



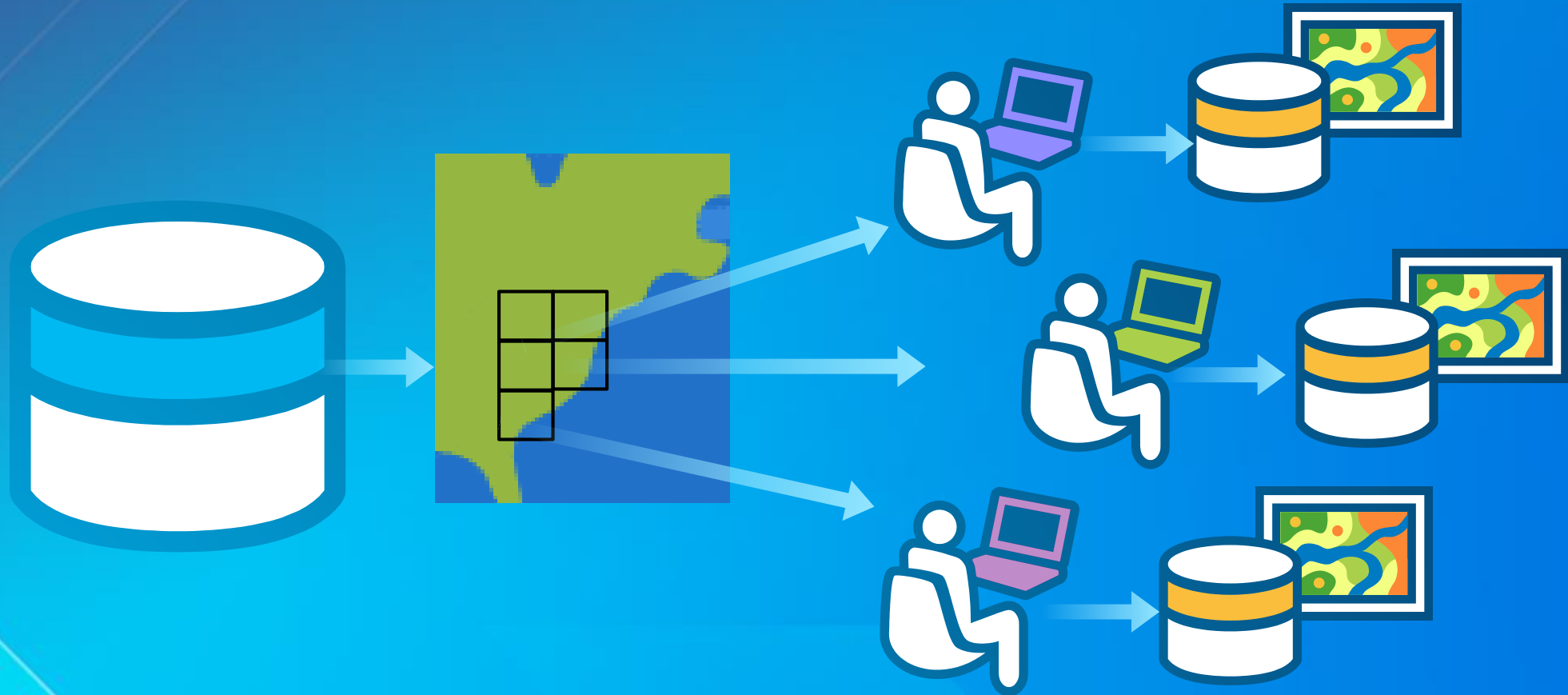
Esri Production Mapping: Map Automation and Advanced Cartography

Amber Bethell

Joe Sheffield

Traditional Cartography

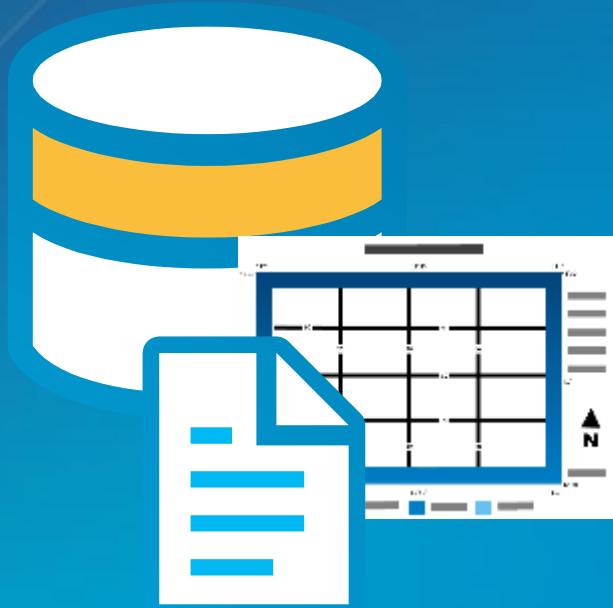
With ArcMap



What you really want

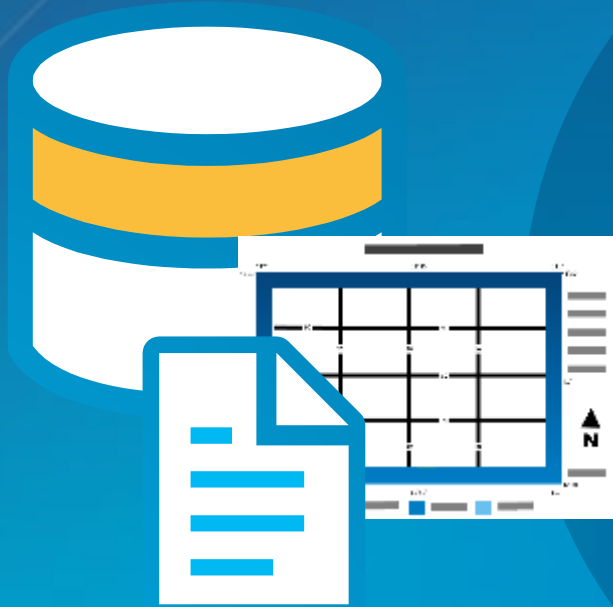


Map Automation

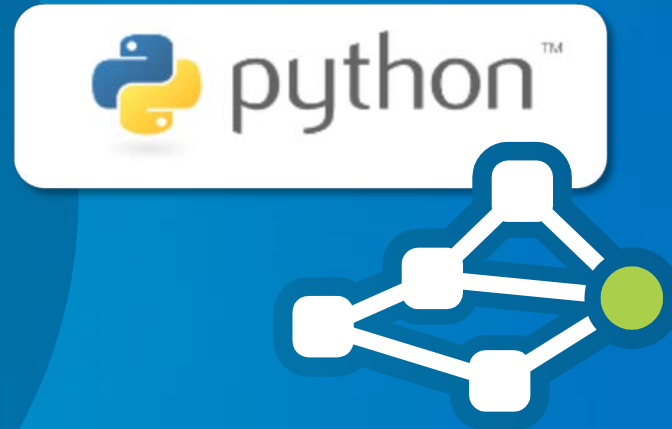


**Production Mapping
Cartographic Rules**

Map Automation

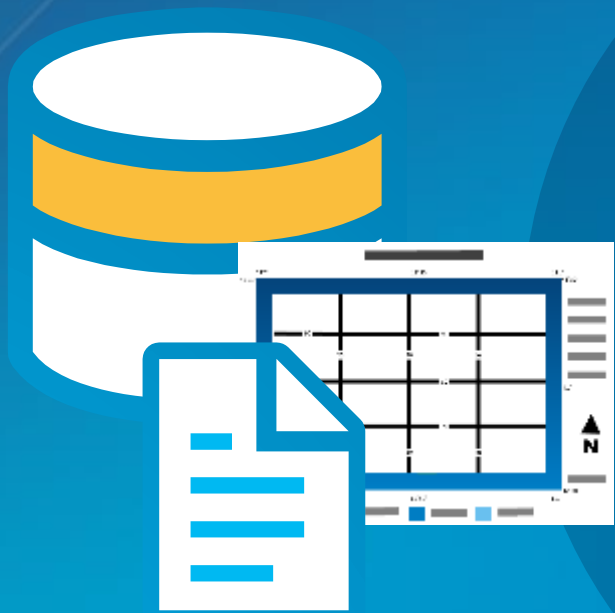


**Production Mapping
Cartographic Rules**



**Geoprocessing
& Python**

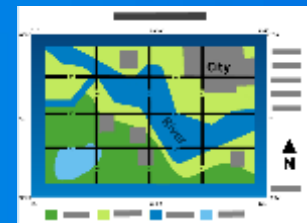
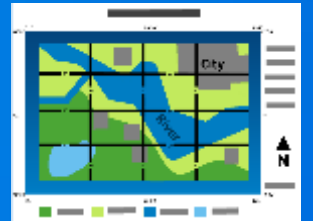
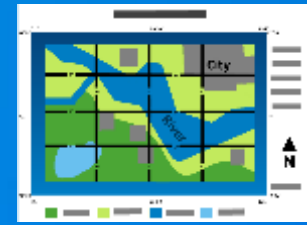
Map Automation



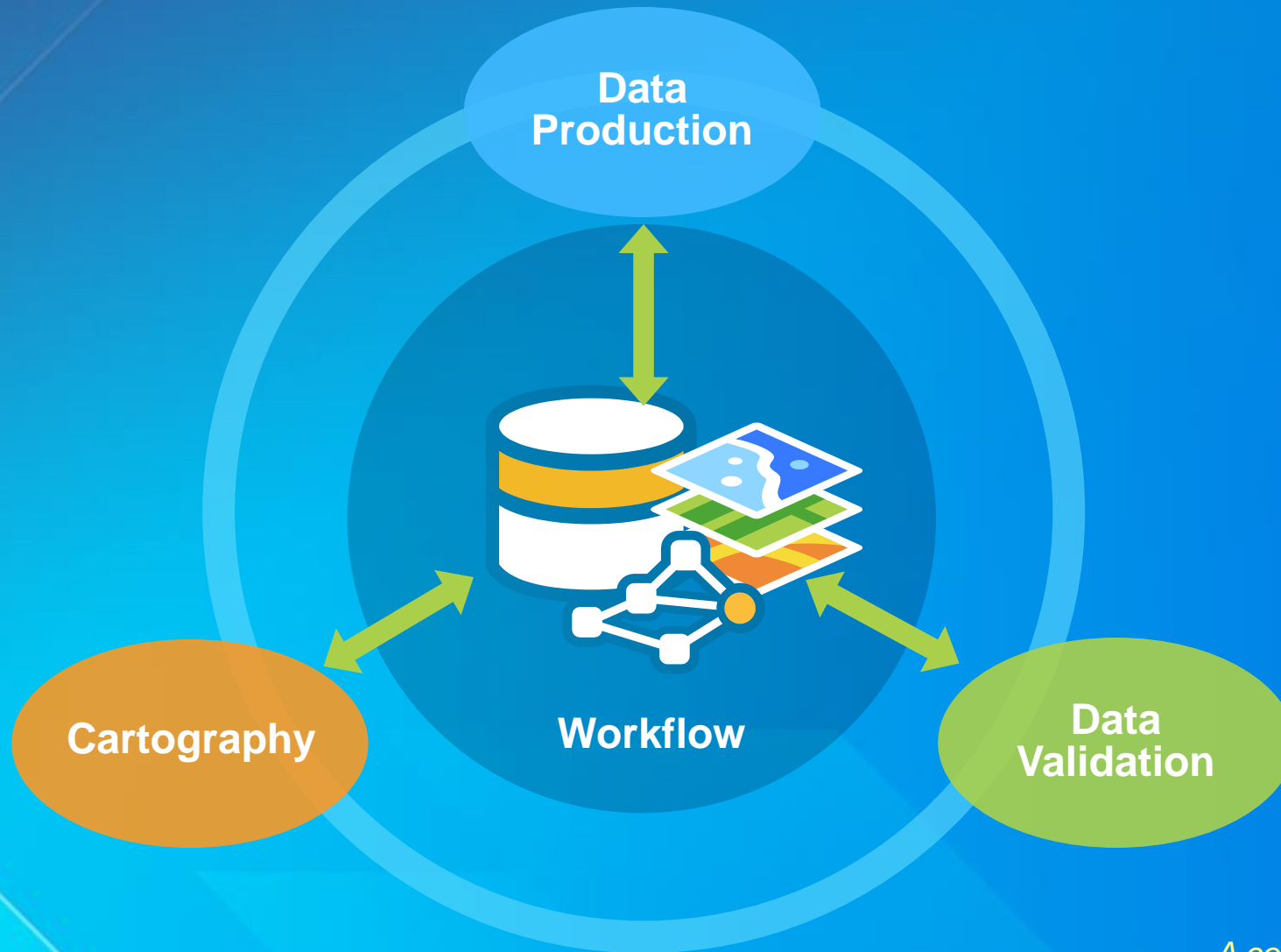
**Production Mapping
Cartographic Rules**



**Geoprocessing
& Python**

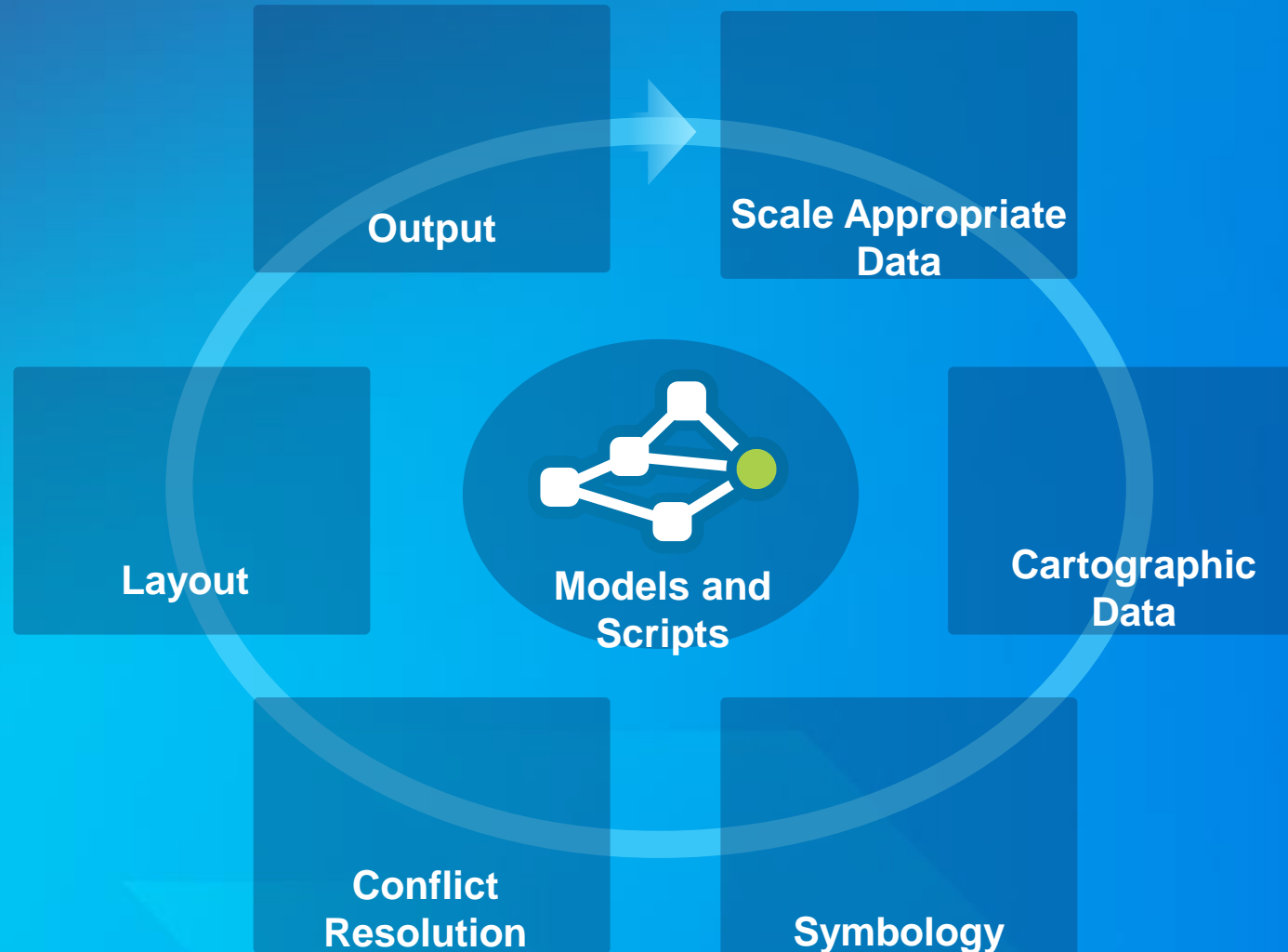


Esri Production Mapping

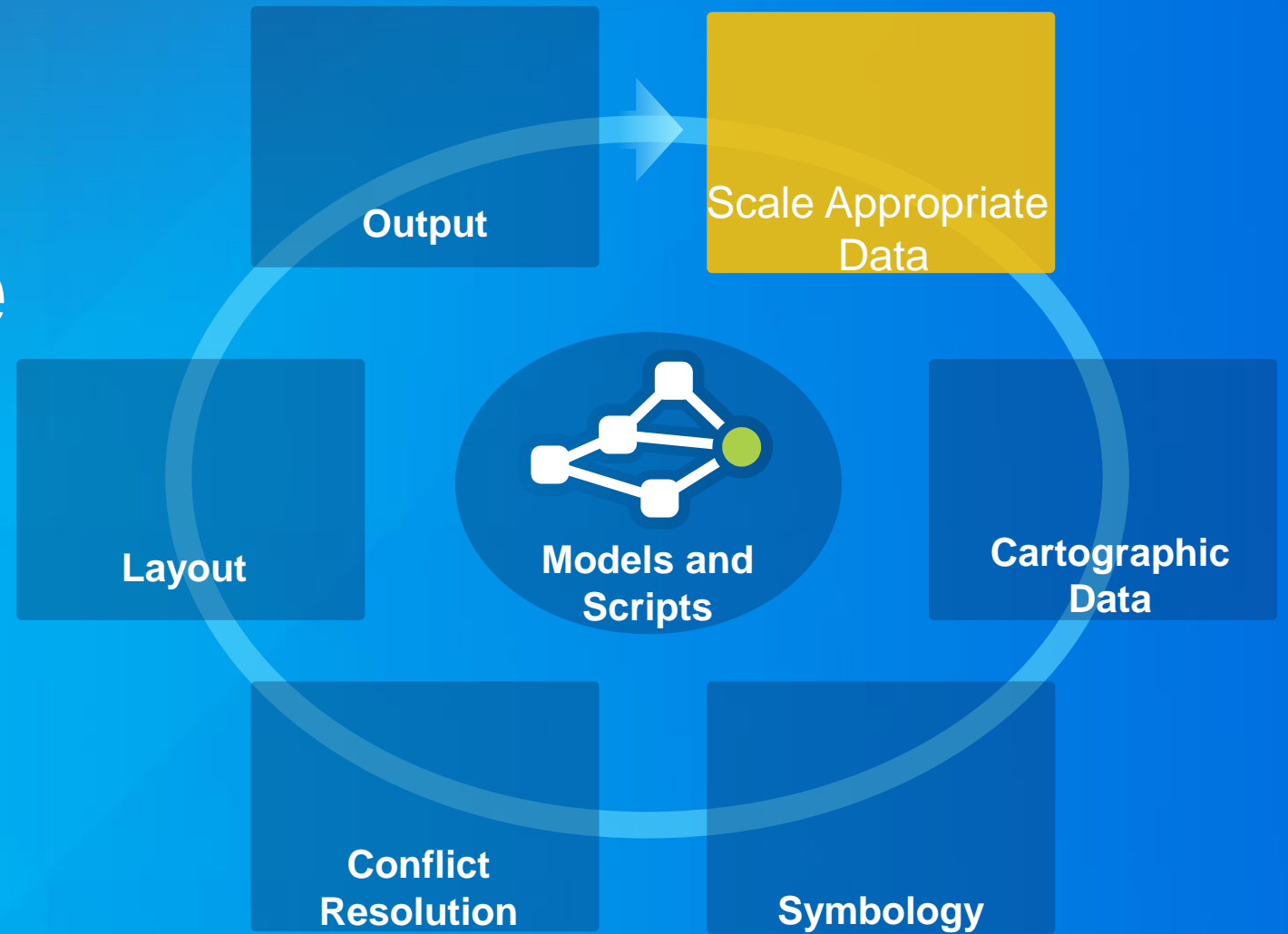


A collection of ArcMap Extensions

Cartographic Workflow



Scale Appropriate Data



Generalization

- Data is collected and maintained in high detail
- When drawn at a smaller scale:
 - it can be too detailed
 - symbols can conflict



Generalization

- Clarifies the display of feature geometry at smaller scales



Generalization Tools

Production Mapping Toolset

- + Cartographic Data
- + Cartographic Editing
- + Conversion
- + Distributed Geodatabase
- Generalization
 - Aggregate Polygons
 - Convert Polygons
 - Delete Dangles
 - Delete Polygons And Extend Lines
 - Extend Polygon Sides
 - Fill Gaps
 - Generalize Shared Features
 - Increase Line Length
 - Increase Polygon Area
 - Modify Underlying Polygon
 - Thin Hydro Features
 - Thin Spot Heights
- + Product Library
- + Surround Elements

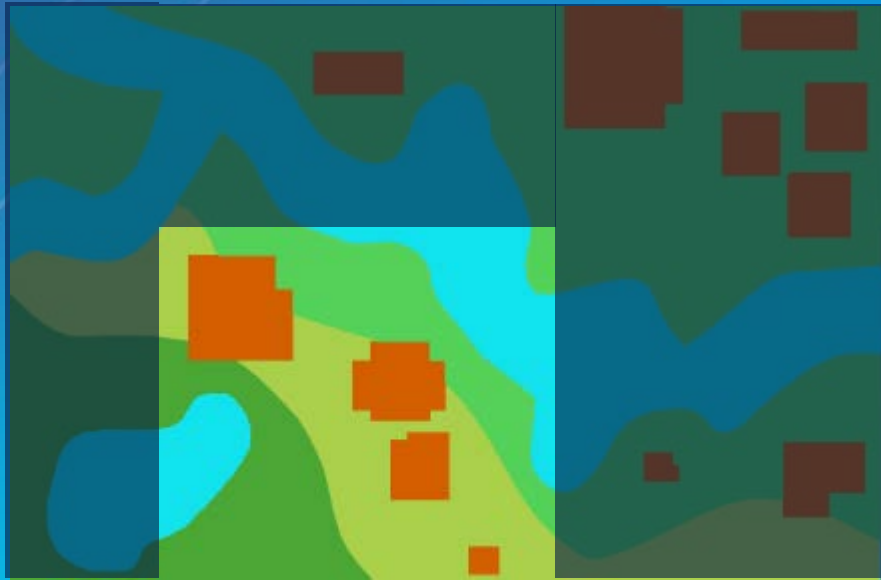
Cartography Toolset

- + Annotation
- + Cartographic Refinement
- + Data Driven Pages
- Generalization
 - Aggregate Points
 - Aggregate Polygons
 - Collapse Dual Lines To Centerline
 - Collapse Road Detail
 - Create Cartographic Partitions
 - Delineate Built-Up Areas
 - Merge Divided Roads
 - Simplify Building
 - Simplify Line
 - Simplify Polygon
 - Smooth Line
 - Smooth Polygon
 - Thin Road Network
- Graphic Conflicts
 - Detect Graphic Conflict
 - Propagate Displacement
 - Resolve Building Conflicts
 - Resolve Road Conflicts
- + Grids and Graticules
- + Masking Tools
- + Representation Management

Data Management Toolset

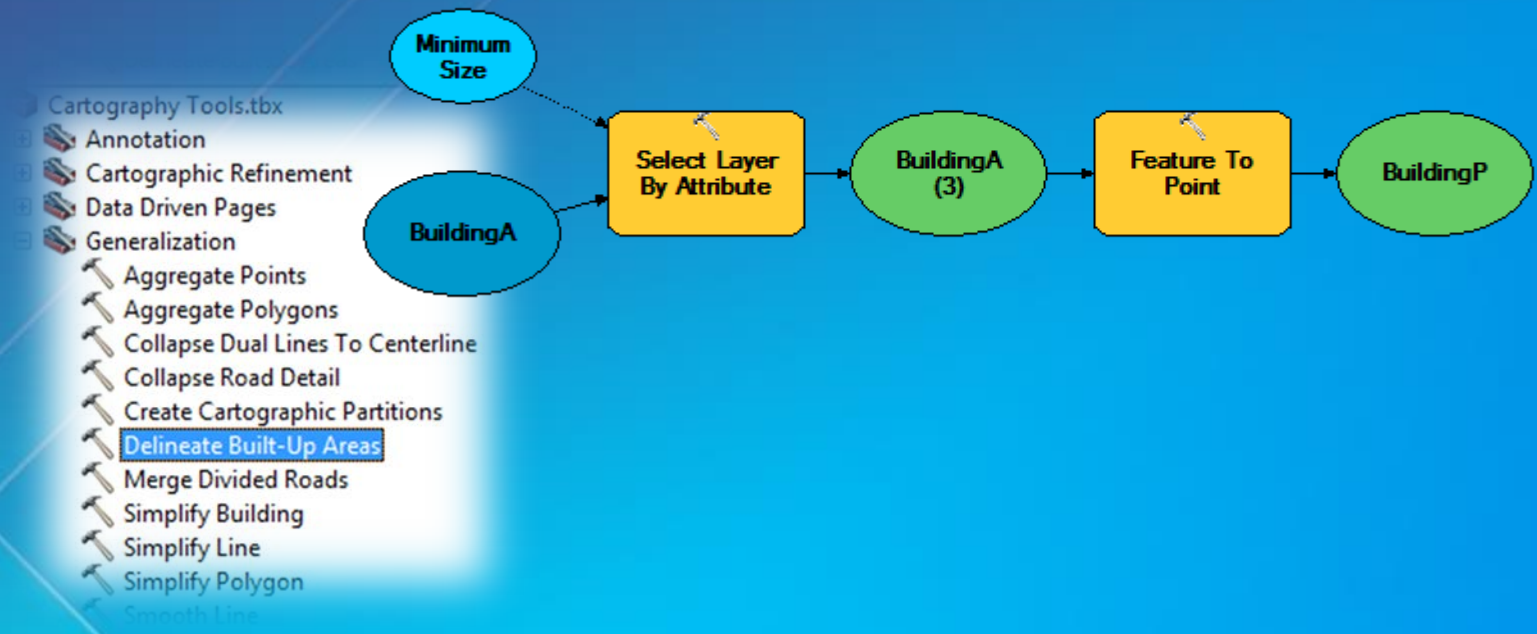
- + Archiving
- + Attachments
- + Data Comparison
- + Distributed Geodatabase
- + Domains
- + Feature Class
- Features
 - Add Geometry Attributes
 - Add XY Coordinates
 - Adjust 3D Z
 - Bearing Distance To Line
 - Check Geometry
 - Copy Features
 - Delete Features
 - Dice
 - Feature Envelope To Polygon
 - Feature To Line
 - Feature To Point
 - Feature To Polygon
 - Feature Vertices To Points
 - Geodetic Densify
 - Minimum Bounding Geometry
 - Multipart To Singlepart
 - Points To Line
 - Polygon To Line
 - Repair Geometry
 - Split Line at Point
 - Split Line At Vertices
 - Table To Ellipse
 - Unsplit Line
 - XY To Line

Feature Generalization



- Features assessed individually without regard to symbology or spatial relationships

Find the tool and add to a model

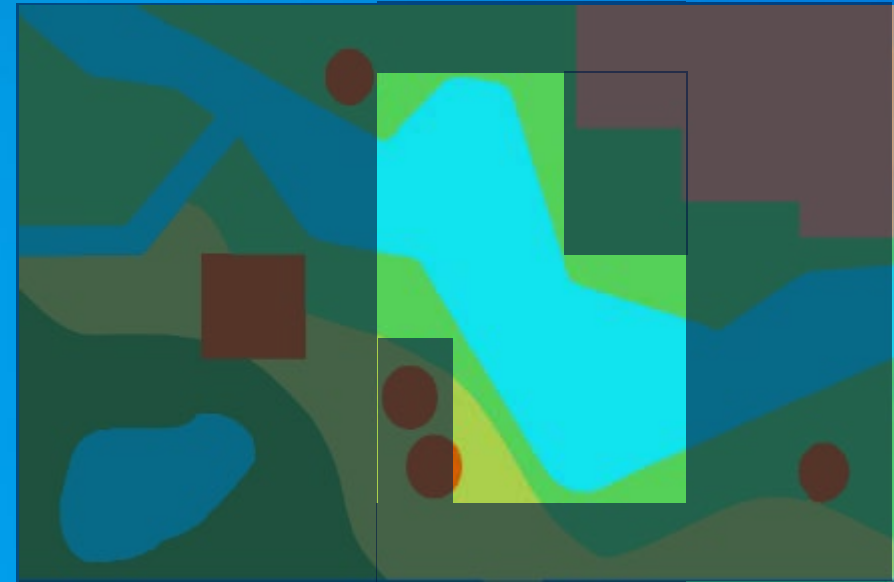
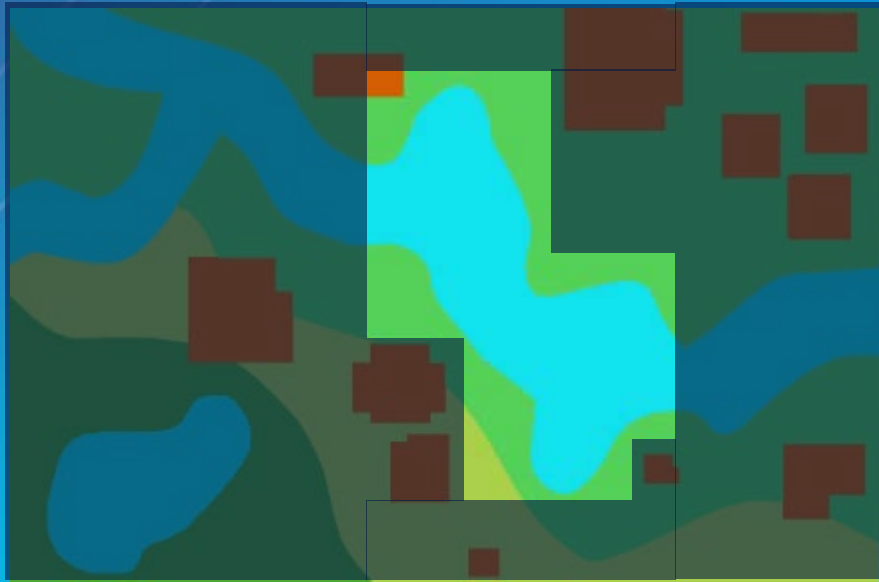


Contextual Generalization



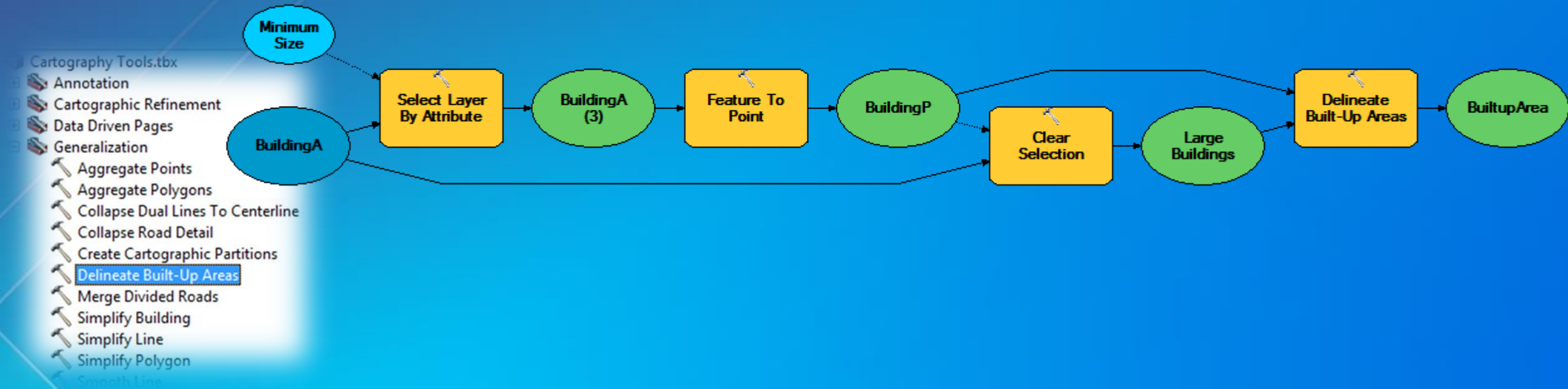
- Features from multiple layers assessed simultaneously
 - Maintain pattern, density, and spatial relationships

Contextual Generalization

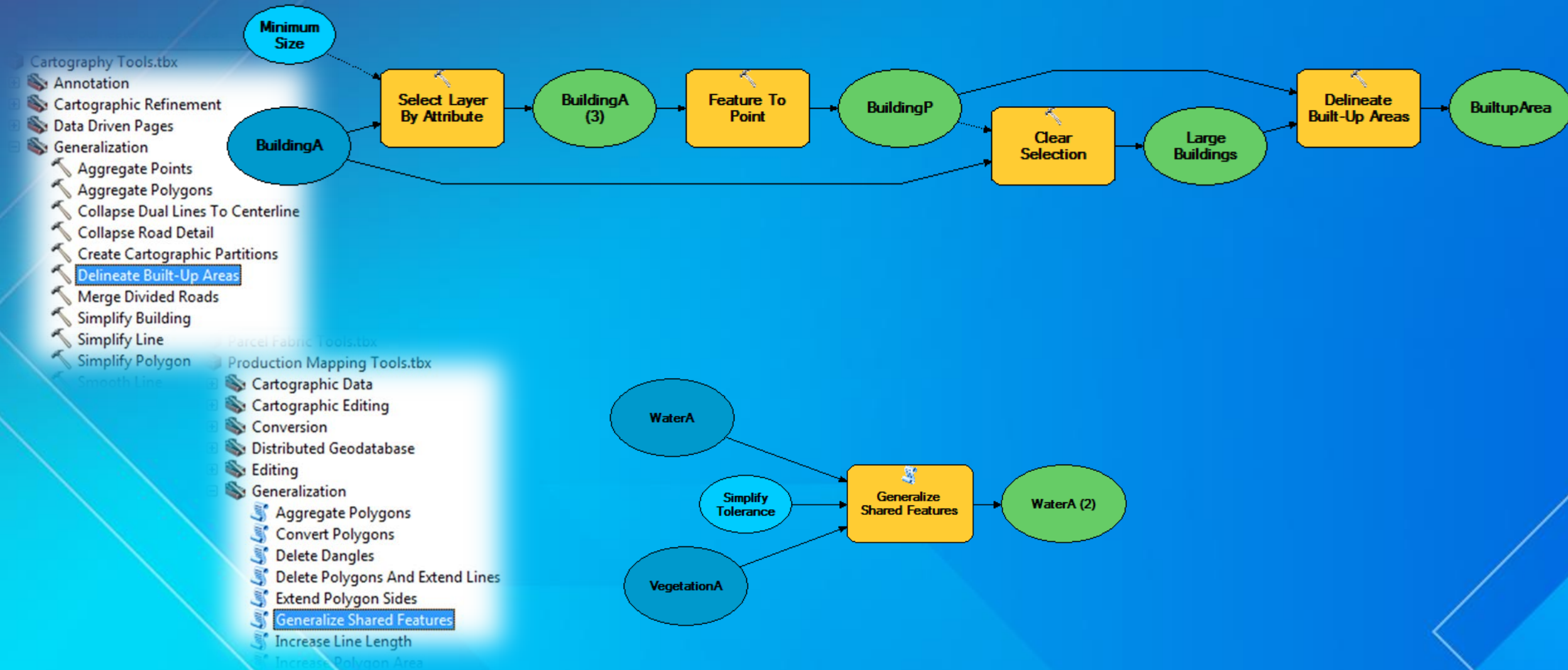


- Features from multiple layers assessed simultaneously
 - Maintain pattern, density, and spatial relationships

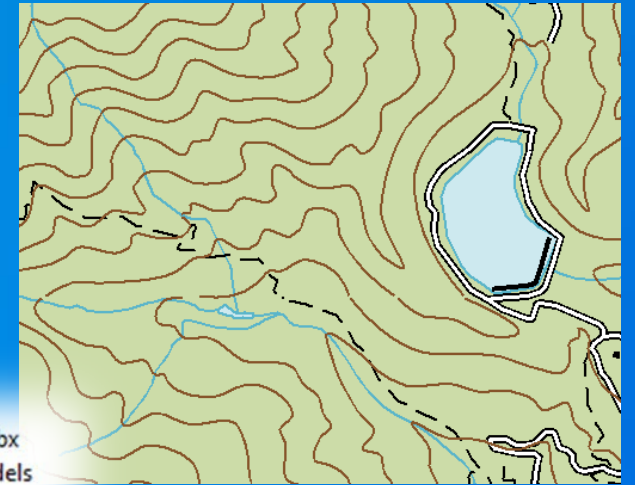
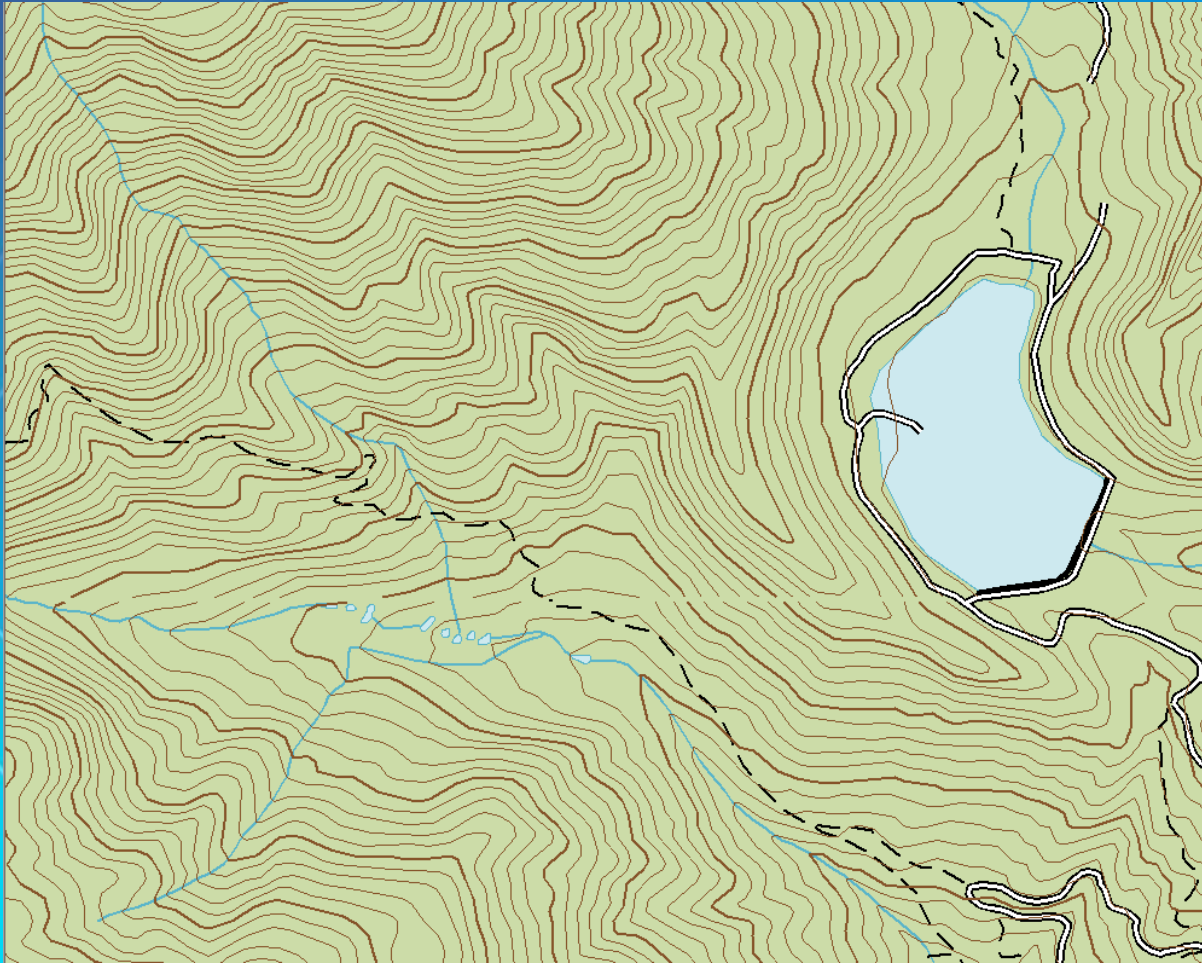
Find the tool and add to a model



Find the tool and add to a model



Run the models



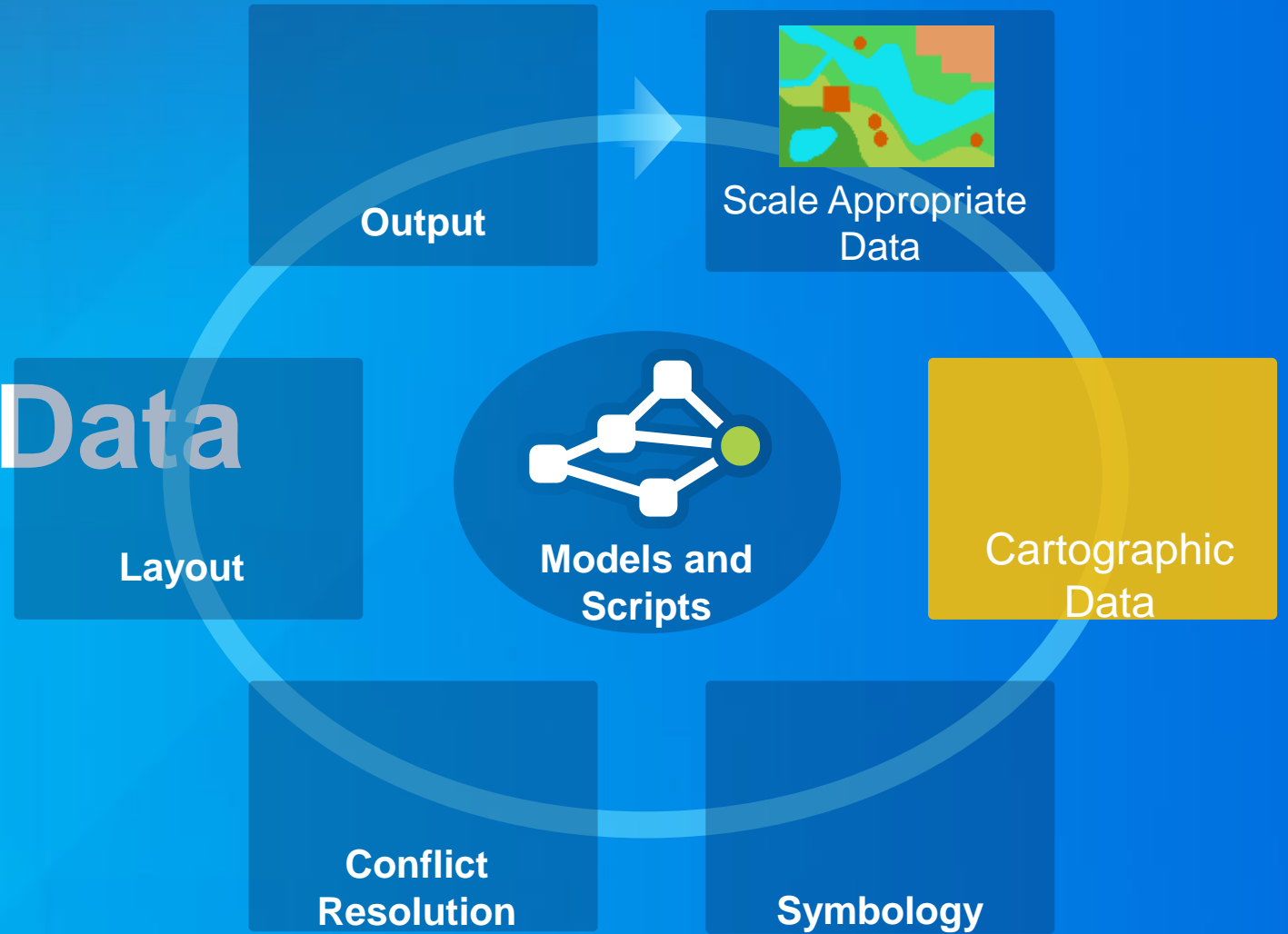
- Fixed50K
- Generalization
- CTM_50K_Generalization.tbx
 - Generalization Submodels
 - Prepare Models
 - 0 Prepare Data for Generalization
 - 1 Transportation
 - 2 Buildings
 - 3 Hydrography
 - 4 Land Cover
 - 5 Elevation
 - 6 Apply Symbology
 - 7 Resolve Line Conflicts
 - 8 Resolve Structure Conflicts

Demo

Creating Scale Appropriate Data

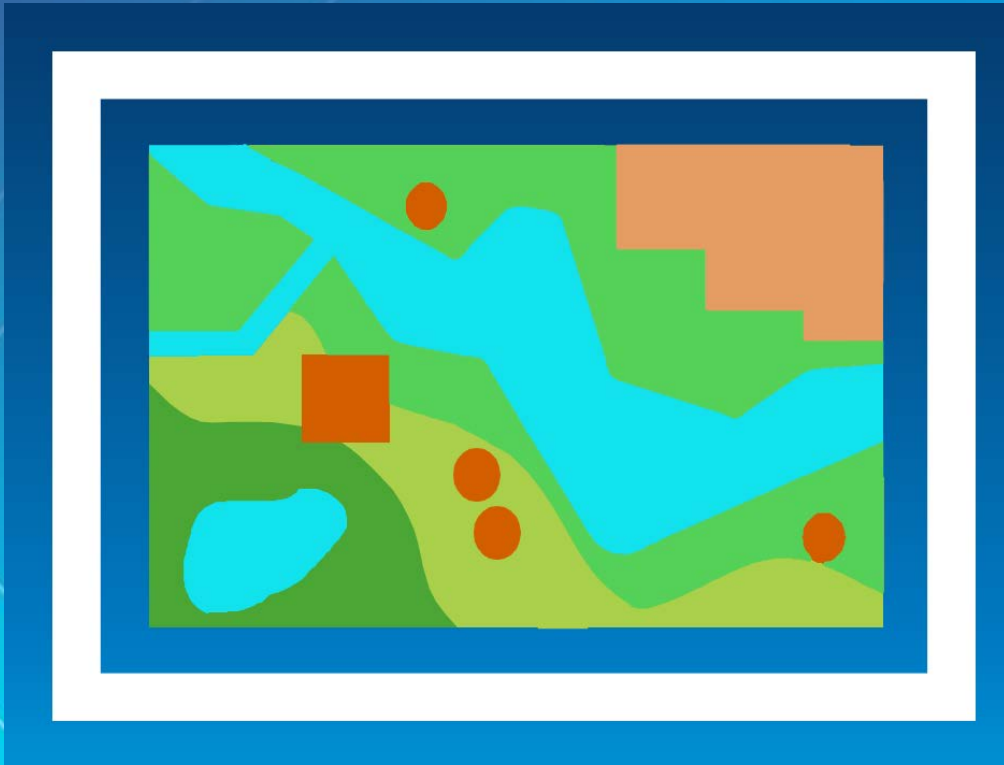


Cartographic Data



Cartographic Data

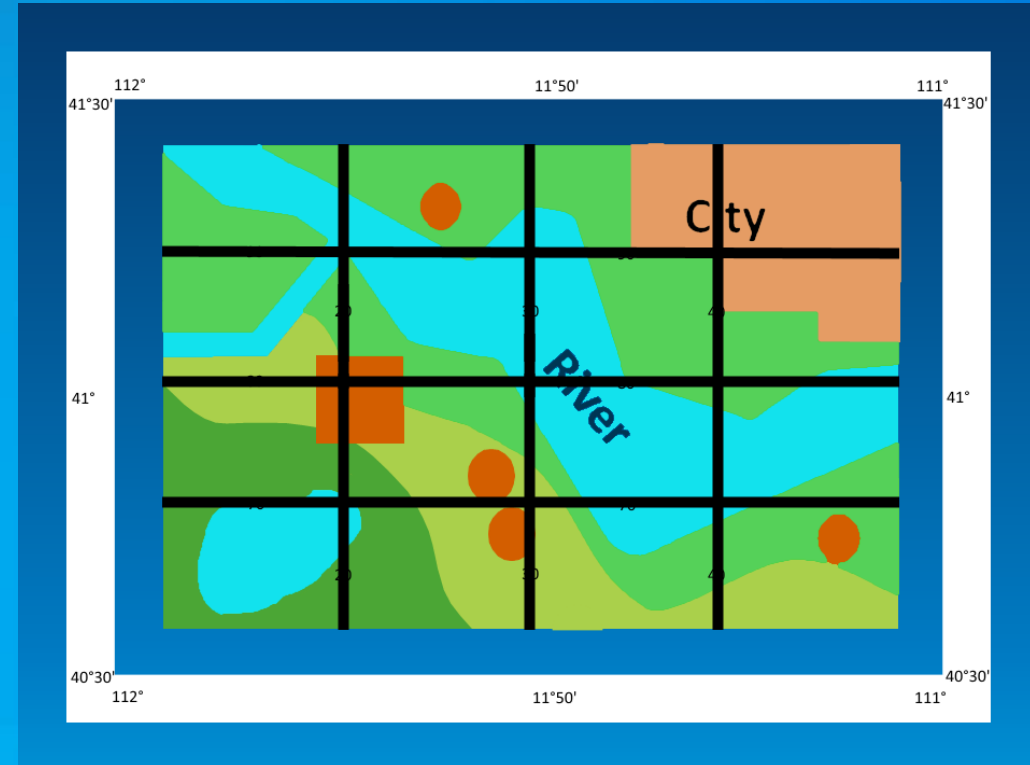
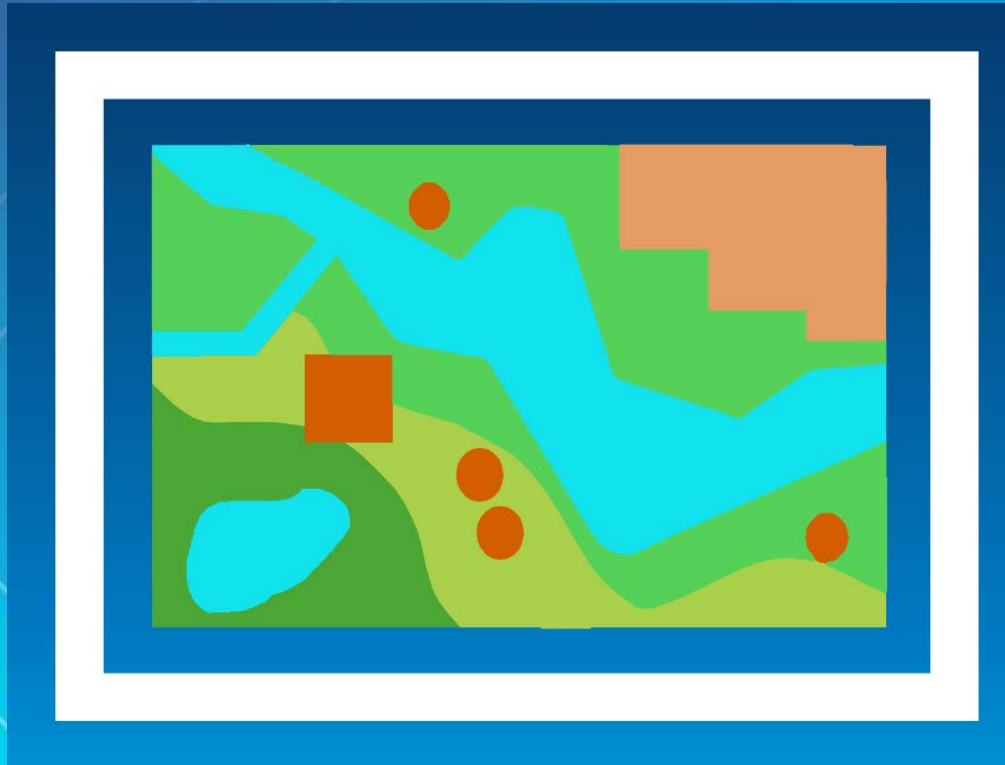
Data and text used to enrich cartographic products



Visualization of abstract concepts

Cartographic Data

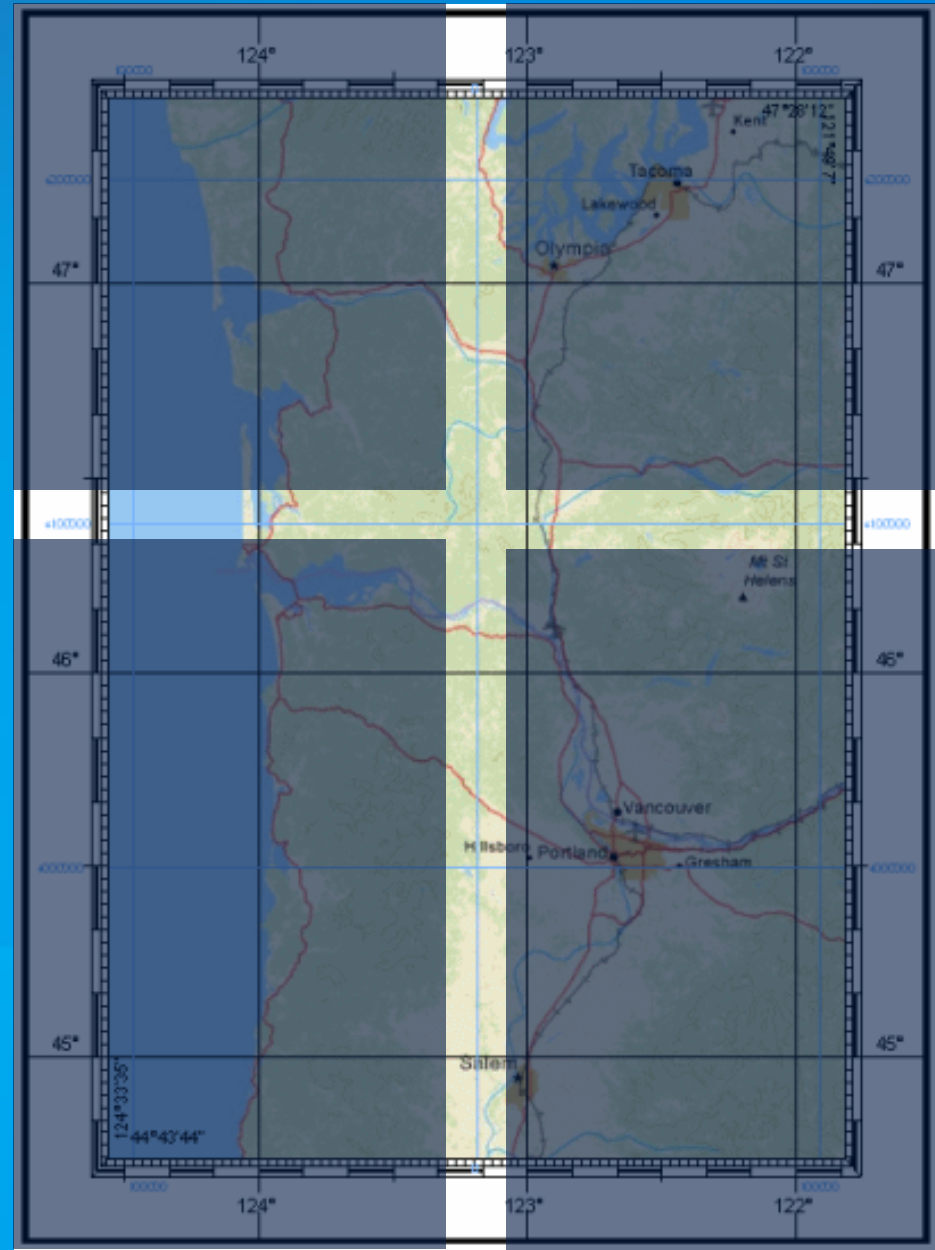
Data and text used to enrich cartographic products



Visualization of abstract concepts

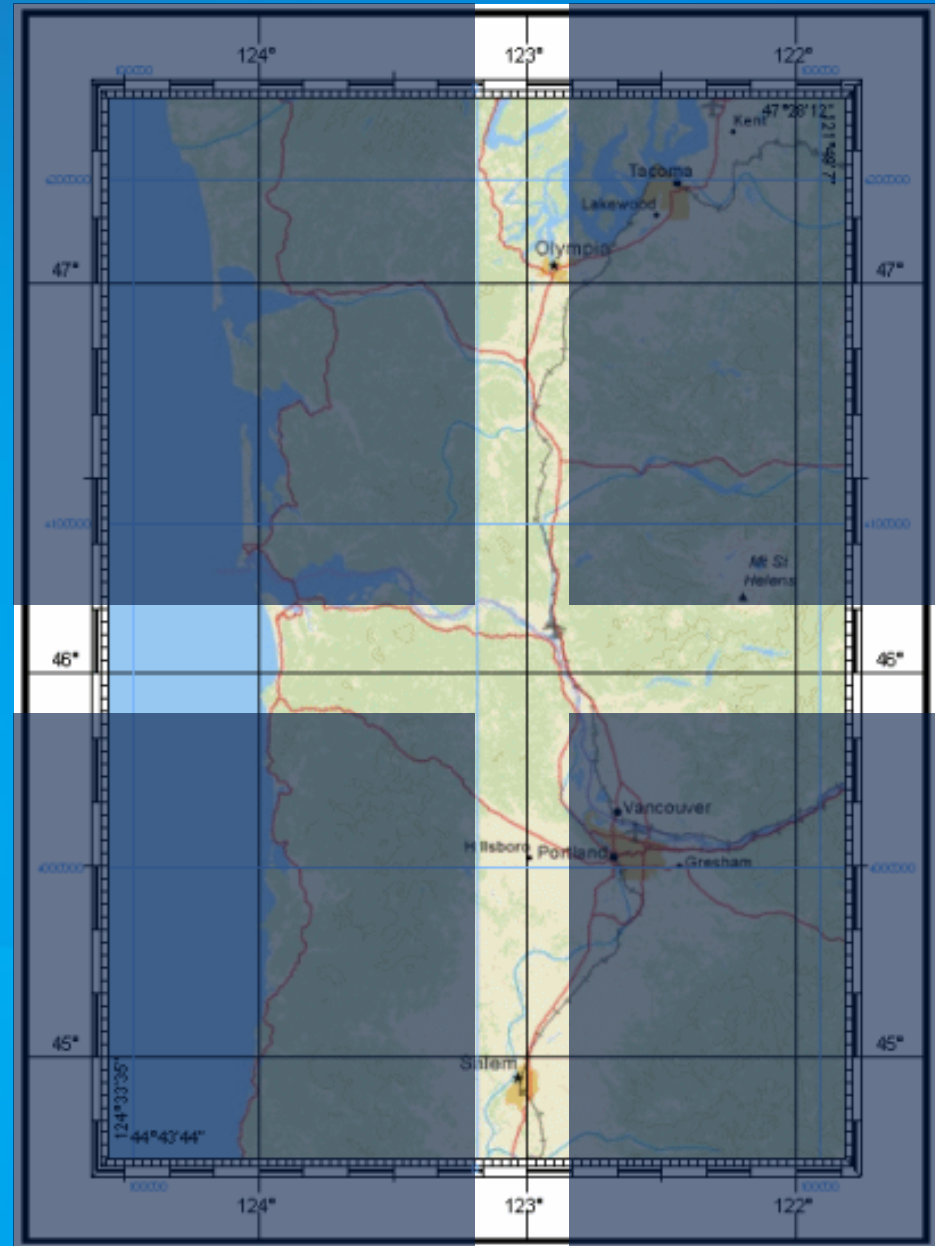
Grids and Graticules

- Grids



Grids and Graticules

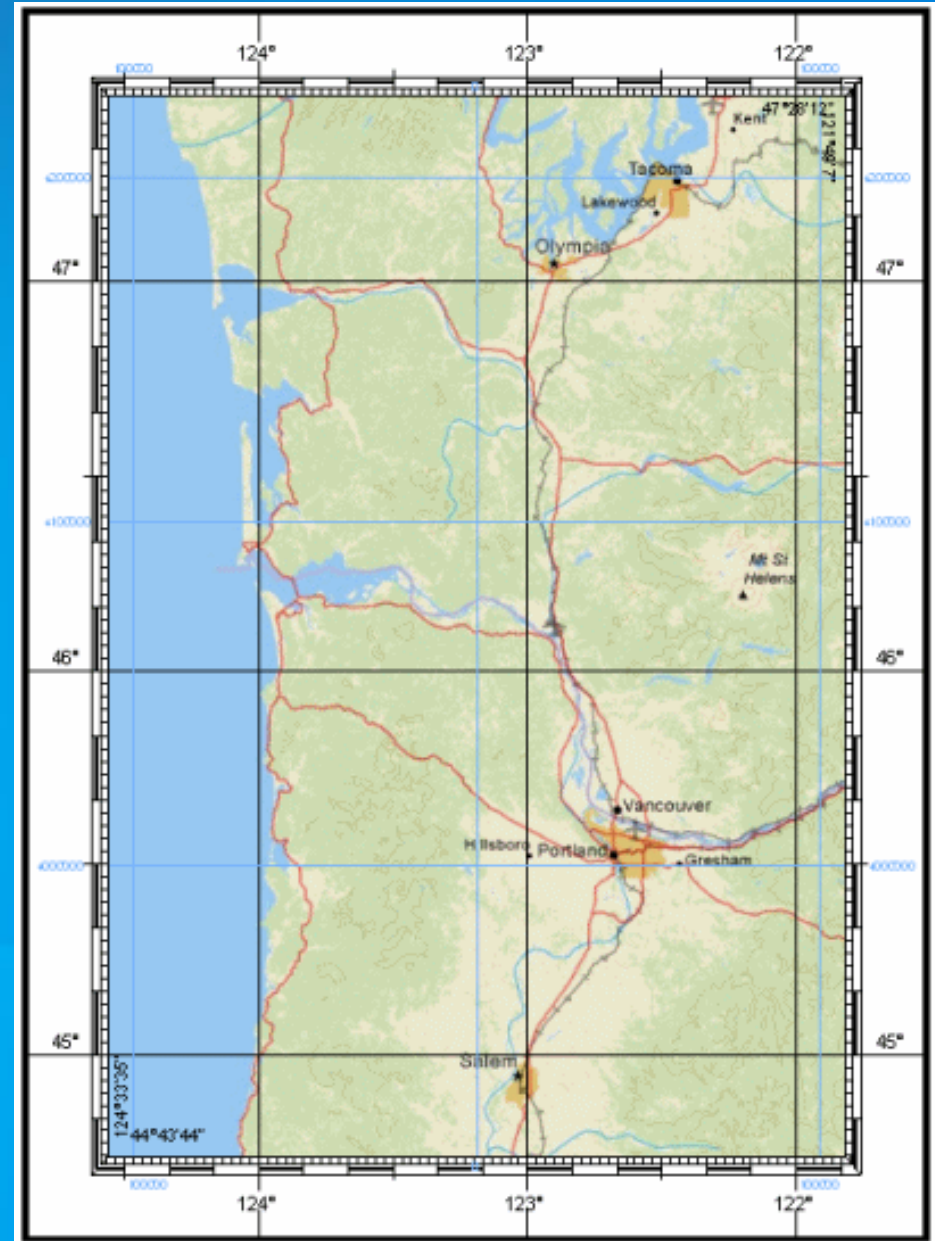
- Grids
- Graticules



Grids and Graticules

About

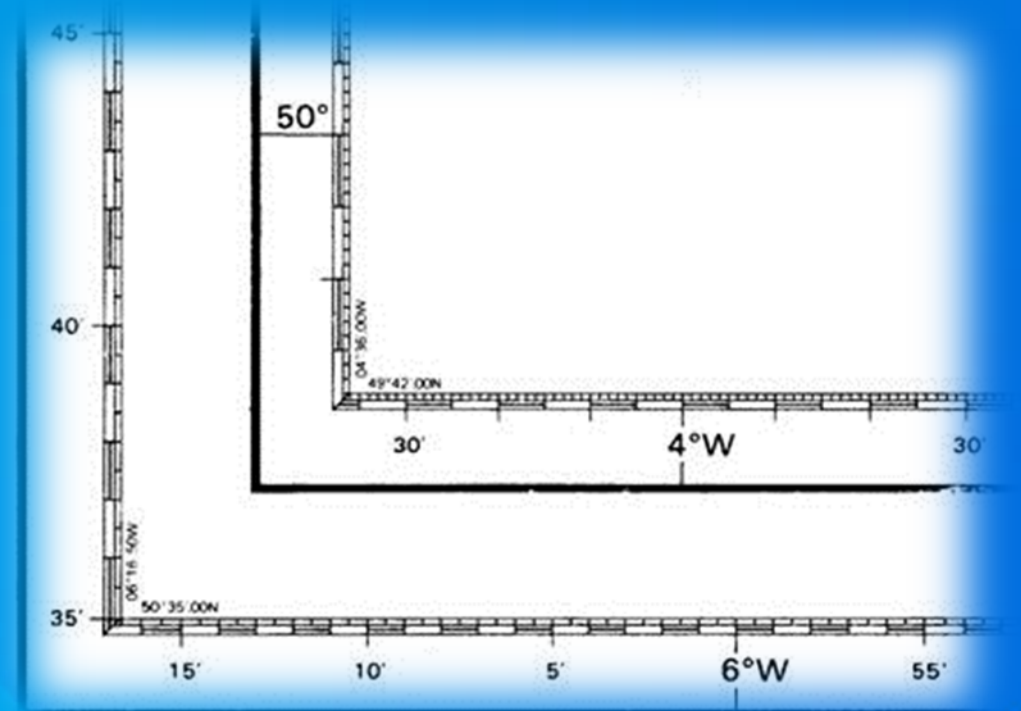
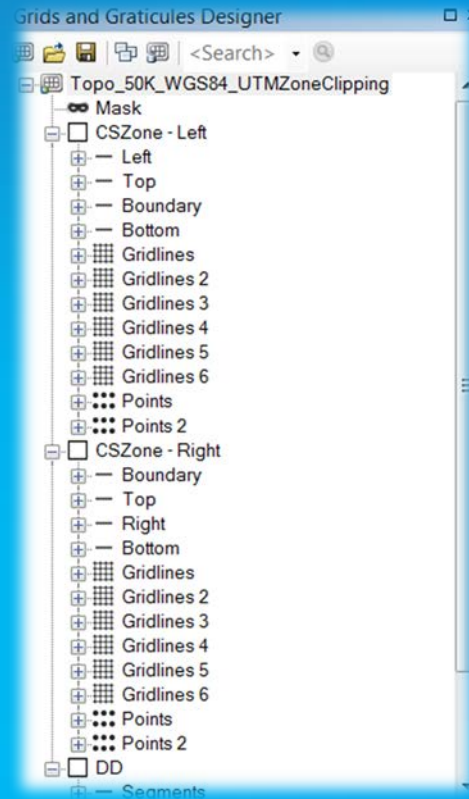
- Grids
- Graticules
- Features



Grids and Graticules

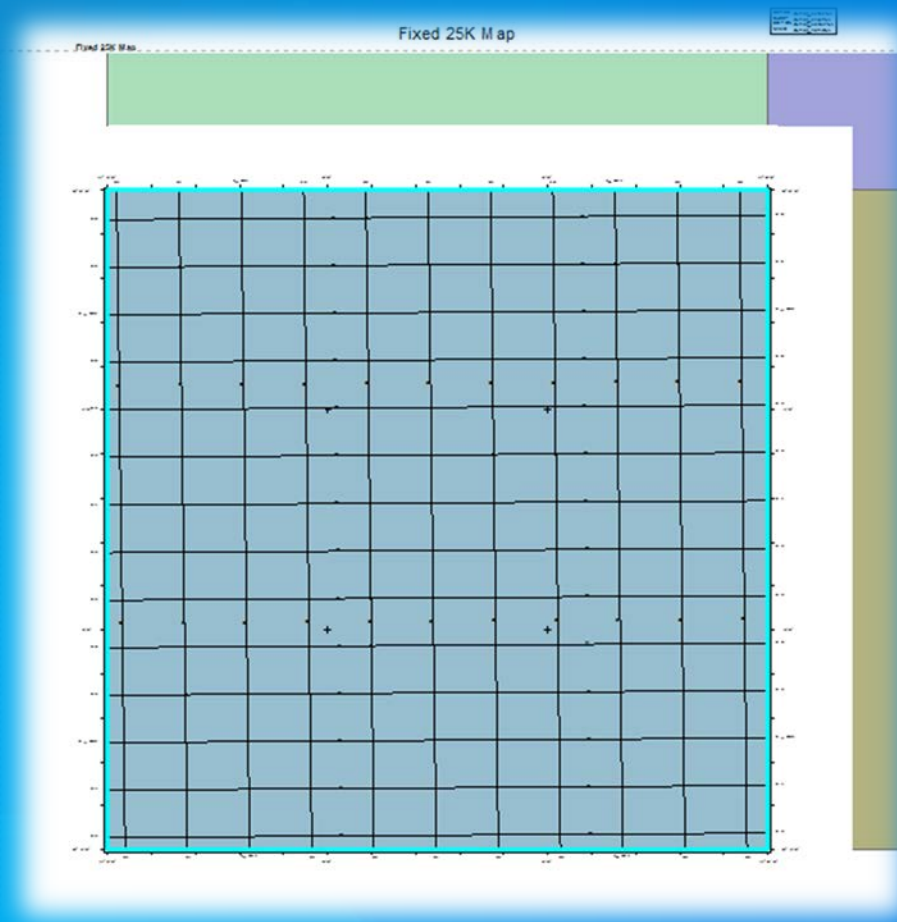
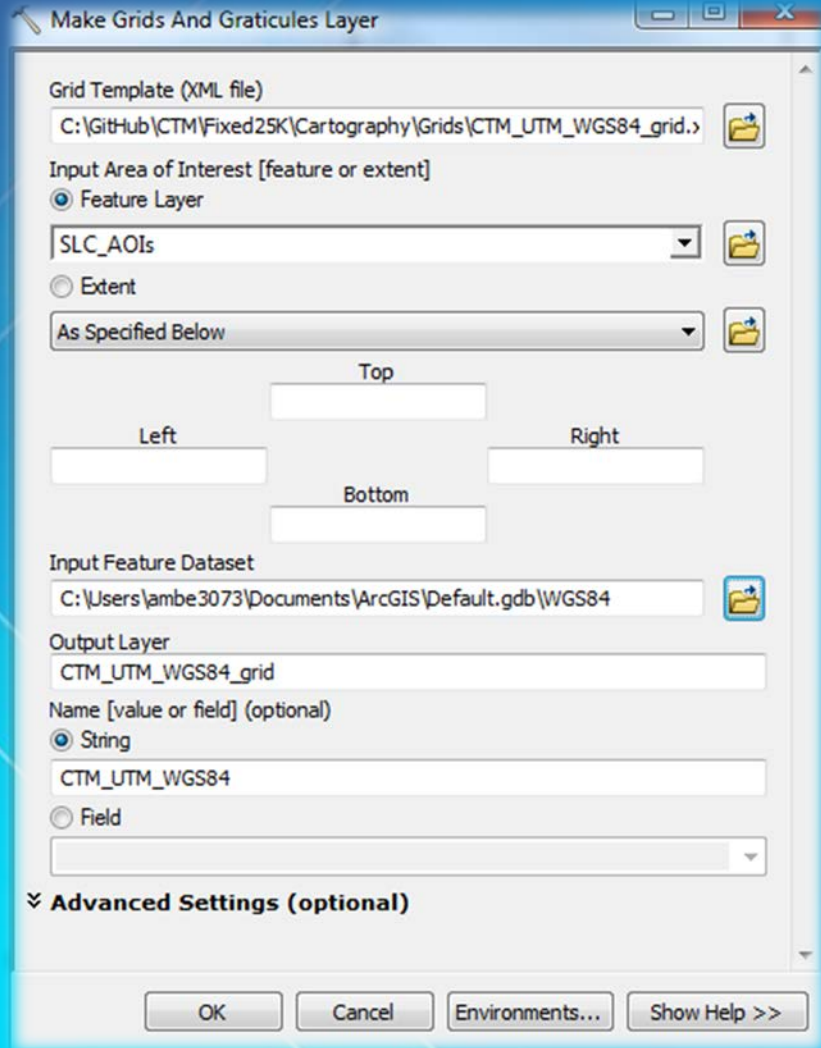
Designing

- Scale
- Coordinate system
- Grid line spacing
- Annotation placement
- Rotation
- Line weight, font



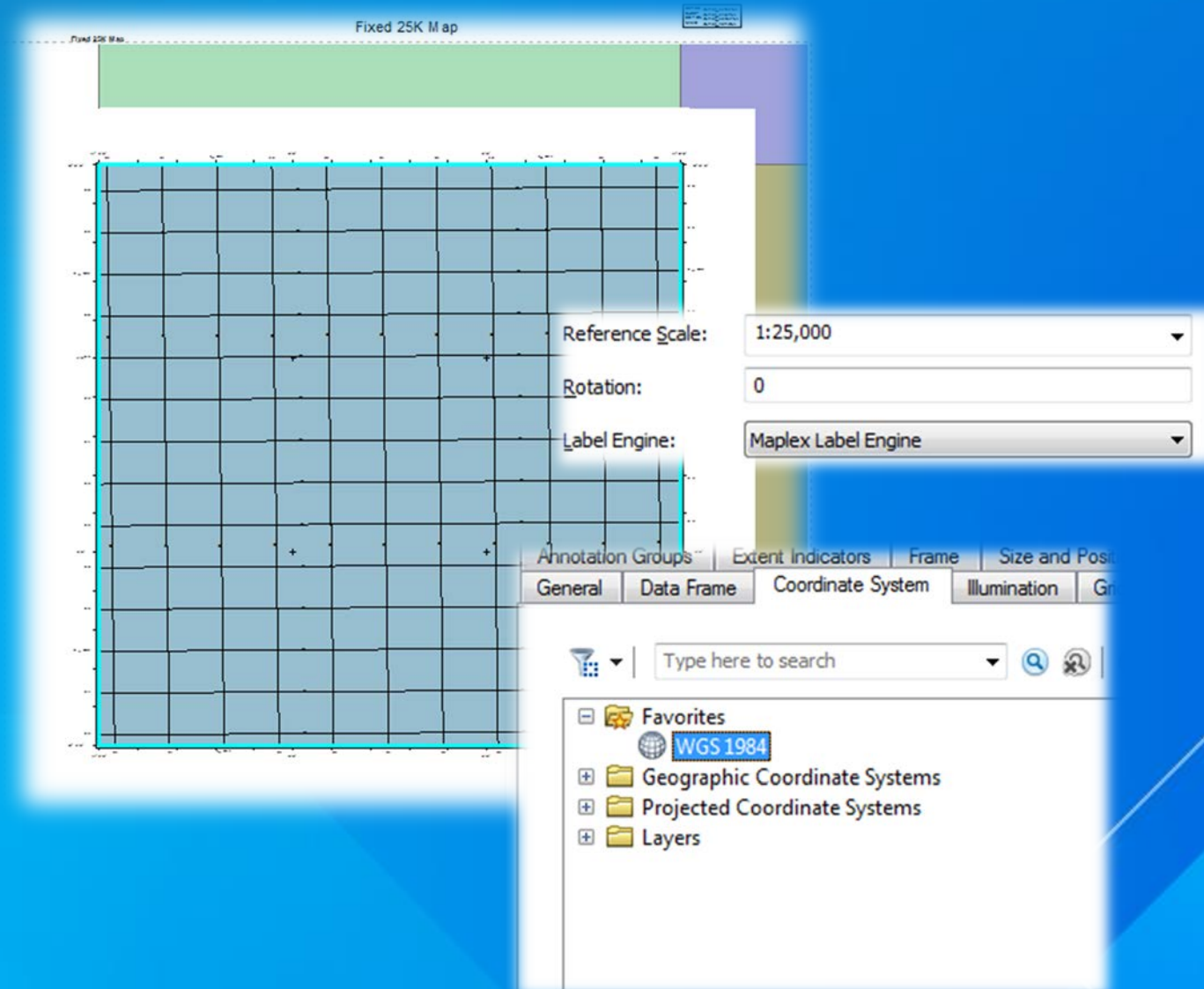
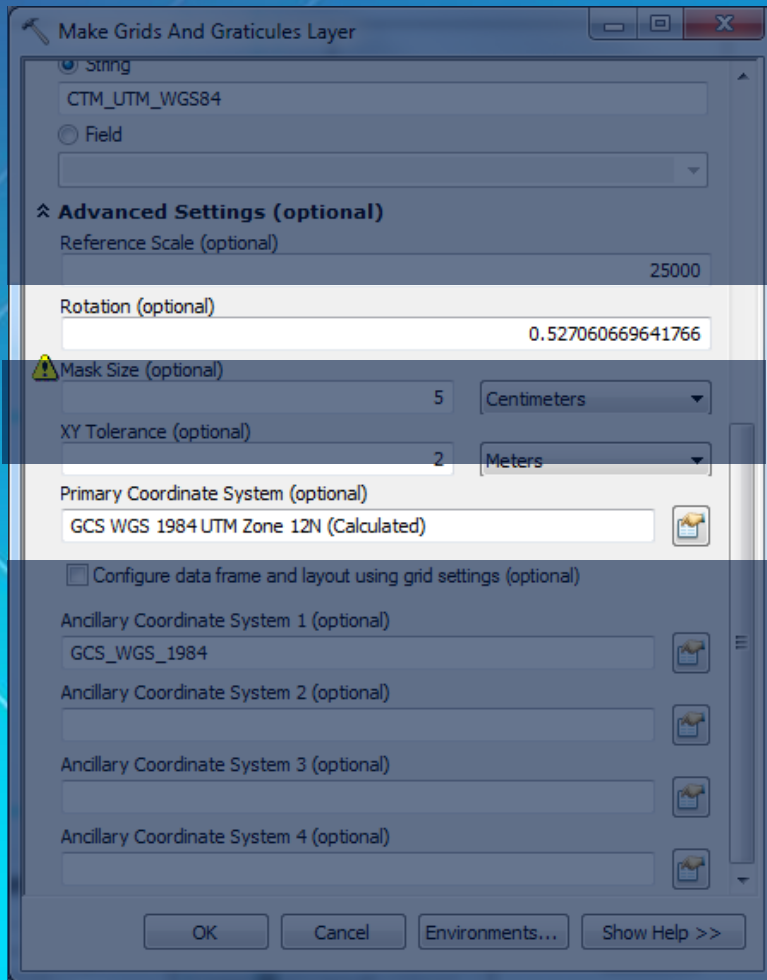
Grids and Graticules

Applying



Grids and Graticules

Applying



Grids and Graticules

Applying

#Define grid object

```
grid = arcpyproduction.mapping.Grid(grid_xml)
```

#Uses the appropriate XML for to create the grid

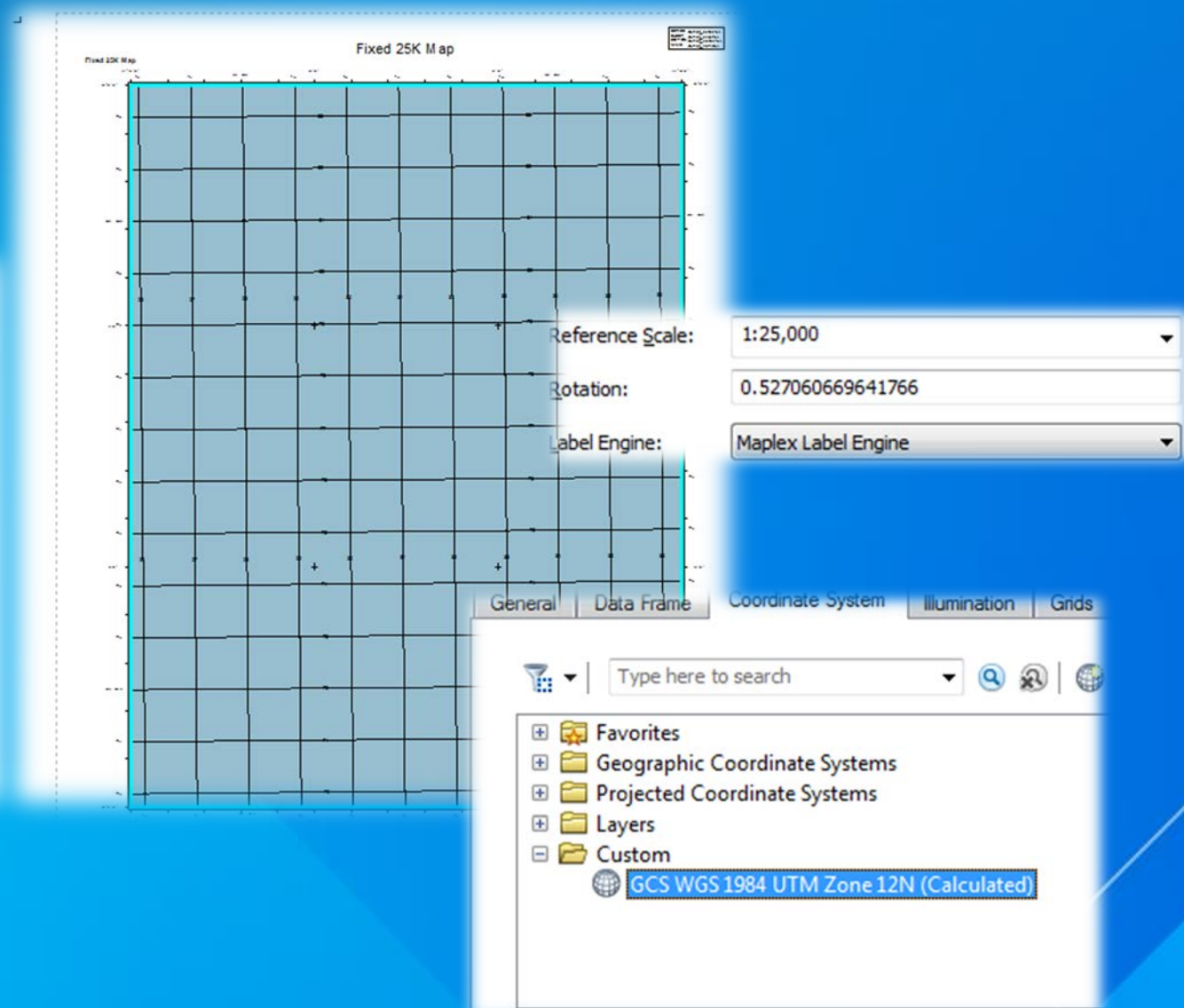
```
arcpy.AddMessage("Creating the Grid...")  
output_layer = map_name + '_' + grid.type  
grid_result = arcpy.MakeGridsAndGraticulesLayer_cartography(grid_xml,  
    aoi, gfs, output_layer, map_name)  
grid_layer = grid_result.getOutput(0)
```

Add the grid layer to the top of the map

```
arcpy.mapping.AddLayer(data_frame, grid_layer, "TOP")  
arcpy.AddMessage("Grid Layer added to map...")
```

Updates the data frame properties base on the grid

```
final mxd.activeView = 'PAGE LAYOUT'  
grid.updateDataFrameProperties(data_frame, aoi)
```

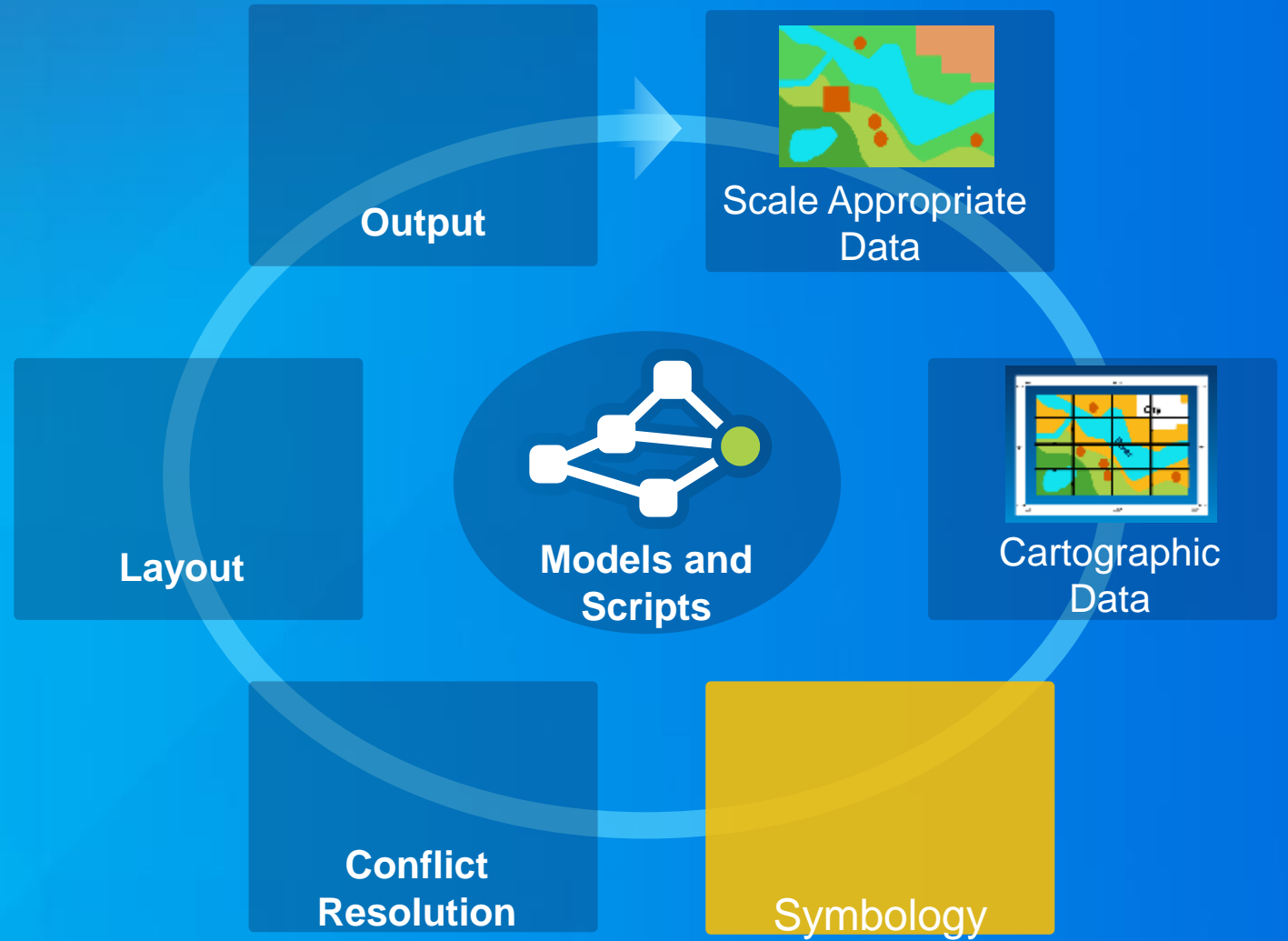


Demo

Cartographic Data

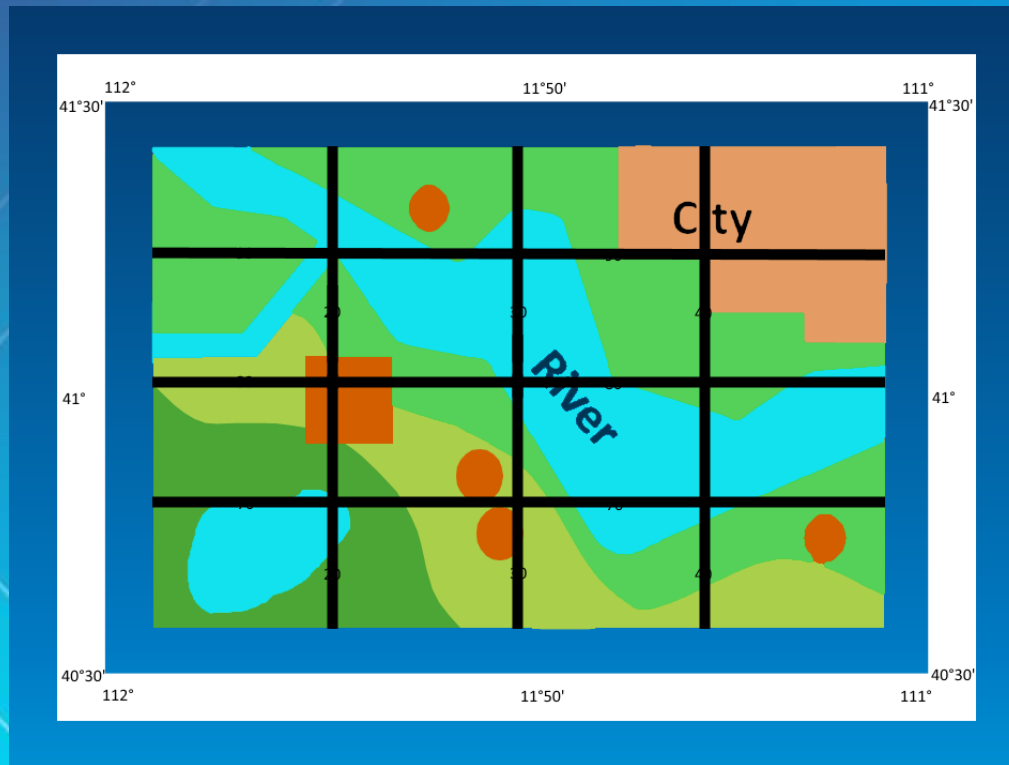


Symbology



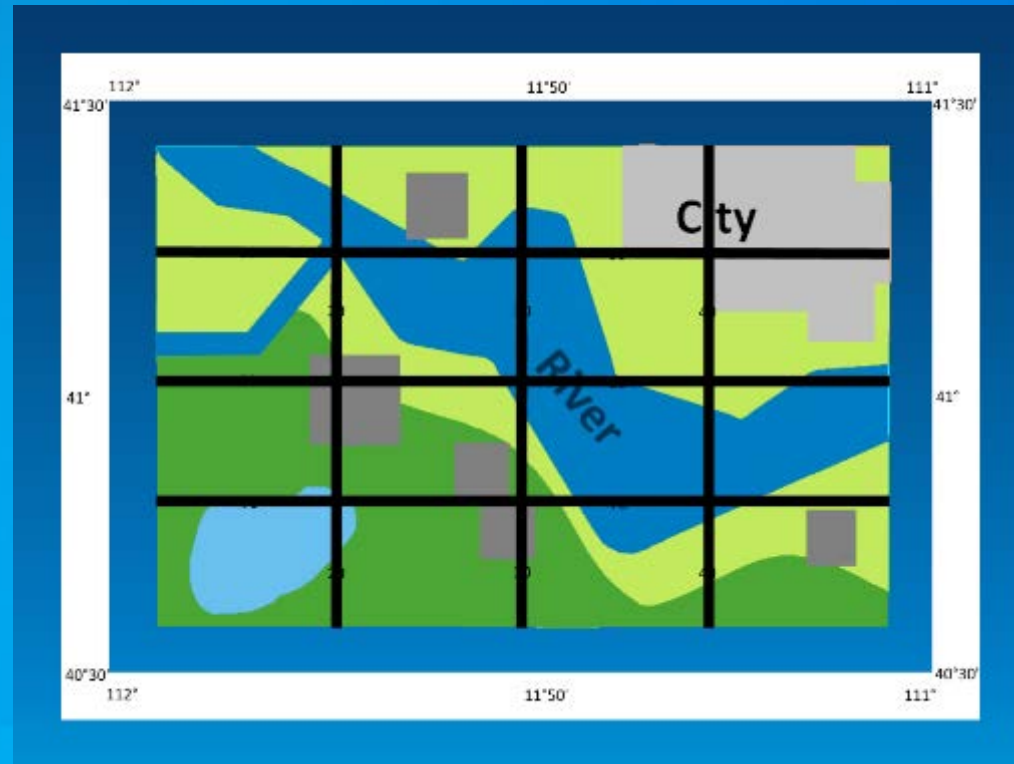
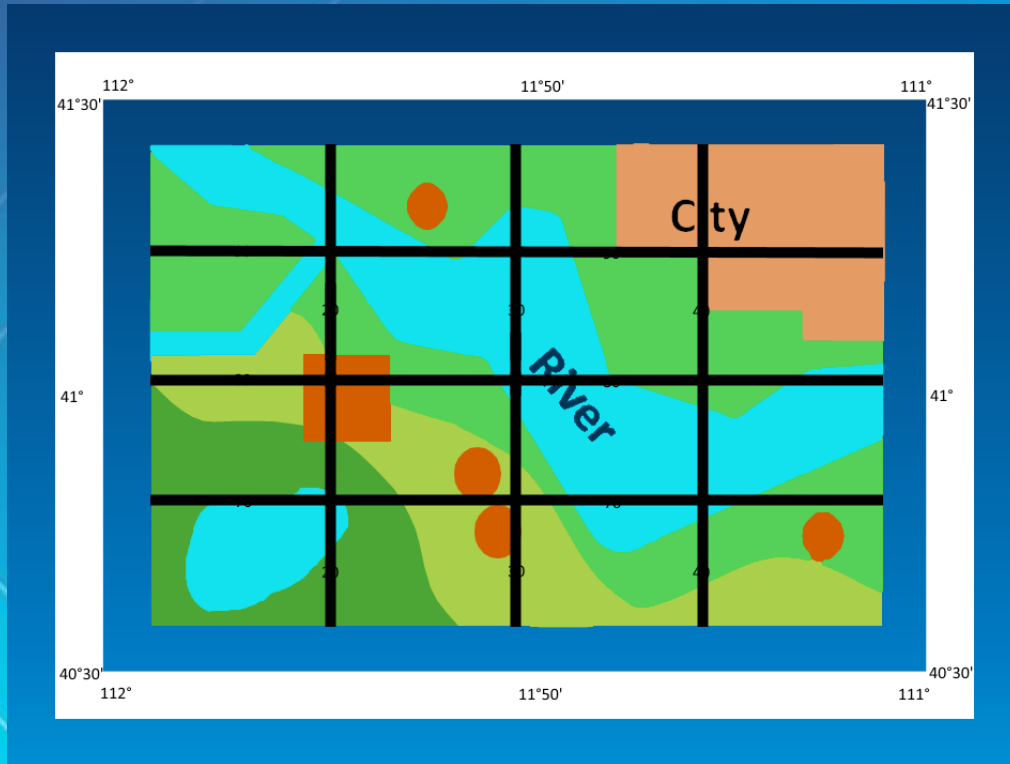
Symbology

Intuitively displaying information

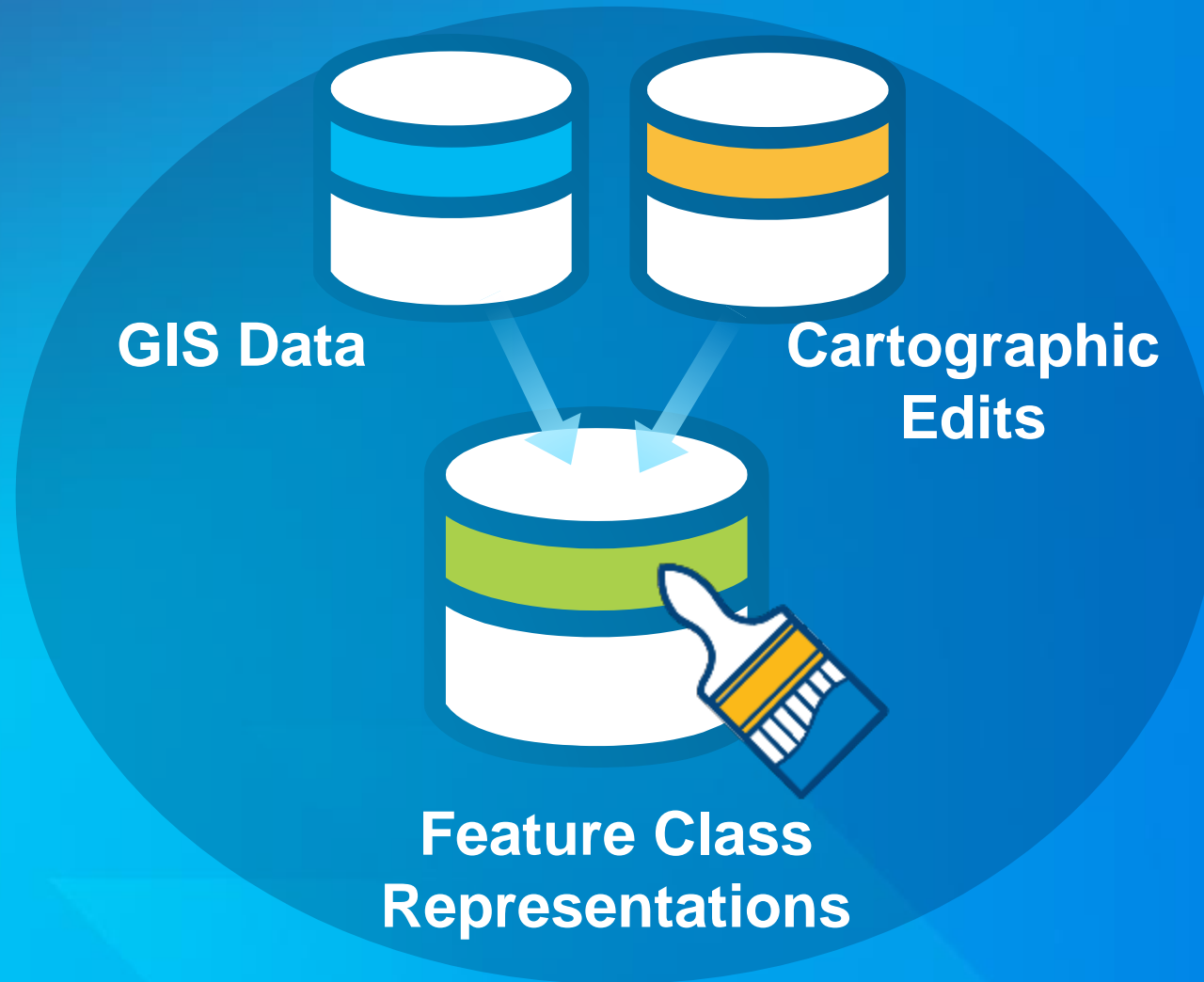


Symbology

Intuitively displaying information



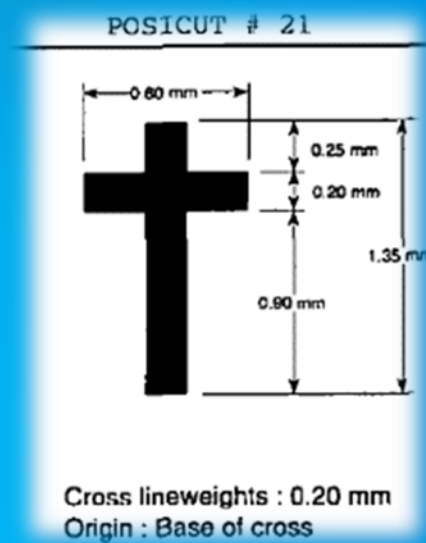
Feature Class Representations



Visual Specifications

Defining

- Create Symbology



Visual Specifications

Defining

- Create Symbology
- Know Your Rules

POINTS – BUILDING
POINT FEATURE... SYMBOL#1L015P011

ATTRIBUTES:

HWT – HOUSE OF WORSHIP TYPE

000 – UNKNOWN

002 – CATHEDRAL

003 – CHAPEL

004 – CHURCH

NAM – NAME CATEGORY

ANY

PARAMETERS:

Origin: Center of square

FILL: SQUARE

Lineweight: 0.630mm

Length: 0.630mm

Color: BLACK (#58600)

LABEL: NAM

Type Size: 6 point

Type Style: Upper/Lower Case, Condensed

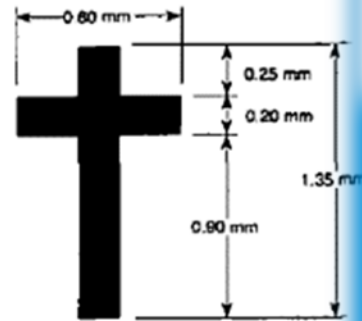
Color: RED (#60862)

POSICUT

Posicut: #21

Color: BLACK (#58600)

POSICUT # 21



Cross lineweights : 0.20 mm

Origin : Base of cross

Visual Specifications

Defining

- Create Symbology
- Know Your Rules
- Define Specifications

AL241 - BUILDING
POINT FEATURE... SYMBOL#1L015P011

ATTRIBUTES:
HWT - HOUSE OF WORSHIP TYPE
000 - UNKNOWN
002 - CATHEDRAL
003 - CHAPEL
004 - CHURCH
NAM - NAME CATEGORY
ANY

PARAMETERS:
Origin: Center of square
FILL: SQUARE
Lineweight: 0.630mm
Length: 0.630mm
Color: BLACK (#58600)
LABEL: NAM
Type Size: 6 point
Type Style: Upper/Lower Case, Condensed
Color: RED (#60862)
POSICUT
Posicut: #21
Color: BLACK (#58600)

POSICUT # 21

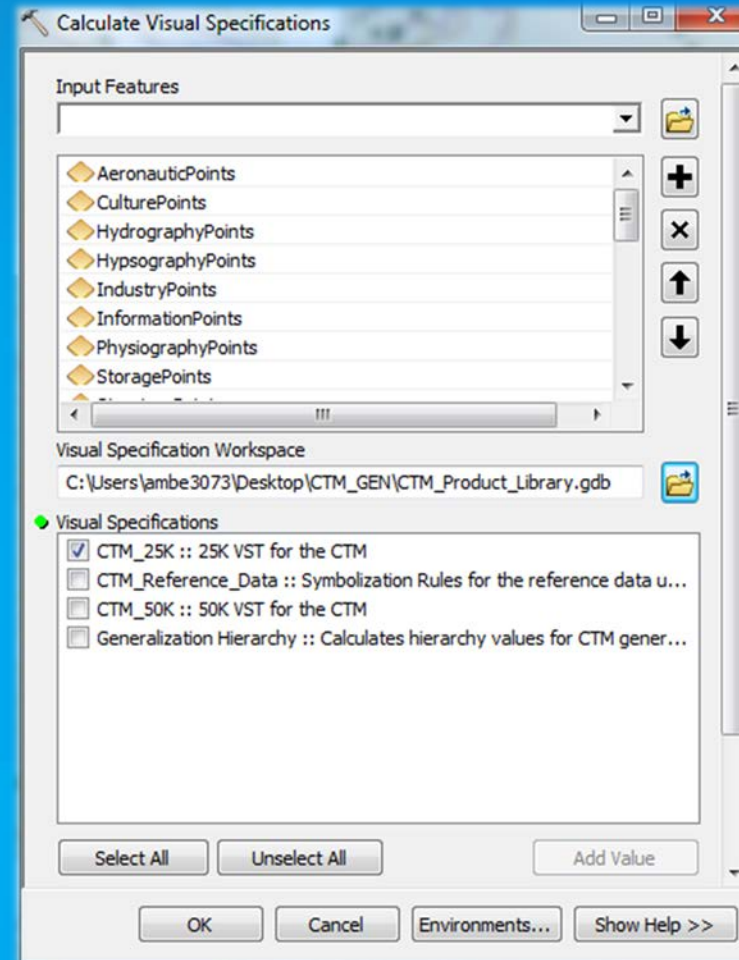
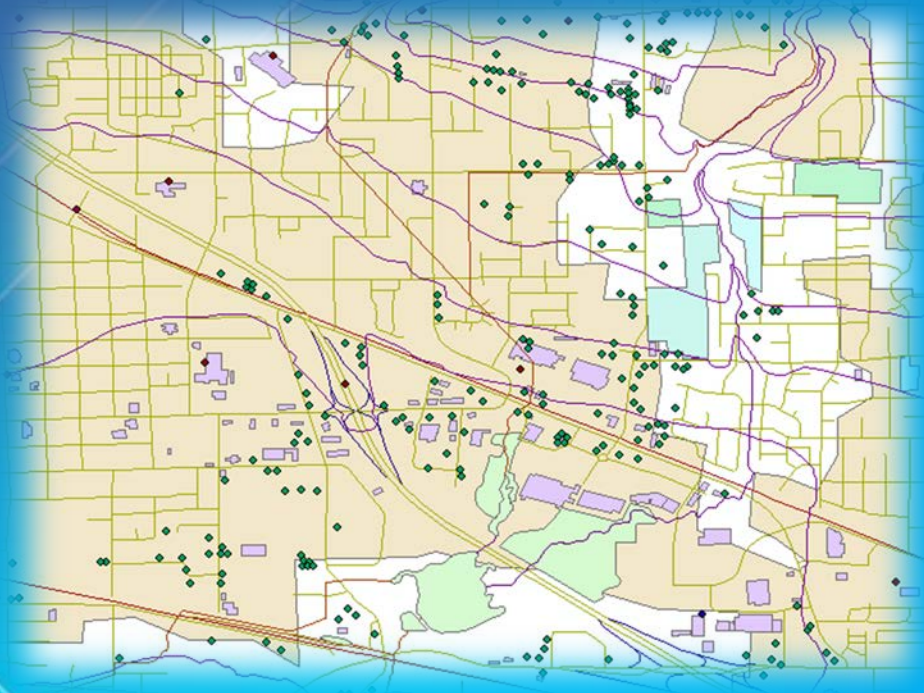
Cross lineweights : 0.20 mm
Origin : Base of cross

Rule Description	Dataset	SQL Statement	Preview
Tower	StructurePnt ...	SELECT <TargetTable.OID> FROM <TargetTable> WHERE F_CODE = 'AL241'	Structure: Tower (with Annotation) Pnt
Church	StructurePnt ...	SELECT <TargetTable.OID> FROM <TargetTable> WHERE HWT in (000, 002, 003, 004)	Structure: Building, HOW - Christian Pnt
Building/Shed	StructureSf	SELECT <TargetTable.OID> FROM <TargetTable> WHERE F_CODE = 'AL013' OR F_CODE =	Structure: Building

Options >> OK Cancel

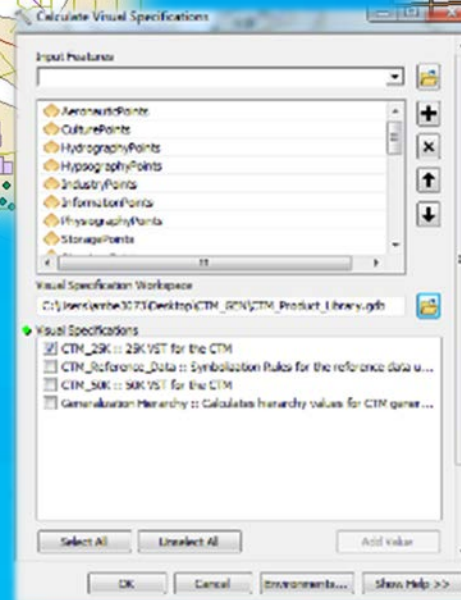
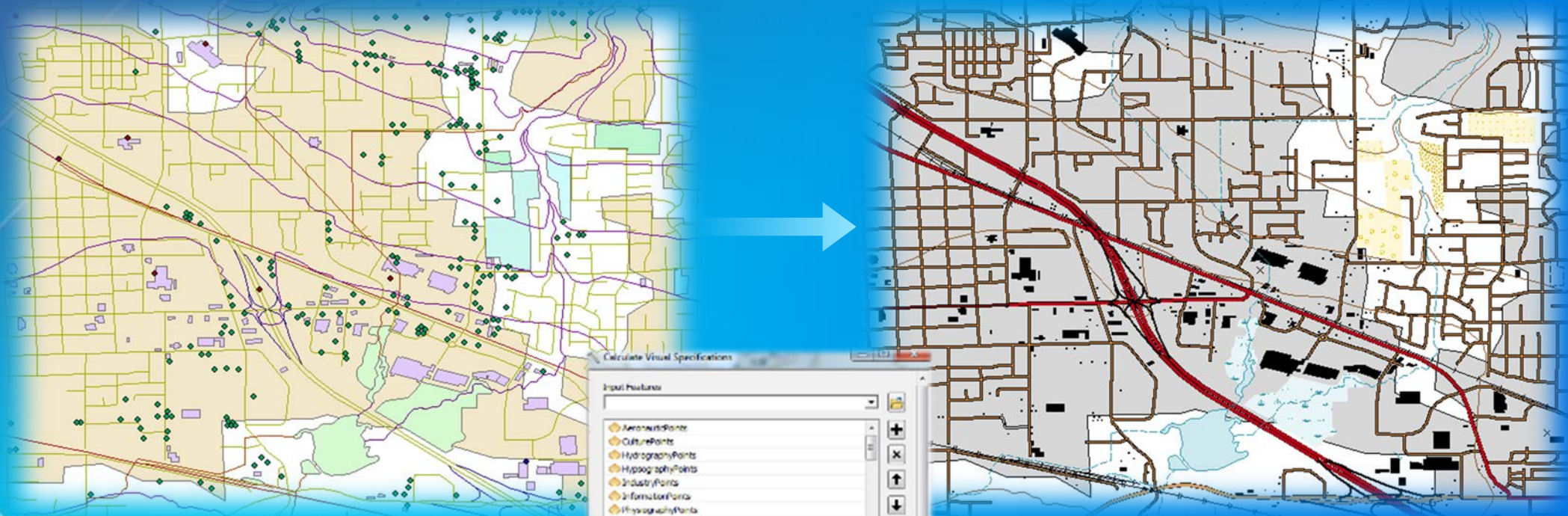
Visual Specifications

Applying

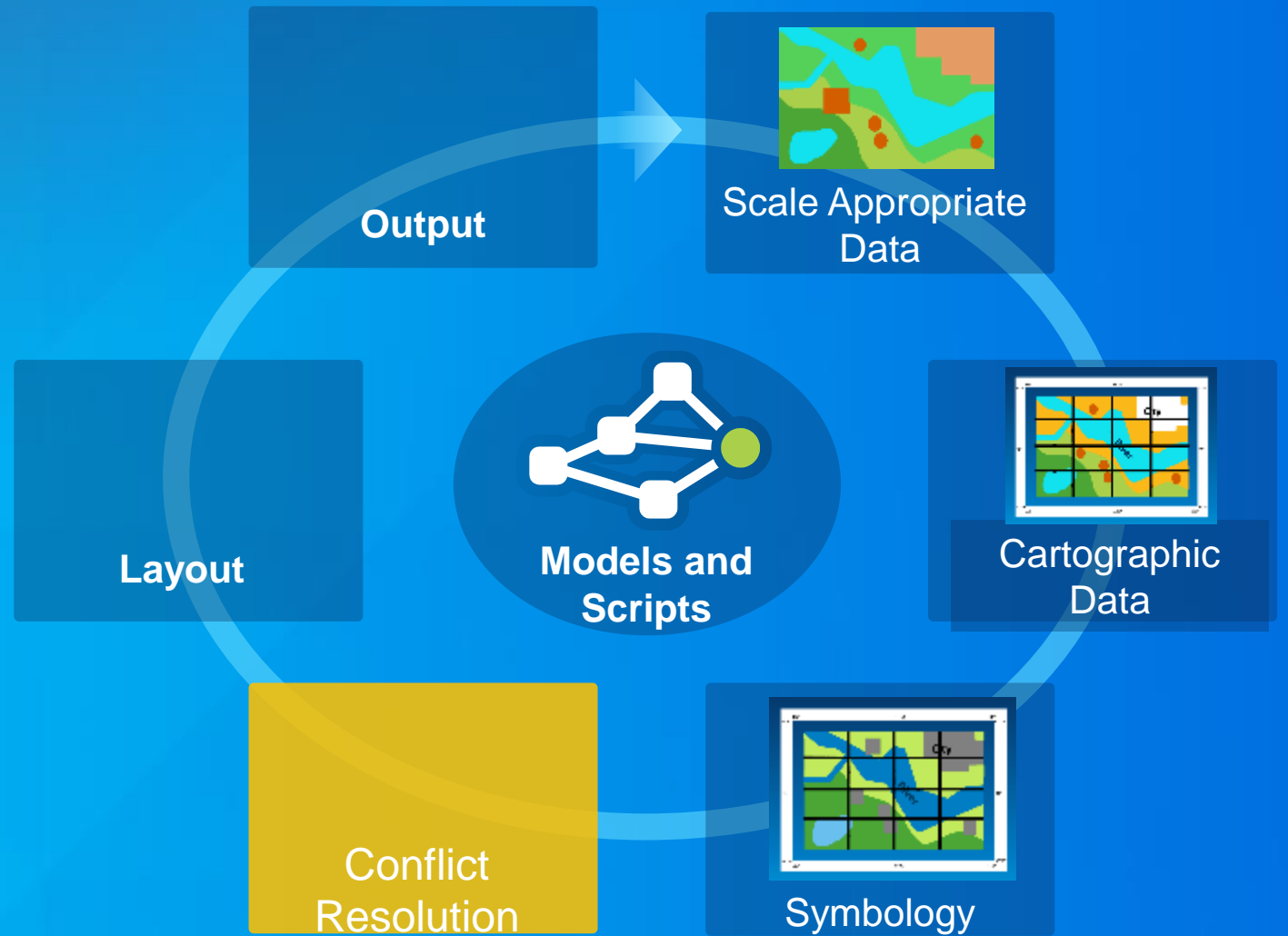


Visual Specifications

Applying

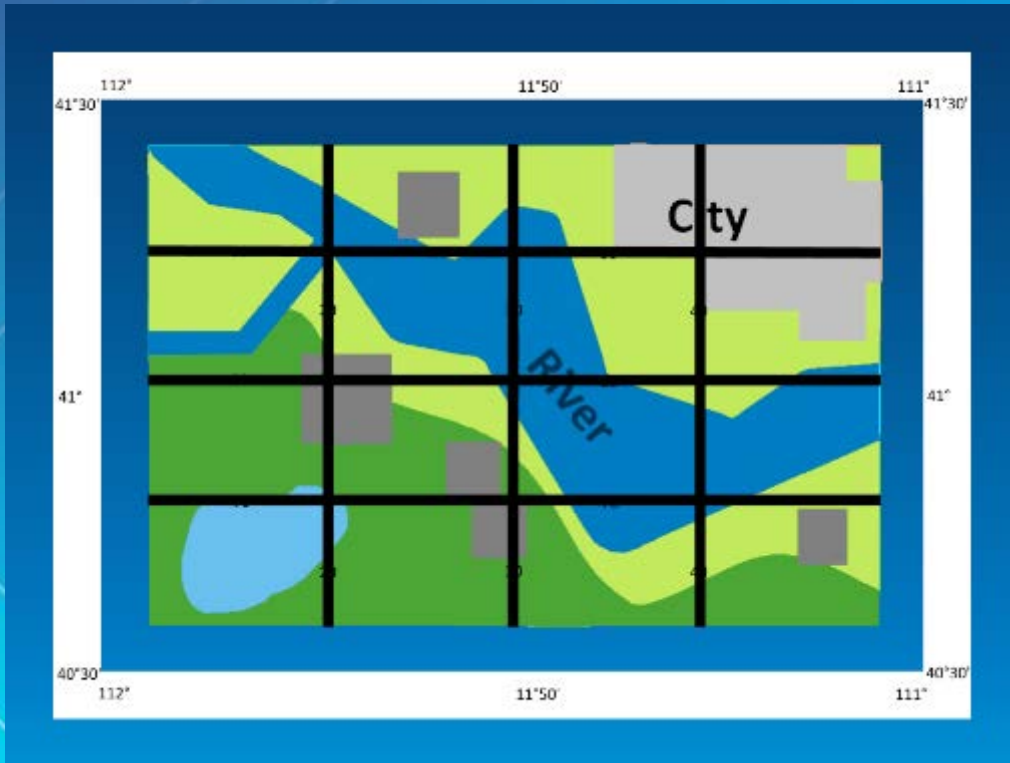


Cartographic Edits



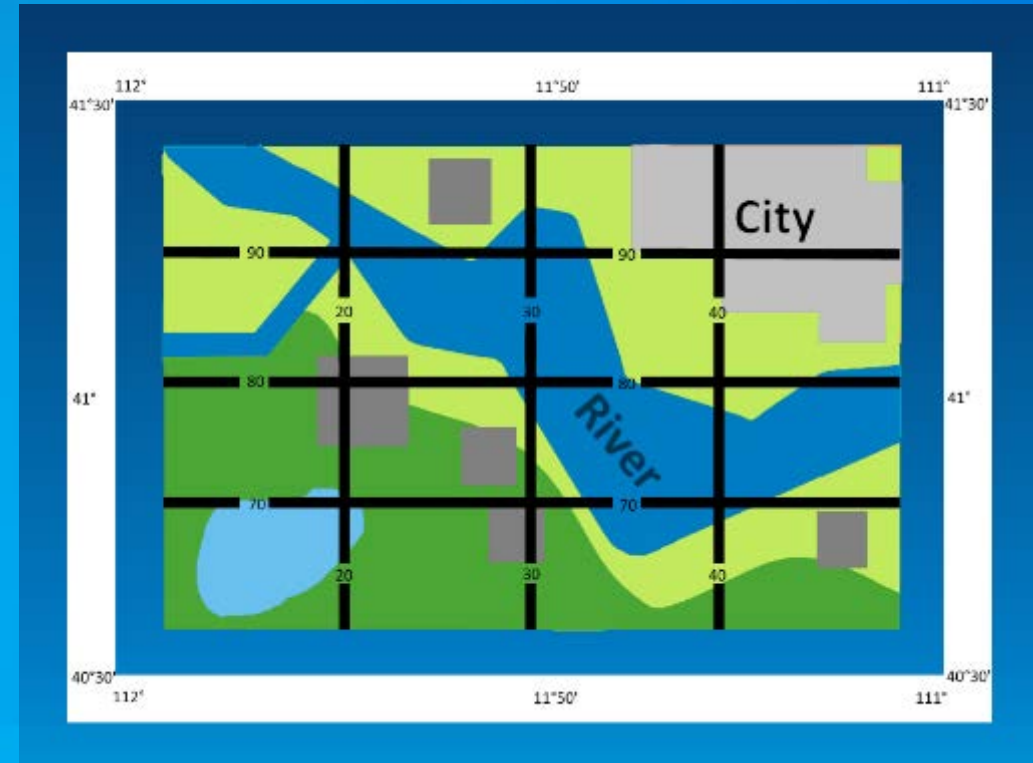
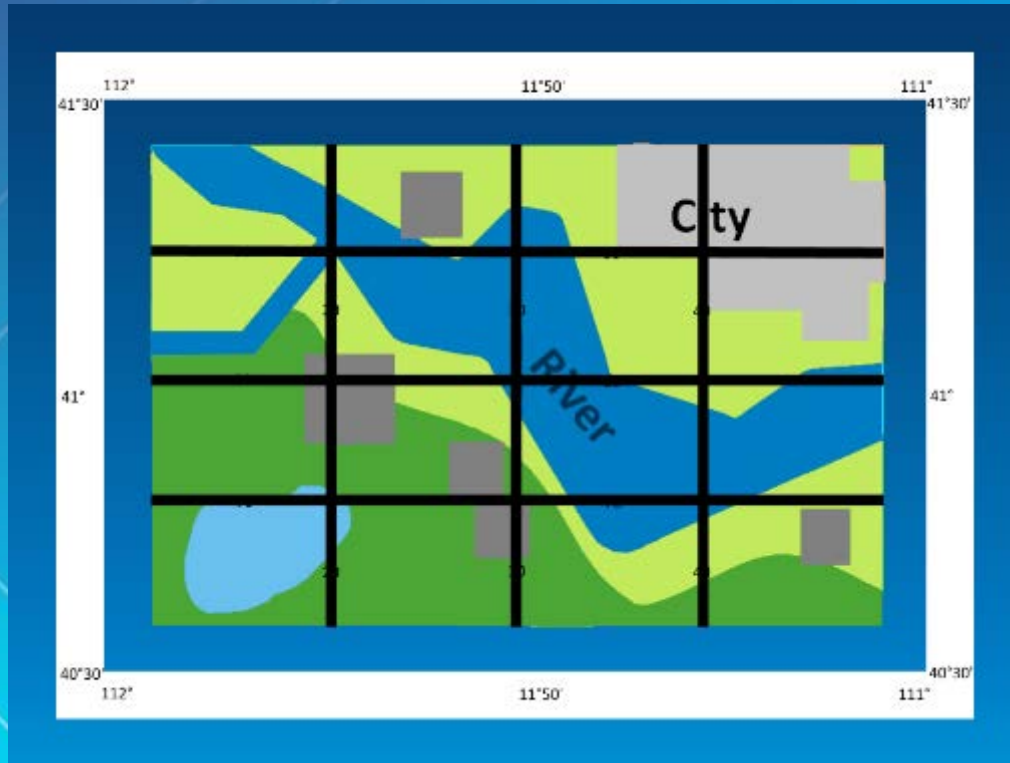
Cartographic Edits

Improving map clarity



Cartographic Edits

Improving map clarity



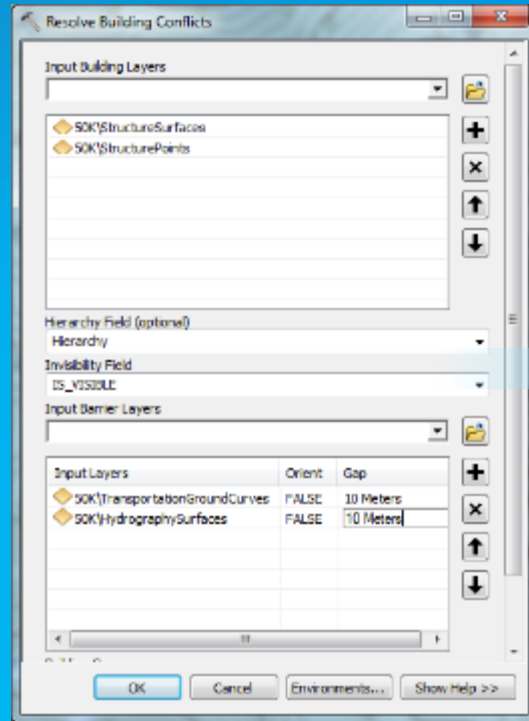
Conflict Resolution

Managing the extent and placement of symbolized features on maps



Conflict Resolution

Managing the extent and placement of symbolized features on maps

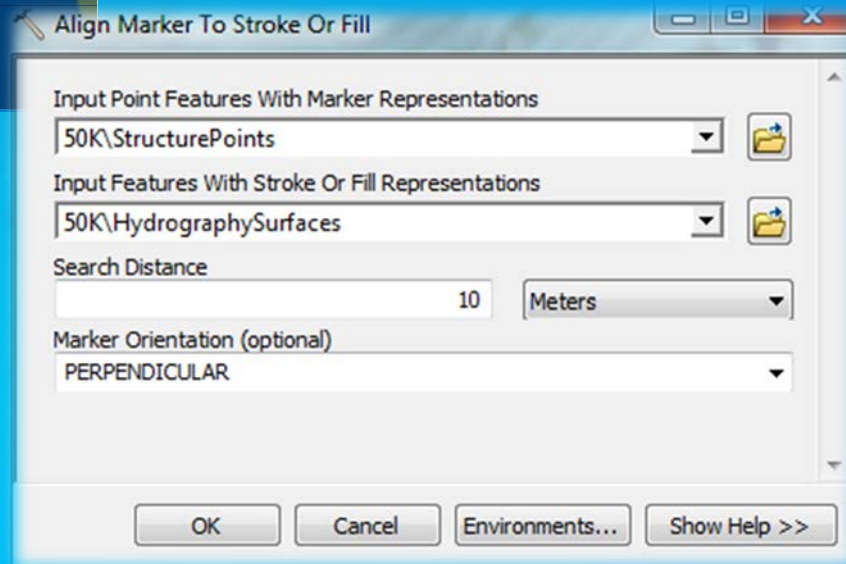


Feature Class Representations

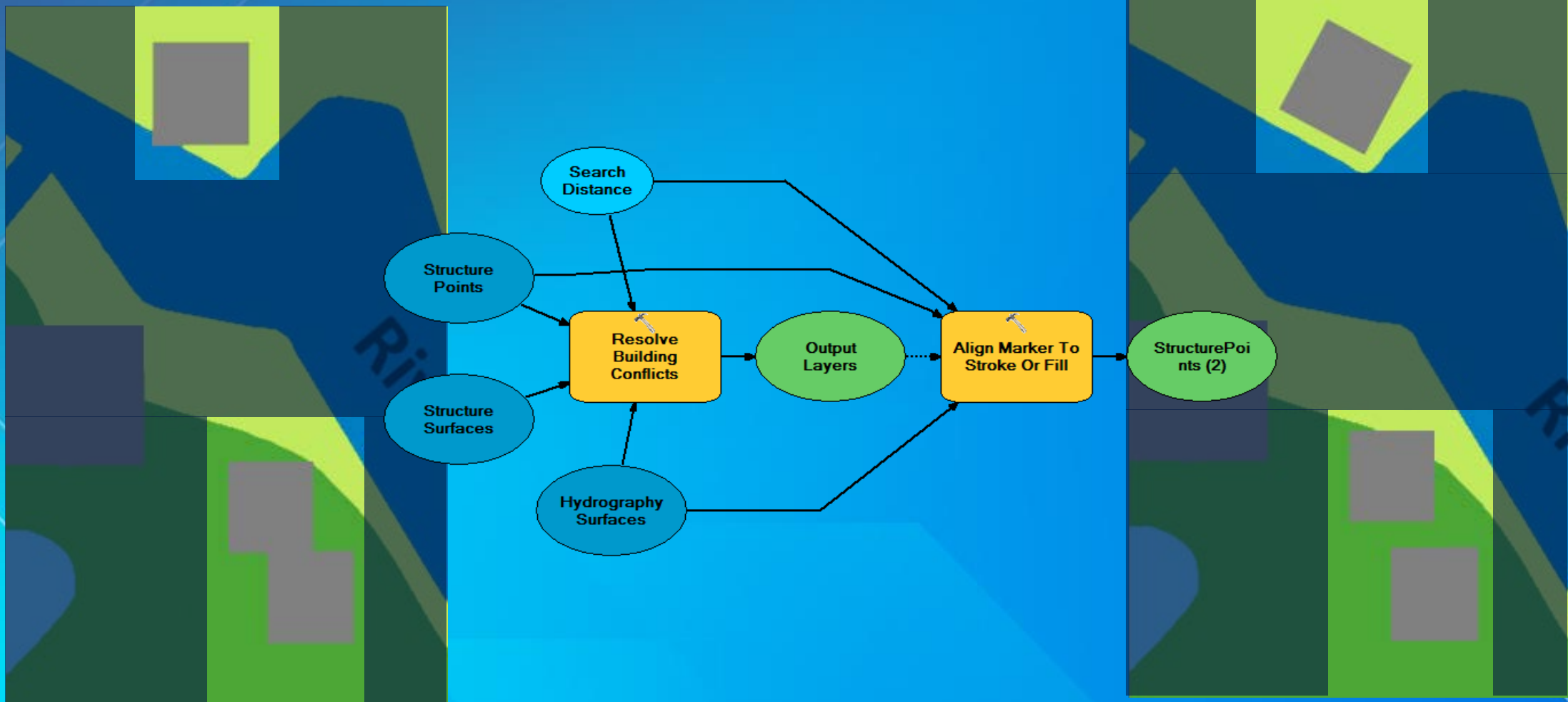


Cartographic Refinement

Adjusting the alignment and arrangement of symbols

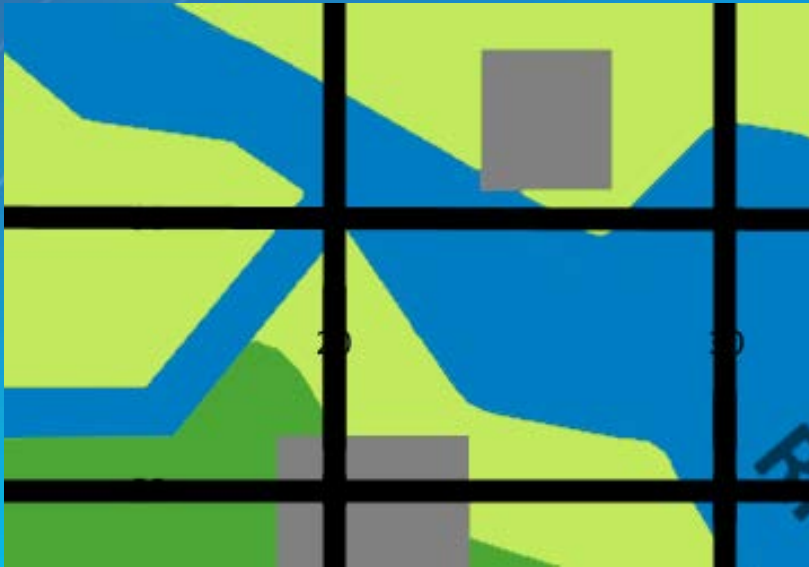


Automating Conflict Resolution



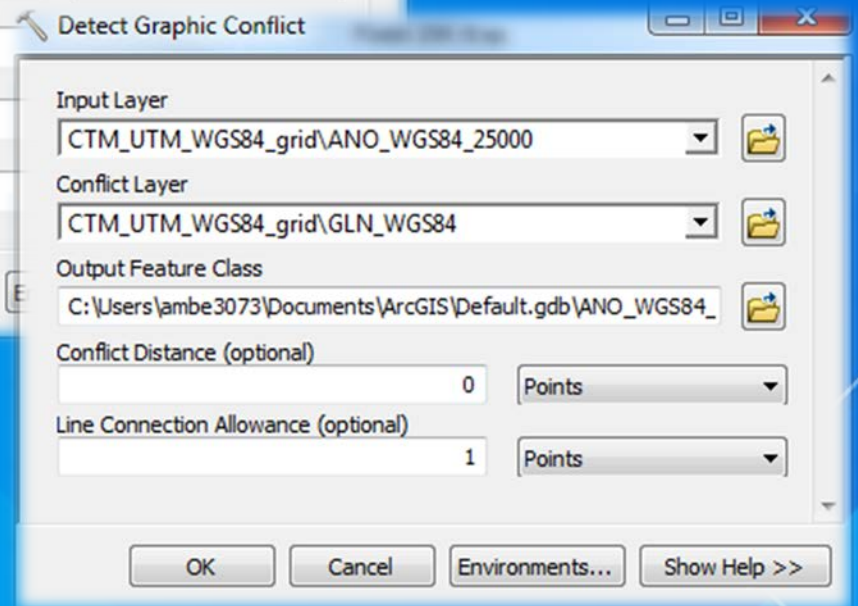
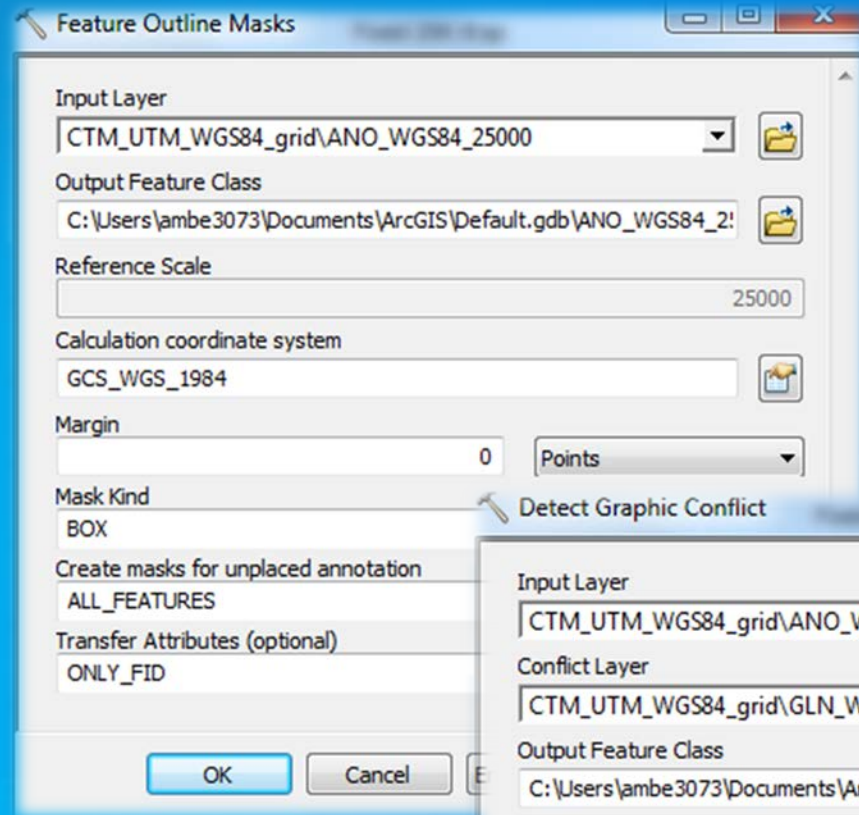
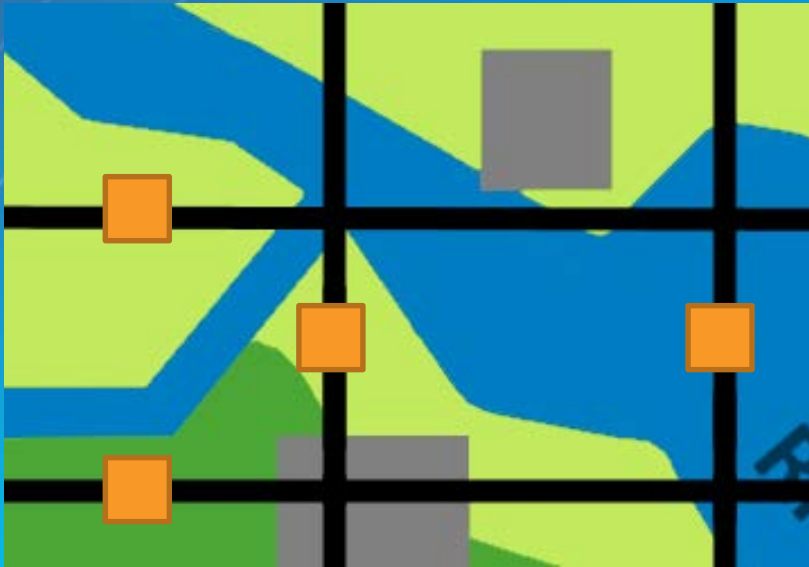
Masking

Enhancing cartographic display by obscuring conflicting symbols

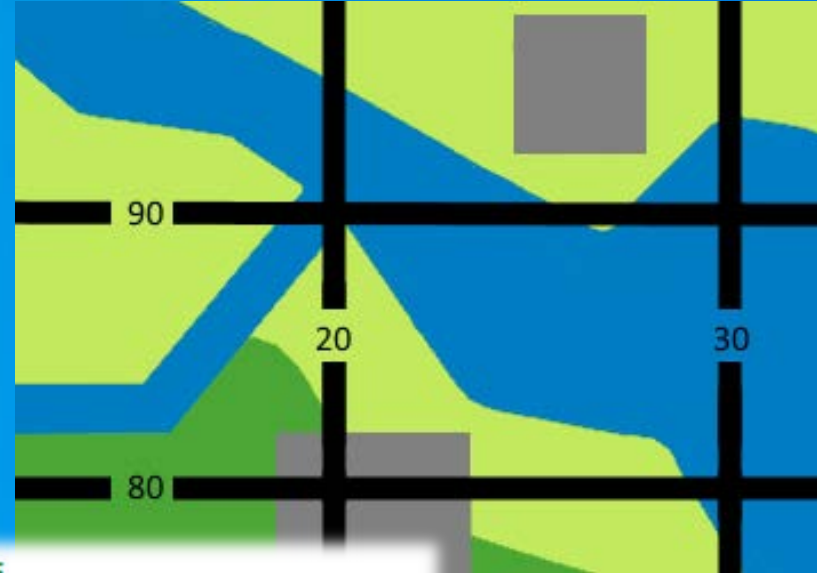


Masking

Enhancing cartographic display by obscuring conflicting symbols



Masking



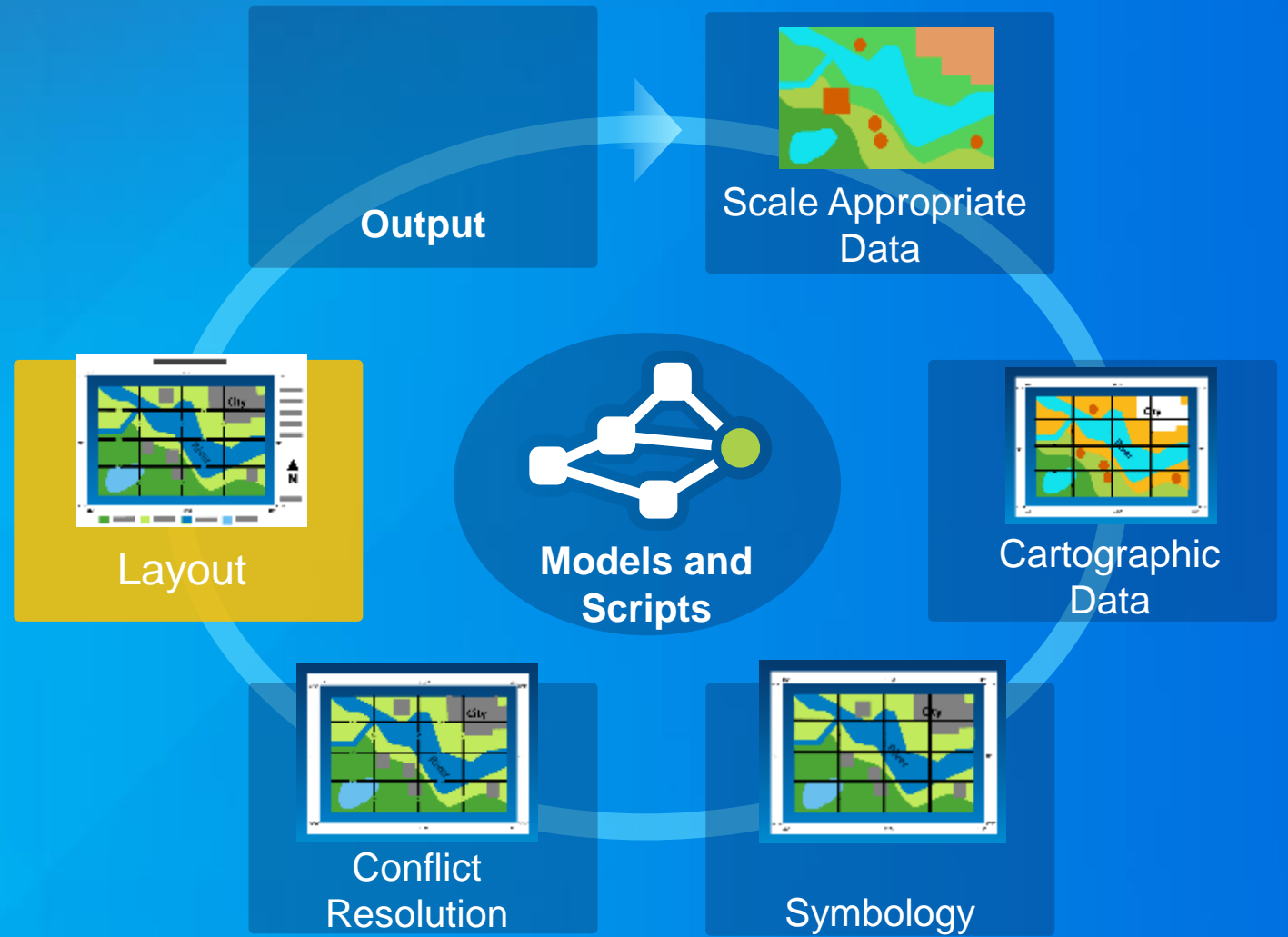
```
# Masking the grid ladder values and annotations
arcpy.AddMessage("getting output of masks.")
mask_layer = arcpy.mapping.Layer(masks.getOutput(0))
arcpy.mapping.AddLayer(data_frame, anno_mask_layer, 'BOTTOM')
anno_mask = arcpy.mapping.ListLayers(final_mxd, mask_layer.name,
                                     data_frame)[0]
arcpy.AddMessage("Annotation Mask layer added to the map...")
arcpyproduction.mapping.EnableLayerMasking(data_frame, 'true')
arcpyproduction.mapping.MaskLayer(data_frame, 'APPEND', anno_mask,
                                   gridline_layer)
arcpy.AddMessage("Masking applied to gridlines...")
```


Demo

Symbology and Conflict Resolution

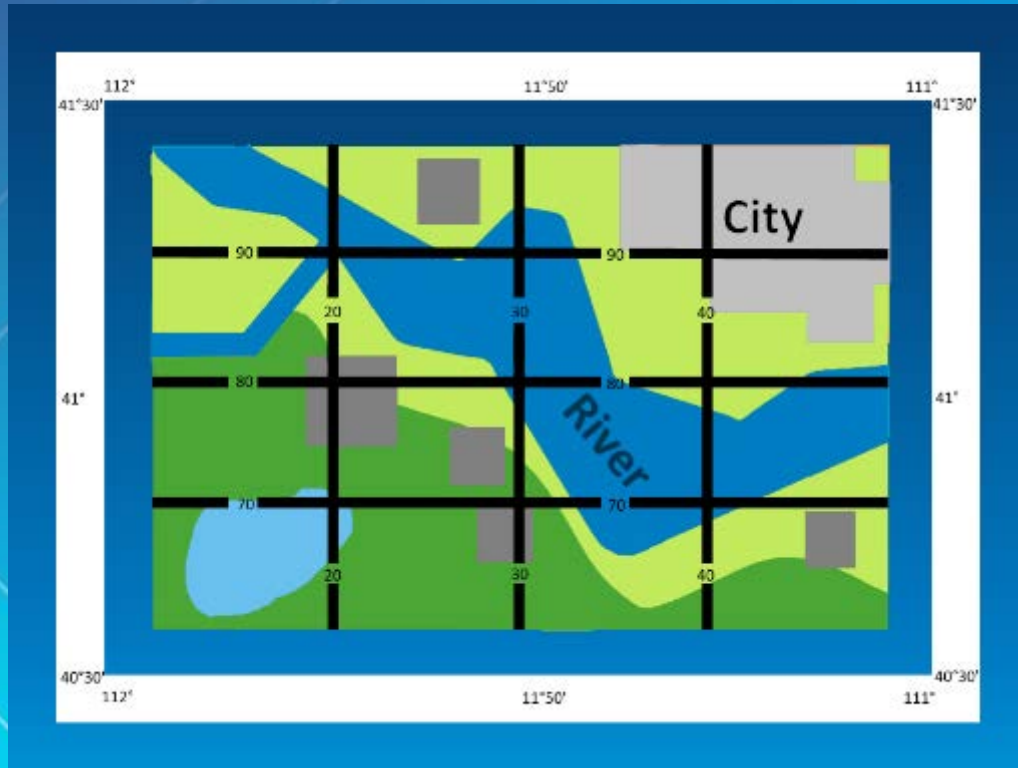


Layout



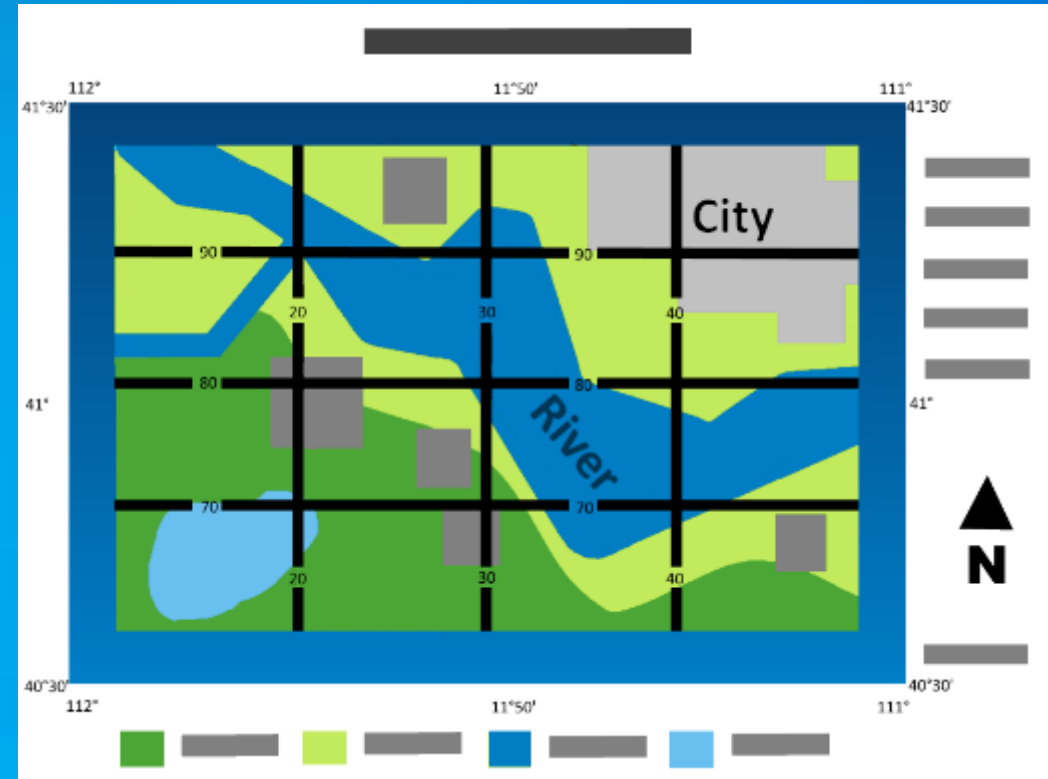
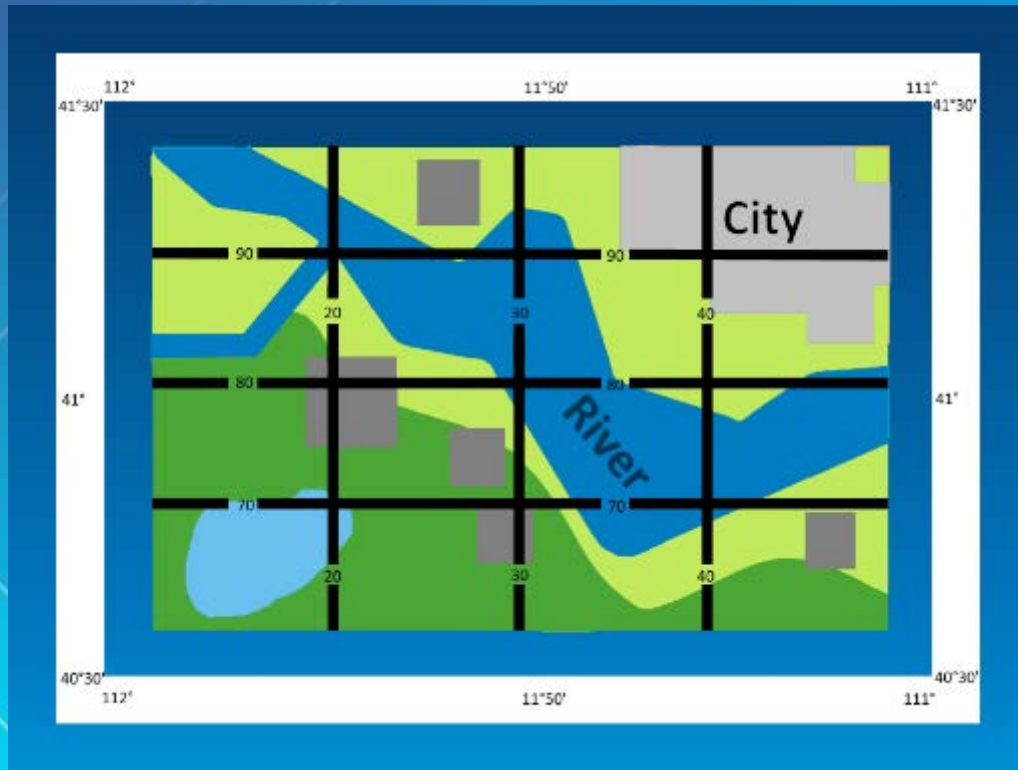
Layout

Providing Context



Layout

Providing Context



Templates

- Static Elements



Company
Information

Legend

Templates

- Static Elements
- Dynamic Elements
 - Dynamic Text

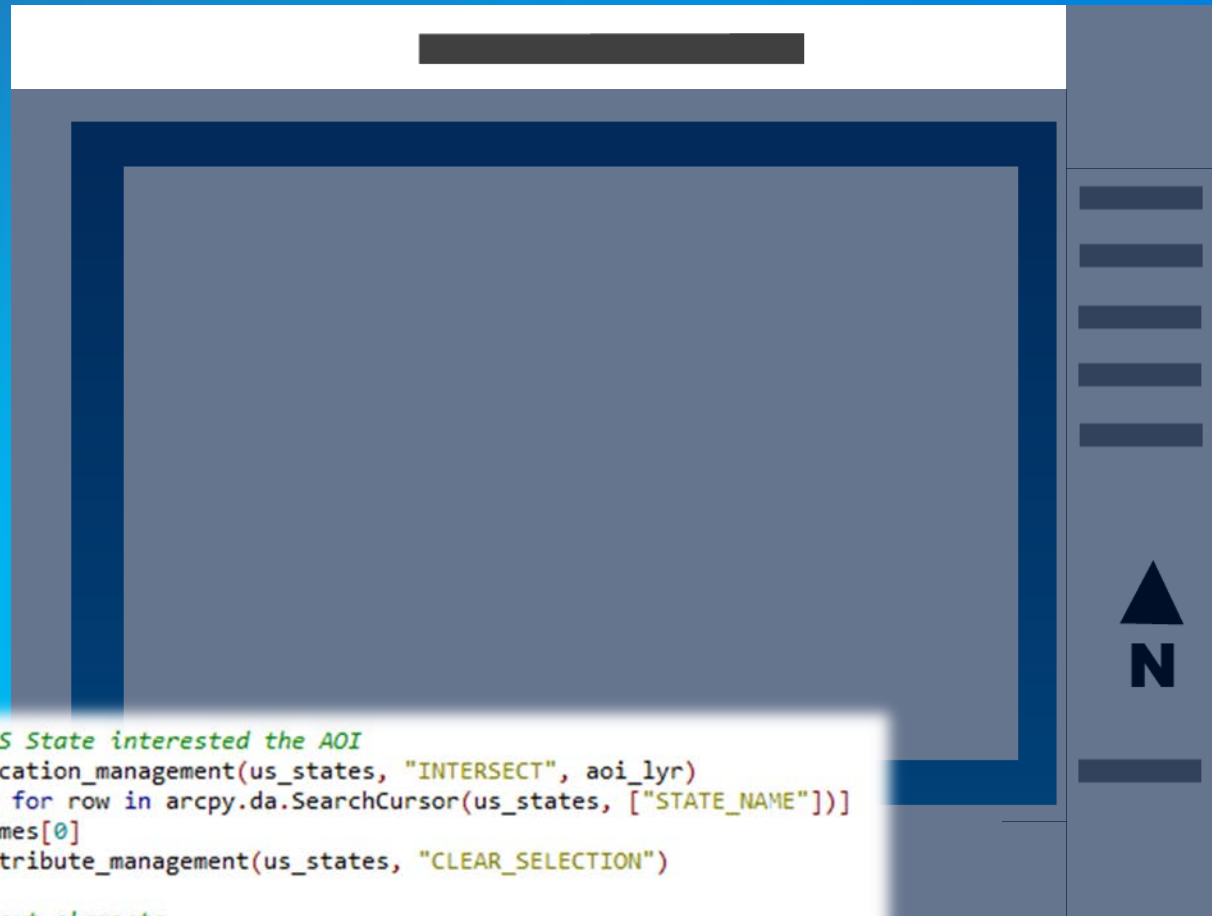


Projection
Information

Templates

- Static Elements
- Dynamic Elements
 - Dynamic Text
 - Python

Title



```
# Determining which US State interested the AOI
arcpy.SelectLayerByLocation_management(us_states, "INTERSECT", aoi_lyr)
state_names = [row[0] for row in arcpy.da.SearchCursor(us_states, ["STATE_NAME"])]
state_name = state_names[0]
arcpy.SelectLayerByAttribute_management(us_states, "CLEAR_SELECTION")

#Gets the list of layout elements
layout_elements = arcpy.mapping.ListLayoutElements(final_mxd)
for element in layout_element_list:

    #Update State Name text element
    if element.name == "State Name":
        element.text = state_name.upper()
```

Templates

- **Static Elements**
- **Dynamic Elements**
 - Dynamic Text
 - Python
 - Graphic Table Element

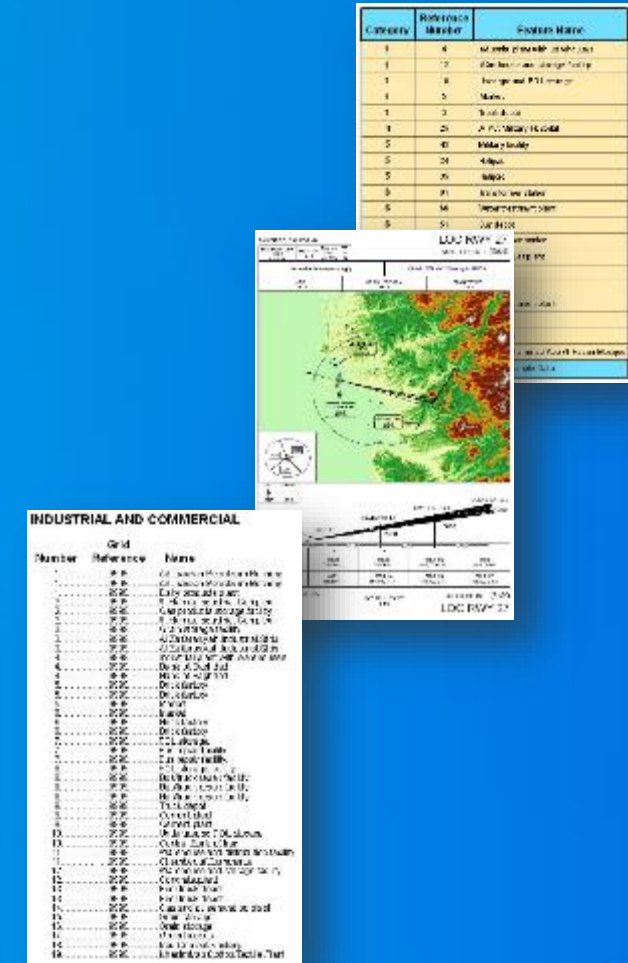
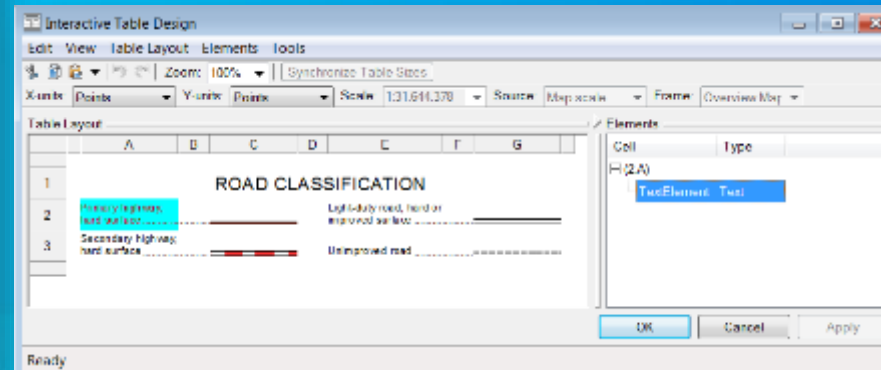
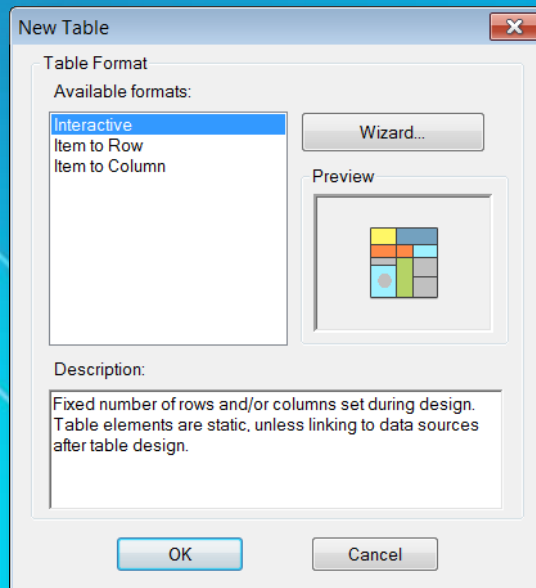


**Dynamic Legend
or Table**

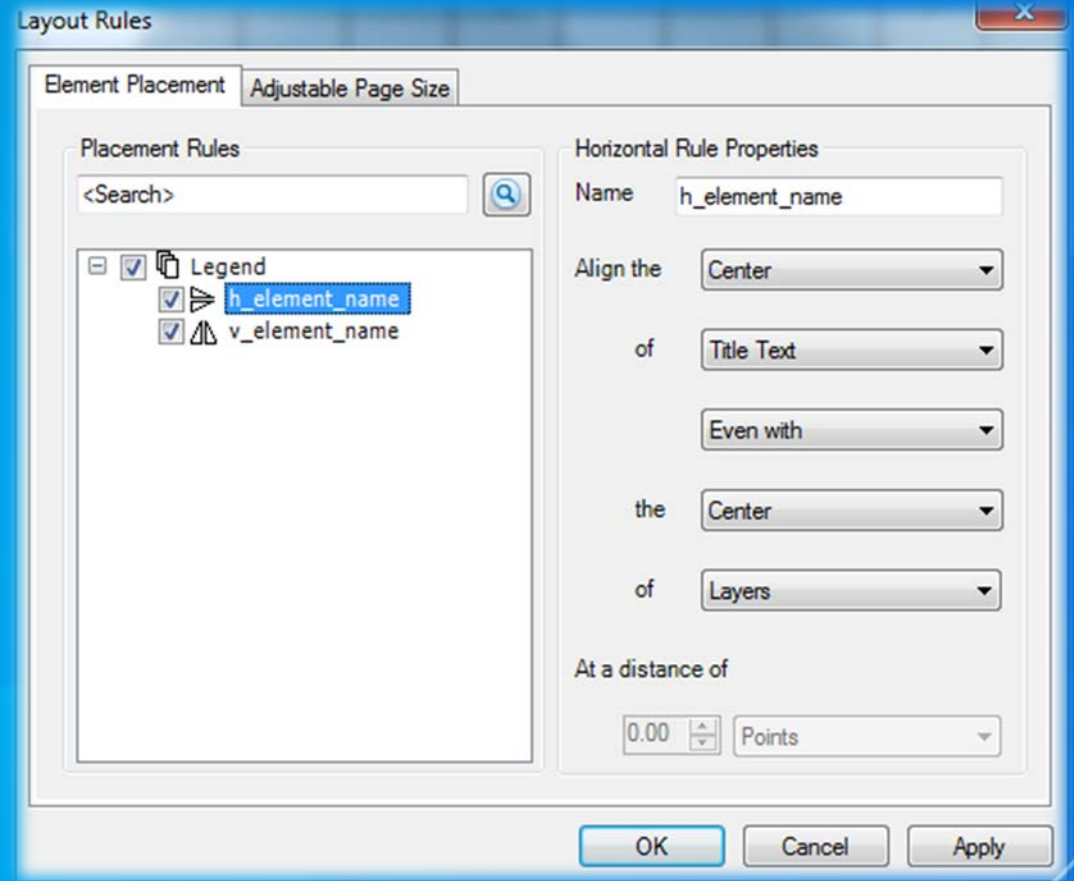
Graphic Table

Dynamic illustrated table

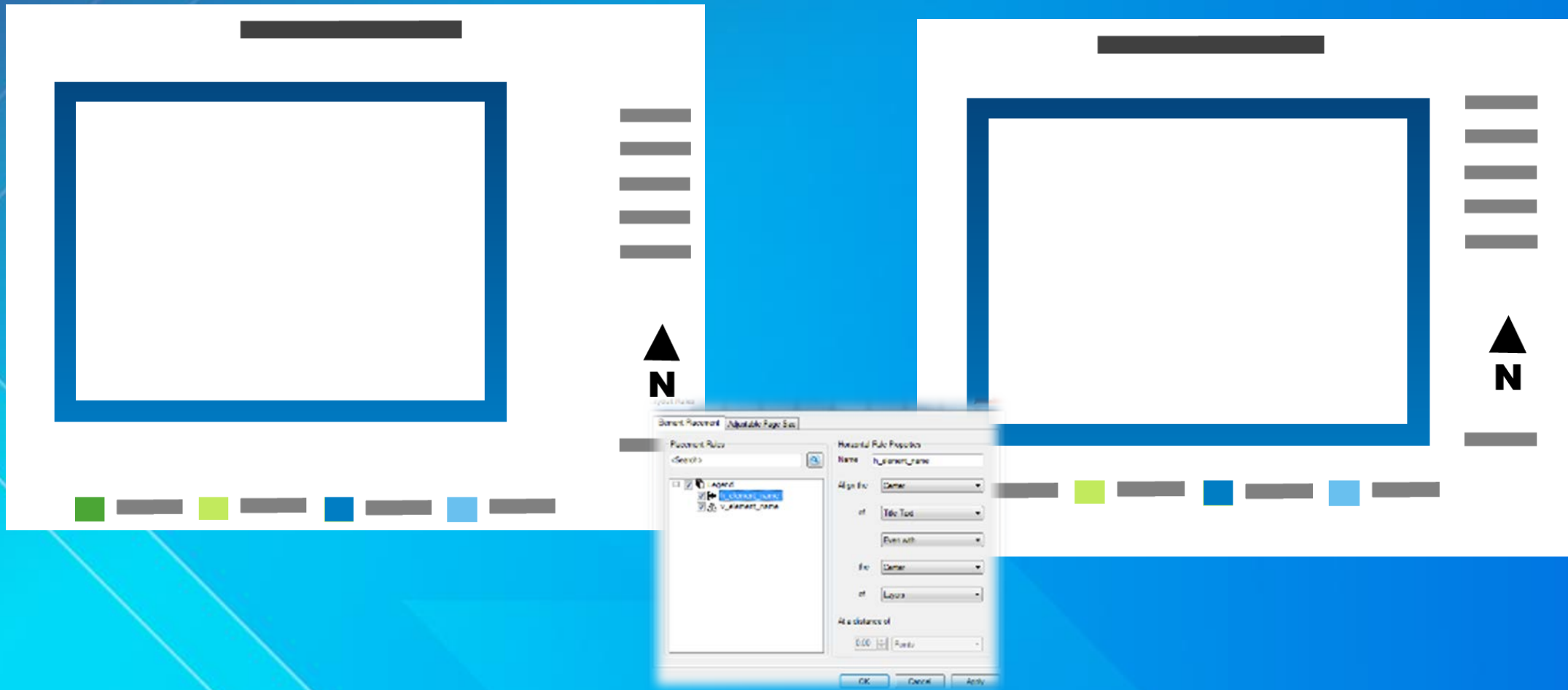
- Dynamic table creation capabilities
- Tables are linked or independent of feature layers
- Ability to include text, symbols and graphics



Element Placement



Element Placement

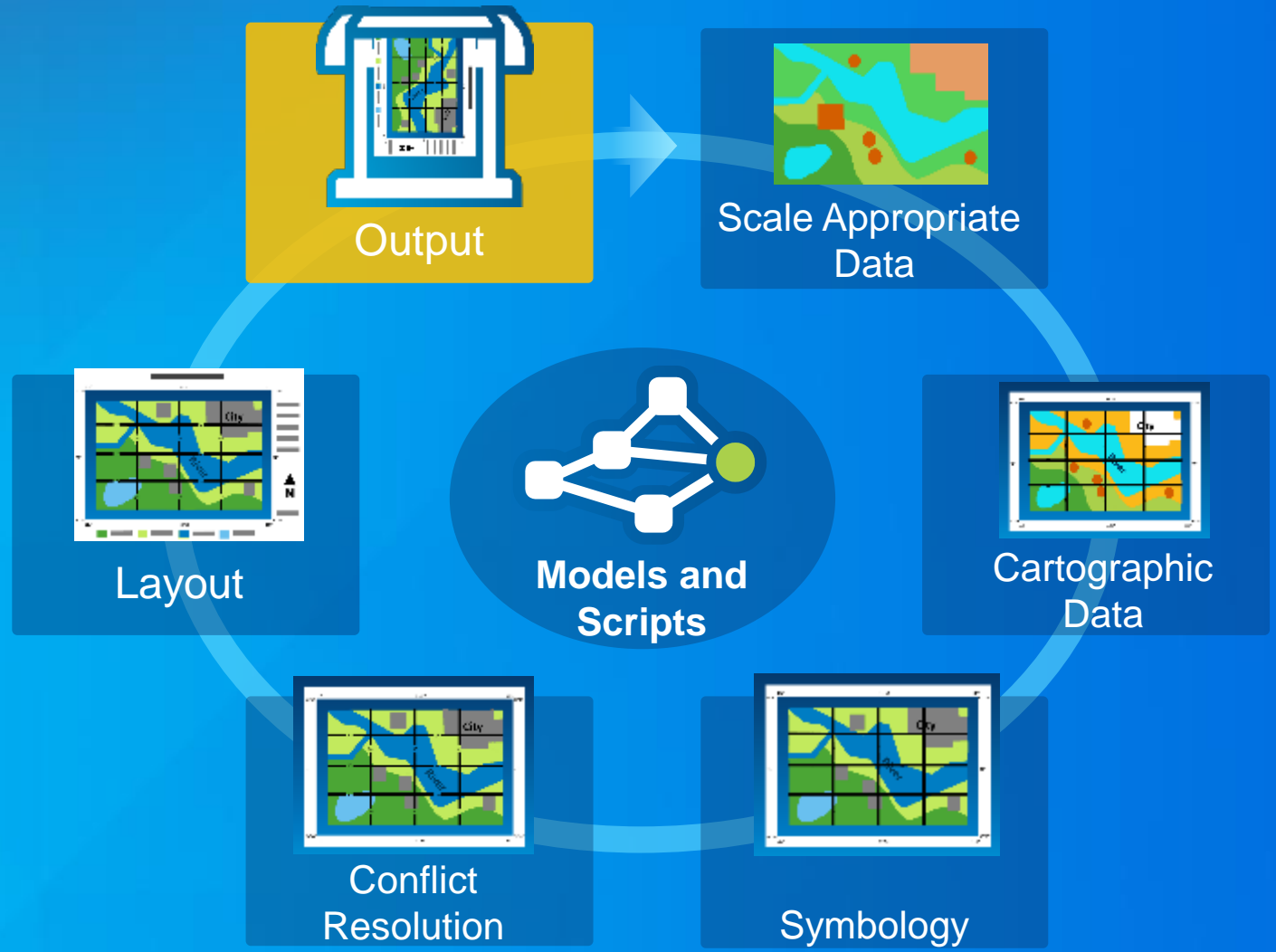


Element Placement



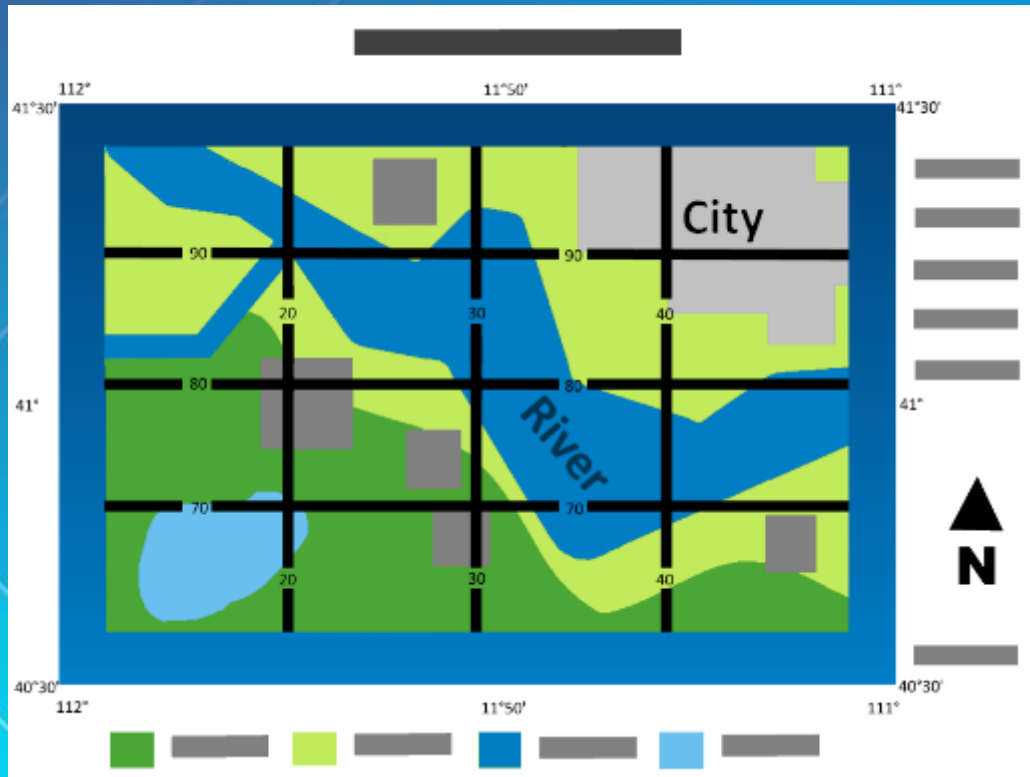
```
mxd = arcpy.mapping.MapDocument("CURRENT")  
arcpyproduction.mapping.ApplyLayoutRules(mxd, layout_rules.xml)
```

Output



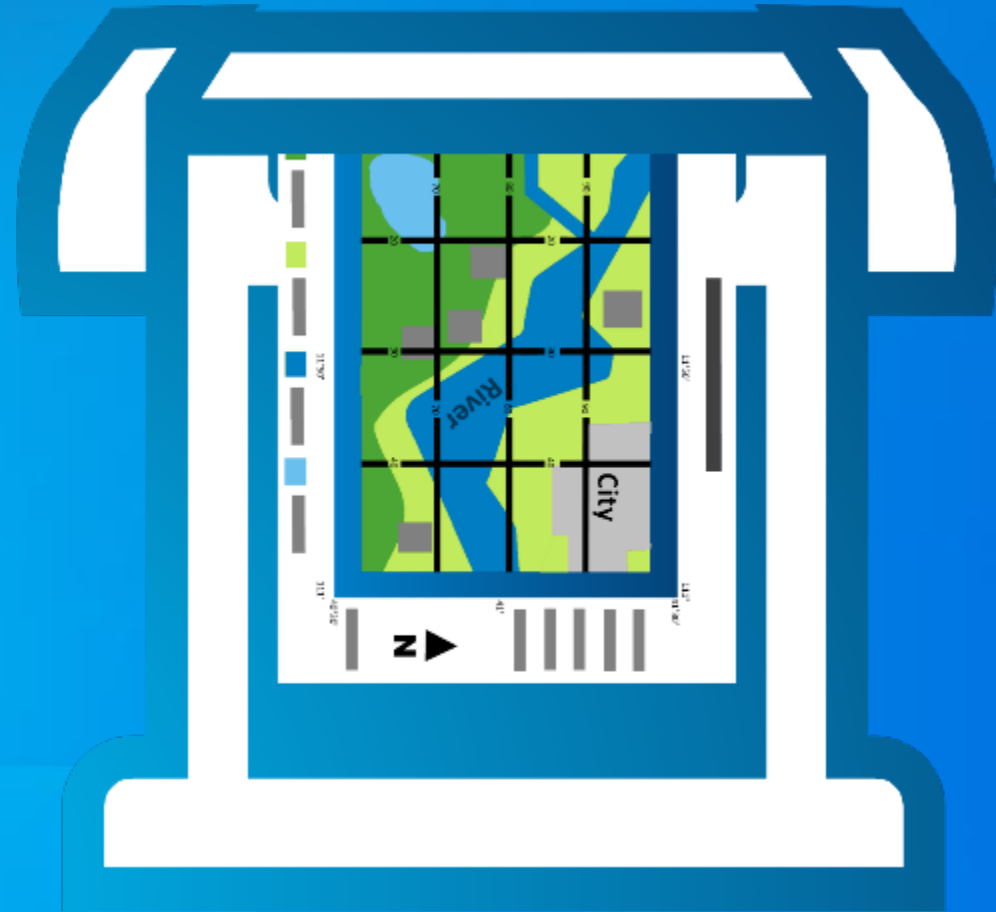
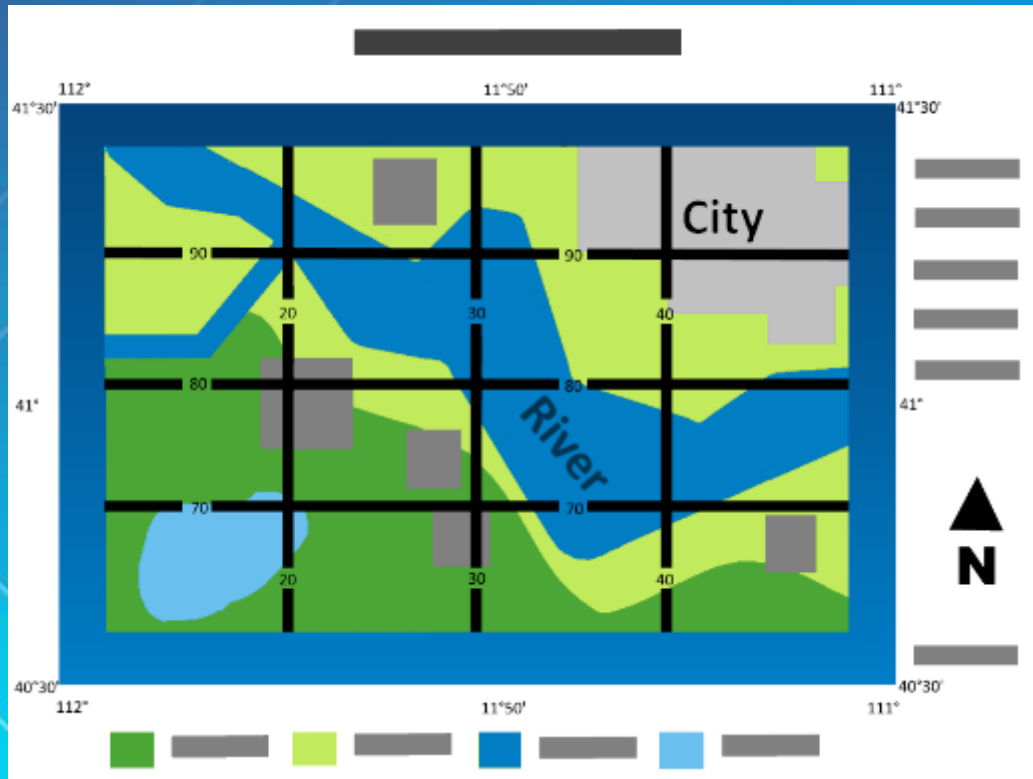
Output

Getting your map to the people who need it

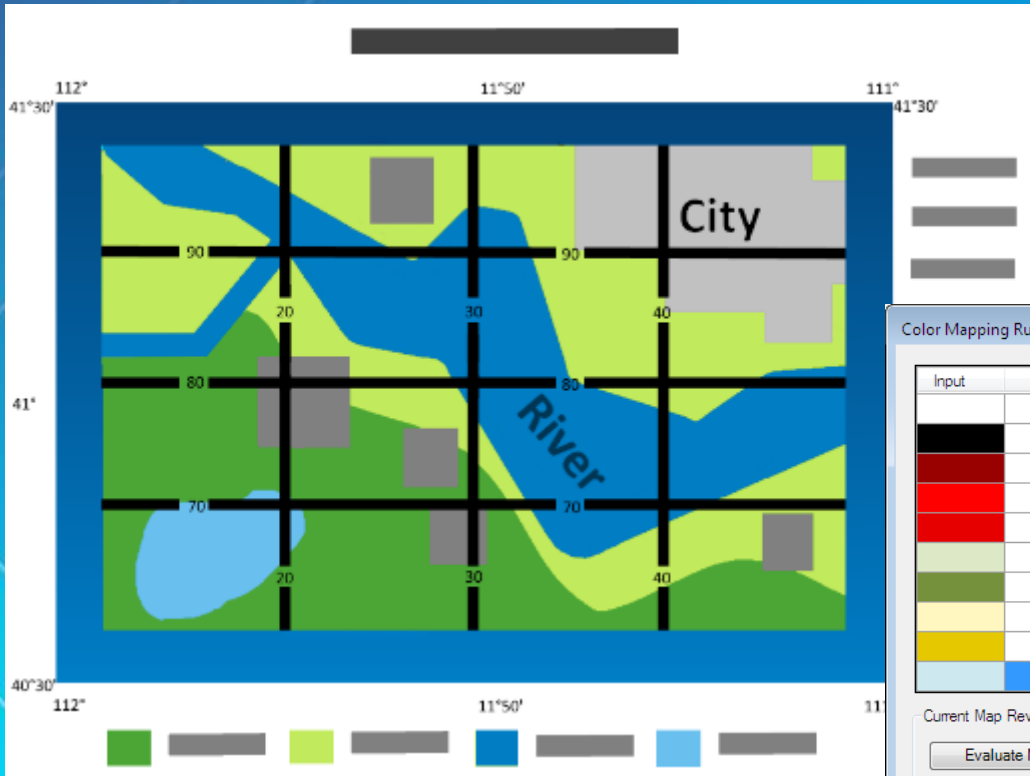


Output

Getting your map to the people who need it



Color Separation



Color Mapping Rules (changed)

Input	Input Value	Output	Output Value	Tint %	Overprint
	RGB 255 255 255		CMYK 0 0 0 0	n/a	<input type="checkbox"/>
	RGB 0 0 0		CMYK 0 0 0 100	n/a	<input type="checkbox"/>
	RGB 153 0 0		CMYK 40 100 100 0	n/a	<input type="checkbox"/>
	RGB 255 0 0		CMYK 0 100 100 0	n/a	<input type="checkbox"/>
	RGB 230 0 0		CMYK 10 100 100 0	n/a	<input type="checkbox"/>
	RGB 221 232 198		CMYK 13 9 22 0	n/a	<input type="checkbox"/>
	RGB 118 145 59		CMYK 54 43 77 0	n/a	<input type="checkbox"/>
	RGB 255 247 191		CMYK 0 3 25 0	n/a	<input type="checkbox"/>
	RGB 230 200 0		Mustard 10 22 100 0	100	<input type="checkbox"/>
	RGB 205 233 239		CMYK 20 9 6 0	n/a	<input checked="" type="checkbox"/>

Current Map Review

Use this button to add colors from map to the table. Only colors that are not in the table will be shown.

Show preview for selected input color(s), vector graphics only. This starts the PDF viewing application registered in your system.

1 out of 24 selected Warning(s) ...



Automating Export

Using Python

```
if export == 'JPEG':
    filename = map_doc_name + ".jpg"
    outfile = os.path.join(outputdirectory, filename)

    # Run the export tool
    arcpy.mapping.ExportToJPEG(mxd, outfile)

elif export == "MAP PACKAGE":
    filename = map_doc_name + ".mpk"
    outfile = os.path.join(outputdirectory, filename)
    mxd = mxd.filePath

    # Run the export tool
    arcpy.PackageMap_management(mxd, outfile)

elif export == 'PRODUCTION PDF':
    filename = ap_doc_name + ".pdf"
    outfile = os.path.join(outputdirectory, filename)
    setting_file = os.path.join(product_location, "colormap.xml")

    arcpyproduction.mapping.ExportToProductionPDF(mxd, outfile, setting_file)

arcpy.AddMessage("Output is located: " + outfile)
```

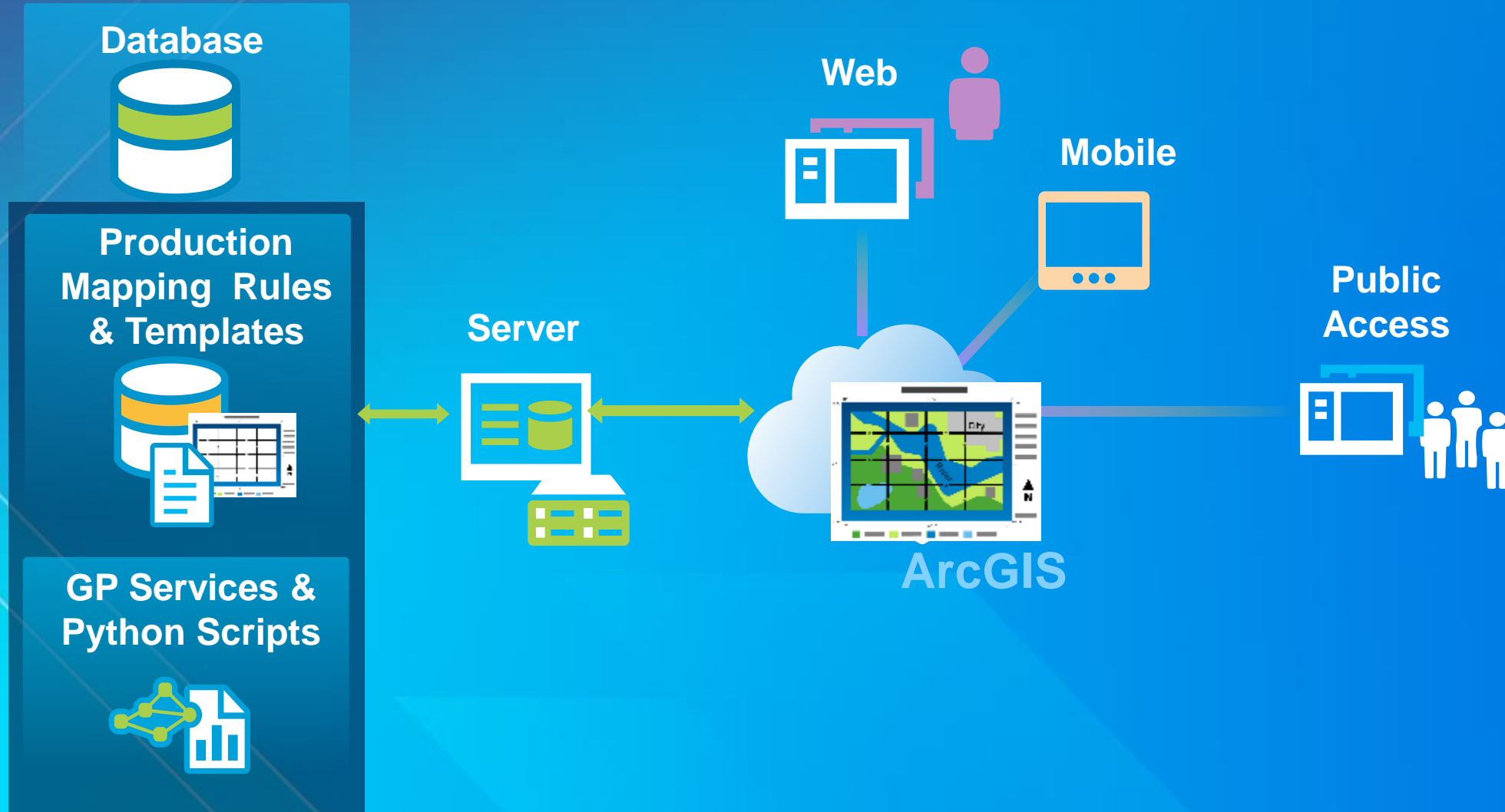
Production Mapping for ArcGIS Server

Authoritative Map Product Services

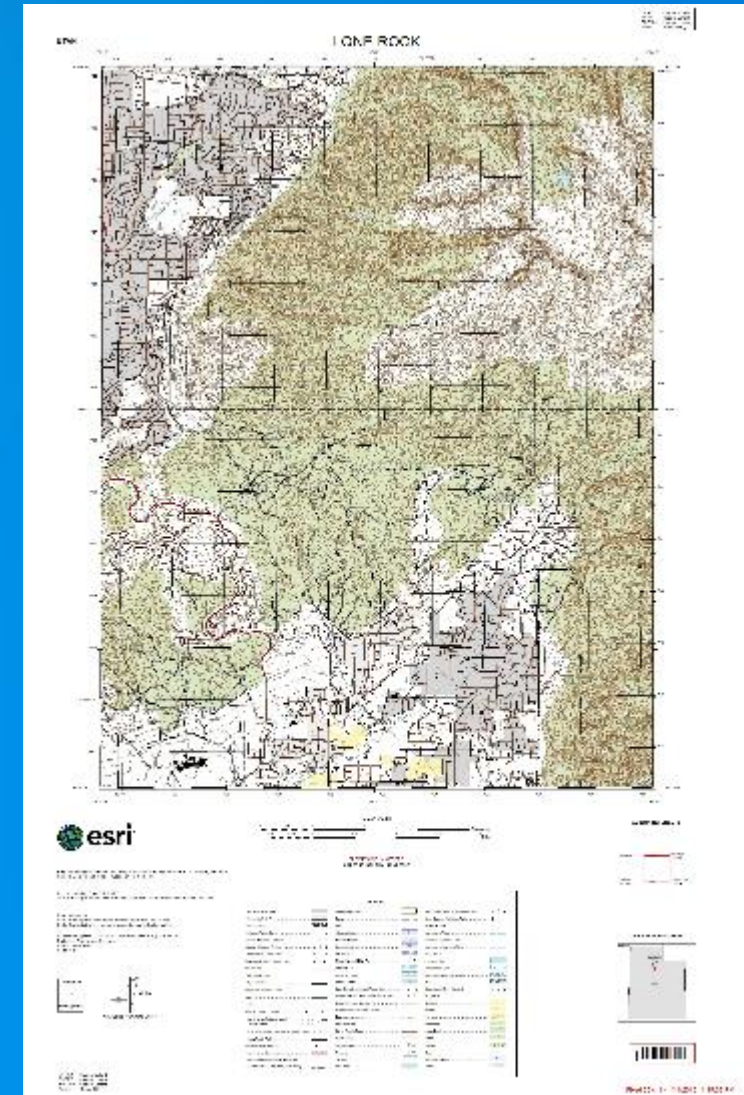
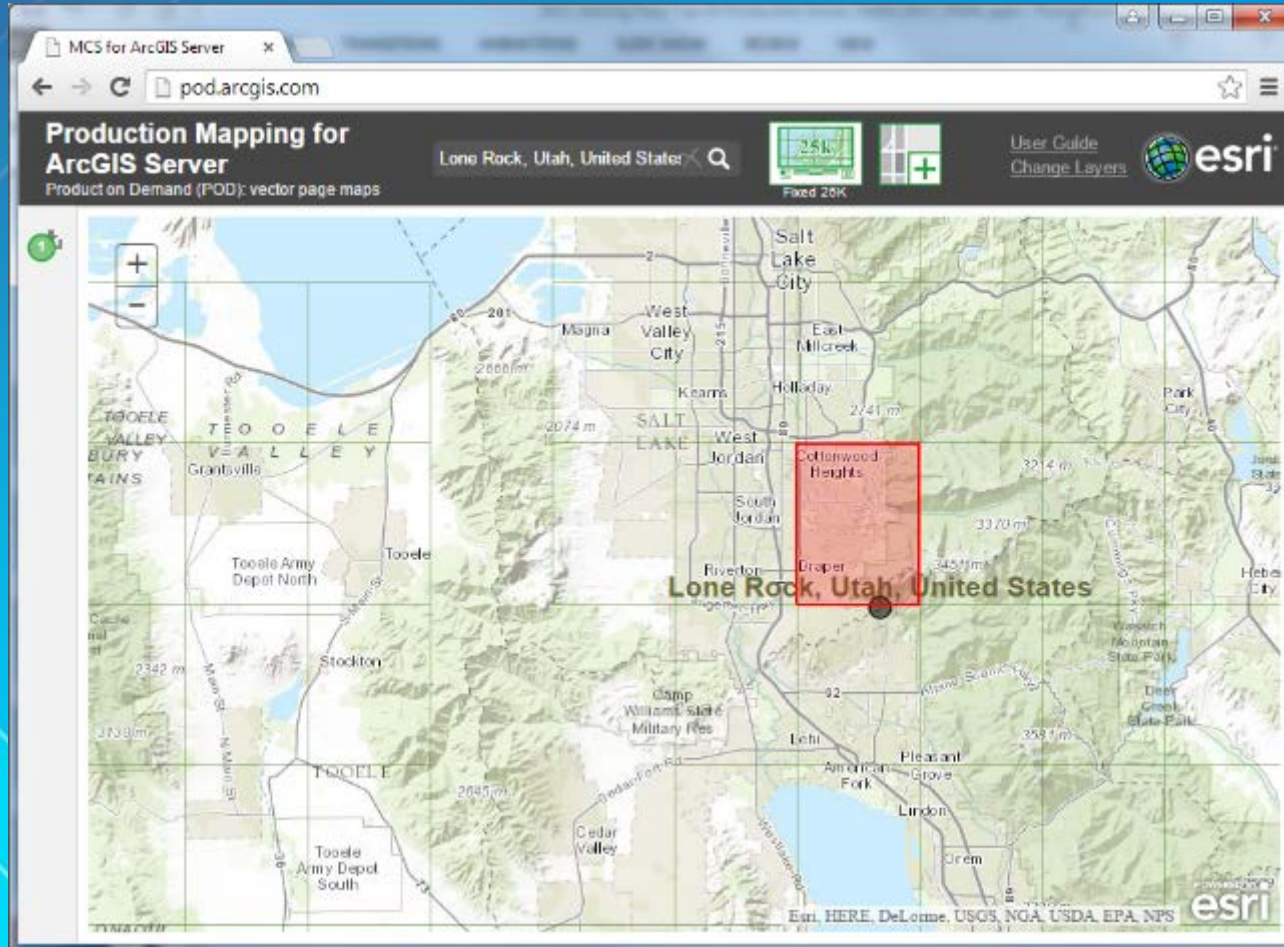


Production Mapping for ArcGIS Server

Authoritative Map Product Services



Product on Demand



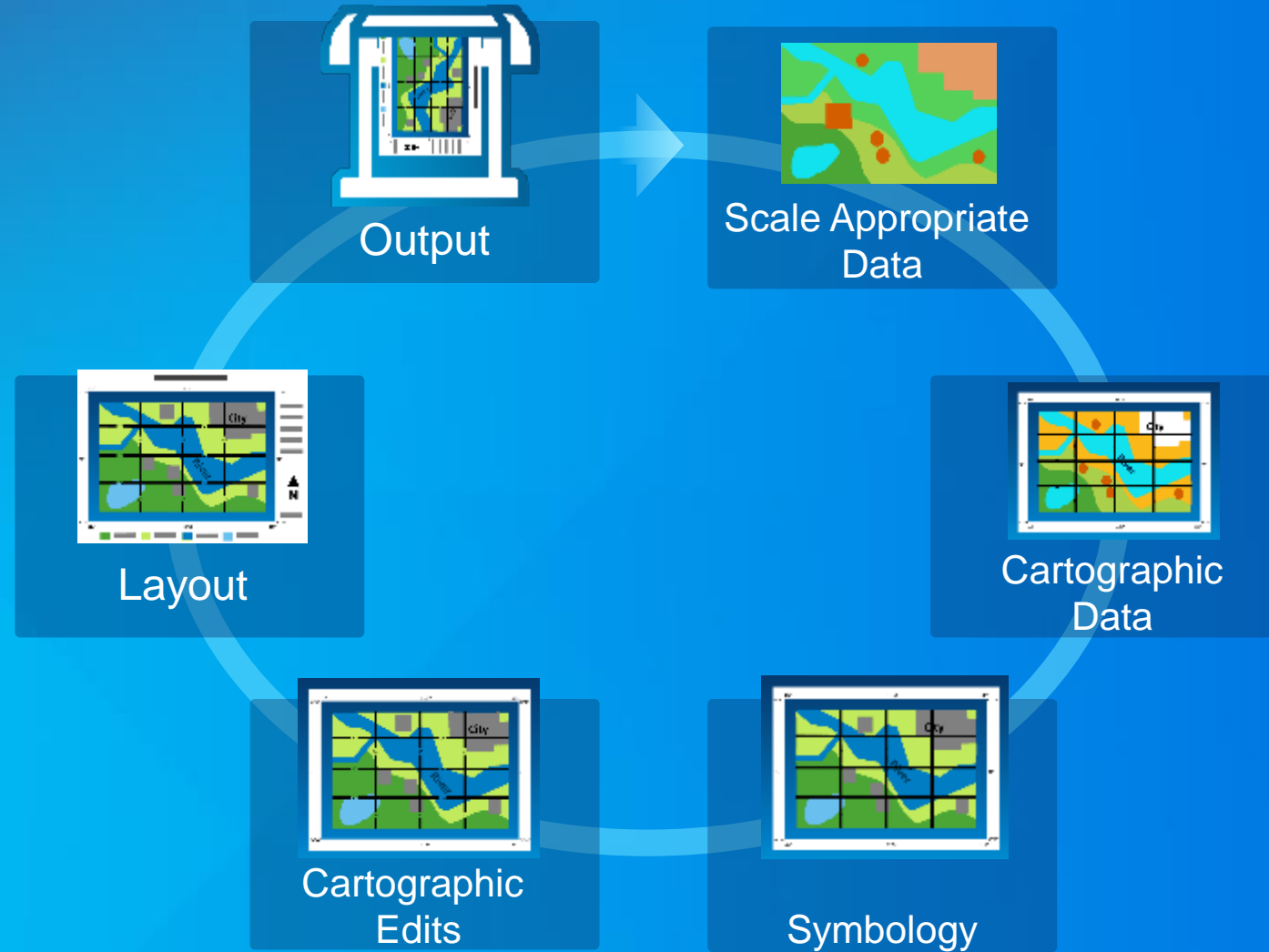
Demo

Product on Demand

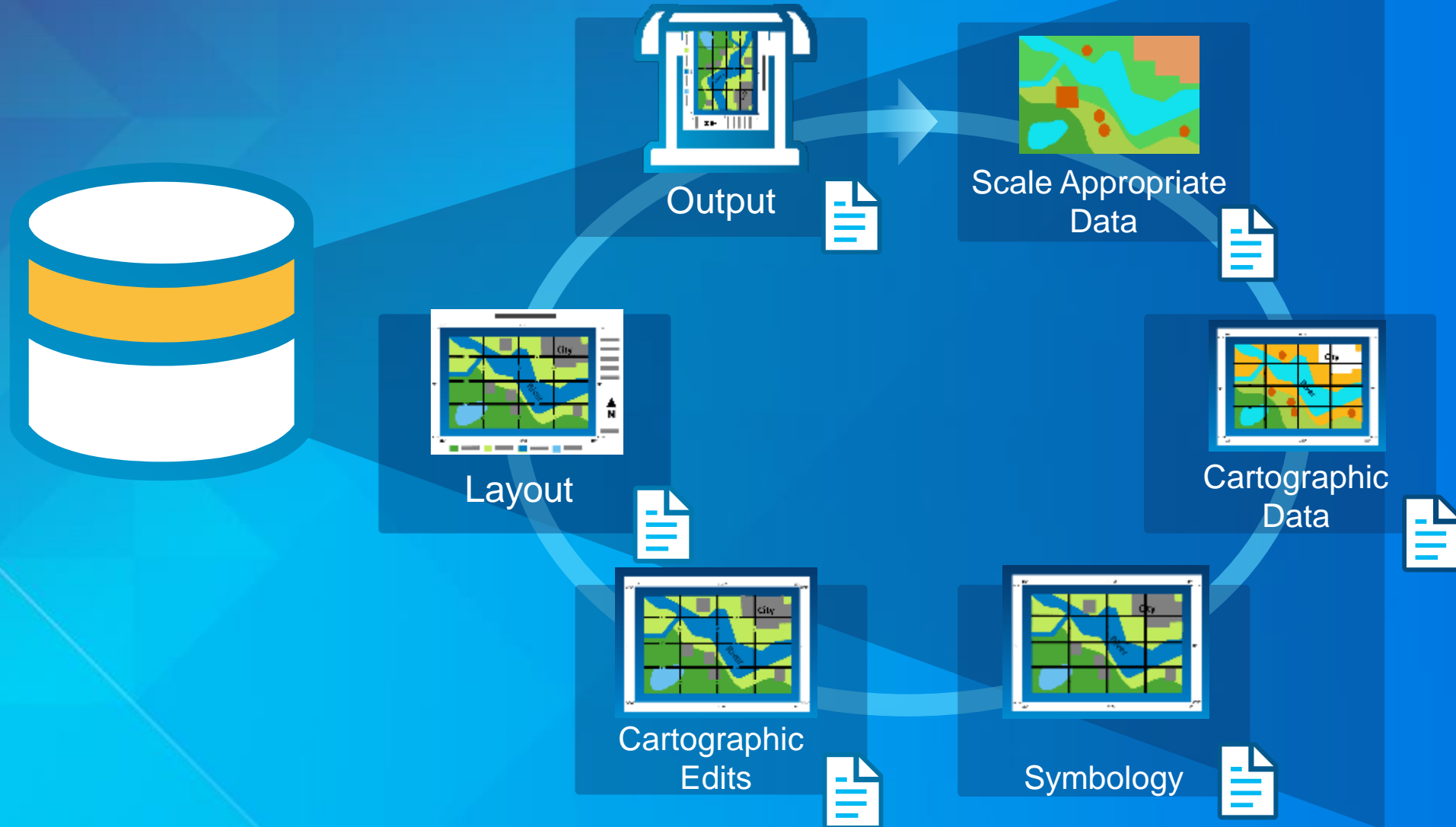
The background features a vibrant blue gradient. On the left side, there are several overlapping geometric shapes: a large purple triangle pointing upwards, a yellow triangle pointing downwards, and a purple triangle pointing to the right. These shapes are layered, creating a sense of depth. The word "Conclusion" is centered in the upper half of the image in a white, bold, sans-serif font.

Conclusion

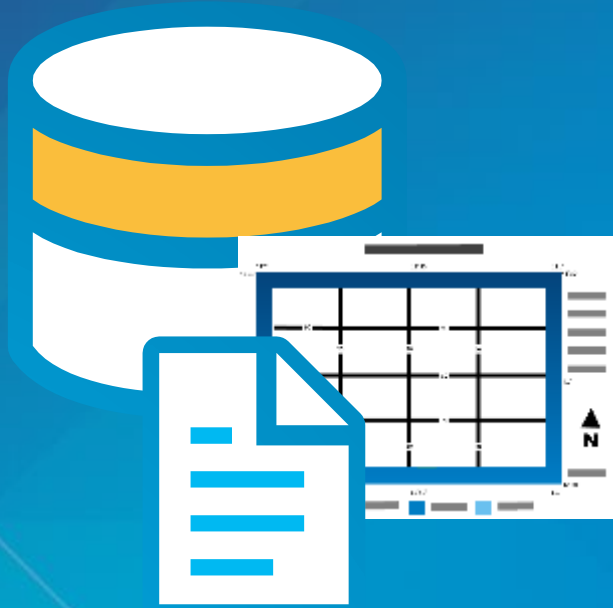
Map Automation and Advanced Cartography



Map Automation and Advanced Cartography

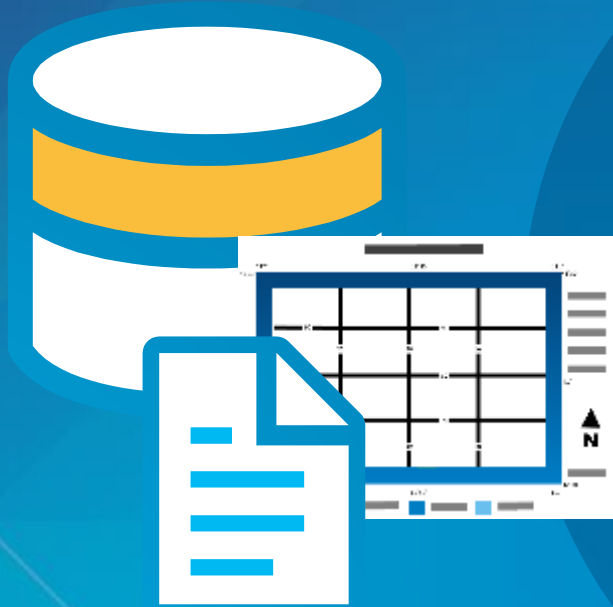


Map Automation and Advanced Cartography



**Production Mapping
Cartographic Rules**

Map Automation and Advanced Cartography

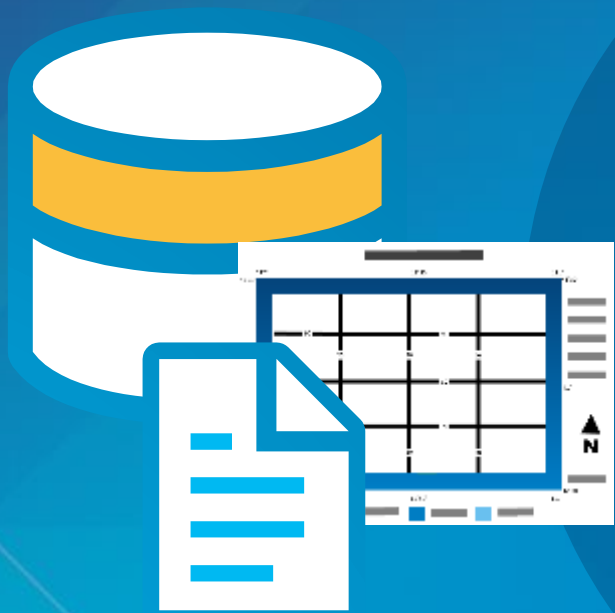


**Production Mapping
Cartographic Rules**

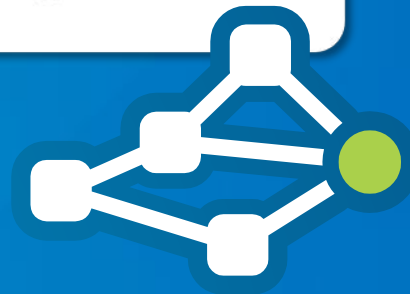


**Geoprocessing
& Python**

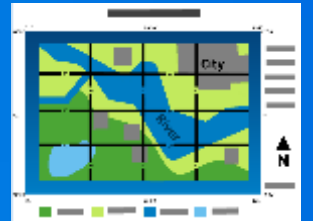
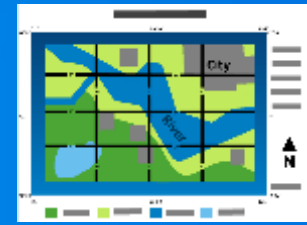
Map Automation and Advanced Cartography



**Production Mapping
Cartographic Rules**



**Geoprocessing
& Python**



Thank you...

- **Please fill out the session survey:**

Esri Production Mapping: Map Automation and Advanced Cartography

UC App

Paper – pick up and put in drop box

References

Get the configurations:

<https://github.com/esri/ctm>

Product on Demand

Get it:

<https://github.com/Esri/product-on-demand>

Try it:

<http://pod.arcgis.com/>

Production Mapping

Learn More:

<http://www.esri.com/productionmapping>

Email us:

productionmapping@esri.com

Reach out:

MapAutomation_External@esri.com



Understanding our world.