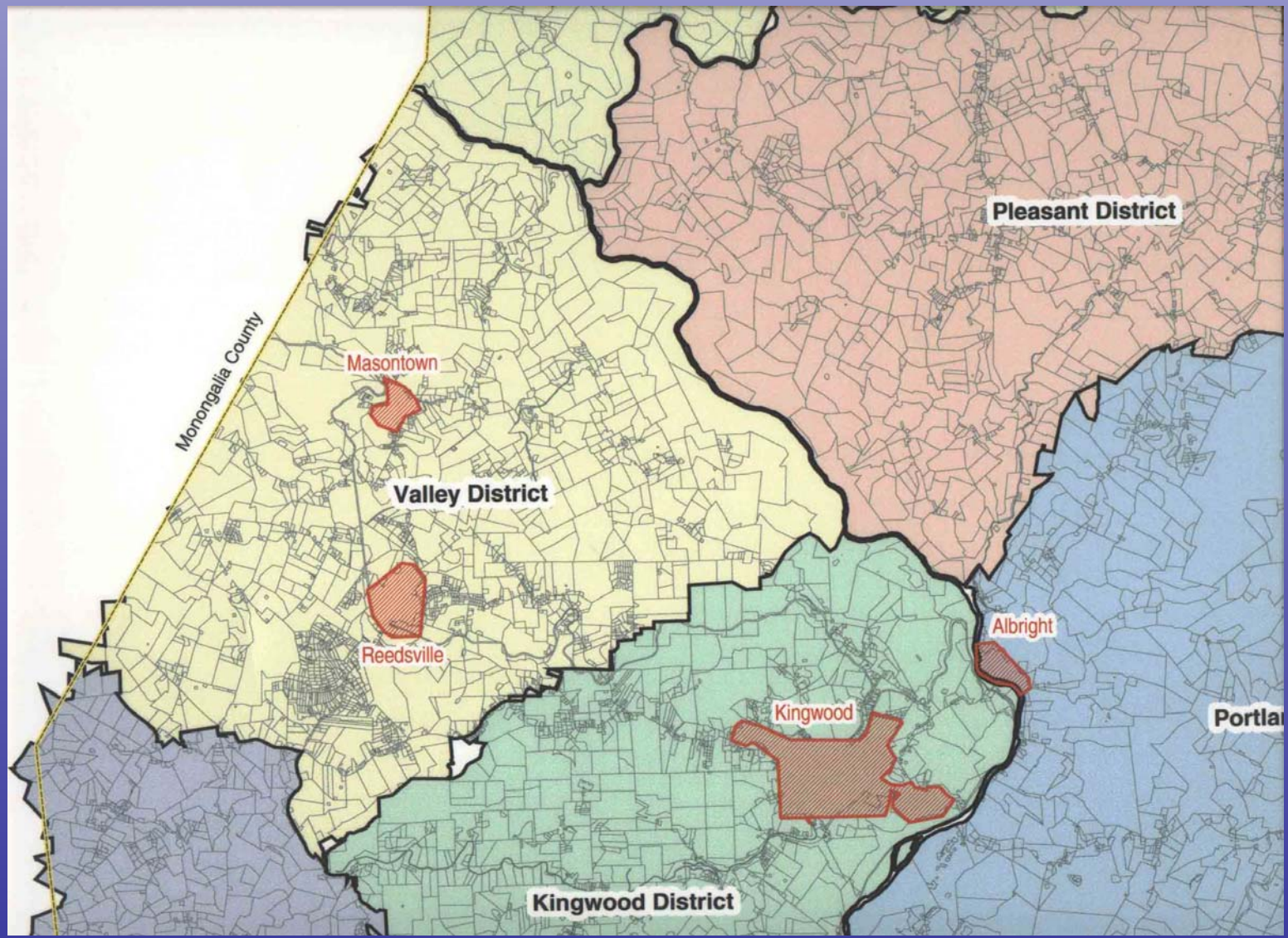


Seamless



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

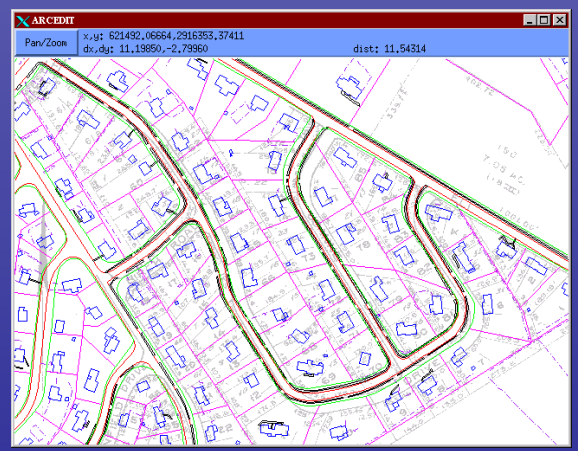
- A digital landbase is not the official cadastre of record – only a reference to it. A digital landbase does **not define** land tenure boundaries.

- 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

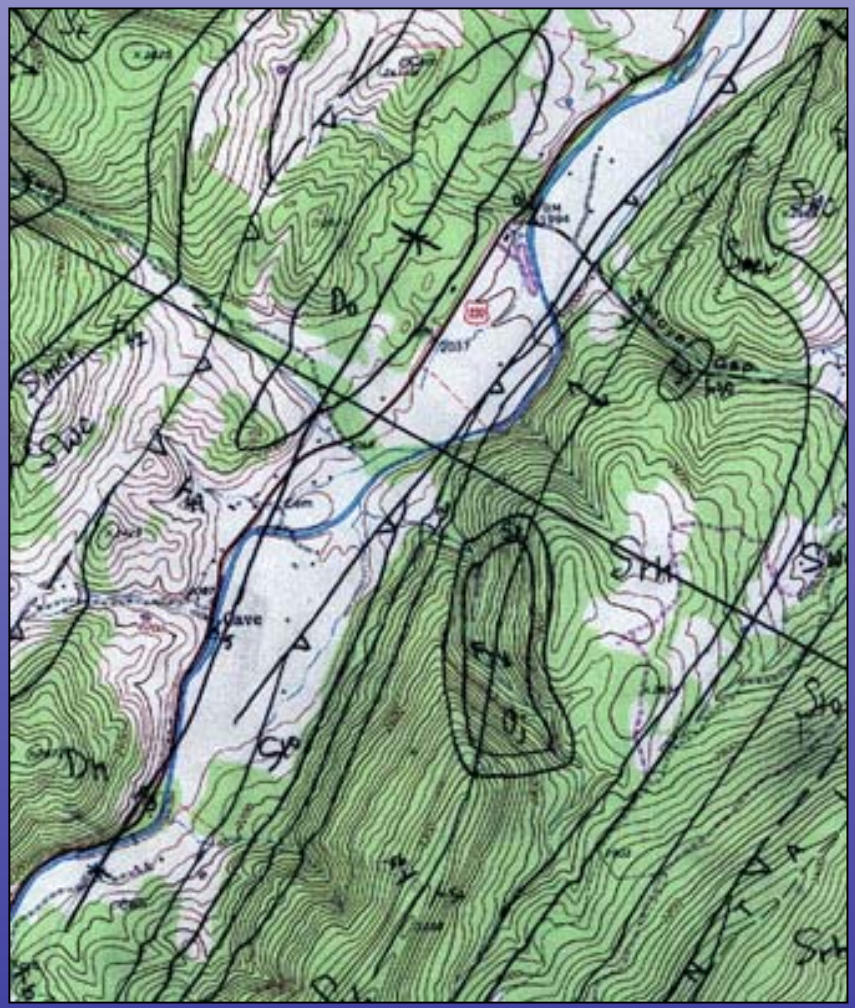
- **Approaches for parcel data automation**
  - Automation of hard copy $2 - $6+ /parcel
  - Conversion of CAD data $2 - $6+ /parcel
  - Parcel deed research (COGO) $15 - $20/parcel

- **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

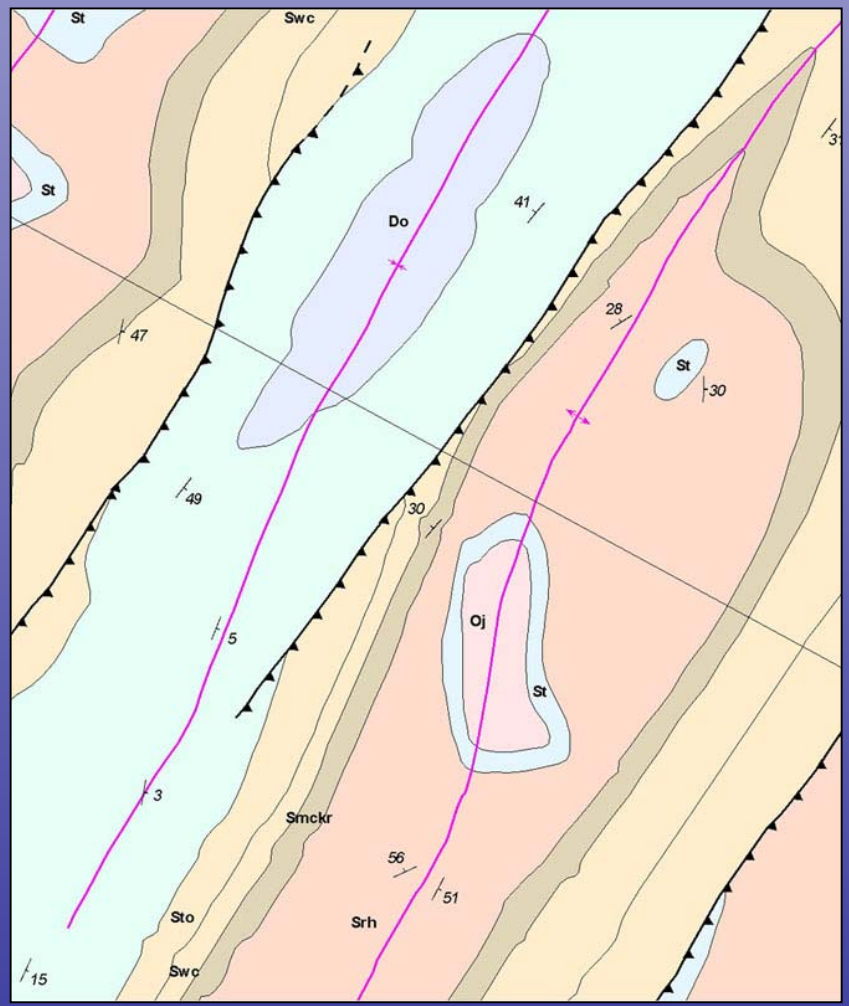


Source: Applied Geographics, Inc.

Digital Conversion - Geology



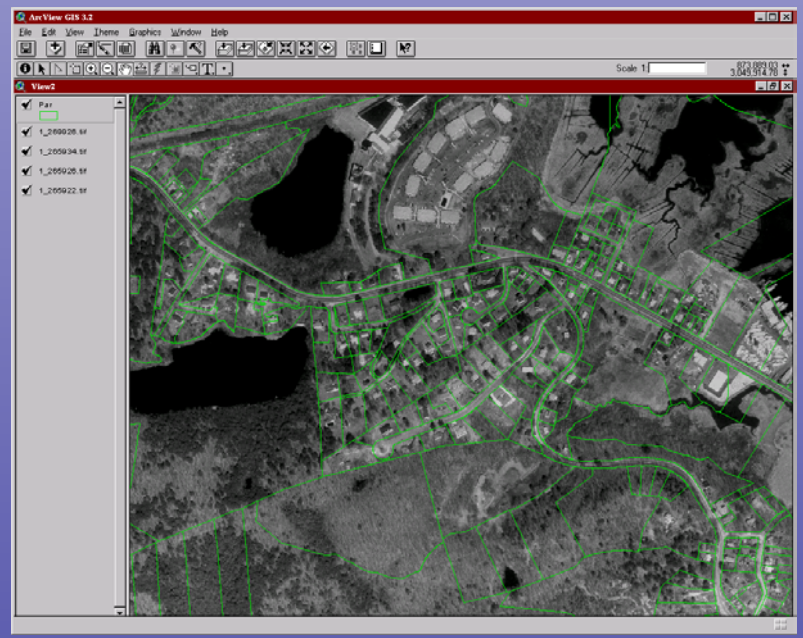
Hand drawn geologic features on USGS 1:24,000-scale topographic map



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

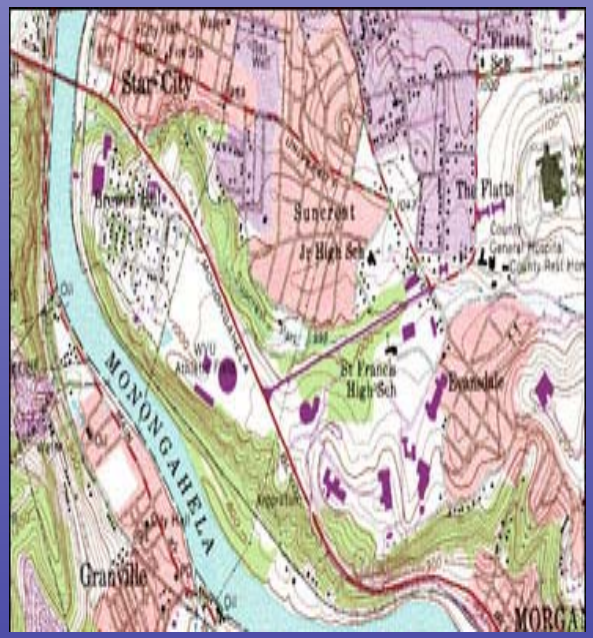


- Create topology
- Label parcels with their ID number (e.g. Map and Lot) Link to to CAMA database
- Obtain “dump” from CAMA in DBF, MDB or ASCII
- Database “table join” using ID number as primary key
- Produce checkplots
- Integrate parcel related features with other reference base layers
- Create electronic 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

Scale: 1:24,000
1” = 2,000 ft.

Date: avg. map 23 yrs. old

CIR AERIAL PHOTOS

Scale: 1:12,000
1” = 1,000 ft.

Date: 1996-97

AERIAL PHOTOS

Scale: 1:4800
1” = 400 ft.

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

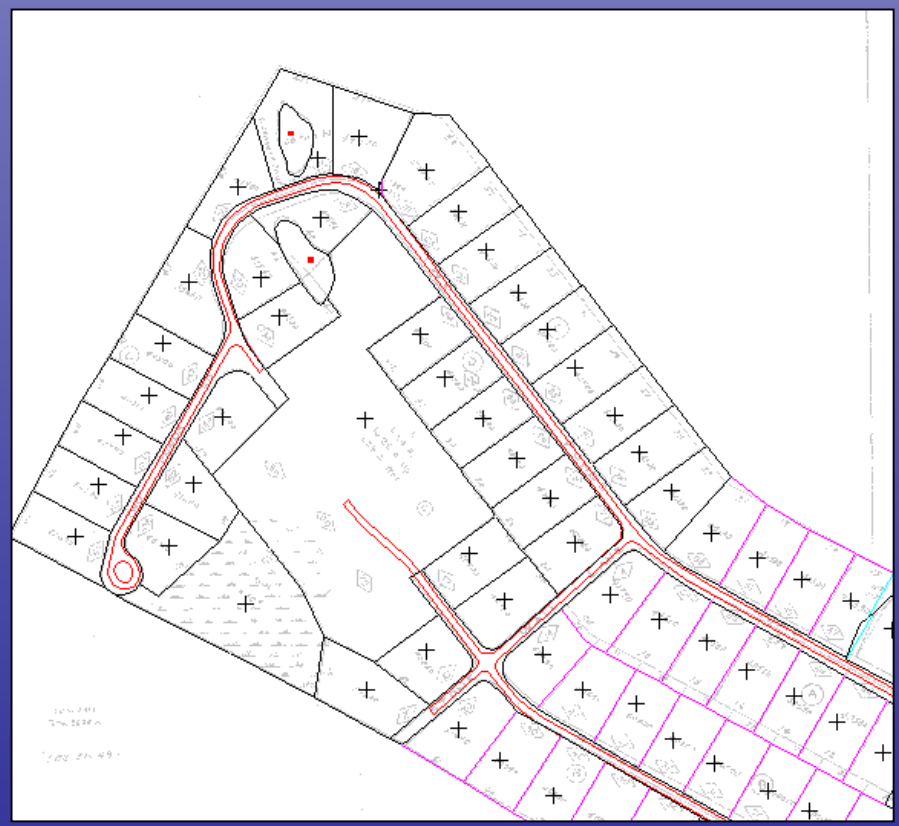
Reference Datasets

- Road and Water Layers
- Arial Photography

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

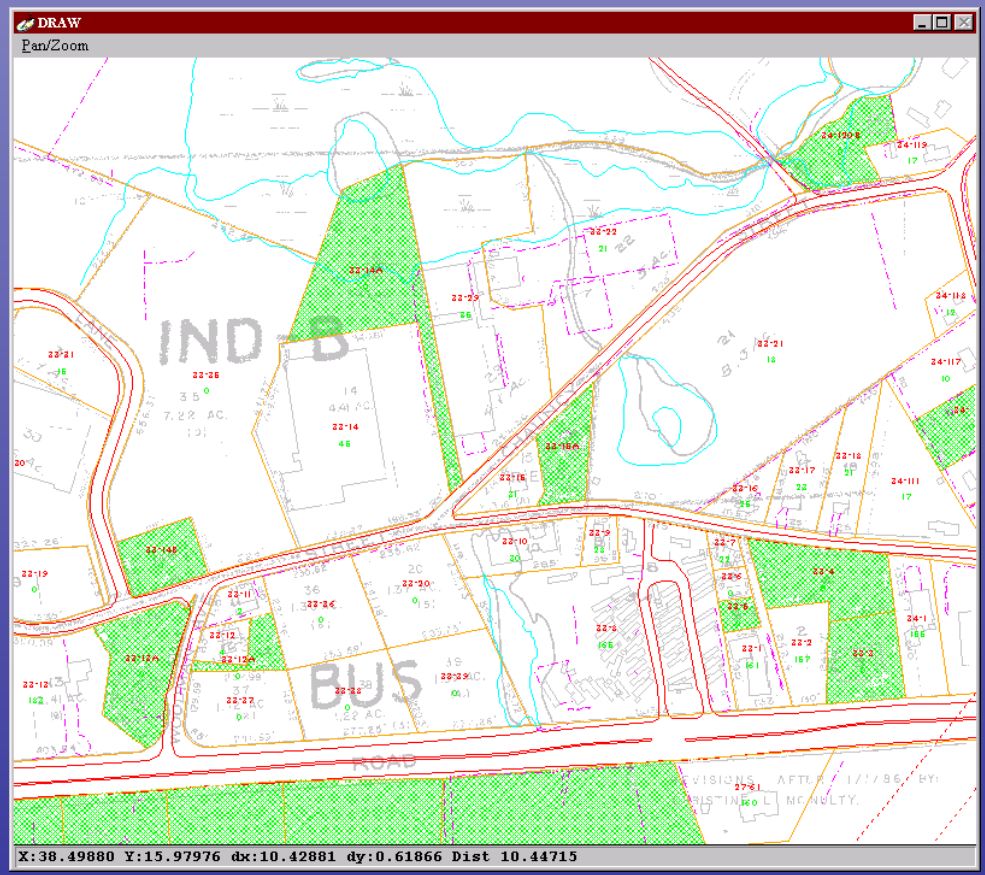
Parcel Line Work Adjustments

- 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

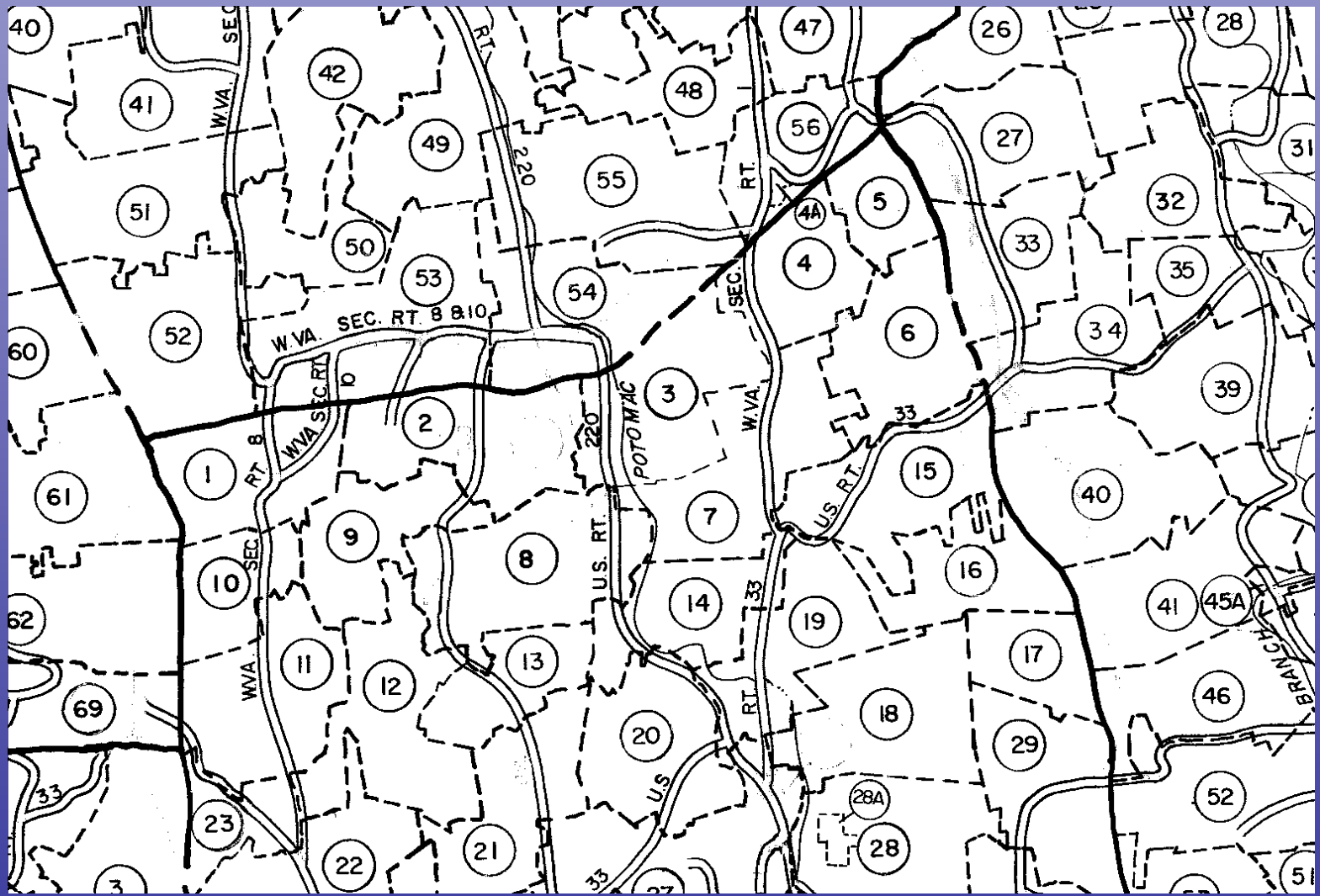
Map Tile Reference System

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

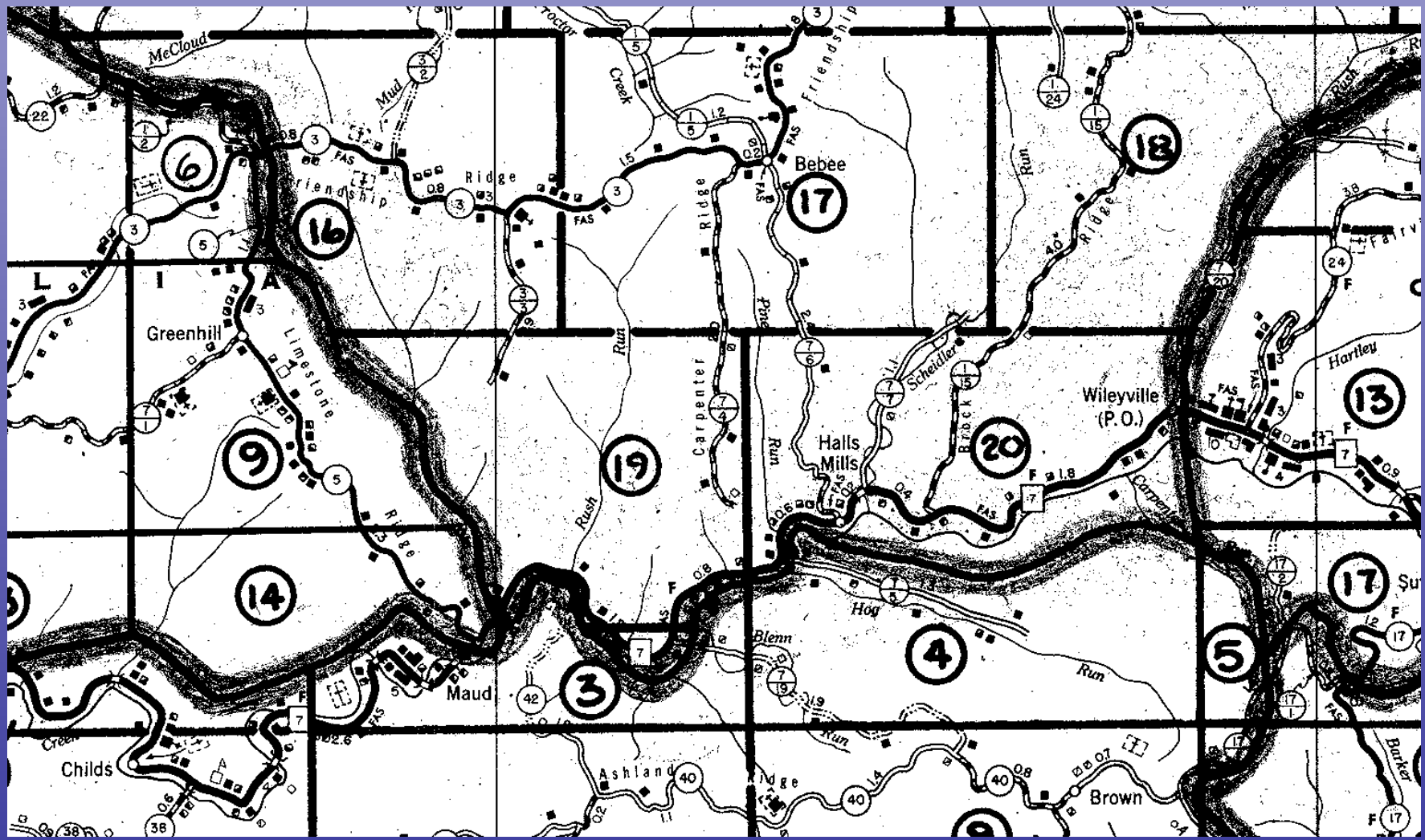
Map Tile Reference System: The parcel reference system for each county is subdivided into rural tax districts and corporations, which are further subdivided into map tiles / map sheets. The type of parcel reference system is determined by the primary map scale (usually 1”=400’ scale) configuration for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

Random Grid – Pendleton County



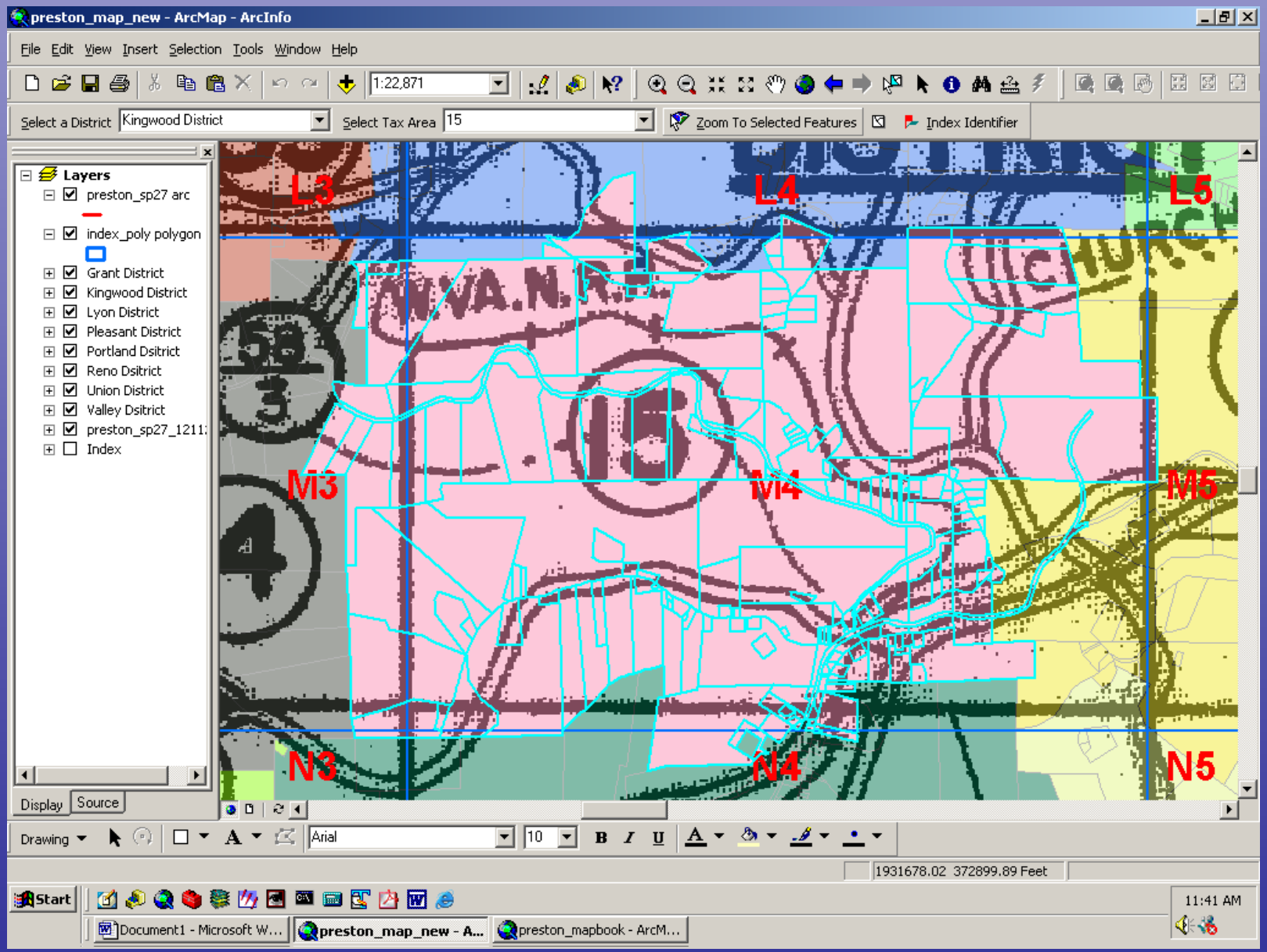
Random Orientation, No uniform tile size, No nesting of 100’ and 400’ scale maps

Modified Grid - Wetzel County

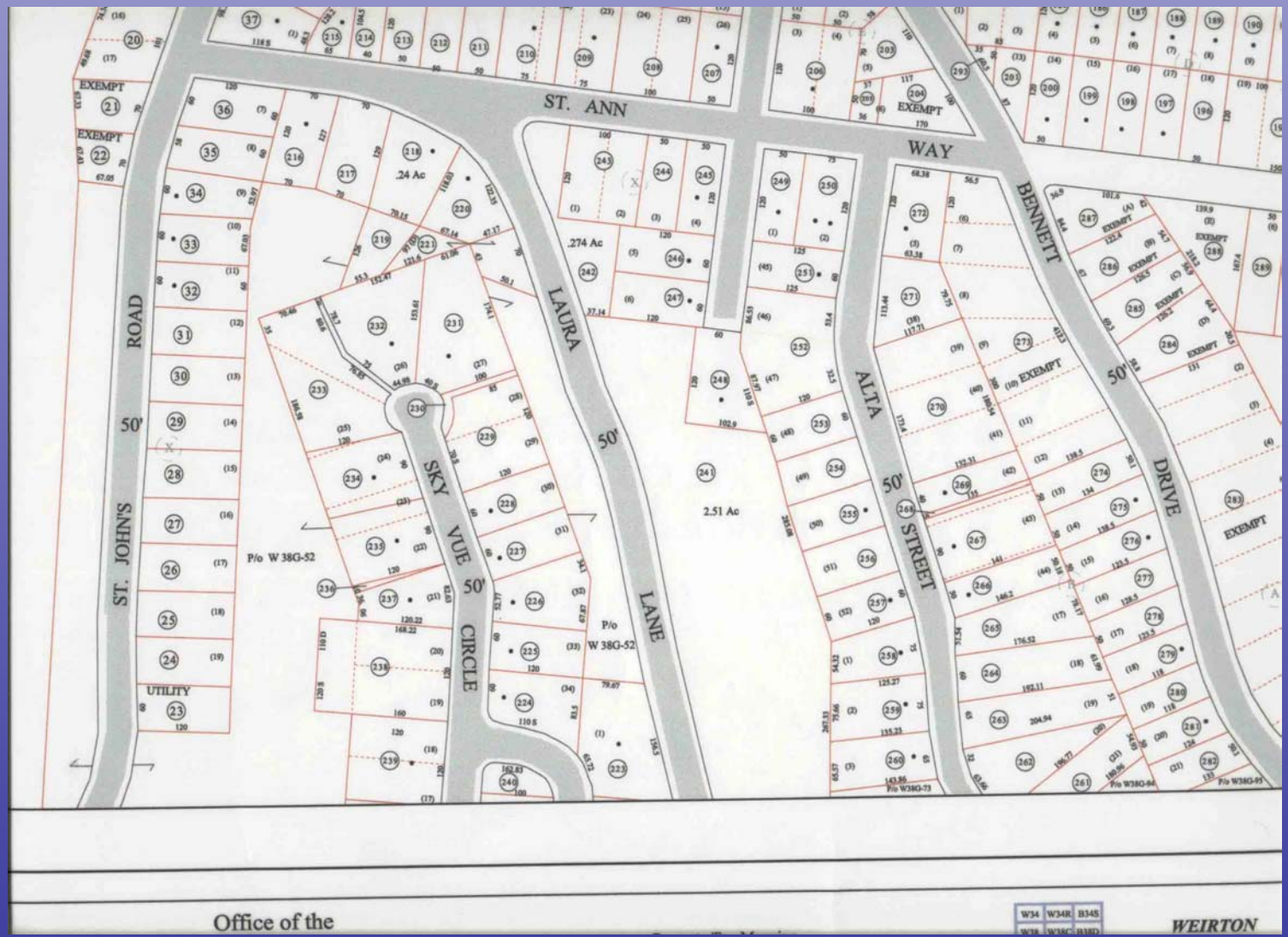


True North Orientation, No uniform tile size, No nesting of 100’ and 400’ scale maps

Electronic Map Books – using indexes

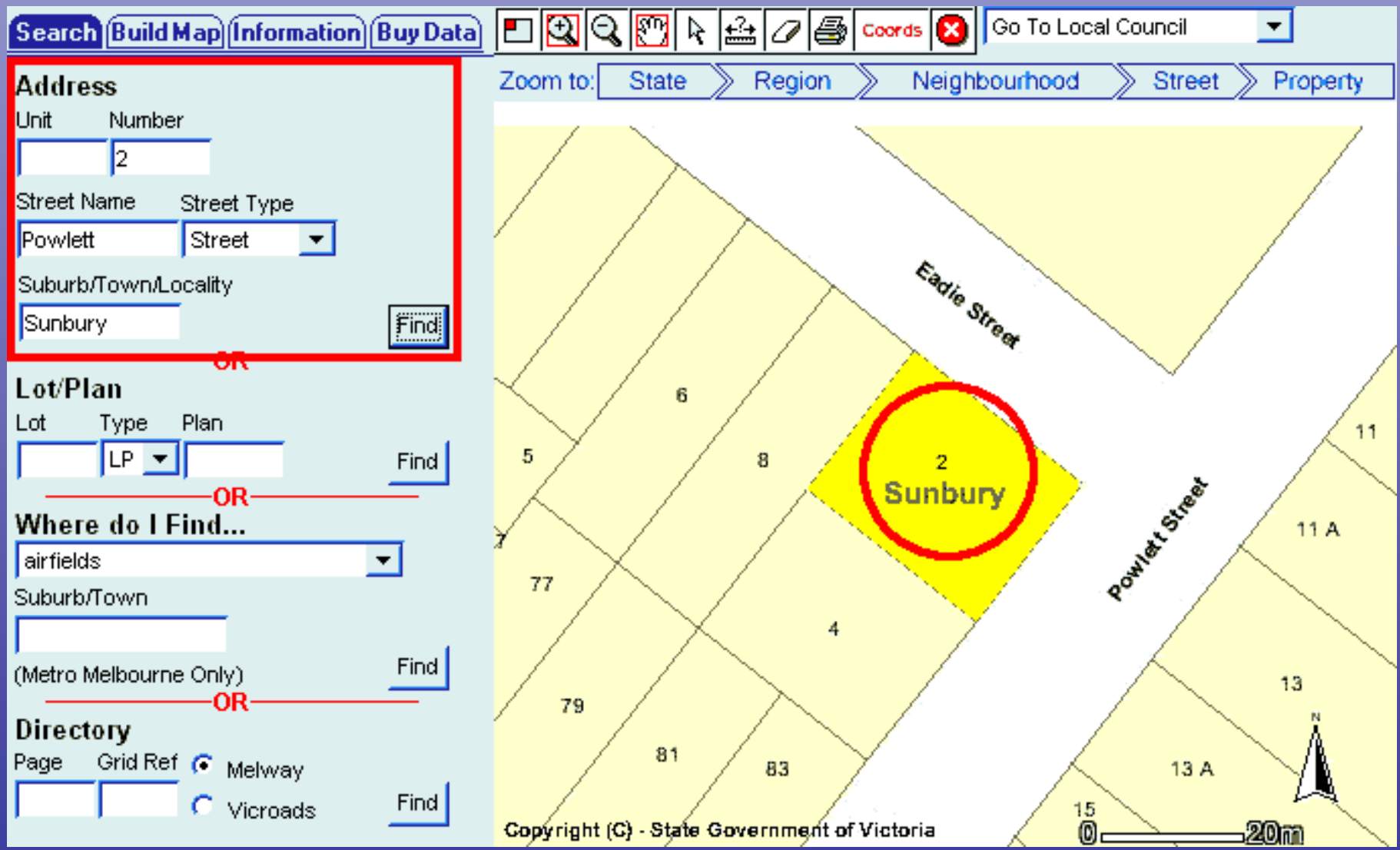


Map Products – Pretty Maps



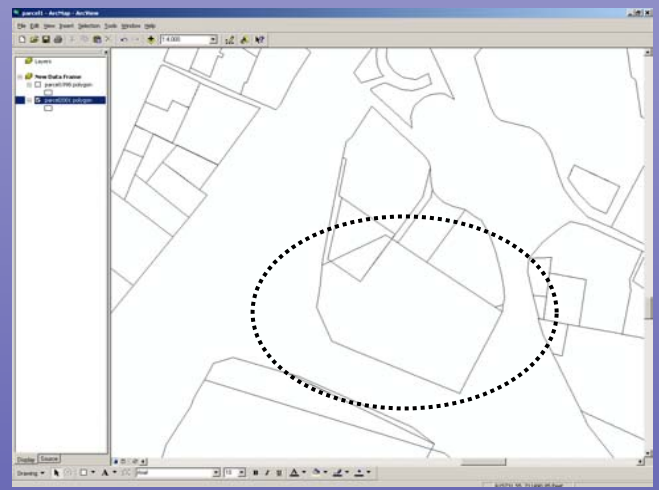
- *Visually appealing cartographic product*
- *Print-ready electronic versions*

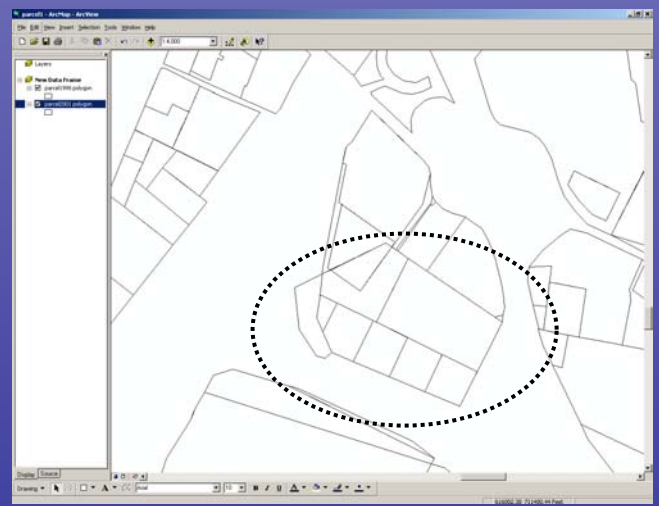
Internet Applications



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.

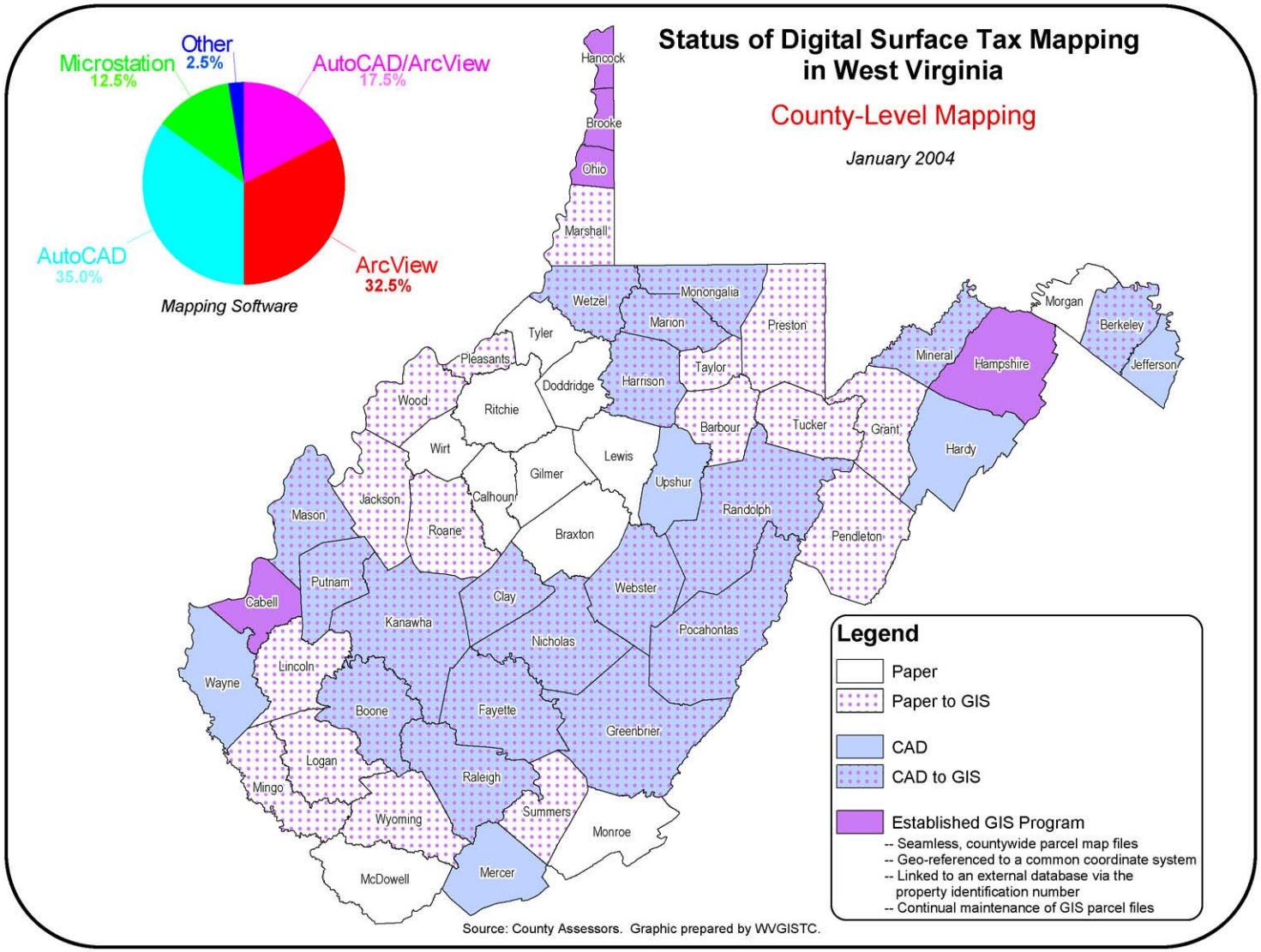
Challenges – digital conversion

- **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



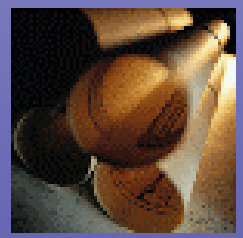
Components of a Tax GIS

- 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

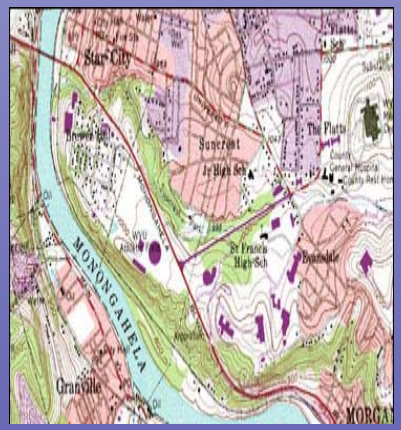
GIS software provides the functions and tools users need to store analyze, and display geographical information. It includes the assessment database software.

- 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

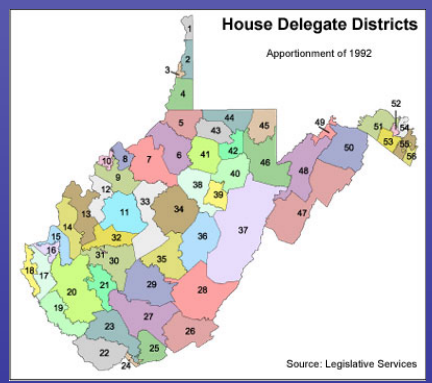
Image

Digital Ortho Quarter Quad
Aerial Photography

A form of GIS data structure that quantizes space into an array or 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

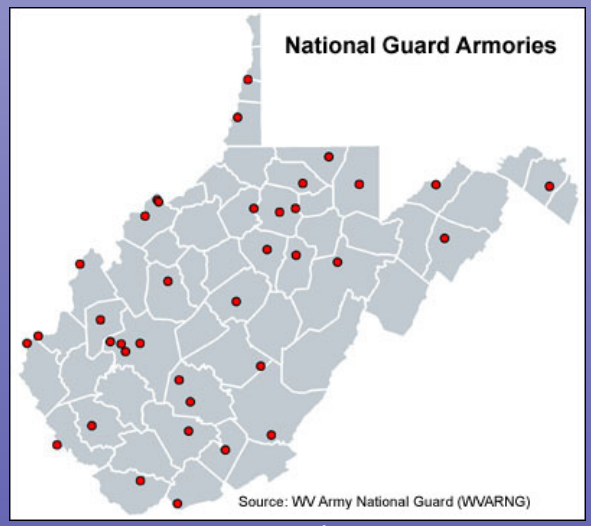


County boundaries with
linked data

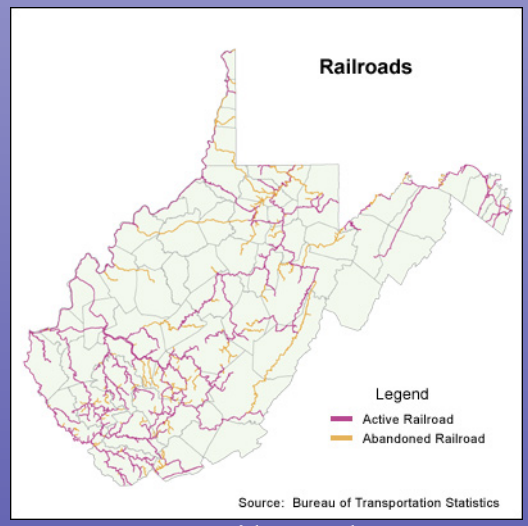
A graphic data structure that represents the points, lines, and areas of geographical space by exact X and Y coordinates.

WV Spatial Data Infrastructure

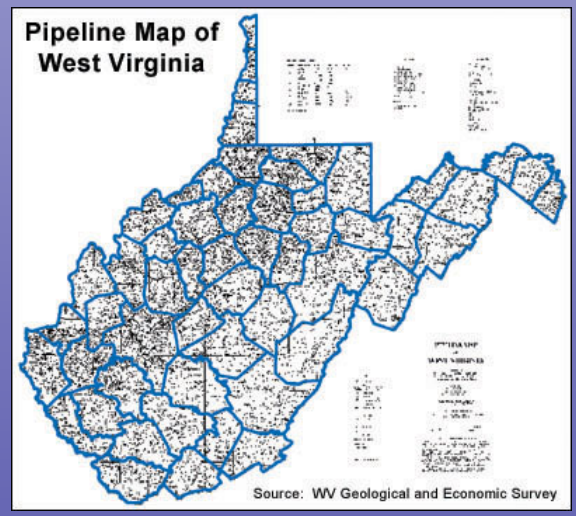
Access to $50 million dollars worth of spatial data



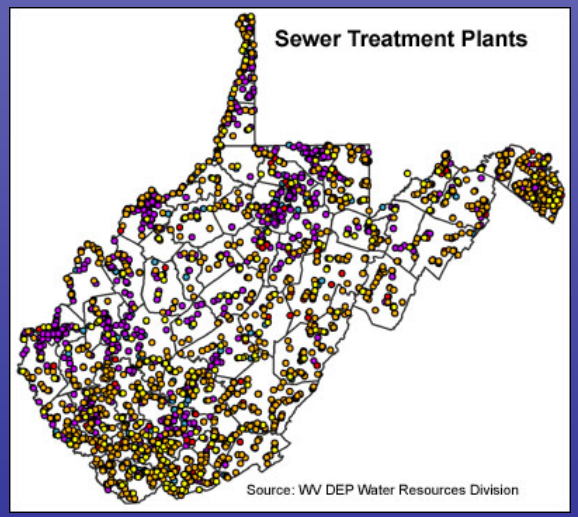
Armories



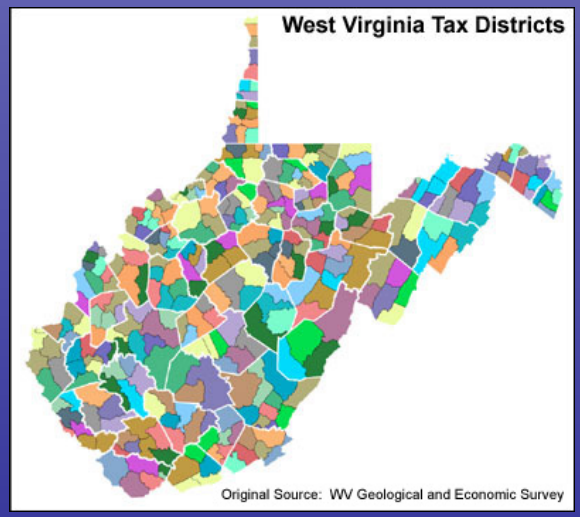
Railroads



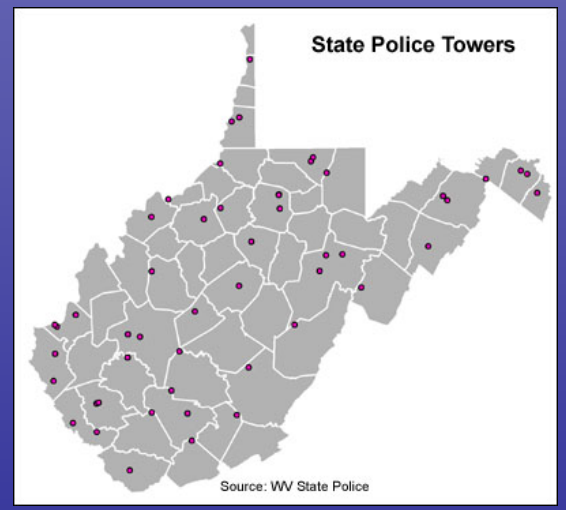
Pipelines



Sewer Treatment Plants



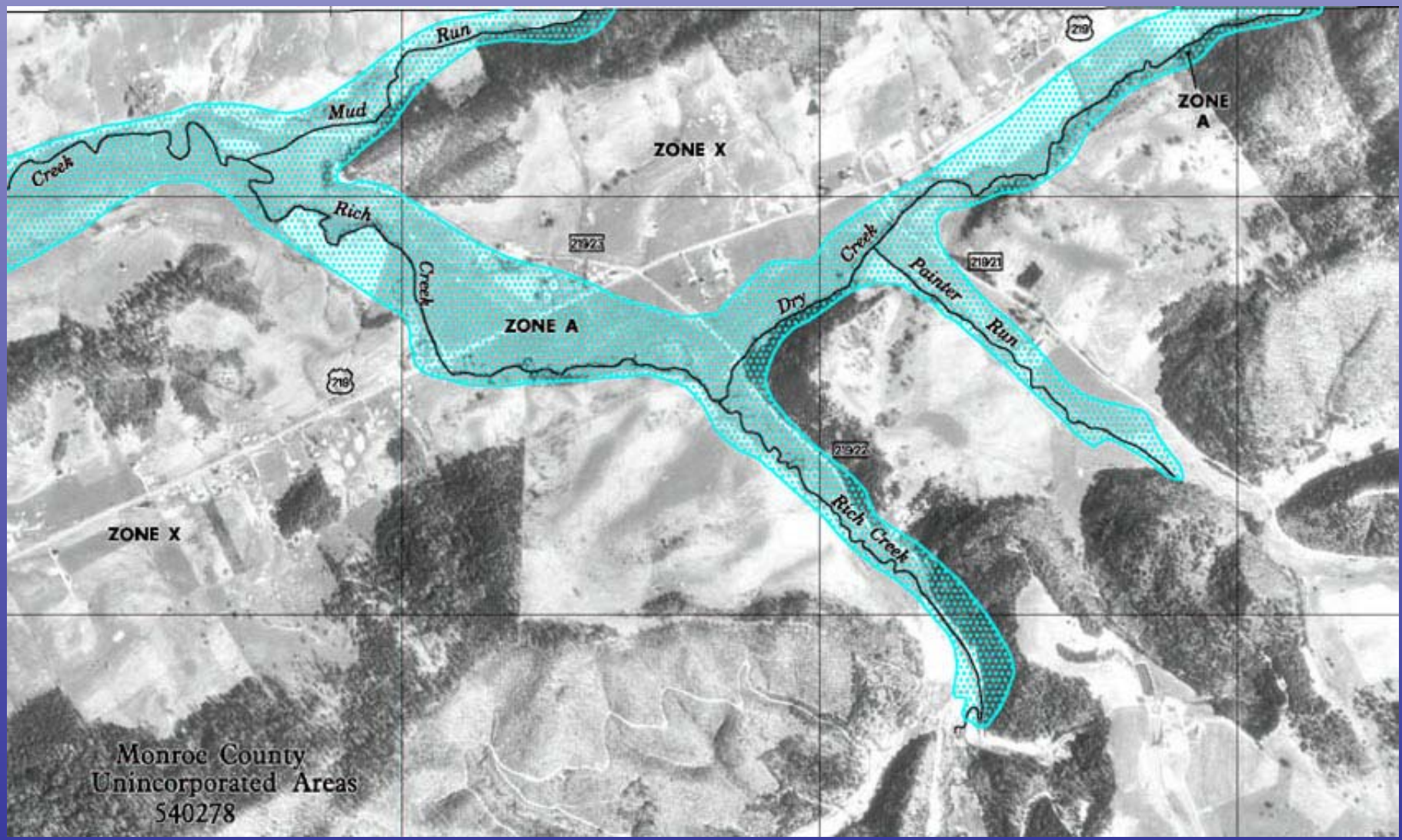
Rural Tax Districts



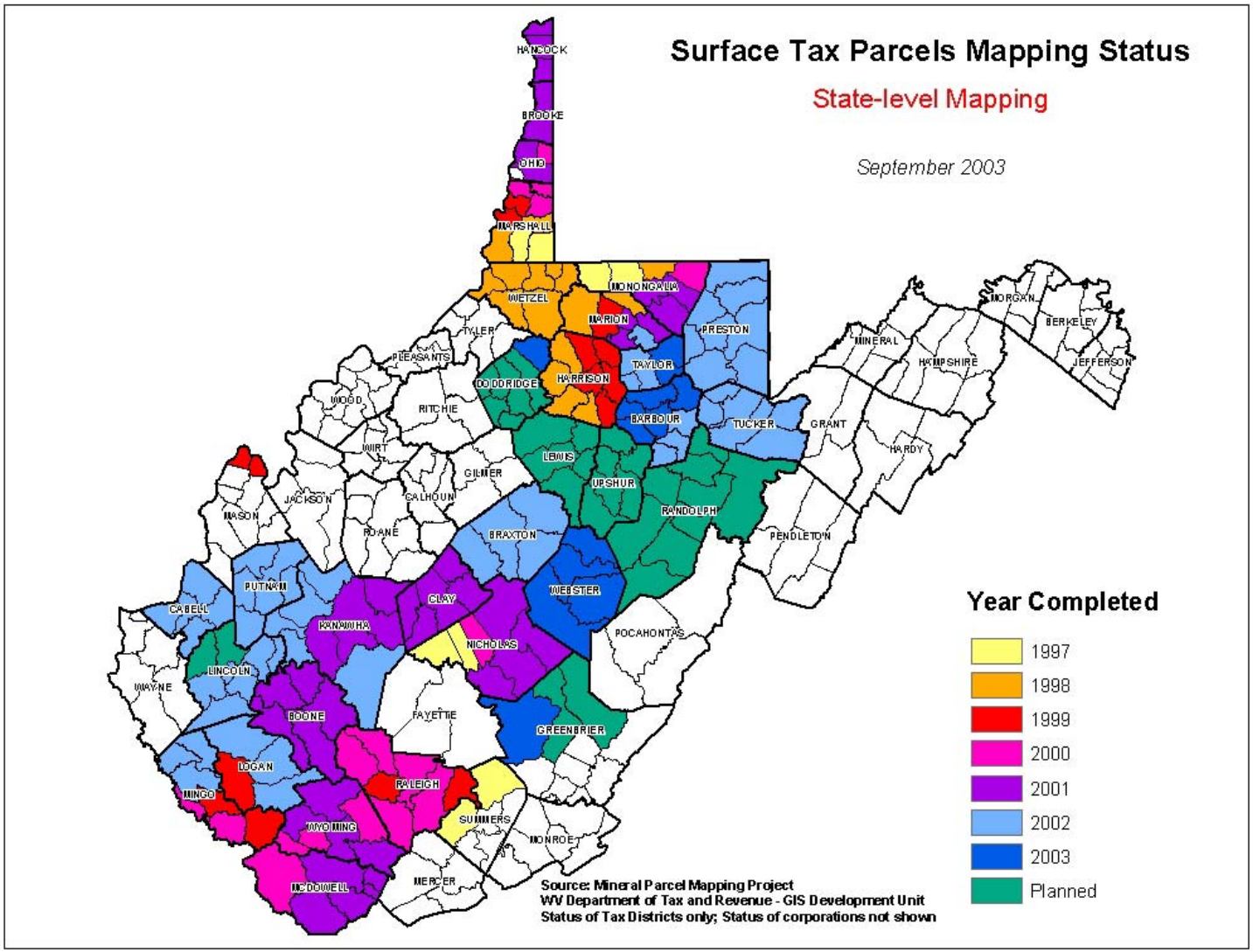
Police Towers

WV Addressing & Mapping Layers ($15 million value)

Digital Flood Layers

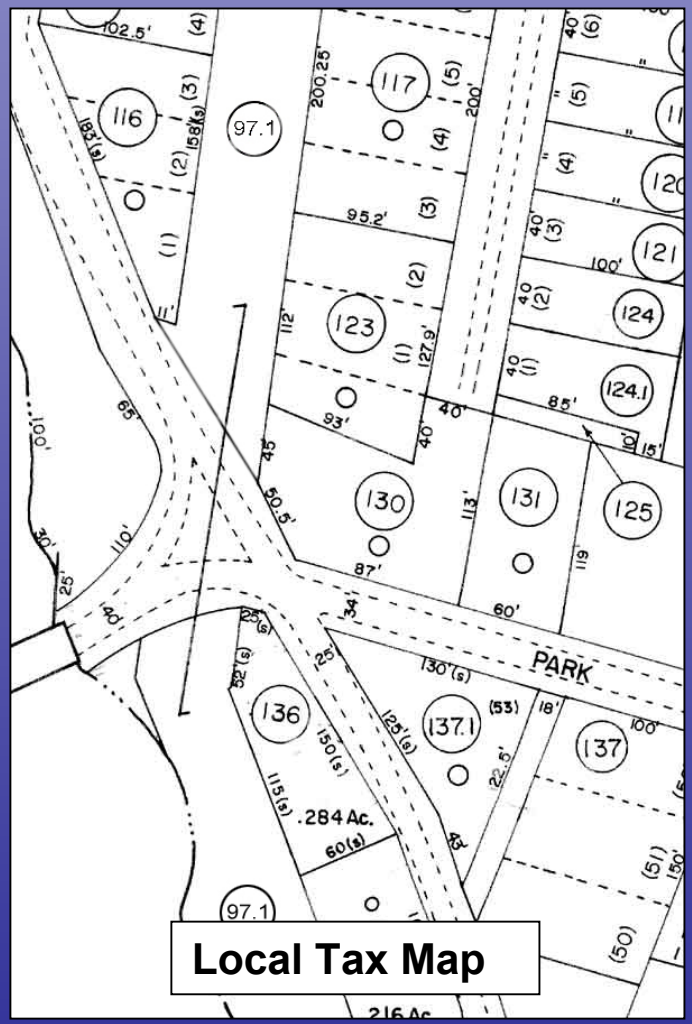


Mineral Parcel Mapping Project - WVDTR



Mineral Parcel Mapping Project

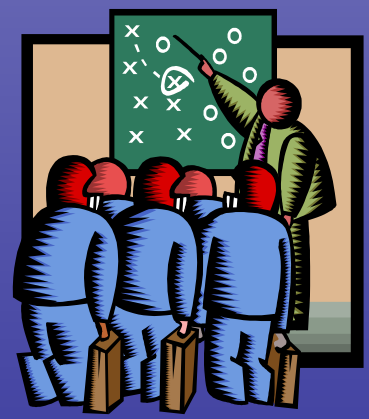
- *Can be a starting point for digital tax map conversions*
- *Not all surface parcel related features collected*
- *Not continually updated*



People

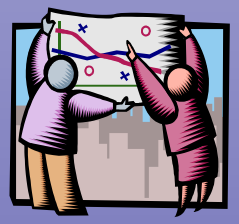
GIS technology is clearly of limited value without people to manage the system and to develop plans for applying it.

- **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

Vision

- **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

Methods (cont.)

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

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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