

## Appendix 2: GIS and Transmission Related Resources

### 1.0 GIS Resources

One of the most widely used GIS platforms is ESRI's (Environmental Systems Research Institute) ArcGIS, a system that allows companies to easily author data, maps, globes and models on the desktop and serve them out for use on desktop, in a browser or in the field depending on the need. ArcGIS utilizes a database view (geodatabase data storage structure) where the data are stored in tables, easily accessed and able to be managed and manipulated to fit the terms of whatever work is being conducted.

Useful ESRI website links include:

ESRI GIS Electric

<http://www.esri.com/industries/electric/index.html>

ESRI Solutions for Power Generation and Transmission Services

<http://www.esri.com/library/brochures/pdfs/gis-sols-for-power-generation.pdf>

ESRI products include: ArcGIS, Desktop GIS (ArcGIS Desktop products include ArcInfo, ArcEditor, ArcView, Extensions (e.g., 3D Analyst Extension to use ArcScene or ArcGlobe tools for visualization simulation), Server GIS, Online GIS, Mobile GIS, and Developer Tools (ArcGIS web mapping); free viewing includes ArcGIS Explorer Desktop and ArcReader (for desktop), and ArcGIS Explorer Online and ArcGIS.com Map Viewer for use on the web

[<http://www.esri.com/products/index.html>]

Other useful links to GIS applications include:

Map Analysis: Procedures and Applications in GIS Modeling. 2004. Online publication, Spatial Information Systems, Inc. Accessed at:

<http://www.innovativegis.com/basis/MapAnalysis/Default.htm> [Joseph K. Berry. 2004]

GeoCommunity GIS Viewing Tools: <http://spatialnews.geocomm.com/features/viewers2002/>

MapWindow: <http://www.mapwindow.org/pages/overview.php>

MapWindow is an open source "Programmable Geographic Information System" that supports manipulation, analysis, and viewing of geospatial data and associated attribute data in several

standard GIS data formats. MapWindow is a mapping tool, a GIS modeling system, and a GIS application programming interface (API) all in one convenient redistributable open source form.

Finally, examples of ways to share GIS data with broader audiences, including stakeholders, are identified below.

- Adobe Connect: example of internet webcast technology – effective means of sharing GIS technology with participants in various locations.
- ArcReader Project: ESRI ArcGIS publisher extension allows for export of GIS project to interactive map with similar, but more limited interface, than commercial desktop software. Users download and install the free ArcReader software from ESRI to view the map.
- GeoPDF files: Map2PDF is a second party ArcGIS extension available from TerraGo Technologies. It produces Adobe PDF files with extra enhancements that provide basic GIS function such as zooming, panning, turning layers on and off, and querying features. The files are viewed with Adobe Reader software with a free TerraGo extension.
- Interactive GIS Website: Examples include Google Maps API (develop web application that displays selected GIS information over standard Google Map display). ArcGIS Server is an ESRI product which allows a standardized map viewer similar to the desktop project to be rapidly published or, with programming, custom tools and capabilities can be added.
- Downloadable data: for stakeholders who have their own GIS systems and databases, provide data in non-proprietary format such as shape files, so that more applications can read it. Metadata should be produced for any GIS data being distributed.
- Keyhole Markup Language (kml): The kml format (or kmz for larger or more complex information) can also be used for data distribution. GIS layers can be easily viewed in Google Earth by exporting to kml format, including viewing in 3D.

## 2.0 Examples of Software Applications for transmission line siting

The following are examples of software applications for transmission line siting built on ESRI's ArcGIS platform.

- Public Service of New Mexico (PNM) has vast data sources that it draws on for its transmission siting projects. These include USGS topographic (TOPO) maps, Digital

Orthophoto Quarterly Quads (DOQQ), high-resolution photography, satellite data, digital elevation models, hillshades and georeferenced scans. Combining these image layers enable PNM to assess land contours and model various corridor scenarios. PNM is creating GIS models for engineers to create a “first guess” route for transmission line siting which considers a host of criteria. Criteria for guiding the line recommendation include data layers for federal land, open areas, water, current utility corridors, new utility lines near existing lines and terrain. The model minimizes the footprint the transmission corridor makes on the land and values cultural consideration such as federally protected lands and Native American pueblos. Uses ArcGIS Spatial Analyst

- Bonneville Power Administration (BPA) uses web-accessible GIS applications to manage a database that contains data on more than 800,000 transmission towers. BPA developers designed an internet tool for viewing its geographic transmission data (TView2, built using ESRI’s internet mapping software ArcIMS). The same data used for monitoring the transmission system can also be applied to best site analysis for building the system. BPA created the Transmission Business Line tool (TBL) which interacts with GIS for a variety of uses including siting transmission lines and facilities.
- The widely used EPRI-GTC Siting Methodology designed by EPRI is being used by GTC, a not-for-profit cooperative. It is an extension to ArcGIS designed by Photo Science called Corridor Analyst 9. This software supports each step of the siting methodology’s rigorous procedures for documenting and consistently applying planning assumptions, evaluation criteria and decisions. GIS successfully integrates with the method for analyzing the factors of suitability surfaces for natural, engineering and man-made conditions. It is used to map all geographic features within an area of interest and offers visualization of corridor options. The selection process uses ArcGIS to identify macro-corridors, define the project area boundaries, identify the alternative corridors within the macro-corridors, and select a preferred route. The software maps all geographic features in a study area and assigns numerical suitability values to all features. Features such as open land, agriculture and wetlands are ranked 1 (most suitable) to 9 (least suitable). Using the cell values, a computer algorithm calculates optimal paths for three types of suitability surfaces: locating with existing transmission lines, locating with existing rights of way, and crossing less developed areas. The optimal paths identified are called macro corridors. The model creates reports that include maps, applied criteria descriptions and cost implications. Ranks and weights are calculated for each alternative, and the siting team ranks each alternative route.
- Source: Barbara Shields, ESRI, as found on:  
<http://www.elp.com/index/display/article-display/325005/articles/utility-automation-engineering-td/volume-13/issue-4/features/using-gis-for-efficient-transmission-line-siting.html>

- Tetra Tech created a multi-media web based interface for 2-D, 3-D, and animated GIS maps and data. Two dimensional GIS based maps, data and aerial photography can be viewed through a user friendly, intuitive interface to allow illustration of various resources e.g., T&E species, vegetation, population, land use, viewsheds, etc.). To improve visualization of the transmission line alternatives, 3-D animated “fly throughs” of the landscape elements were prepared.

[http://rd.tetrattech.com/software/projects/tuscon\\_electric\\_power\\_mmgis.asp](http://rd.tetrattech.com/software/projects/tuscon_electric_power_mmgis.asp)

### 3.0 Environmental Resource and Land Use Data

Sources of U.S. Government and other GIS data are rapidly developing and improving. Internet sites such as Geodata.gov provide comprehensive indexes of, and links to, data distribution sites. Clearinghouses such as Geocommunicator.gov, Seamless.usgs.gov, Datagateway.nrcs.usda.gov and NationalAtlas.gov provide access to many popular layers from different agencies, while other Web sites concentrate on one agency or theme. Most states, and many counties and municipalities, provide GIS data clearinghouses for their jurisdictions and typically provide larger scale data than federal data sources.

- **Geodata.gov, Geospatial One Stop**
- <http://geodata.gov>
- Geodata.gov is intended to be the first place to go for locating U.S. GIS data and related products. It provides search capabilities and links to all major U.S. government GIS data sources, many of which are included below.
- **ESRI Data and Maps**
- <http://www.esri.com/data/data-maps/index.html>
- Distributed on a set of DVDs with commercial ESRI products. This source includes a diverse and high quality set of ready to use GIS layers.
- **Bureau of Land Management, National Integrated Lands System**
- <http://www.geocommunicator.gov>
- Provides GIS map services which stream GIS data via the Internet to ESRI GIS software applications. Includes many GIS layers, such as Federal Surface Management Agency, Public Land Survey System, base map layers, mining and minerals, and many energy-related layers. This source also provides interactive maps for users lacking ESRI GIS software.

- **USDA, Geospatial Data Gateway**
- <http://datagateway.nrcs.usda.gov>
- Provides automated, location-specific GIS data distribution system for many natural resource layers, including hydrologic units, watershed boundaries, topographic map imagery, quadrangle map indices, elevation data, land use/land cover data, soils and climate data.
  
- **U.S. Geological Survey, National Map Seamless Server**
- <http://seamless.usgs.gov>
- Clearinghouse focused primarily on topographic information, which includes orthoimagery (aerial photographs and satellite imagery), scanned topographic maps, elevation, geographic names, hydrography, boundaries, transportation, structures and land cover.
  
- **U.S. National Atlas, GIS Map Layers**
- <http://www.nationalatlas.gov/atlasftp-na.html>
- Provides hundreds of national map layers in GIS format; useful but may not be the most detailed or current data available for a particular theme.
  
- **National States' Geographic Information Council, GIS Inventory**
- <http://gisinventory.net>
- Data clearinghouse providing primarily standardized parcel data from county and other local sources.
  
- **U.S. Geological Survey, National Elevation Dataset**
- <http://gisdata.usgs.gov>
- Provides best available elevation data across the U.S., including high resolution. Light Detection and Ranging (LIDAR) data are available in some locations.
  
- **U.S. Geological Survey, Center for Biological Informatics**
- <http://biology.usgs.gov/cbi>
- Data clearinghouse providing links to biological resources data.
  
- **U.S. Geological Survey, Geologic Hazards**
- <http://geohazards.cr.usgs.gov>
- USGS geologic hazards information site with GIS data for some hazard types.

- **National Park Service, Data and Information Clearinghouse**
- [http://www.nps.gov/gis/data\\_info](http://www.nps.gov/gis/data_info)
- Provides wide variety of NPS GIS data.
  
- **National Park Service, National Archaeological Database**
- <http://www.cast.uark.edu/other/nps/nadb>
- Searchable bibliographic inventory of over 350,000 reports on archaeological investigations and planning, mostly of limited circulation, representing a large portion of the primary information available on archaeological sites in the U.S.
  
- **U.S. Fish and Wildlife Service, National Wetlands Inventory**
- <http://www.fws.gov/wetlands/data>
- Provides wetland GIS data including classification nomenclature, which describes the habitat.
  
- **U.S. Census Bureau, TIGER Line Shapefiles**
- <http://www.census.gov/geo/www/tiger>
- Provides jurisdictional and census-related boundaries with geographic entity codes that can be linked to U.S. Census Bureau demographic data.
  
- **U.S. Census Bureau, Demographic Data**
- <http://factfinder.census.gov>
- Provides U.S. Census Bureau population, housing, economic data that can be linked to jurisdictional and census-related boundaries.
  
- **U.S. Department of Agriculture, Natural Resource Conservation Service**
- <http://soildatamart.nrcs.usda.gov>
- Provides tabular and spatial data on soils.
  
- **GeoCommunity, GIS Data Depot**
- <http://data.geocomm.com>
- Commercial Web site providing free and low-cost access to many U.S. Government GIS data layers, including scanned topographic maps, digital elevation models, orthophotography, Federal Emergency Management Agency floodplain maps, Defense Mapping Agency vector product format layers, U.S. FWS National Wetland Inventory data, and others. Some layers have value added in that they can be obtained in commonly used GIS formats, while others are more accessible from resource agencies.

- **Federal Emergency Management Agency Map Service Center**
- <http://www.msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1>
- Provides access to digital flood insurance rate map databases.

#### 4.0 Other Transmission Planning and Siting Related Resources

##### Transmission System Planning:

Bonneville Power Administration Transmission System Planning

[http://www.transmission.bpa.gov/system\\_planning](http://www.transmission.bpa.gov/system_planning) Information about transmission system planning studies.

##### Transmission Siting

Electric Power Research Institute (EPRI) - Georgia Transmission Corporation (GTC) *Overhead Electric Transmission Line Siting Methodology*. EPRI, Palo Alto, CA; Georgia Transmission Corporation, Tucker, GA, 2006. 1013080

EPRI - *Kentucky Transmission Line Siting Methodology*. EPRI, Palo Alto, CA, California; Kentucky Power Cooperative, Winchester, KY; and E.ON U.S., Louisville, KY, 2007. 1016198

Both reports can be downloaded at no charge from EPRI website ([www.epri.com](http://www.epri.com)) by conducting a search for EPRI publications, by research area and key word (“siting” or “transmission line siting methodology”). Additional information also available at: [www.epri-gtc-siting.com](http://www.epri-gtc-siting.com).

\*<http://my.epri.com/portal/server.pt?space> [search on “EPRI publications” in box in upper right hand corner of screen and then search on phrase, “electric transmission line siting methodology”].

Tribal Energy Siting Guidance Manual

[http://teeic.anl.gov/documents/docs/Tribal Energy Siting Guidance Manual.pdf](http://teeic.anl.gov/documents/docs/Tribal_Energy_Siting_Guidance_Manual.pdf)

Edison Electric Institute

*State Generation and Transmission Siting Directory: Agencies, Contacts, and Regulations* (2004). This resource contains regulatory contacts and summary information for siting

of generation and transmission facilities in 50 states. While it contains no siting guidance, it identifies which states have specific transmission siting requirements, the basis for the requirement (e.g., voltage level, line length or other), and contact information. It may be a useful resource to reference in the Macro-Corridor exhibit. ([http://www.eei.org/ourissues/ElectricityTransmission/Documents/State\\_Generation\\_Transmission\\_Siting\\_Directory.pdf](http://www.eei.org/ourissues/ElectricityTransmission/Documents/State_Generation_Transmission_Siting_Directory.pdf)).

*Transmission Projects: Supporting Renewable Resources* (February 2009). This special report illustrates the recent and ongoing efforts of EEI members to develop transmission to support renewable resource interaction. The report is intended to give a broad perspective on the variety of transmission projects being built to support renewable resource integration. <http://www.eei.org/ourissues/ElectricityTransmission/Pages/TransmissionProjectsSupportingRenewableResources.aspx>

*Transmission Projects at a Glance* (updated February 2010). This report highlights major EEI member company transmission projects either recently completed, currently under construction, or in various stages of the proposal/planning/siting process. Three broad categories of transmission investment are covered by projects in the 2010 report: transmission line and non-transmission line transmission system investments, transmission supporting the integration of renewable resources, and transmission related smart grid. This report appears to include some overlap with the one above relating to transmission supporting the integration with renewable resources. <http://www.eei.org/ourissues/ElectricityTransmission/Pages/TransmissionProjectsAt.a.aspx>

Federal Energy Regulatory Commission (FERC)

Transmission Siting

<http://www.ferc.gov/industries/electric/indus-act/siting.asp>.

FERC Guidance for applicants relating to siting, construction and operation of natural gas pipelines (available at: <http://www.ferc.gov/industries/gas/enviro/guidelines.asp>), identified the following potential resources:

Office of Energy Projects *Guidelines for Reporting on Cultural Resource Investigations for Pipeline Projects* (December 2002)

Department of Energy, Office of Electricity Delivery and Energy Reliability (OE).



OE website has link to National Council on Electricity Policy: *Coordinating Interstate Electric Transmission Siting: An Introduction to the Debate*. (July 2008), available at: [http://www.oe.energy.gov/DocumentsandMedia/Transmission\\_Siting\\_FINAL\\_41.pdf](http://www.oe.energy.gov/DocumentsandMedia/Transmission_Siting_FINAL_41.pdf)

West Wide Energy Corridor Programmatic EIS (DOE/EIS-0386, November 2008) evaluates potential impacts associated with the proposed action to designate corridors on federal land in 11 Western States (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) for oil, gas and hydrogen pipelines and electricity transmission and distribution facilities. <http://corridoreis.anl.gov/documents/fpeis/index.cfm>