Colorado Water Science Center
Geodatabase of Drainage Basins

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drainage basin for gage
at Animas River at Durango, CO
TALK OUTLINE

1. Why do we need basin boundaries
2. One way to digitally store them
3. How to maintain data quality
4. Delineating basins using this architecture
1. Why do we need basin boundaries?
Basin Delineation:

- Provides two properties:
  - Basin **boundary**: if digital, can use to partition landscape characteristics.
  - Numeric **drainage area**:
    - Normalize/compare basin landscape characteristics to understand effects of landscape on water movement or on constituent transport
    - Often dominant independent variable in regression equations for streamflow statistics
    - Forerunner for StreamStats

Land use, Big Thompson River watershed, CO

USGS StreamStats Website
USGS Data Sections at each WSC

- Publish drainage areas for streamgages:
  - Annual USGS Water Data Reports (ADRs): active gages
  - NWISWeb: inactive and active gages
  - Most still based on paper topos
2. One way to digitally store basins...

South Platte River at Fort Morgan, CO
File Geodatabase

- Unlimited size
- Nested basins: geodatabase polygon feature class is ideal: stores coincident polygon boundaries and can add topology rules
  - Shapefiles – can store coincident polygon boundaries but no topology- so, nested features are not easily edited simultaneously
  - Coverages – topology, but difficult to deal with nested polygons w/o using region coverages

The Loch Outlet, Loch Vale, CO
Feature Dataset

- Impose projection system: Albers equal area, NAD83 – drainage areas w/ high accuracy
- Include topology rules
- Can add a cluster tolerance to match that of the Watershed Boundary Dataset, from which we copy basins

Clear Creek at Golden, CO
Feature Classes in the Feature Dataset:

- 3 permanent feature classes:
  - Site points
  - Basin lines
  - Basin polygons

- Temporary feature classes added when delineating basins

Slate R ab Baxter Gulch @ HWY 135 nr Crested Butte, CO
Sites

- Point for which basin is derived - determines basin boundary
- Digital representation of a streamgage orifice, water-quality sampling site, confluence, and other types of site locations

gage location for Red Rock Canyon Creek at Mouth nr Thatcher, CO
## Added attributes: Sites Feature Class

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<th>SiteName</th>
<th>Latitude</th>
<th>Longitude</th>
<th>SiteType</th>
<th>GageType</th>
<th>Active</th>
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<td>Continuous monitoring</td>
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<td>Buckhorn Mouth</td>
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<td>Confluence</td>
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<td>Crest-stage gage</td>
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Basin Lines

- Basin perimeter
- One use - store metadata for line origin
- Another use - via topology rules, the line FC can be used to ‘glue’ together coincident nested/adjacent basin boundaries: if each poly boundary must overlie a single line and if there is one line at any location – can simultaneously edit all as one topological feature
Added attribute: Basin Lines
Feature Class

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</table>
Basin Polys

- Each polygon = a separate basin
- Generally nested
- Source of published numeric drainage area, automatically calculated in the polygon feature class Shape_area field

basin polygon for gage at Red Rock Canyon Creek at Mouth, Thatcher, CO
Added attributes: Basin Polygons
Feature Class

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<th>AreaRounded</th>
<th>Approved</th>
<th>NWISChanged</th>
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3. Maintaining data quality

Terror Creek at Mouth near Bowie,
Domains:

- 4 coded - value domains
- Data consistency: easier selection and editing
Four ‘Static’ Topology Rules:

- Four ‘static’ rules:
  - Basin lines must not have dangles.
  - Basin lines must not intersect or touch interior.
  - Basin lines must be covered by boundary of basin polygons.
  - Basin polygon boundaries must be covered by basin lines.

- Add temporary topology rules during basin delineation
4. How We Do Basin Delineation Using This Architecture

Yampa River near Maybell, CO
Source Datasets:

- Watershed Boundary Dataset (WBD), NRCS, certified for CONUS.
- 1:24k Digital Raster Graphics (DRGs) - digitizing new lines from sites to WBD.

Mineral Creek at Silverton, CO
Scope:

- Colorado basins.
- Only geomorphic/topographic basins.
- Corollary: do not (typically) derive basins for artificial features (canals, ditches) unless it is a channelized stream feature.

Crest-stage gage at Lakewood Gulch at Denver, CO
Production Workflow

- **Determine site location**
- **Delineated in GIS**
  - Copy/paste from WBD, adding lines digitized to site:1:24K DRGs
  - Compare to NHD stream pattern
  - Check against topology rules
- **Finalized by the Data Section**
  - Basin is reviewed using DRGs.
  - GIS drainage area compared to NWIS drainage area OR to NWIS area of nearest upstream and/or downstream site(s)
  - Drainage area is entered into NWIS.

Fraser River at Upper Sta, near Winter Park, CO
518 Basins delineated, including those for all active CO streamgages:
Comparisons of New and Old Drainage Areas

- Of 221 new basins, 21 had GIS drainage areas > 3% difference from old NWIS areas
- Errors: delineation, tabulation, not updating
- Mainly: poor quality, variable scale paper topographic maps.

Wild Horse Creek above Holly, CO
GIS Method

- 10-20 minutes
- Automatic, accurate area computation.
- Simple, accessible, editable storage.
- Uniform map scale 1:24k DRGs.
- Honors vector WBD ‘standard’
- Easy to teach, even to non-GIS folks.
- Other WSCs: Virginia and Maine - portable

Animas River at Tall Timber, CO
Remaining Issues

- Delineate basins for inactive Colorado stream gages.
- Non-contributing areas.
- 2011 USGS pubs:
  - “How to” report (Techniques and Methods)
  - Digital Data Series = geodatabase itself

Piceance Creek bl Ryan Gulch, nr Rio Blanco, CO