United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS

Using ArcGIS® and Digital Pen for Soil Survey

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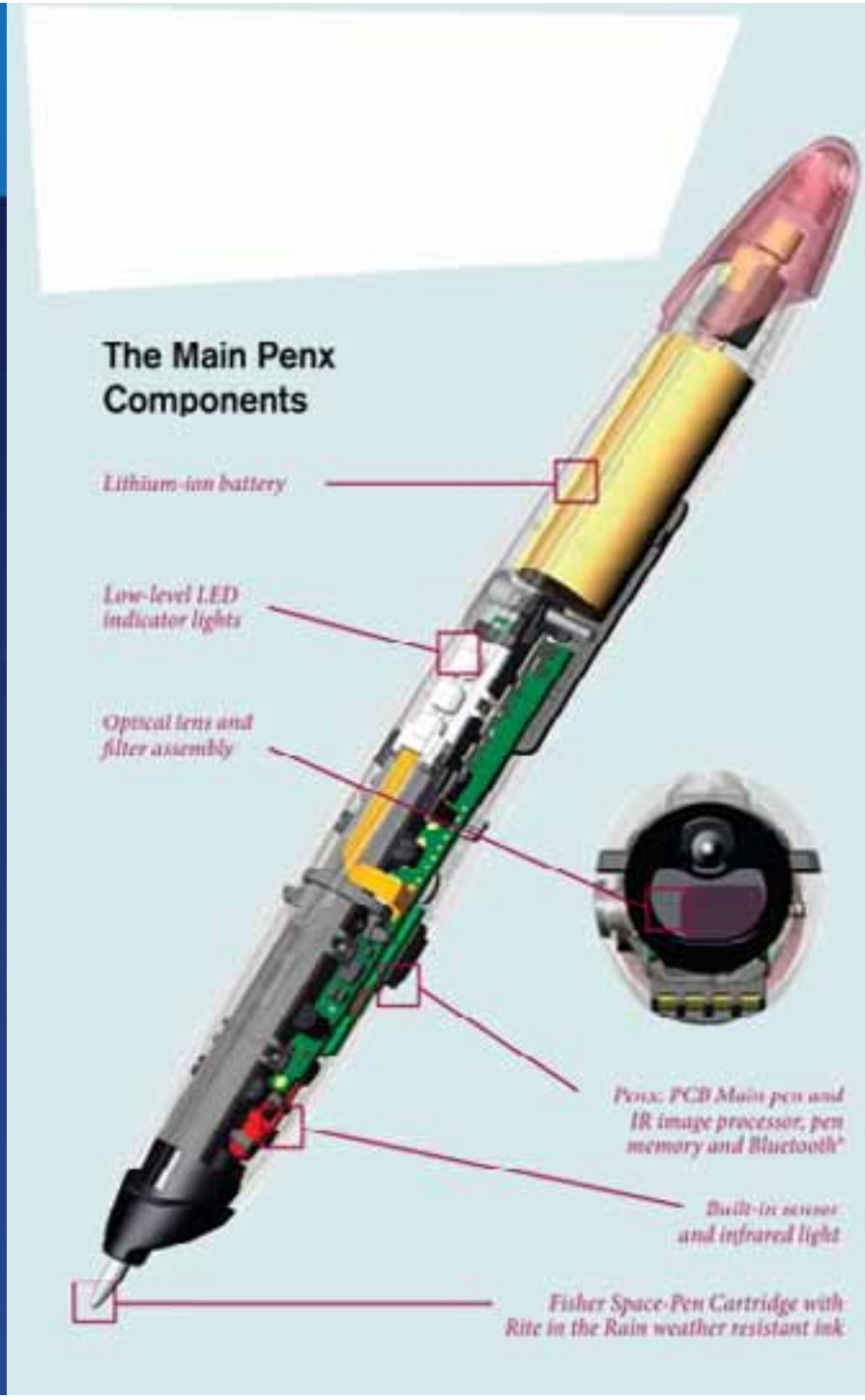
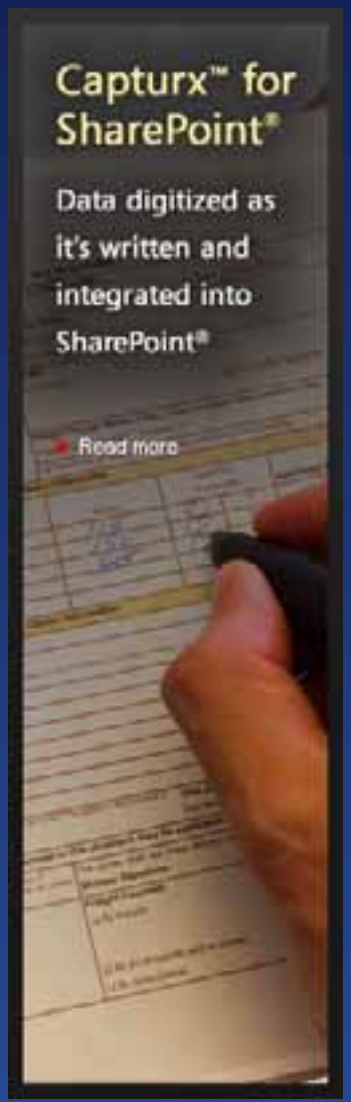
- The Natural Resources Conservation Service (NRCS), an agency of The United States Department of Agricultural, has national responsibilities for the coordination of the National Cooperative Soil Survey.
- The Adapx™ digital pen and associated Capturx™ ArcGIS® Desktop extension are technologies being evaluated as tools to assist in the completion of the initial soil survey of the United States and to assist in the update and maintenance of the spatial and attribute data for completed soil surveys.



Digital pen records 75 frames per second and digitally stores the location of ink marks on the paper and the attribute associated with the digitized feature (e.g., feature class and symbol)

Software products available:



Pilot Test:

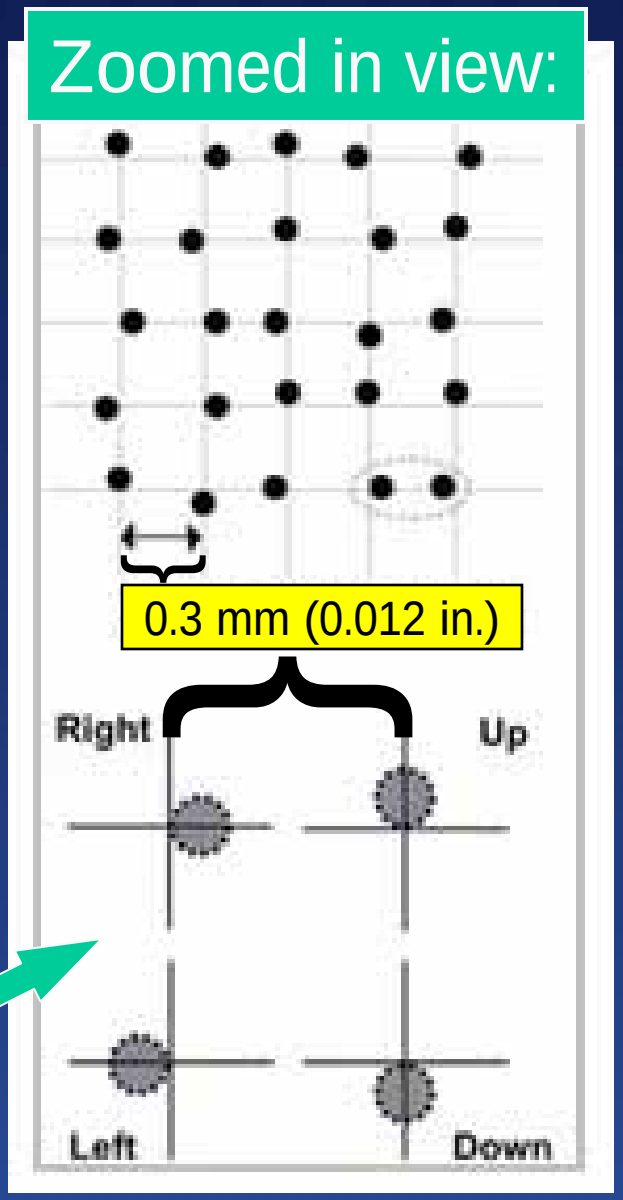
- Conducted in IA, WY, TX, & AL Aug. 26-Oct. 9, 2009
- Results were generally positive
- NRCS-Soil Business Area Analysis Group (SBAAG) recommended adopting this technology

Digital Pen Technology, Here's how it works:

- Create a layout covering the area of interest within ArcMap
- Add a legend to the layout using the ArcMap Legend Wizard
  - Include feature classes necessary for markup with the pen, e.g., Pen_lines, point and linear features

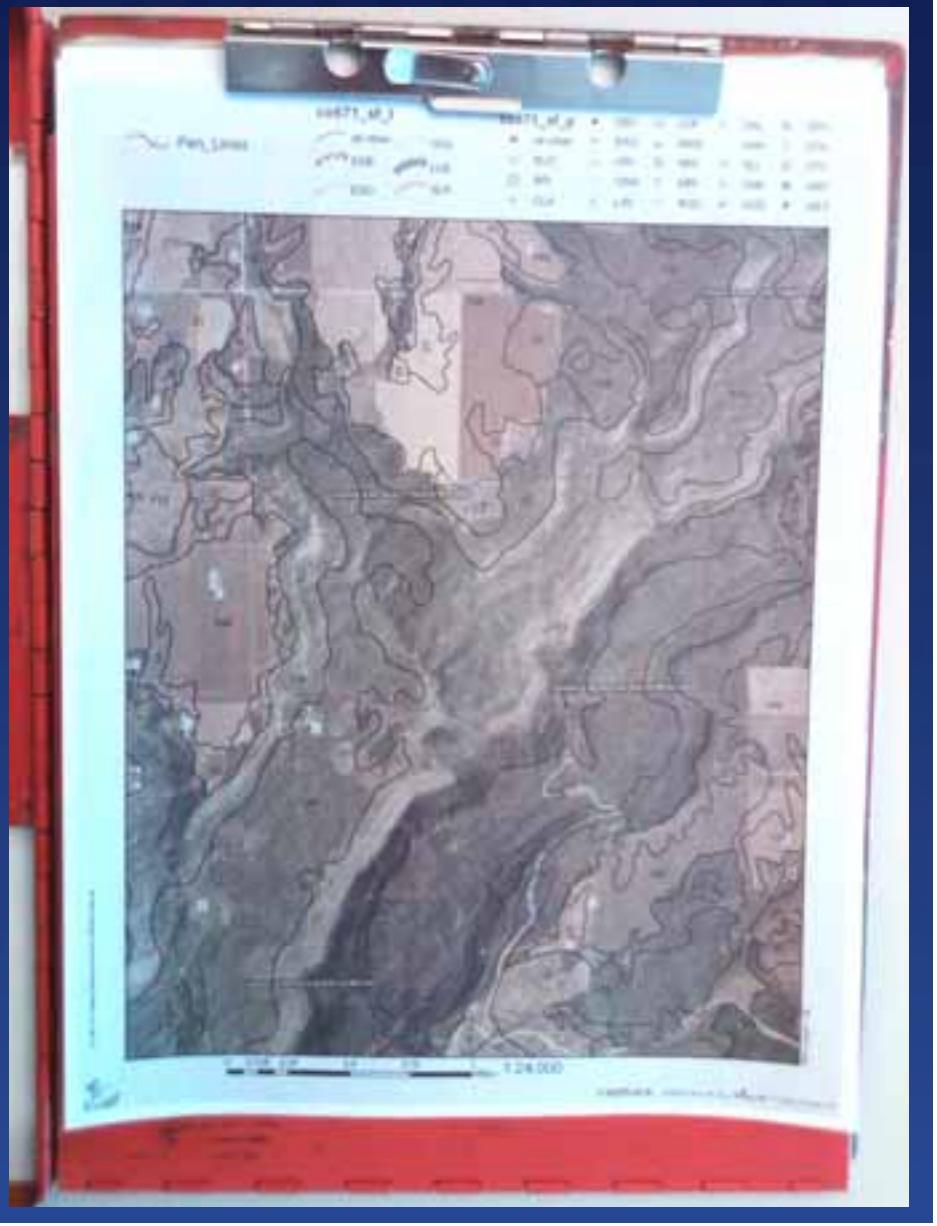
Digital Pen Technology, Here's how it works (cont):

- Print this layout from ArcMap on ANY white paper using the digital pen ArcMap extension
- Printed map will have a legend and map with an overlayed microdot pattern



Digital Pen Technology Here's how it works (cont.):

- Put the printed map and legend on your clipboard and go to the field

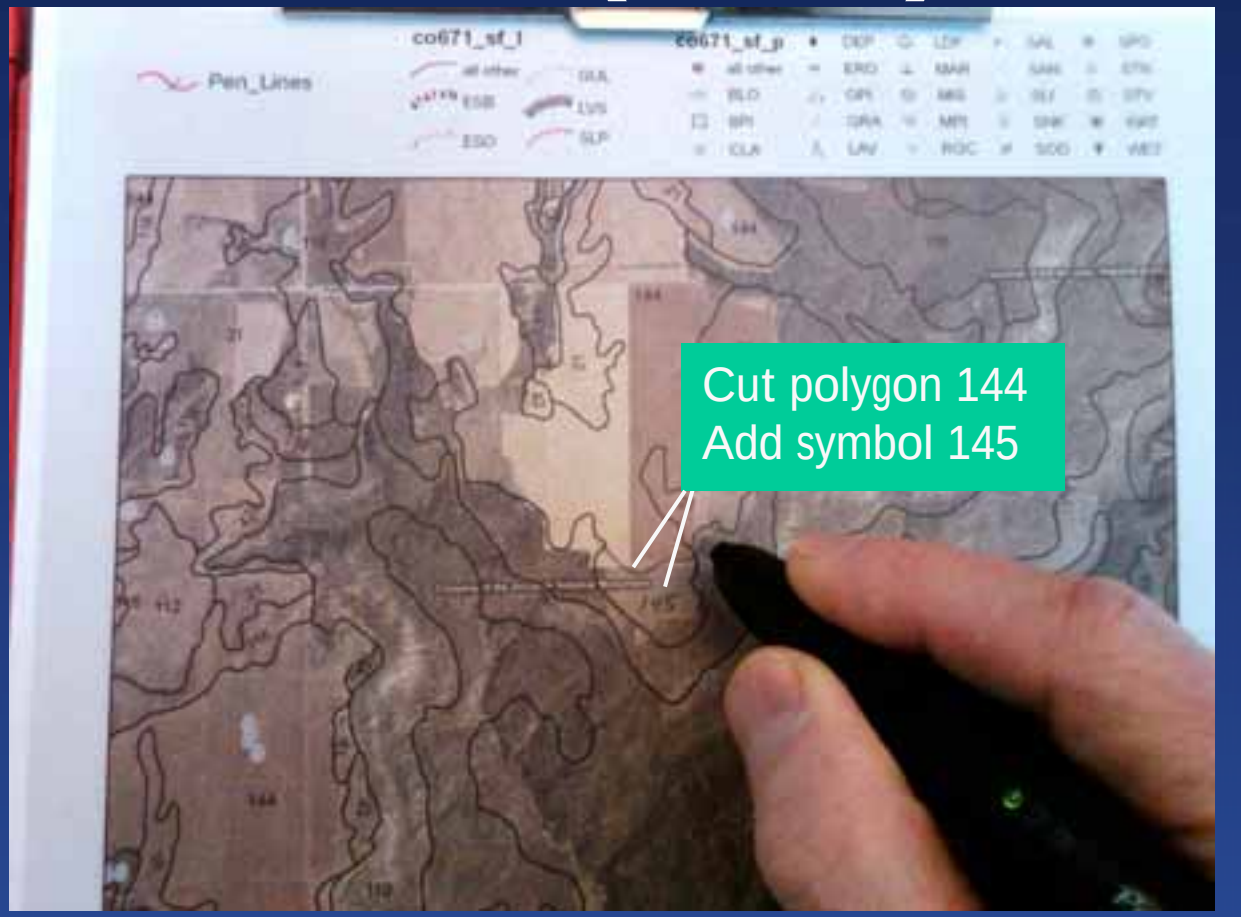


Digital Pen Technology Here's how it works (cont.):

- Mark the legend with the pen on the feature you want to digitize
- Features can be points, lines, polygons, or notes (annotations)

Digital Pen Technology Here's how it works (cont.):

- Make your edits/add-tions/notes on the map with the pen
- You now have a hard copy map with your changes as well as a digital version stored on the pen

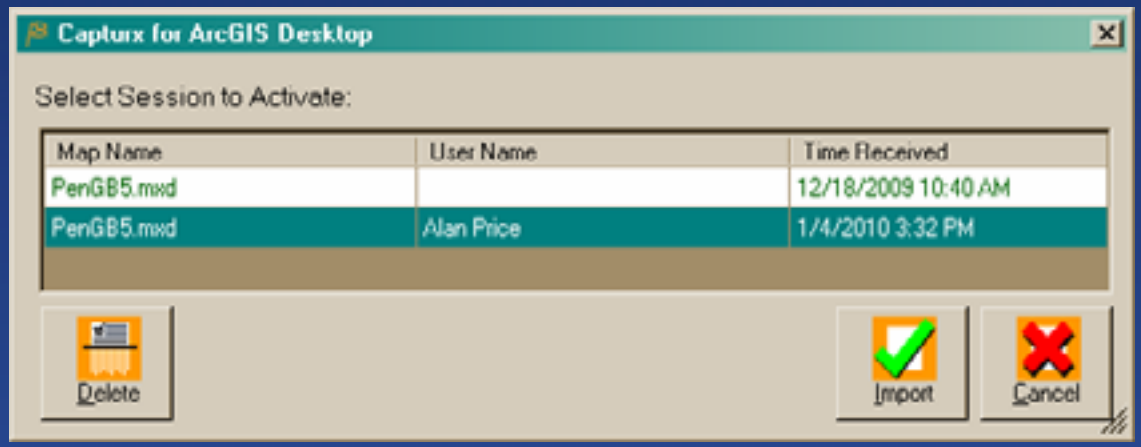


Digital Pen Technology Here's how it works (cont.):

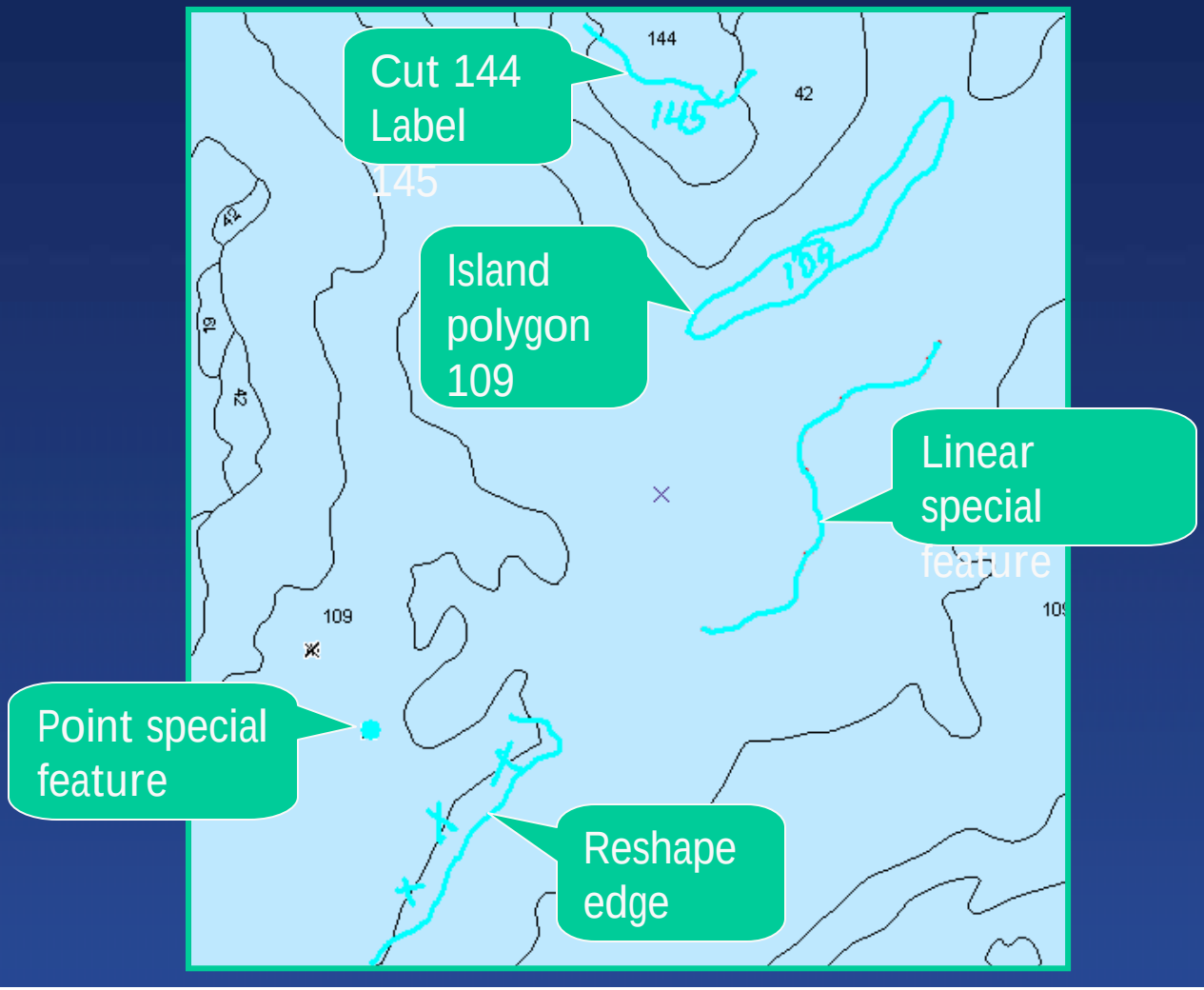
- Return to the office, dock the pen in the cradle connected to your computer
  - All recorded features on the pen are transferred to the appropriate feature class in the geodatabase.

ArcMap Workflow:

- Import pen markups to map document
  - Use Capturx ArcGIS Desktop Toolbar
    - Import current session 
    - Select from a list of sessions 



Imported features selected :



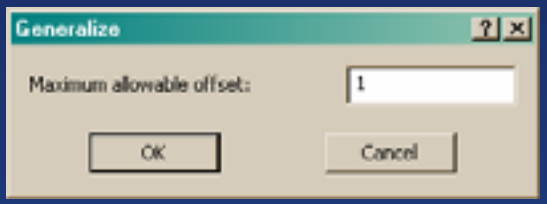
Digital Pen Technology Here's how it works (cont.):

- Overview of edits in ArcMap:
  - Generalize pen line features (reduce vertices)
  - Cut polygons (convert pen lines to polygon edges)
  - Add polygons (islands)
  - Reshape polygons
  - Merge polygons

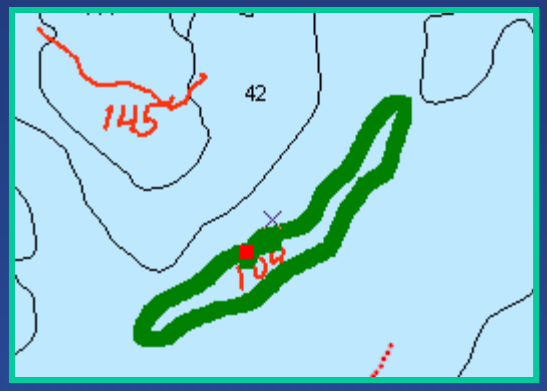
  Note: Linear and point features do not need further editing in ArcMap. Both are attributed when marked on the map with the pen.

Generalize Workflow:

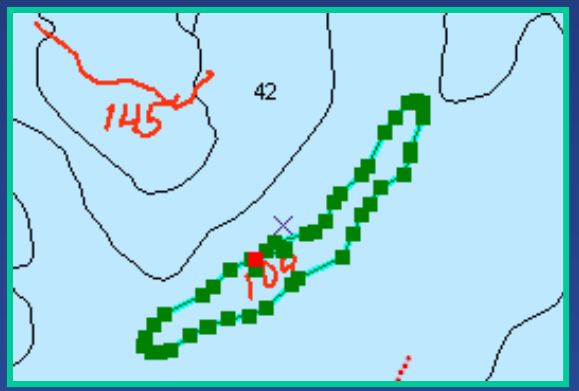
- Generalize pen lines (reduce vertices)
  - Select all pen line features
  - Select the“Generalize” button on the Advanced Editing Toolbar 
  - Maximum allowable offset: 1 meter



Before:



After:



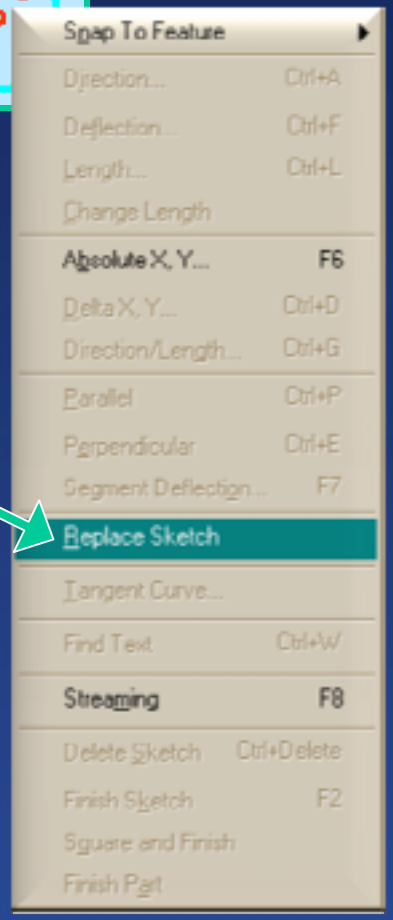
Cut Polygon Workflow:

- Set Task to "Cut…" and

  Set Target to soil polygon layer
- Select original polygon that will be cut
- Select Sketch tool from Editor Toolbar

Cut Polygon Workflow (cont.):

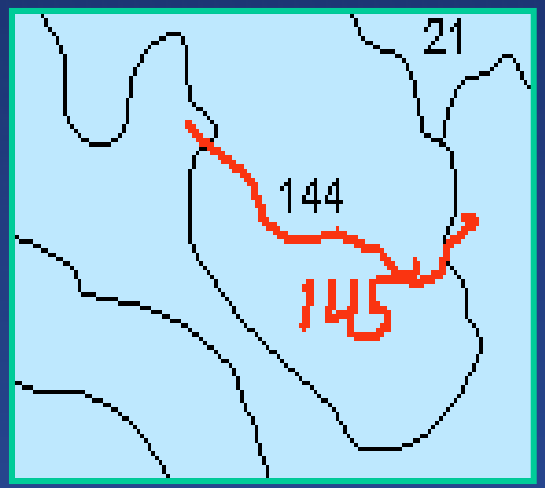
- Right-click with Sketch tool on pen line that is cutting the polygon
- Select “Replace Sketch” from drop-down menu
- Press “F2” to end replacement



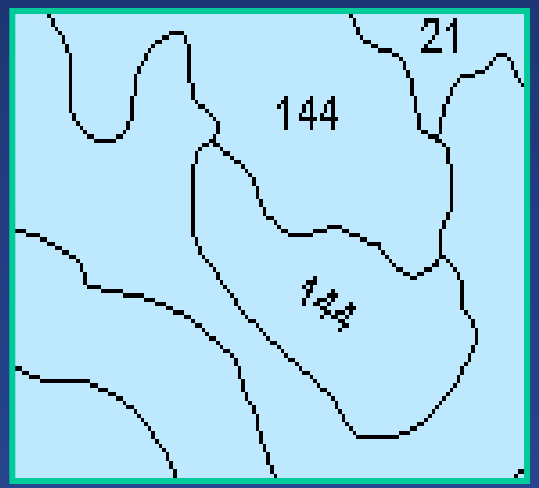
Cut Polygon Workflow (cont.):

- Original polygon is now cut in two

Before

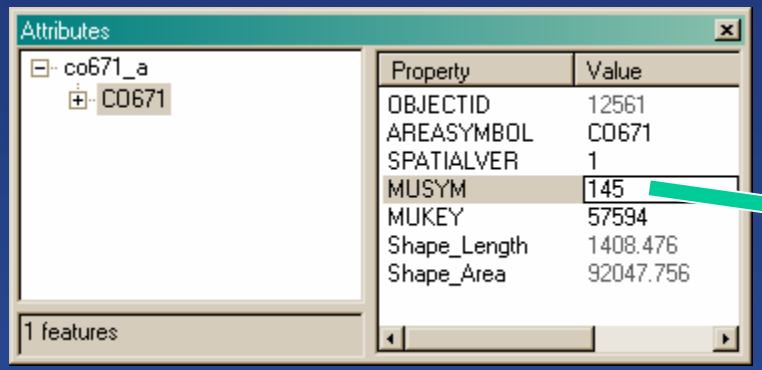


After



Cut Polygon Workflow (cont.):

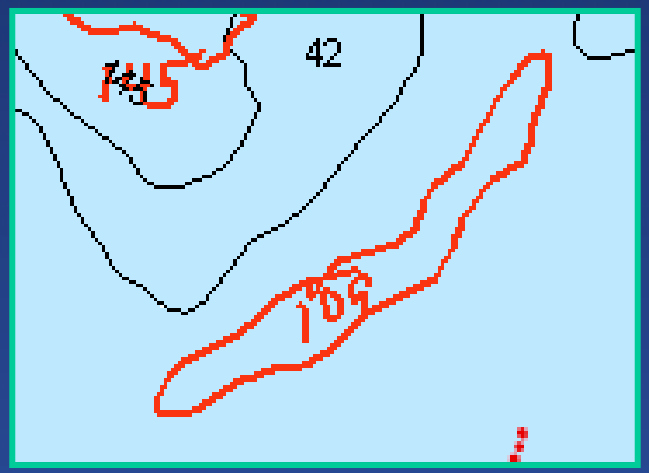
- Change the map unit symbol to "145" as noted with pen
  - Select new cut polygon
  - Open the Attributes table
  - Change "MUSYM" to "145"



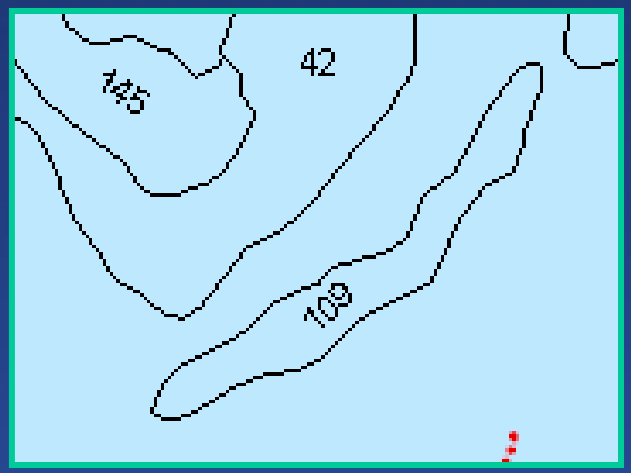
Add Polygon (island) Workflow

- Exactly the same workflow as cut polygon

Before



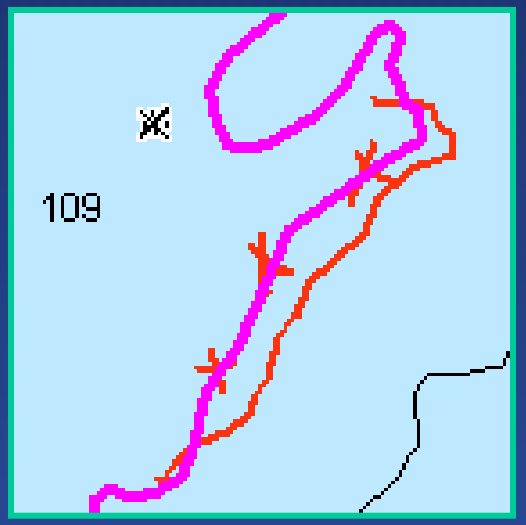
After



Reshape Edge Workflow:

- Set Task to "Reshape Edge" and

  Set Target to soil polygon layer
- Select the Topology Edit Tool 
- Click on the polygon edge that will be reshaped (polygon edge turns magenta)



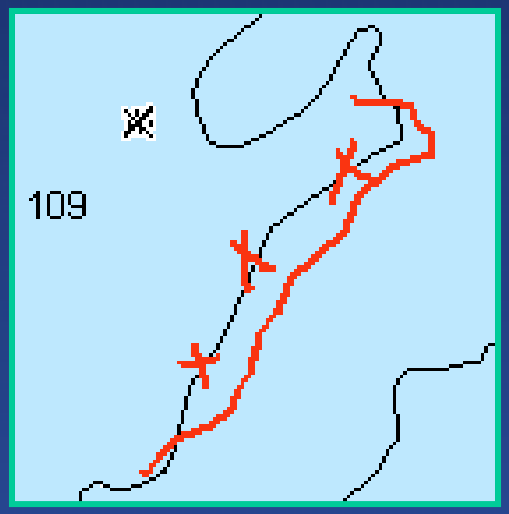
Reshape Edge Workflow (cont.):

- Select the Sketch tool
- Right-click with Sketch tool on the pen line that will reshape the polygon edge
- Select "Replace Sketch" from the drop-down menu
- Press "F2" to end the replacement

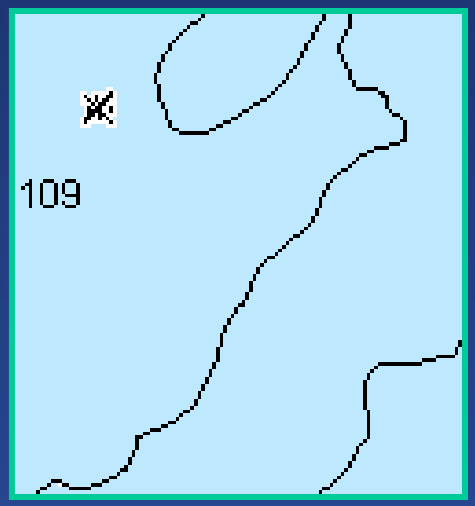
Reshape Edge Workflow (cont.):

- Polygon edge is reshaped using the line created with the pen

Before



After



Merge Polygon Workflow:

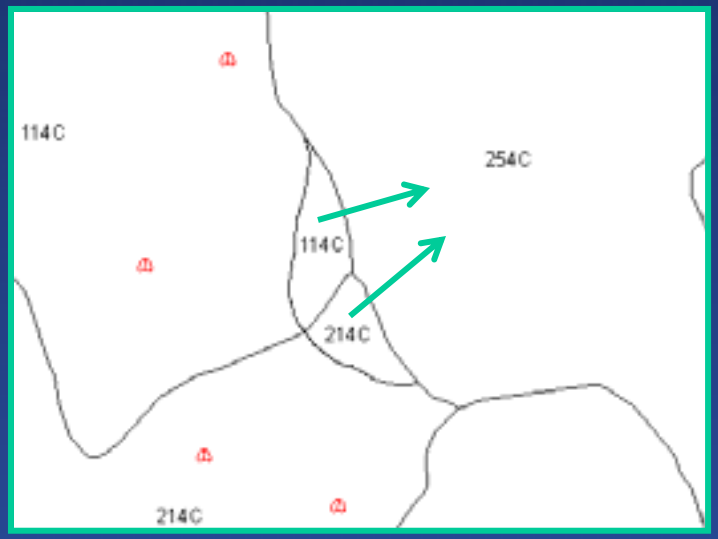
- Use pen to markup map
- Import pen markups as previously described

- Cut polygons that pen lines cross as previously described

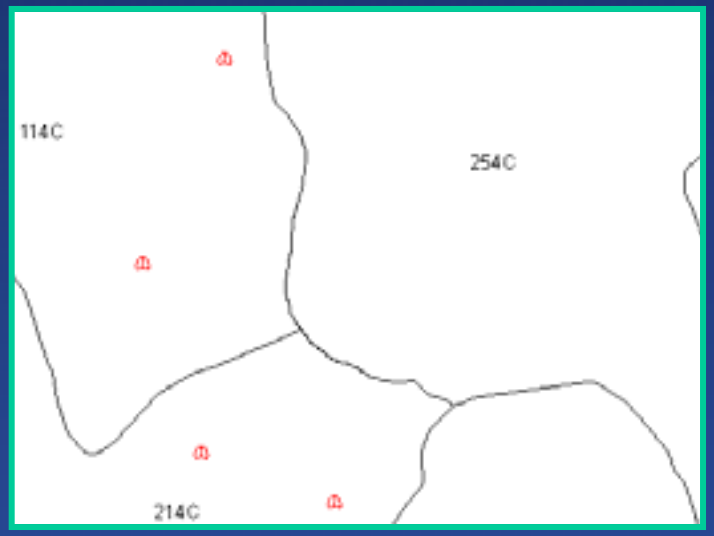
Merge Polygon Workflow (cont.):

- Merge resultant polygons into target polygon using ArcMap “Merge” command

Before



After



Conclusions:

- Digital pen can be an additional tool for recording spatial and attribute data in the field
- Digital pen may be more "culturally" acceptable to those field workers already using pen and paper

Conclusions (cont.):

- Digital pen and paper are more portable and less expensive than most other electronic devices used to record field data
- Digital pen records data electronically as well as on paper simultaneously (data are recoverable if pen is lost or damaged)

Conclusions (cont.):

- Workflows using the digital pen and ArcMap are relatively simple
- Digital pen markups are accurately captured and displayed in ArcMap
- The potential benefits of capturing spatial and attribute data in the field with the digital pen include efficiency and cost savings

Special thanks to:

- Pilot testers:
  - Auburn, AL soil survey office
  - Powell, WY soil survey office
  - Temple, TX MLRA Regional Office
  - Waverly, IA soil survey office
- Digital pen core team:
  - Caryl Radatz, St. Paul, MN
  - Whityn Owen, Portland, OR
  - Steve Peaslee, Lincoln, NE
  - Darrell Kautz, Morgantown, WV
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