

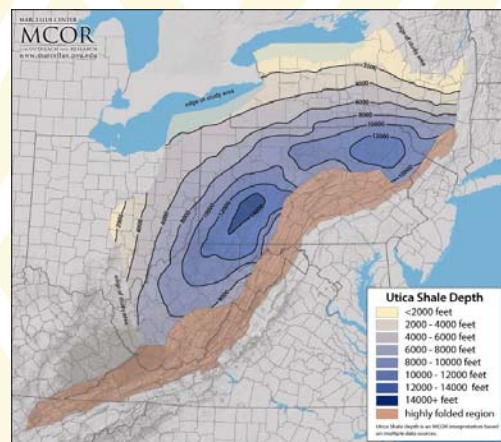
INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

Shawn T. Grushecky, Ph.D



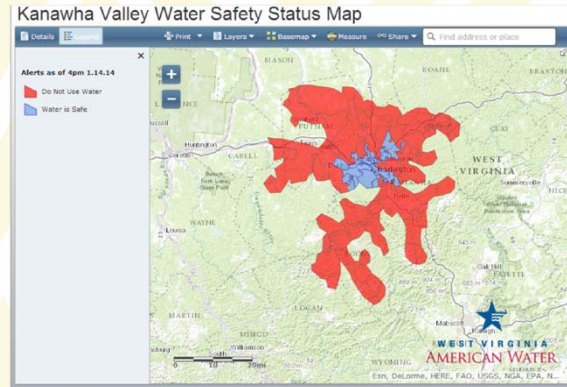
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BOMBARDED WITH SPATIAL INFO



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CHARLESTON, WV



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WHAT IS GIS ANYWAY?

- Geographic information systems link geographic information with descriptive information
- “provides map-based access to information”
- Data do not have to have spatial context – can link to data not in GIS
 - Reports
 - Images
 - Videos
 - Linkages to outside databases



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DATA MANAGEMENT IS FOUNDATION OF GIS

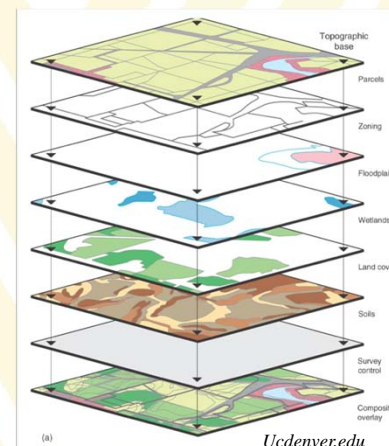
- Large amounts of digital information must be
 - Managed
 - Organized
 - Displayed



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GIS PROVIDES FRAMEWORK FOR DATA MANAGEMENT

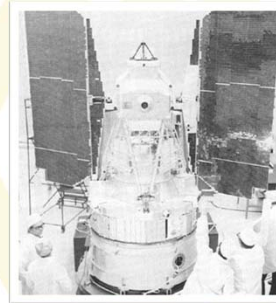
- GIS used to enter, maintain, store, distribute, and analyze geospatial data
- Geographic data – things that have a location
 - Homes (date, depth, lateral, production)
 - Roads (name, lanes, type, quality)
 - Rivers (size, type)
- Geographic data can be “stacked” – allowing data access from multiple layers



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HISTORY OF GIS – FIRST USES

- Early 1960s: Canada Geographic Information System, Canada Land Inventory
- Late 1960s: academic work in GIS, textbooks, computer cartography
- Early 1970s: digitizing advances, Landsat 1 satellite launched
- Early 1980s: major commercial GIS software available (ESRI's "ArcInfo" – precursor to ArcGIS)



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COMPONENTS OF A GIS

- Hardware : computer, server, GPS, plotters
- Software :ARCGIS, GRASS, Bentley, Autodesk
- Data
- Methods & protocols: standards
- People: GIS professionals



Bolstad, Chapter 1 Page 13



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FIVE ESSENTIAL FUNCTIONS OF A GIS



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1. CAPTURING SPATIAL DATA

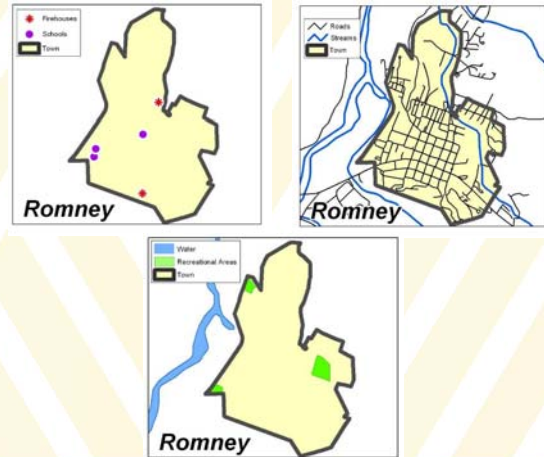
- GPS Receivers
- Scanning Existing Maps
- Mapping Websites
- Mapping From Aerial Photos



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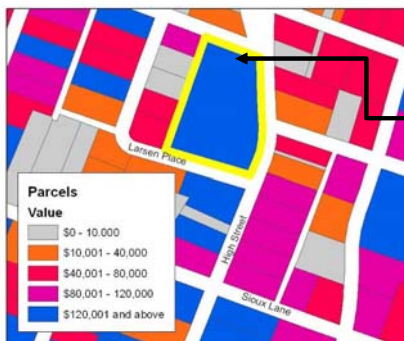
2. STORING SPATIAL DATA

- Spatial Features & Descriptive info
 - Points – wells, pipeline taps, houses,
 - Lines – roads, streams
 - Polygon – water bodies, ownership



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SPATIAL FEATURES LINKED TO DB

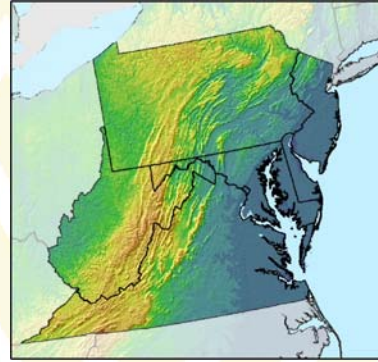


Parcel ID	Owner	Acres	Zoning	Building Value	Year Built
08-001	West, Peggy	0.45	R	\$64,000	1954
08-002	School District	5.12	Ex	-	1972
08-003	North, Tim	1.33	R	\$72,000	1956
08-004	7-Eleven	2.03	C	\$92,000	1995



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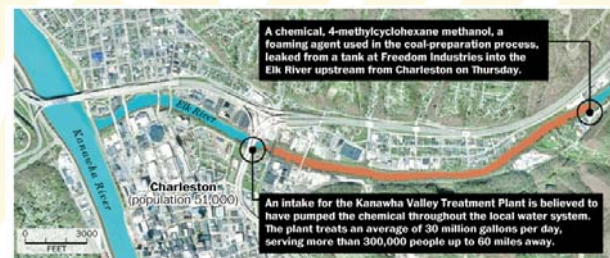
IMAGERY AND GRID-BASED DATA



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3. ANSWERING QUESTIONS

- Feature size/location
- spatial relationships of features from different datasets/layers
- Distance



Population affected:

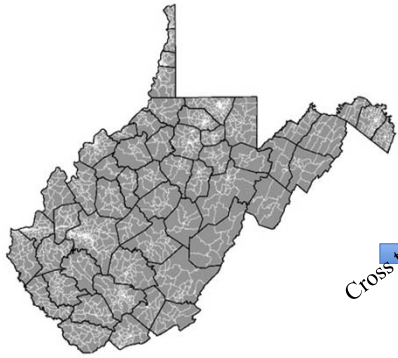
- Total population: 294,350; of that 65,237 are children
- 123,451 households
- Median household income is \$47,191 (W.Va. average is \$40,400)
- Number of families: 78,856; of those 8,445 in poverty; poverty rate 10.7 percent (W. Va. average)

Source: Google Earth and the U.S. Census Bureau. Gene Thorpe/The Washington Post. Published on January 10, 2014, 7:45 p.m.



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HOW DID THEY ANSWER?



Census Block polygons:
stored detailed population data

Cross tabulate

Water use ban area



Result

Total population:
294,350 including 65,237
children

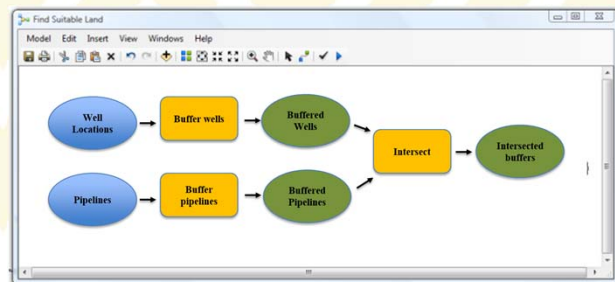
Total families: 78,856
including 8,445 in poverty



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4. ANALYZING DATA

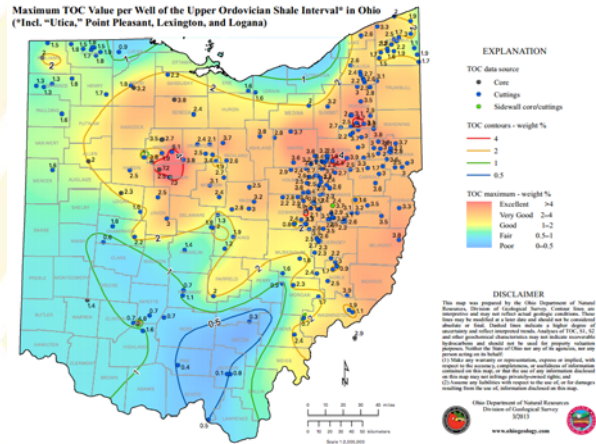
- Combining data layers
- Proximity analyses: what's nearby?
- Compare temporal changes
- Modeling
- Network Analysis and "problem solving"



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5. DISPLAYING DATA

- Summarizing with map or graphic
- Visually interpret results



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LIMITATIONS OF GIS

- “Static” or snapshot nature of spatial data – need for frequent updates
- Need standard protocols, methods to ensure proper use of data, analyses
- Expenses involved in data acquisition, specialized training, etc.
- know why GIS is necessary for your needs: careful planning and organization required

Source: Bolstad, Chapter 1, Page 18



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GIS IN ACTION – ENERGY LAND MANAGEMENT

- Examples using familiar data



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<http://wvgis.wvu.edu>

The screenshot shows the West Virginia GIS Technical Center website. The header includes the logo and navigation links: Home, GIS Data, GIS People, Resources, Training, About, and Help. The main content area is organized into three columns:

- About:** Text describing the center's services, including State Data Clearinghouse, a GIS Resource Directory, and the MapIt! gov web mapping portal. It also lists contact information for the WV GIS Technical Center.
- Data Spotlight:** A map of West Virginia with red dots indicating specific locations. Below the map is the text "Emergency Medical and Ambulance Service (EMAP)".
- Featured Organizations:** A list of four organizations with their logos and names: Map West Virginia, State GIS Coordinator, West Virginia Association of Municipalities, and Official Website of West Virginia.

At the bottom of the page, there is a "News & Jobs" section with a heading "Grant funds available from WV Geological and Economic Survey to promote economic development" and a brief description of the grant program.



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The screenshot shows the 'WV State GIS Data Clearinghouse' website. At the top, there is a navigation menu with 'Home', 'GIS Data', 'GIS People', 'Resources', 'Training', 'About', and 'Help!'. Below the menu is a search bar with a 'Keyword Search' field and a 'Browse By Category' dropdown. A 'Search' button and an 'Options' button are also present. Below the search area is a table listing various GIS data categories and their download options.

A Data Set	Category	Summary Data	Date Created	Download	Web Service
Air Pollution Non-Alignment Areas	Environmental Resources	W	2005	Download	
Airport (Proposed Regional)	Transportation	W	2002	Download	
Airport Facilities	Transportation	W	2008	Download	
Airport Runways	Transportation	W	2002	Download	
Appraisals	Transportation	W	1996	Download	
Appalachian Counties (LARC Boundary)	Boundaries	W		Download	
Appalachian Oil and Gas Data (PTTC)	Economics	W	2002		
Archaeological Sites	Society and Culture	W			
Base Maps - S48S Planimetrics	History and Base Maps	W	2002	Download	
Base Maps - USFS Cartographic Feature File (CFF)	History and Base Maps	W	1995	Download	
Block Groups with Population Data (2002 and 2010 Census)	Society and Culture	W	2011	Download	
Blocks with Population Data (2010 Census)	Society and Culture	W	2011	Download	
Boat Launches	Society and Culture	W	2004	Download	
Bridges	Non-Build Structures	W	2008	Download	
Canaan Valley National Wildlife Refuge Boundary	Boundaries	W	2009	Download	
Catalogue of Aerial Historical Photos (1936 - 1976)	History and Base Maps	W		Download	
Census - Unincorporated Areas (1990 and 2000)	Locations	W	2011	Download	
Census Designated Places (2010)	Boundaries	W	2011	Download	
Census Tracts with Population Data (2010)	Society and Culture	W	2011	Download	
Cities with Population > 10,000 (Census 1990 and 2010)	Locations	W	2011	Download	
Cities with Population < 2,500 (Census 1990 and 2010)	Locations	W	2011	Download	
Community Health Care Providers	Health	W		Download	
Conditional Institutions - Federal, State and Local (HSP)	Non-Build Structures	W	2009	Download	
County Boundaries (1100,000 scale)	Boundaries	W	2008	Download	
County Boundaries (1:24,000 scale)	Boundaries	W	2002	Download	
County Seats	Locations	W		Download	



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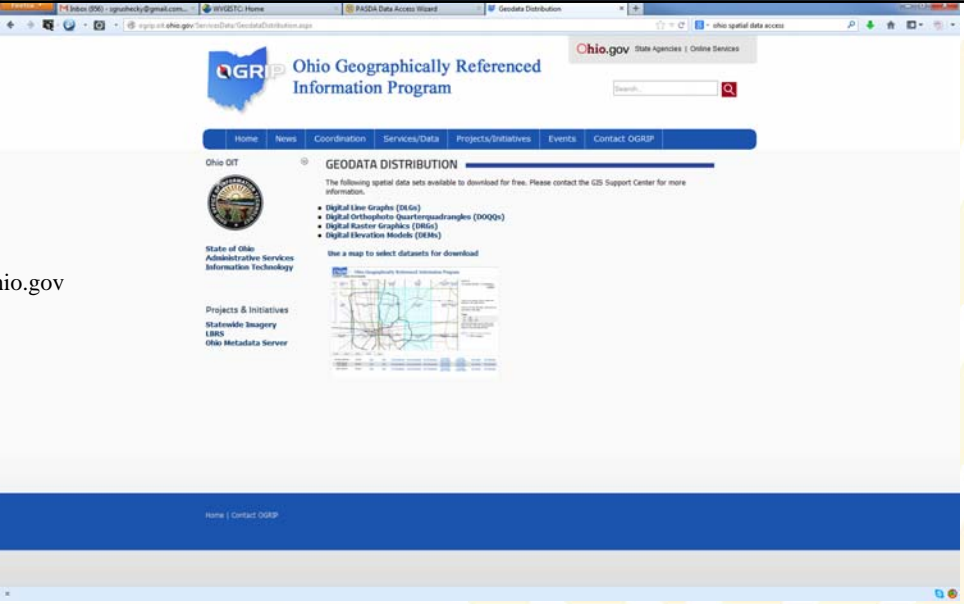
The screenshot shows the 'PASDA PENNSYLVANIA SPATIAL DATA ACCESS' website. The header includes the PASDA logo and the text 'The Pennsylvania Geospatial Data Clearinghouse'. Below the header is a navigation menu with 'Home', 'About PASDA', 'Download Data', 'Online Services', 'News & Events', 'Support Center', 'Services', and 'Help'. The main content area is titled 'Data Access Wizard' and features a 'Search Options' section with several search criteria: 'Search by Keyword(s)', 'Search by Theme', 'Search by Data Provider', and 'Search by County'. Each search criterion has a text input field and a 'Submit' button. There is also a 'View Your Map Cart' button. Below the search options, there is a link that says 'OR you can browse Online Map Services or Browse All Data'. At the bottom of the page, there is a footer with 'Site Map', 'Contact Us', and 'Disclaimer' links, along with contact information for the Pennsylvania Spatial Data Access team.

http://pasda.psu.edu



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<http://ogrip.oit.ohio.gov>



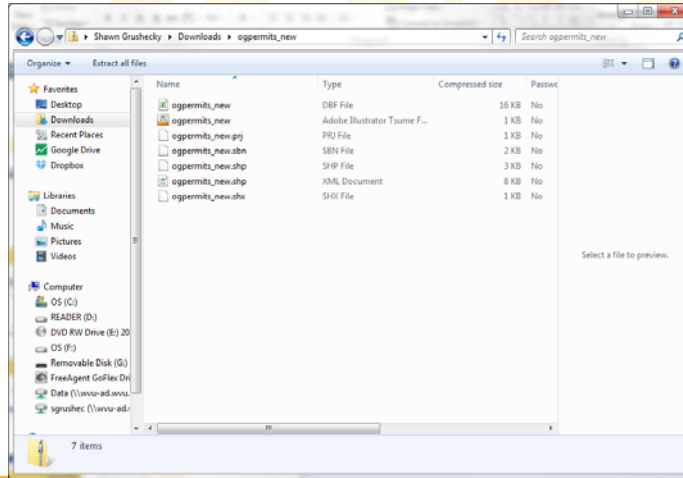
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TODAYS PROJECT

- Ownership
- Hydrology
- Relief/Topography
- Land Cover Type
- New OG Permits

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DATA DOWNLOAD



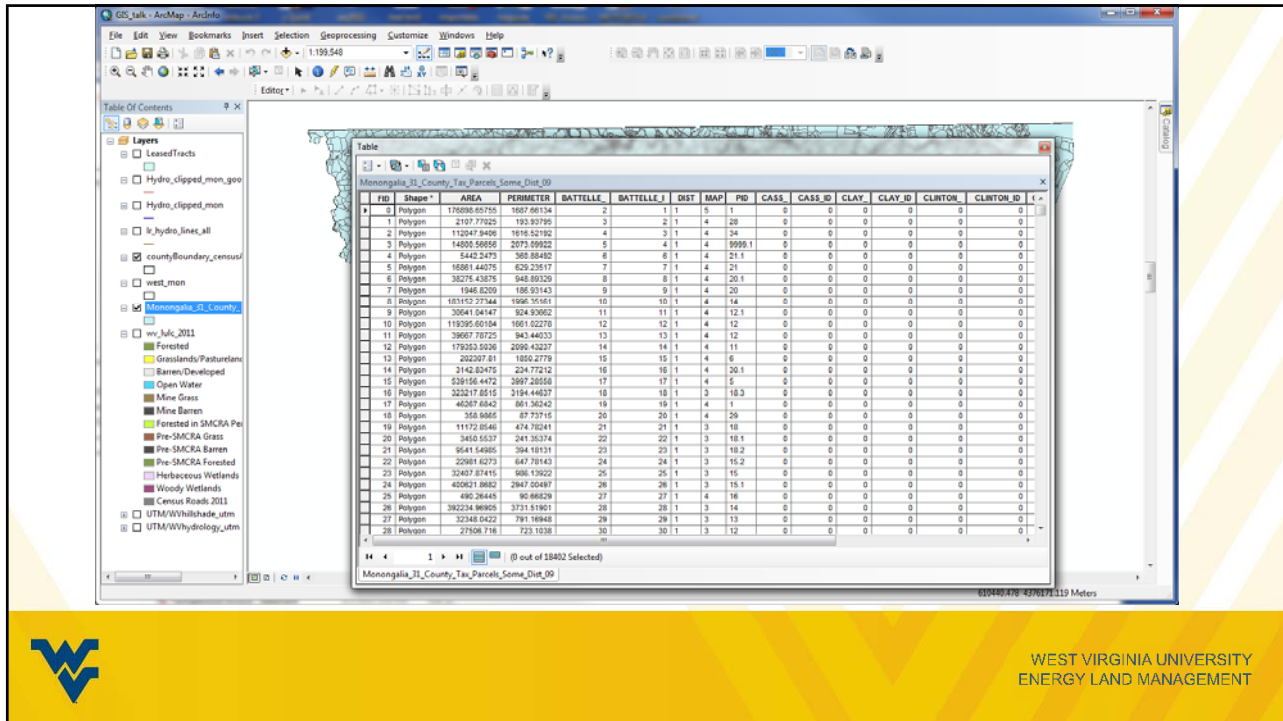
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DBF

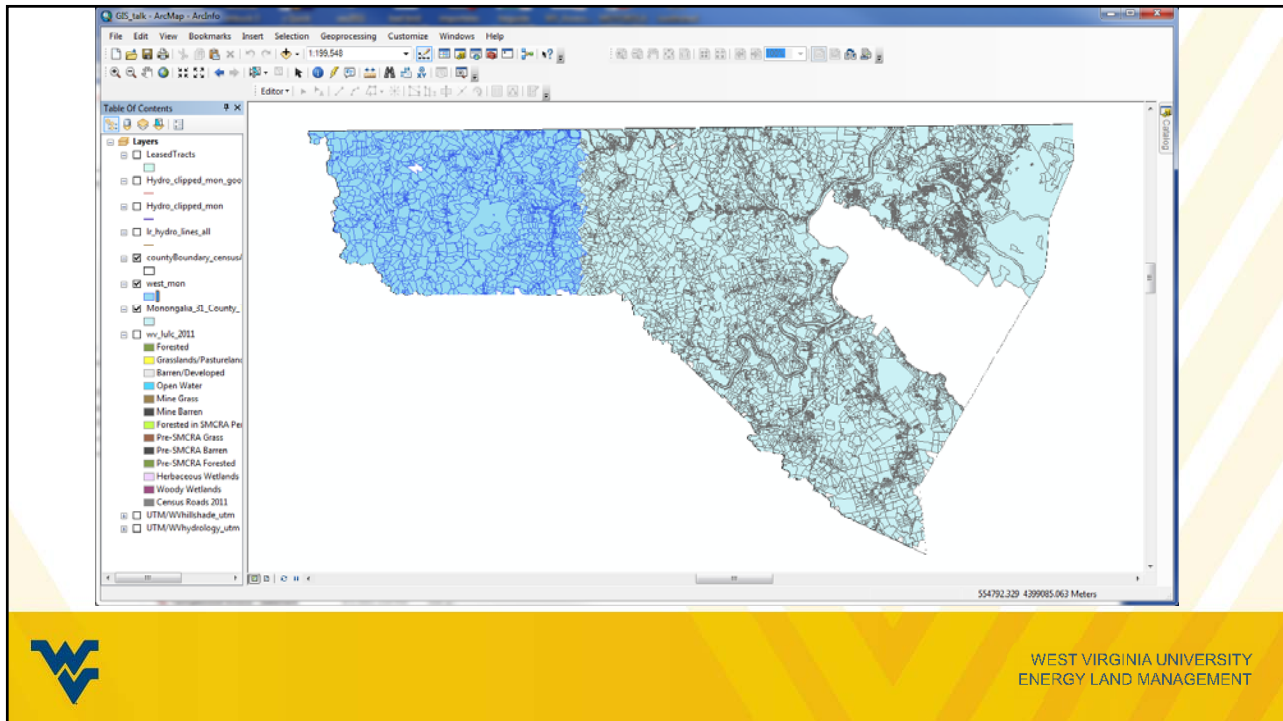
Permit ID	Date	Company Name
1	2/24/09	ANTERO RESOURCES CORPORATION
2	3/9/09	CHESAPEAKE APPALACHIA, L.L.C.
3	4/15/09	ANTERO RESOURCES CORPORATION
4	5/1/09	ANTERO RESOURCES CORPORATION
5	5/1/09	ANTERO RESOURCES CORPORATION
6	5/1/09	ANTERO RESOURCES CORPORATION
7	5/1/09	ANTERO RESOURCES CORPORATION
8	5/1/09	ANTERO RESOURCES CORPORATION
9	5/1/09	ANTERO RESOURCES CORPORATION
10	5/1/09	ANTERO RESOURCES CORPORATION
11	5/1/09	ANTERO RESOURCES CORPORATION
12	5/1/09	ANTERO RESOURCES CORPORATION
13	5/1/09	ANTERO RESOURCES CORPORATION
14	5/1/09	ANTERO RESOURCES CORPORATION
15	5/1/09	ANTERO RESOURCES CORPORATION
16	5/1/09	ANTERO RESOURCES CORPORATION
17	5/1/09	ANTERO RESOURCES CORPORATION
18	5/1/09	ANTERO RESOURCES CORPORATION
19	5/1/09	ANTERO RESOURCES CORPORATION
20	5/1/09	ANTERO RESOURCES CORPORATION
21	5/1/09	ANTERO RESOURCES CORPORATION
22	5/1/09	ANTERO RESOURCES CORPORATION
23	5/1/09	ANTERO RESOURCES CORPORATION
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46	5/1/09	ANTERO RESOURCES CORPORATION
47	5/1/09	ANTERO RESOURCES CORPORATION
48	5/1/09	ANTERO RESOURCES CORPORATION
49	5/1/09	ANTERO RESOURCES CORPORATION
50	5/1/09	ANTERO RESOURCES CORPORATION



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ADDING FIELD

Table

FID	Shape	AREA	PERIMETER	BATTELLE_	BATTELLE_I	DIST	MAP	PID	CASS_	CASS_ID	CLAY_
0	Polygon	962631.60625	5778.66953	128	128	1	8	2	0	0	0
1	Polygon	264815.64455	2286.26038	136	136	1	9	17	0	0	0
2	Polygon	103499.2203	1651.23316	144	144	1	9	4	0	0	0
3	Polygon	207248.20835	1929.94343	147	147	1	9	3	0	0	0
4	Polygon	129508.91745	1481.89218	158	158	1	9	1.1	0	0	0
5	Polygon	699259.2958	3381.88251	262	262	1	9	22	0	0	0
6	Polygon	288745.79745	3347.82174	321	321	1	9	42	0	0	0
7	Polygon	92152.58245	1444.82584	345	345	1	9	40.1	0	0	0
8	Polygon	38884.8796	817.83318	388	388	1	8	13.1	0	0	0
9	Polygon	4771.39005	421.15769	359	359	1	7	54	0	0	0
10	Polygon	184738.862	1879.89223	360	360	1	7	38	0	0	0
11	Polygon	48726.30115	965.13873	362	362	1	10	13	0	0	0
12	Polygon	65718.51705	1059.22593	363	363	1	7	19.1	0	0	0
13	Polygon	191039.20615	1736.93759	365	365	1	9	31	0	0	0
14	Polygon	58152.16895	978.82097	366	366	1	9	40	0	0	0
15	Polygon	16114.64955	538.79862	367	367	1	8	5.2	0	0	0
16	Polygon	397927.34705	4032.43969	369	369	1	7	37	0	0	0
17	Polygon	185537.88545	1208.35758	370	370	1	9	40.3	0	0	0
18	Polygon	4413.02375	292.4245	371	371	1	8	23.2	0	0	0
19	Polygon	194895.29675	2367.29052	372	372	1	8	38	0	0	0
20	Polygon	233792.0182	2391.49301	373	373	1	7	56	0	0	0
21	Polygon	887.8448	138.14378	374	374	1	8	22	0	0	0
22	Polygon	4953.1307	254.26582	375	375	1	8	23	0	0	0

Add Field

Name:

Type: **Short Integer**

Field Properties: Long Integer, Float, Double, Text, Date

OK Cancel

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Table

west_mon

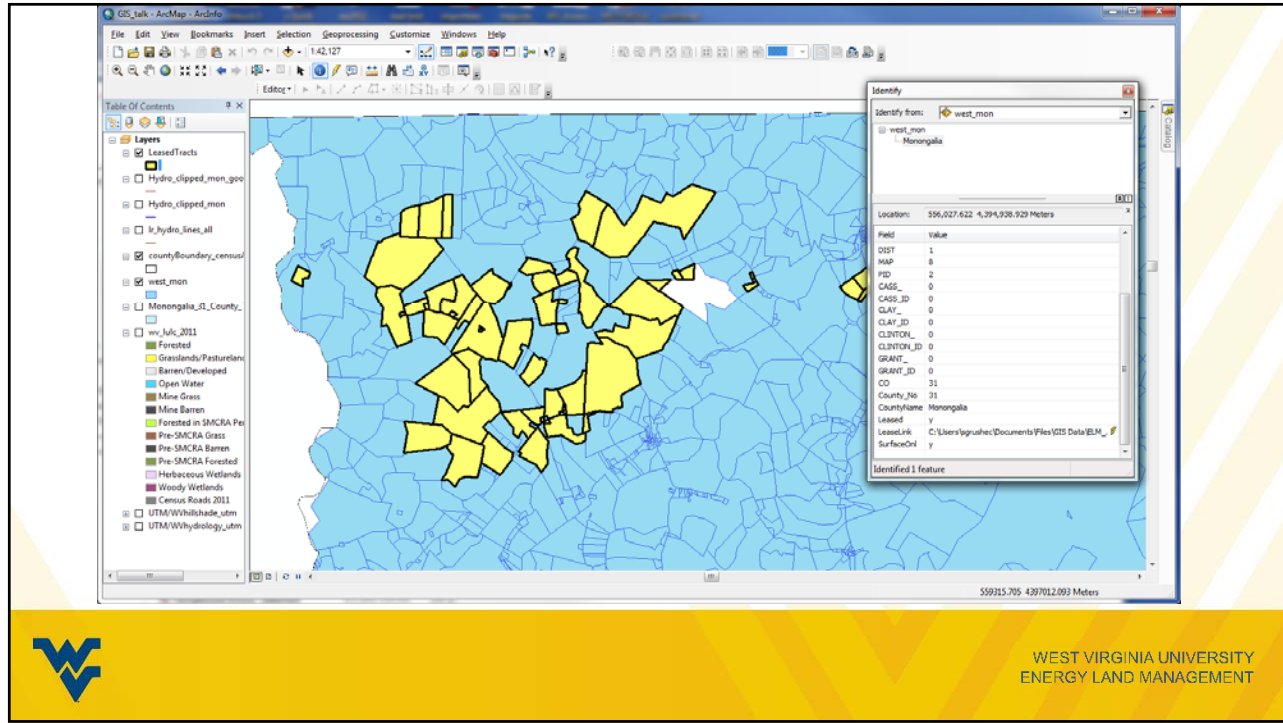
County_No	CountyName	Leased	LeaseLink	SurfaceOnl
31	Monongalia			
31	Monongalia			
31	Monongalia			
31	Monongalia			
31	Monongalia	y	C:\Users\grushec\Documents\Files\GIS Data\ELM_tak\Lease\EnerGas_Lease_pd	
31	Monongalia			
31	Monongalia			
31	Monongalia	y	C:\Users\grushec\Documents\Files\GIS Data\ELM_tak\Lease\EnerGas_Lease_pd	
31	Monongalia			
31	Monongalia			
31	Monongalia			
31	Monongalia	y	C:\Users\grushec\Documents\Files\GIS Data\ELM_tak\Lease\EnerGas_Lease_pd	
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31	Monongalia			
31	Monongalia			
31	Monongalia			
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31	Monongalia			
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31	Monongalia			
31	Monongalia	y	C:\Users\grushec\Documents\Files\GIS Data\ELM_tak\Lease\EnerGas_Lease_pd	

(0 out of 2130 Selected)

west_mon



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PAID-UP OIL AND GAS LEASE

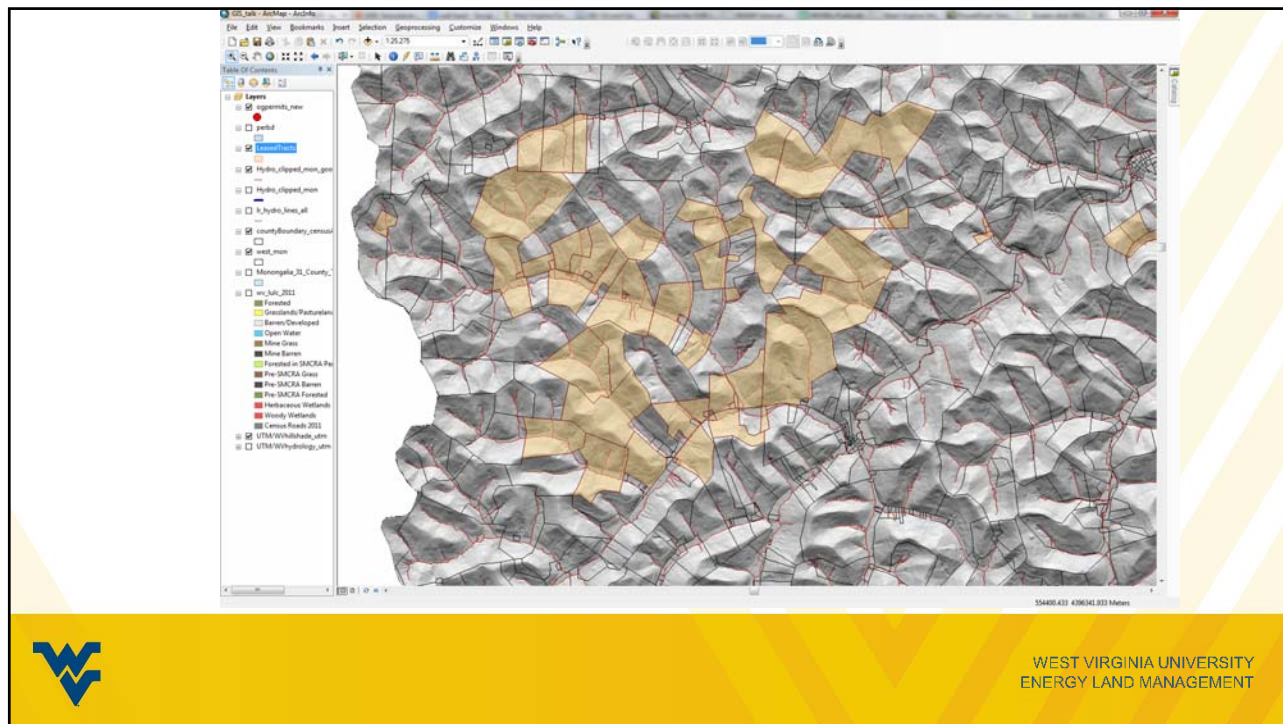
Pennsylvania

This Paid-Up Oil and Gas Lease (the "Lease") is made and entered into this _____ day of _____ 2013 (the "Date Hereof") by and between Jason and Jennifer Smith, having an address of 326 VanVoorhis Dr., Morgantown, WV 26505 (hereinafter referred to as "Lessor") and EnerGas, LLC, a Delaware limited liability company, having an address of 6902 W. Snowwhite Rd. Morgantown WV 26505 (hereinafter referred to as "Lessee").

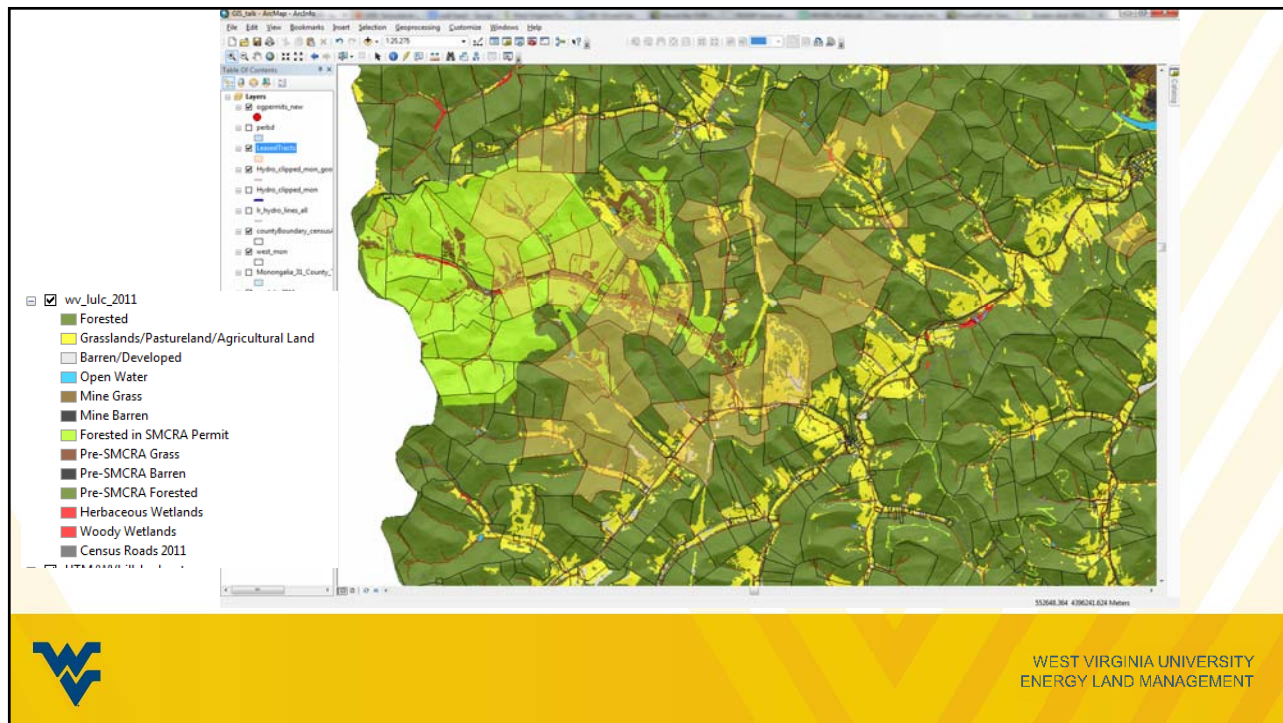
- 1. Leasing Provision.** Lessor, for consideration, the receipt and sufficiency of which is hereby acknowledged, and of the royalties herein provided and of the covenants and agreements of Lessee hereinafter contained, hereby leases and lets exclusively, with respect to the leased premises described below, to Lessee for the purpose of exploring for (including geophysical operations), drilling for, developing, treating, producing, operating for, gathering and marketing oil and/or gas, plus all other rights and privileges that are necessary for or convenient in producing, withdrawing, storing (in above ground containment), transporting, and marketing oil and/or gas in and to the lands covered hereby. Expressly excluded from this Lease are coal, potable water, sand, gravel, or any solid minerals or substances of any type that can be produced from the lands covered hereby separate and apart from, or independently of, oil, gas or other liquid and gaseous hydrocarbons.
- 2. Description of Leased Premises.** The lands covered by this Lease are those certain tracts or parcels of land situate in Township of Valley, Gauley County, Ohio, as each tract or parcel is more completely described on Exhibit "A", which is attached hereto and made a part hereof. On the Date Hereof, the total acres of all lands covered by this Lease are **138.63 net mineral acres** (138.63 gross acres x 100% interest), more or less. This Lease includes any interest in said lands that Lessor currently owns and/or hereafter acquires by reversion or prescription. In addition to the lands set forth on Exhibit "A", this Lease covers any and all easements, roads, rights-of-way, bodies of water and small strips, strings or parcels of land that are owned or may be claimed by Lessor that traverse, adjoin or are contiguous to the lands specifically identified hereunder. The foregoing notwithstanding, it is not intended for this Lease to include any lands now owned or subsequently owned by Lessor other than those specifically described herein. All lands and/or rights in and to the oil and gas hereby leased by Lessor to Lessee, including all subsurface strata or horizons, are hereinafter referred to as the "Leased Premises."

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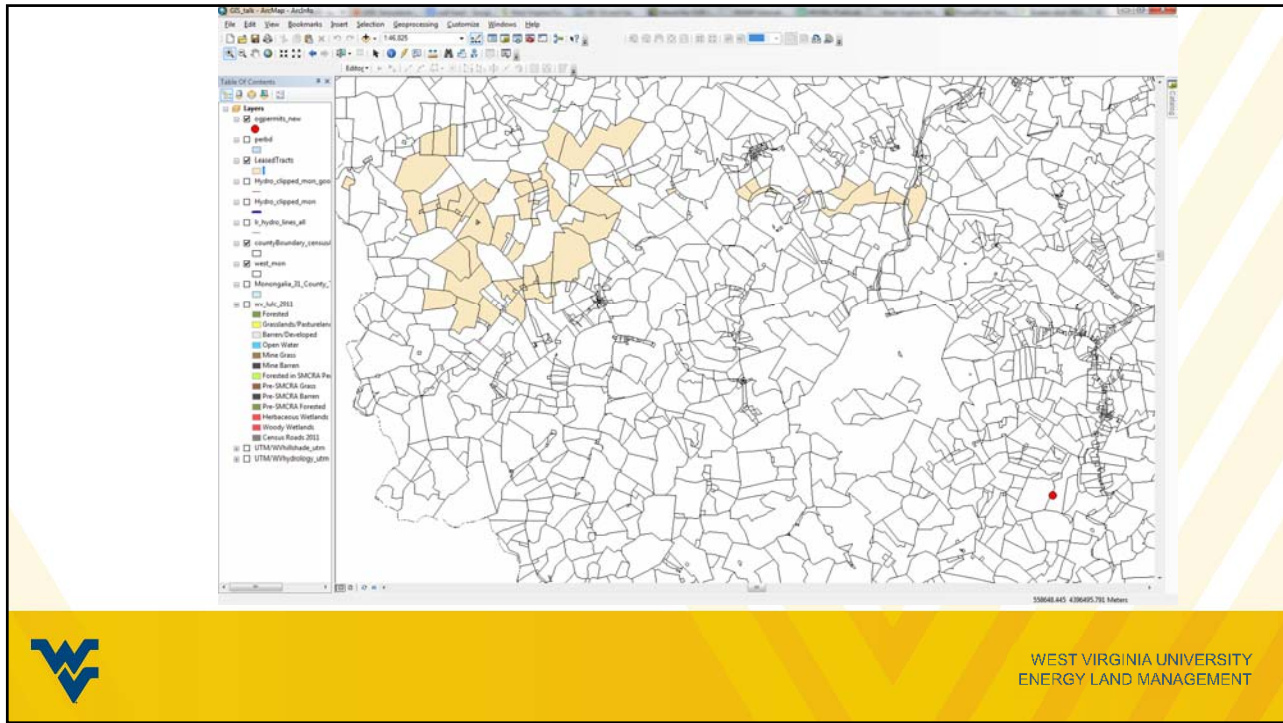
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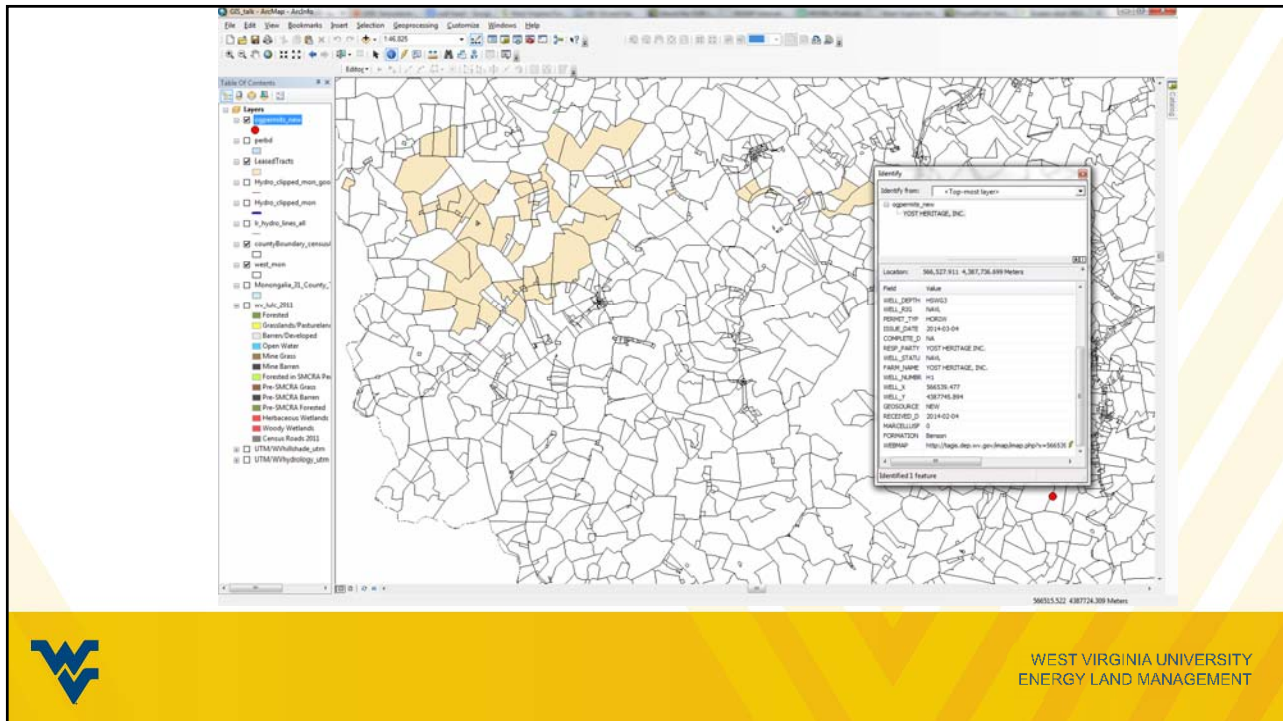
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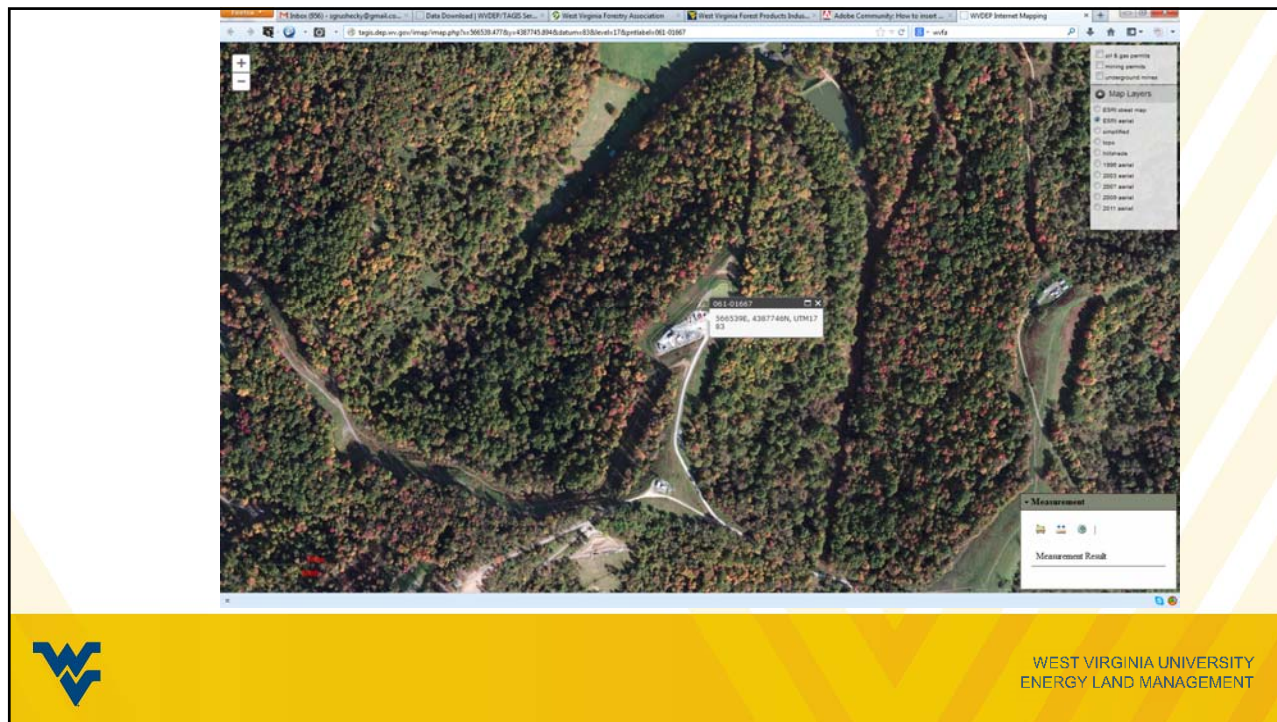
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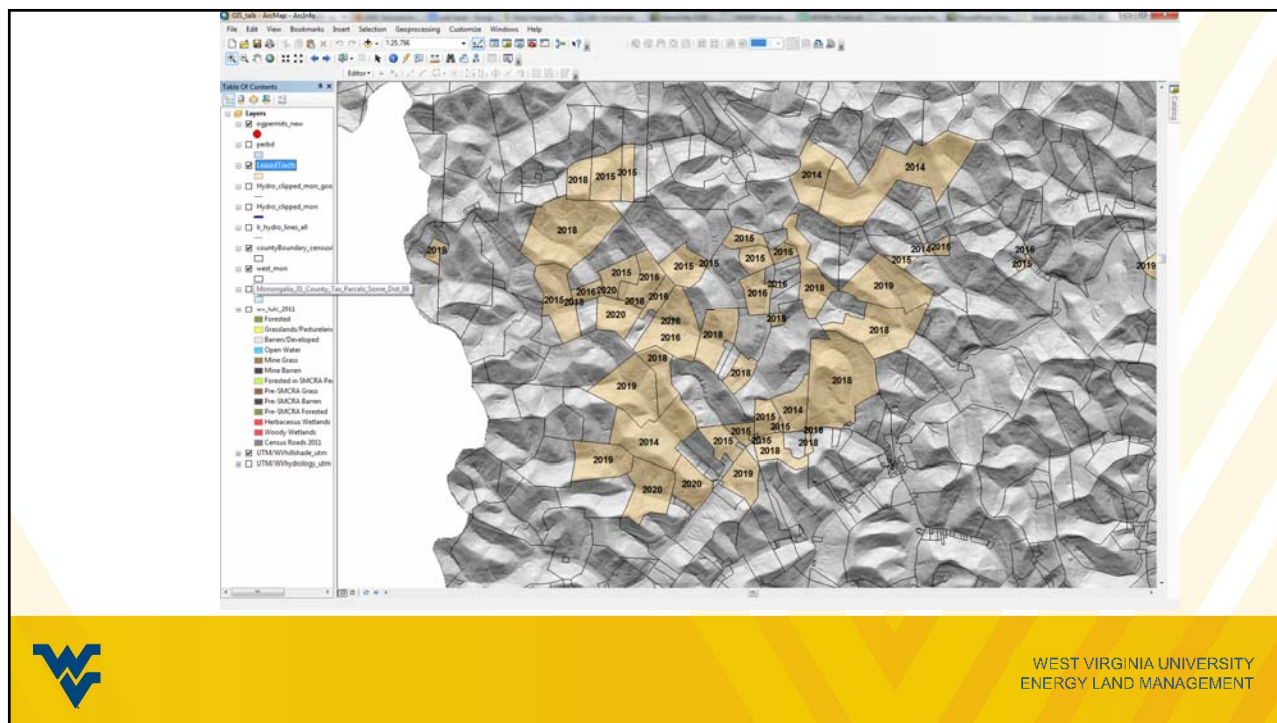
WEST VIRGINIA UNIVERSITY
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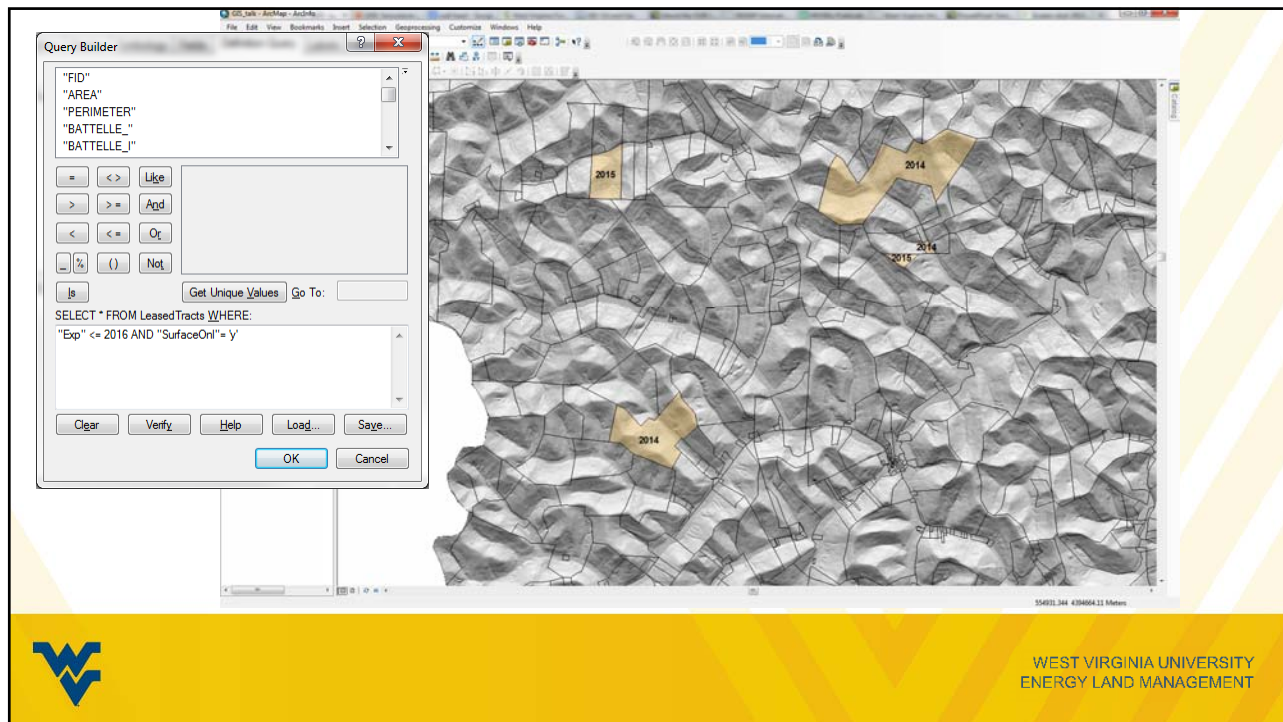
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The screenshot shows a GIS application window with a 'Query Builder' dialog box open. The dialog box contains a list of fields: "FID", "AREA", "PERIMETER", "BATTELLE_", and "BATTELLE_I". Below the list are buttons for logical operations: Like, Add, Or, Not, and Is. A text box contains the query: "SELECT * FROM LeasedTracts WHERE: 'Exp' <= 2016 AND 'SurfaceOnl' = 'Y'". The main map area displays a topographic map with several land tracts highlighted in yellow. The tracts are labeled with years: 2015 and 2014. The background of the slide features a yellow and white geometric pattern.

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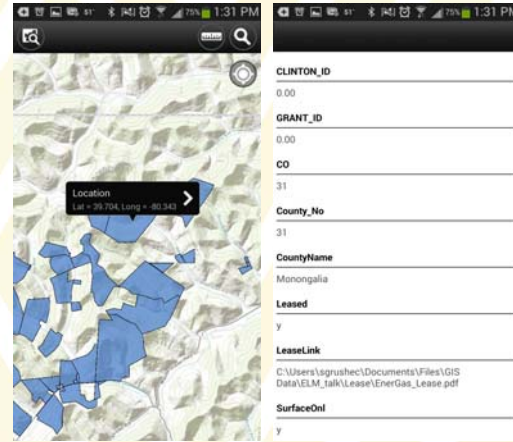
GIS ON THE CHEAP

- explorer.arcgis.com
- Free to start – 2GB data
- Can annotate base maps and load data files (zipped shp)
- Accessible via the web



MOBILE VERSION

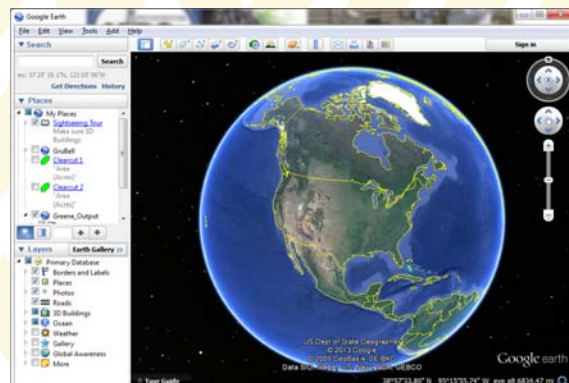
- View projects created in explorer
- Can view your location and data associated with features



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GOOGLE EARTH

- Similar process
- Must convert shp to kmz
- Easier to share with other users
- Some ability to edit – via google spreadsheet linkage



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Google Earth interface showing a map of a region with brown shaded areas. The interface includes a search bar, a 'Places' list on the left, and a 'Layers' list. The map shows locations like Burton, Wadestown, and Wana. The Google Earth logo and version information are visible at the bottom.



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Google Earth interface showing a map of a region with brown shaded areas. A data popup window is open over one of the shaded areas, displaying a table of information for 'Monongalia'. The interface includes a search bar, a 'Places' list on the left, and a 'Layers' list. The map shows a detailed view of the shaded area. The Google Earth logo and version information are visible at the bottom.

Monongalia	
FID	0
AREA	862631.69625
PERIMETER	5776.65953
INTELLEL_I	108
INTELLEL_J	108
DIST	1
IMP	0
PID	2
CASH	0
CASH_ID	0
CLAF	0
CLAF_ID	0
CLAYTON	0
CLAYTON_ID	0
GRANT	0
GRANT_ID	0
CO	21
Count	31
CountName	Monongalia
LayerName	
LayerID	
LayerType	
LayerColor	
LayerOpacity	
LayerVisible	
LayerLocked	
LayerFrozen	
LayerSelectable	
LayerEditable	
LayerDeletable	
LayerMoveable	
LayerZoomable	
LayerPrintable	
LayerExportable	
LayerImportable	
LayerRefreshable	
LayerResettable	
LayerZoomable	
LayerPrintable	
LayerExportable	
LayerImportable	
LayerRefreshable	
LayerResettable	



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WHY GIS MATTERS

- Used to visualize data
- Can answer spatially-based questions
- Links multiple data types to geographic locations
- Adds value to organization
 - Increase productivity
 - Produce professional products
 - Ultimately more profitable

