

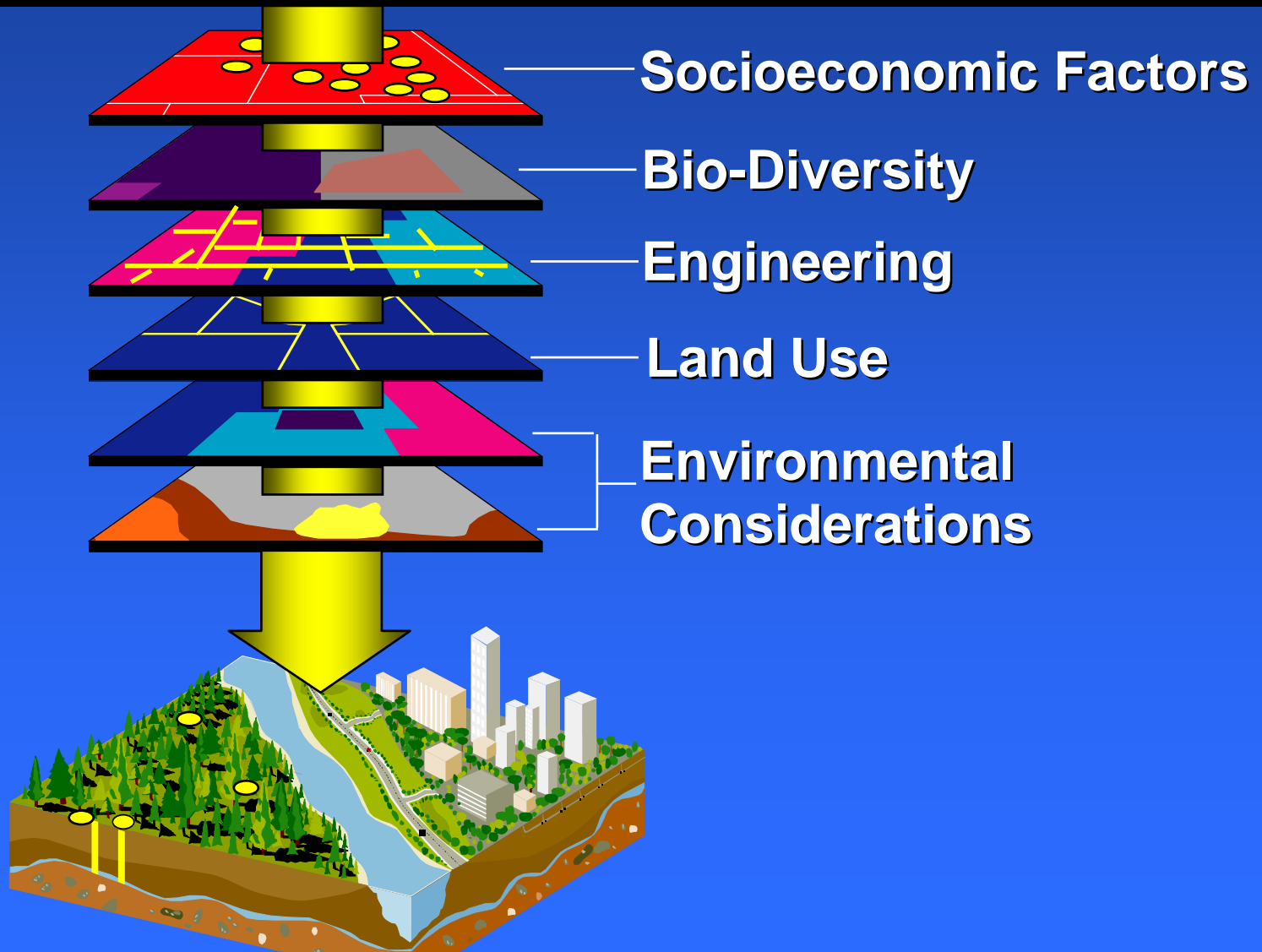
Supporting the Planning Process With ArcGIS ModelBuilder and Visualization Tools

Milton Ospina
Urban & Regional Planning
Solutions Manager

Tom Wesp, AICP
Regional Marketing Manager
ESRI - San Antonio

CORP 2005
February, 2004

GIS Planning Support Systems / Models & Visualization: Integrating Information

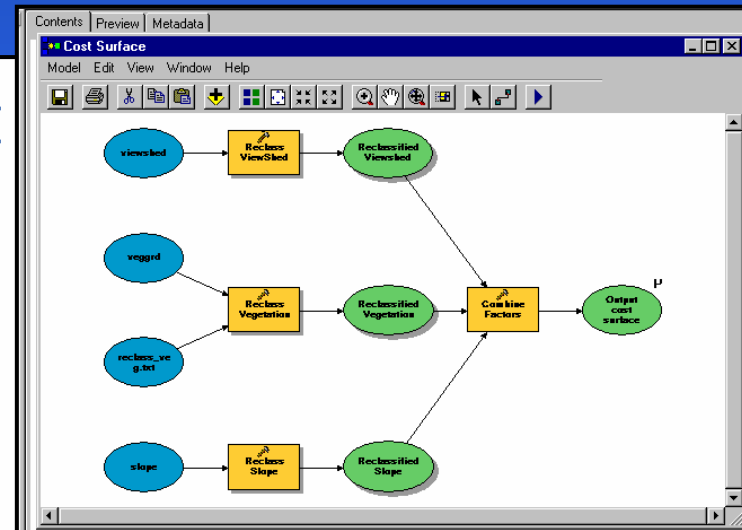
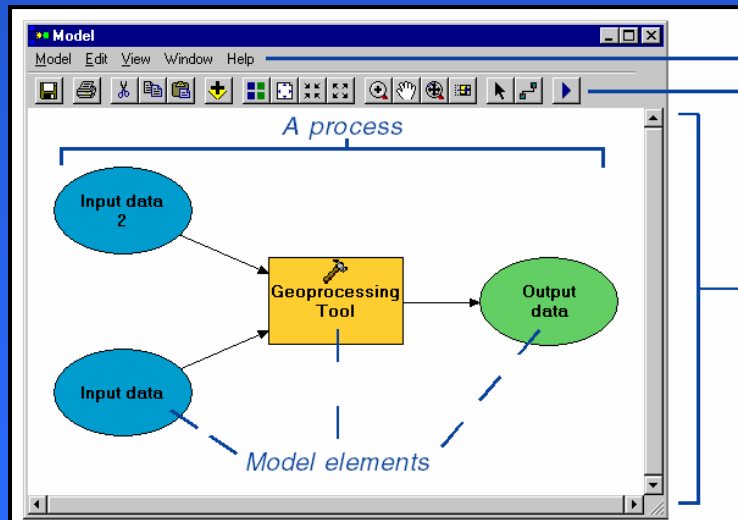
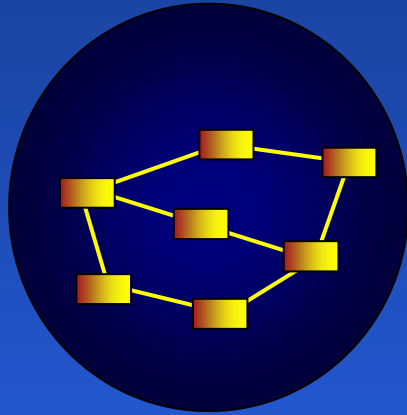


Building models

Modeling concepts and tools

- Why build models?
- Binary suitability models
- Weighted suitability models
 - Methodology
- Reclassify and Weighted Overlay tools
- Demo

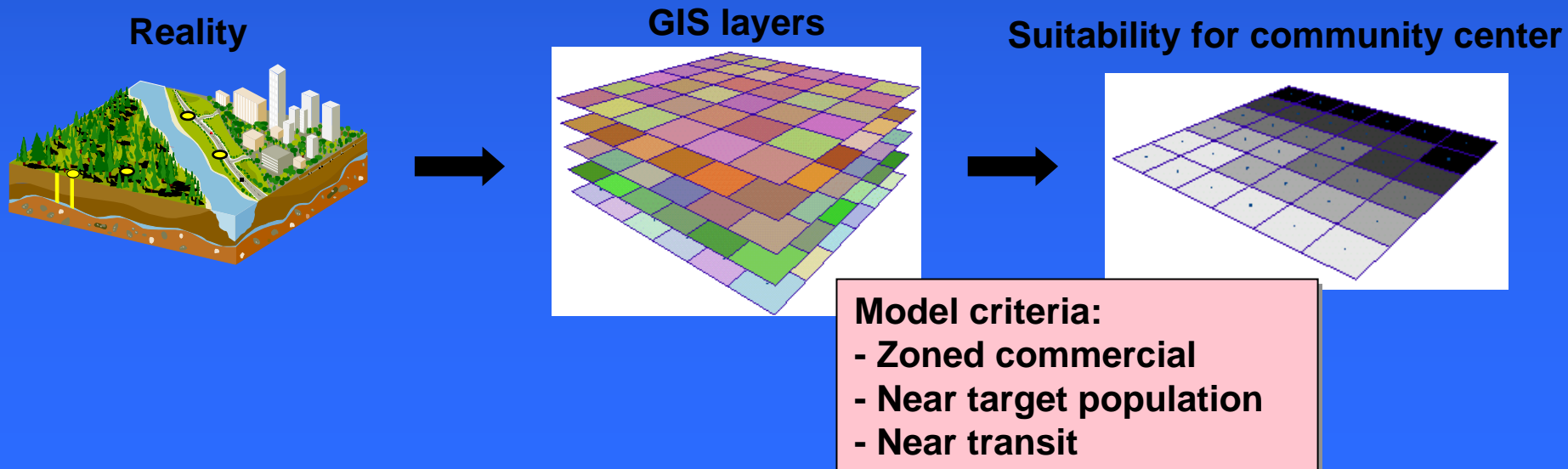
Models – Best Practices and Applications



... Sharing Geographic Knowledge

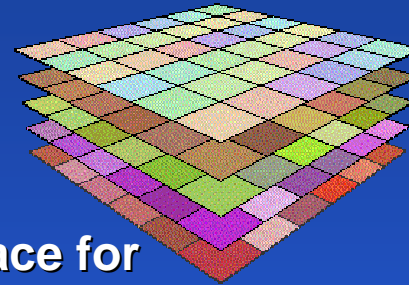
Modeling spatial problems

- Models help us understand and solve complex town and regional problems
 - Simplify reality
 - Combine geographic layers to answer questions
 - e.g., “Where should you build your next community center?”

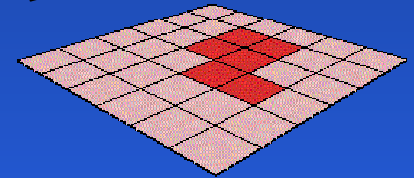


Types of models

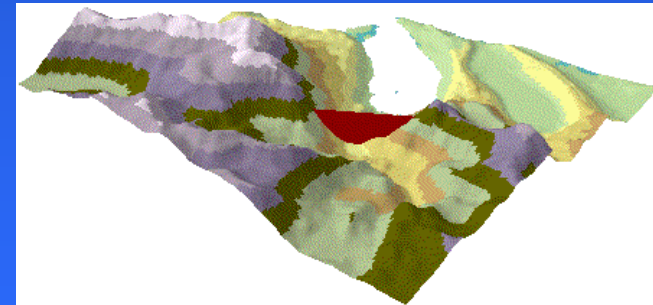
- **Representation models**
 - Describe the landscape (your GIS data layers)
- **Suitability models**
 - Use GIS layers to find best place for something (businesses, vineyards, evacuation centers)
 - Relatively easy; standard methodology
- **Process models**
 - Show the landscape as conditions change (fire spreads, rivers flood, oil slicks move)
 - Often difficult; no standard methodology
- **Automated work flows**
 - Data processing



GIS data layers



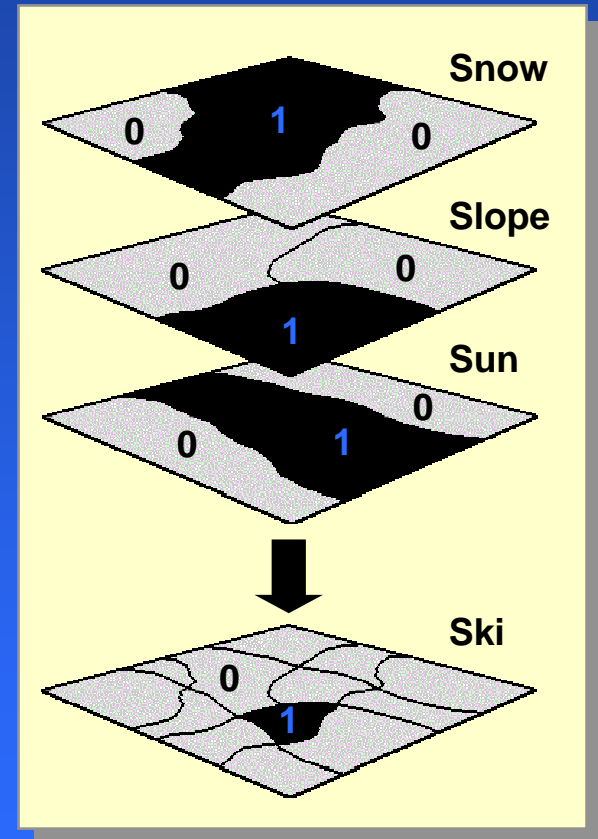
Best store location



Filling a reservoir

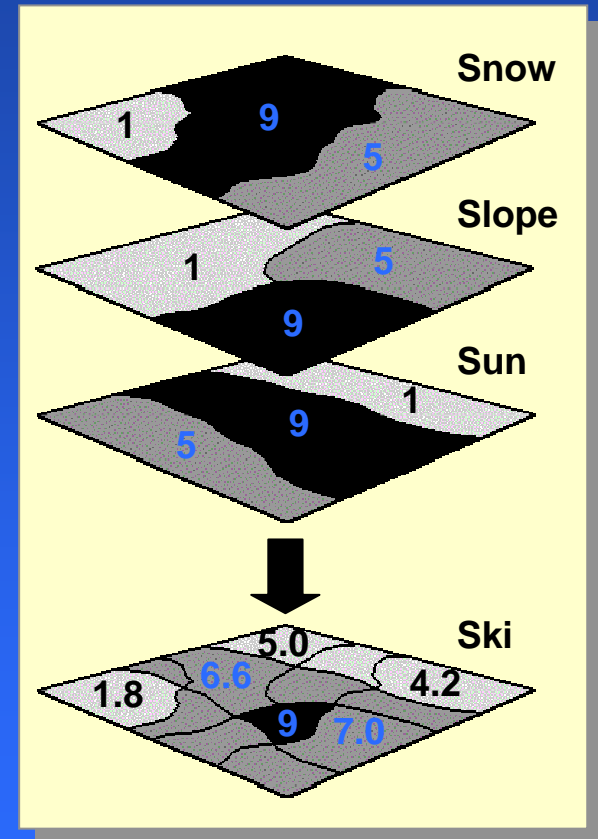
Binary suitability models

- Use for simple problems
 - Like a query
- Classify layers into good (1) and bad (0)
 - Combine with AND, addition, or multiplication:
 $\text{Ski} = \text{Snow And Slope And Sun}$
- Advantages:
 - Easy
- Disadvantages:
 - No 'next-best' sites
 - All layers have same importance
 - All good values have same importance



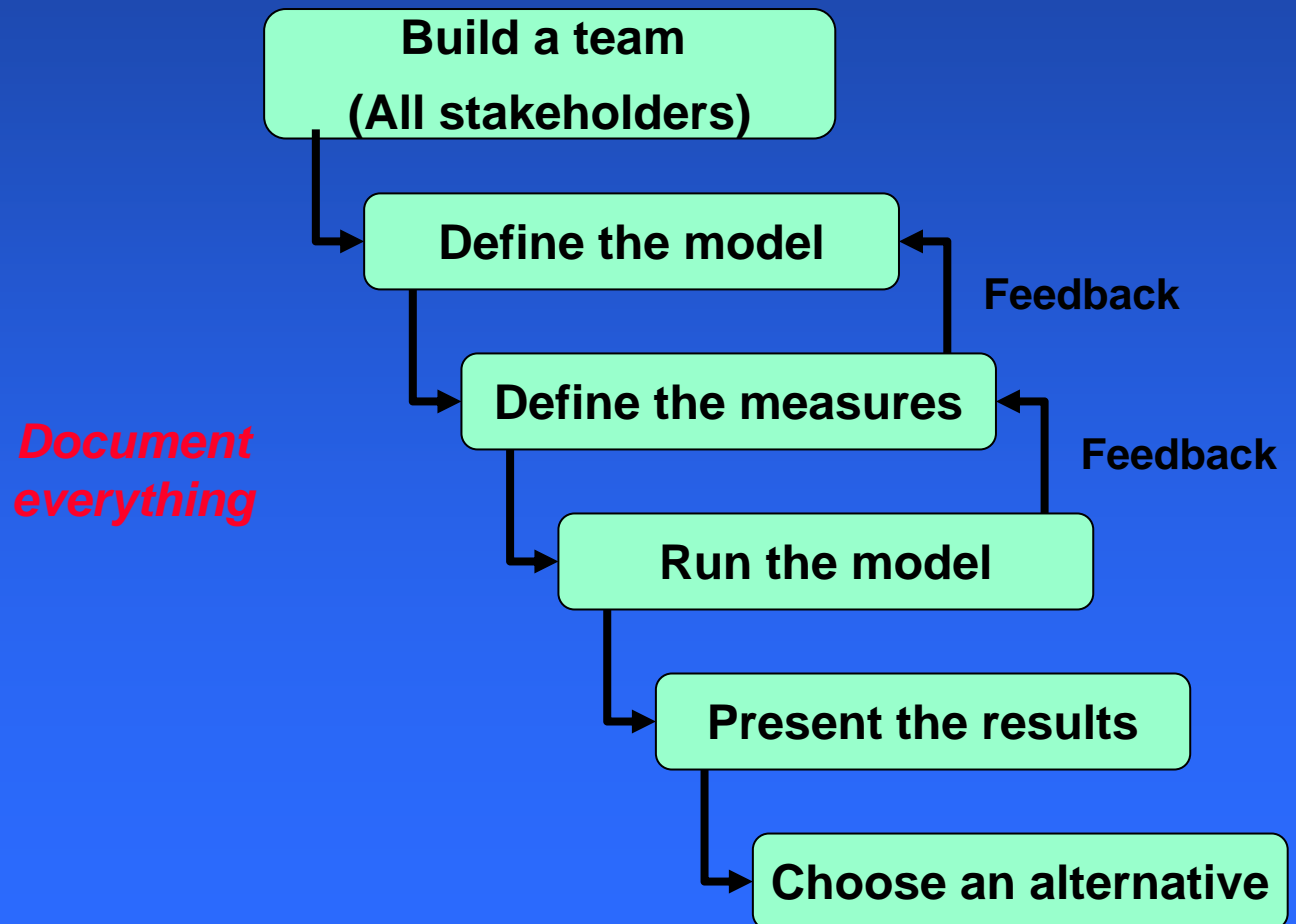
Weighted suitability models

- Use for complex problems
- Classify layers into suitability 1–9 (9 = best)
 - Weight and add together:
$$\begin{aligned} \text{Ski} &= (\text{Snow} * 0.5) \\ &+ (\text{Slope} * 0.3) \\ &+ (\text{Sun} * 0.2) \end{aligned}$$
- Advantages:
 - All values have relative importance
 - All layers have relative importance
 - Returns suitability on a scale 1–9
- Disadvantages:
 - Preference assessment is harder



Weighted suitability methodology

- There is a fairly standard methodology to follow:



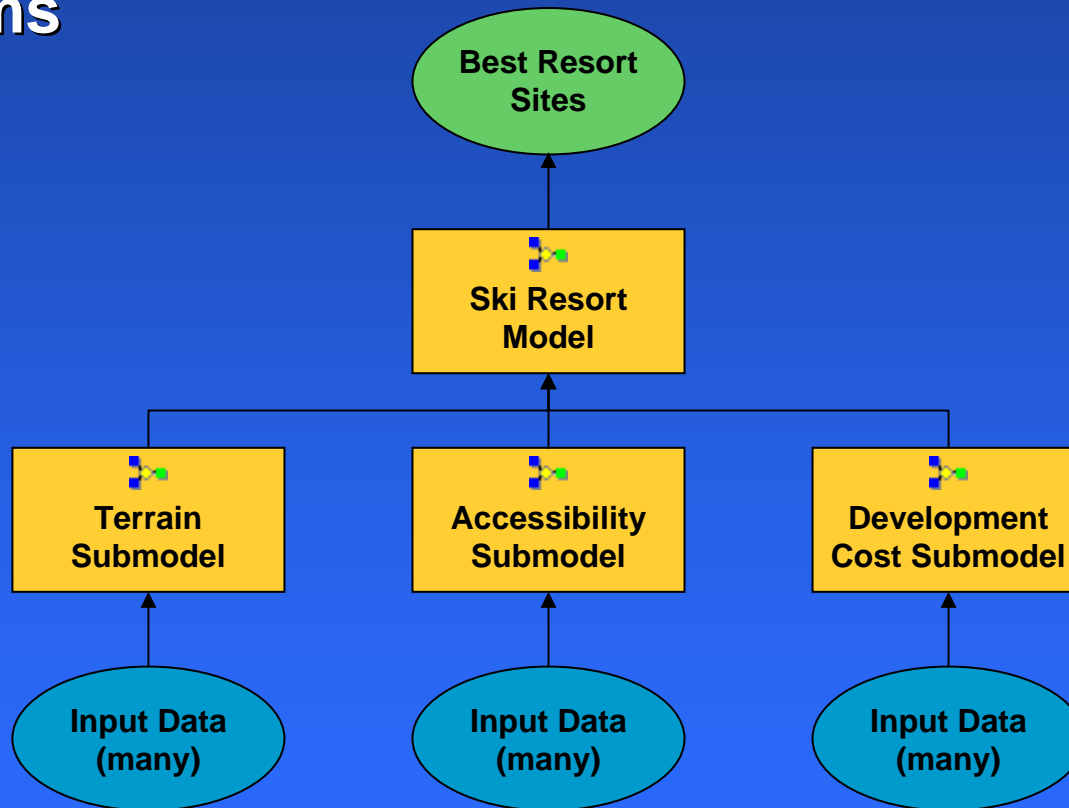
Define the model

- This is a team activity
 - Stakeholders, decision makers
- Define the problem (i.e. Economic development)
 - “Locate a ski resort”
- Identify issues
 - “Accessible to skiers”
- Determine how to measure
 - “Drive time to the city”
- Obtain GIS data



Break big models into submodels

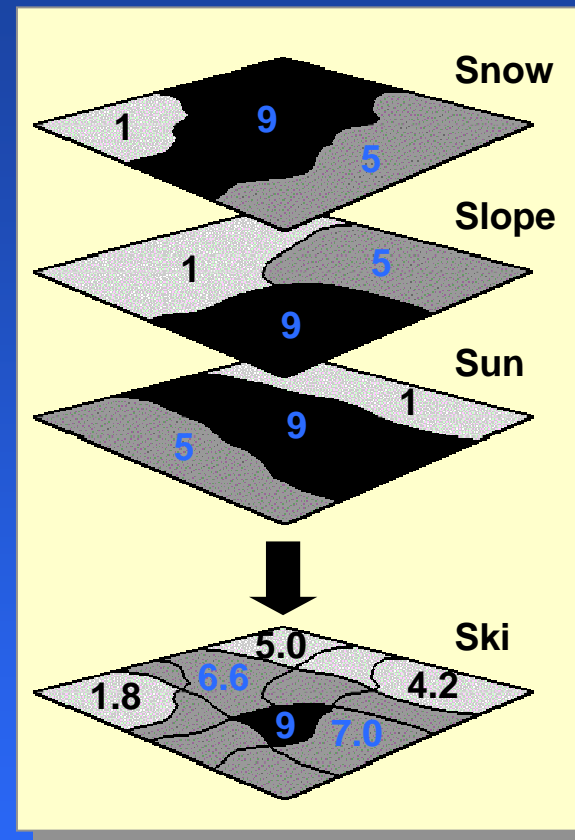
- Helps clarify relationships and simplifies problems



Weight and combine the layers

- For each submodel
 - Multiply suitability layers by weights
 - Weights must add up to one
 - Add the weighted layers together
- Repeat to combine submodels

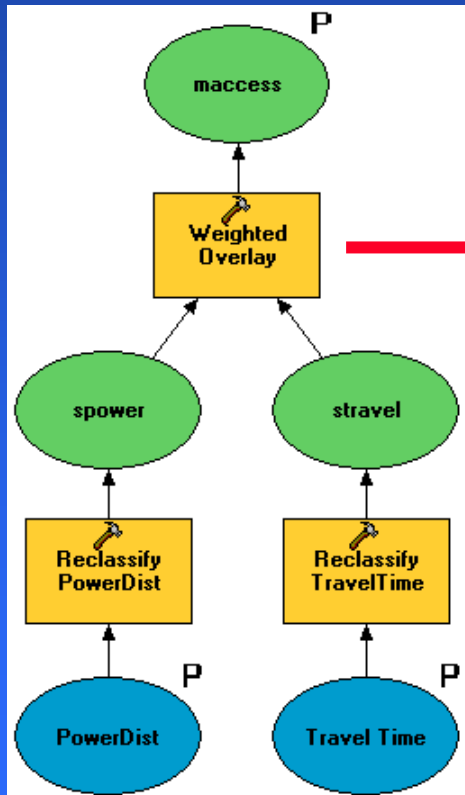
- Use the Weighted Overlay tool
- Or use a Map Algebra expression



$$\text{Ski} = (\text{Snow} * 0.5) + (\text{Slope} * 0.3) + (\text{Sun} * 0.2)$$

Weighted Overlay tool

- Weights and combines multiple inputs



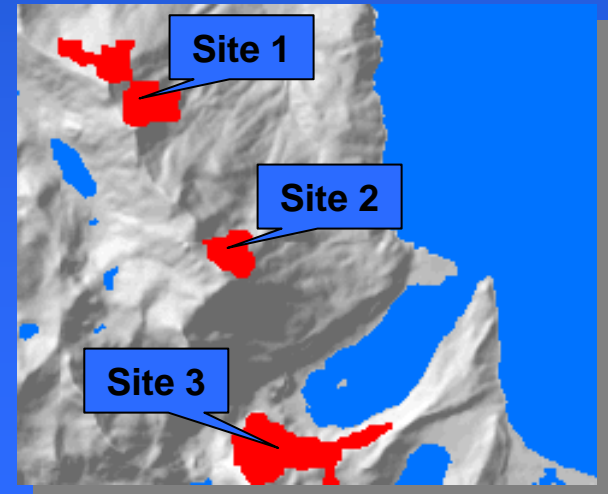
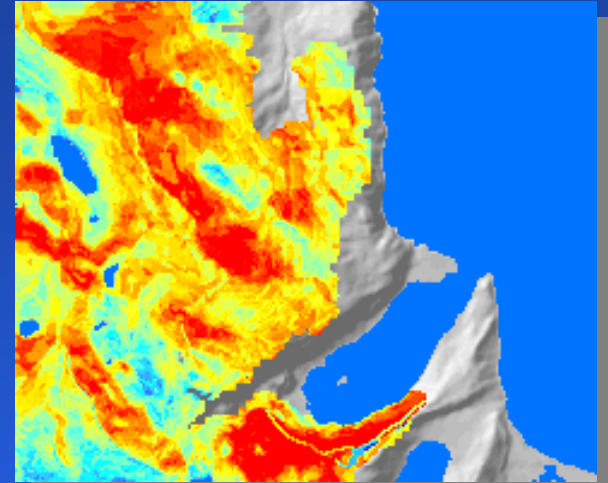
A screenshot of the 'Weighted Overlay' tool interface. The window title is 'Weighted Overlay'. Below the title bar, the text 'Weighted overlay table' is displayed. The main area contains a table with the following data:

Raster	% Influence	Field	Scale Value
stravel	70	Value	
		1	1
		2	2
		3	3
		4	
		5	
		6	
		7	
		8	
		9	
		NODATA	NODATA
spower	30	Value	
		1	1
		2	2
		3	3

Below the table, the 'Sum of influence' is set to 100, and the 'Set Equal Influence' button is visible. The 'Evaluation scale' is set to '1 to 9 by 1'. The 'Output raster' field contains the path 'C:\Student\SPAG\Exercise10\SkiModel\maccess'. The interface includes standard buttons: 'OK', 'Cancel', 'Apply', and 'Show Help >>'. Red circles with numbers 1, 2, 3, and 4 are overlaid on the interface to highlight specific elements: 1 is on the Evaluation scale dropdown, 2 is on the plus sign button, 3 is on the Scale Value column, and 4 is on the % Influence column.

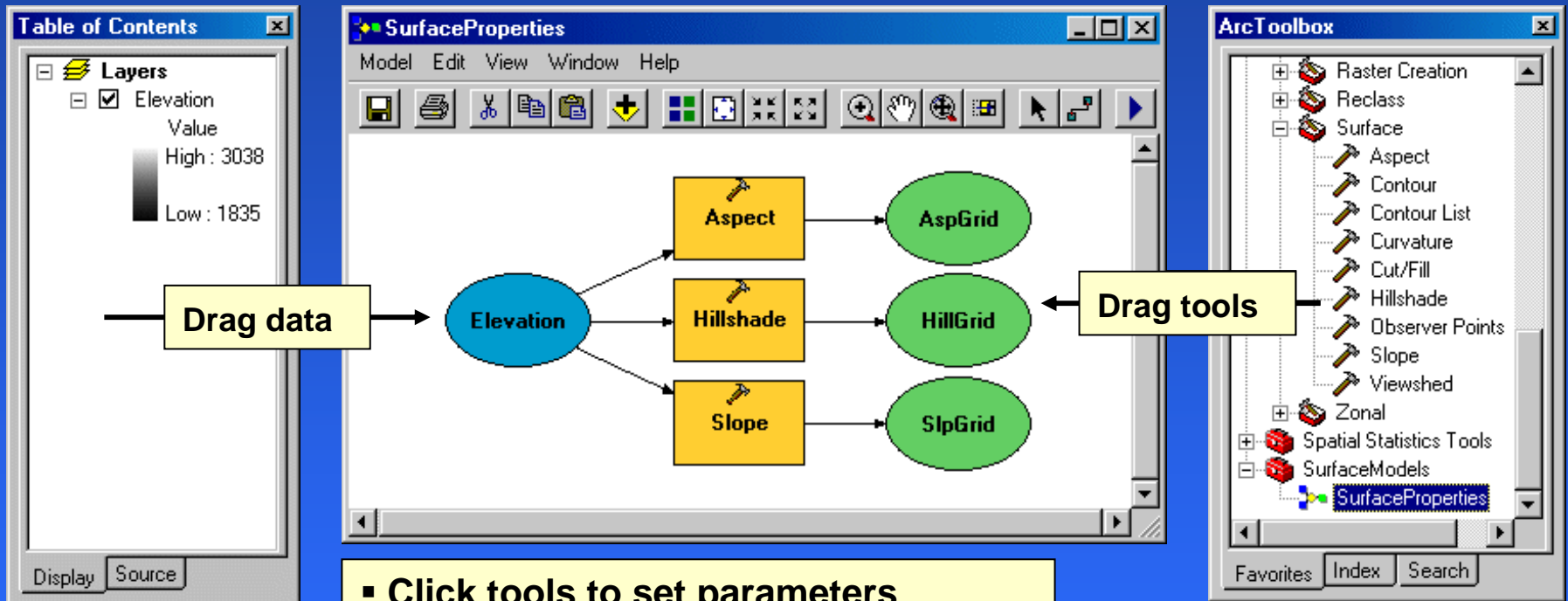
Find the best locations

- Model returns a suitability 'surface'
 - Often does not return a perfect 9
- Create candidate sites
 - Select cells with highest scores
 - Define regions with unique IDs
 - Eliminate regions that are too small
- Choose between the candidates
 - Another modeling problem?



Building models with ModelBuilder

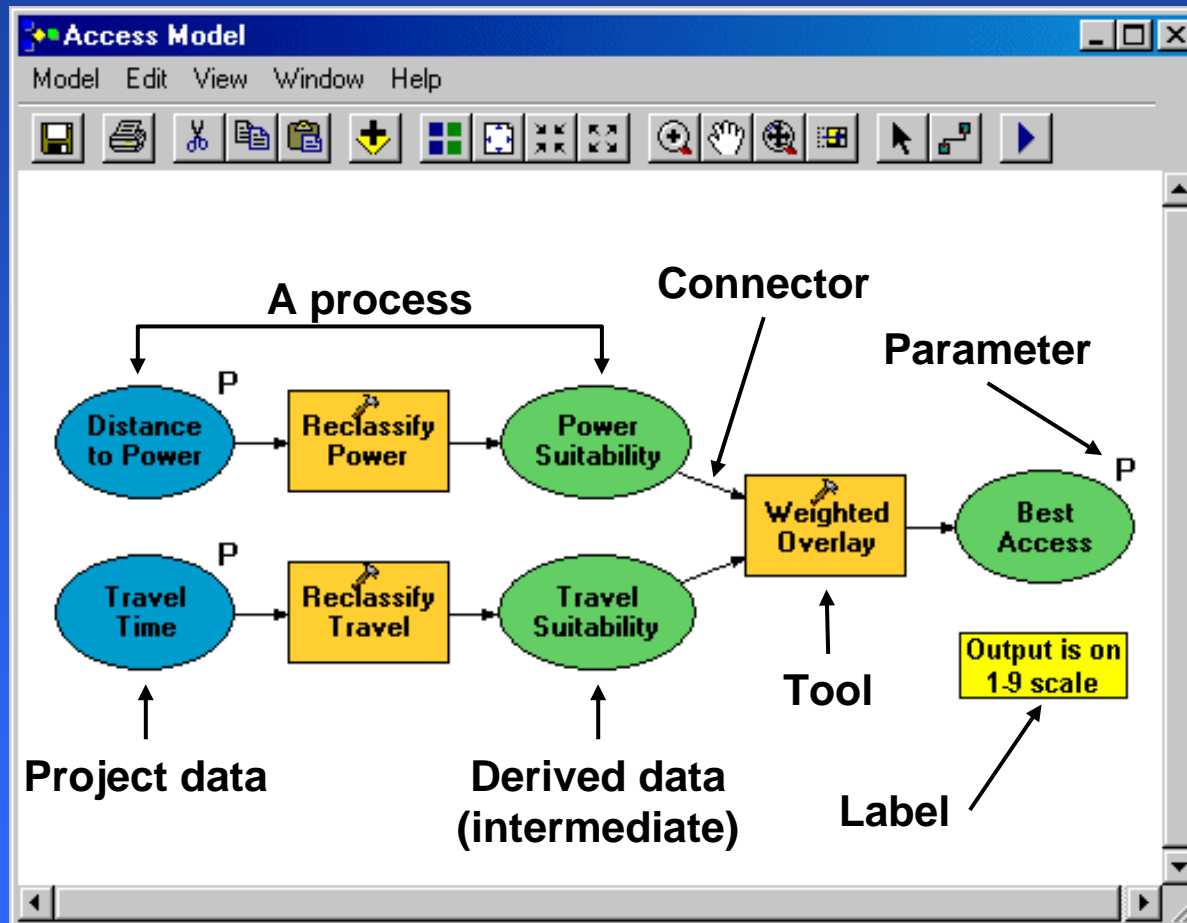
- A graphical modeling environment for ArcGIS



- Click tools to set parameters
- Set model and diagram properties
- Save model and run
- Edit, change model as desired
- Uses geoprocessing environment

- Add a new toolbox
- Add a new model (opens ModelBuilder)

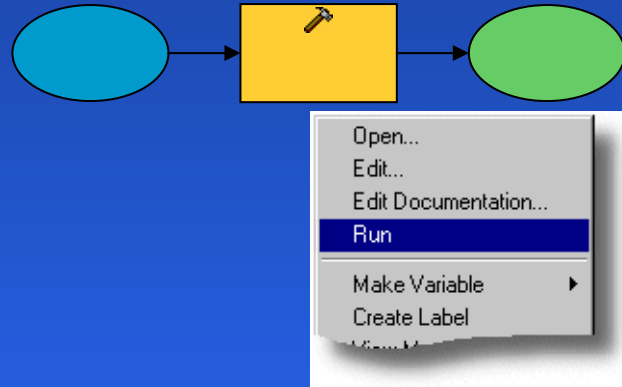
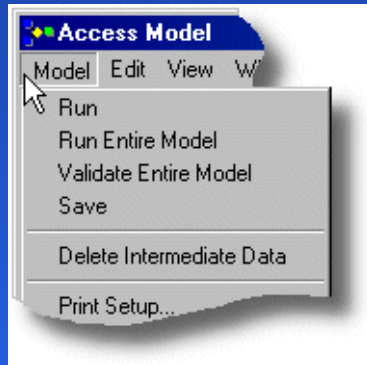
Model elements



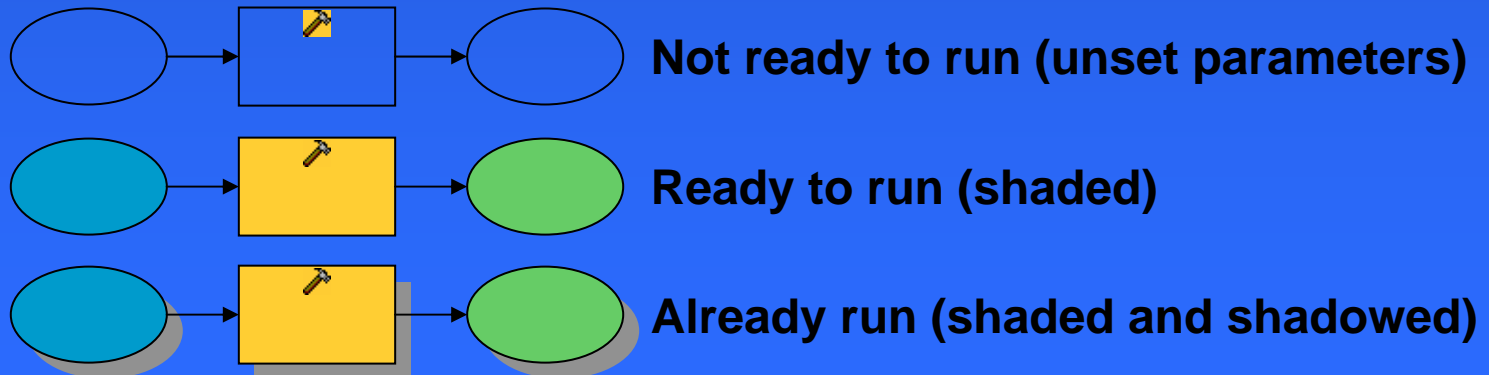
All elements have context menus

Running a model

- Run from ArcToolbox like other tools
- Run in the ModelBuilder window—all or one process

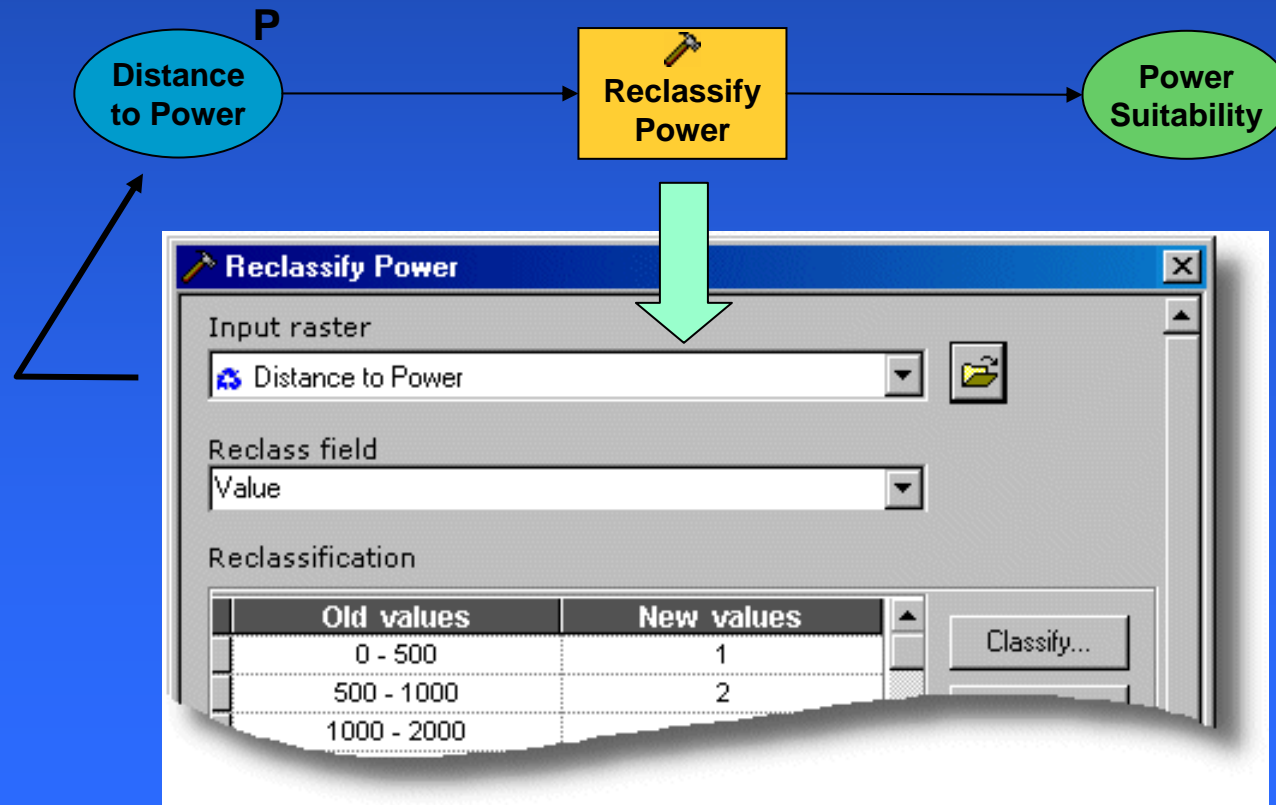


– Three states of a process:



Setting tool parameters

- Open the standard tool dialog
 - Double-click the tool or choose Open from the context menu



Setting model parameters

- Mark data as a parameter; appears in the model dialog

The diagram illustrates a model workflow and its configuration. The workflow consists of the following steps:

- Distance to Power** (Parameter P) and **Travel Time** (Parameter P) are input data.
- Distance to Power** is processed by **Reclassify Power** to produce **Power Suitability**.
- Travel Time** is processed by **Reclassify Travel** to produce **Travel Suitability**.
- Power Suitability** and **Travel Suitability** are combined in a **Weighted Overlay** process.
- The final output is **Best Access** (Parameter P).

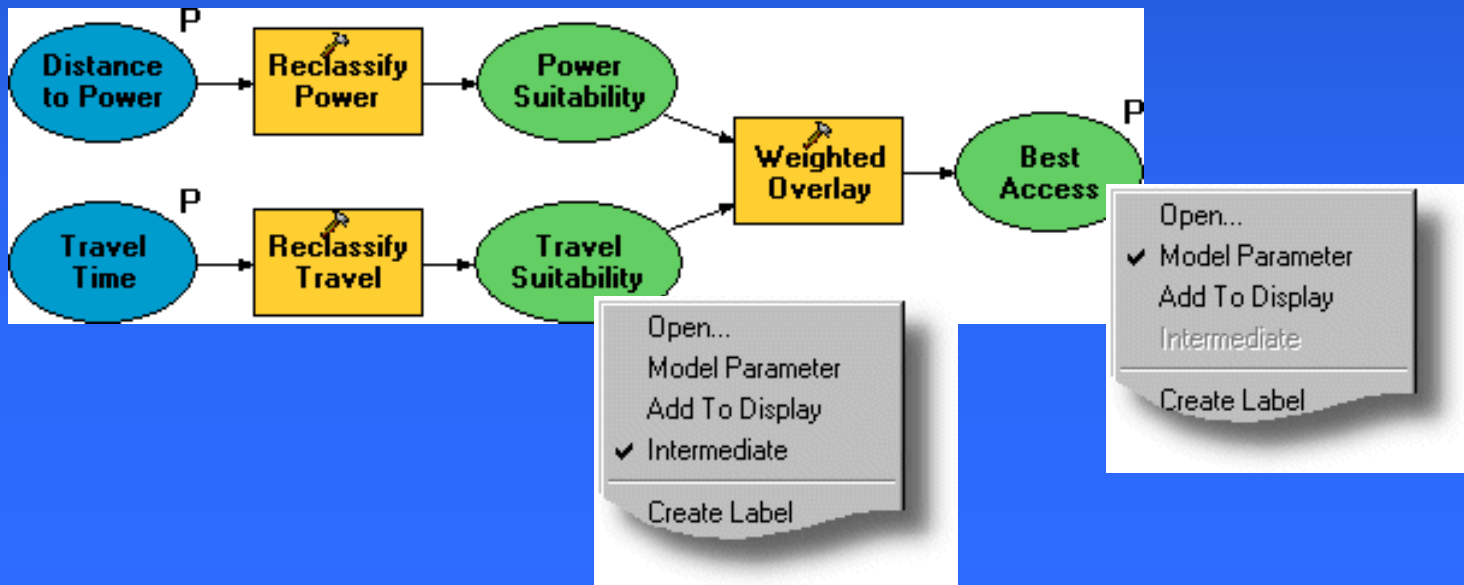
The **Access Model** dialog box shows the configuration for these parameters:

- Distance to Power** is mapped to the variable **PowerDist**.
- Travel Time** is mapped to the variable **TravelTime**.
- Best Access** is mapped to the file path **C:\Student\SPAG\Exercise11\Access**.

A context menu is shown over the **Best Access** parameter, with the **Model Parameter** option checked. A yellow callout box states: **Set Model Properties to control the parameter order in the tool dialog**.

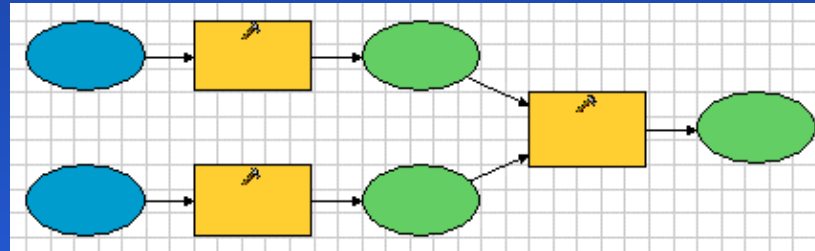
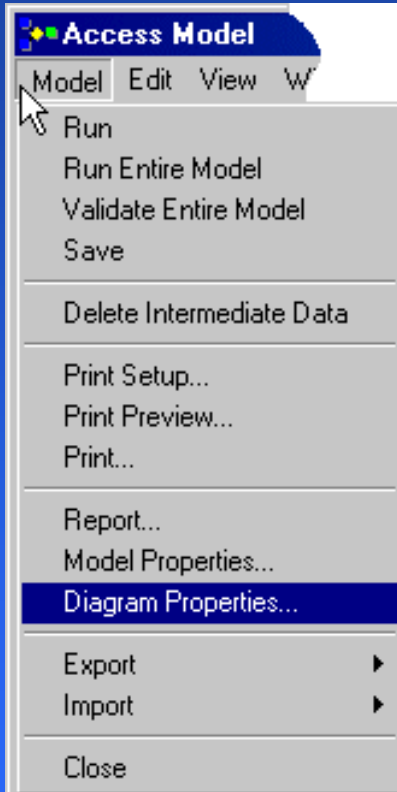
Setting derived data properties

- Control how derived data is handled
 - **Intermediate:** Temporary (auto-delete ... or not)
 - **Add to Display:** Add to ArcMap Table of Contents
 - **Model Parameter:** Add to ArcMap and permanent

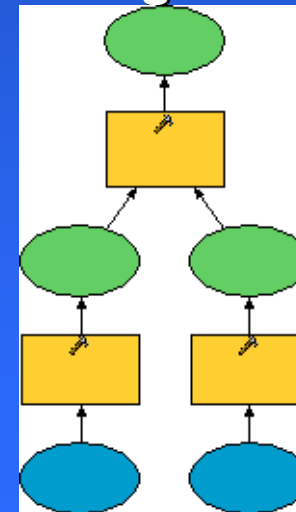


Setting diagram properties

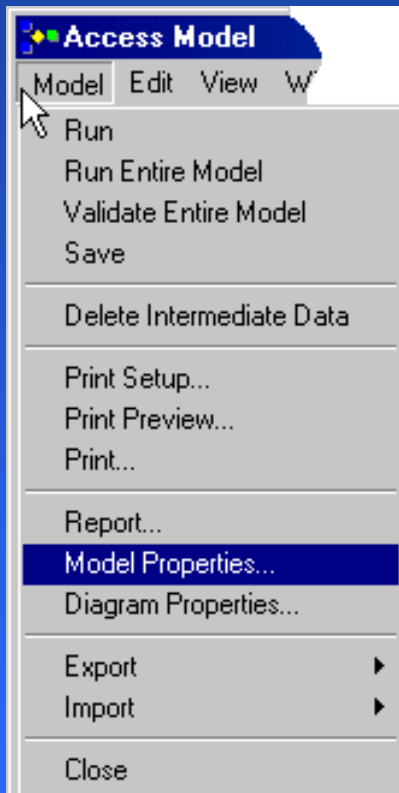
- Set Manual or Automatic layout mode
- Turn snapping grid on or off



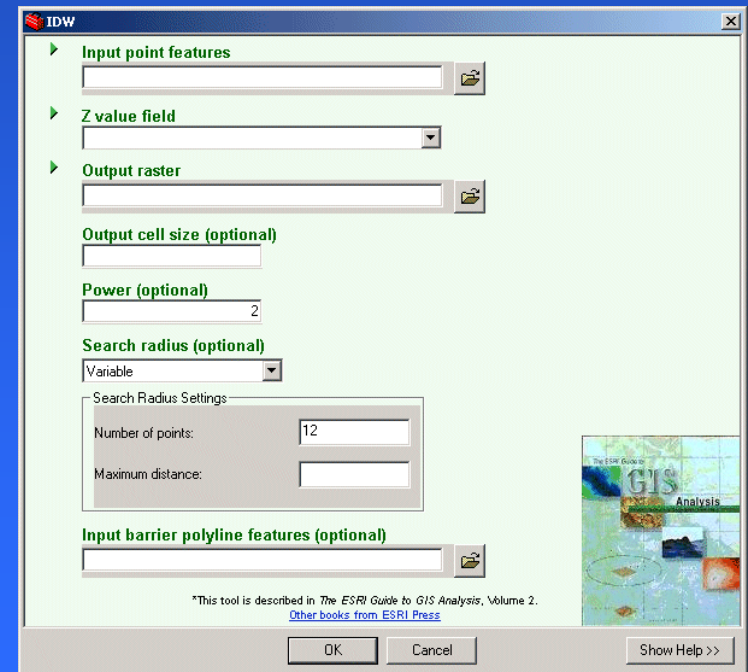
- Control Auto Layout tool settings
 - Orientation
 - Element spacing
 - Layout quality
 - Connector routing
 - More ...



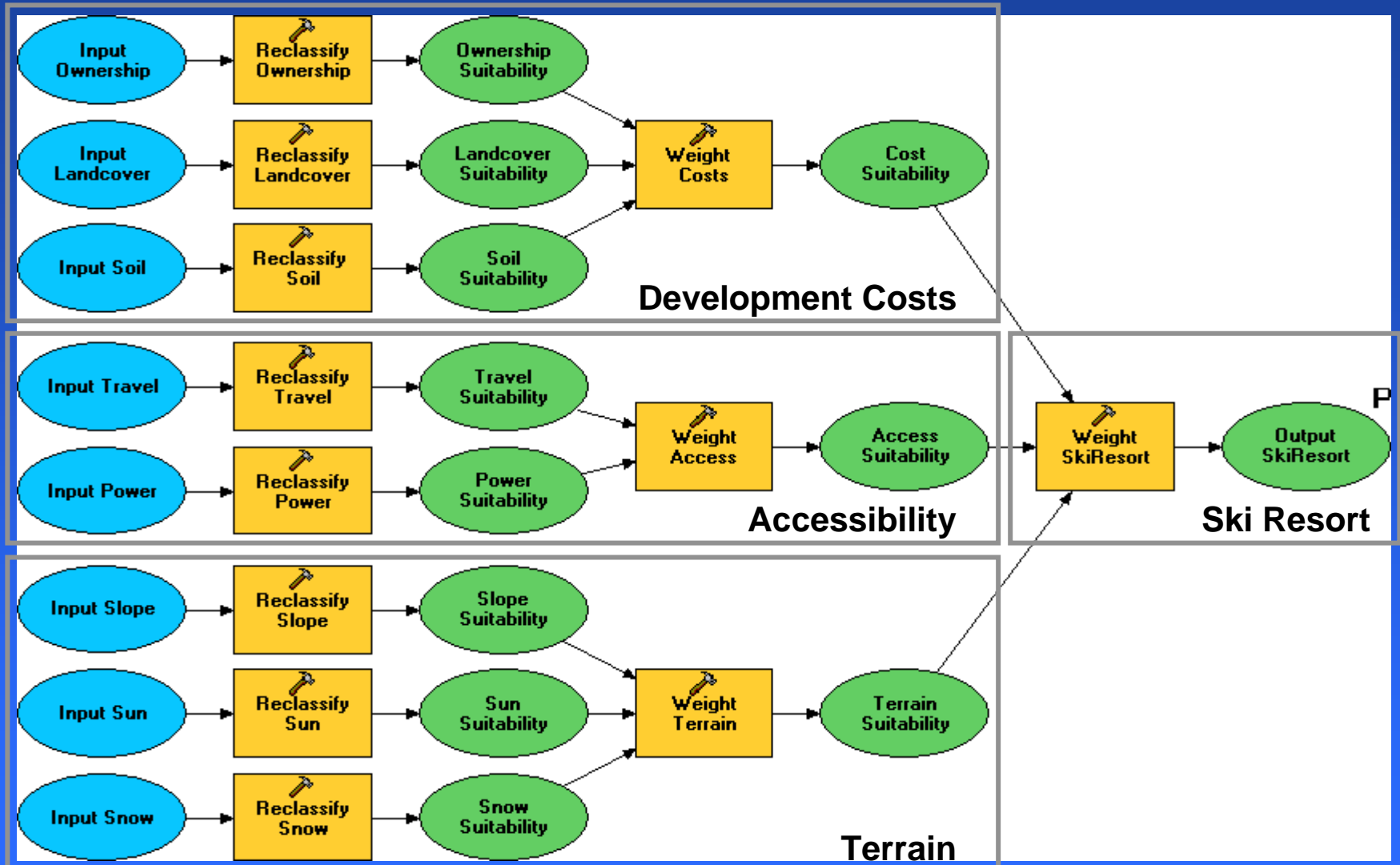
Setting model properties



- Set Name, Label, Description
- Set Parameters order
- Set Environments (local to model)
- Set Help file (HTML)
- Set Stylesheet (XSL)

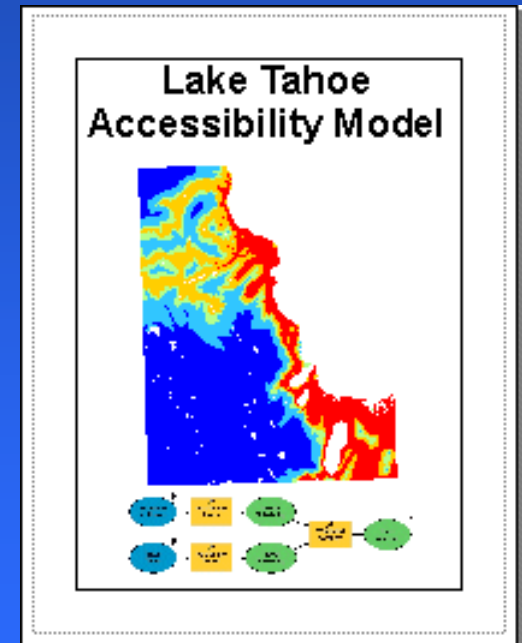


Ski Resort model



Saving, exporting, and printing a model

- Model is saved to a TBX file or a geodatabase
 - Share TBX or geodatabase with others
- Export models
 - To a graphic: BMP, JPG, EMF (may add to ArcMap layouts)
 - To a script: Python, JScript, VBScript (quick way to learn scripting)
- Print models
 - With borders, captions, page numbers
- Generate reports
 - List data, all tool parameters, and so on



Examples

Integrating biodiversity information into planning processes

NatureServe Vista

paper.mxd - ArcMap - ArcView

File Edit View Insert Selection Tools Window Help

NatureServe Vista

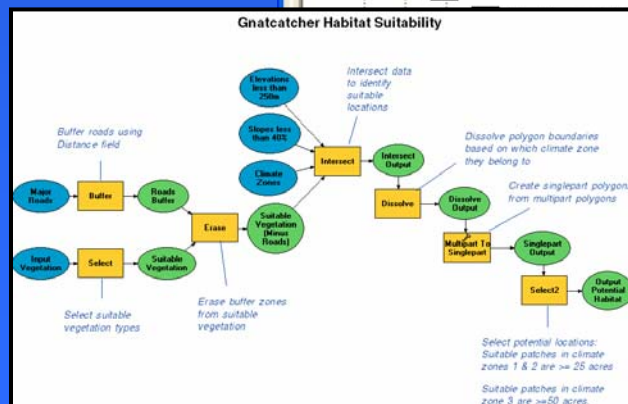
- Selection
- Project
- Lists
 - Element List...
 - Category System List...
 - Filter List...
 - Weighting System List...
 - Goal Set List...
 - Scenario List...
 - Translation List...
 - Map Context List...
- Reports
- Manage Elements ...
- Summarize Conservation Value ...
- Evaluate Scenario ...
- Import Scenario ...
- About NatureServe Vista...

Legend:

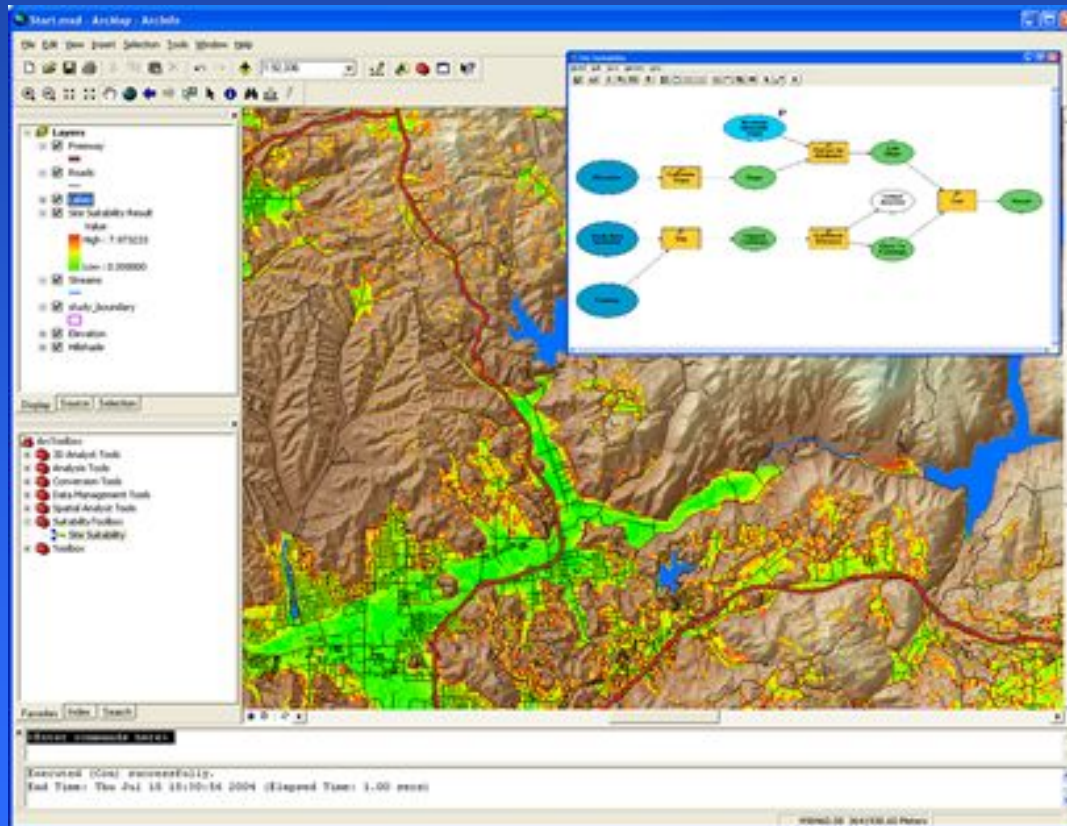
- Elements (by Element)
- Terrestrial Commu
 - Northern Interi
 - Serpentine Bu
 - Wildflower Fiel
- Terrestrial Ecologic
- Freshwater Commu

Map: Western Big-ee

Units used: 6393479.98 2024380.95 Feet

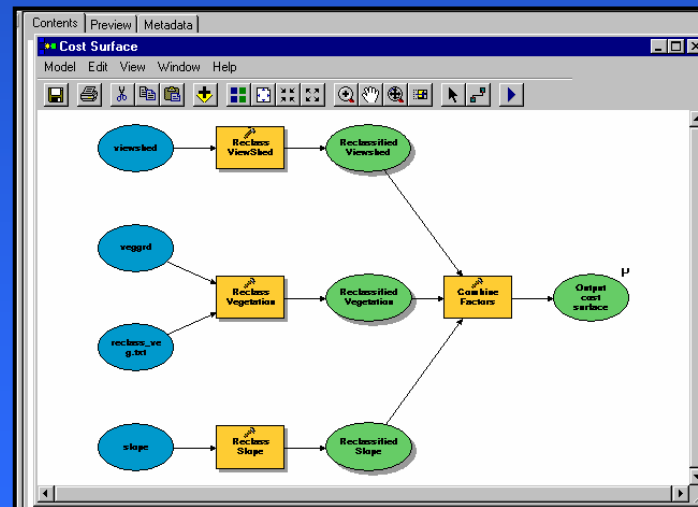
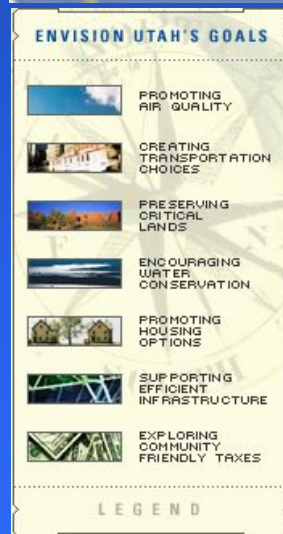


Hierarchical models for open space protection/programs



By Trust For Public Lands _ (www.tpl.org)

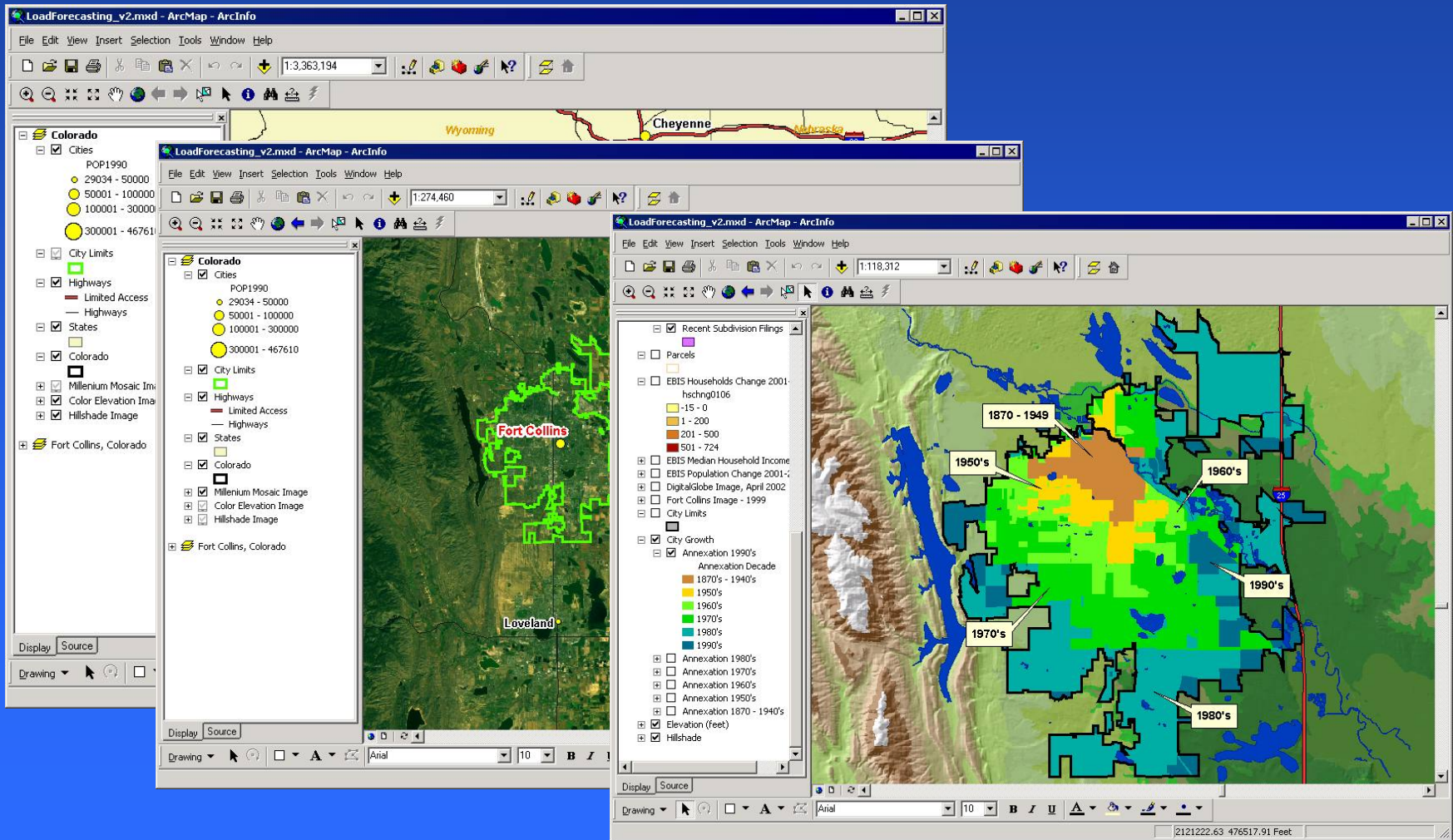
Water Demand Prediction Models



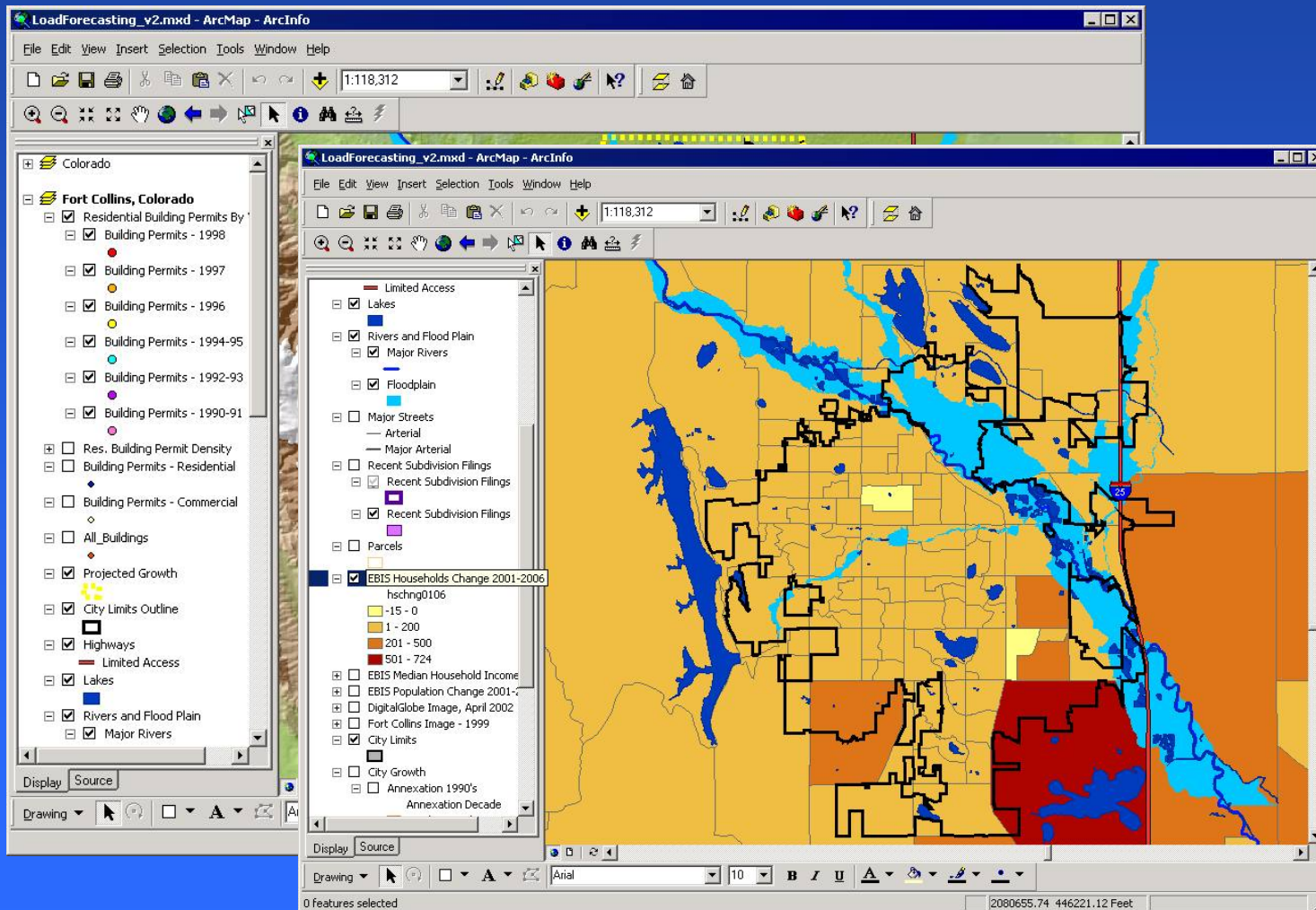
Being developed by (<http://www.envisionutah.org/>)

ModelBuilder Demo

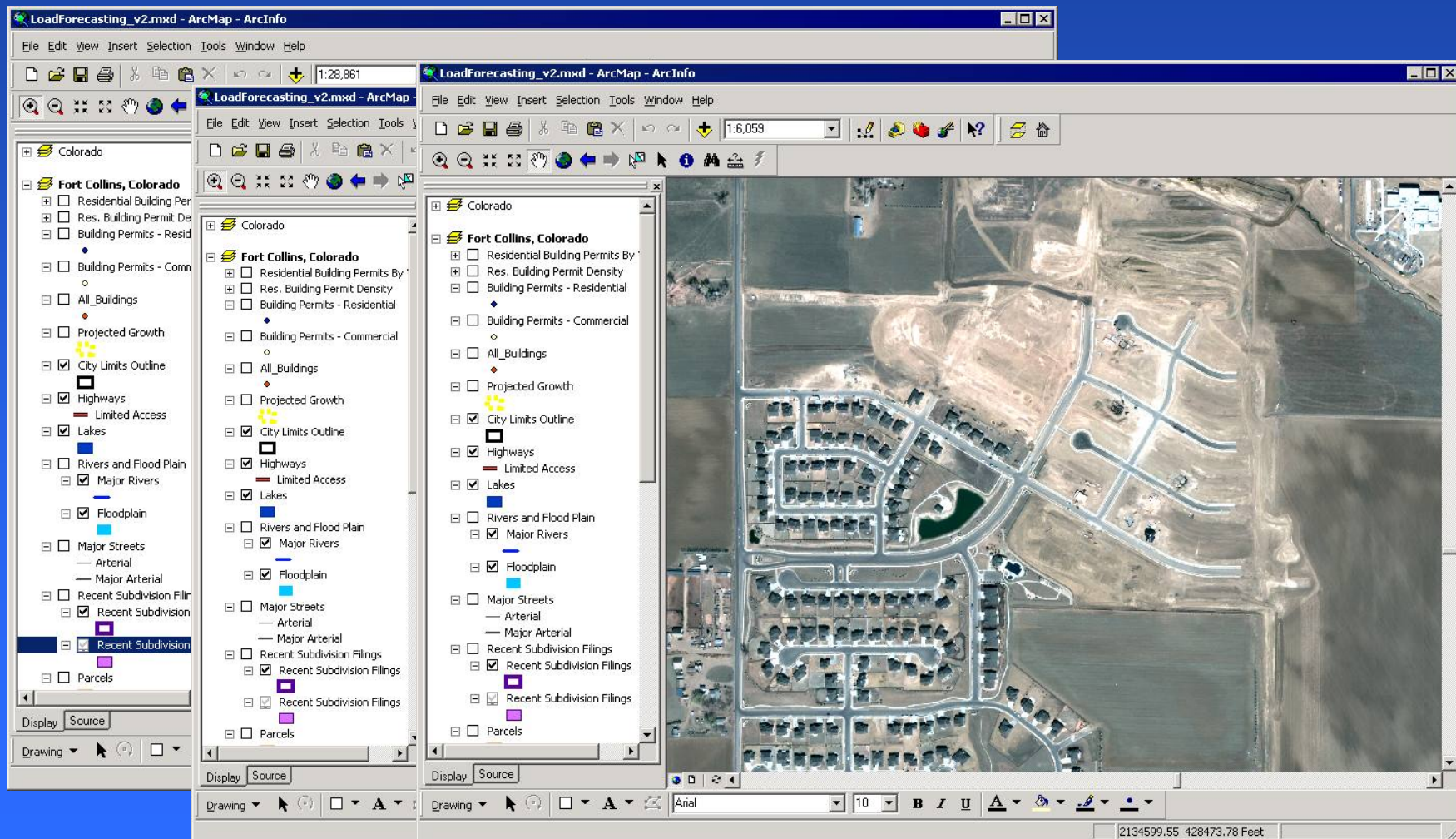
Utility Load Forecasting / Urban Growth Modeling



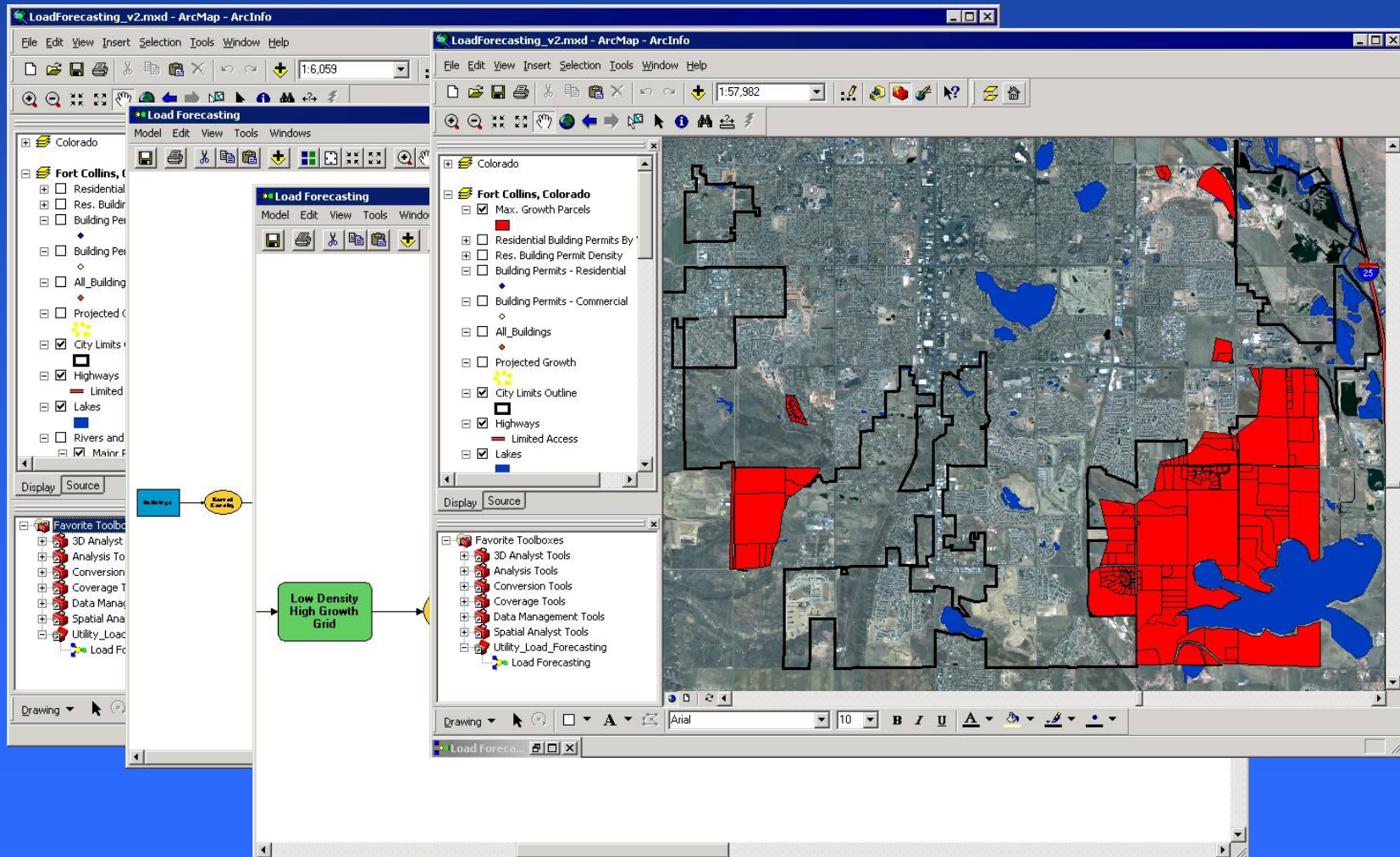
Utility Load Forecasting / Growth Modeling



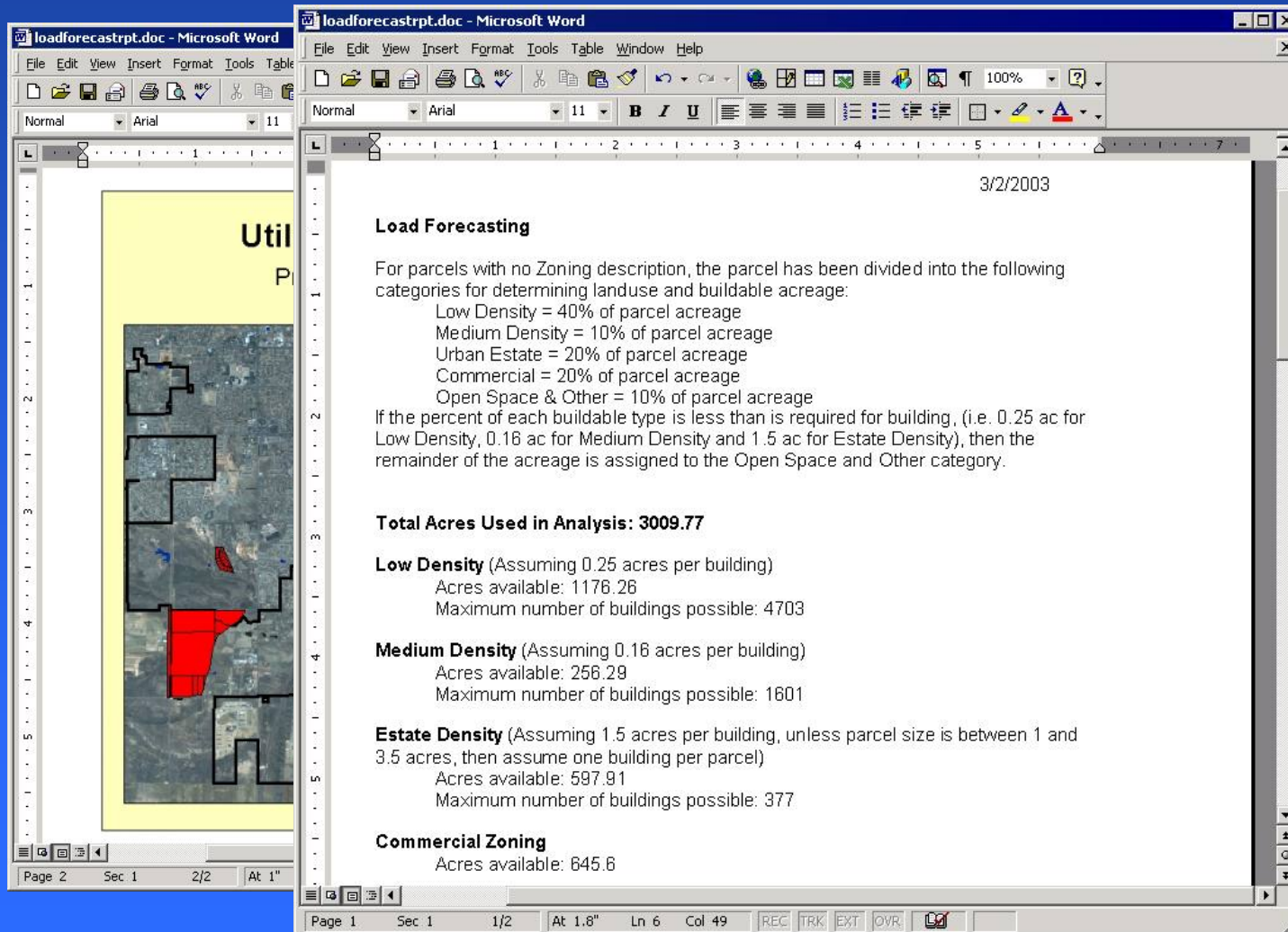
Utility Load Forecasting / Growth Modeling



Utility Load Forecasting / Growth Modeling



Utility Load Forecasting / Growth Modeling



The image shows two overlapping Microsoft Word windows. The background window displays a map of a utility area with a red-shaded region. The foreground window contains a document titled 'loadforecstrpt.doc' with the following content:

3/2/2003

Load Forecasting

For parcels with no Zoning description, the parcel has been divided into the following categories for determining landuse and buildable acreage:

- Low Density = 40% of parcel acreage
- Medium Density = 10% of parcel acreage
- Urban Estate = 20% of parcel acreage
- Commercial = 20% of parcel acreage
- Open Space & Other = 10% of parcel acreage

If the percent of each buildable type is less than is required for building, (i.e. 0.25 ac for Low Density, 0.16 ac for Medium Density and 1.5 ac for Estate Density), then the remainder of the acreage is assigned to the Open Space and Other category.

Total Acres Used in Analysis: 3009.77

Low Density (Assuming 0.25 acres per building)
Acres available: 1176.26
Maximum number of buildings possible: 4703

Medium Density (Assuming 0.16 acres per building)
Acres available: 256.29
Maximum number of buildings possible: 1601

Estate Density (Assuming 1.5 acres per building, unless parcel size is between 1 and 3.5 acres, then assume one building per parcel)
Acres available: 597.91
Maximum number of buildings possible: 377

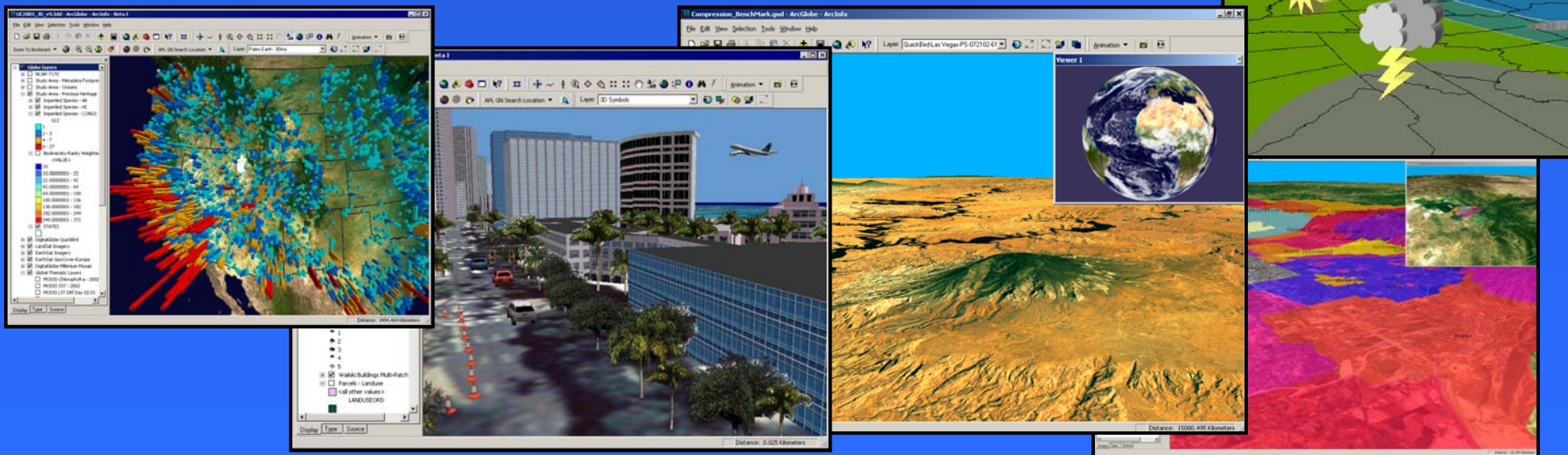
Commercial Zoning
Acres available: 645.6

Global and 3D Visualization

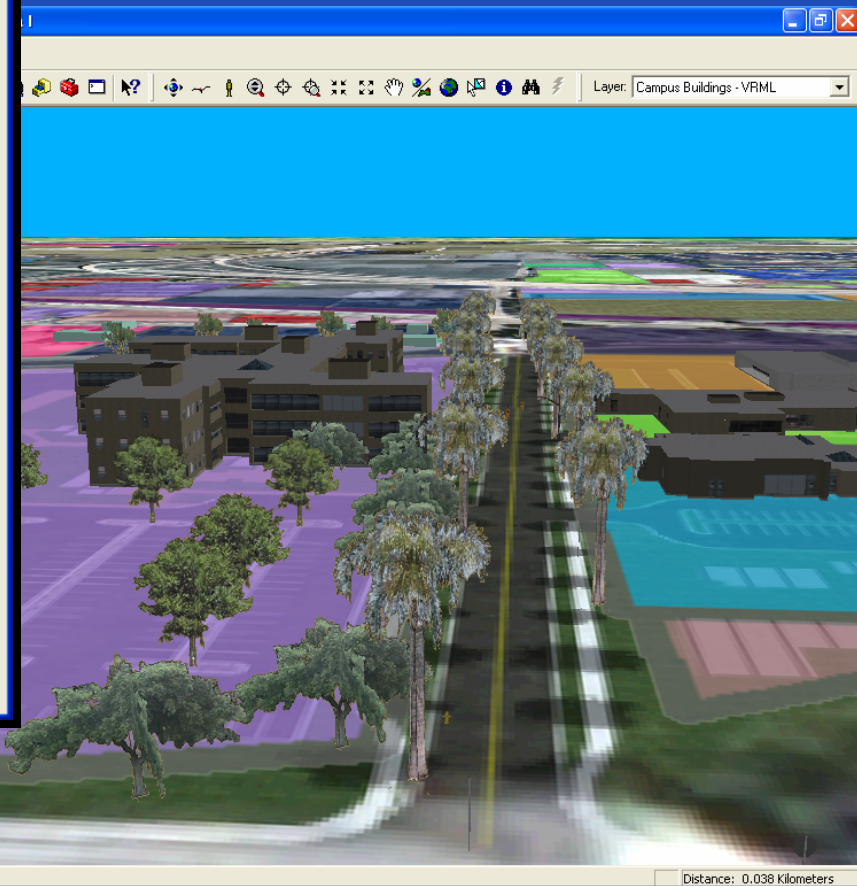
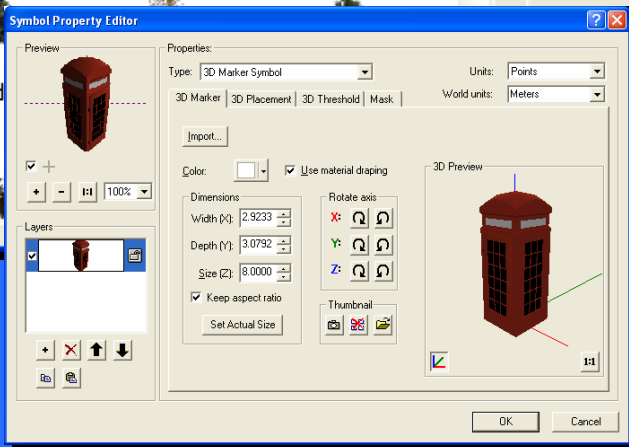
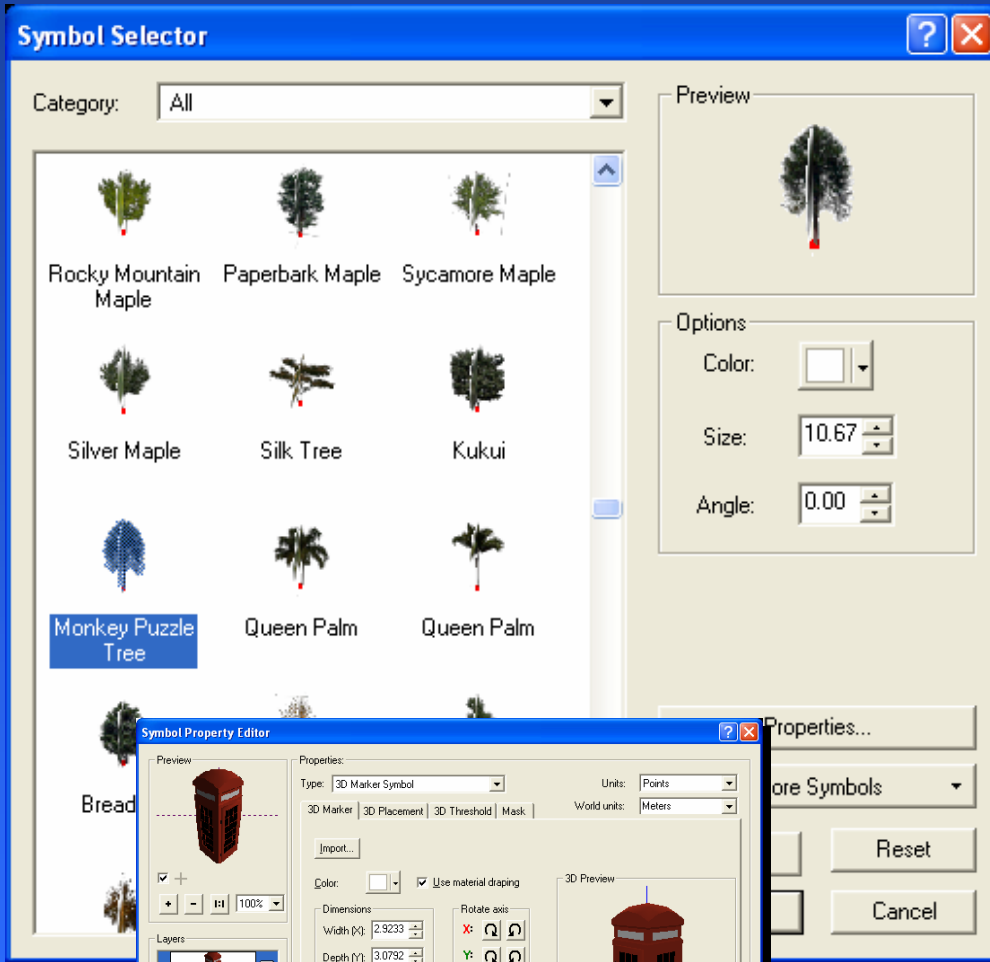


ArcGIS 3D Analyst

- Perspective visualization of data for analysis and communication
- Supports all GIS data types
- Includes symbol library, import tools, and 150 m global imagery

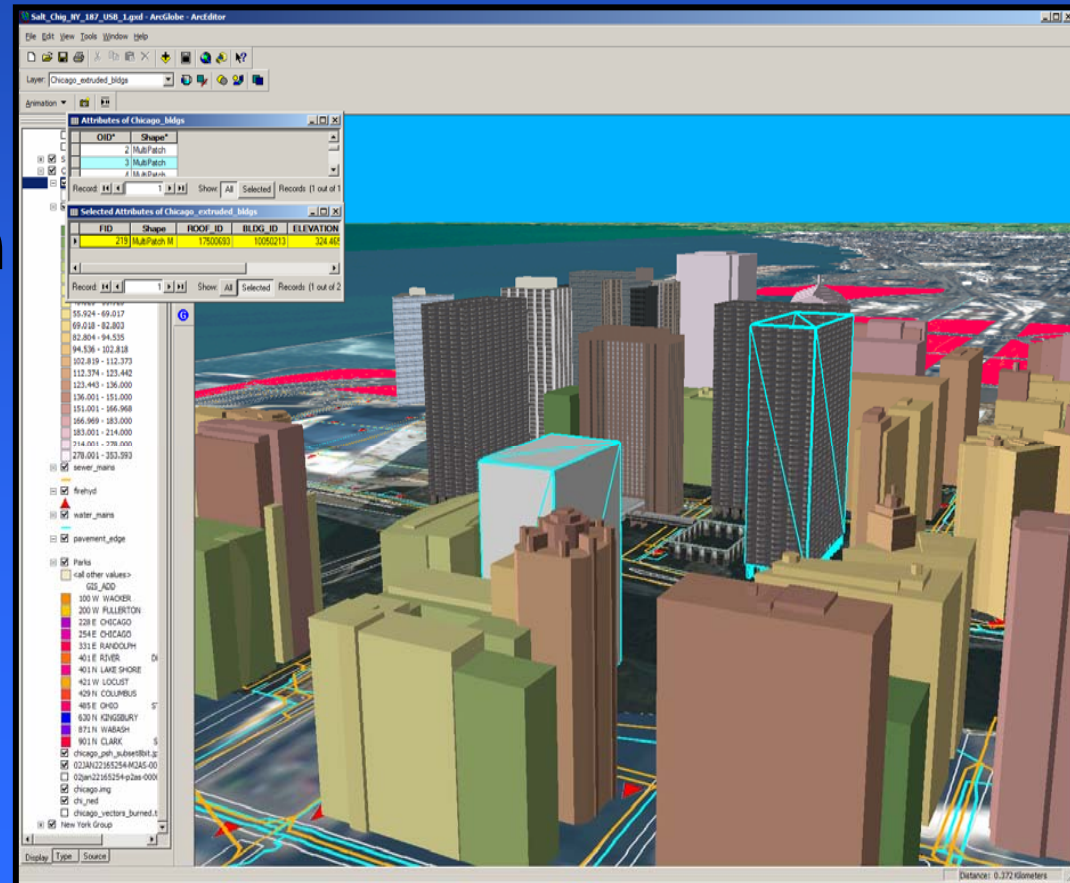


3D Symbols



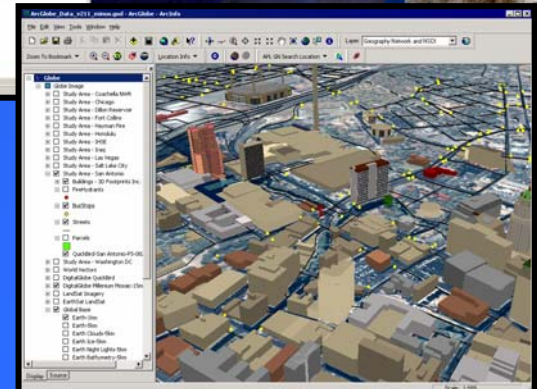
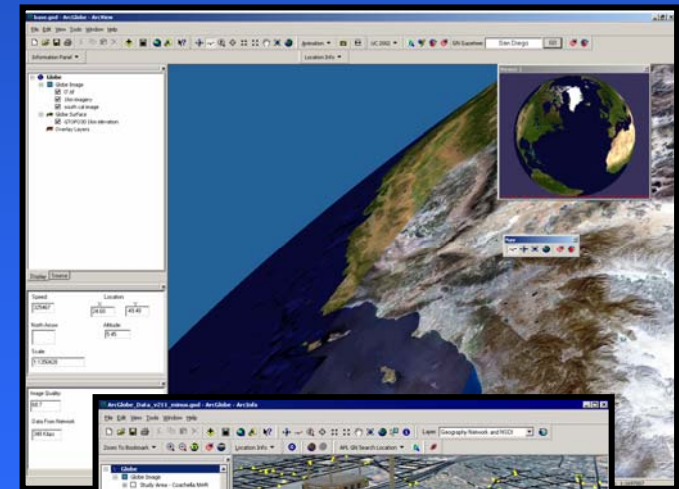
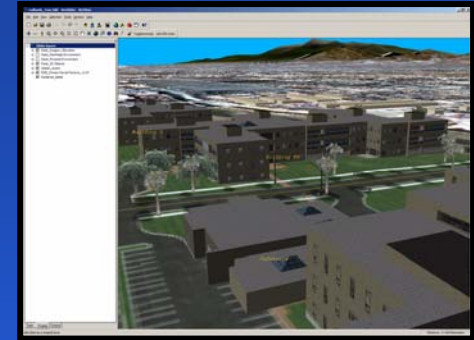
3D Features

- 3D Features Coordinates (x, y, z or x, y, z, m)
- Multipatch geometry (solids) with textures in the shape column

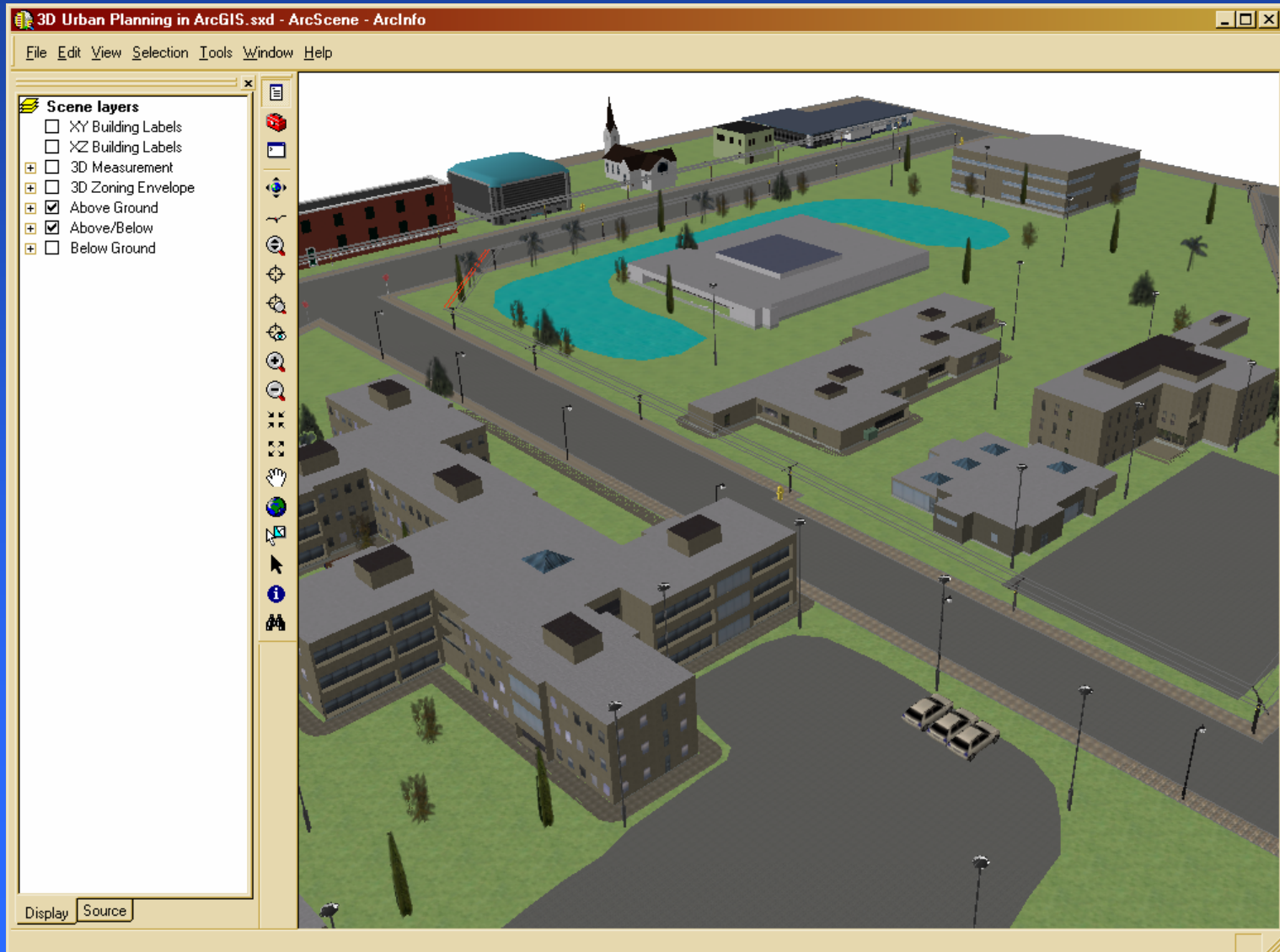


ArcGIS 3D Analyst Featuring ArcGlobe

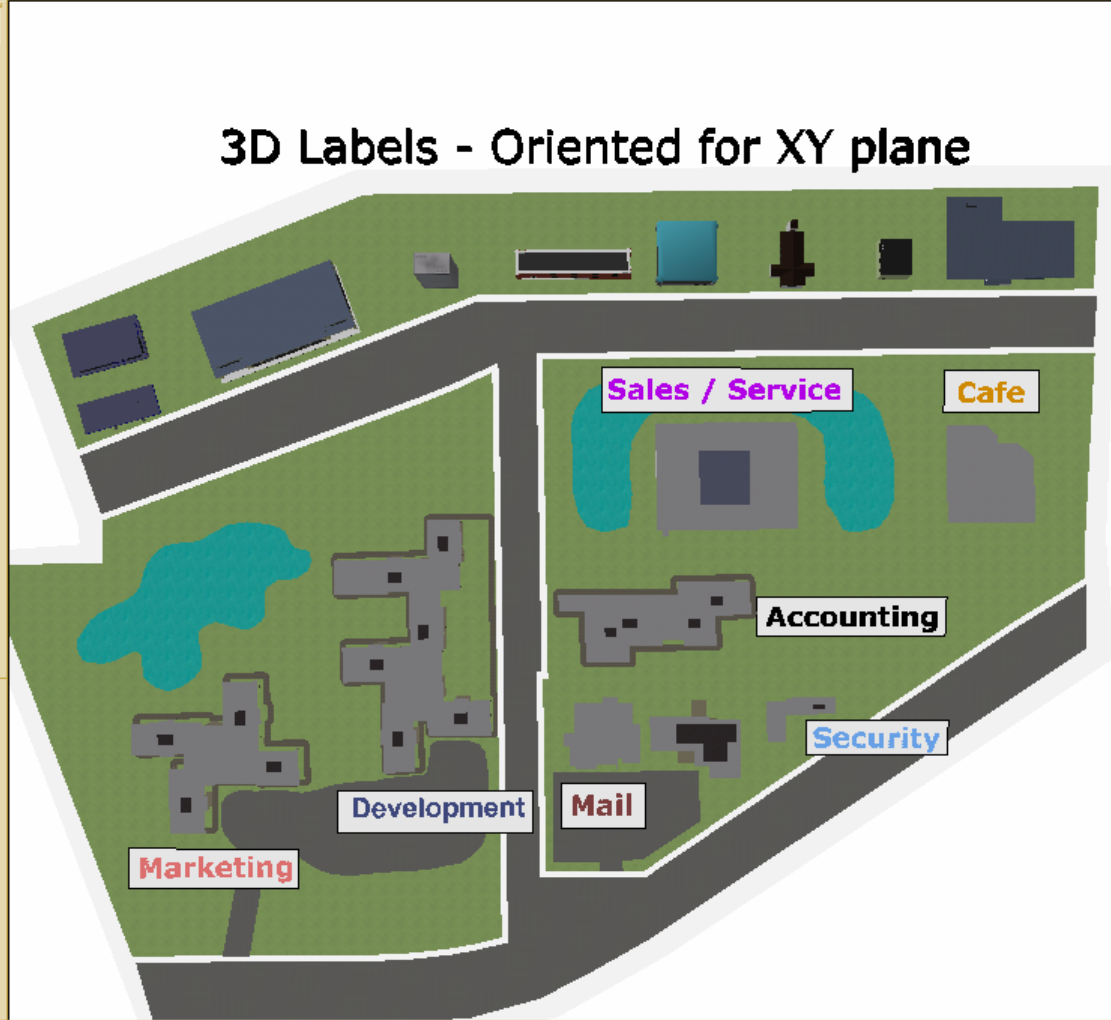
- High performance, continuous pan and zoom
- Real-time, multiresolution data access for easy data exploration
- Supports all GIS data types including terrain, raster, and vector
- Includes global base data



ArcGIS 3D Analyst for Urban and Site Design



- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Corporate Buildings
 - Surrounding Buildings
 - Overhead Power Lines
 - Live
 - Out
 - Trees
 - Ponds
 - Paths
 - Lunch Benches
 - Sidewalks
 - Parking Lots
 - Cars
 - Roads
 - Parcels
 - Extent Patch
 - Above/Below
 - Below Ground



3D Labels - Oriented for XY plane

Scene layers

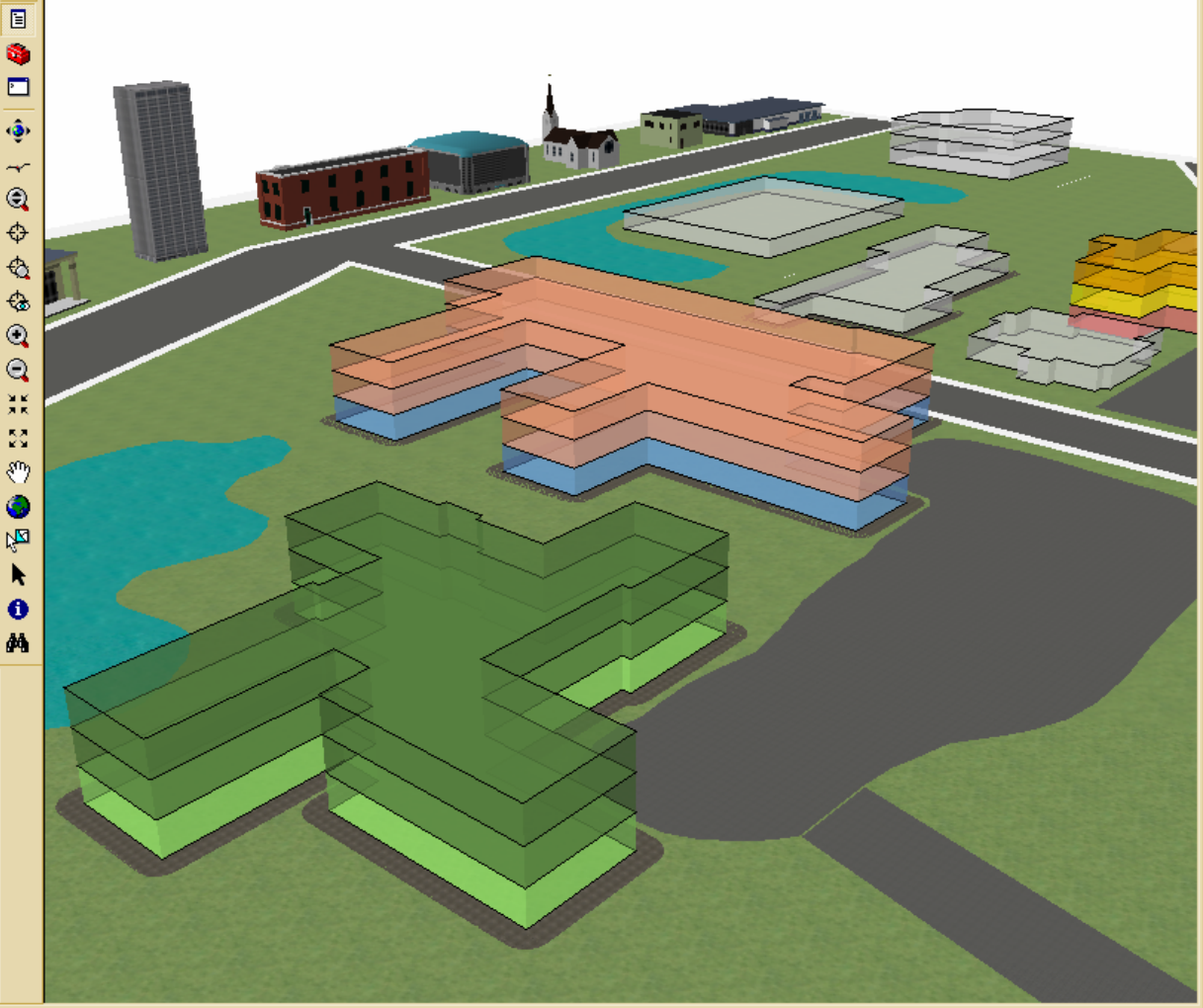
- XY Building Labels
- XZ Building Labels
- 3D Measurement
- 3D Zoning Envelope
- Above Ground
 - Corporate Buildings
 - Surrounding Buildings
 - Overhead Power Lines
 - Live
 - Out
- Trees
- Ponds
- Paths
- Lunch Benches
- Sidewalks
- Parking Lots
- Cars
- Roads
- Parcels
- Extent Patch
- Above/Below
- Below Ground



Display Source

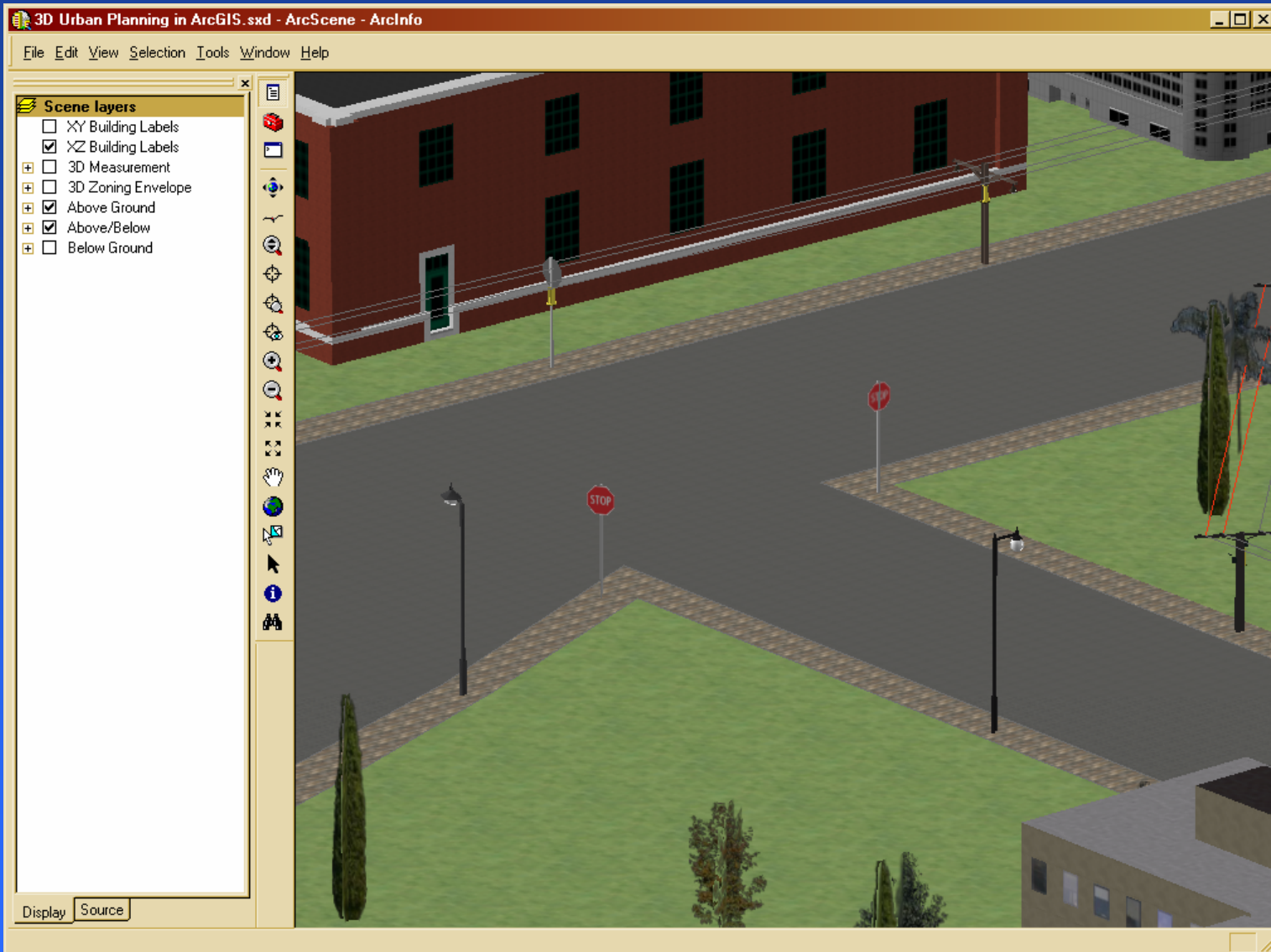
Go to a bookmark

- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - 3D Thematic Map
 - Above Ground
 - Corporate Buildings
 - Surrounding Buildings
 - Overhead Power Lines
 - Live
 - Out
 - Trees
 - Ponds
 - Paths
 - Lunch Benches
 - Sidewalks
 - Parking Lots
 - Cars
 - Roads
 - Parcels
 - Extent Patch
 - Above/Below
 - Below Ground



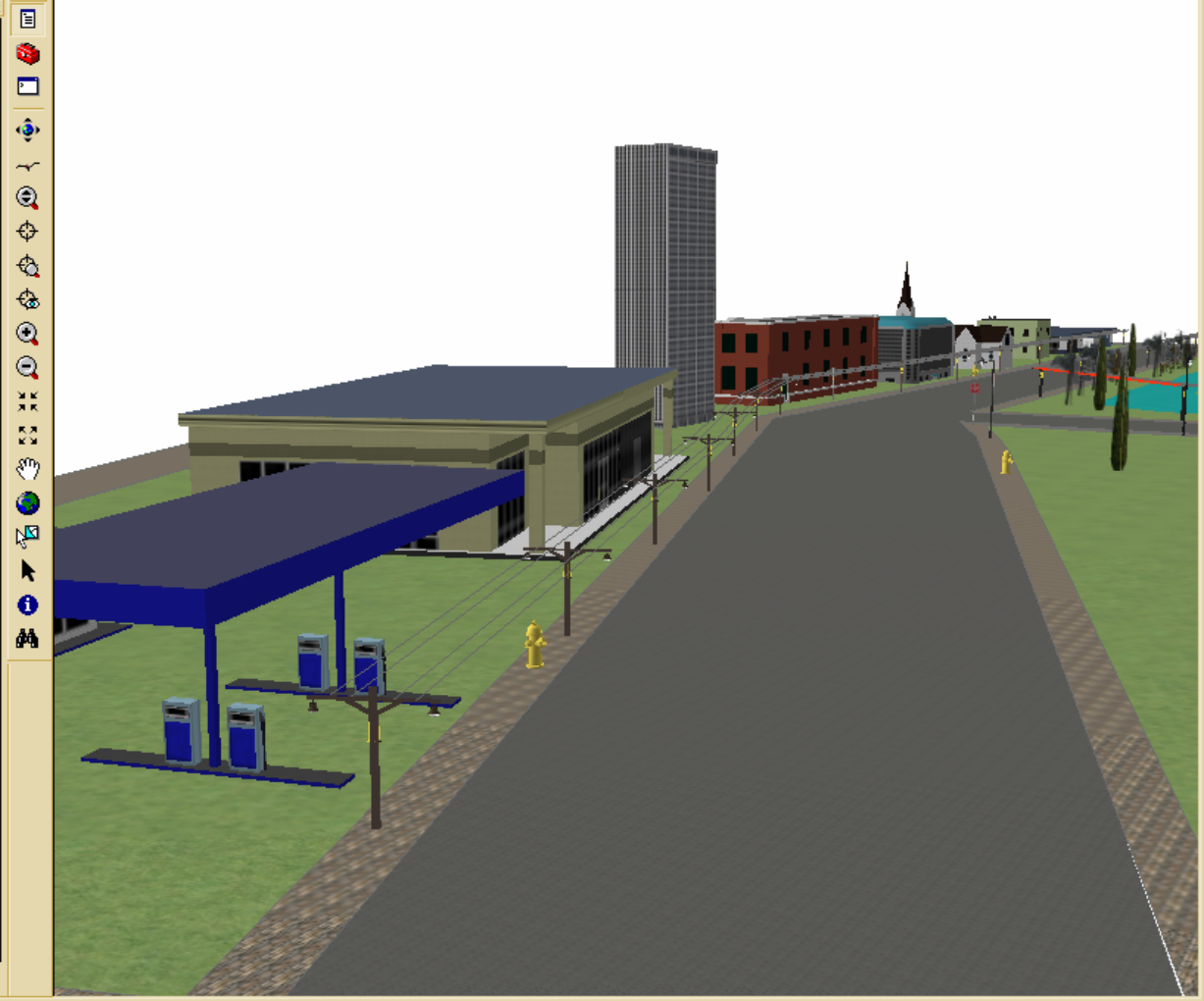
Display Source





Scene layers

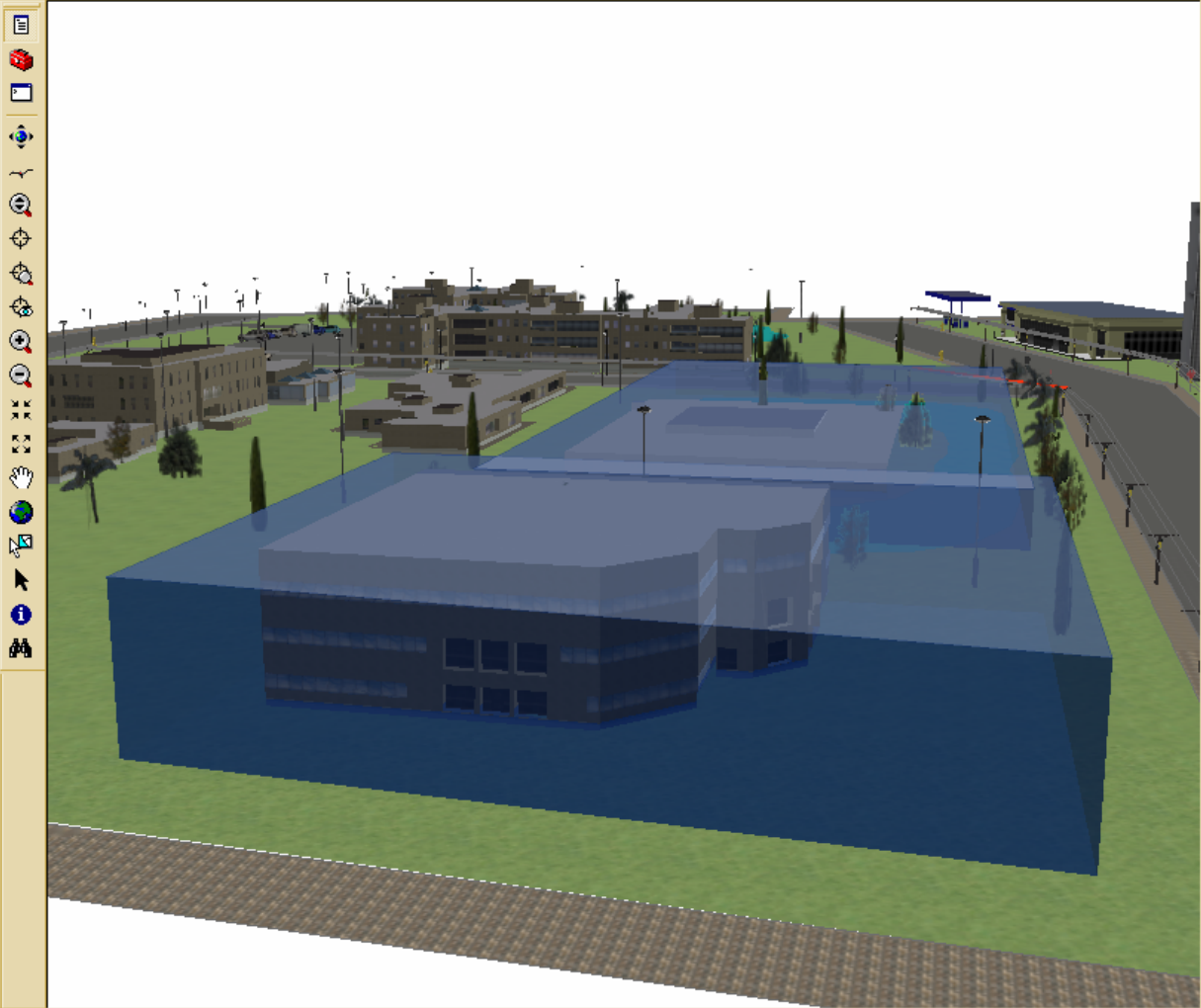
- XY Building Labels
- XZ Building Labels
- 3D Measurement
- 3D Zoning Envelope
- Above Ground
- Above/Below
- Below Ground



Display Source

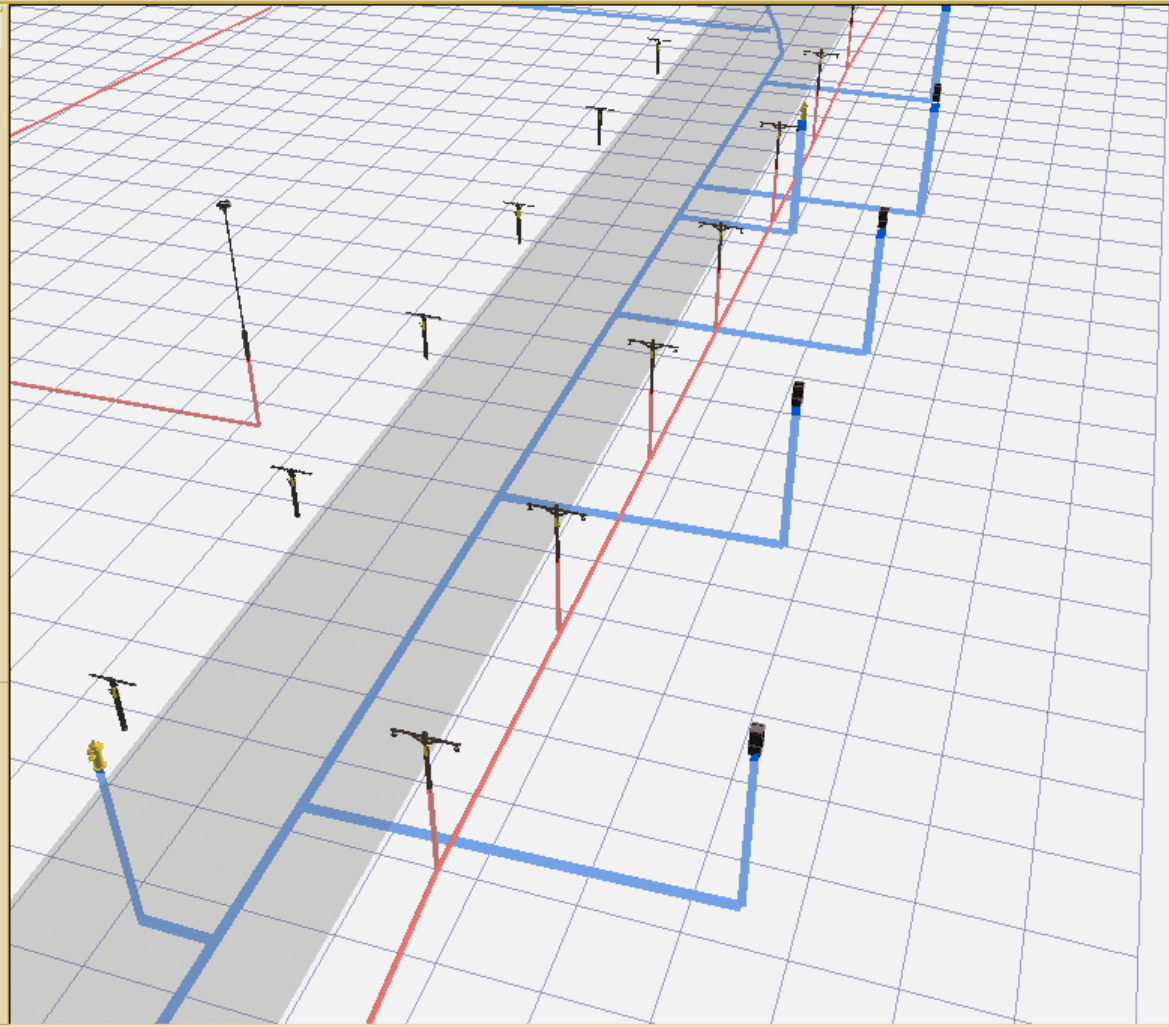
Go to a bookmark

- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Above/Below
 - Below Ground



Display Source

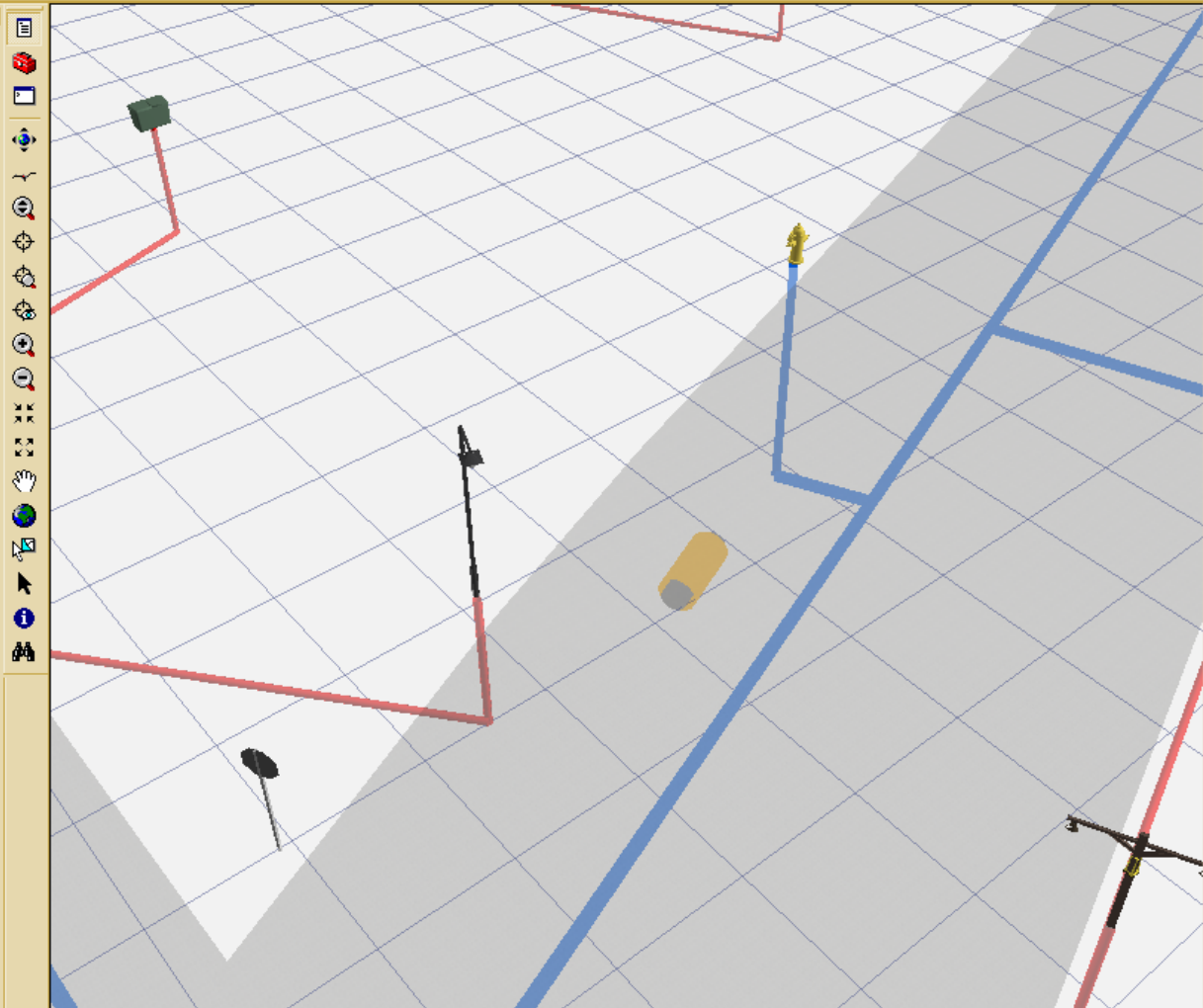
- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Above/Below
 - Below Ground



Display Source

Scene layers

- XY Building Labels
- XZ Building Labels
- 3D Measurement
- 3D Zoning Envelope
- Above Ground
- Above/Below
- Below Ground

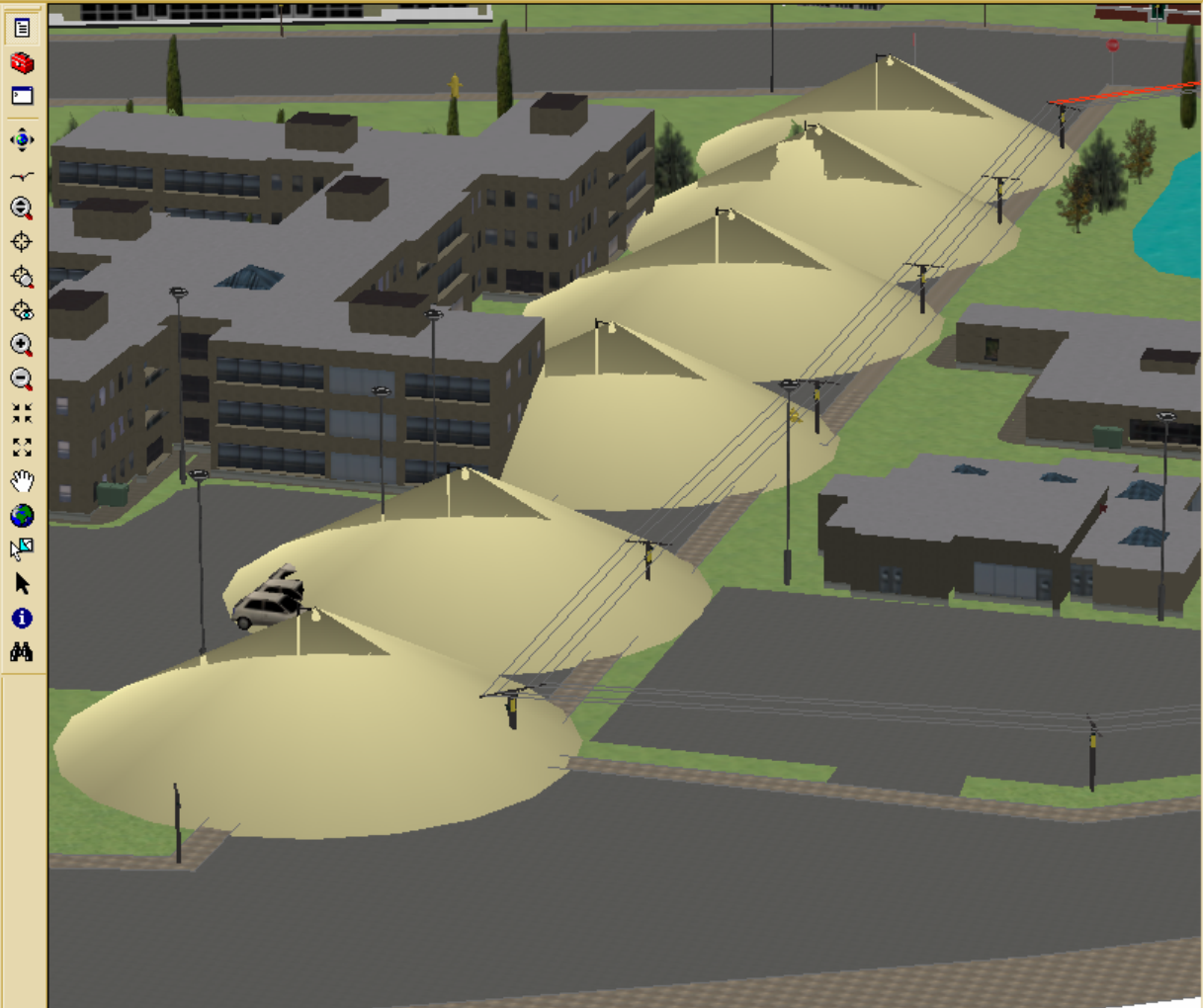


- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Corporate Buildings
 - Surrounding Buildings
 - Overhead Power Lines
 - Live
 - Out
 - Trees
 - Ponds
 - Paths
 - Lunch Benches
 - Sidewalks
 - Parking Lots
 - Cars
 - Roads
 - Parcels
 - Extent Patch
 - Above/Below
 - Below Ground



Scene layers

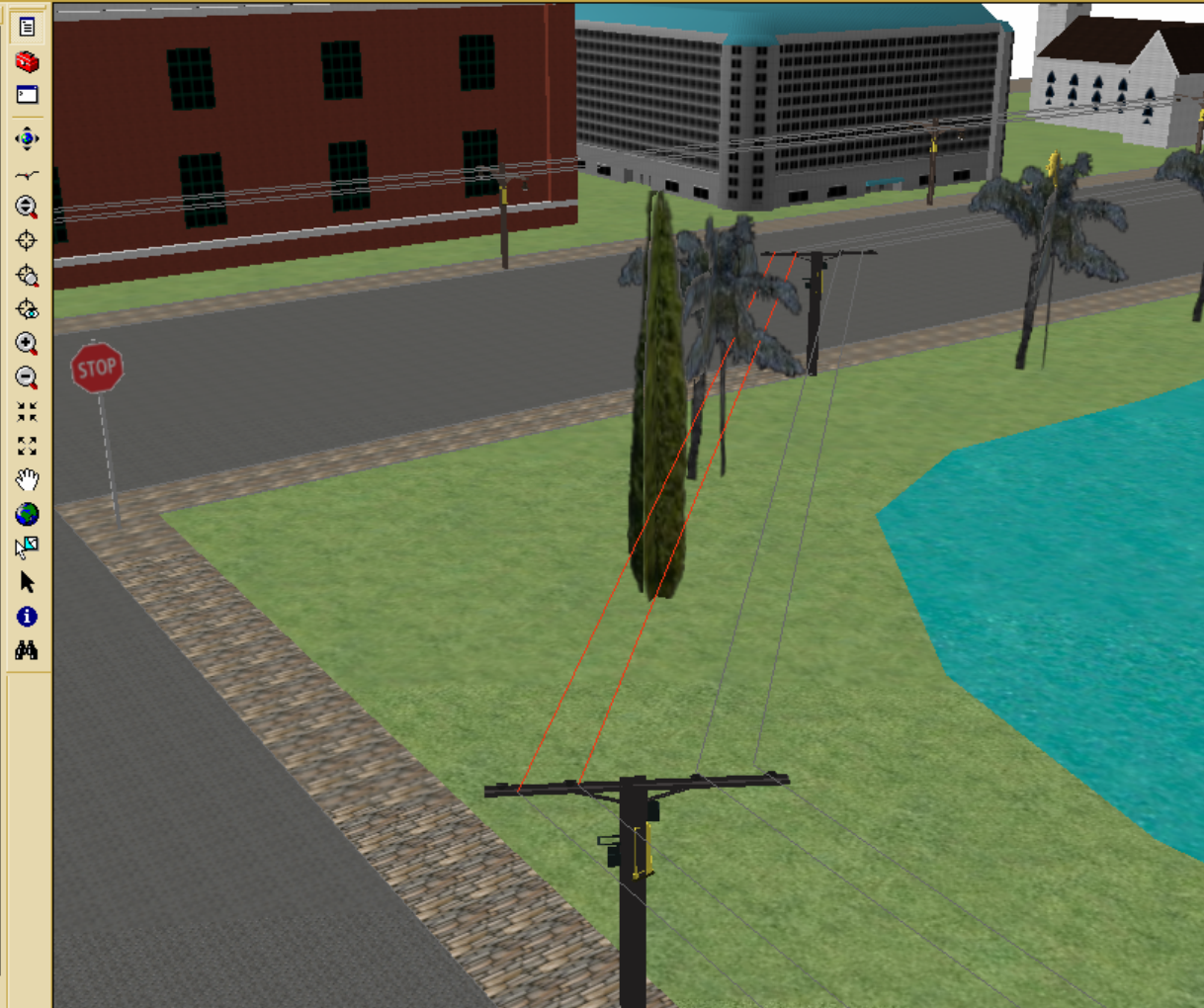
- XY Building Labels
- XZ Building Labels
- 3D Measurement
- 3D Zoning Envelope
- Above Ground
 - Corporate Buildings
 - Surrounding Buildings
 - Overhead Power Lines
 - Live
 - Out
- Trees
- Ponds
- Paths
- Lunch Benches
- Sidewalks
- Parking Lots
- Cars
- Roads
- Parcels
- Extent Patch
- Above/Below
- Below Ground



Display Source

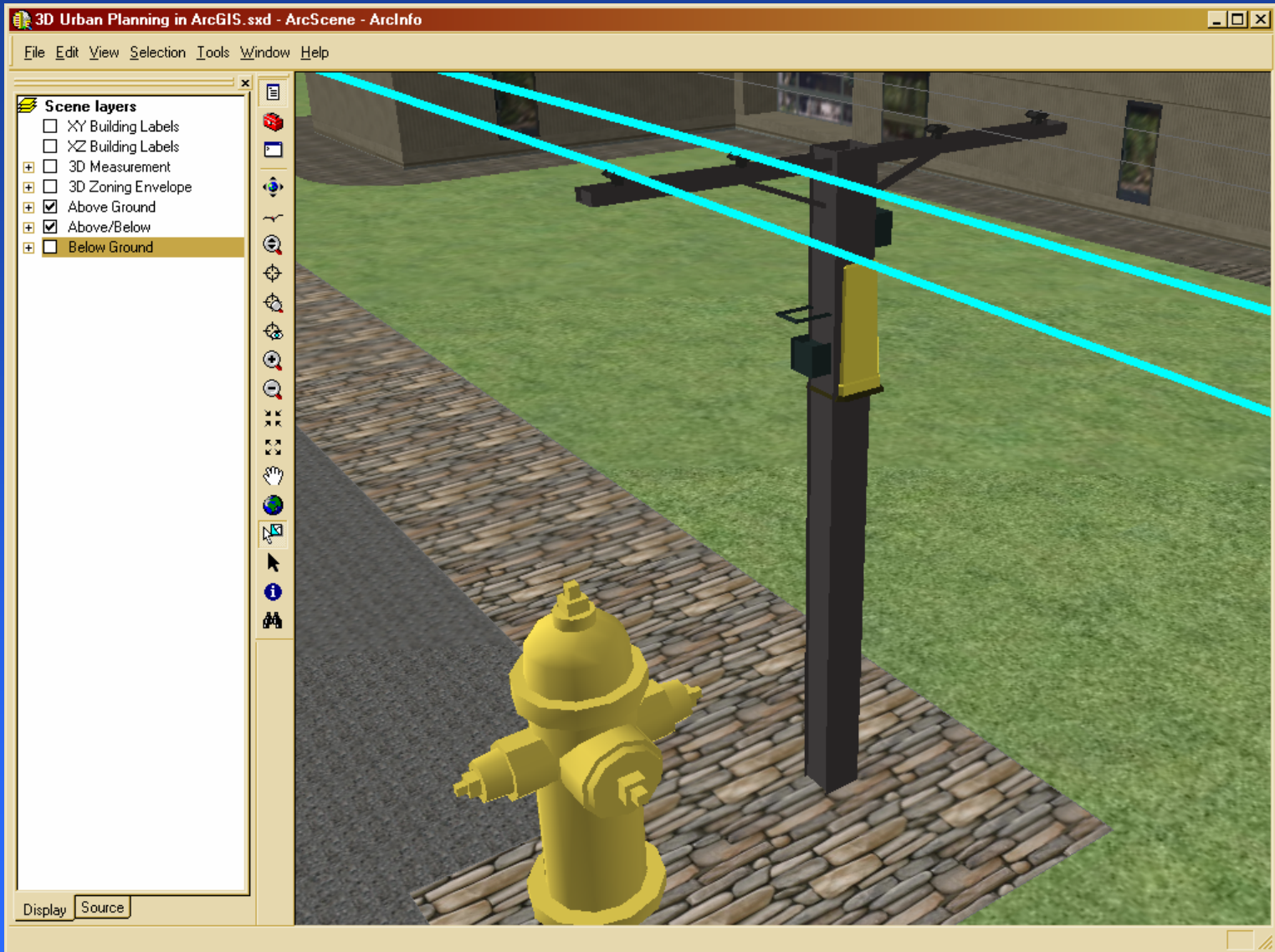
Scene layers

- XY Building Labels
- XZ Building Labels
- 3D Measurement
- 3D Zoning Envelope
- Above Ground
 - Corporate Buildings
 - Surrounding Buildings
 - Overhead Power Lines
 - Live
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- Paths
- Lunch Benches
- Sidewalks
- Parking Lots
- Cars
- Roads
- Parcels
- Extent Patch
- Above/Below
- Below Ground

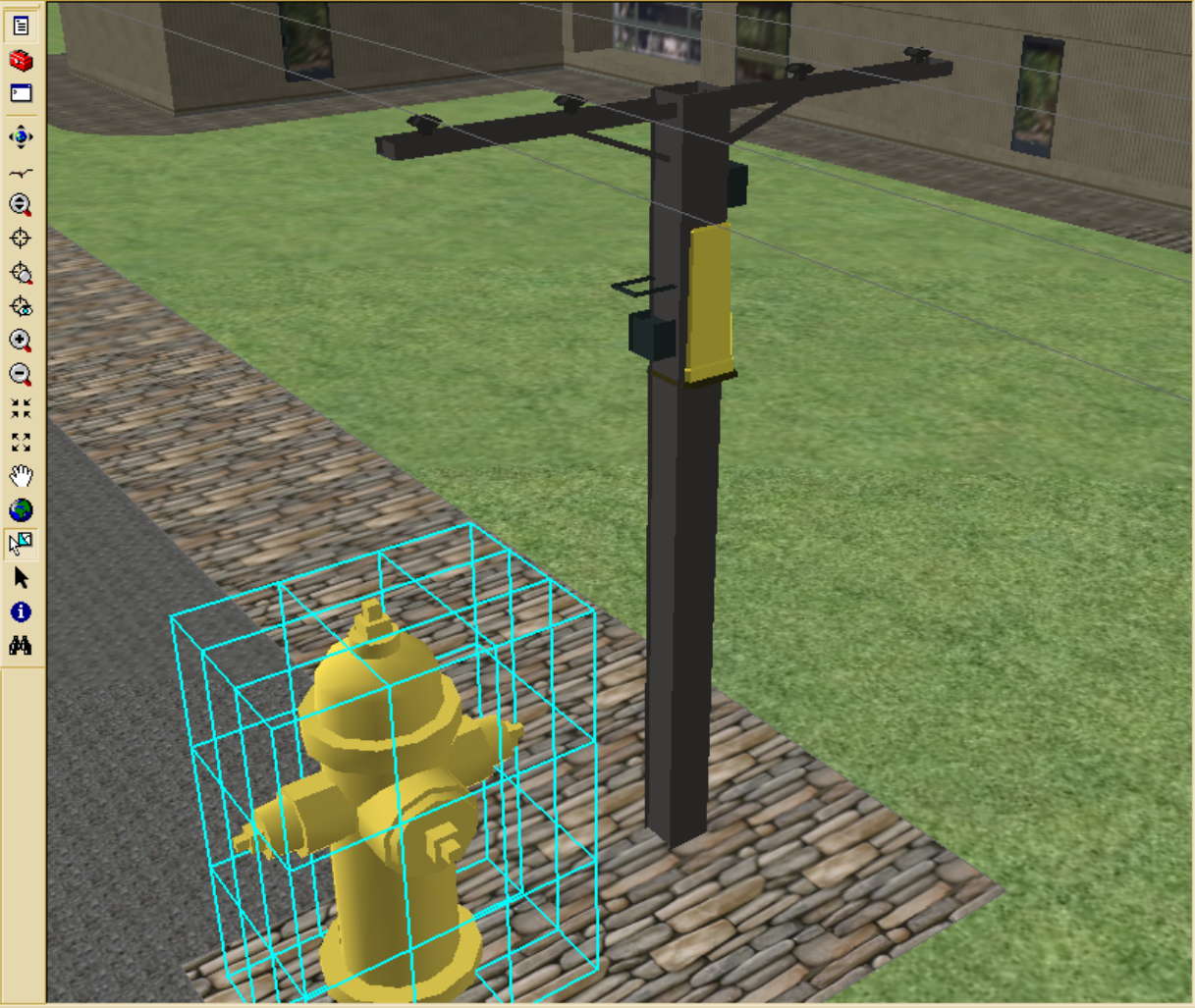


Display Source

Go to a bookmark

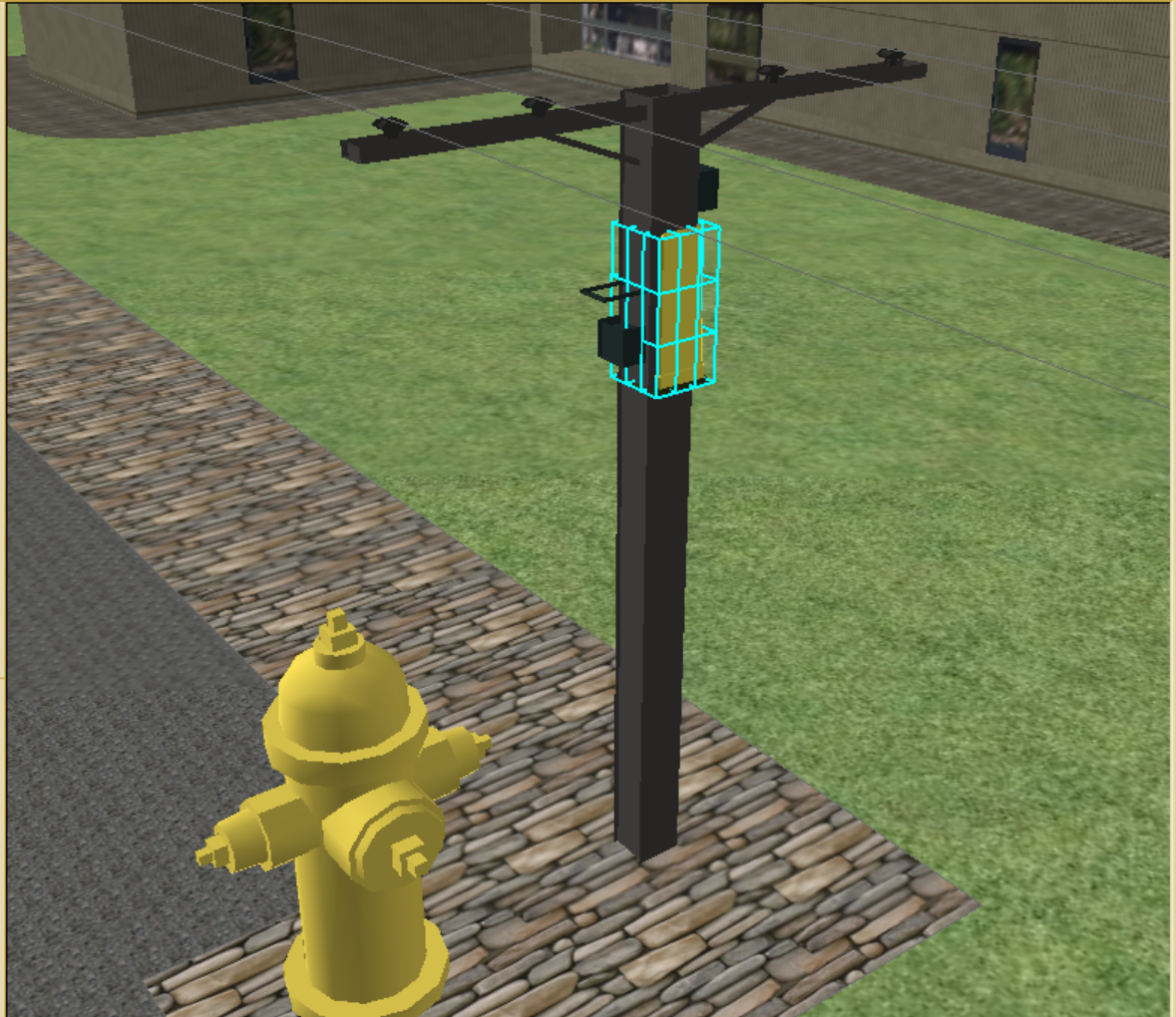


- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Above/Below
 - Below Ground



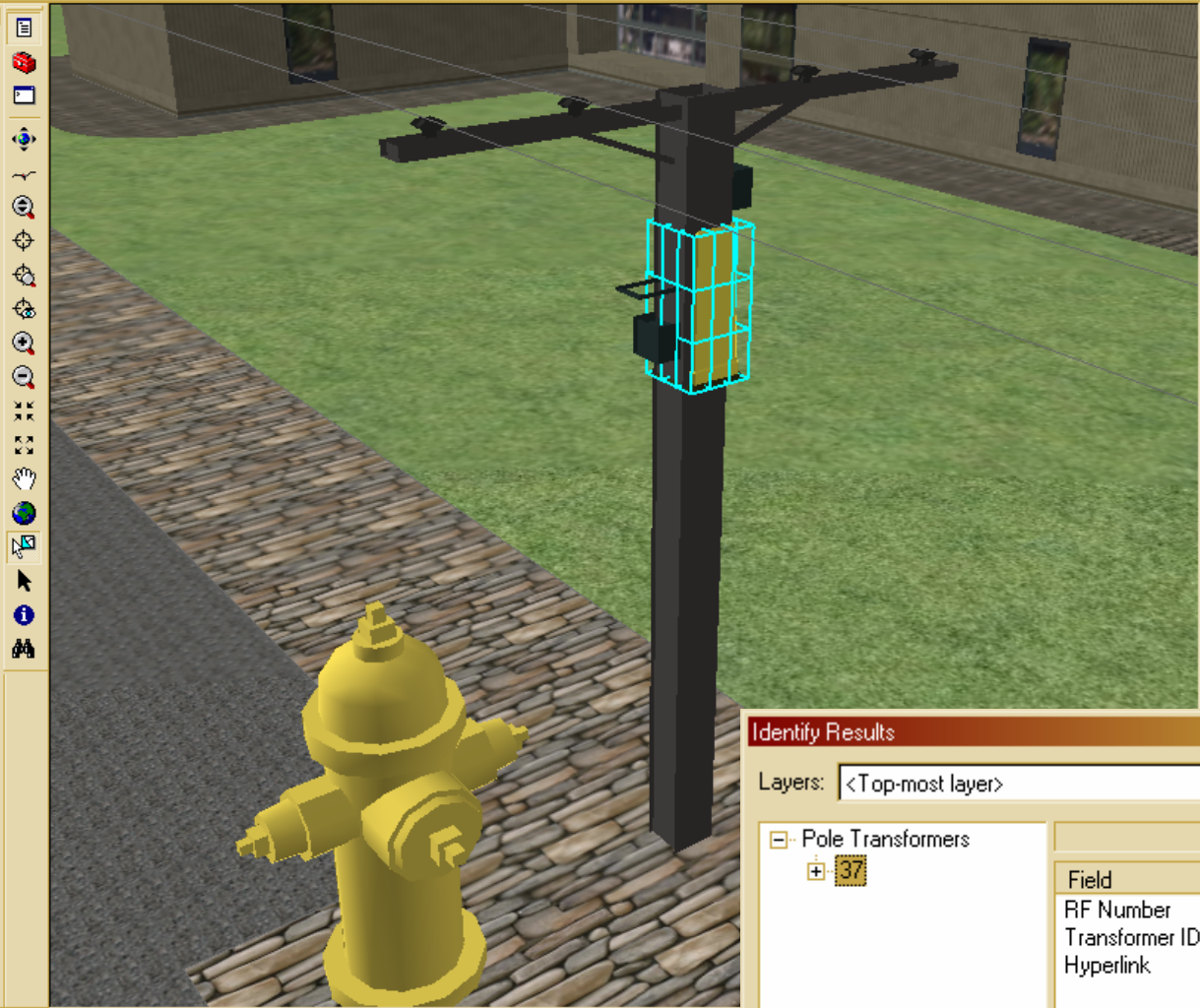
Display Source

- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Above/Below
 - Below Ground



Display Source

- Scene layers**
- XY Building Labels
 - XZ Building Labels
 - 3D Measurement
 - 3D Zoning Envelope
 - Above Ground
 - Above/Below
 - Below Ground

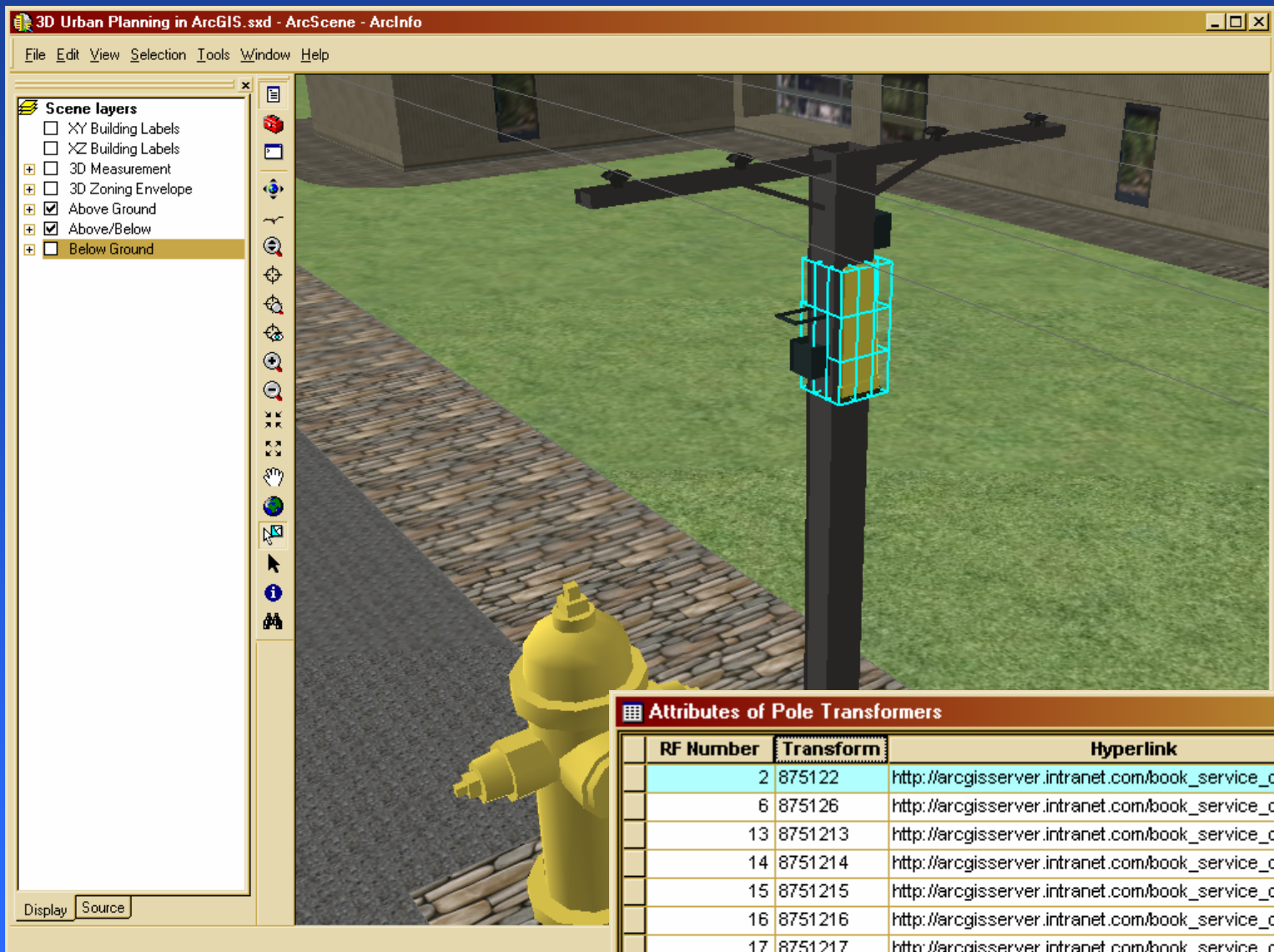


Identify Results

Layers: <Top-most layer>

- Pole Transformers
 - 37

Field	Value
RF Number	37
Transformer ID	8751237
Hyperlink	http://arc



Attributes of Pole Transformers

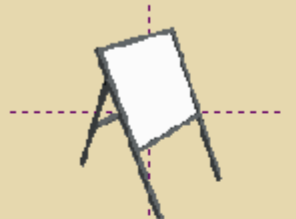
RF Number	Transform	Hyperlink
2	875122	http://arcgisserver.intranet.com/book_service_call?ID=2
6	875126	http://arcgisserver.intranet.com/book_service_call?ID=6
13	8751213	http://arcgisserver.intranet.com/book_service_call?ID=13
14	8751214	http://arcgisserver.intranet.com/book_service_call?ID=14
15	8751215	http://arcgisserver.intranet.com/book_service_call?ID=15
16	8751216	http://arcgisserver.intranet.com/book_service_call?ID=16
17	8751217	http://arcgisserver.intranet.com/book_service_call?ID=17
18	8751218	http://arcgisserver.intranet.com/book_service_call?ID=18
19	8751219	http://arcgisserver.intranet.com/book_service_call?ID=19
20	8751220	http://arcgisserver.intranet.com/book_service_call?ID=20

Record: 0 Show: All Selected Records (1 out of 34 Selected.)

Symbol Property Editor



Preview



+
[Zoom In] [Zoom Out] [Fit] [100%]

Layers

[Layer 1: Whiteboard] [Layer 2: Stand]

[Add] [Remove] [Up] [Down] [Copy] [Paste]

Properties:

Type: 3D Marker Symbol World units: Meters

3D Marker | 3D Placement

Import...

Color: [Color Picker] Use material draping

Dimensions
Width (X): 0.4820
Depth (Y): 0.6324
Size (Z): 0.7190
 Keep aspect ratio
Set Actual Size

Rotate axis
X: [Rotate] [Reset]
Y: [Rotate] [Reset]
Z: [Rotate] [Reset]

Thumbnail
[Camera] [Reset] [Refresh]

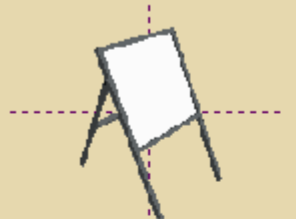
3D Preview
[3D View of whiteboard on stand with axes and zoom controls]

OK Cancel

Symbol Property Editor



Preview



+
[Zoom In] [Zoom Out] [Fit] [100%]

Layers

[Chair Symbol] [Icon]
[Empty Layer]

[Add] [Remove] [Up] [Down]
[Copy] [Paste]

Properties:

Type: 3D Marker Symbol

World units: Meters

3D Marker | 3D Placement

Offset

X: 0.0000
Y: 0.0000
Z: 0.0000

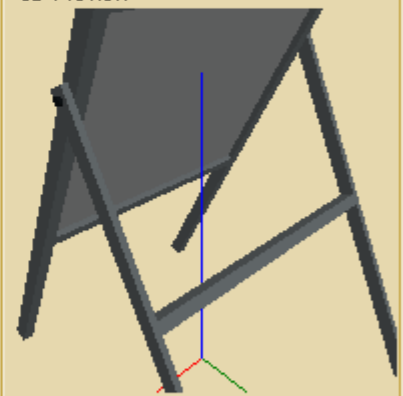
Rotation angles

X: 0.00
Y: 0.00
Z: 0.00

Normalized origin offset

dx: 0.50 0 [Slider] 1
dy: 0.50 0 [Slider] 1
dz: 0.00 0 [Slider] 1

3D Preview



[3D Viewport Controls] [1:1]

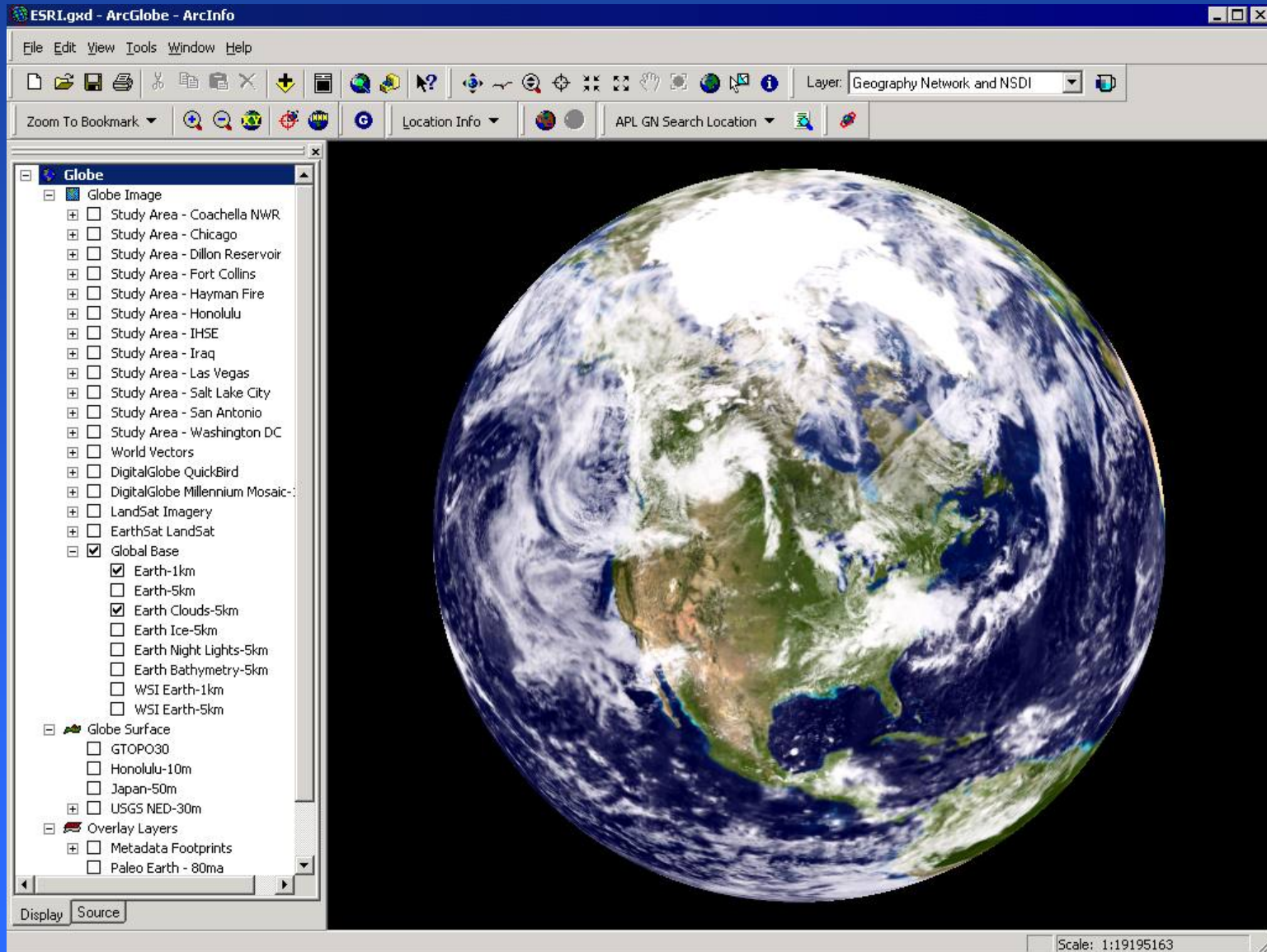
OK Cancel

ArcGIS 3D Analyst

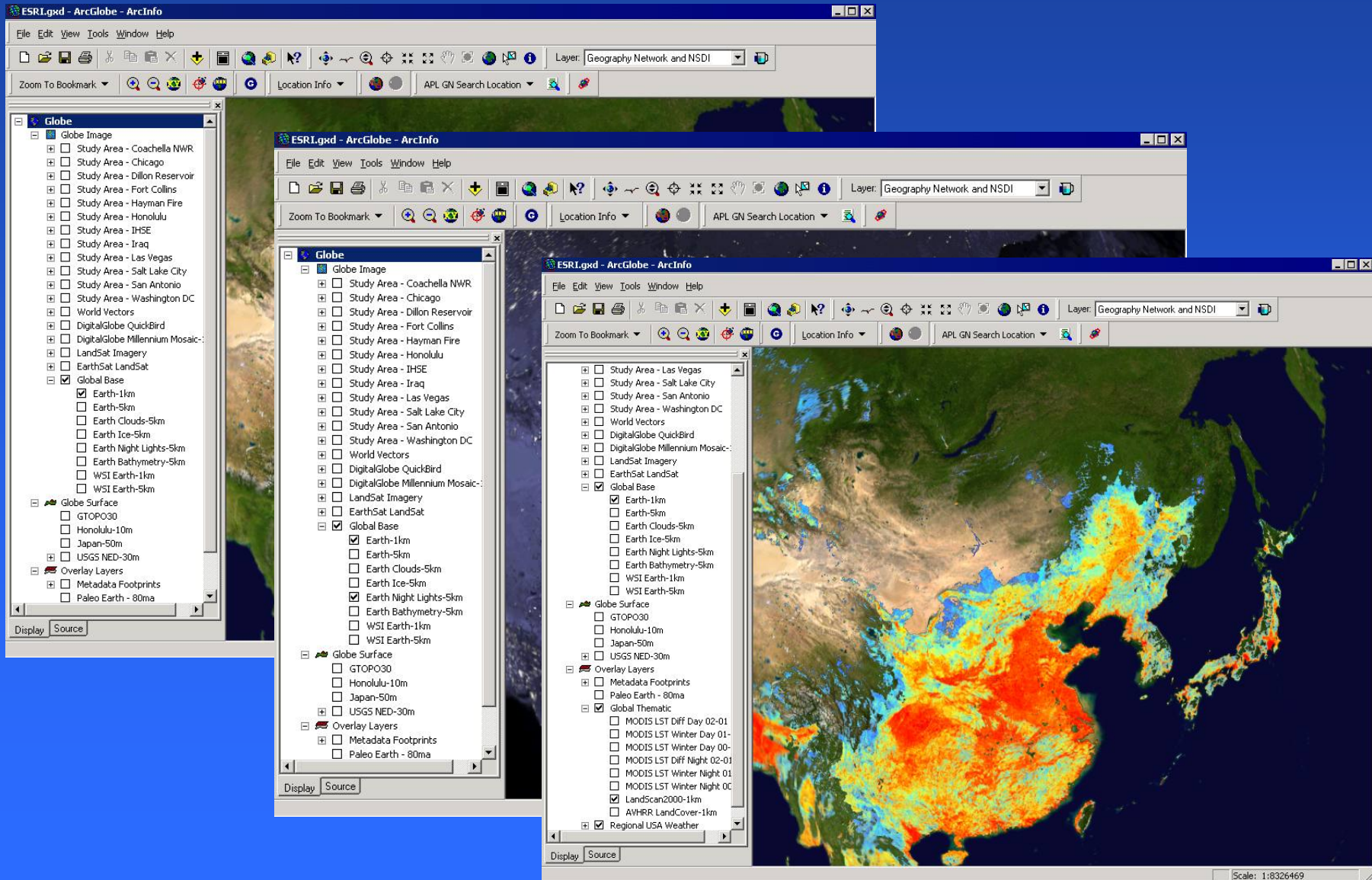
- **Map features stored in a database.**
- **Coordinates, measures, symbology, attributes, hyperlinks, links to other applications, management processes, websites, email...**
- **Advanced ArcGIS users build and maintain a 3D GIS using out of the box 2d editing tools, 3D visualization tools and VBA customization techniques.**
- **Hook into live data feeds, use geoprocessing and analysis tools.**

ArcGlobe

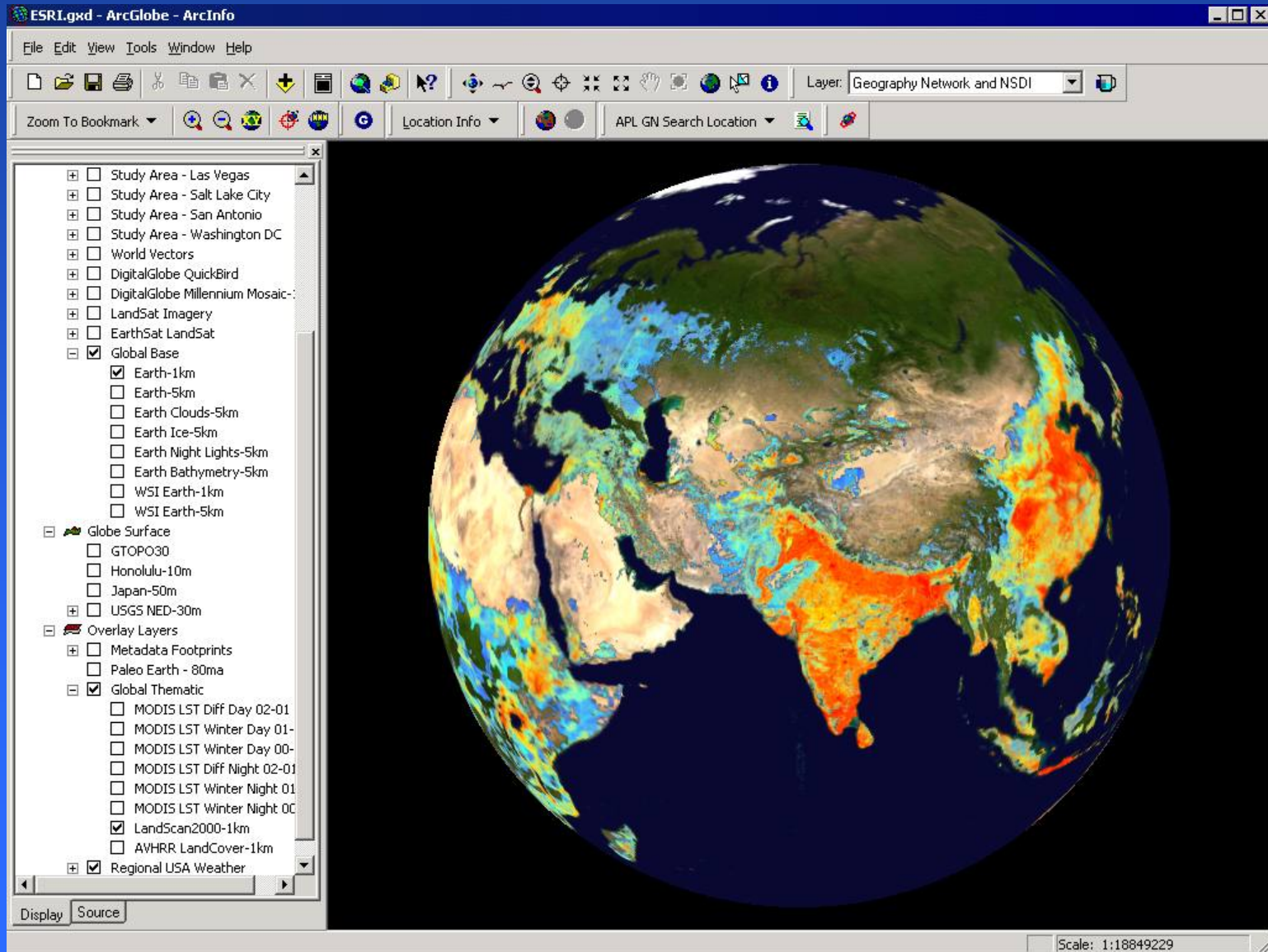
ArcGlobe – Earth With Clouds



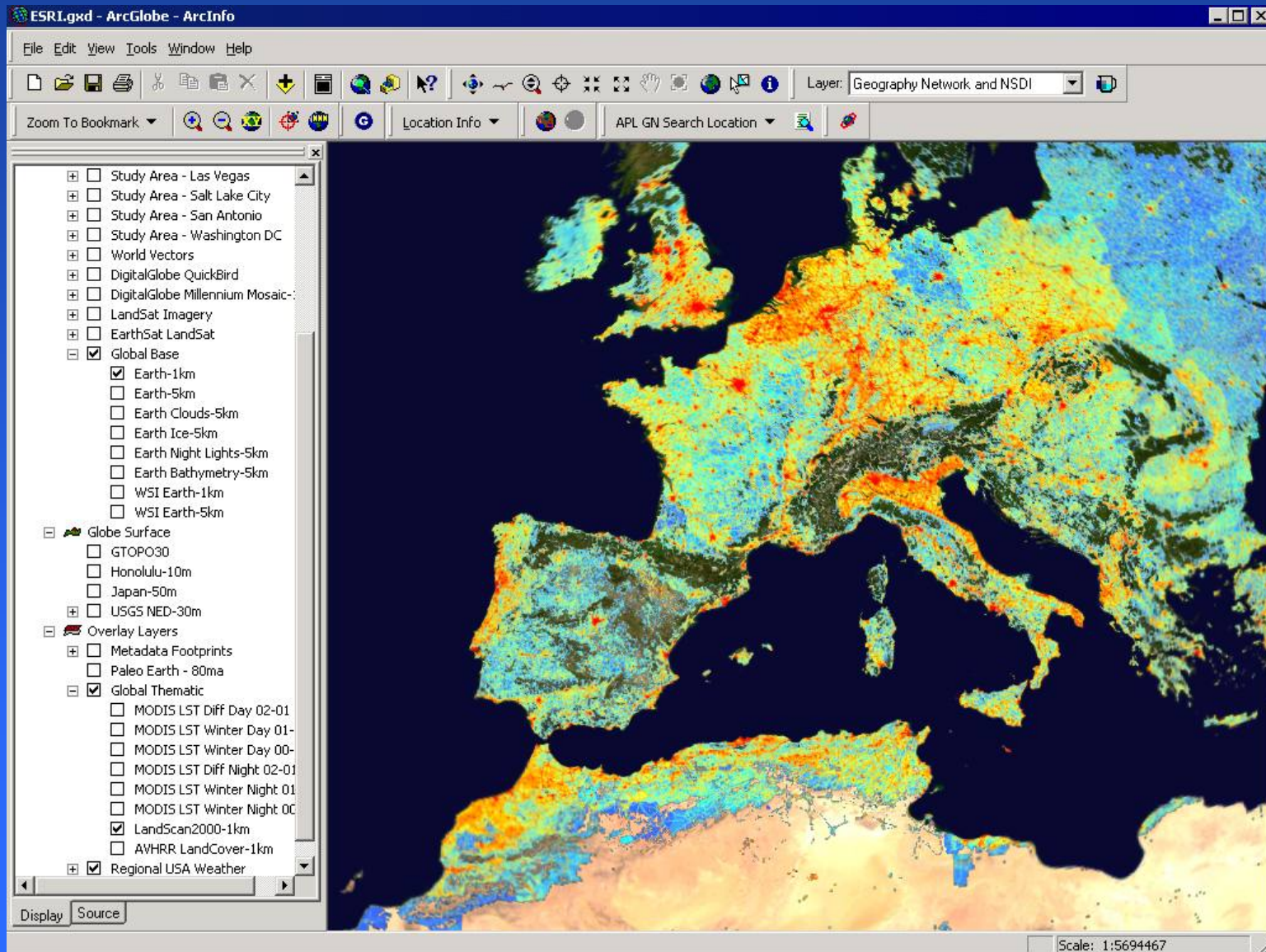
ArcGlobe – Korea Population Density



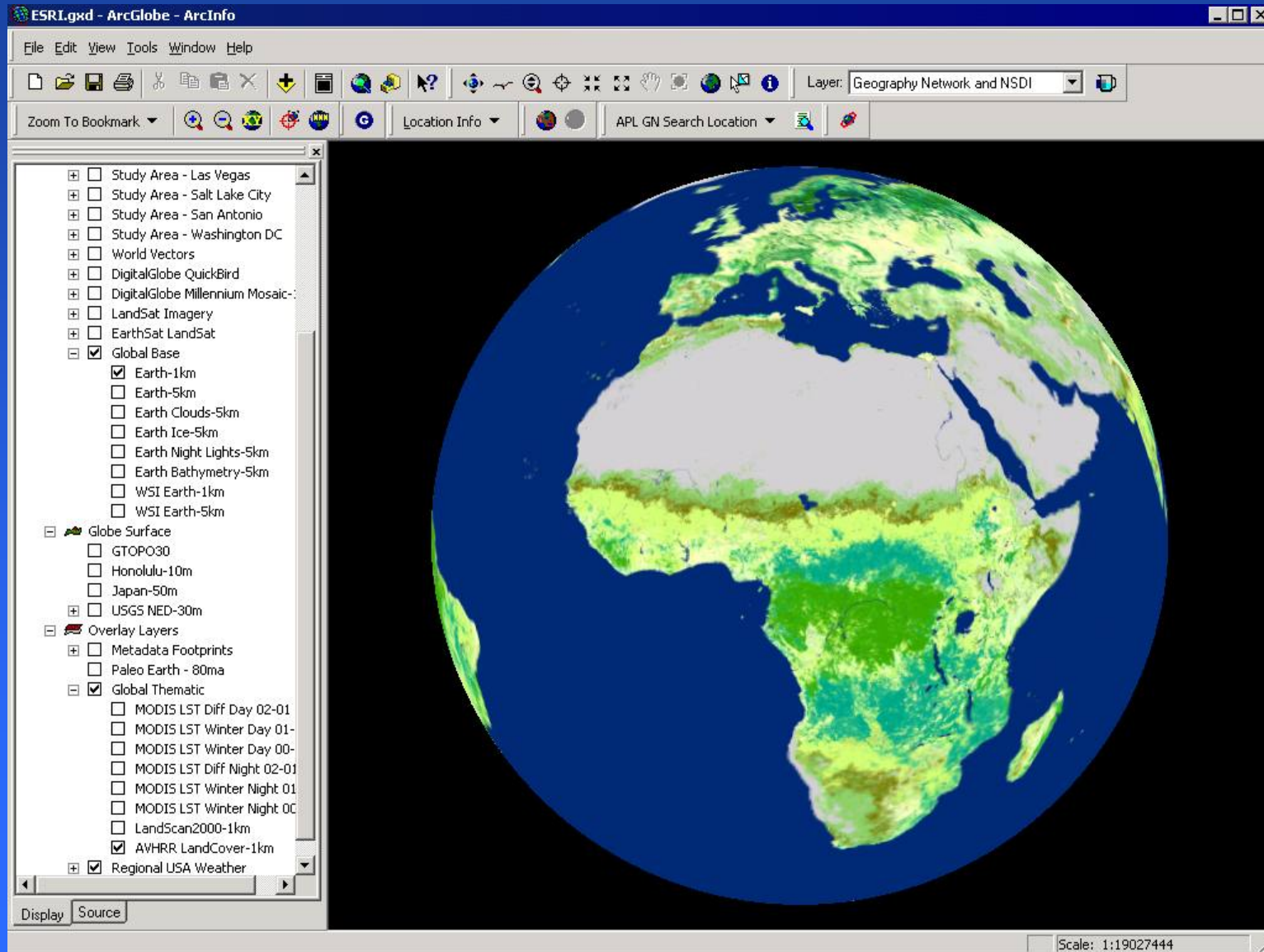
ArcGlobe – Population Density



ArcGlobe – Population Density



ArcGlobe – Land Cover



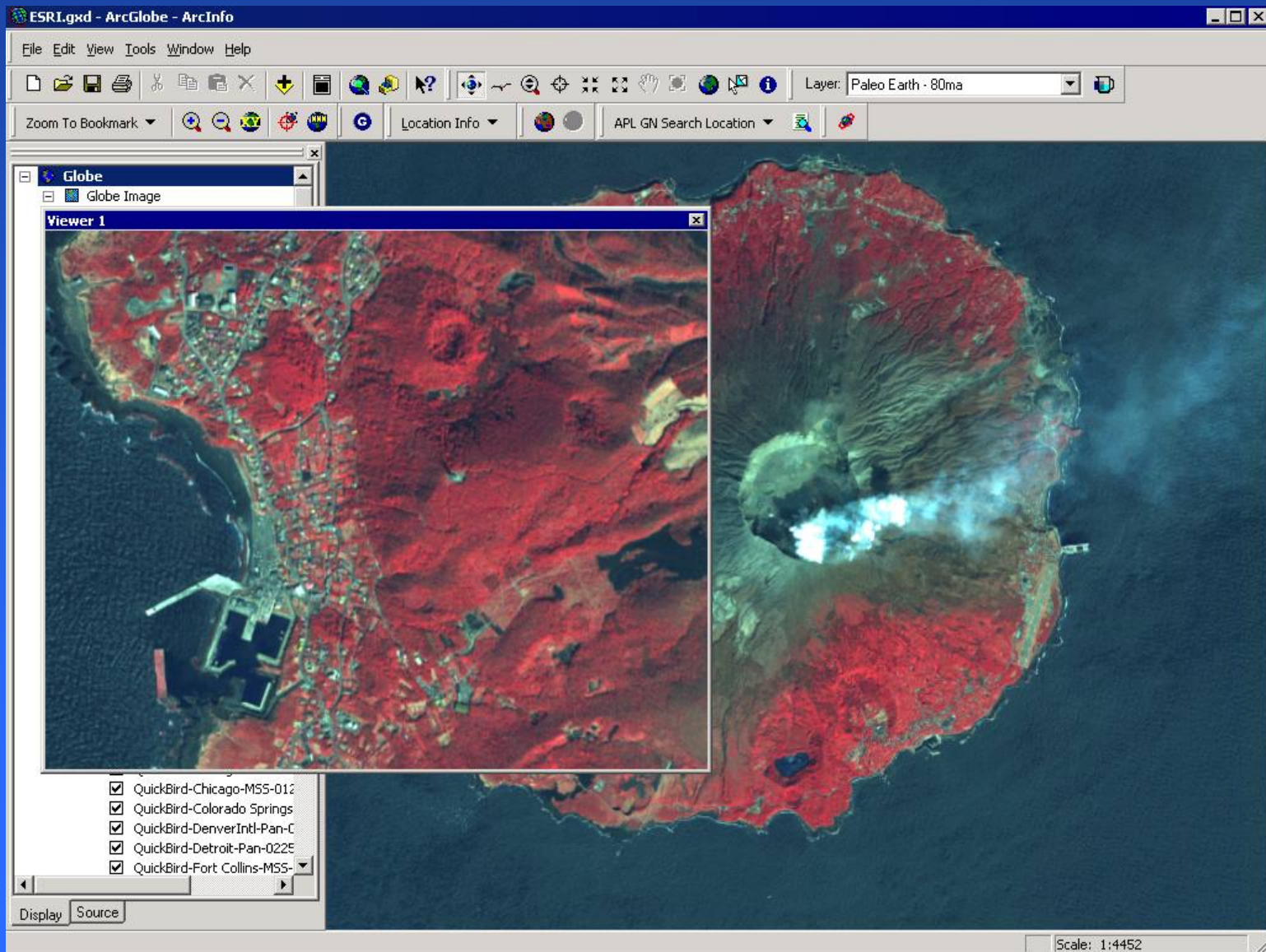
ArcGlobe – Geography Network & NSDI

The image displays two instances of the ArcGlobe software interface. The top window is titled "ESRI.gxd - ArcGlobe - ArcInfo" and shows a menu bar (File, Edit, View, Tools, Window, Help) and a toolbar. The "Layer:" dropdown menu is set to "Paleo Earth - 80ma". The bottom window is also titled "ESRI.gxd - ArcGlobe - ArcInfo" and features a "Location Info" dropdown and an "APL GN Search Location" button. Both windows have a layer list on the left side of the globe. The globe itself is a 3D representation of Earth, showing a color-coded map of the United States and surrounding regions, with a grid of latitude and longitude lines. The layer lists in both windows are identical and include the following items:

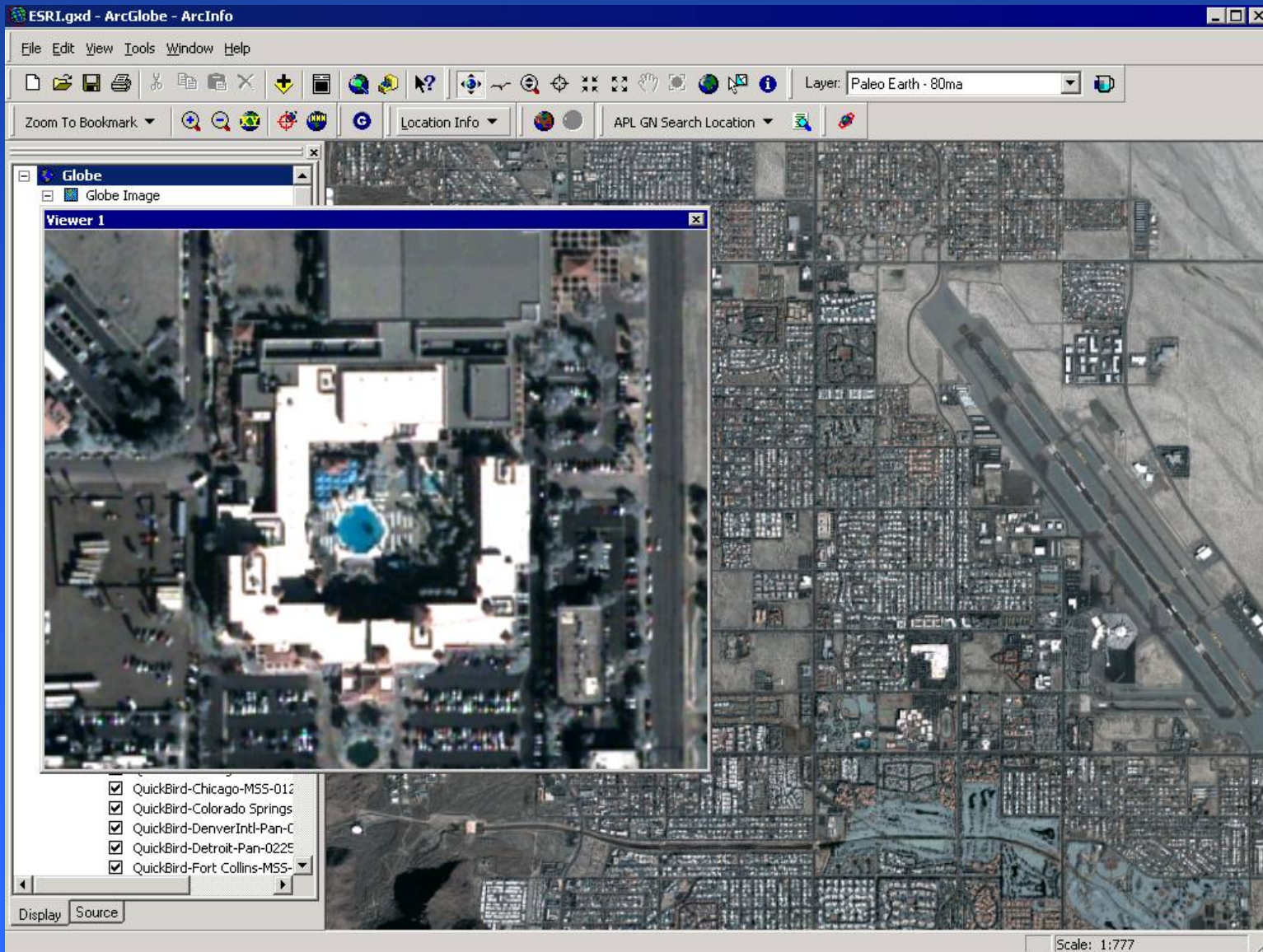
- Study Area - Chicago
- Study Area - Dillon Reservoir
- Study Area - Fort Collins
- Study Area - Hayman Fire
- Study Area - Honolulu
- Study Area - IHSE
- Study Area - Iraq
- Study Area - Las Vegas
- Study Area - Salt Lake City
- Study Area - San Antonio
- Study Area - Washington DC
- World Vectors
- DigitalGlobe QuickBird
- DigitalGlobe Millennium Mosaic:
- LandSat Imagery
- EarthSat LandSat
- Global Base
 - Earth-1km
 - Earth-5km
 - Earth Clouds-5km
 - Earth Ice-5km
 - Earth Night Lights-5km
 - Earth Bathymetry-5km
 - WSI Earth-1km
 - WSI Earth-5km
- Globe Surface
 - GTOPO30
 - Honolulu-10m
 - Japan-50m
 - USGS NED-30m
- Overlay Layers
 - Metadata Footprints
 - Paleo Earth - 80ma
 - Global Thematic
 - Regional USA Weather

At the bottom of each window, there are "Display" and "Source" buttons. The bottom window also includes a "Scale: 1:13533044" indicator in the bottom right corner.

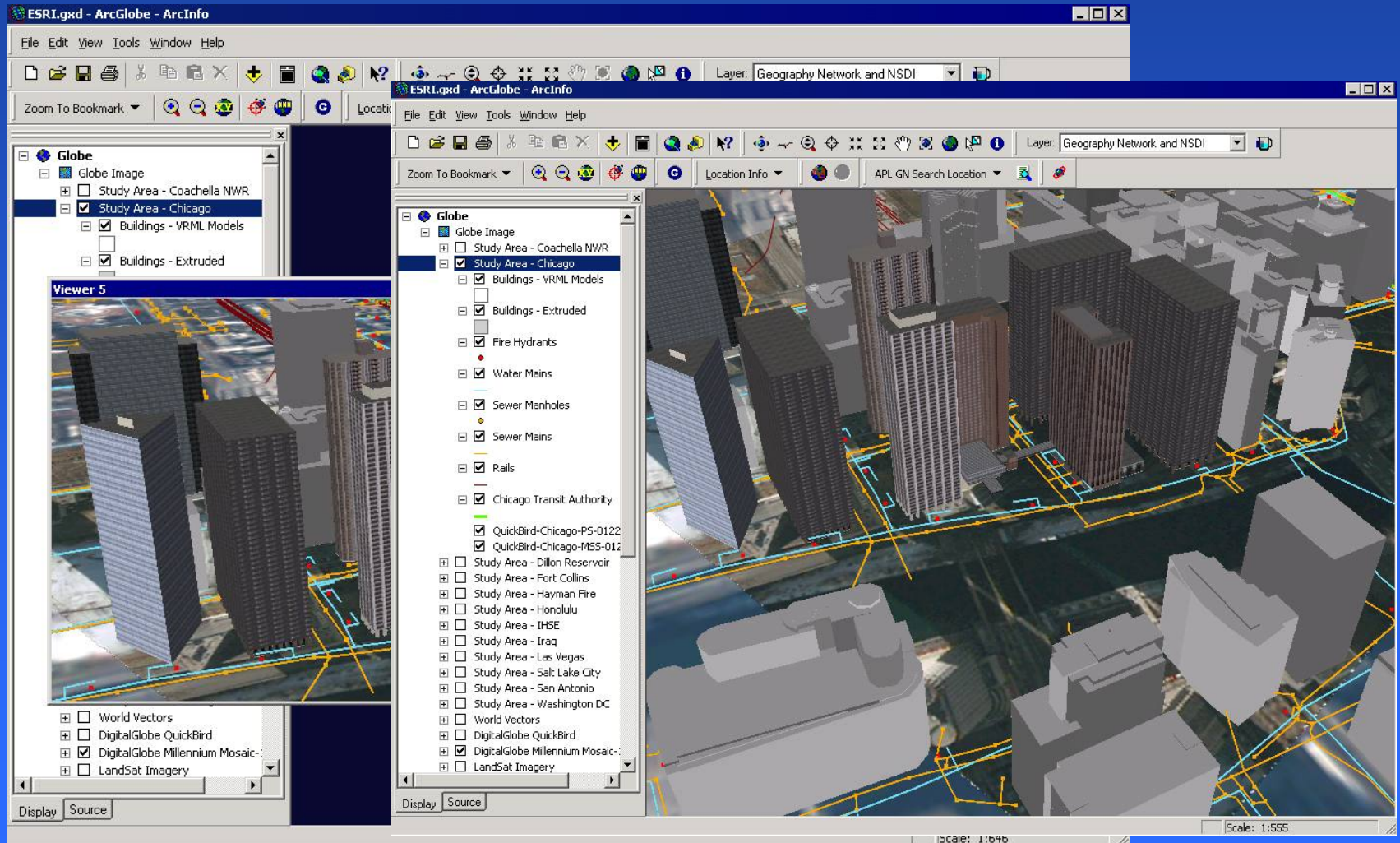
ArcGlobe – QuickBird Miyake Jima – Volcano Eruption



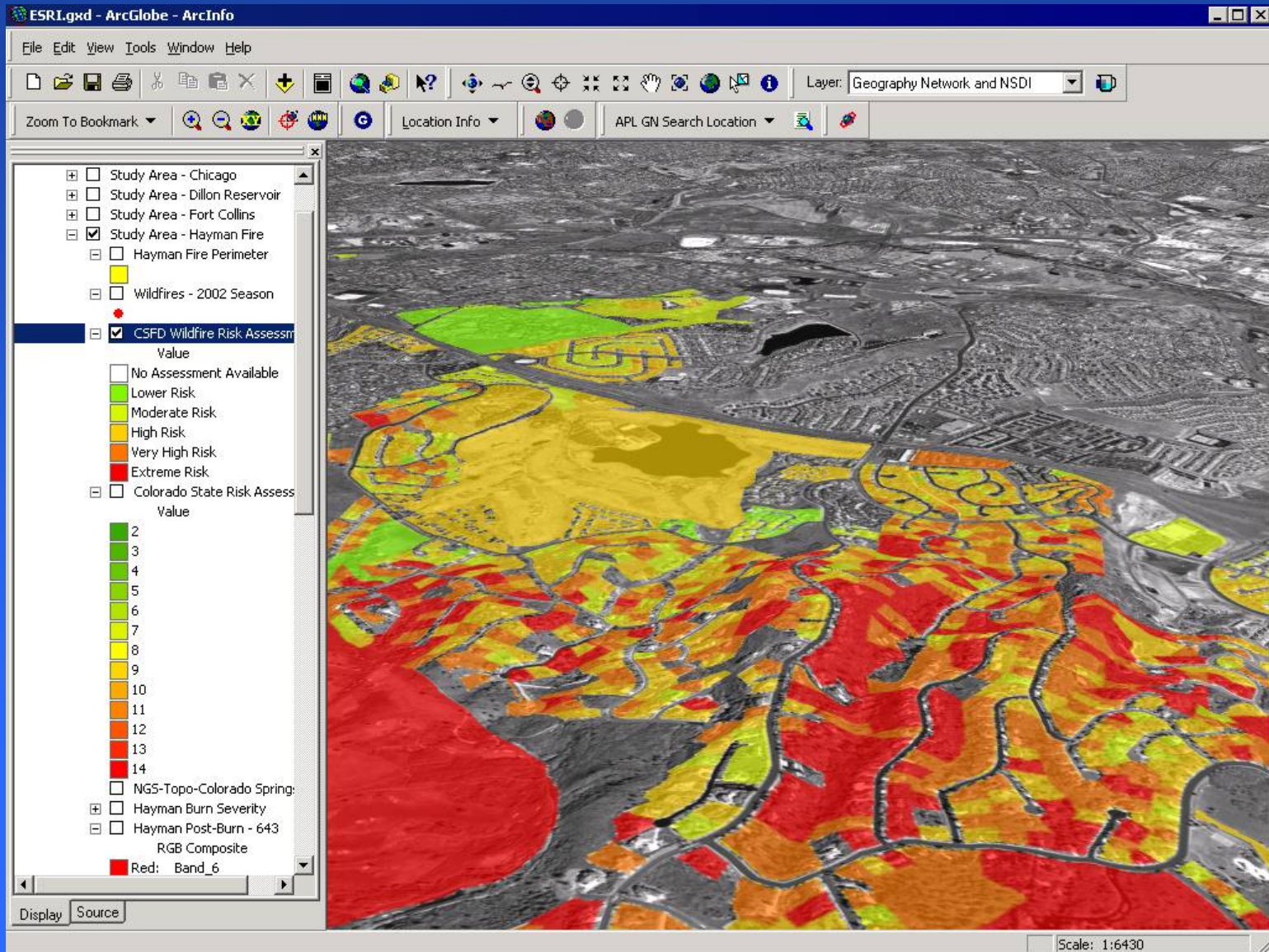
ArcGlobe – QuickBird Urban Sprawl Impact Palm Springs



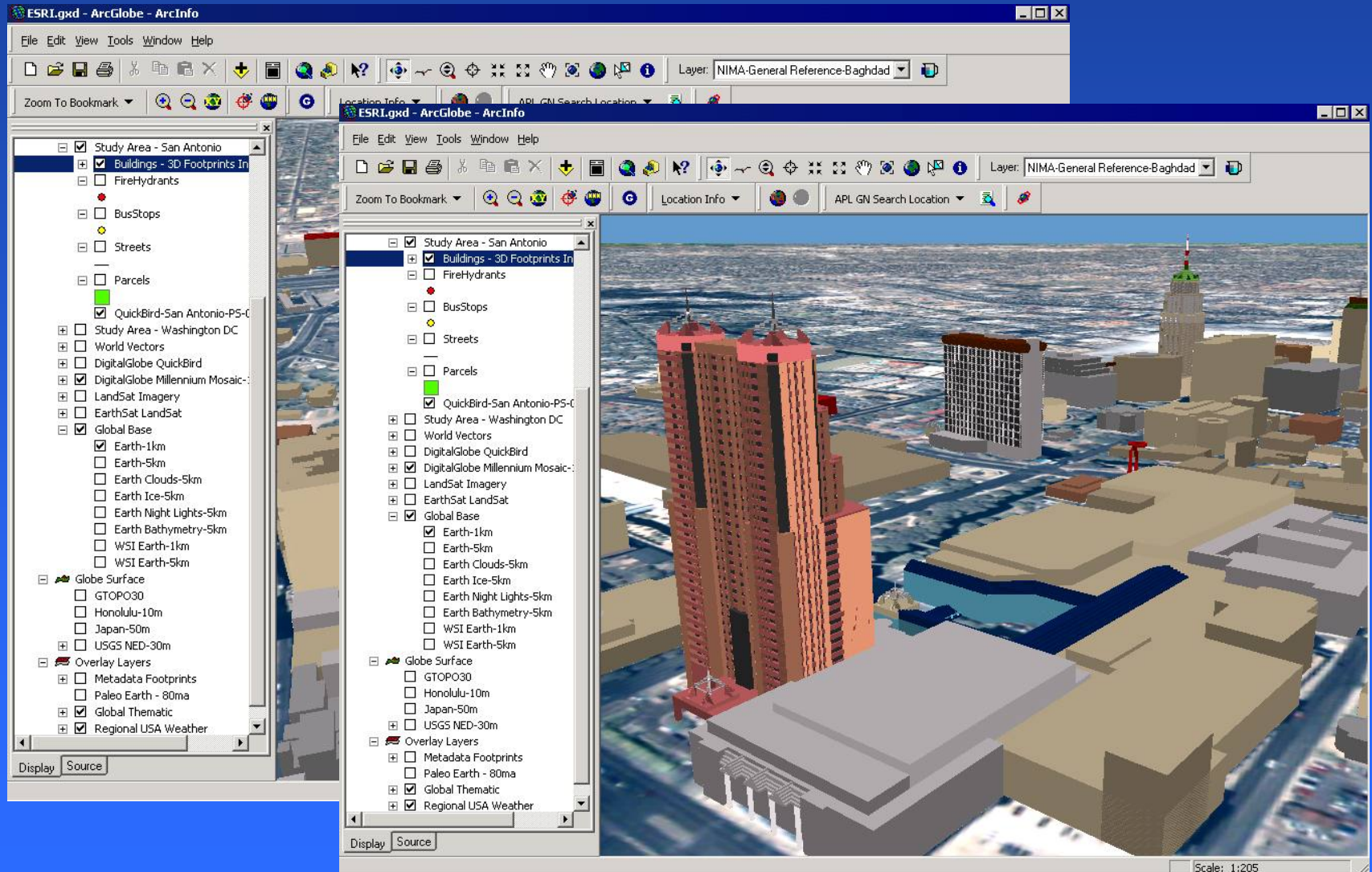
ArcGlobe – QuickBird Urban Design Chicago



ArcGlobe – QuickBird Wildfire Risk Assessment – Colorado Springs



ArcGlobe – QuickBird San Antonio



Thank You!

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Mospina@esri.com