National Streamflow Information Program Network Analysis

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USGS

Why?

- To define a base network of Federally-funded NSIP stations
- To develop a long-term investment plan for implementing the NSIP
- To develop legislative support for implementing the NSIP plan

NSIP Network Analysis

- Initially consists of 4 goals to be assessed by the district offices using the ArcMap GIS tool
- The full analysis consists of 14 goals, the remaining 10 of which will initially be assessed by the Office of Surface Water

USGS

Time Frame

- Tools and data for analysis provided to districts by August 16, 2000
- Analyses to be completed by the districts by September 15, 2000
- OSW will compile data from districts, resolve differences, and finalize results for the 4 goals by October 15, 2000

USGS

Goal 1- Definition

Provide discharge data for USGS water-quality monitoring networks

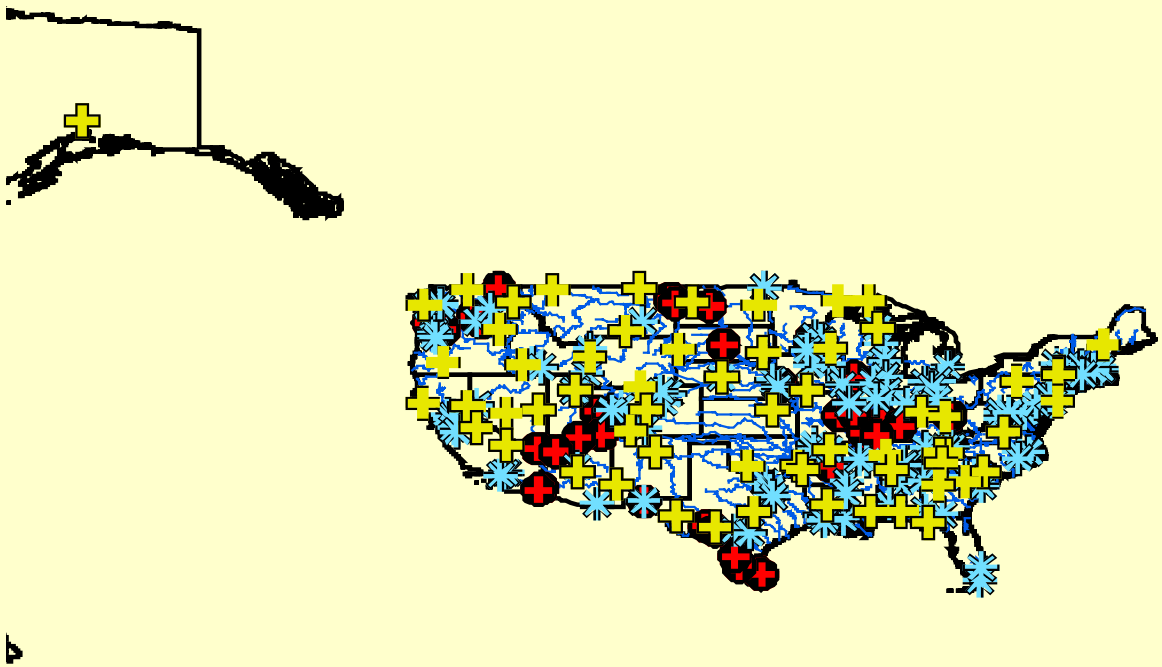
USGS

Goal 1 - Metric

Operate a discharge station at or near each Hydrologic Benchmark, NASQAN, and NAWQA Low-Intensity Phase station

USGS

Goal 1 – USGS Networks



Goal 2 - Definition

Provide discharge data for locations of treaties, compacts, and flows across State and International boundaries

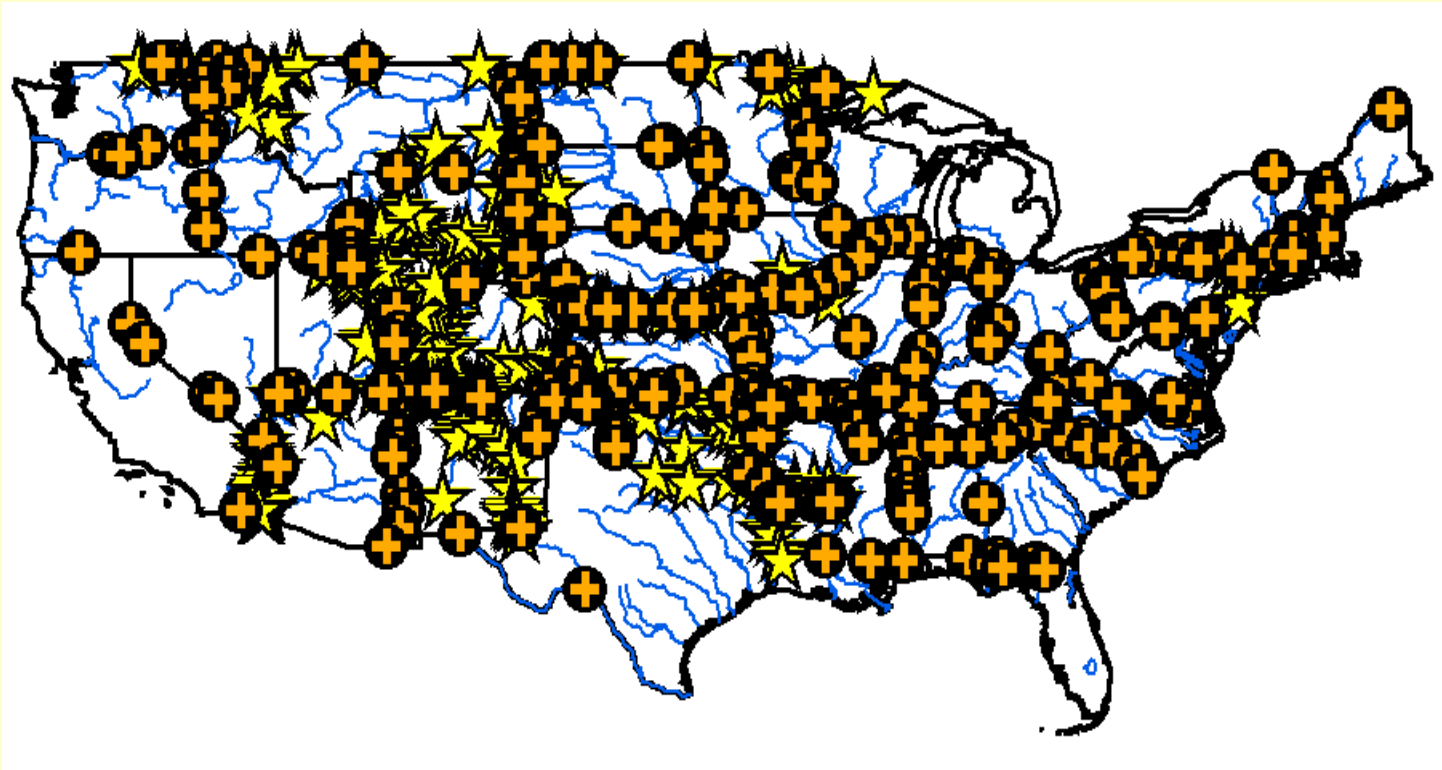
USGS

Goal 2 - Metric

Operate a station on the RF1 reach mandated in all compacts and decrees, and on all rivers with drainage areas greater than 500 sq. mi. at State and International boundaries

USGS

Goal 2 Initial Map



USGS

Goal 3 - Definition

Provide representative discharge data for each of the major river basins in the Nation

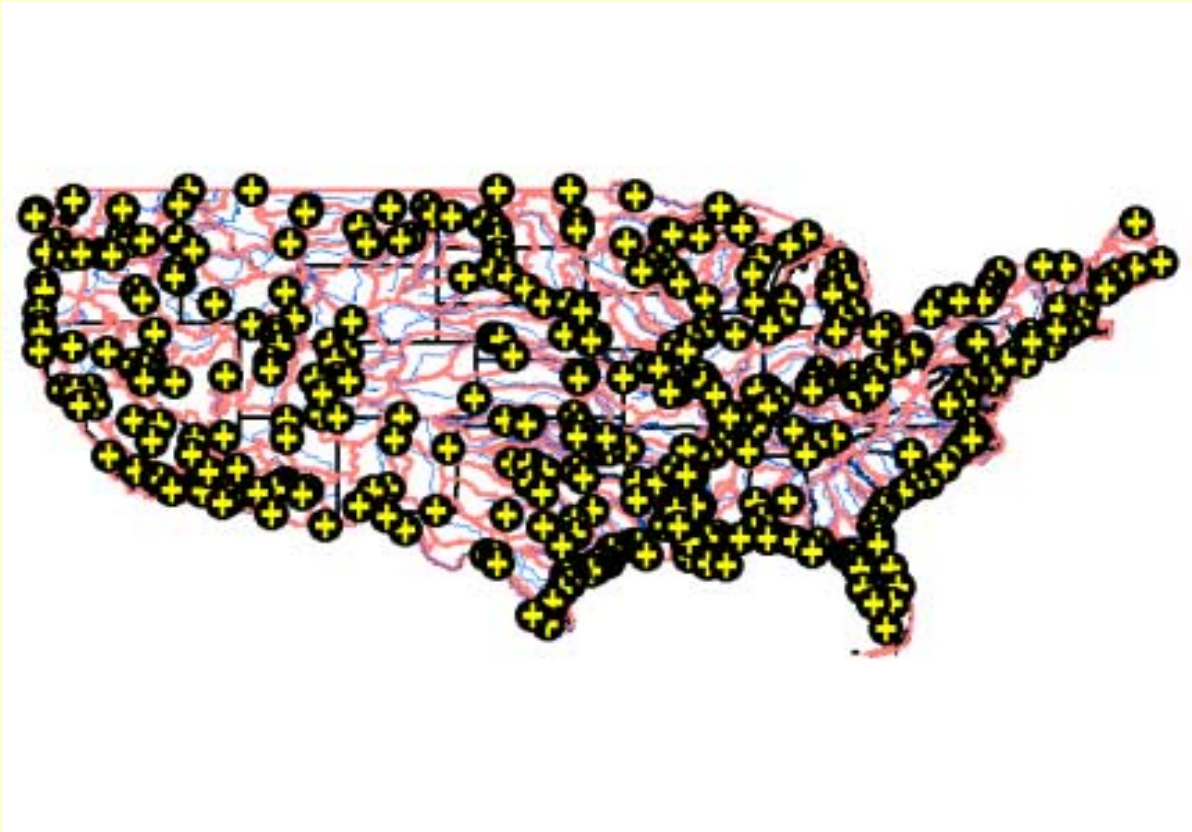
USGS

Goal 3 - Metric

Operate 1 or 2 stations that provide discharge data for at least 50 percent of the drainage area of each hydrologic accounting unit (6-digit HUC)

USGS

Goal 3 --Hydrologic Accounting Units



USGS

Goal 4 - Definition

Provide discharge data for "Sentinel Watersheds" that typify regional natural streamflow conditions and enable assessments of long-term trends

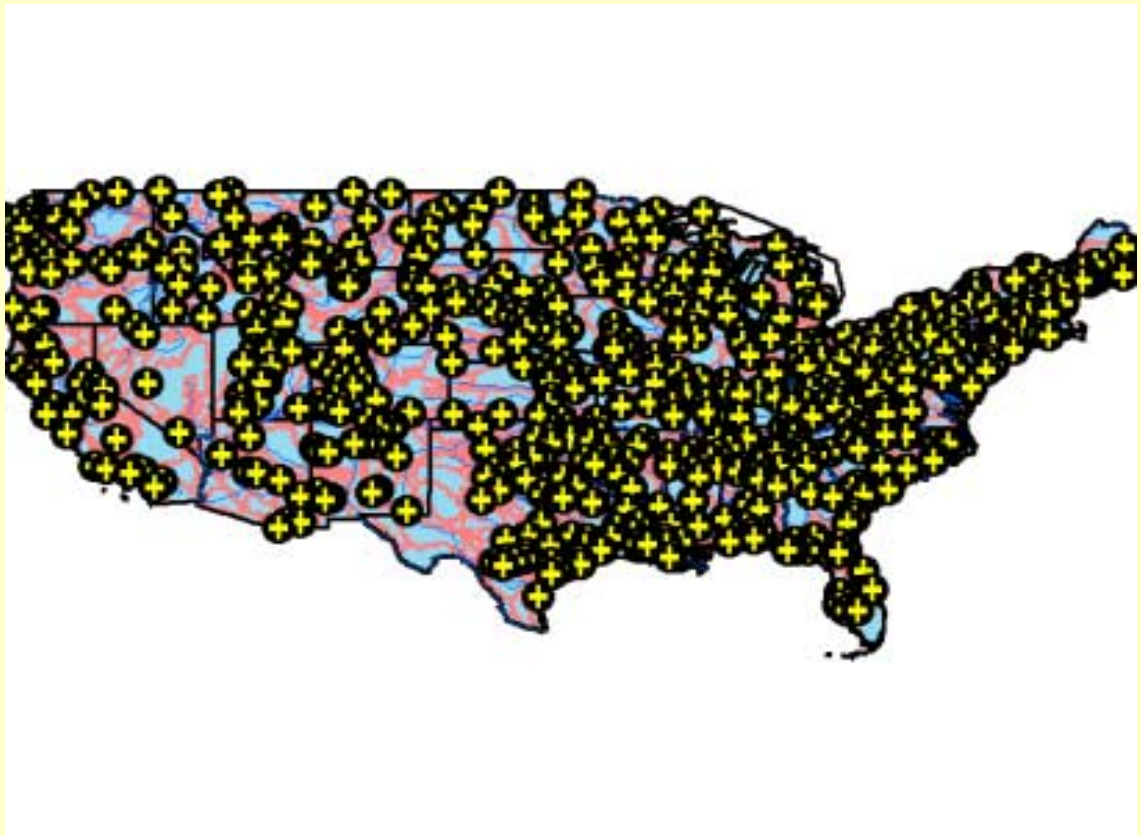
USGS

Goal 4 - Metric

Operate an unregulated station in each area of 100 sq. mi. or greater formed by the intersection of the 6-digit HUCs and Ecological Regions

USGS

Goal 4 – Sentinel Stations



USGS

Gaging Station List

- 20,825 stations in all
- 6,913 active USGS discharge stations
- 11,598 discontinued USGS stations
- 1,852 stations operated by other agencies
- 462 non-USGS network stations served real-time by USGS

USGS

Active USGS stations

- 1,129 active HCDN stations
- 418 furnished-record stations
- 4,150 USGS real-time stations
- Includes only discharge stations

Discontinued USGS stations

- 407 inactive HCDN stations
- Includes stage-only stations

Other-Agency Stations

- 1,308 discharge stations
- 544 stage stations
- 906 stations with telemetry
- Quality of data is not well documented

USGS

Non-Network Real Time

- Includes stations operated by other agencies but served on USGS Web pages
- Includes USGS project stations not considered part of the network

Determining Active USGS Stations

- Queried NWIS database of each district to identify stations with discharge daily values during 1999 (stage-only sites were not included)
- Deleted duplicate station ID’s and multiple time series at single locations
- Deleted “test” and “work” records, etc.

Determining Active USGS Stations, cont'd

- Checked list against 1999 data reports to verify active status and identify furnished-record stations
- Contacted some districts to resolve questions
- Each district should check the station list before proceeding further with the analysis

USGS

Determining Stations Operated by Other Agencies

- Members of the ACWI Streamgaging Task Force and USGS district offices identified agencies and provided contacts
- Agencies provided lists of stations not operated by USGS or served through USGS Web pages

Determining Non-Network Real-Time Stations

- The active station list was merged with a list of all stations served by USGS on the Web
- All stations common to both lists were removed

Station Selection Priorities

1. Active HCDN
2. Active non-HCDN
3. Active furnished-record
4. Recently discontinued HCDN
5. Recently discontinued non-HCDN

USGS

Station Selection Priorities, cont'd

6. Non-network real time
7. Other agency discharge
8. Other agency stage
9. Long discontinued HCDN
10. Long discontinued non-HCDN
11. New station

USGS

Using the ArcMap Tool

USGS

First Steps

- Install ArcInfo 8.0.2 with ArcMap on an NT workstation
- Insert the NSIP CD into your CD drive

USGS

Copy Files to a New Directory on Your Hard Disk

- goal_1.mxd
- goal_2.mxd
- goal_3.mxd
- goal_4.mxd
- nsip_sites.ldb
- nsip_sites.mdb

USGS

In NT Explorer

1. Click on the new directory you created in the folders frame
2. Click anywhere in the contents frame
3. From the Edit pull-down menu, click on Select All to highlight the files
4. With your cursor over any of the highlighted files, click your right mouse button

USGS

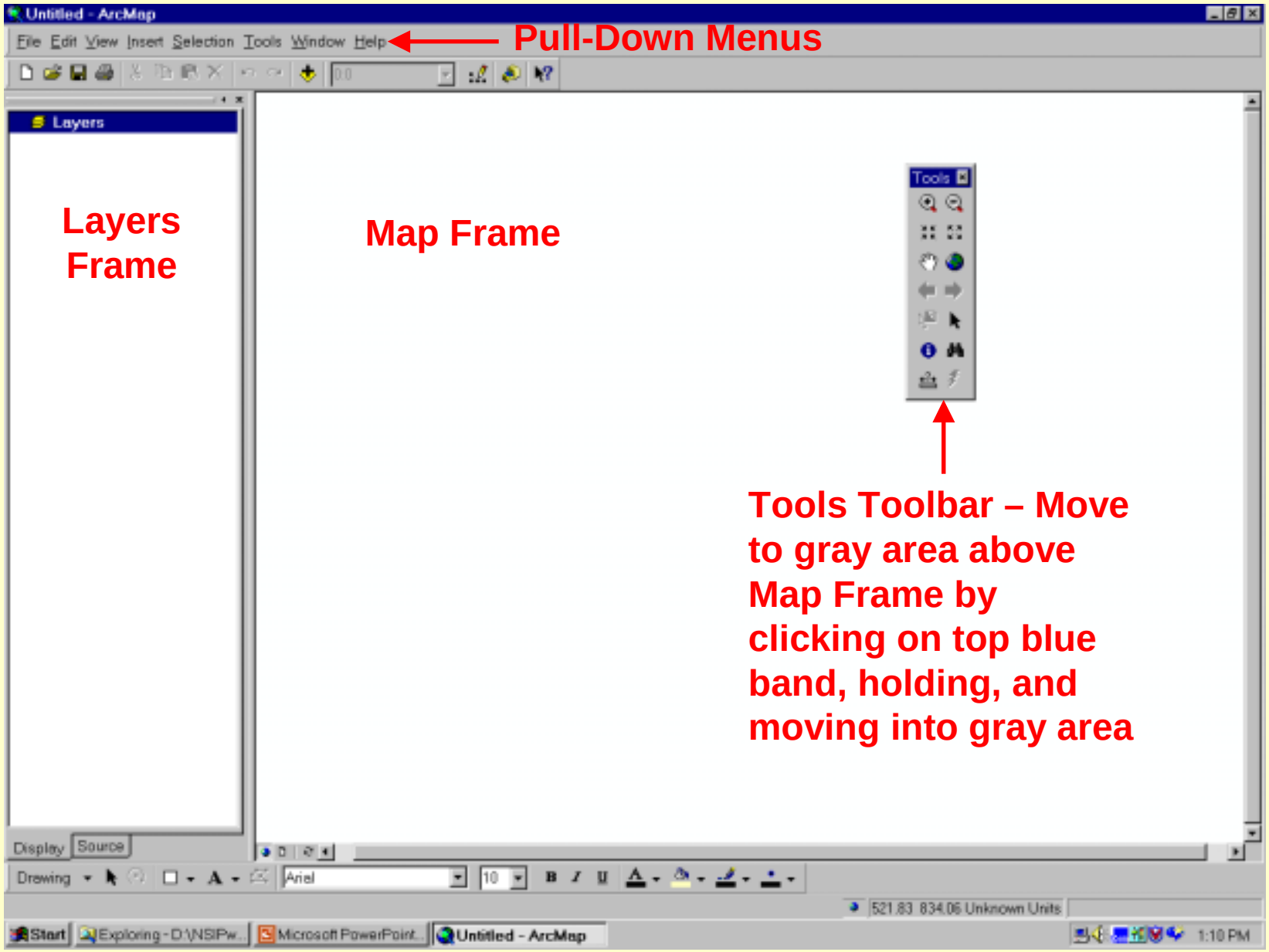
In NT Explorer, cont'd

5. Select Properties from the menu that appears by clicking on it with your left mouse button
6. Left click on the check box beside Read Only to turn it off, click on Apply, then on OK

Starting ArcMap

- Click on the Start button at the bottom left of your screen
- Select Programs, then ArcInfo, then ArcMap
- Initially, the screen will be split into a small Layers frame on the left and a large Map frame on the right

USGS

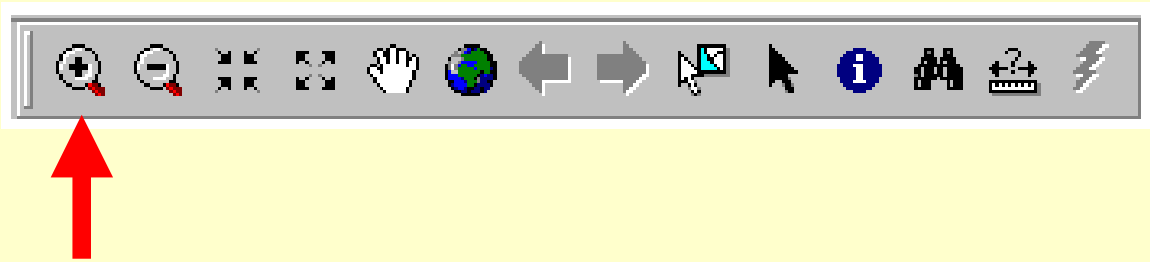

Untitled - ArcMap
File Edit View Insert Selection Tools Window Help
Pull-Down Menus
Layers
Layers Frame
Map Frame
Tools
Tools Toolbar – Move to gray area above Map Frame by clicking on top blue band, holding, and moving into gray area
Display Source
Drawing
Arial
10
521.83 834.06 Unknown Units
Start
Exploring - D:\NSIPw...
Microsoft PowerPoint...
Untitled - ArcMap
1:10 PM

USGS

Starting ArcMap, cont'd

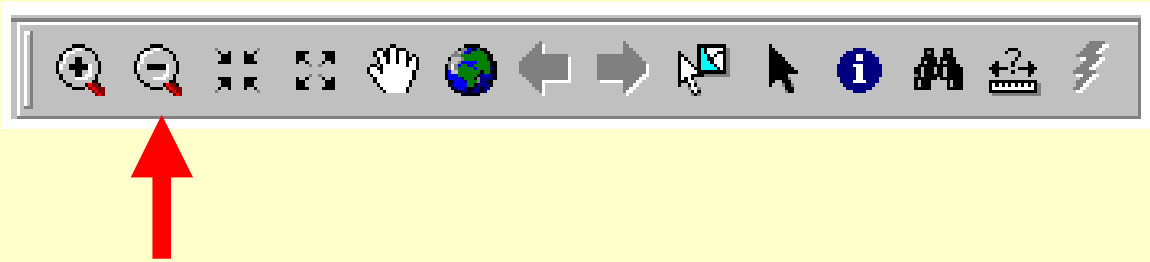
- A Tools toolbar will be shown in the Map frame. You can move it to the gray area above the Map frame by grabbing the blue band at the top of the Tools box (hold down left mouse button) and moving it up out of the Map frame
- Holding your cursor over the items in the bar causes their definitions to be shown

The Tools Toolbar



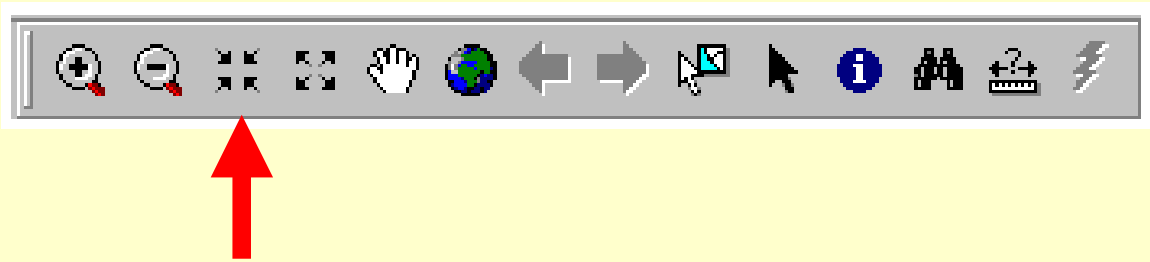
Zoom In – Changes the mapped area to a smaller area defined by holding the left mouse button down and moving the cursor to define a rectangle

The Tools Toolbar, cont'd



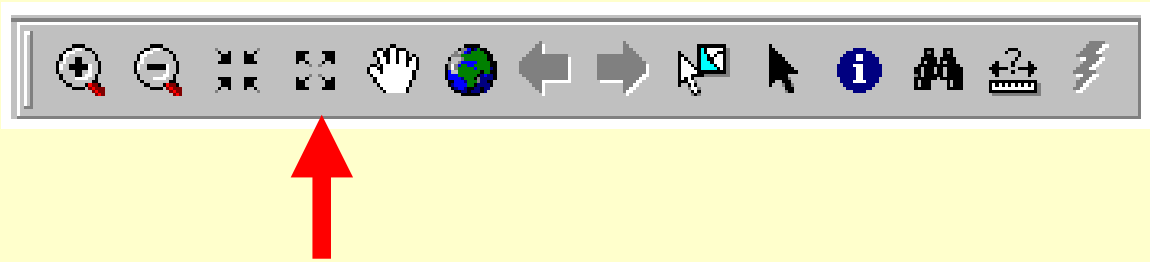
Zoom Out – Changes the mapped area to a larger area defined by holding the left mouse button down and moving the cursor to define a rectangle

The Tools Toolbar, cont'd



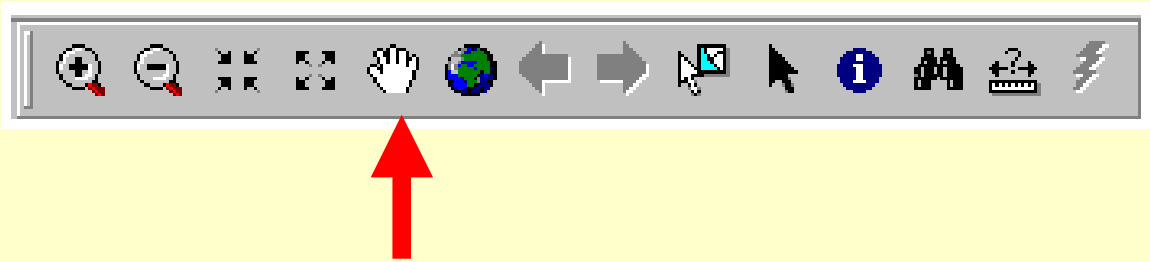
Fixed Zoom In – Changes the mapped area to a smaller area defined by software-defined fixed amount

The Tools Toolbar, cont'd



Fixed Zoom Out – Changes the mapped area to a larger area defined by software-defined fixed amount

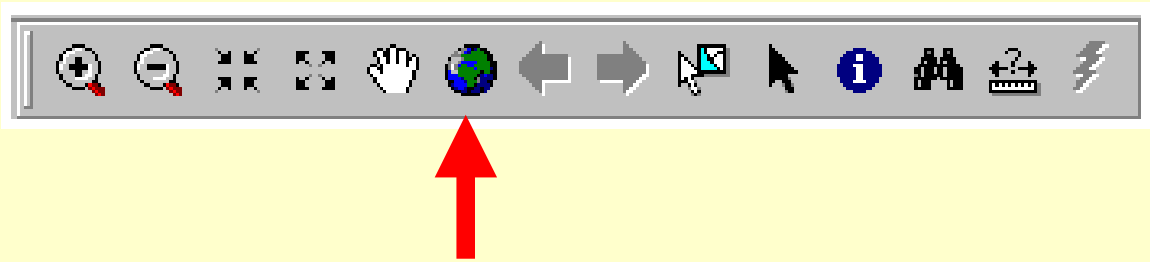
The Tools Toolbar, cont'd



Pan – Changes the center of the mapped area by clicking and holding on a location on the map and moving your mouse

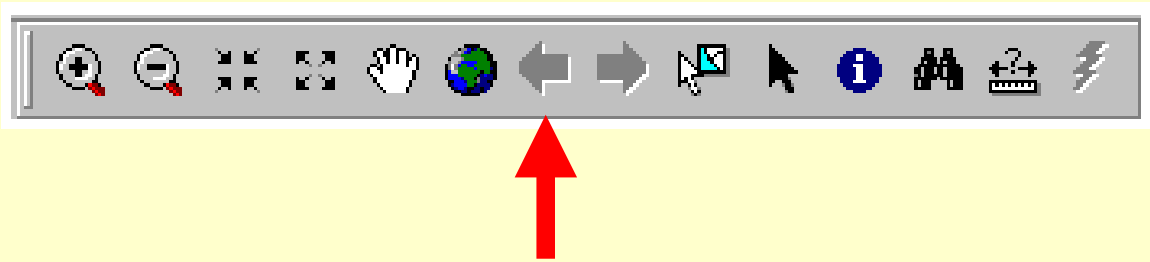
USGS

The Tools Toolbar, cont'd



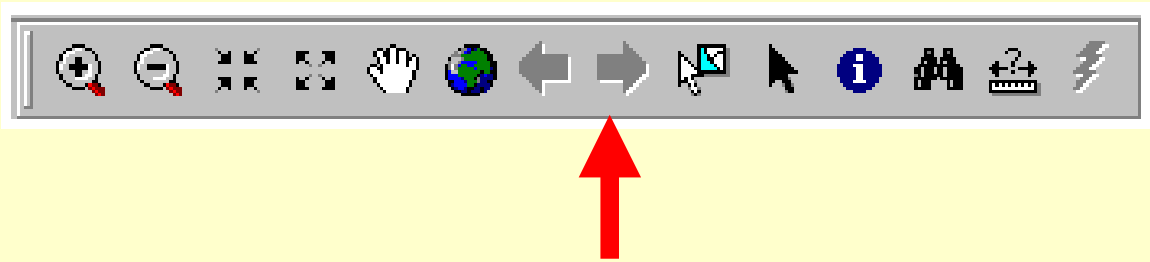
Full Extent – Shows the entire mapped area in the map frame

The Tools Toolbar, cont'd



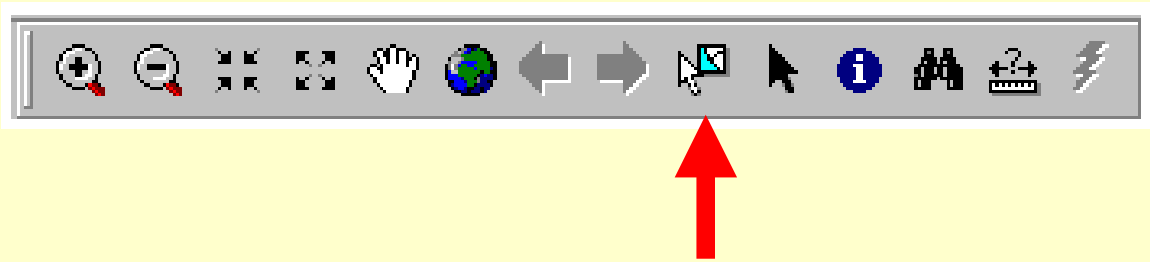
Go Back – Returns to the previous view

The Tools Toolbar, cont'd



Go Forward – Goes to the next view

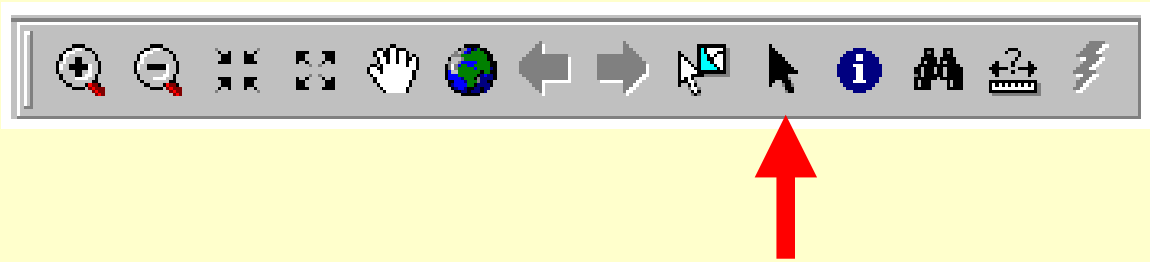
The Tools Toolbar, cont'd



Select Feature – Selects a feature on the map for further analysis

USGS

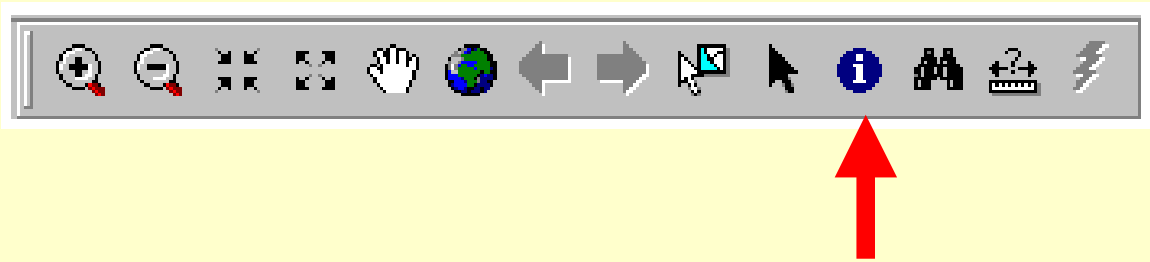
The Tools Toolbar, cont'd



Select Graphics – Lets you select graphics for editing, such as north arrows and scale bars

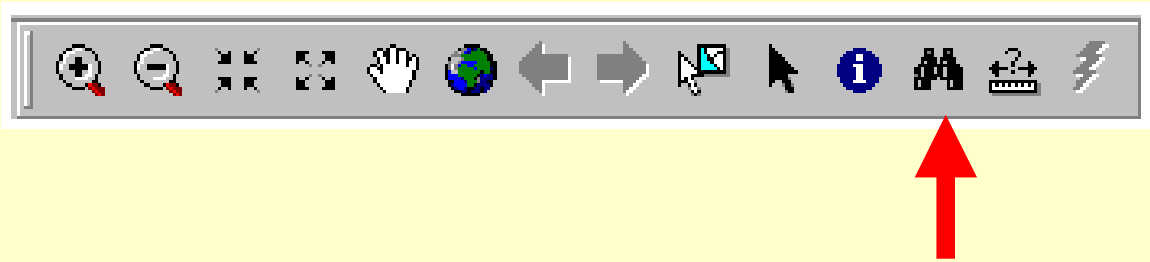
USGS

The Tools Toolbar, cont'd



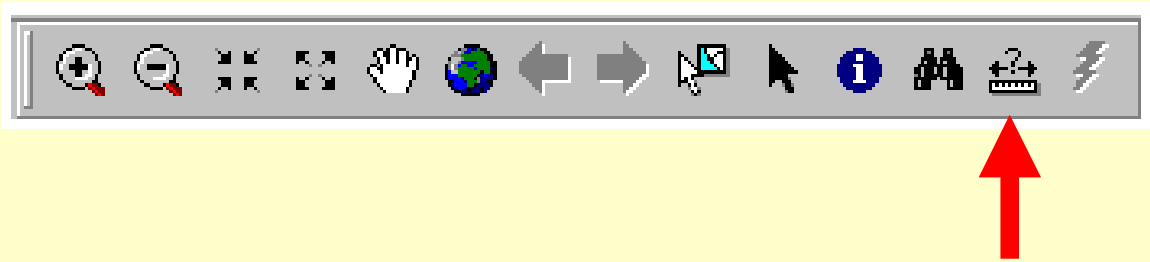
Identify Features – Provides tables of attributes for the features you select

The Tools Toolbar, cont'd



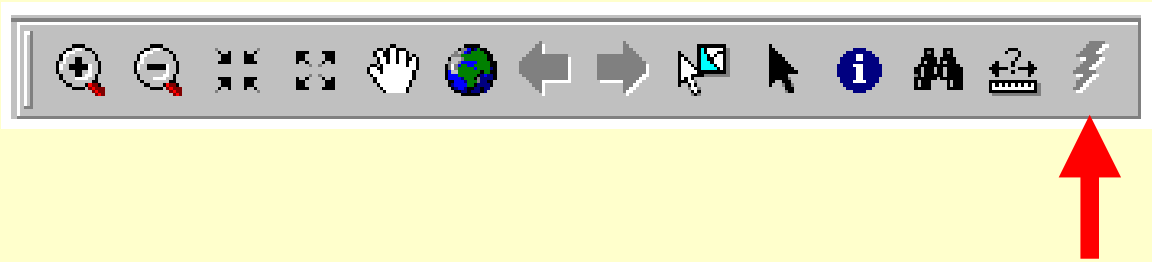
Find Features – Finds geographic features based on the attributes you select

The Tools Toolbar, cont'd



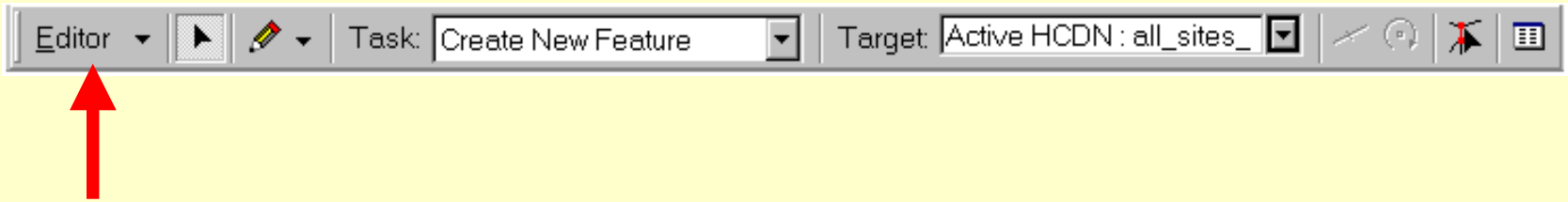
Measure Tool – Measures distances on the map

The Tools Toolbar, cont'd



Hyperlink Tool – Triggers a hyperlink to a file or URL

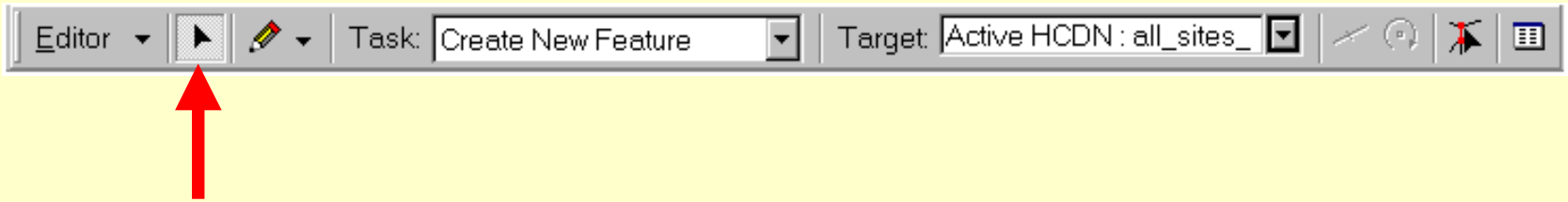
The Editor Toolbar



Editor Button – Activates a pull-down menu that allows you to start, stop, and save edits, as well as other actions that you likely will not use

USGS

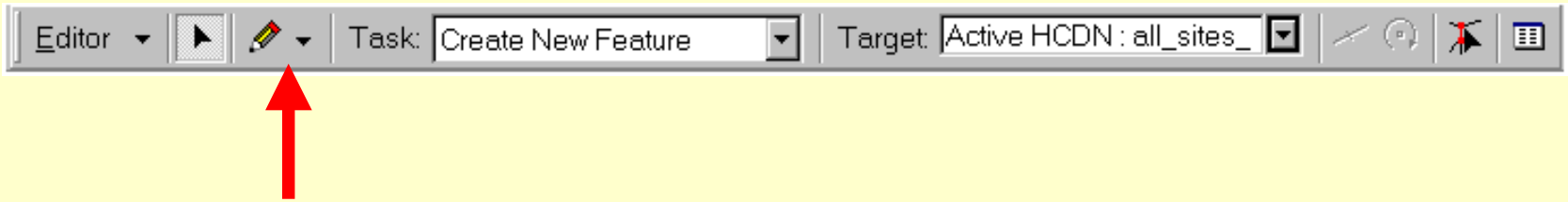
The Editor Toolbar, cont'd



Editor Tool – Allows you to select features for editing

USGS

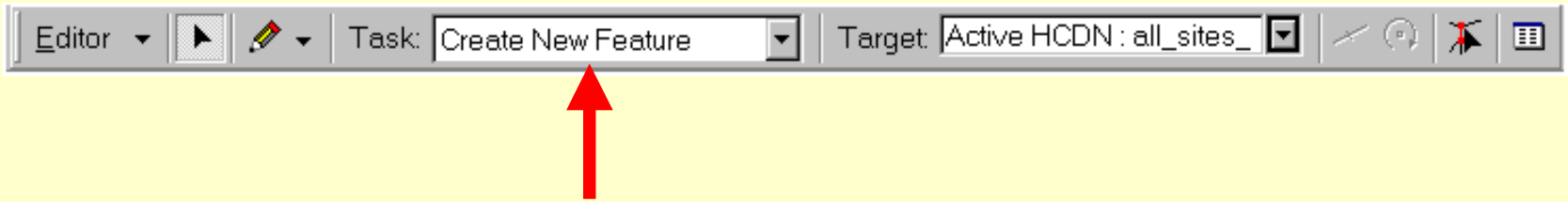
The Editor Toolbar, cont'd



Sketch Tool – Allows you to add points, lines, and polygons. You will use this feature to add new stations to the database when existing stations do not satisfy network goals.

USGS

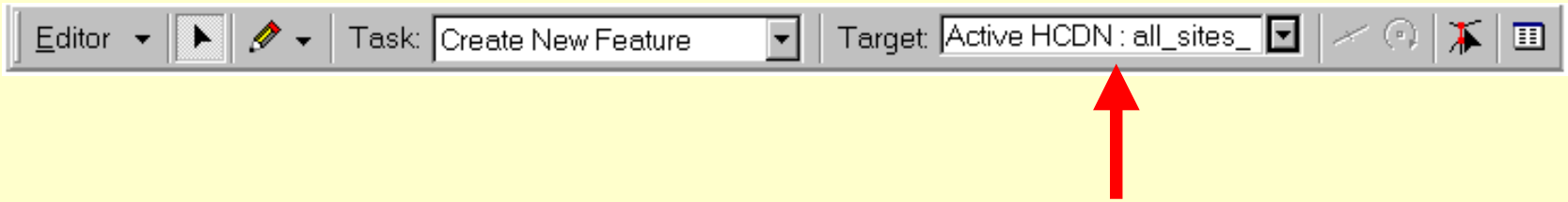
The Editor Toolbar, cont'd



Task Control – Sets the current editing task to be performed

USGS

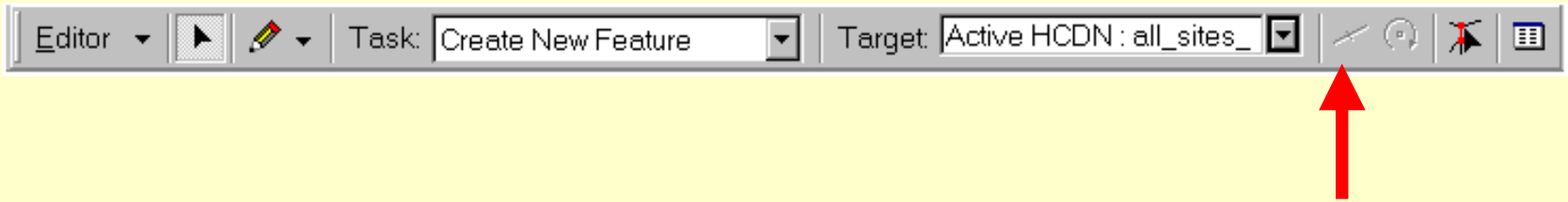
The Editor Toolbar, cont'd



Target Layer Control – Specifies the data layer in which to store new features

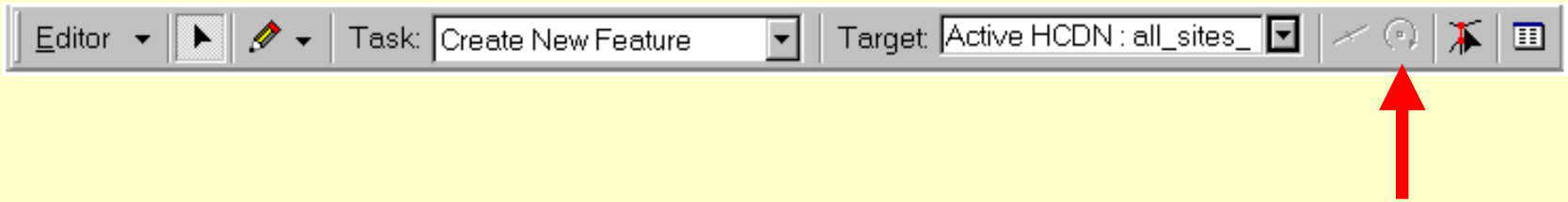
USGS

The Editor Toolbar, cont'd



Split Tool – Divides one selected feature into two; not likely to be needed.

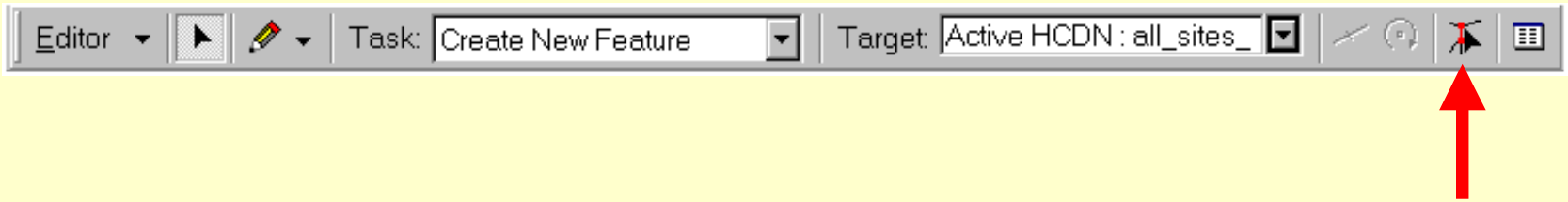
The Editor Toolbar, cont'd



Rotate Tool – Rotates features by a user-defined angle; not likely to be needed.

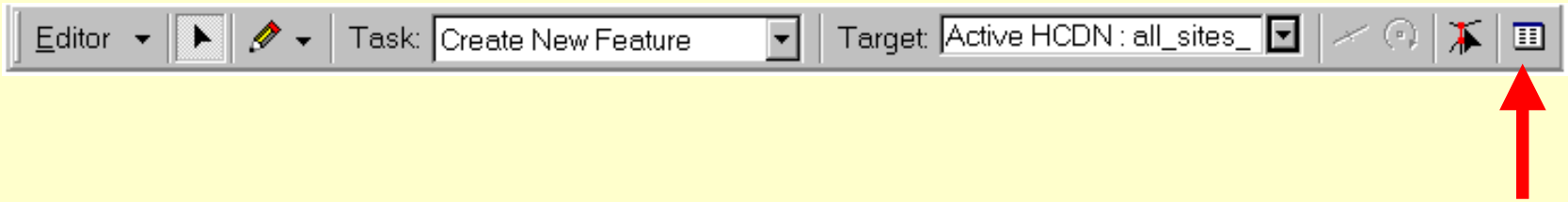
USGS

The Editor Toolbar, cont'd



Shared Edit Tool – Selects a common point or edge shared by two features for editing; not likely to be needed.

The Editor Toolbar, cont'd



Attributes – Allows you to display and edit feature attributes

The Editor Toolbar, cont'd

A B C

Unless you need to add a new station, you will need to use only the Editor Button (A) to start, stop, and save edits, the Editor Tool (B) to select features, and the Attributes Button (C) to edit features

USGS

TIP!

Left-click on the What's This button and then left-click on any other button or menu item to see a more detailed description of its purpose

USGS

Select a Goal

- Open a goal in ArcMap by clicking on Open from the File menu
- Select the goal (ex. goal_1.mxd) from the appropriate directory on your hard drive, then click on Open

USGS

Define Data Sources

1. The Layers frame on the left of your screen shows the data layer names and symbols used in the analysis
2. A red exclamation mark will be shown initially beside the check box to the left of each data layer name
3. Click on the exclamation mark on the Active HCDN line to make the Data Source window appear

USGS

Define Data Sources, cont'd

4. Select the nsip_sites.mdb file you saved on your hard drive
5. Select the all_sites_g_point file that appears next in the window
6. The exclamation points will disappear from the Layers frame for the first 7 data layers

USGS

Define Data Sources, cont'd

7. Double-click on the exclamation point on the RF1 Streams layer to make the Data Source window appear
8. Select the rf1_str.shp file your CD drive
9. The remaining exclamation points will disappear and a map will be drawn in the Map frame

USGS

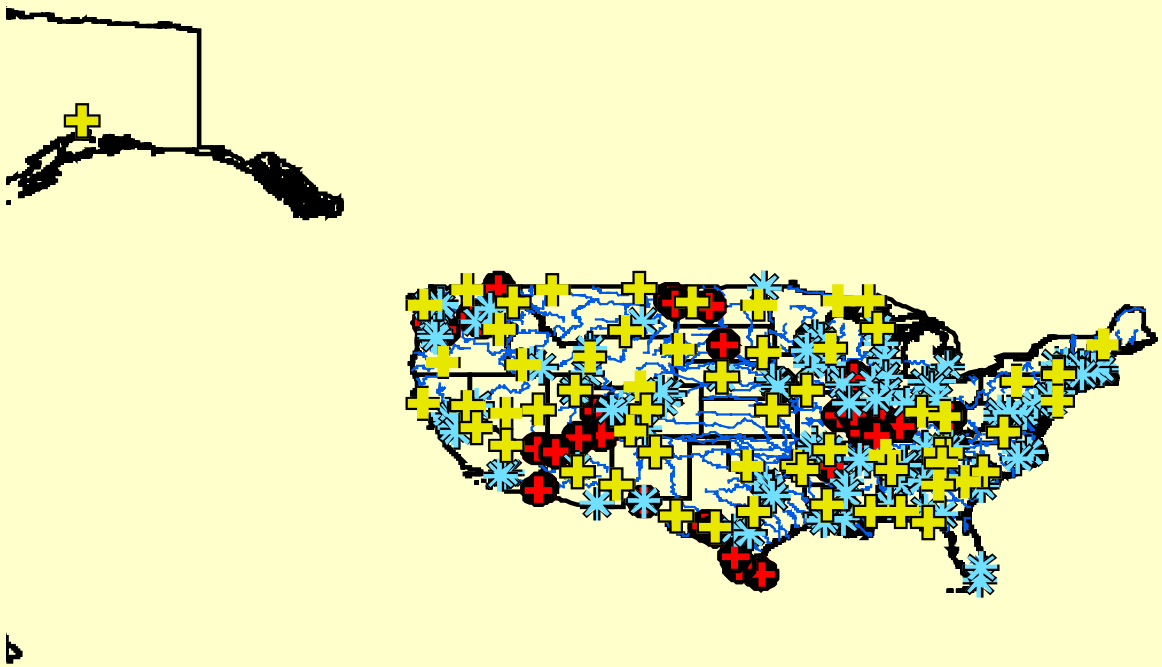
Goal 1 – Water Quality Networks

Goal 1 – USGS Networks

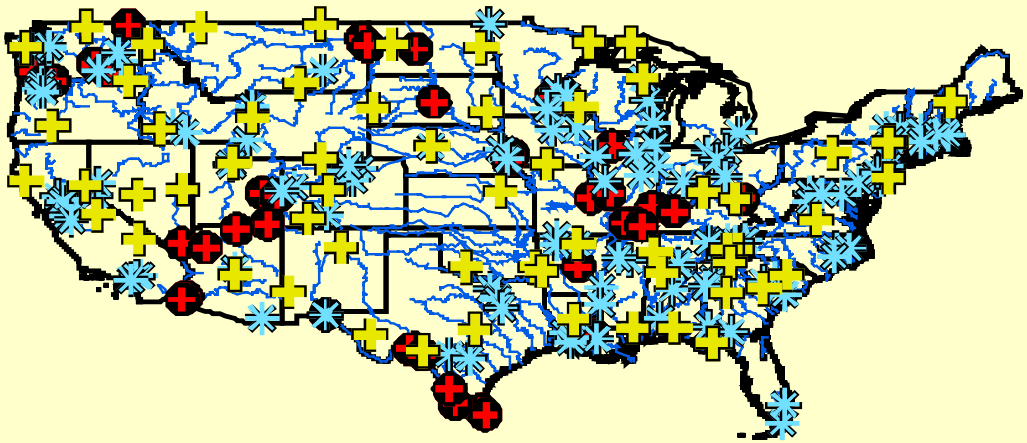
- NASQAN -- Redesigned Sites
- HBM – Hydrologic Bench Mark
- NAWQA-LIP – Low Intensity Phase

USGS

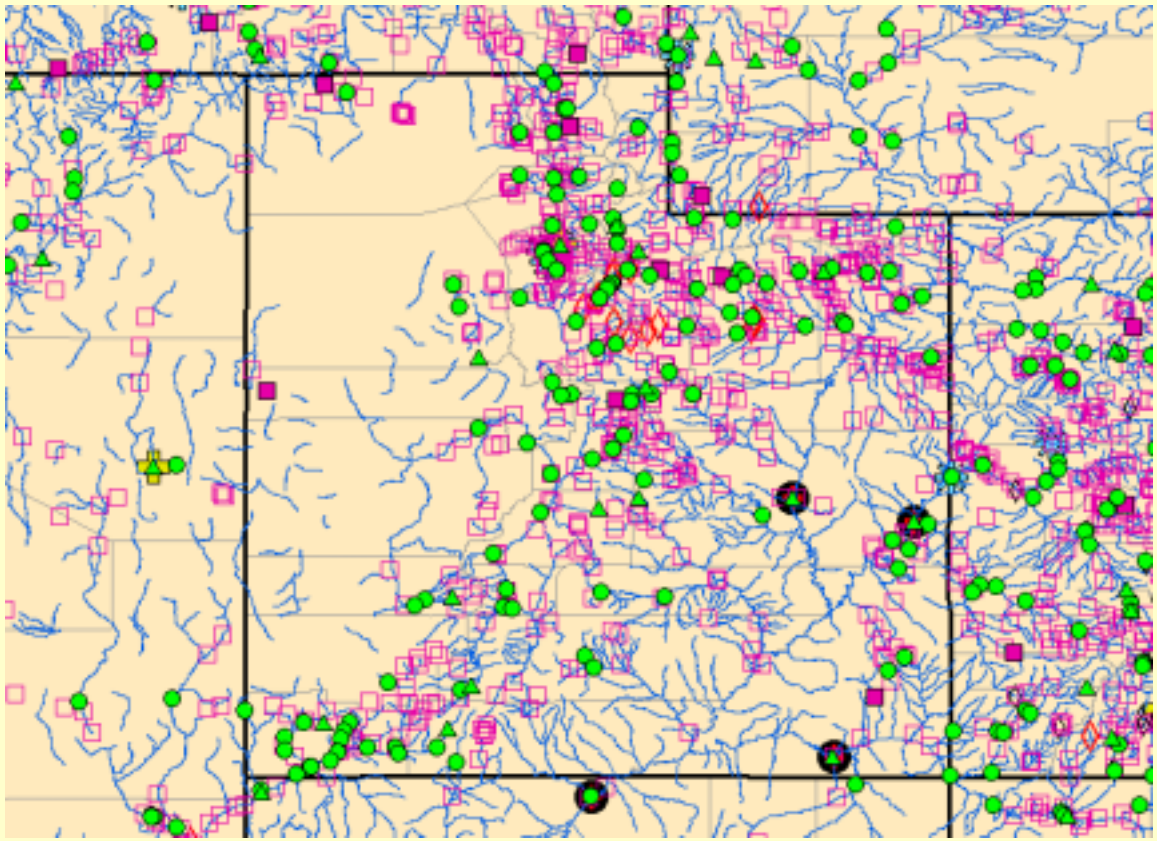
Goal 1 – USGS Networks



Goal 1 --USGS Networks



Goal 1 – Initial State Map Example



USGS

Goal 1 -- Task

- Verify Water Quality network sites have an associated streamgage.
- Using goal_1.mxd from your hard drive
- If water-quality network stations in your District are correct, nothing else is required.
- If incorrect please email jrkolva@usgs.gov with corrections.

USGS

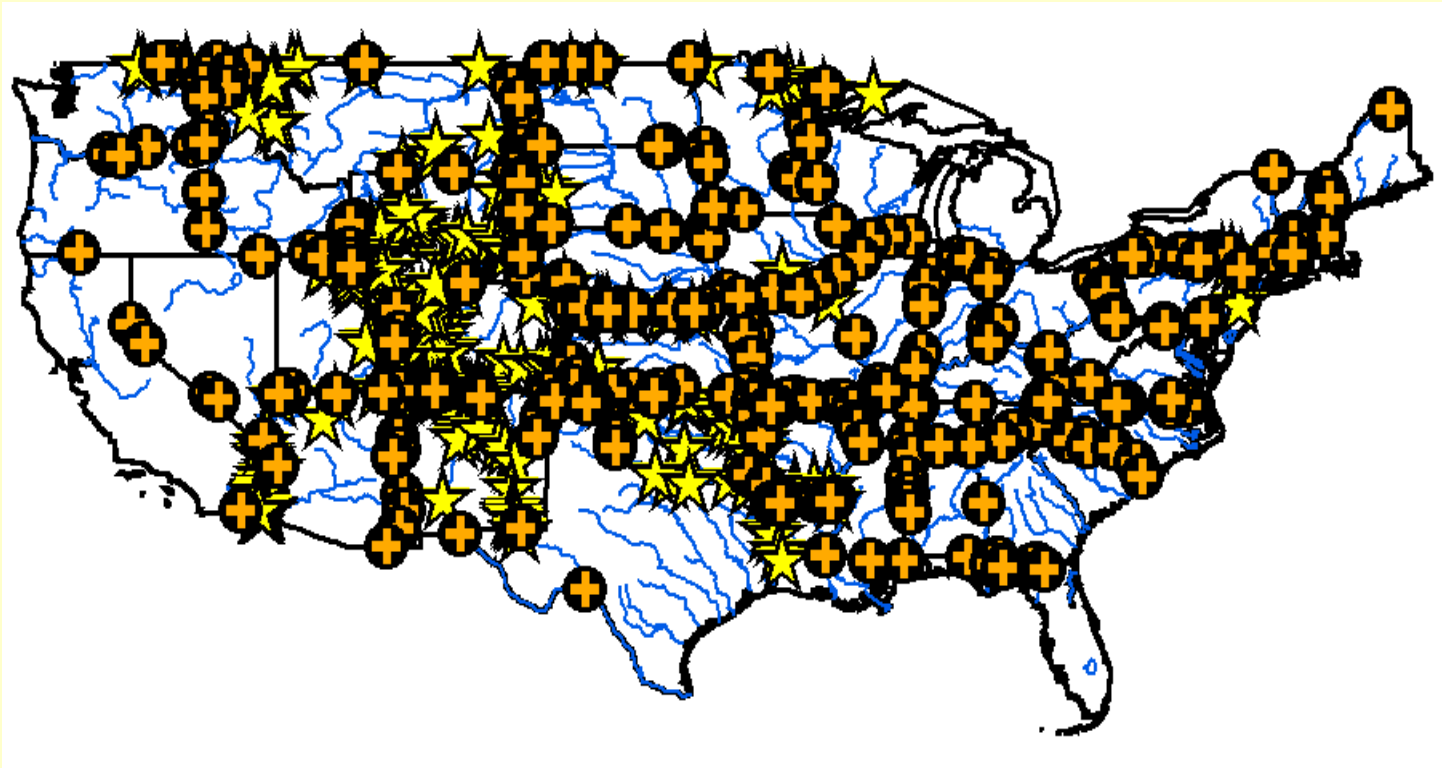
Goal 2 Analysis

USGS

Goal 2 Setup

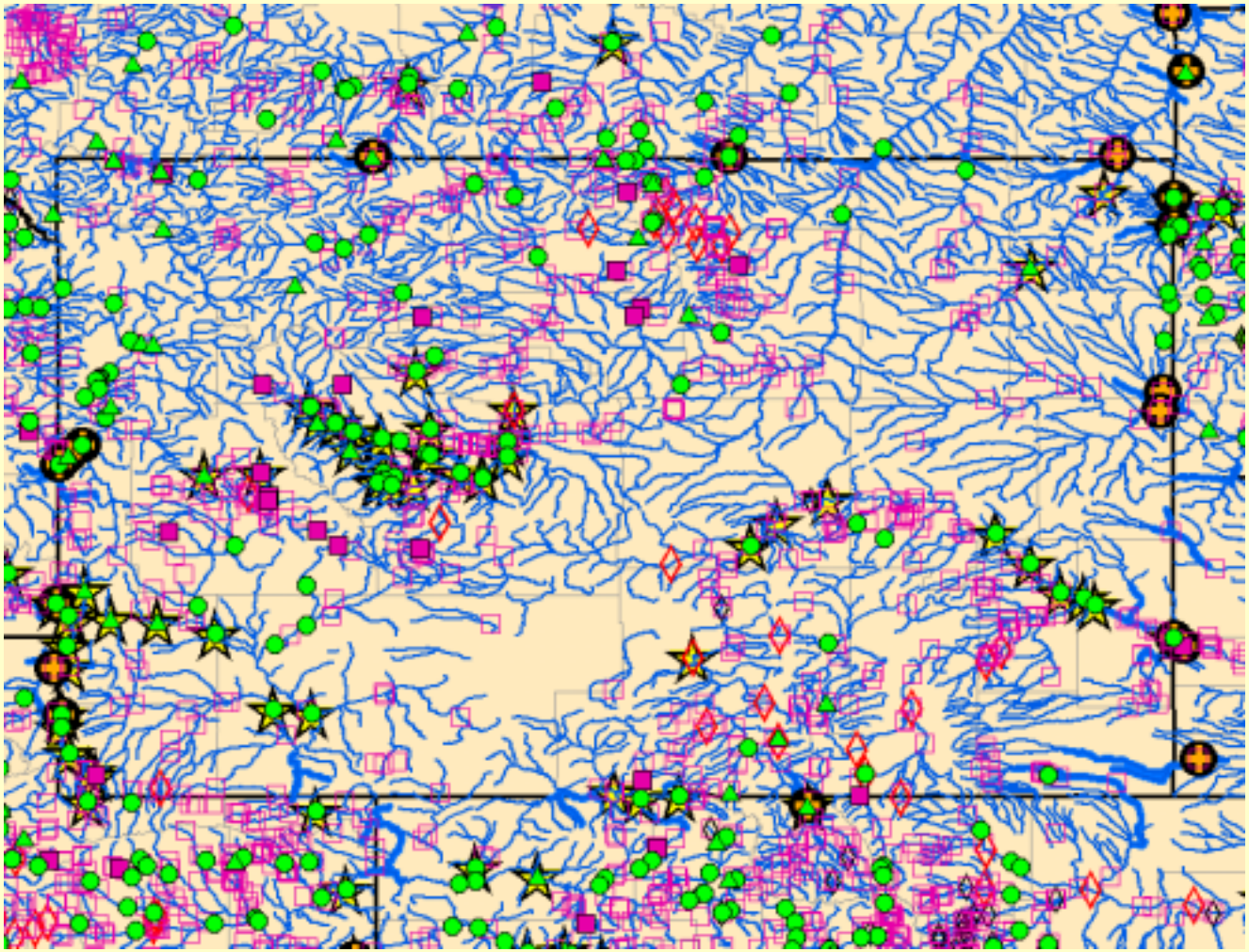
1. Open goal_2.mxd from your hard disk
2. Follow steps 1 through 9 of Define Data Sources
3. Zoom in to your State

Goal 2 Initial Map



USGS

Goal 2 Example State Map



USGS

Goal 2 Tasks

1. Associate gaging stations to stream reaches that cross state or international borders and have drainage areas greater than 500 sq. mi.
2. Associate gaging stations to locations of compacts and/or decrees

USGS

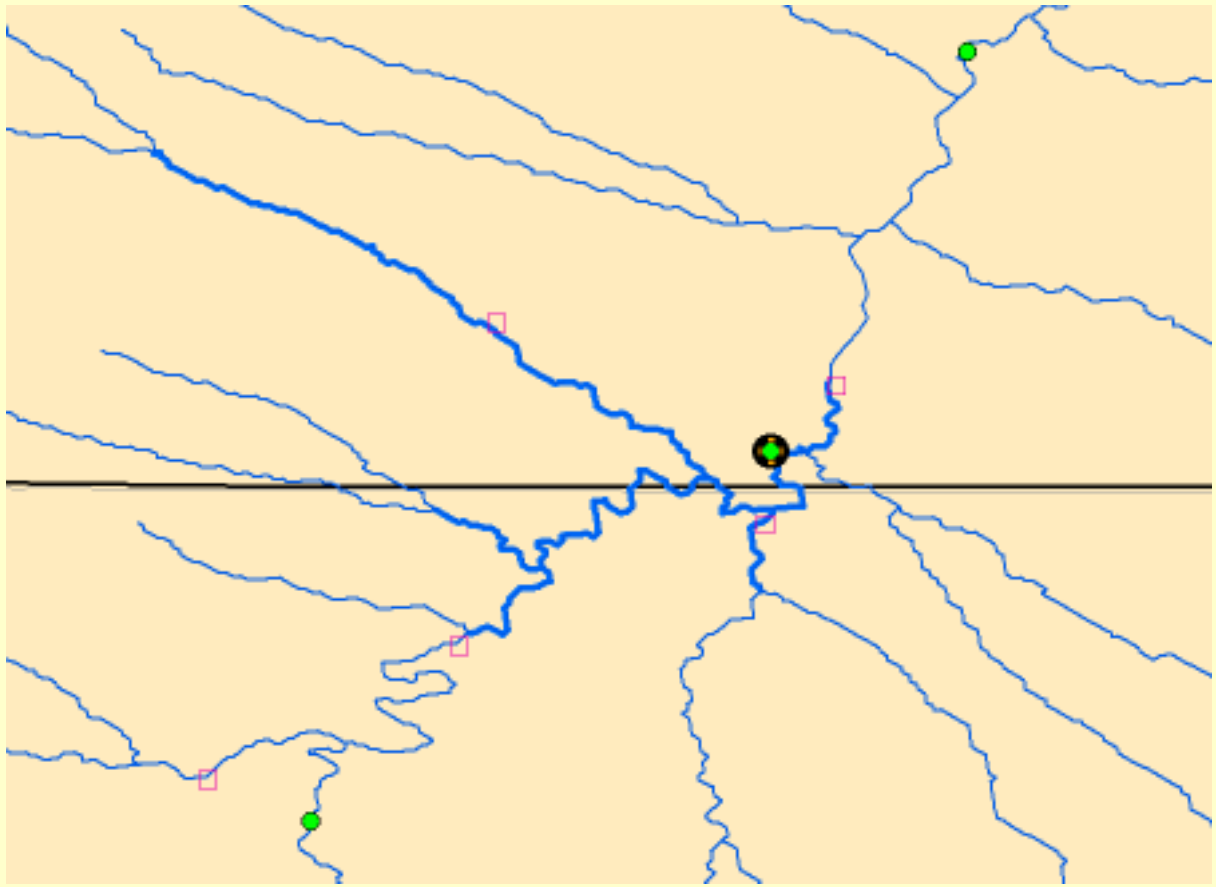
Border Crossing Process

- Reaches with drainage areas greater than 500 sq. mi and adjacent reaches are shown in thick blue lines
- “Contender” stations initially identified as best representing discharges from these reaches are shown with an orange cross in a black circle

USGS

Border Crossing Process, cont'd

1. Zoom in to the thick blue reaches



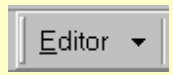
USGS

Border Crossing Process, cont'd

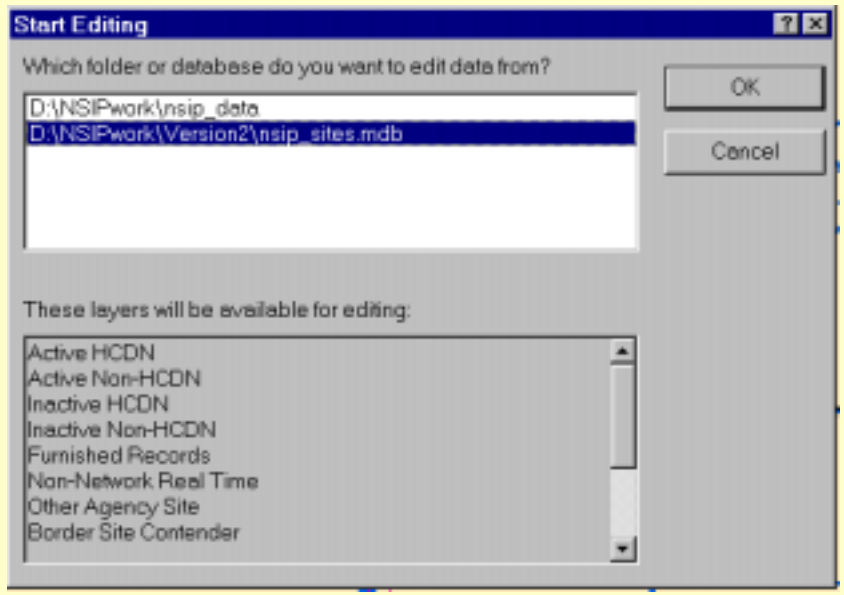
2. Determine if a contender station has been selected for the reach in question
3. If there is a contender station, determine if the selection is correct by using the identify tool to examine the attributes of all other nearby stations and reaches

USGS

Border Crossing Process, cont'd

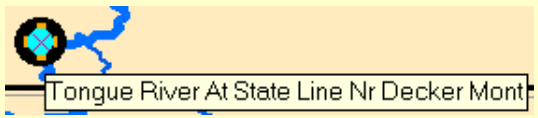
4. Click Editor in the Editor toolbar, then click Start Editing 

5. When the Start Editing window appears, select the nsip_sites.mdb file that you saved on your hard drive



USGS

Border Crossing Process, cont'd

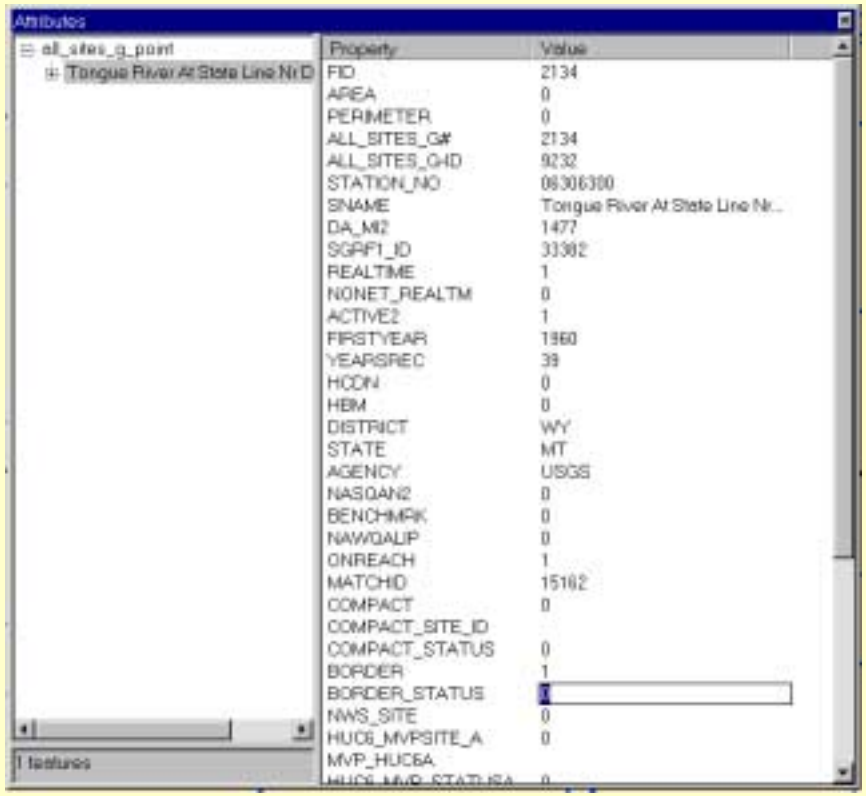
6. If the contender station is correct:
   a. Click on the Edit button in the Editor Toolbar 
   b. Click on the contender site, making it turn blue 

   c. Click on the Attributes button in the Editor Toolbar to make the Attributes table appear 

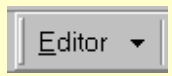
USGS

Border Crossing Process, cont'd

d. Click in the Value field to the right of the BORDER_STATUS attribute and change the Value from 0 to 1



Border Crossing Process, cont'd

e. Set the BORDER attribute to 1 if it is not already set
f. Click on the X in the top right corner of the Attribute table window to close it
g. The orange cross on the map will turn red
h. Click on the Editor button in the Editor Toolbar again 

i. Click on Save Edits

USGS

Border Crossing Process, cont'd

7. If the contender station is incorrect:
   a. Follow steps 6 a. to 6 g., except select the station you feel is most appropriate and change its BORDER attribute to 1 and BORDER_STATUS attribute to 2
   b. Select the original contender station, then change its BORDER and BORDER_STATUS attributes to 0

USGS

Border Crossing Process, cont'd

8. If no contender station was selected, either
   a. Select the station you feel is most appropriate and change its BORDER attribute to 1 and BORDER_STATUS attribute to 2, as in 7 a., **OR**
   b. Click on the Create New Feature button in the Editor toolbar 

Border Crossing Process, cont'd

c. Click on a location along the highlighted reach to mark the map location with a blue circle 
d. Click on the Attributes button in the Editor Toolbar to make the Attributes table appear 
e. Set the BORDER_STATUS to 1 and BORDER attribute to 2, and add any other attributes for the new station

TIP!

To select from among more than one station at the same location:

1. Determine the station type by its symbol or by using the Identify tool
2. Click on the Selection pull-down menu, then on Set Selectable Layers
3. Turn off all but the station type that you want to select
4. Turn all the types back on when you are done

USGS

TIP!

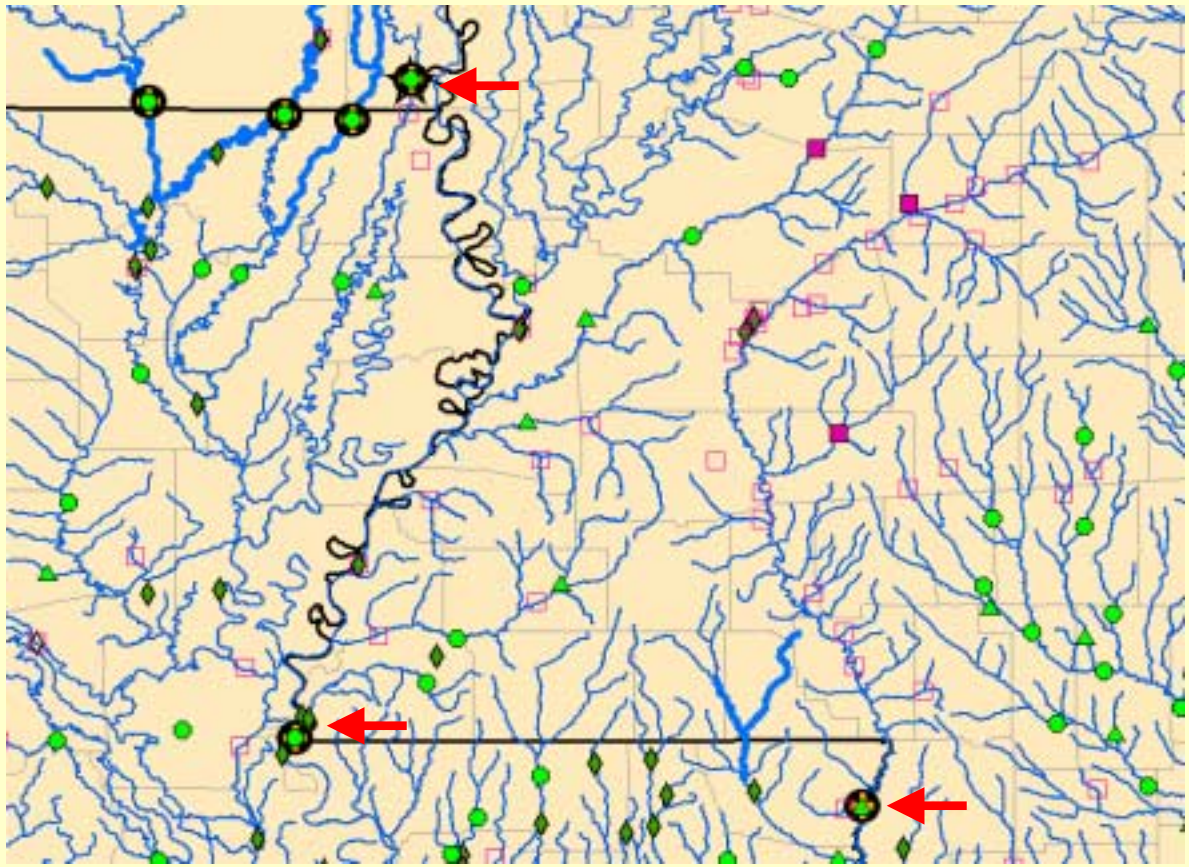
Sometimes more than one station needs to be selected to document flows across state borders; for instance, when there is no station on the reach that crosses the border but there are stations on the main-stem reach above it and on a major tributary that also enters the border reach

USGS

Rivers That Form Borders

- Reaches along rivers that form state or international borders are not highlighted in thick blue
- USGS stations near border crossings where rivers flow from one state to another have been selected as contenders

Example Map With Red Arrows Indicating Contender Stations Along the Mississippi and Pearl Rivers



USGS

Rivers That Form Borders, cont'd

- These stations should be reviewed to confirm that they are the best candidate stations to quantify flows across the state boundaries
- Additional existing stations or new stations should be added where appropriate

USGS

Compacts Process

- Compact locations are indicated on the map by yellow stars
- One or more active or inactive USGS stations are always associated with the location of a yellow star

USGS

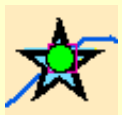
Compacts Process, cont'd

1. Click the Edit button in the Editor toolbar 
2. Click on a Compact location, causing a blue circle to appear 
3. Click on Attributes in the Editor toolbar 
4. Set the COMPACT_STATUS and COMPACT attribute values to 1 in the attribute table

USGS

Compacts Process, cont'd

5. Specify a station number in the COMPACT_SITE_ID attribute value if a different station provides information for the compact location
6. Close the attribute window
7. The star will turn from yellow to blue



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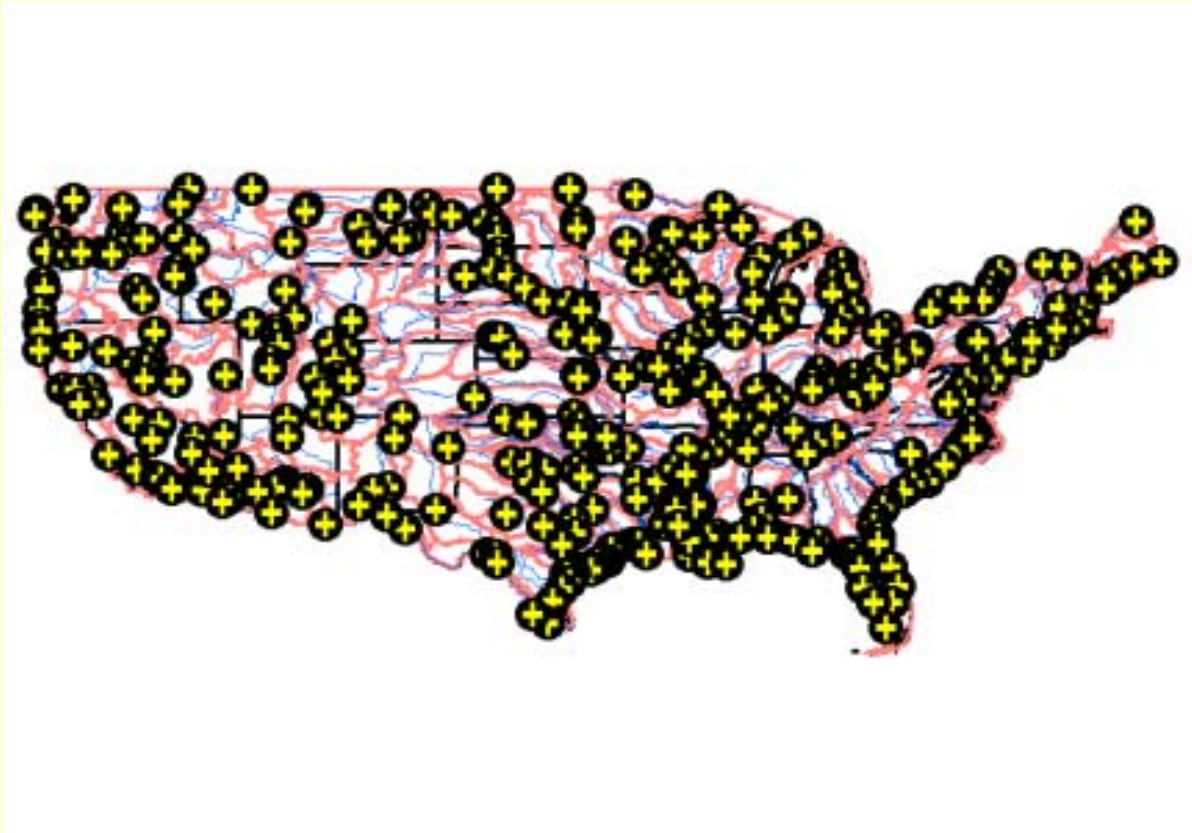
Compacts Process, cont'd

8. Click on the Editor button in the Editor Toolbar 

9. Click on Save Edits
10. When all Compact stations have been edited, click on the File pull-down menu, then on Save to save your file to your hard disk

USGS

Goal 3 --Hydrologic Accounting Units



USGS

Goal 3 -- Task

- Determine station that is the Most Valuable Point (MVP) for each Hydrologic Accounting Unit

Goal 3 --Hydrologic Accounting Units MVPs

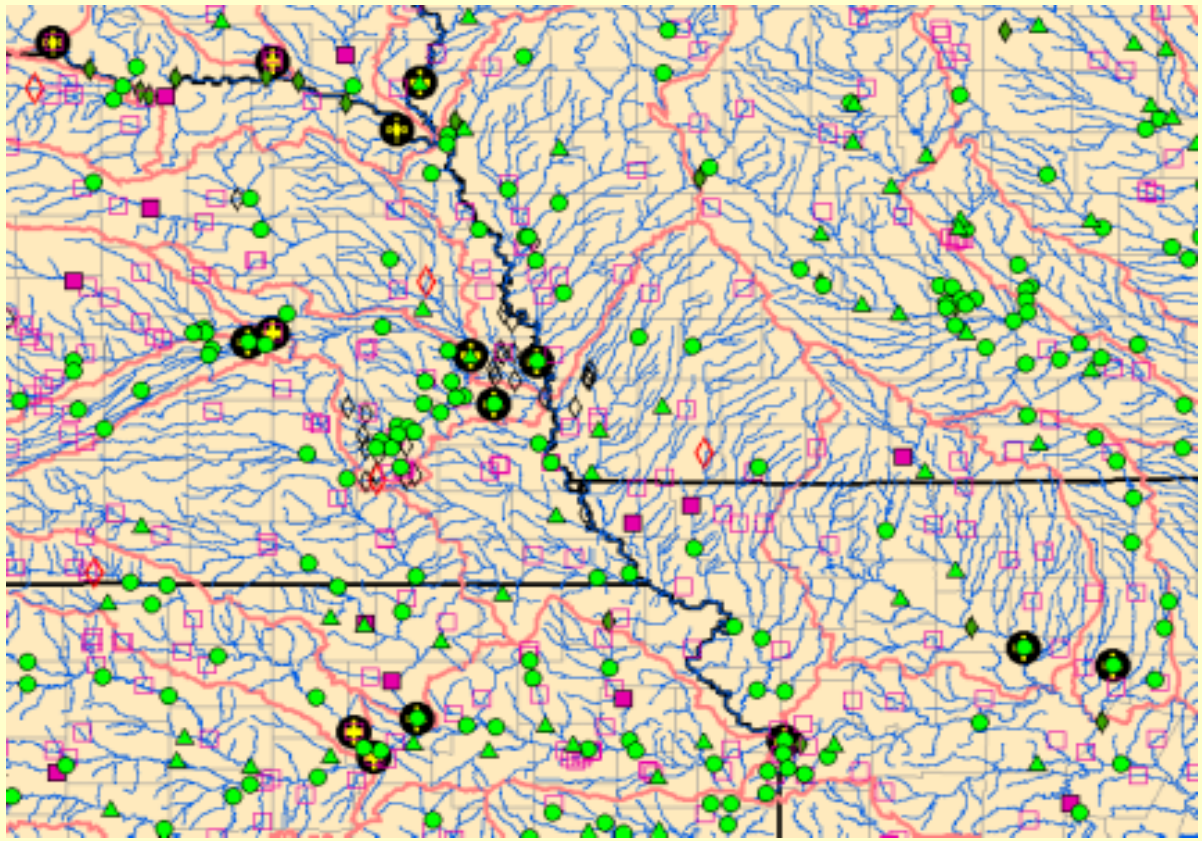
- Criteria – The station (or stations) needed to best determine the flow out of the Accounting Unit.
  - For closed basins, the most representative flow in the Accounting Unit.

Goal 3 --Hydrologic Accounting Units -- Criteria

- Main stem – The main stem station nearest the Accounting Unit pore point. May be downstream in the next Accounting Unit.
- Headwaters – The station or stations with the largest drainage area(s) in the Accounting Unit. May also be downstream in the next Accounting Unit.
- Coastal or Closed Basin – The station or stations with the largest drainage areas in the Accounting Unit.

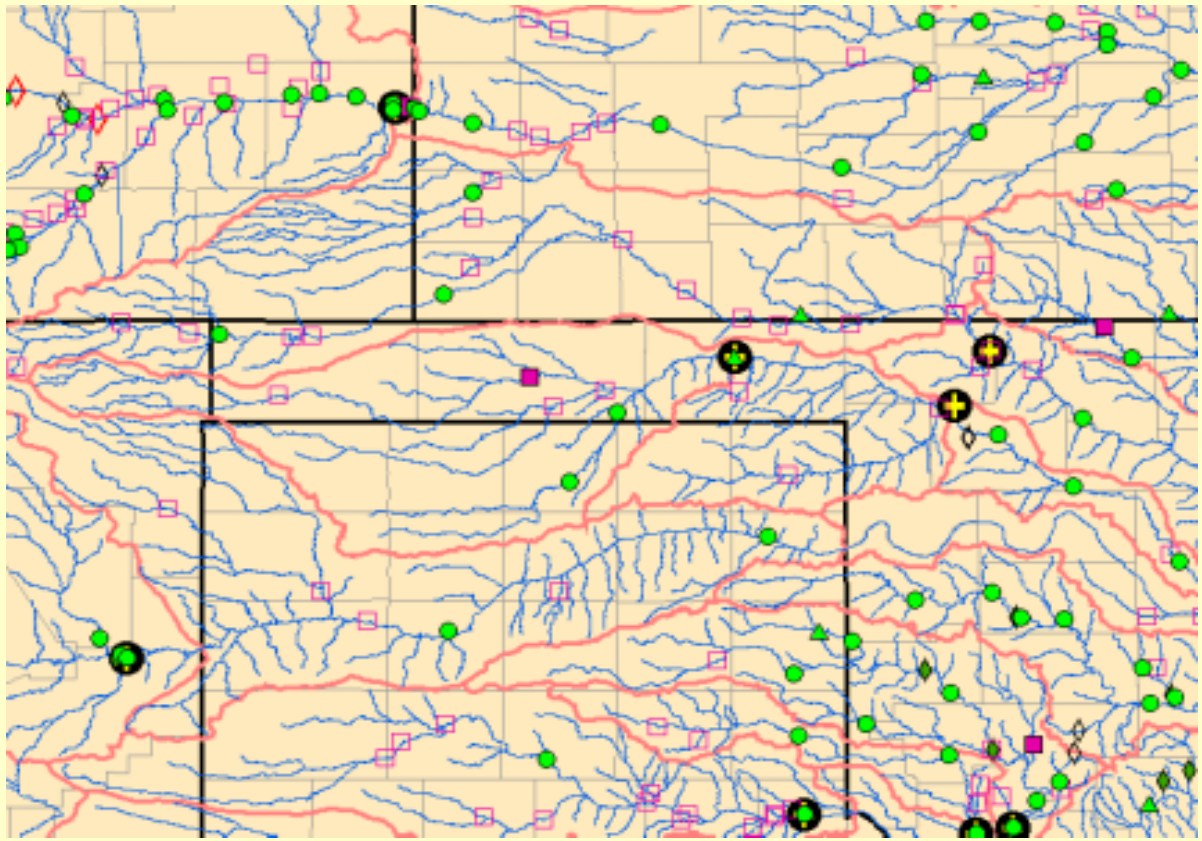
USGS

Goal 3 – Main Stem Accounting Units



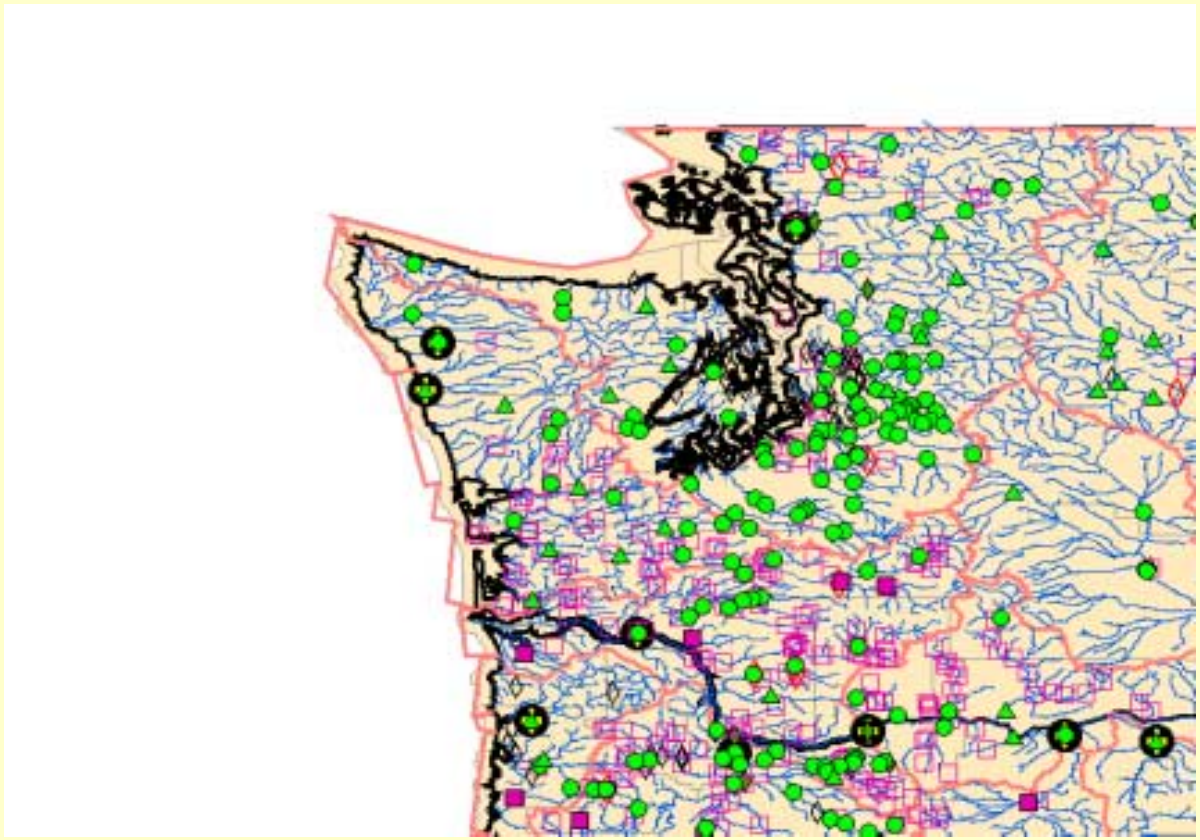
USGS

Goal 3 – Headwater Accounting Units



USGS

Goal 3 – Coastal or Closed Basin Accounting Units



USGS

Goal 3 --ArcMap Attributes

- HUC6_MVPSITE_A
- MVP_HUC6A
- HUC6_MVPSTATUSA
- HUC6_MVPSITE_B
- MVP_HUC6B
- HUC6_MVPSTATUSB

USGS

Goal 3 -- ArcMap Attributes

- HUC6_MVPSITE_A – Station that best meets criteria. Indicate with a 1 in attributes table.

- HUC6_MVPSITE_B – Supplemental station needed in that Accounting unit to meet criteria. Also indicated with a 1 in attributes table.

USGS

Goal 3 -- ArcMap Attributes (continued)

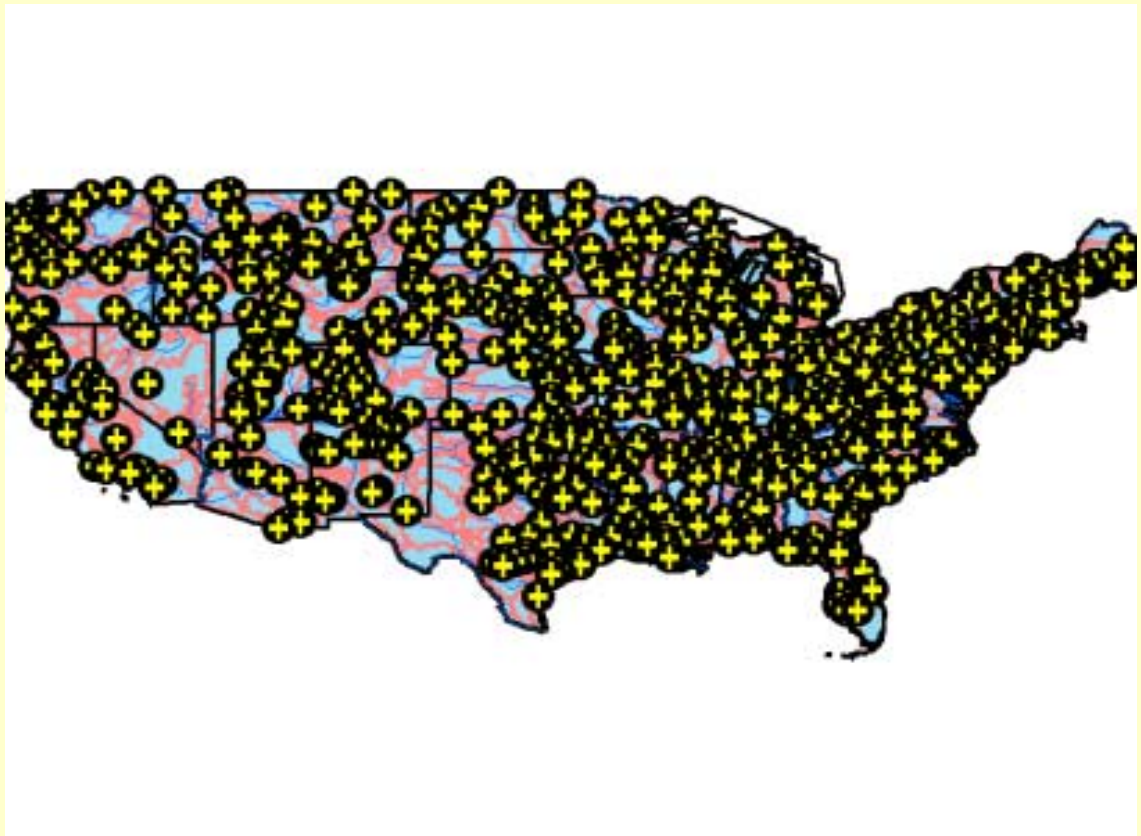
- MVP_HUC6A – Station is the MVP point for an Accounting Unit but not located in that Accounting Unit. Enter the HUC6 number of the Accounting unit represented.

Goal 3 -- ArcMap Attributes (continued)

- HUC6_MVPSTATUSA (or B) – Status indicator of the site.
- 0 – Not a MVP SITE or not yet reviewed
- 1 – Reviewed, accepted station.
- 2 – New site, rejected first cut selection and replaced with this station.

USGS

Goal 4 – Sentinel Stations



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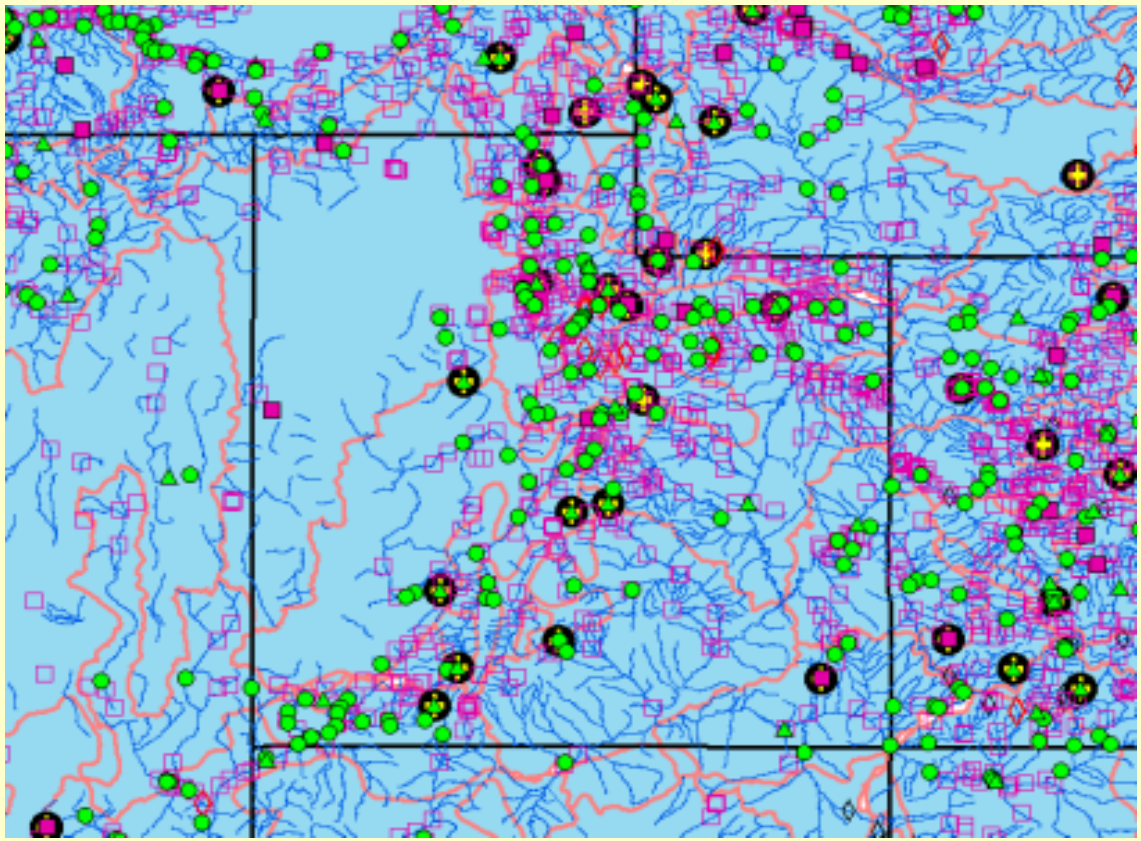
Goal 4 -- Task

- Determine the best “Sentinel Station” for an eco-huc. The station best for determining long term trends in flow for that particular area. Station should have 80-90% of its drainage area within the eco-huc it represents.

Goal 4 – Sentinel Stations State Example Map



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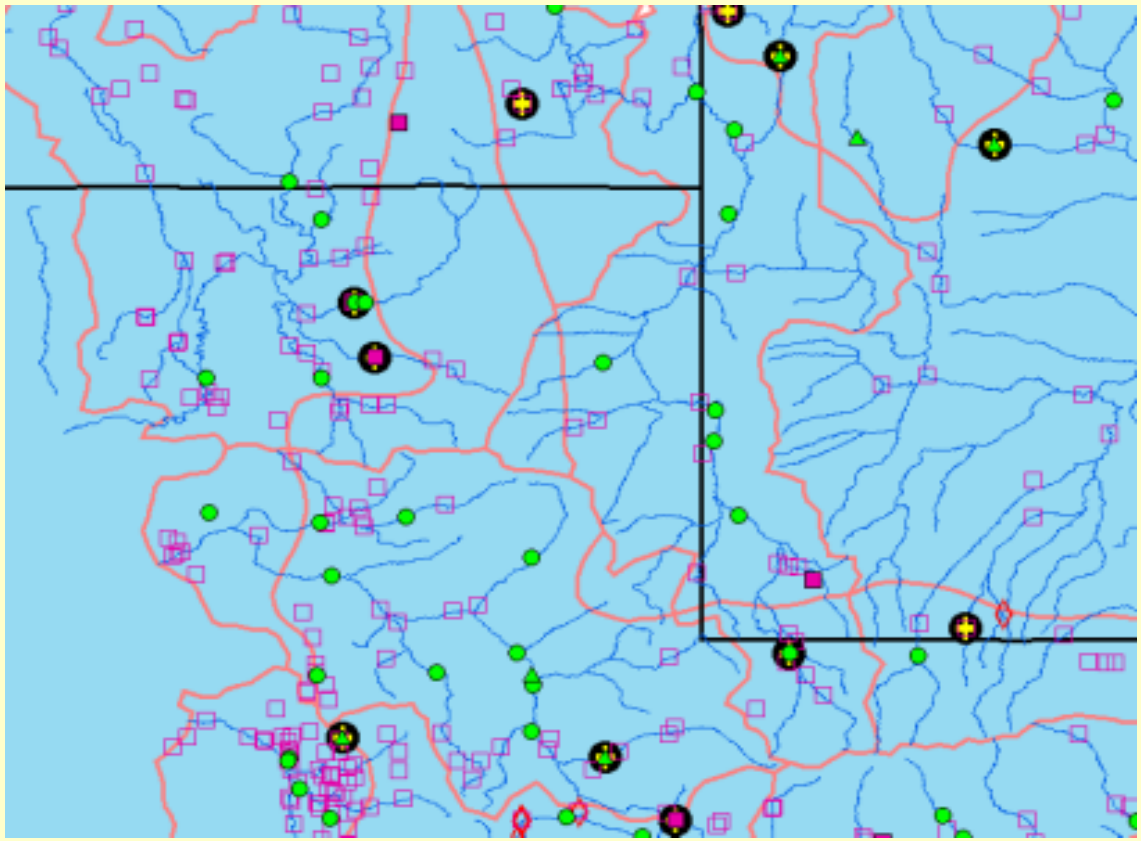
Goal 4 – Sentinel Stations Polygon examples



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Goal 4 – Sentinel Stations

- Criteria – Best represents flow conditions from the “eco-huc”.

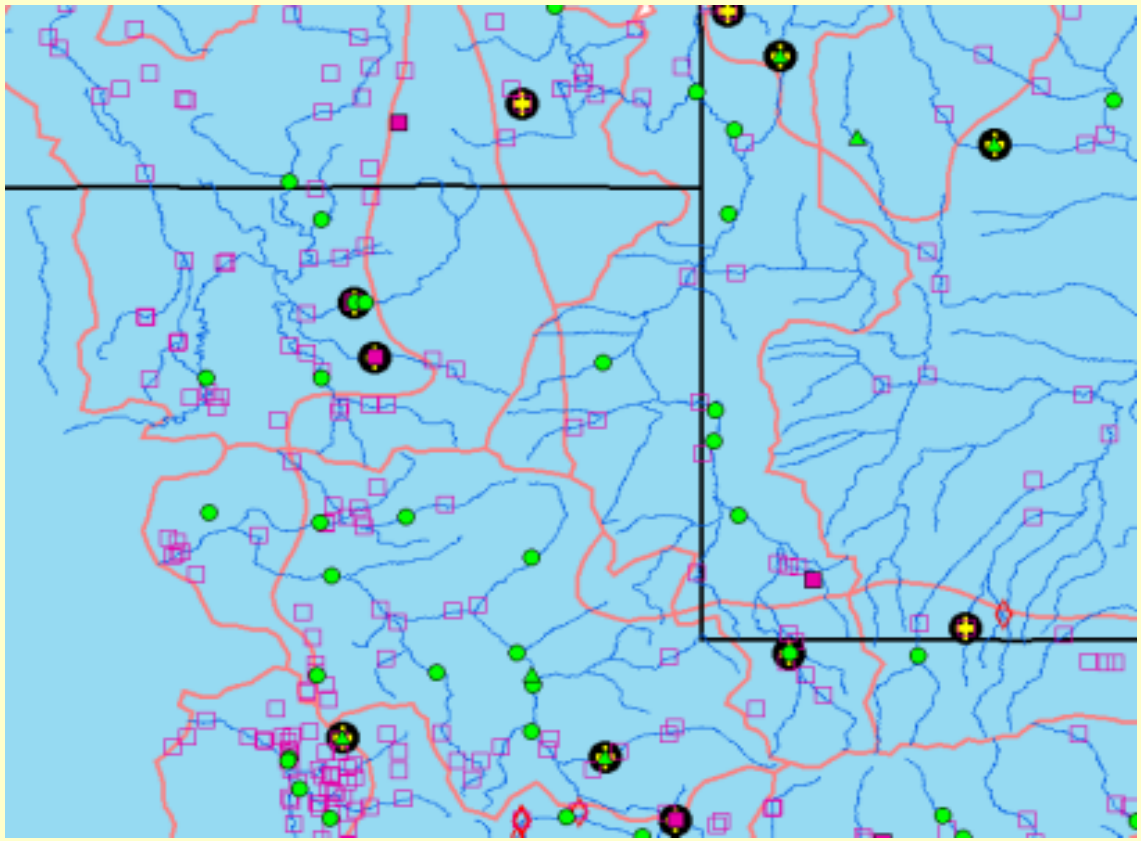
- Longest period of record at active or HCDN station was chosen. May not be representative.

USGS

Goal 4 – Sentinel Stations

- Eco-huc – Intersection of Hydrologic Accounting Units and EPA Ecological Regions (76 in lower 48 states).

Goal 4 – Sentinel Stations

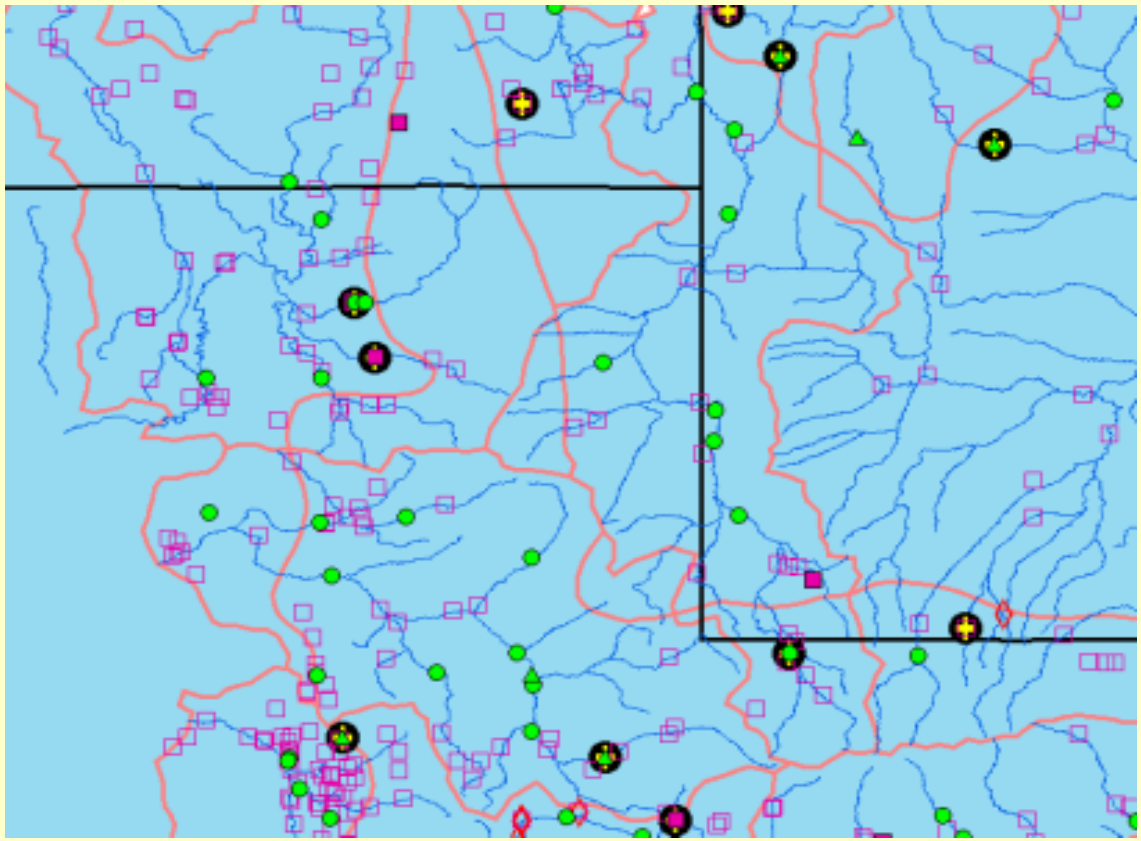


Goal 4 – Sentinel Stations

- Station should have at least 80-90% of the drainage area in the “eco-huc” it represents.

- Station should have the longest period of record possible. (Active stations preferred.)
- Every “eco-huc” over 100 square miles should have a Sentinel Station.

Goal 4 – Sentinel Stations



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Goal 4 – ArcMap Attributes

- SENTINEL_SITE
- SENTINEL_STATUS

USGS

Goal 4 – ArcMap Attributes

- SENTINEL_SITE
-
- 0 – Not a Sentinel Site
- 1 – Is a Sentinel Site

USGS

Goal 4 – ArcMap Attributes

- SENTINEL_STATUS

- 0 – Not a Sentinel Site or Not reviewed.
- 1 – Reviewed Sentinel Site; accepted first cut.
- 2 – Added Sentinel Site; either replacing first cut site or adding to an eco-huc that had no contender site.

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When The Analyses Are Complete

- Save the 7 files on your hard disk that you copied from the CD
- Zip the files together
- Email them to Dave Stewart at dwstewar@usgs.gov

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THANKS!

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