

The background of the slide is a light green map showing a dense network of roads and highways. The roads are represented by thin, light green lines, while major highways are shown as thicker, darker green lines. The map covers the entire area of the slide, providing a visual context for the title.

# Conflating a Traffic Model Network With a Road Inventory

David Knudsen

**CTPS**

Central Transportation  
Planning Staff

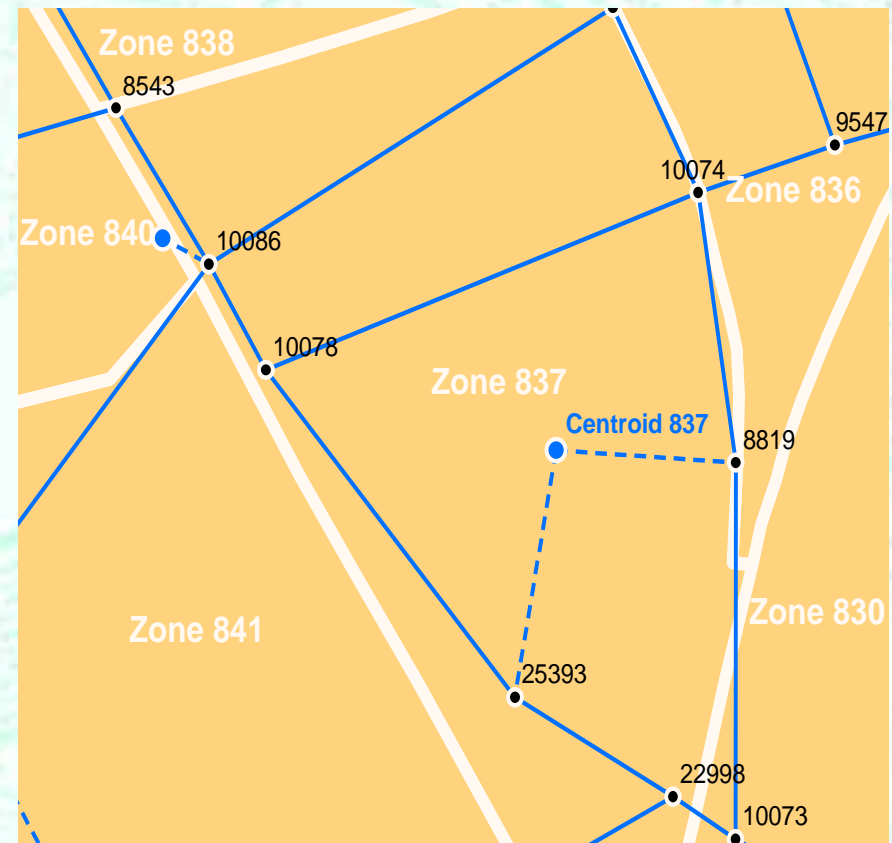
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Traffic modelers need to derive attributes of their abstracted networks from road layers maintained by highway departments, and planners want to present model predictions using these road layers, which the public recognizes and understands. GIS and data analysts may be responsible for developing and maintaining a codified relationship between the two data stores, neither of which they own or control. In the worst possible case, both stores may be completely redesigned simultaneously, breaking previously created relationships.

Both out-of-the-box and ArcObjects-customized GIS tools making use of path finding on network datasets, topologies, versioned editing, SDE views, and carefully-designed symbolization ease the task of conflating two related but dissimilar data layers and error-checking the resulting many-to-many relationship. With both planning and hindsight, the conflation can become more responsive to continuing edits to the member data layers and more resilient to future wholesale changes.

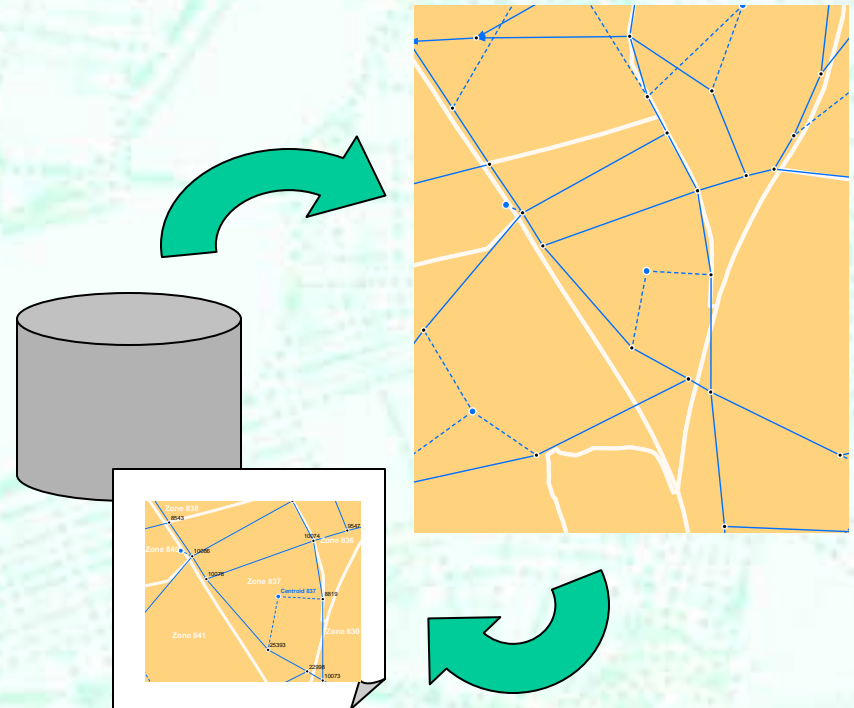
# Traffic Modeling Primer

- Traffic analysis zones
- Network defined by nodes and links
- Classic four-step modeling process
  - Trip generation
  - Trip distribution
  - Mode choice
  - Route assignment
- Predicts traffic volumes, speeds, travel times



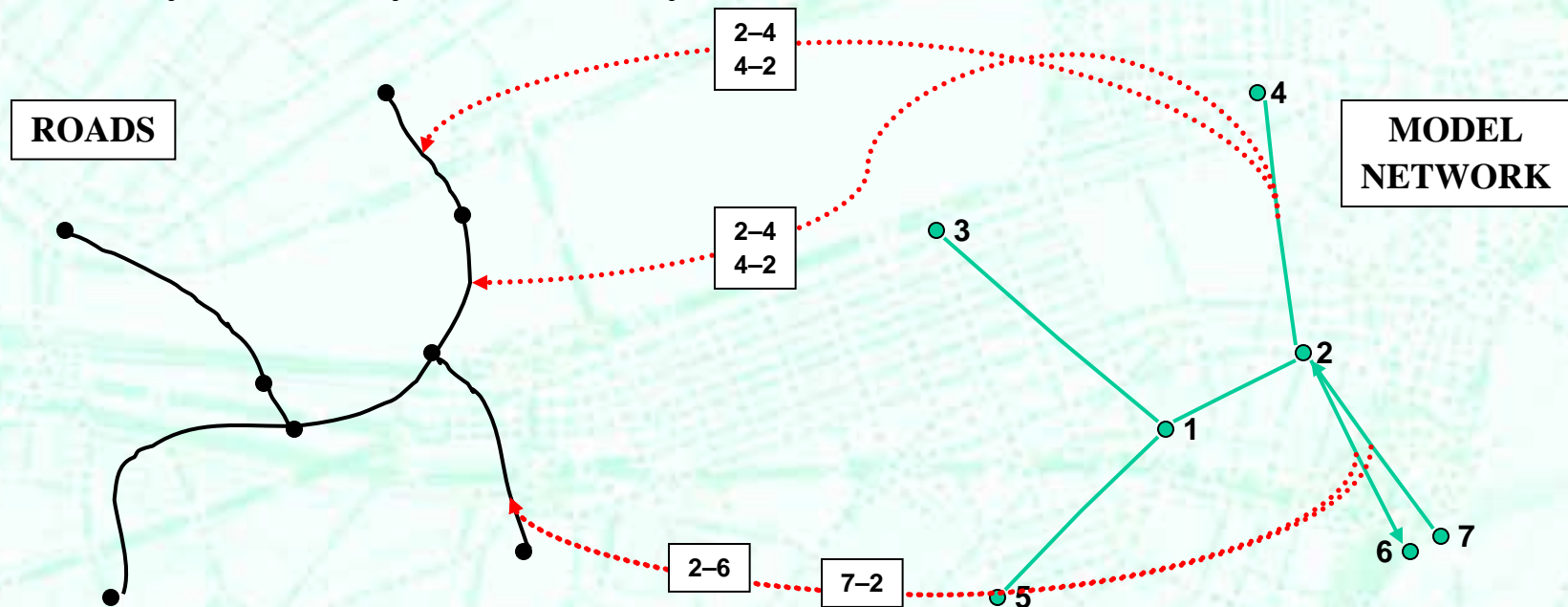
# GIS and Models Complement Each Other

- GIS is a source of model inputs
  - demographic data
  - network attributes, i.e.
    - length
    - lanes
    - capacity
- GIS maps model outputs with greatest flexibility and sophistication
- Relationships must exist to exchange data

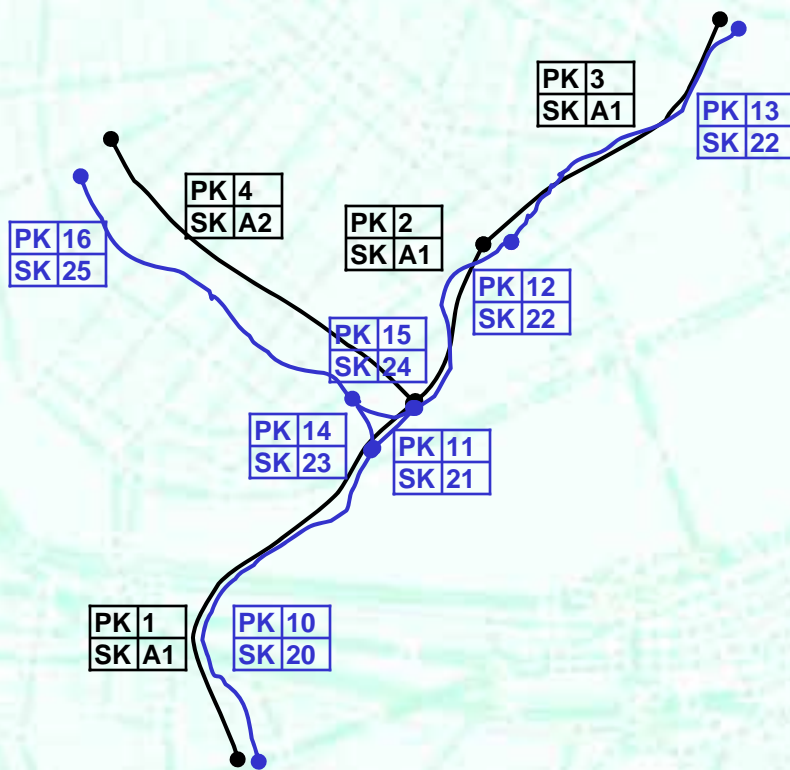


# CTPS' First Road/Network Relationship

- Established in 2001 on a coverage using AMLs
- Coded road features with model node IDs
- Many-to-many cardinality

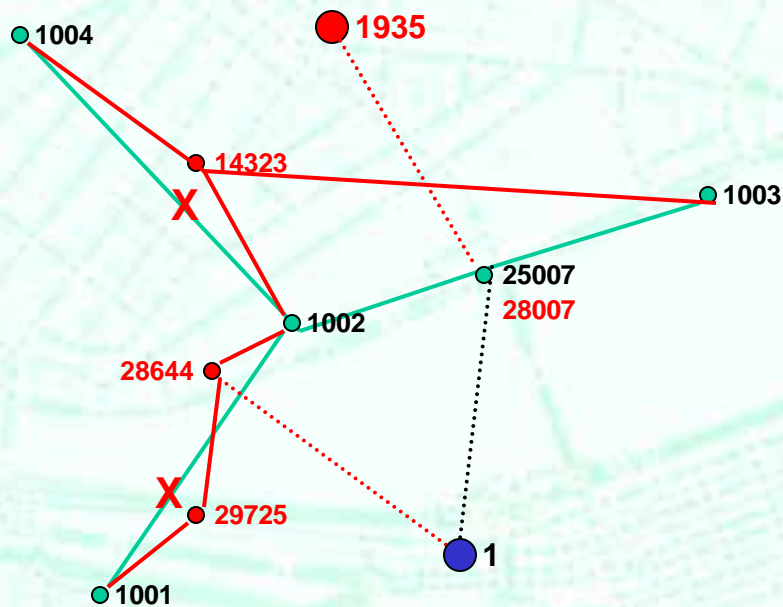


# Road/Network Relationship Ends: “Irreconcilable differences”



- Conflation of roads to new linework
  - Orthophoto-derived centerlines more detailed, accurate than old DLGs
  - New primary key
  - No published conversion from old to new primary key
  - Secondary keys not comparable

# Road/Network Relationship Ends: “Irreconcilable differences” (2)



- Expansion of model
  - From 987 to 2727 zones
  - New nodes and links for additional roads
  - New centroid connectors
  - New shape nodes
  - Node renumbering

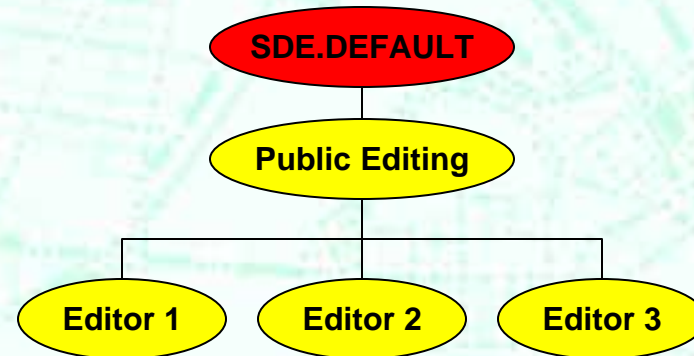
# CTPS' New Road/Network Relationship

- Creating from scratch estimated to be no more costly than fixing and error-checking existing one
- ArcGIS desktop and server technology used to
  - manage workflow
  - perform semi-automated conflation
  - aid quality control
  - create plots with good cartographic quality



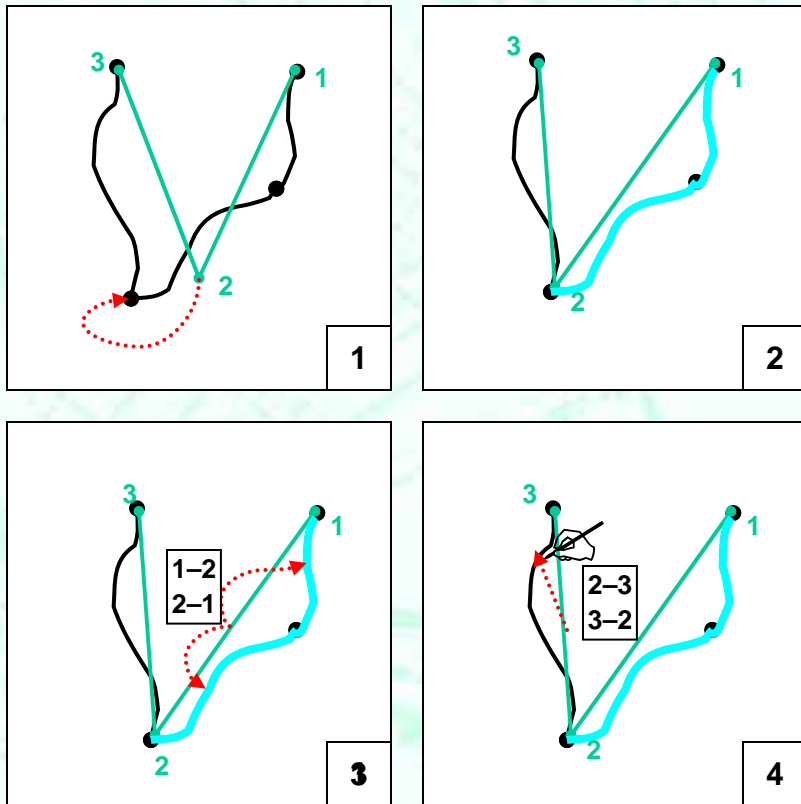
# Workflow Management

- ArcSDE versions
  - Versions for each editor
  - Parent, reconciliation version
- Status and progress
  - Town-level table
  - Map symbolization
- Verbal coordination still needed to avoid time-consuming conflict reconciliation



TOWN	STATUS	STAFF_ASSIGNED
ABINGTON	Checklines	David Knudsen/MD/DK
ACTON	Checklines	Shane/DK
AMESBURY	Checklines	
ANDOVER		Knudsen
ARLINGTON		

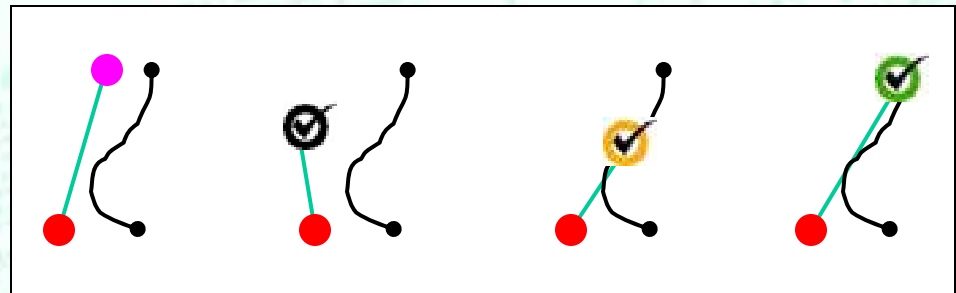
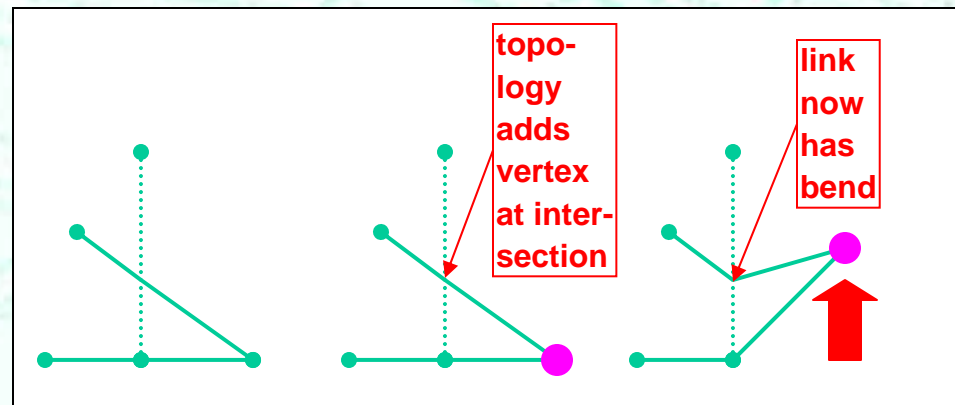
# Semi-automated Conflation



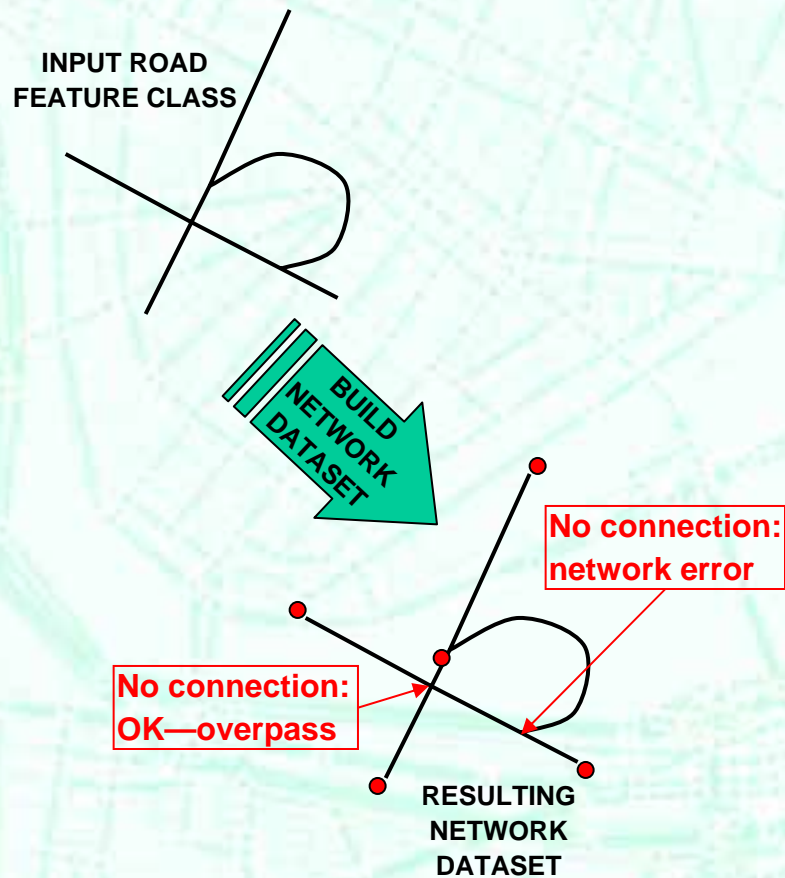
1. Manually snap network nodes to appropriate road intersections
2. Automatically select roads along shortest path between intersections
3. Automatically transfer corresponding link IDs
4. Manually transfer link IDs when path finding fails

# Snapping Nodes

- Topology ensured links moved with nodes, introduced a problem (geometric network better choice)
- ArcObjects script set node symbol field when node dropped
- Topology errors do not provide same degree of progress-checking



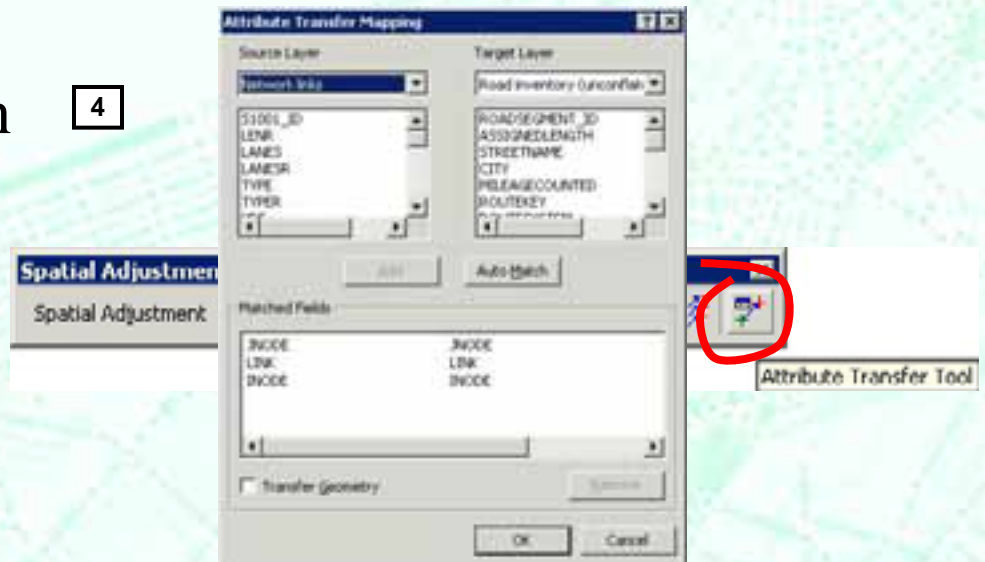
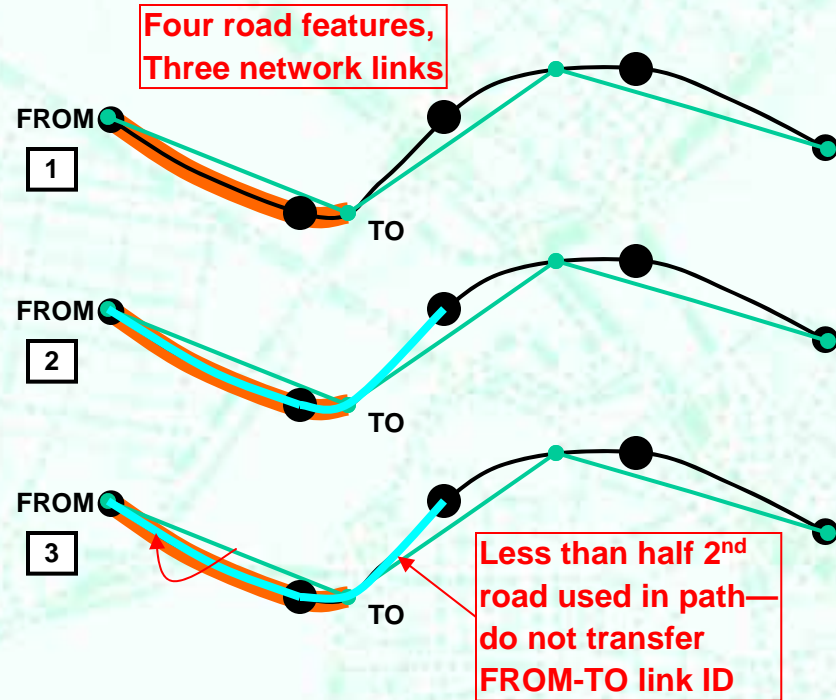
# Shortest Path Selection



- Shortest path selection is only provided in ArcGIS in “network datasets” under the Network Analyst
- A network dataset was built using roads as an input feature class
- GIS road data had some connection errors, which could cause the true shortest path not to be found

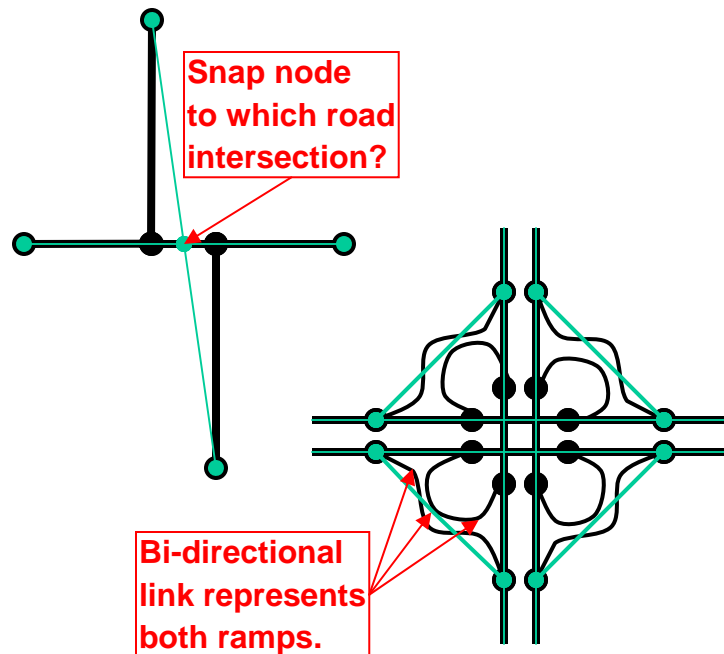
# Shortest Path Selection (2)

1. Shortest path “solver” creates path as new feature
2. ArcObjects code selects roads used in path feature
3. ArcObjects code transfers corresponding link IDs to selected roads if more than half of road used in path
4. Attribute Transfer Tool used when automatic path finding failed

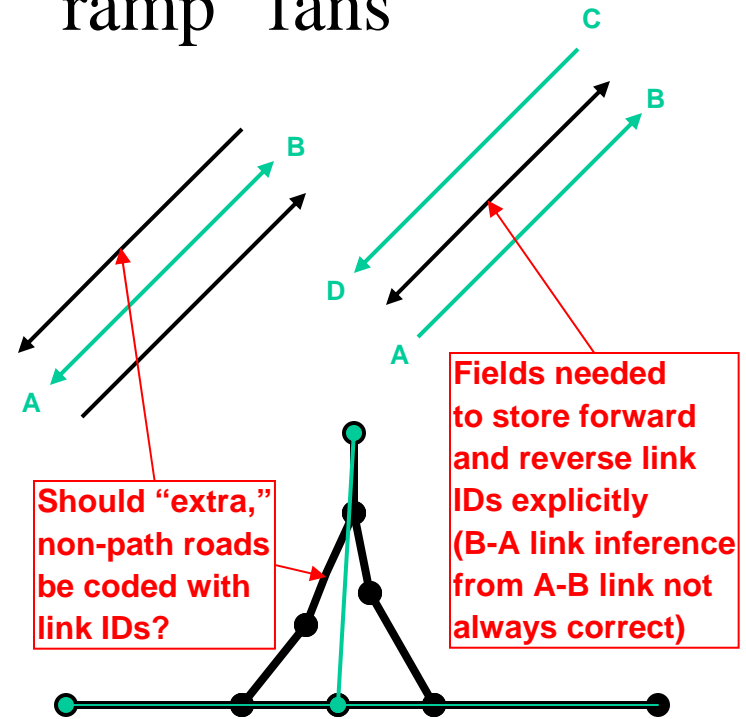


# Conflation Logic Problems

- Model intersection simplification

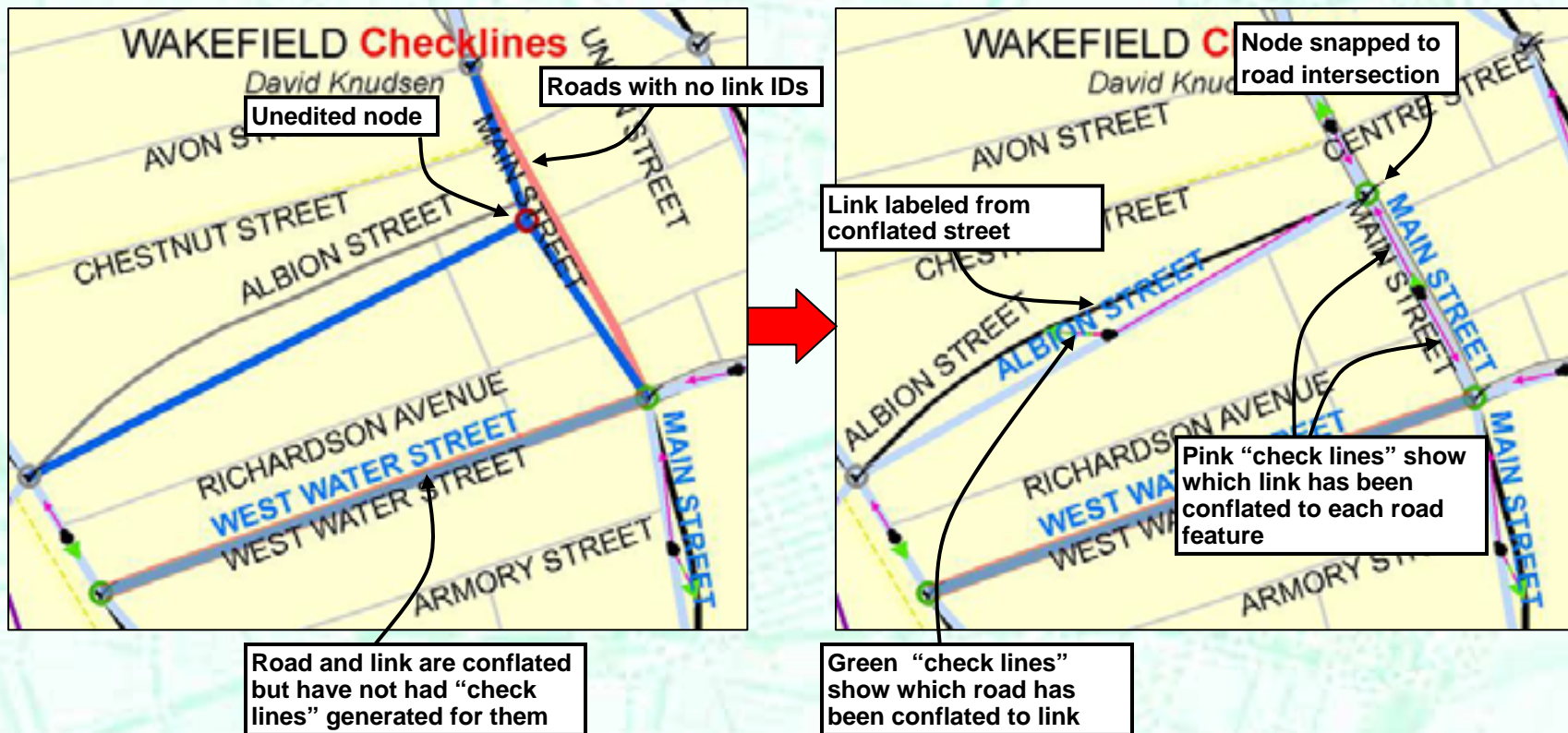


- Double barrels and ramp “fans”



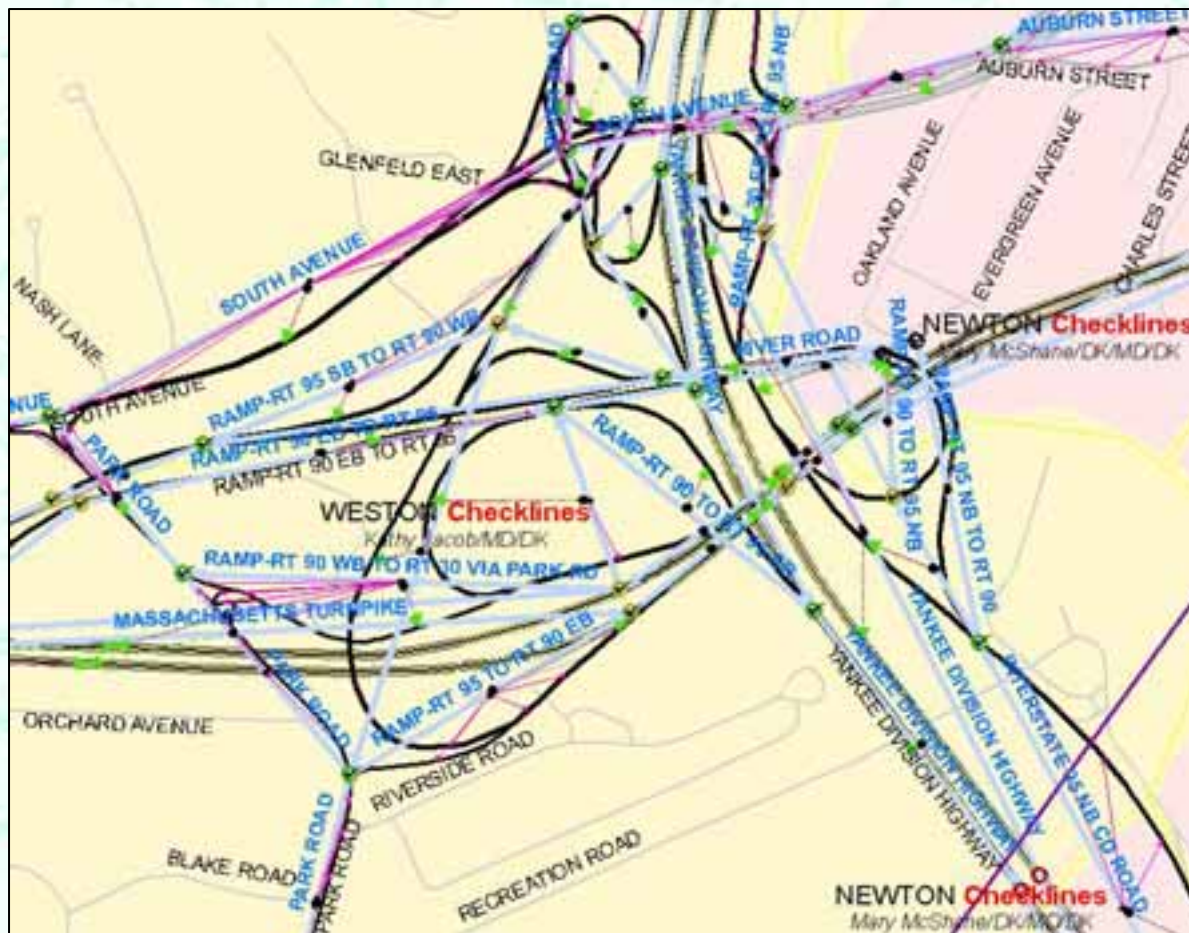
# Quality Control Illustration

## Snapping node to intersection of Main and Albion



# Quality Control Illustration

## Extra Credit Challenge





# Quality Control

- Careful symbolization key to controlling quality
- Visual checks/feedback originally envisioned for review stages integrated with initial editing as well
- Completeness addressed by showing nodes, links, and roads not yet edited with special symbols
- Correctness addressed by node symbols, “check lines,” and links labeled from conflated roads
- Thoroughness of review addressed by highlighting missing “check lines” using ArcSDE views

# Checkplots

- Modelers liked to work on paper
- Network shown both prior to and after editing
- Paper allowed much greater information density (labels and other data layers)

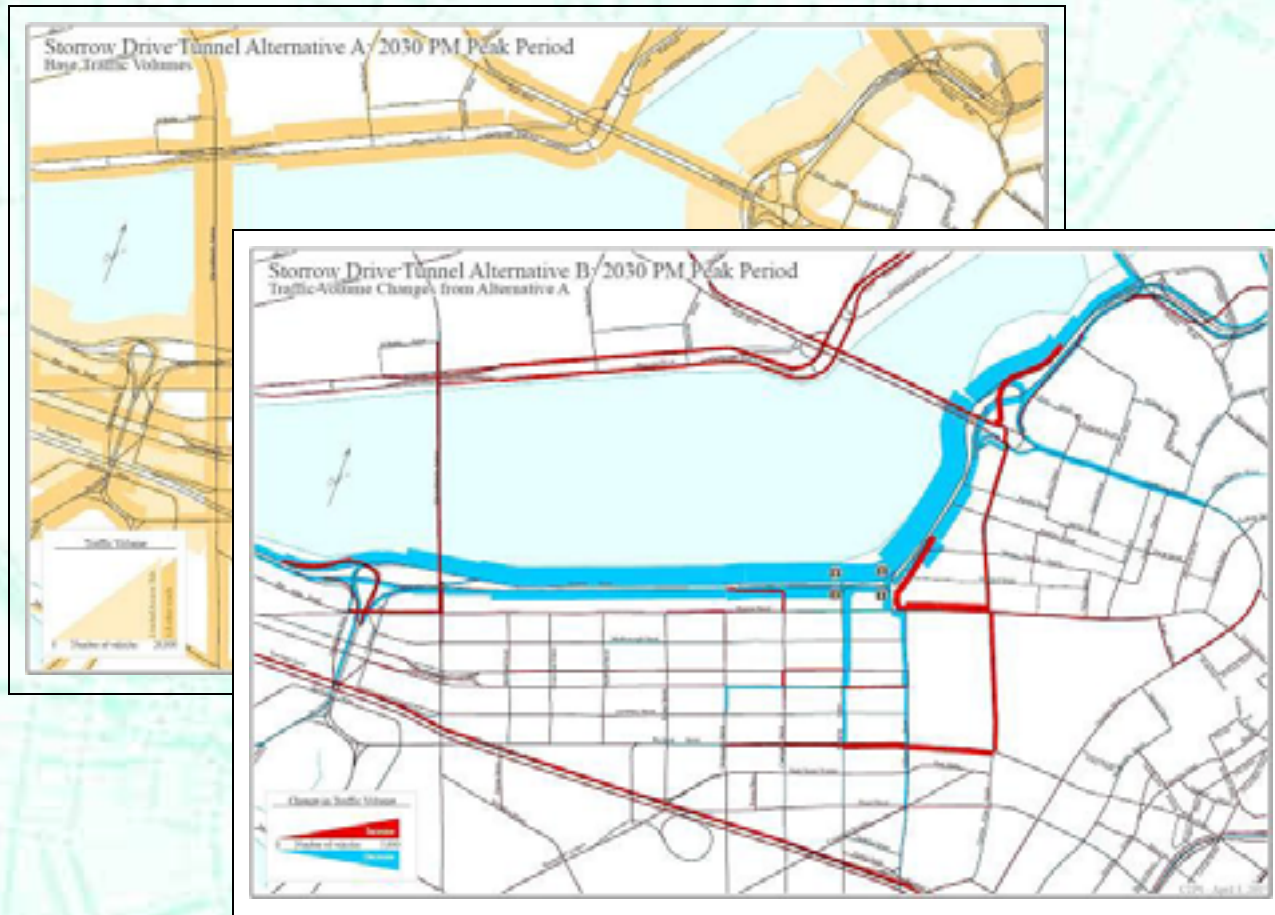


# Mapping Model Output

Volume-to-capacity ratios or congested speed mapped using fixed width and different colors

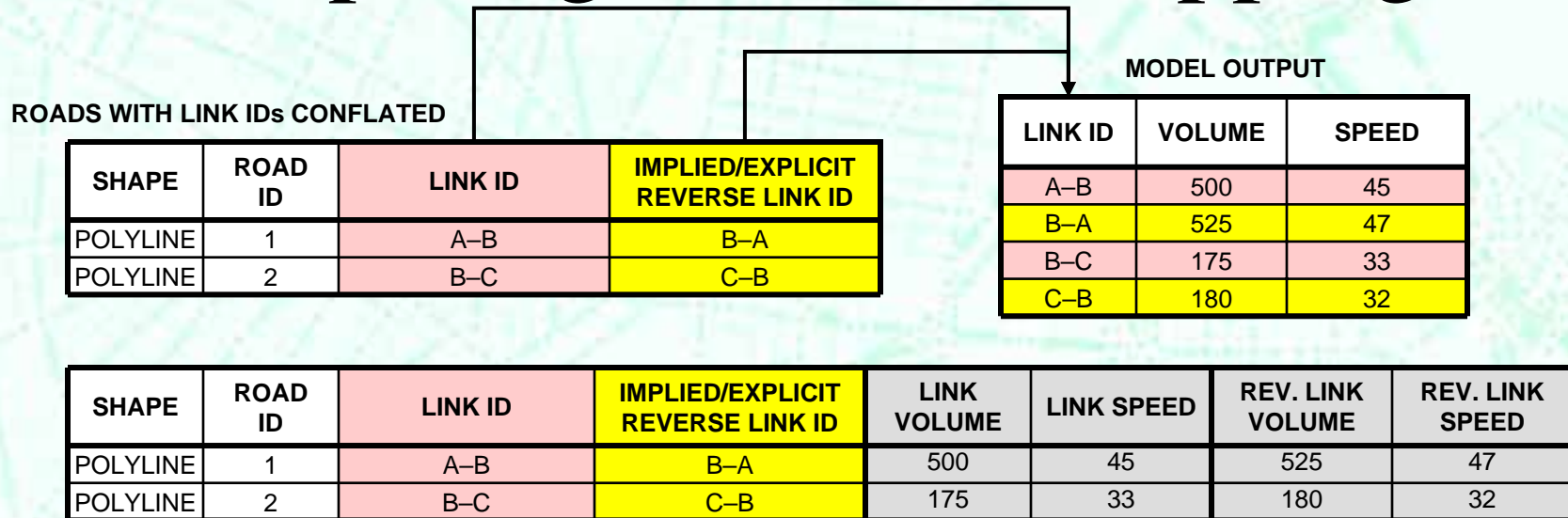


# Mapping Model Output (2)



Volumes or volume changes mapped using varying widths and single color

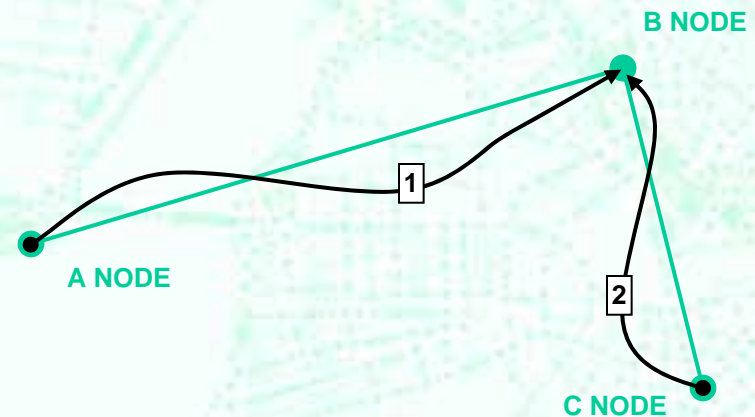
# Preparing Data for Mapping



- Model output keyed by link ID
- May need to be converted to table readable by GIS
- Joined *twice* to roads using both link ID and opposing direction link ID fields in road attributes

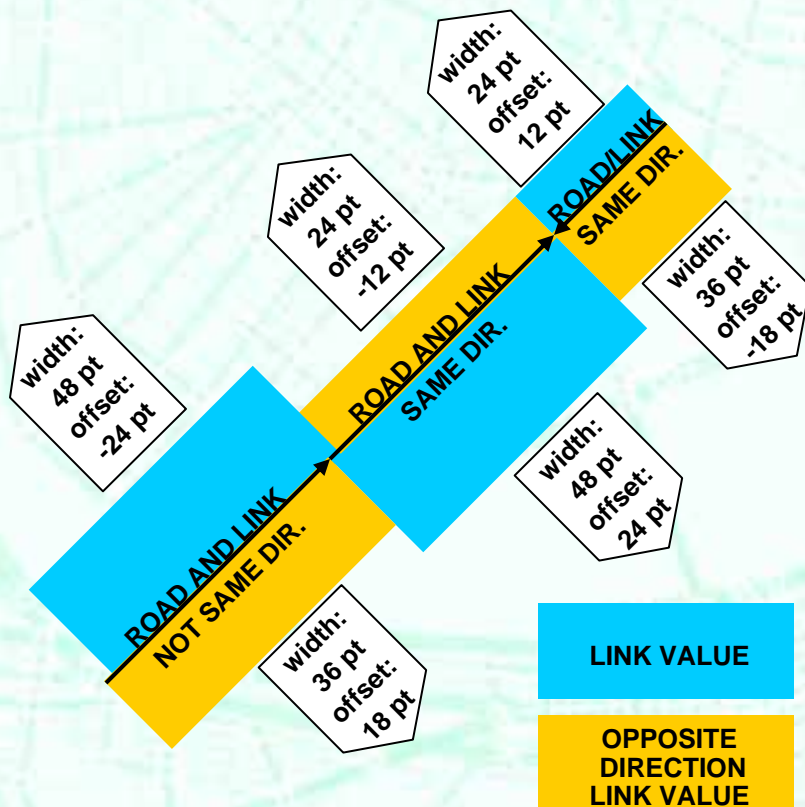
# Preparing Data for Mapping (2)

- To show directional data on correct side of line, must determine if direction of road feature matches direction of conflated links
- ArcObjects calculates direction of roads and their related links and sets a direction “flag” field accordingly



ROAD ID	LINK ID	SAME DIR.	IMPLIED/EXPLICIT REVERSE LINK ID
1	A-B	YES	B-A
2	B-C	NO	C-B

# Preparing Data for Mapping (3)



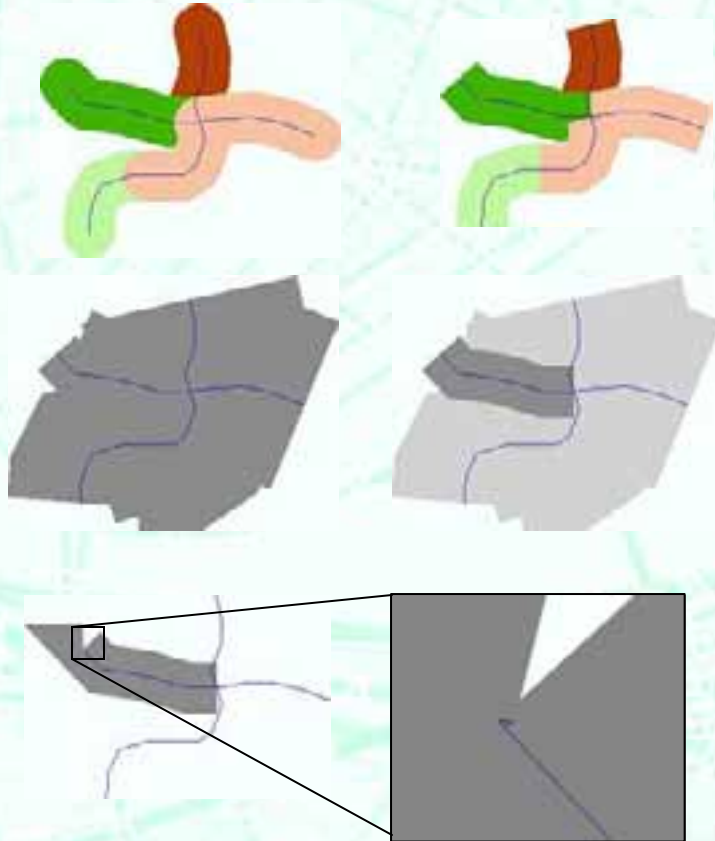
\* MULTIPLY OFFSET BY -1  
WHEN ROAD AND LINK  
NOT SAME DIRECTION

- When symbol width varies for directional data, symbol offset should vary
- With classification, offset is hard-coded for symbol for each numeric range
- With proportional width, offset is infinitely variable and must depend on a field value, only supported in a route-event system

# Cartographic Considerations

SIMPLE LINE SYMBOL

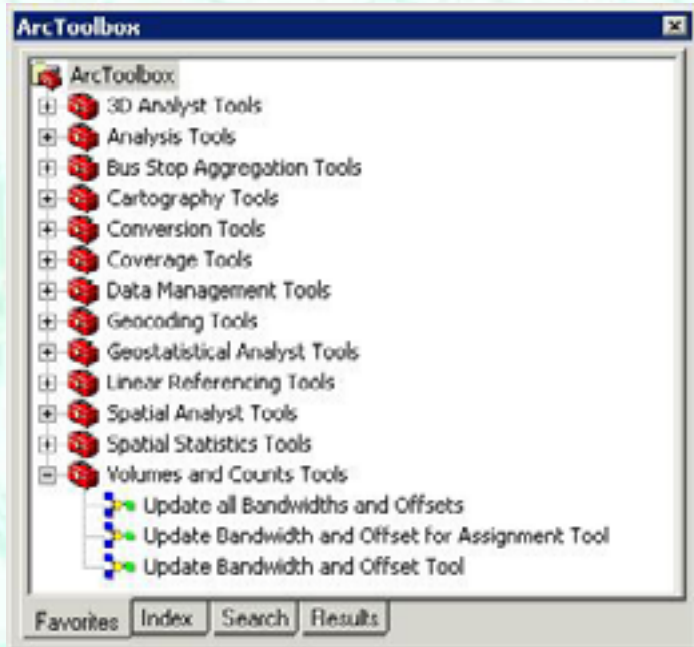
CARTOGRAPHIC LINE SYMBOL



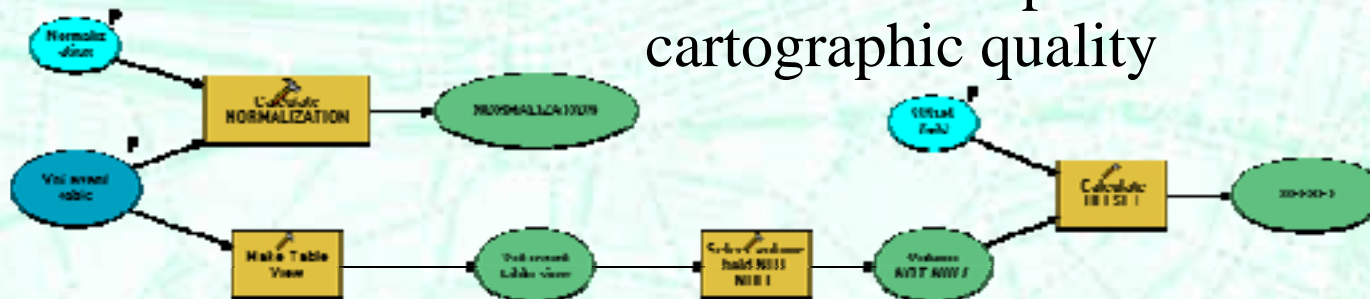
- Cartographic line symbol slower but better defined than simple line symbol
- Small symbols may be lost in, or hidden under, large symbols
- Cartographic line symbol has fill limitations
- No beveling is available at intersections



# Work Continues!



- The QC tools we developed will help us keep up with new model scenarios as modelers code them
- Even with road-network relationship re-established, preparing model output for mapping is slow
- Through scripting and building geoprocessing models we want to streamline the process and improve cartographic quality



# Contact

David Knudsen

**CTPS**

Central Transportation  
Planning Staff

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Ten Park Plaza, Suite 2150

Boston, MA 02116

[dknudsen@ctps.org](mailto:dknudsen@ctps.org)