Source Water Assessment and Wellhead Protection Program

Using GIS to Protect Public Drinking Water in West Virginia

Yueming Wu, Ph.D., GISP, GIS Manager
Geospatial Transportation Information Section
West Virginia Division of Highways

James Mitchell, GIS Technical Administrator
Source Water Assessment and Protection Program GIS Group
West Virginia Department of Health and Human Resources

Background

- Safe Drinking Water Act (SDWA) of 1974
- Amendments of 1996
  - All states are required to develop and implement program elements to protect the sources for all public water supplies.
- Source Water Assessment and Protection (SWAP)
  - Created within the West Virginia Department of Health and Human Resources , Bureau for Public Health, Office of Environmental Health Services
  - Responsible for assessing and protecting all of West Virginia's public drinking water systems

GIS Activities in SWAP

- SWAP GIS data acquisition
- SWAP GIS data warehouse management
- SWAP web mapping application
- SWAP ArcGIS Explorer applications
- ArcGIS Desktop customization
- Smart map templates

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SWAP GIS Data Acquisition

- Public drinking water systems (PWS)
- Public drinking water sources (Source)
- Potential contaminant sources (PCS)
  - Facilities, sites, and activities that have the potential to affect the underlying ground water aquifers or nearby surface waters used for public drinking water supply

Delineation of Source Water Protection Area

- Source water protection area (PA): the area where the water used for public drinking water supplies comes from
- Type
  - Zone of Critical Concern (ZCC) for surface water intakes
  - Wellhead Protection Area (WPA) for ground water sources

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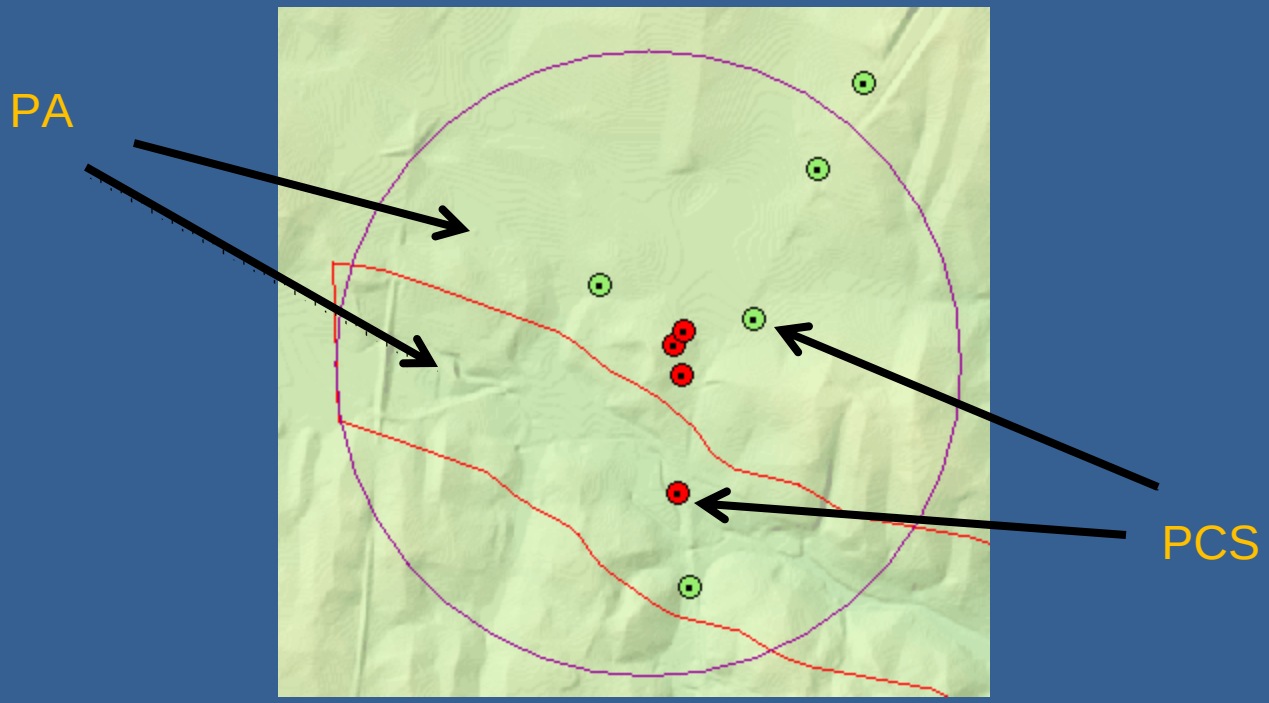
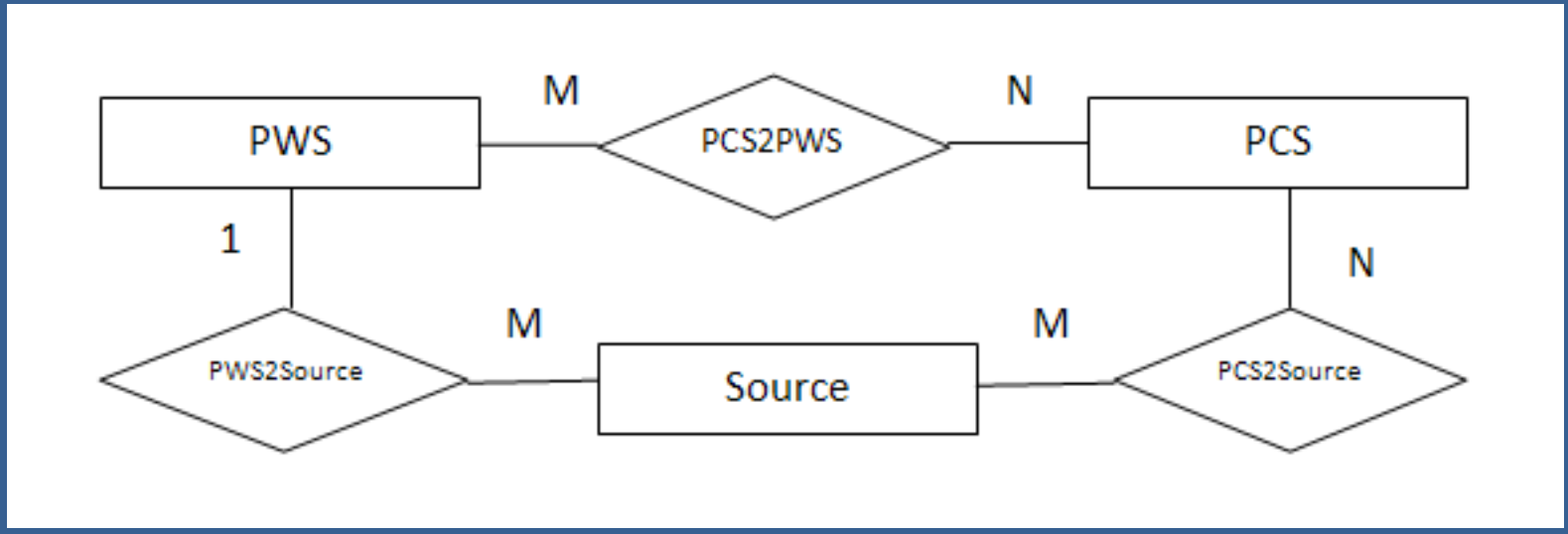
A Many to Many Relationship

- Three entities
  - PCS
  - PWS
  - Source
- Three relations
  - PCS vs. PWS: many to many
  - PCS vs. Source: many to many
  - PWS vs. Source: one to many

Example



ER Diagram



SWAP GIS Data Warehouse

- SWAP Access database
  - Table PCS (*PCS_ID*, Latitude, Longitude, etc.)
  - Table PWS (*PWS_ID*, Latitude, Longitude, etc.)
  - Table Source (*Source_ID*, PWS_ID, Latitude, Longitude, etc.)
  - Junction table PCS2PWS (*PCS_ID, PWS_ID*)
  - Junction table PCS2Source (*PCS_ID, Source_ID*)
- SWAP geodatabase
  - Feature class PCS (*PCS_ID*, Latitude, Longitude, etc.)
  - Feature class PWS (*PWS_ID*, Latitude, Longitude, etc.)
  - Feature class Source (*Source_ID*, PWS_ID, Latitude, Longitude, etc.)
  - Feature class PA (*Source_ID*, PWS_ID, etc.)
  - Relationship table PCS2PWS (*PCS_ID, PWS_ID*)
  - Relationship table PCS2Source (*PCS_ID, Source_ID*)

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How Is the Data Warehouse Populated?

- In Access create the three tables PCS, PWS, and Source
- In ArcSDE create the three feature classes PCS, PWS, and Source based on the three tables
- In ArcSDE create the PA feature class for individual public drinking water sources
- Extend ArcGIS Desktop to determine the many to many spatial relationship among PCS, PWS, and Source and generate a new layer with three keys included
- In Access extract information from the new layer to generate the two junction tables PCS2PWS and PCS2Source
- In ArcSDE create the two relationship tables based on the two junction tables PCS2PWS and PCS2Source
- In ArcSDE create secondary feature classes if needed

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SWAP Web Mapping Application

- An ArcIMS web mapping application
- Password protected
- Three levels of access

Access

- General Public Access
  - Access to PA data
  - Access to base reference layers
- Full Access
  - Access to all SWAP GIS data
  - Access to base reference layers
- Administrator Access
  - Access to all GIS layers
  - Ability to manage users


http://157.182.212.215/dhhr/login.php? - Windows Internet Explorer
http://157.182.212.215/dhhr/login.php?
File Edit View Favorites Tools Help
Favorites
BlueZone Web-to-Host Main...
Web Slice Gallery
Page Safety Tools
Source Water Assessment and Wellhead Protection Program
Username
Password
Click to Login
Welcome to the West Virginia Safe Drinking Water Information System Interactive Mapping Service. This web site is intended to provide information on source water and wellhead protection pertaining to Public Water Systems. A user account is required to have access to this application. If you would like to apply for an account, please fill out the registration form and contact:
James Mitchell, GIS Analyst
West Virginia Department of Health and Human Resources
Bureau for Public Health
Office of Environmental Health Services
Environmental Engineering Division
Capitol and Washington Streets
1 Davis Square, Suite 200
Charleston, West Virginia 25301-1798
James.E.Mitchell@wv.gov
Phone: (304) 558-6743
Fax: (304) 558-0324
If you identify data that you believe to be inaccurate or incorrect, please contact James Mitchell at the above address.
Done
Internet
100%

Home Page

West Virginia Department of Health and Human Resources

Bureau for Public Health

Office of Environmental Health Services - Environmental Engineering Division

Source Water Assessment and Wellhead Protection Program

West Virginia Source Water Assessment and Wellhead Protection Program

West Virginia Safe Drinking Water Information System Interactive Mapping Service Registration Page

Because of the sensitive nature of public water system locations, the West Virginia Source Water Assessment and Wellhead Protection Program has developed this secure Interactive Mapping Site.

Please fill out all the information on the form and submit to the WV SWAP Program, and submit it by e-mail to janesmith@dhhr.wv.gov. Failure to complete all fields may result in your approval being delayed. We will try to review all submittals within 24 hours of receipt, but account approval could take up to a week. Once approved you will be notified by e-mail. If you have any questions about your submittal or accessing the secured site, please e-mail janesmith@dhhr.wv.gov.

Please complete the following information:

First Name: _____ Last Name: _____

Title: _____

Agency/Company: _____

Address (line 1): _____

Address (line 2): _____

City: _____ State: _____ Zip: _____

Phone: _____ Fax: _____

E-mail Address (this will be your user ID): _____

Requested Password: _____

(Your password must be at least 8 characters long and is case sensitive.)

Main reasons for accessing this site:

- ☐ WV DOT Investigations
- ☐ Voluntary Action/Brownfields Investigations
- ☐ Other Environmental Investigations
- ☐ Curiosity
- ☐ Other:

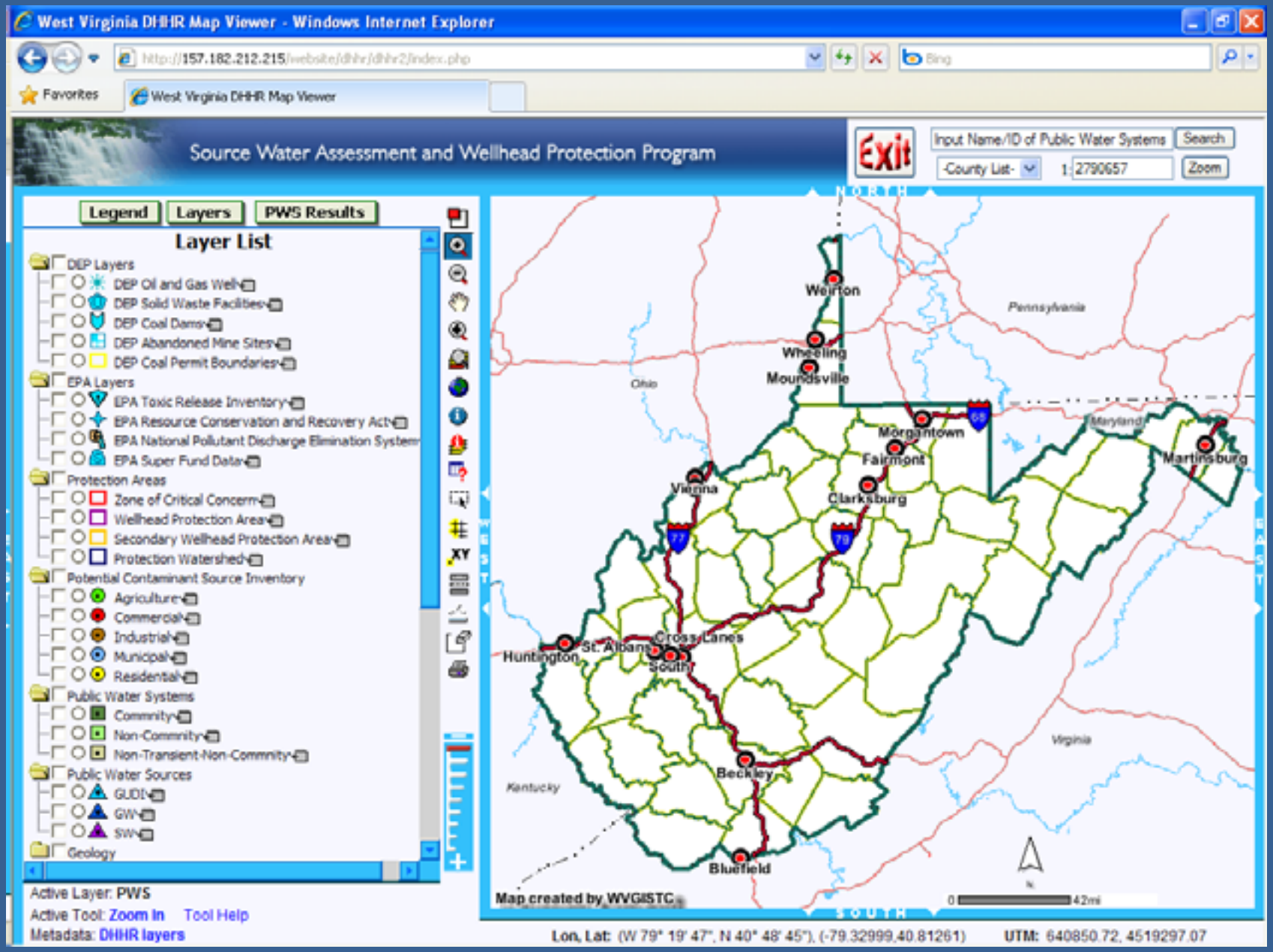
If other please explain: _____

Do you represent:

- ☐ Concerned Citizen
- ☐ Consulting Firm
- ☐ Environmental Group
- ☐ Local government
- ☐ State government
- ☐ Federal government
- ☐ Regulated Community
- ☐ School/university
- ☐ Other:

If other please explain: _____

Registration Page



Mapping Interface at the Full Access Level

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SWAP ArcGIS Explorer Applications

- For internal business purpose only
- ArcGIS Explorer is customized and
- NMF files are stored in a central location accessible to all employees.

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ArcGIS Desktop Customization

- ZCC extension
- WPA tool
- Spatial relationship tool
- Other tools

Glimpse of Code

```
Do Until pPA Is Nothing
    Set pSFilter = New SpatialFilter
    Set pSFilter.Geometry = pPA.Shape
    pSFilter.SpatialRel = esriSpatialRelContains
    pPCSSelection.SelectFeatures pSFilter, esriSelectionResultNew, False

    Set pSelPCS = pPCSSelection.SelectionSet
    pSelPCS.Search Nothing, True, pPCSCursor

    Set pPCS = pPCSCursor.NextFeature
    Do Until pPCS Is Nothing
      Set pFeat = FNewClass.CreateFeature
      Set pFeat.Shape = pPA.Shape

      pFeat.Value(pFeat.Fields.FindField(field1)) = pPA.Value(pPA.Fields.FindField(field1))
      pFeat.Value(pFeat.Fields.FindField(field2)) = pPA.Value(pPA.Fields.FindField(field2))
      pFeat.Value(pFeat.Fields.FindField(field3)) = pPCS.Value(pPCS.Fields.FindField(field3))
      pFeat.Store

      Set pPCS = pPCSCursor.NextFeature
    Loop
    Set pPA = pPACursor.NextFeature
  Loop
```

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Smart Map Templates

- Standard map templates with customized business analysis functions included to meet end users' needs
- Stored in a central location accessible to all ArcGIS Desktop users
- Major components
  - Layers built on top of a variety of sources and standard cartographic design and symbology
  - Layouts for business needs and user preferences
  - Tools/toolbars/toolsets of business analysis functions

Potential Contaminant Source Inventory ESRI Default Marker/Basic Latin

Agriculture

Unicode	Size	RColor	GColor	BColor
46	12	0	0	0
33	12	85	255	0

Commercial

Unicode	Size	RColor	GColor	BColor
47	12	0	0	0
34	12	255	0	0

Industrial

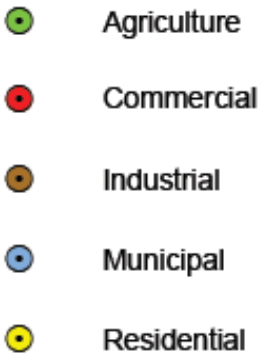
Unicode	Size	RColor	GColor	BColor
47	12	0	0	0
34	12	168	112	0

Municipal

Unicode	Size	RColor	GColor	BColor
47	12	0	0	0
34	12	115	178	255

Residential

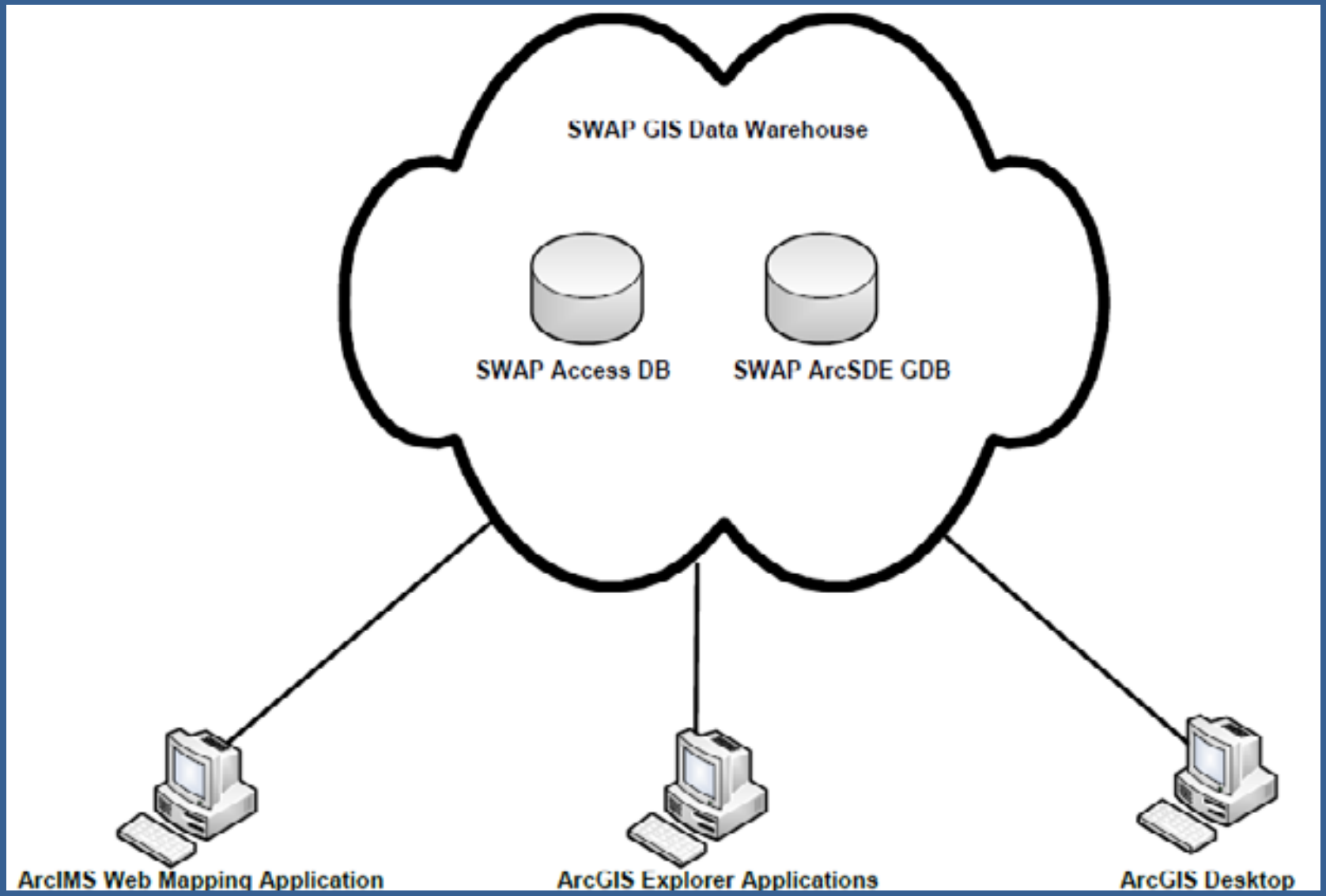
Unicode	Size	RColor	GColor	BColor
47	12	0	0	0
34	12	255	255	0



Standard Symbology Example

SWAP Enterprise GIS

- Server
  - SWAP GIS data warehouse
- Clients
  - ArcIMS web mapping application
  - ArcGIS Explorer applications
  - ArcGIS Desktop
  - Etc.



SWAP Enterprise GIS

Future Work

- An automation is needed to bridge the SWAP Access database and the SWAP ArcSDE geodatabase so a data concurrency is maintained.
- The web mapping application needs to be converted to an ArcGIS Server application.
- The tools developed for ArcGIS Desktop 9 using VBA and ArcObjects will need to be re-written for ArcGIS Desktop 10 using ArcPy.

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Questions?

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