



Principles of GIS Modeling

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What is GIS Modeling?

- *The process of creating new GIS products from existing products is known as “GIS Modeling”*
 - *Typically this is not “modeling” as in a simulation model or a statistical model – although it can be....*

Tools for GIS Modeling

■ *Manual*

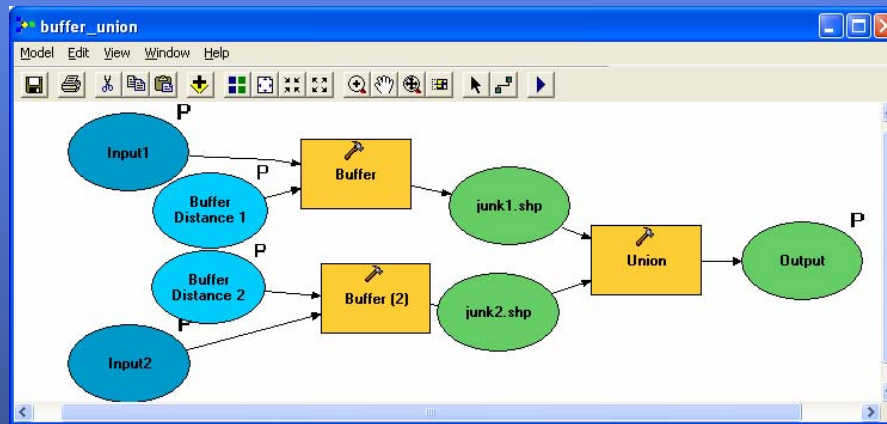
- *Run individual commands (e.g., ArcToolbox wizards) to produce the desired output*

■ *Script*

- *Store commands in a text file that are then executed*
- *Can include “parameters” that allow a script to be used with many different layers or with different settings*
- *Scripts can be written in Python, Visual Basic or Arc Macro Language (AML)*

Tools for GIS Modeling

■ “Modelbuilder” model



More later!

■ Programming Languages

- Use programming languages such as Python, C++, JAVA, or Visual Basic
- Most flexible – but also most difficult!

GIS Modeling Approaches

- *Before you choose a modeling tool and start to work, there are a number of steps you should go through*
- *The first, and most critical, is to determine what the **OUTPUT** of the modeling process should be*
 - *You can't go on a journey without first identifying your destination!*
 - *The "trip" can be a short one, or a long complicated one!*

Determining your Output

Things to ask about your output product:

- *Do you need spatially explicit, or spatially aggregated results (or both)?*
 - *Spatially Explicit – Result is a GIS data layer*
 - *E.g., Dissolving polygon boundaries to simplify the land cover classes in a data layer*
 - *Spatially Aggregated – Result is a number or a set of numbers*
 - *E.g., Calculating the total area of each habitat type in a given county*

Output Product Characteristics

Things to ask about your output product:

- *Spatially Explicit - What form should the final product(s) take?*
 - *Points, lines, routes or polygons?*
- *Spatially Aggregated – What attributes are needed in the table(s)?*

Identify Possible Inputs

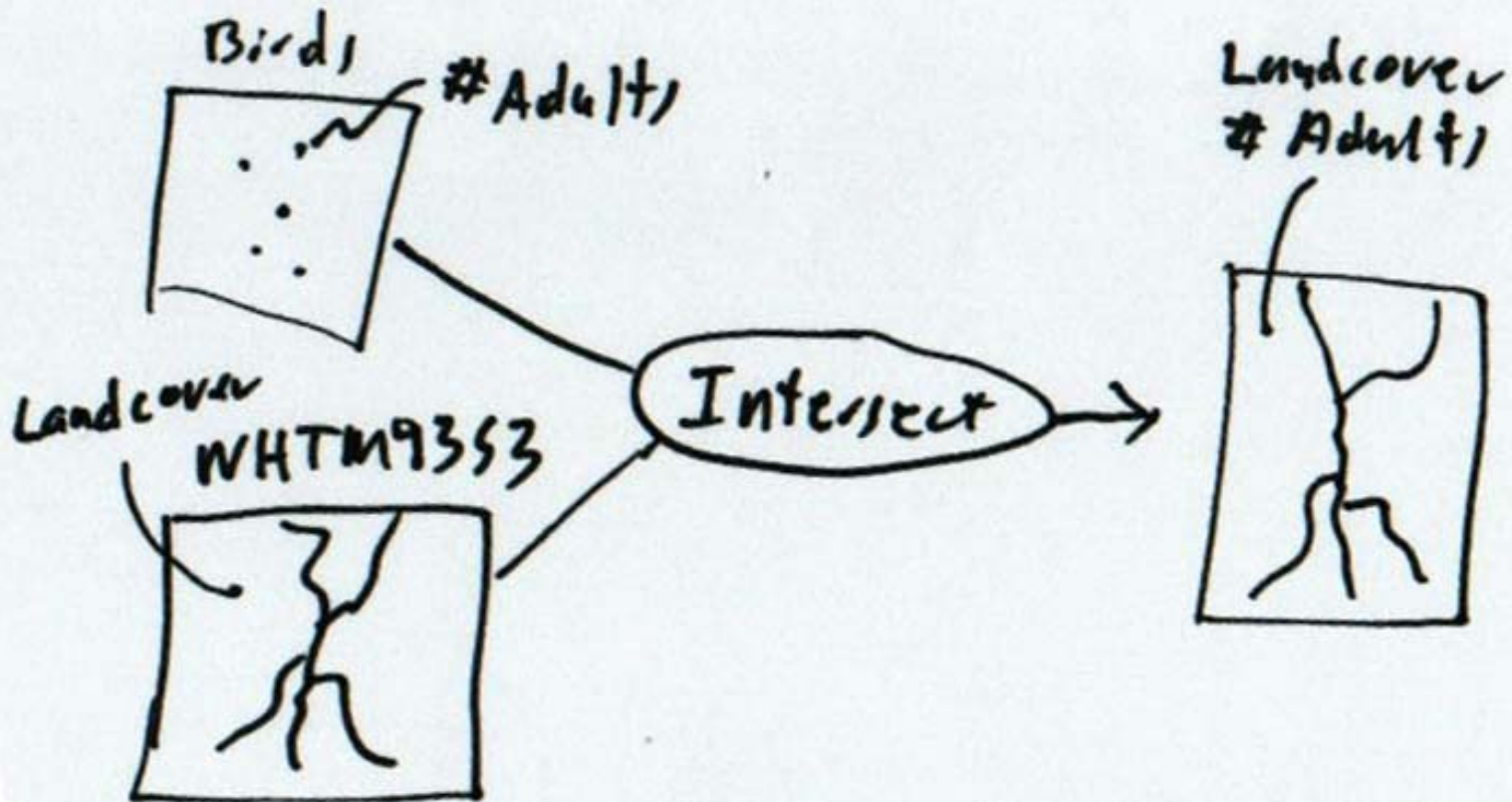
- *Now that you know what the output should contain, identify the possible inputs*
 - *Layers containing needed attributes*
 - *Layers containing the needed points or polygons*
 - *Layers that can be used to produce the needed points or polygons*
 - *E.g., a point coverage that can be buffered to provide polygons*

Develop a Strategy

- *Often the best way to “map out” a modeling process is to create a “cartoon” that lays out individual steps, identifying what the resulting layers and attribute tables will look like*

Sample "Cartoon"

% Birds on Beach



Planning your model

- *Often your model will be complicated with several different intermediate data layers*
- *Even if ultimately you want to do an automated modeling process, it is a good idea to step through the process manually, studying each intermediate data layer as you go along*

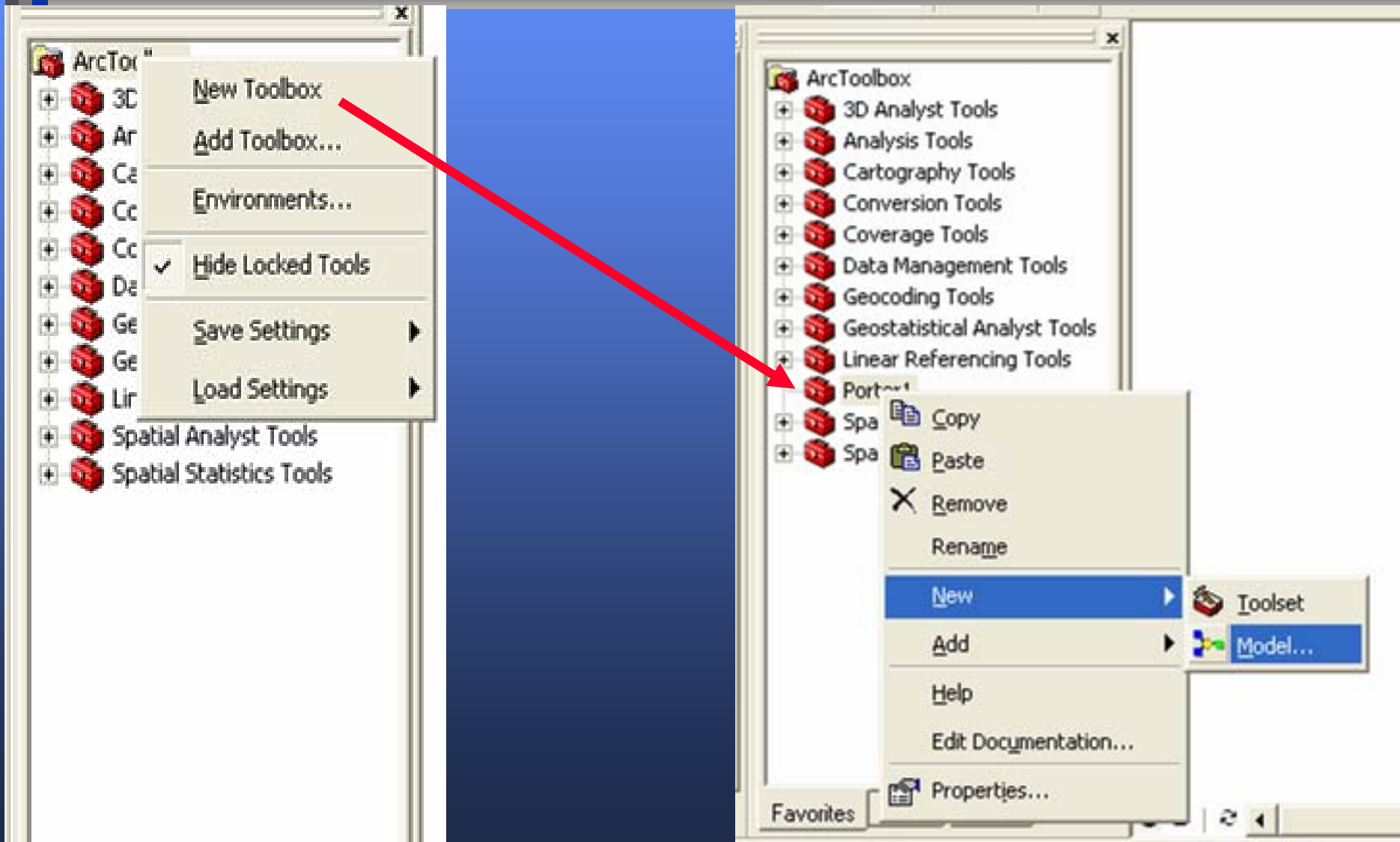
Sample Model Problem

- *Question: What is the percentage of agricultural land that falls within within 200 m of major roads in Northampton Co.?*
 - *Input Layers*
 - *RTF100K – Line coverage - All roads with codes for major and minor roads*
 - *NHTM93S3 – Land cover polygons*
- *Question: Which buildings at Morven Farm are within 1000 feet of both a Road and a Trail?*
 - *Input layers*
 - *morven_buildings_stpl – point shapefile – buildings*
 - *Morven_roads_stpl – line file – roads*
 - *Morven_trails_stpl – line shapefile - trails*

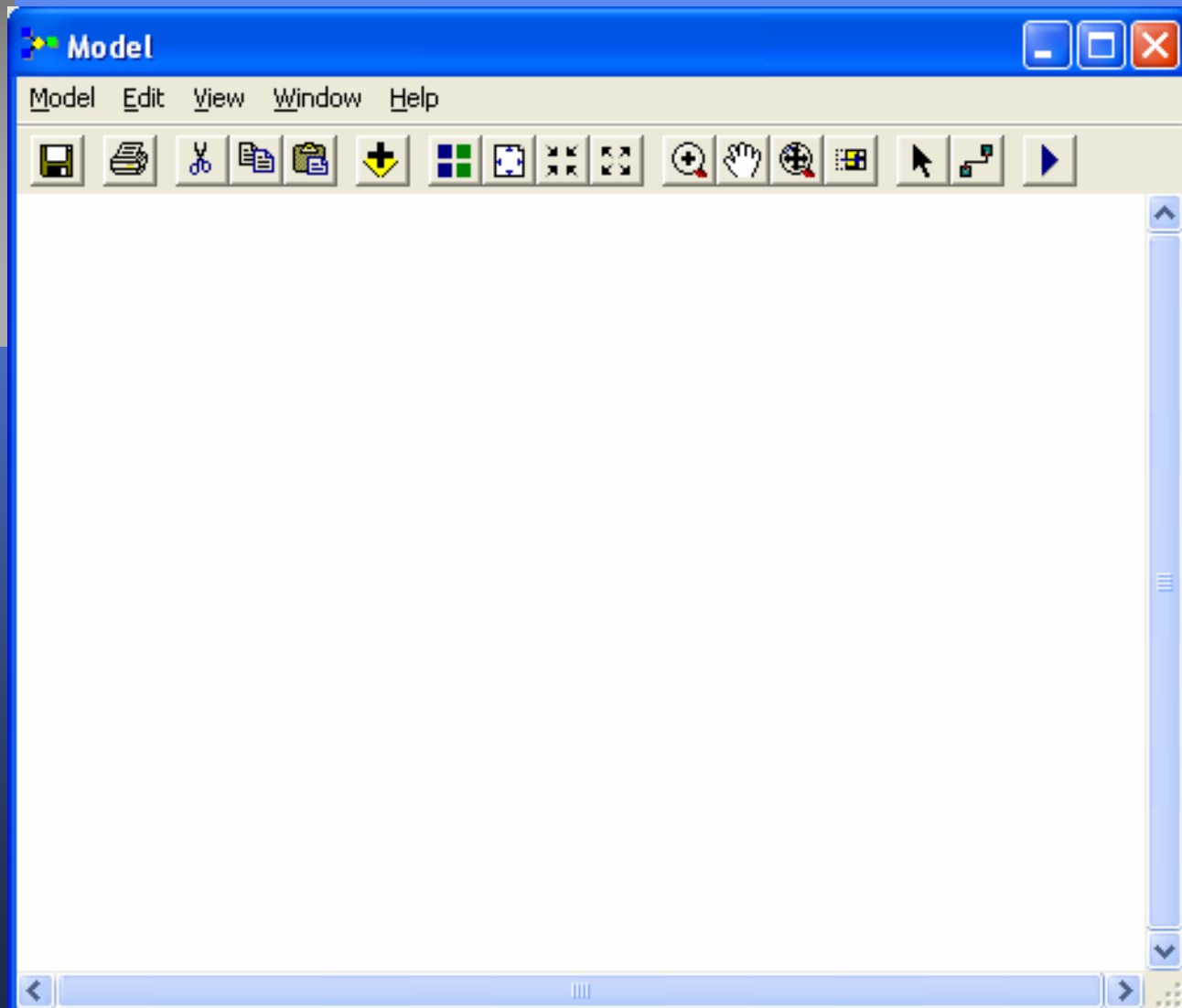
ModelBuilder – A graphical tool

- *Modelbuilder is a graphical tool for automating your model by building a work flow*
 - *Different (existing) components can be linked together to create a new tool*

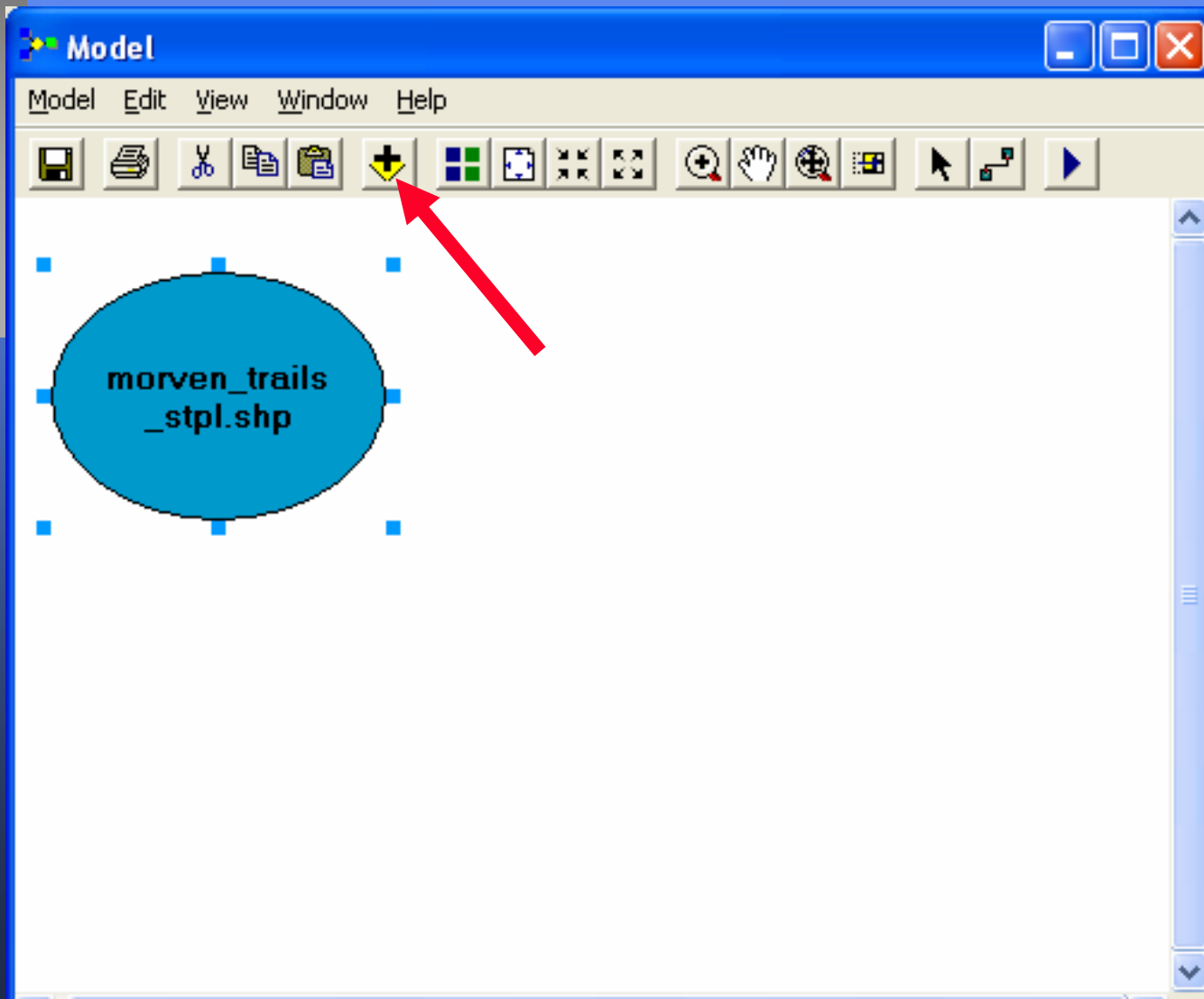
Creating your own Toolbox



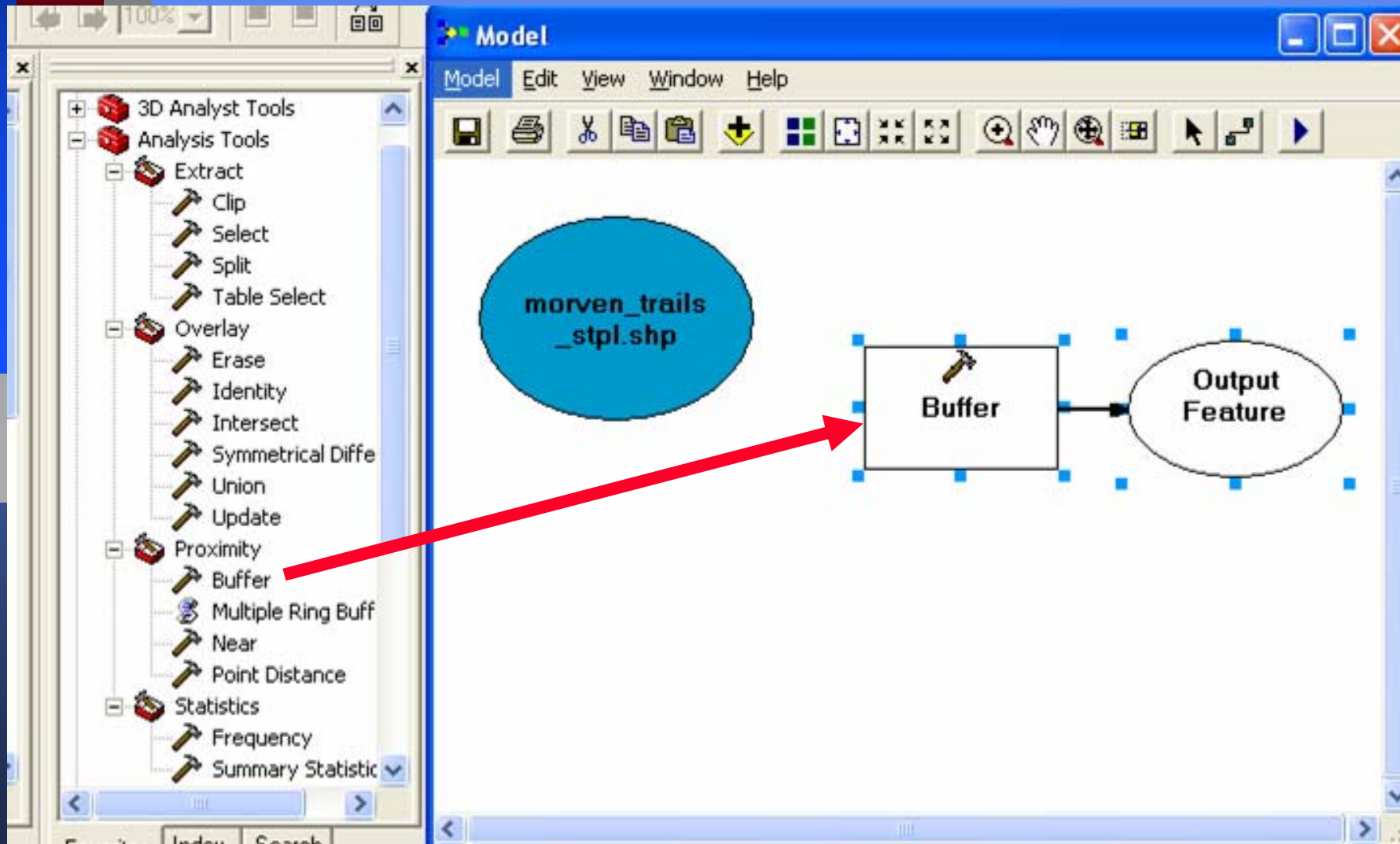
ModelBuilder Screen



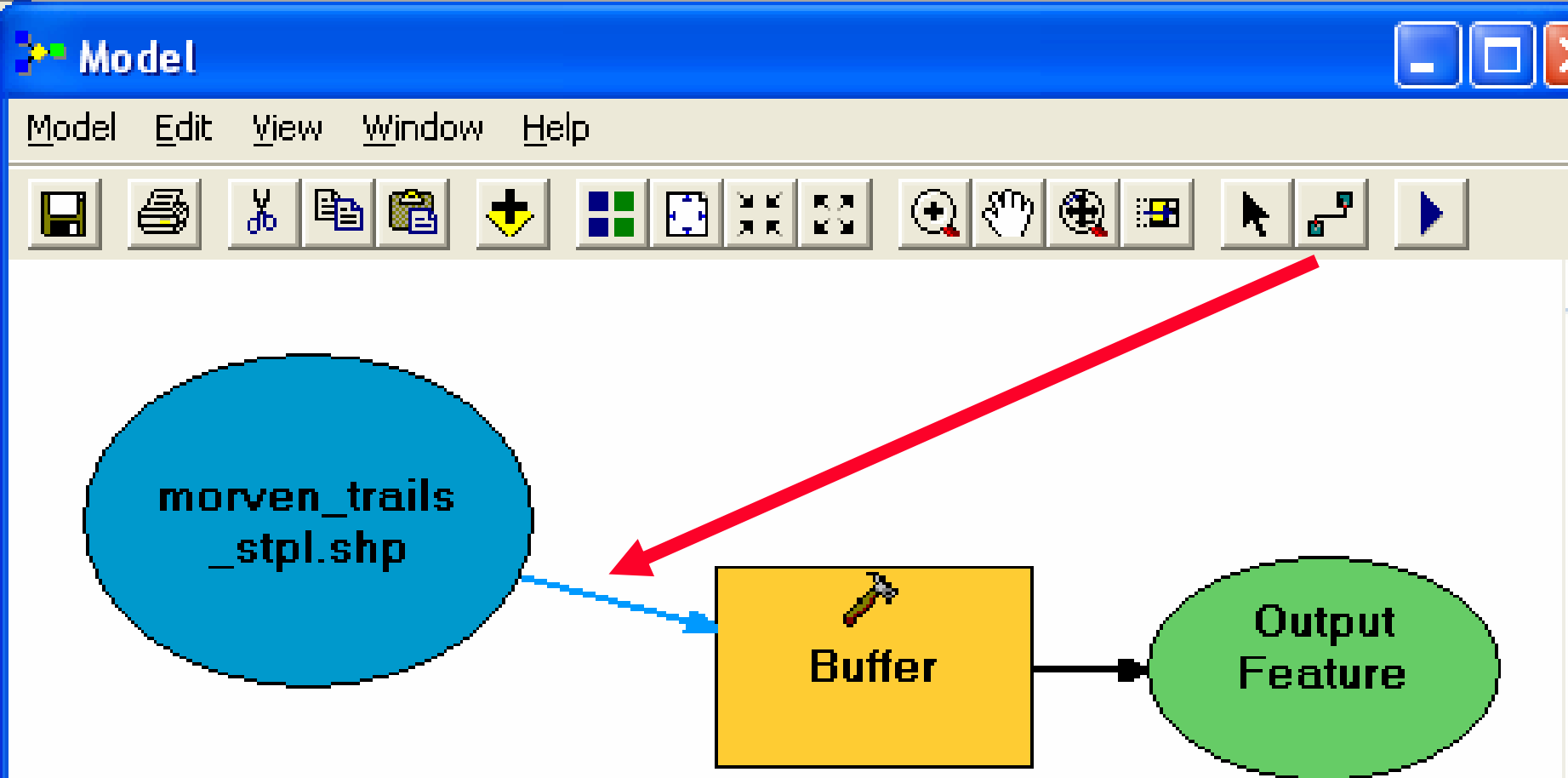
Add a Data Layer



Drag in an existing tool

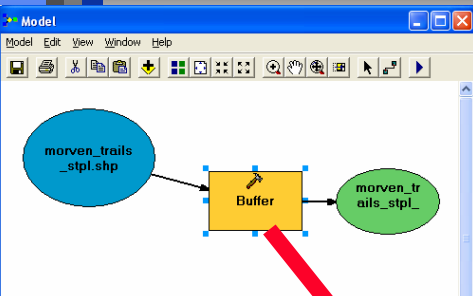


Connect Data Layer to Tool



Note the color change once we connect!

Click on the “Buffer” box to open dialog for additional parameters



The Buffer dialog box is open, showing the following configuration options:

- Input Features:** morven_trails_stpl.shp
- Output Feature Class:** D:\Work\GISDATA\Morven\morven_trails_stpl_Buffer.shp
- Distance [value or field]:**
 - Linear unit**
 - Value: 500
 - Unit: Feet
 - Field**
- Side Type (optional):** FULL
- End Type (optional):** ROUND
- Dissolve Type (optional):** (empty)

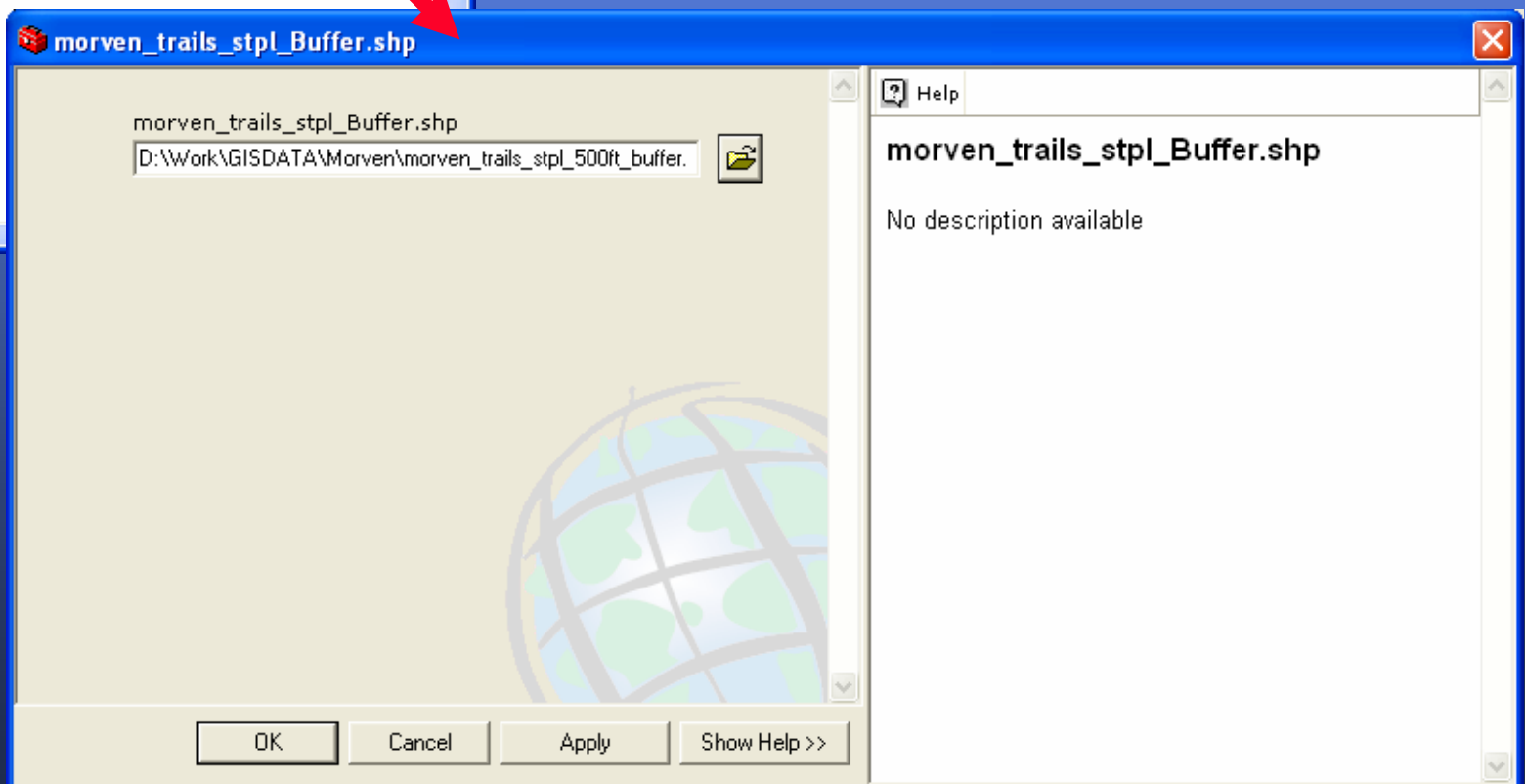
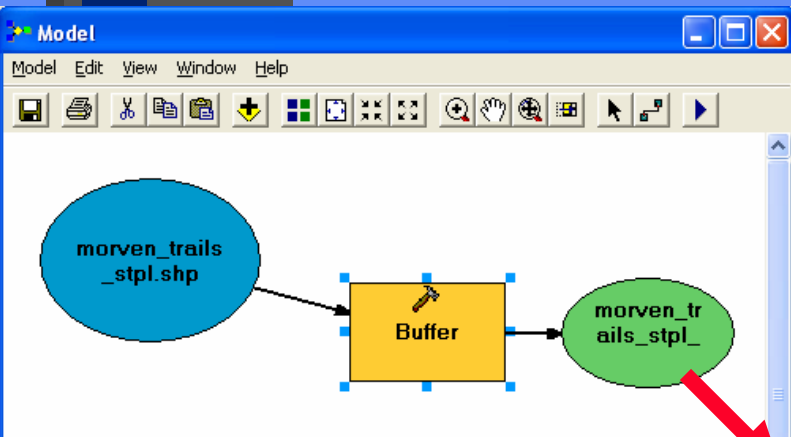
Buttons at the bottom: OK, Cancel, Apply, Show Help >>

Help

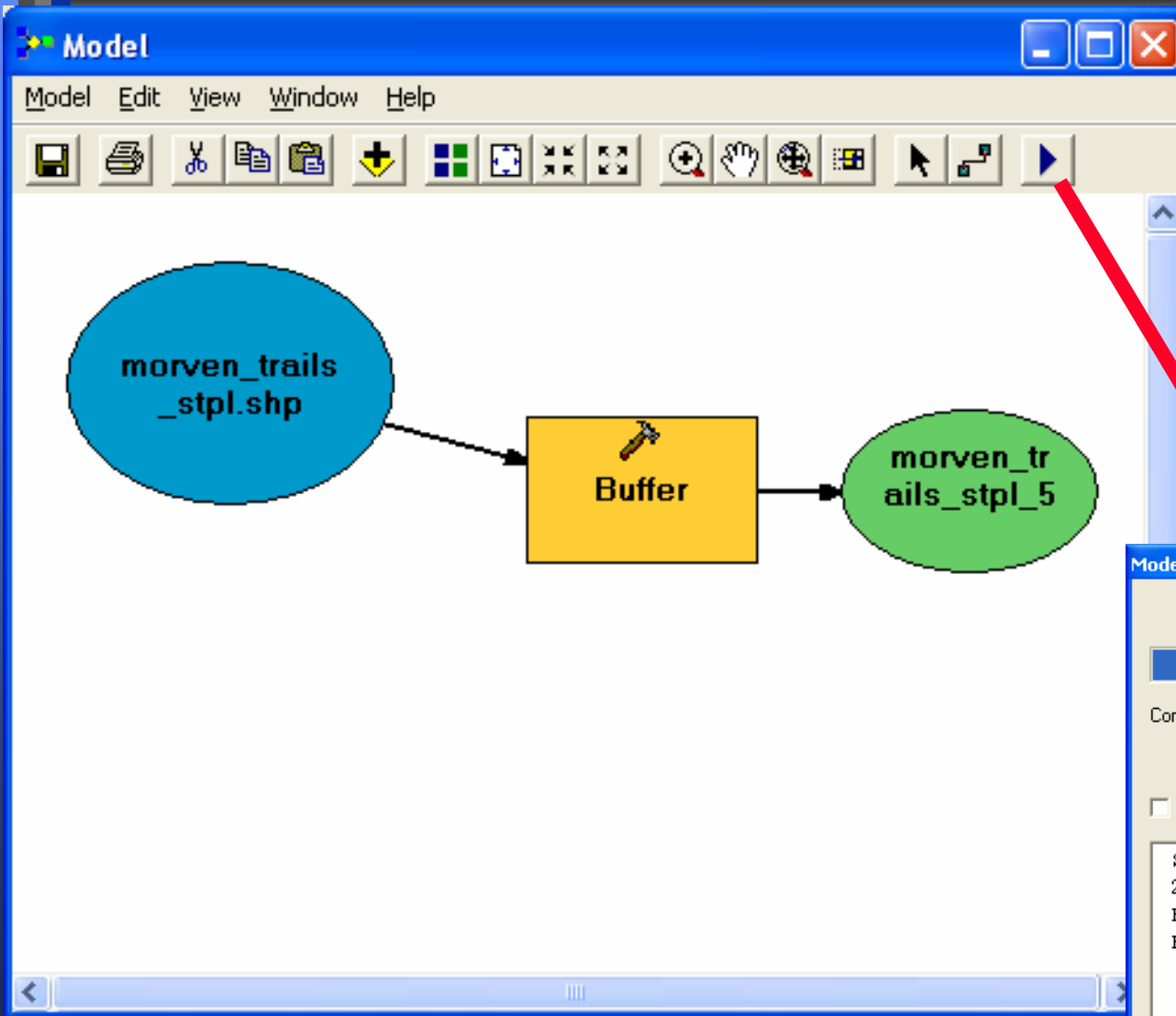
Distance [value or field]

The distance used to create buffer zones around input features. Either a value or a numeric field can be used to provide buffer distances.

*Click on the Output
Oval to set its name*



Hit the RUN button to run the model



The status dialog box, also titled "Model", displays the following information:

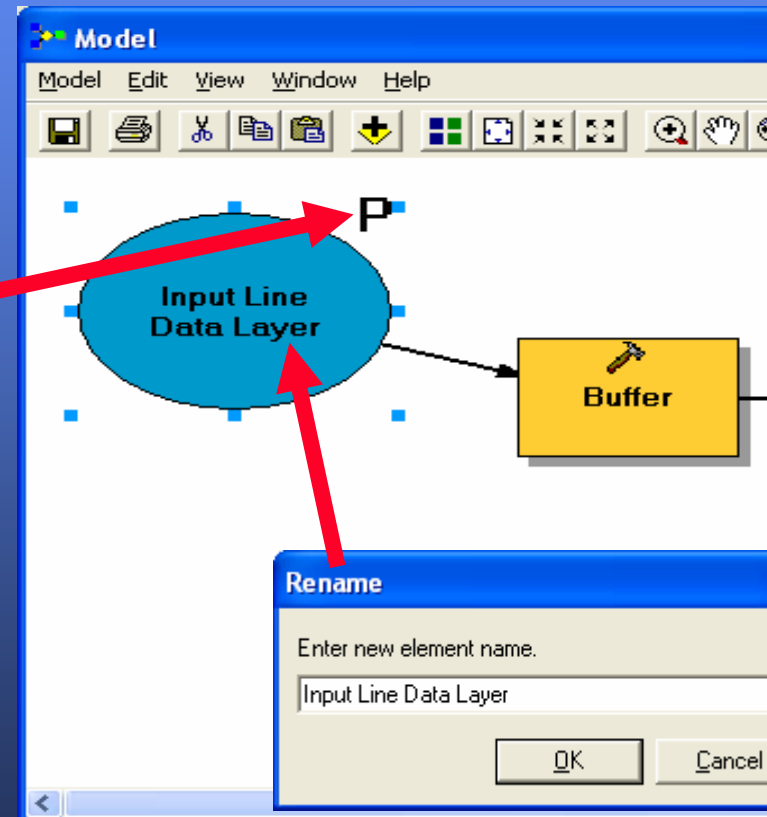
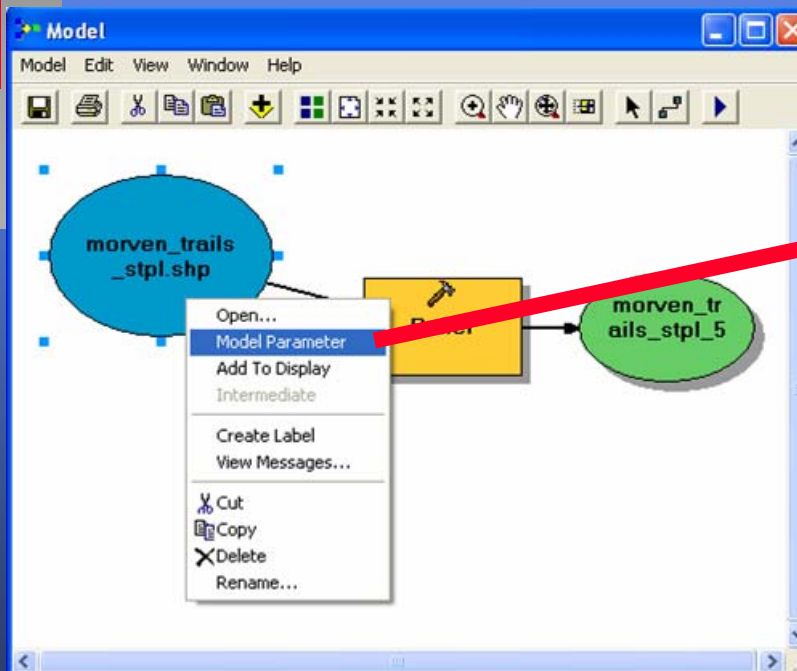
- 1 of 1 processes executed
- Close button
- Progress bar (filled blue)
- << Details button
- Completed
- Close this dialog when completed successfully
- Log text:

```
Start Time: Tue Feb 22 15:04:42
2005
Executed (Buffer) successfully.
End Time: Tue Feb 22 15:04:44 2005
(Elapsed Time: 2.00 secs)
```

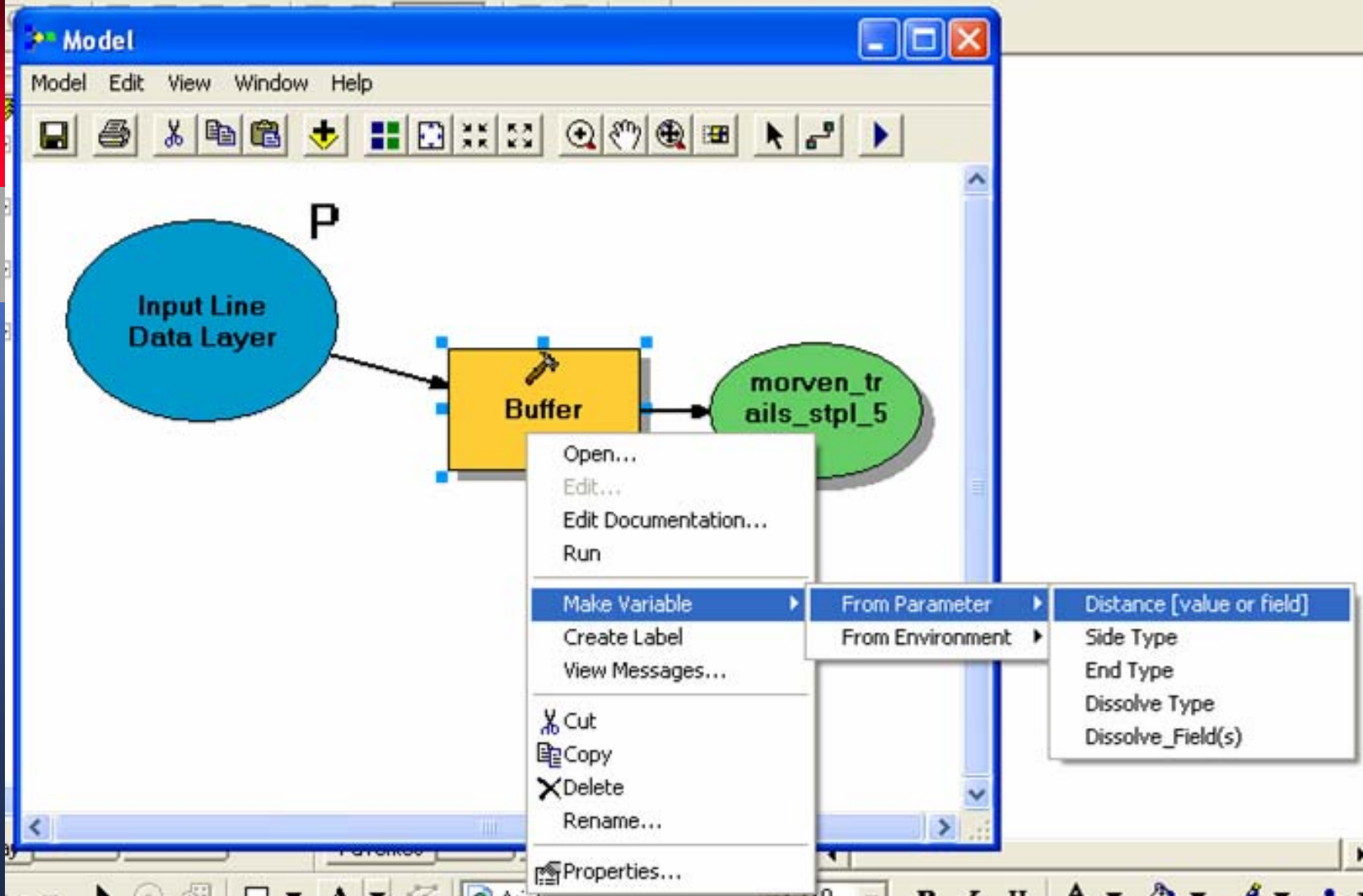
Generalizing the Model

- *Thus far, the model is only useful as a tool once – it always analyzes the Morven Trails data layer!*
- *To be useful for other layers, we need to specify which “PARAMETERS” will be specified at runtime....*

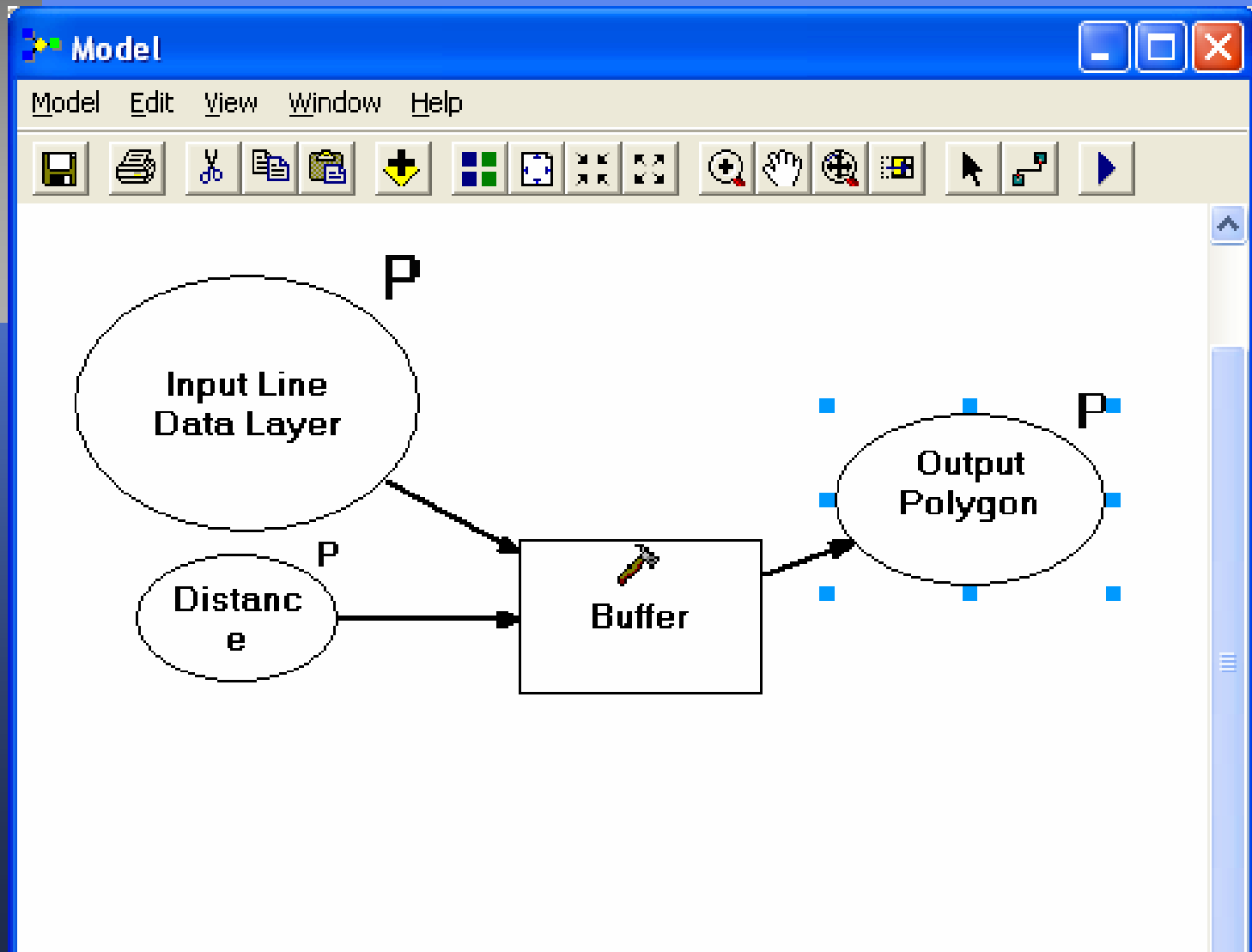
Right click on input layer and add Model Parameter



For Buffer – select which variables to ask for as parameters



New Variable “Distance” added and set as a parameter



Model now requests inputs

Model

- Input Line Data Layer
[Empty text box] [Folder icon]
- Distance [value or field]
 - Linear unit**
 - [Empty text box] [Unknown] [Dropdown arrow]
 - Field**
 - [Empty text box] [Dropdown arrow]
- Output Polygon Layer
[Empty text box] [Folder icon]

OK Cancel Environments... Show Help >>

Additional GIS Modeling Exercises

Using the MORVEN data

- *What percentage of the land within the boundaries of Morven fall within 100 meters of a building and within 500 feet of a pond?*
- *Create a map of trails that do not go within 100 meters of a building*
- *What is the dominant soil type underlying areas covered by trails and roads?*
 - *Assume trails are 10 feet wide and roads are 25 feet wide*
 - *Use “Newname” field for soil type.*