



National Streamflow  
Information  
Program Network  
Analysis

August 16, 2000

# 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

- NSIP committee Identified 5 Federal Interest goals
  1. Water Quality
  2. Compacts, decrees and boundary crossings
  3. Major river basins
  4. Sentinel watersheds
  5. NWS forecast locations
- Districts will do goals 1-4
- OSW Staff will do goal 5 using the ArcMap GIS tool

# District Team Requirements

Data Chief

GIS Specialist

Site Administrator

Field Office Chiefs for more detailed knowledge of sites (optional)

District Chief (optional)

# 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 5 goals by early October, 2000

# Goal 1

Provide discharge data for USGS water-quality monitoring networks

# Metric

Operate a discharge station in the reach of each Hydrologic Benchmark, NASQAN, and NAWQA Low-Intensity Phase station

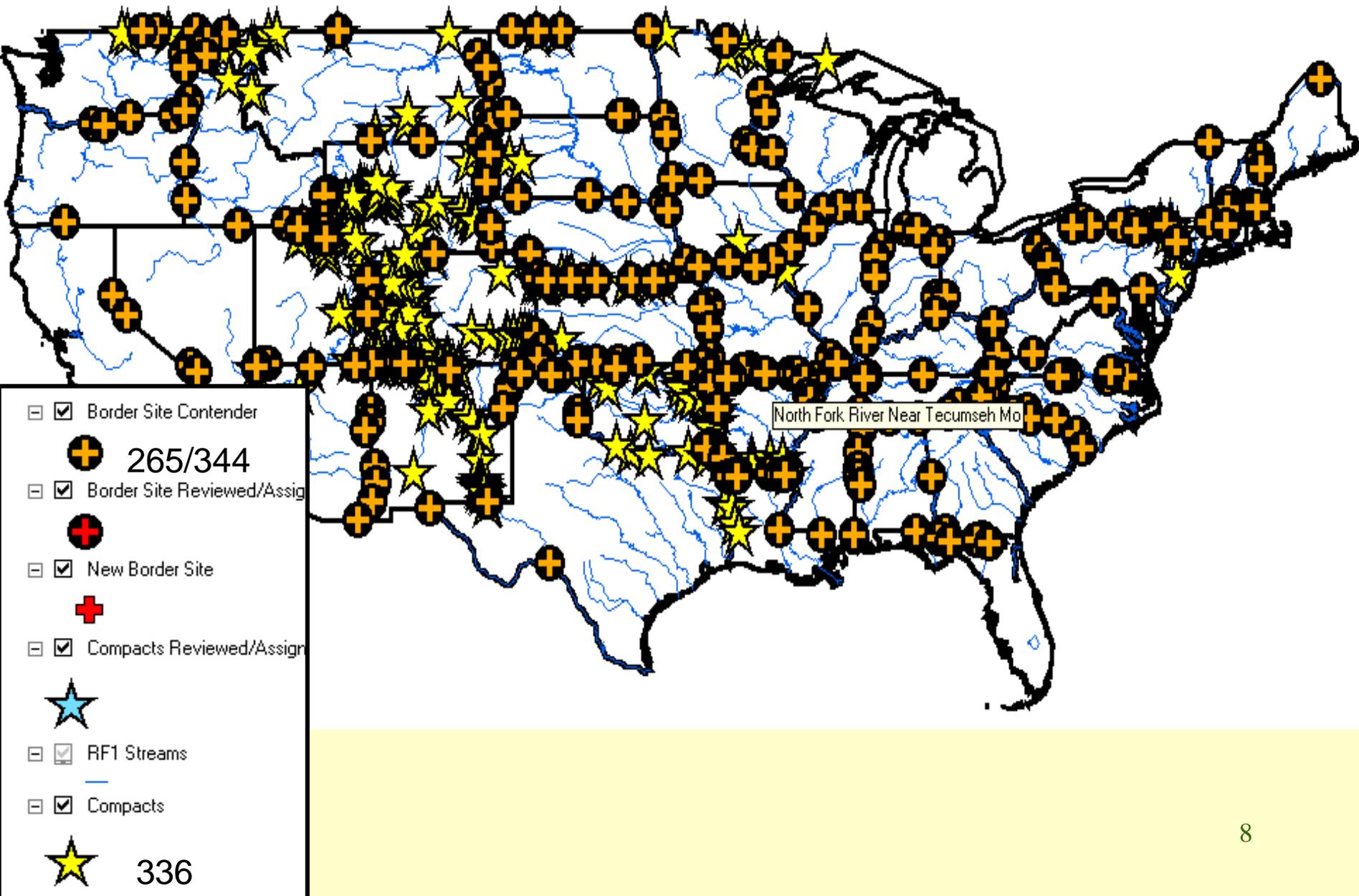
# Goal 2

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

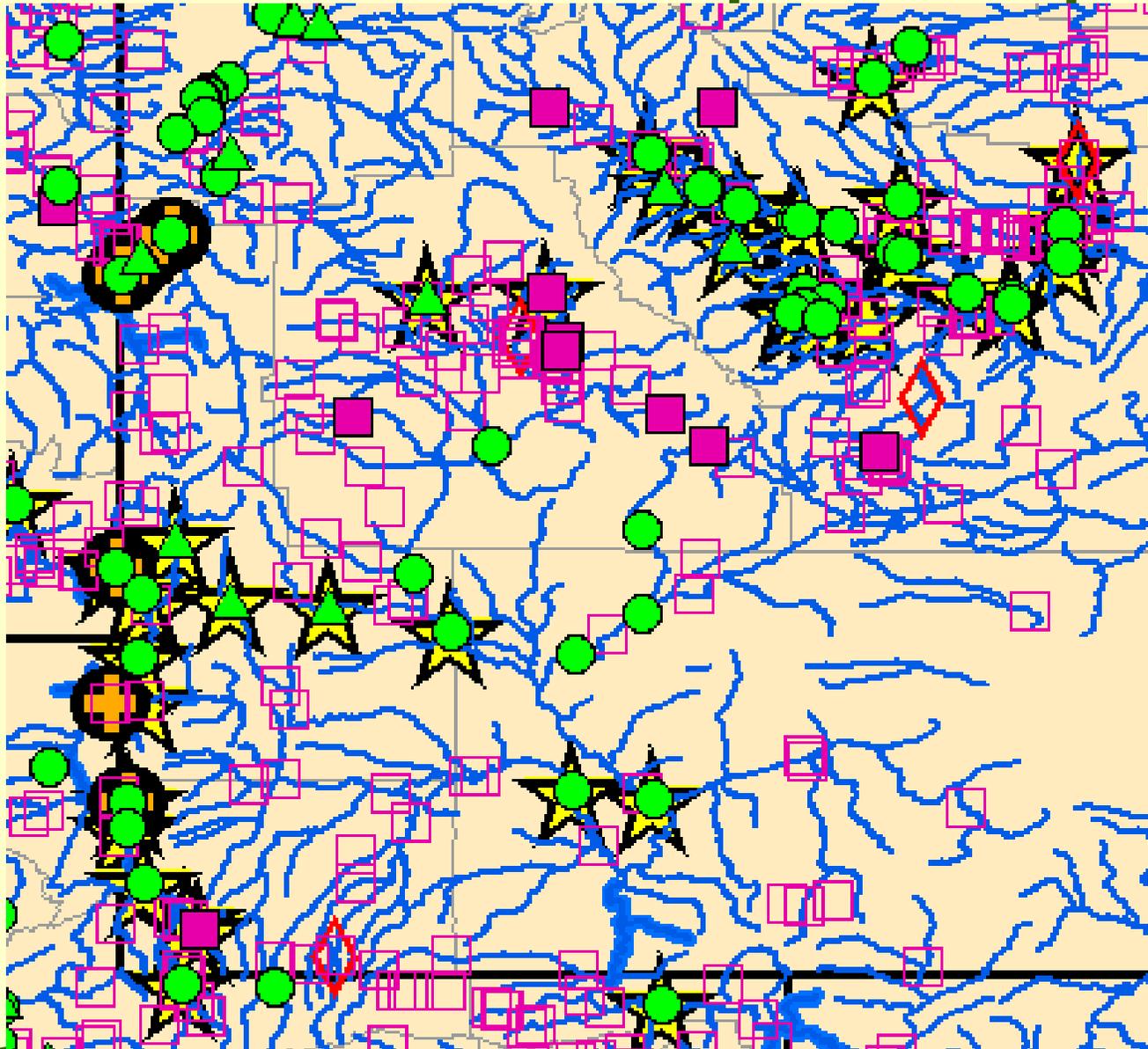
# Metric

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

# Goal 2 - Initial Map



# Goal 2 --Example Map



# Goal 3

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

## 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)

# Goal 4

Provide discharge data for “Sentinel Watersheds” that represent natural streamflow conditions and enable assessments of long-term trends

## Metric

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

## Goal 5

Provide discharge and stage data at all National Weather Service forecast sites.

## Metric

Operate a station at each NWS forecast site or be able to provide flow data from other nearby stations.

# Gaging Stations (lower 48)

- 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

# Station Selection Priorities

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

\* Denotes higher priority for Goals 2 & 3

# Using the GIS Tool ArcMap

- ArcMap - ARC/INFO 8.0.2 Desktop software  
(runs only on the NT)

- **NSIP CD Contains:**

ArcMap Startup Files,  
Station map layers,  
RF1 Streams, Major Rivers  
Counties, HUCs, & Cities



- **Copy 6 CD Files to Your Hard Drive**

goal\_2.mxd

goal\_4.mxd

goal\_3.mxd

nsip\_sites.ldb

goal\_4.mxd

nsip\_sites.mdb

- **Remove Read-only attribute from 6 files**



# Initial ArcMap Look

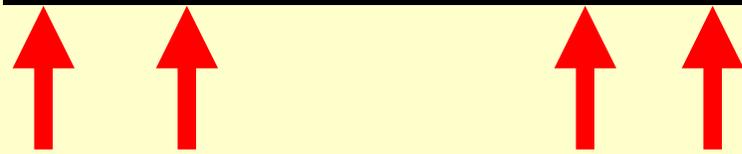
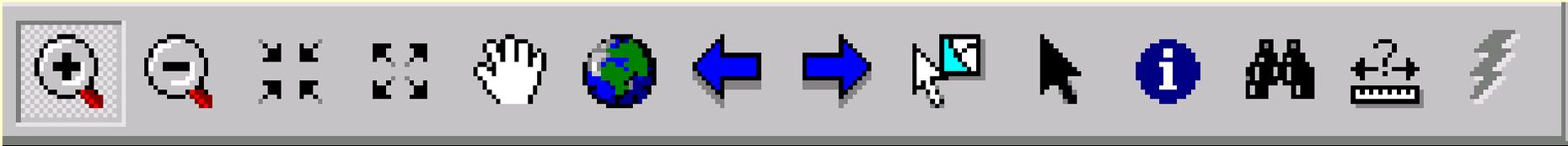
**Layers  
Frame**

**Map Frame**



**Tools Toolbar – Move to  
gray menu area above  
Map Frame**

# The Tools Toolbar



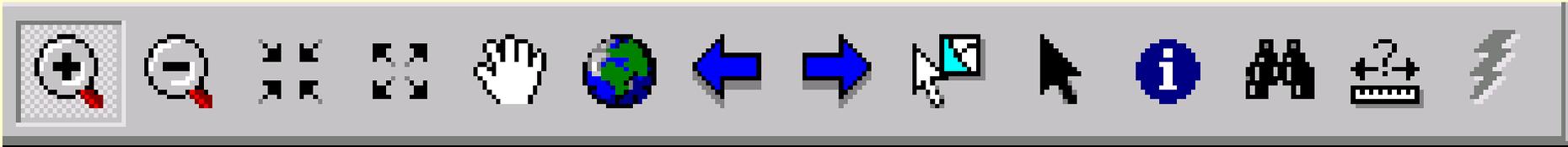
**Zoom In** – Changes the mapped area to a smaller area defined by holding the left mouse button down and dragging the cursor to define a rectangle

**Zoom Out** – Changes the mapped area to a larger area centered on the area clicked in map

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

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

# The Tools Toolbar, cont'd



**Identify Features** – Provides tables of attributes for the map feature you select and other features in the area

## Site Attributes

Station_no	District
Sname	State
DA_MI2	Agency
FirstYear	YearsRec

## Binary Flags, 0 = no, 1 = yes

Active	NASQAN
RealTime	NAWQALIP
HCDN	Compact
HBM	Border
Sentinel	HUC6_MVP

# The Editor Toolbar



**Editor Button** – Activates a drop-down menu -- Start, Stop, and Save Edits of your site attributes

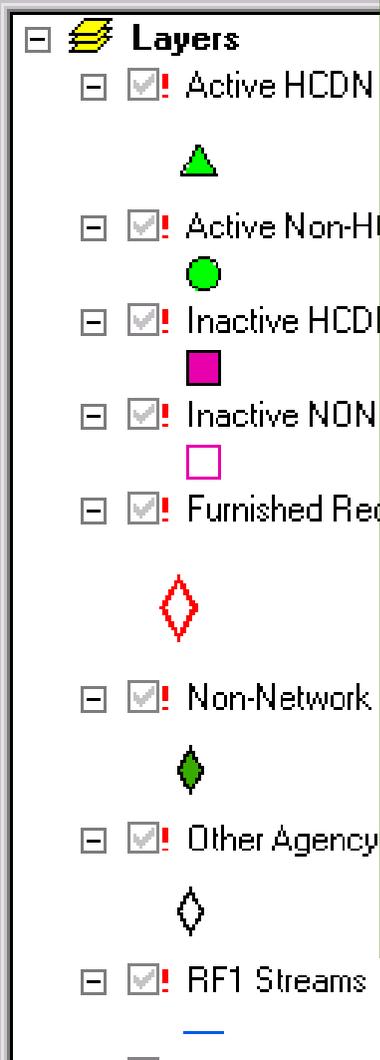
**Edit Tool** –Select Sites for editing attributes

**Sketch Tool** – Add Sites.You will use this feature to add new stations when existing stations do not satisfy network goals.

**Attributes** – List and Edit the selected site attributes

# 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



# 1<sup>st</sup> time Each Goal is Opened, Reset Map Layer Pathnames

1. A red exclamation mark (!) will display initially between the check box and the map layer name, ignore dislex printer not found message
2. Click on the exclamation mark for the **Active HCDN** layer, the Data Source specification window will appear
3. Specify the pathname on your hard drive to the **all\_sites\_g\_point** object in nsip\_sites.mdb. This will associate the top 7 site layers pathnames.
4. Repeat steps 1-3, but click on (!) **RF1 Streams**. Specify pathname to **rf1\_str.shp** on CD. This will associate the remaining layers.
5. Save goal\_x.mxd file on your hard drive.

(see website for details)

# Review Your Active Stations

1. Zoom to your District/state using the state Bookmarks
2. Highlight the **Active HCDN** layer in the Layers Frame
3. Click '**Select by Attributes...**' in the Selection menu and the following menu will appear:

**Select By Attribute**

Layer: Active HCDN

Fields

- [OBJECTID]
- [AREA]
- [PERIMETER]
- [ALL\_SITES\_G\_]
- [ALL\_SITES\_G\_I]
- [STATION\_NO]
- [SNAME]
- [DA\_MI2]
- [SGRF1\_ID]
- [REALTIME]
- [NONET\_REALTIME]

Unique values

Complete List

SELECT \* FROM all\_sites\_g\_point WHERE:

Clear Verify Help Load... Save...

Select procedure: Create a new selection

OK Cancel

# Reviewing Your Active Stations, cont'd

4. Double click the **[DISTRICT]** attribute in the Fields scroll list, **[DISTRICT]** appears in area below the list
5. Click the equal (=) button
6. Click the **'Complete List'** button under the Unique values list

7. Double click on your  
**District 2 char code**

Ex. **[DISTRICT] = 'CA'**

8. Click **OK**

The screenshot shows a software interface with the following components:

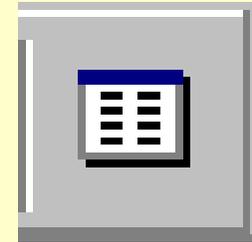
- Fields:** A scrollable list containing attributes: [REALTIME], [NONET\_REALTIME], [ACTIVE2], [FIRSTYEAR], [YEARSREC], [HCDN], [HBM], **[DISTRICT]** (highlighted), [STATE], [AGENCY], [NASQAN2].
- Operators:** A grid of buttons including '=', '<>', 'Like', '>', '>=', 'And', '<', '<=', 'Or', '?', '\*', '()', and 'Not'.
- Unique values:** A scrollable list containing state codes: 'AL', 'AR', 'AZ', **'CA'** (highlighted), 'CO', 'FL', 'GA', 'IA', 'ID', 'IL'. Below this list is a **Complete List** button.
- Query Area:** A text box at the bottom containing the SQL query: `SELECT * FROM all_sites_g_point WHERE: [DISTRICT] = 'CA'`

# Reviewing Your Active Stations, cont'd

9. Click on the **Editor** drop-down menu button and then click **Start Editing**



10. Click on the **Attributes** icon in the Editor tools and a station list will display in the scroll list.

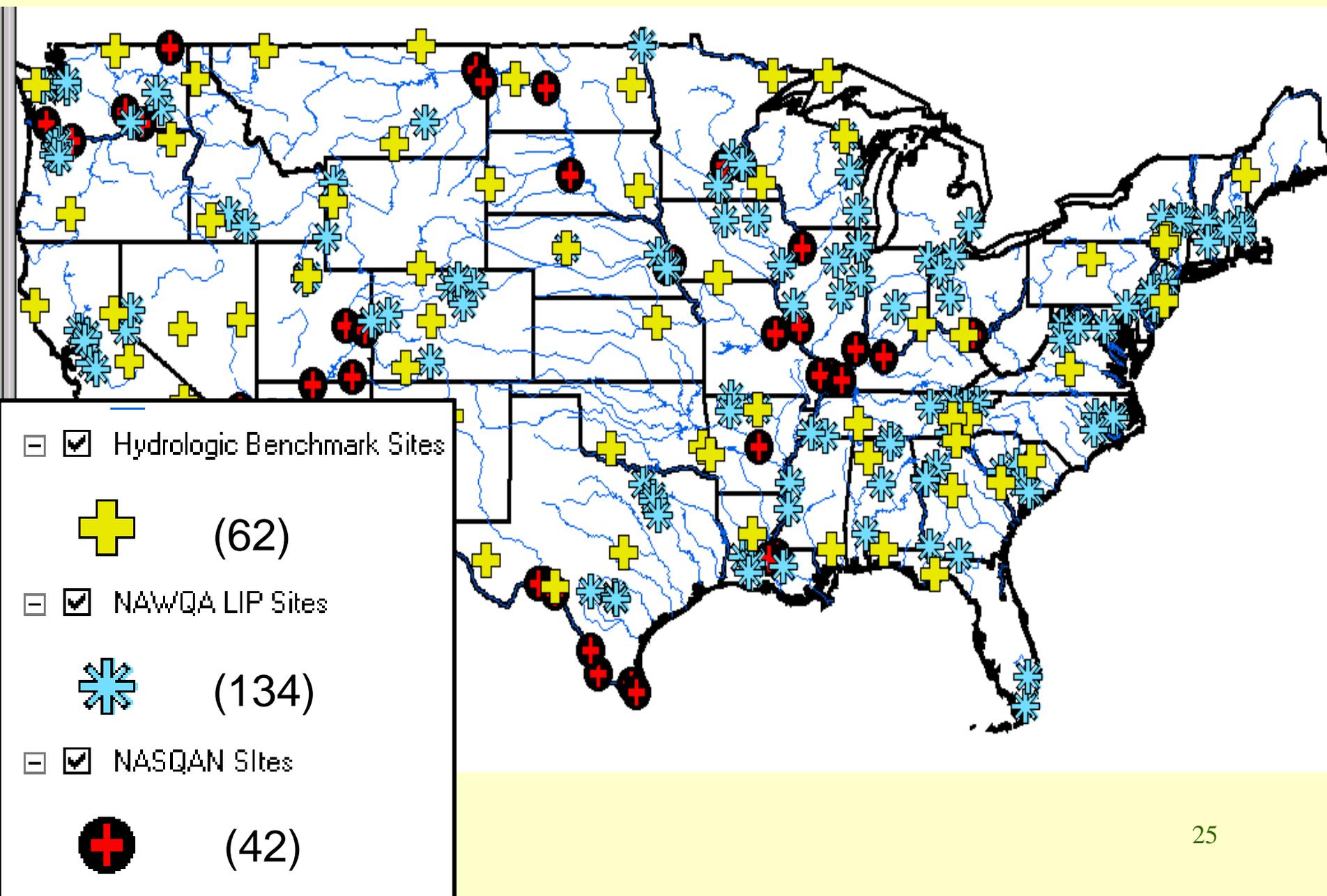


11. Review the list, if an inactive station is listed, select the station and change the **ACTIVE2** attribute from a 1 to a 0

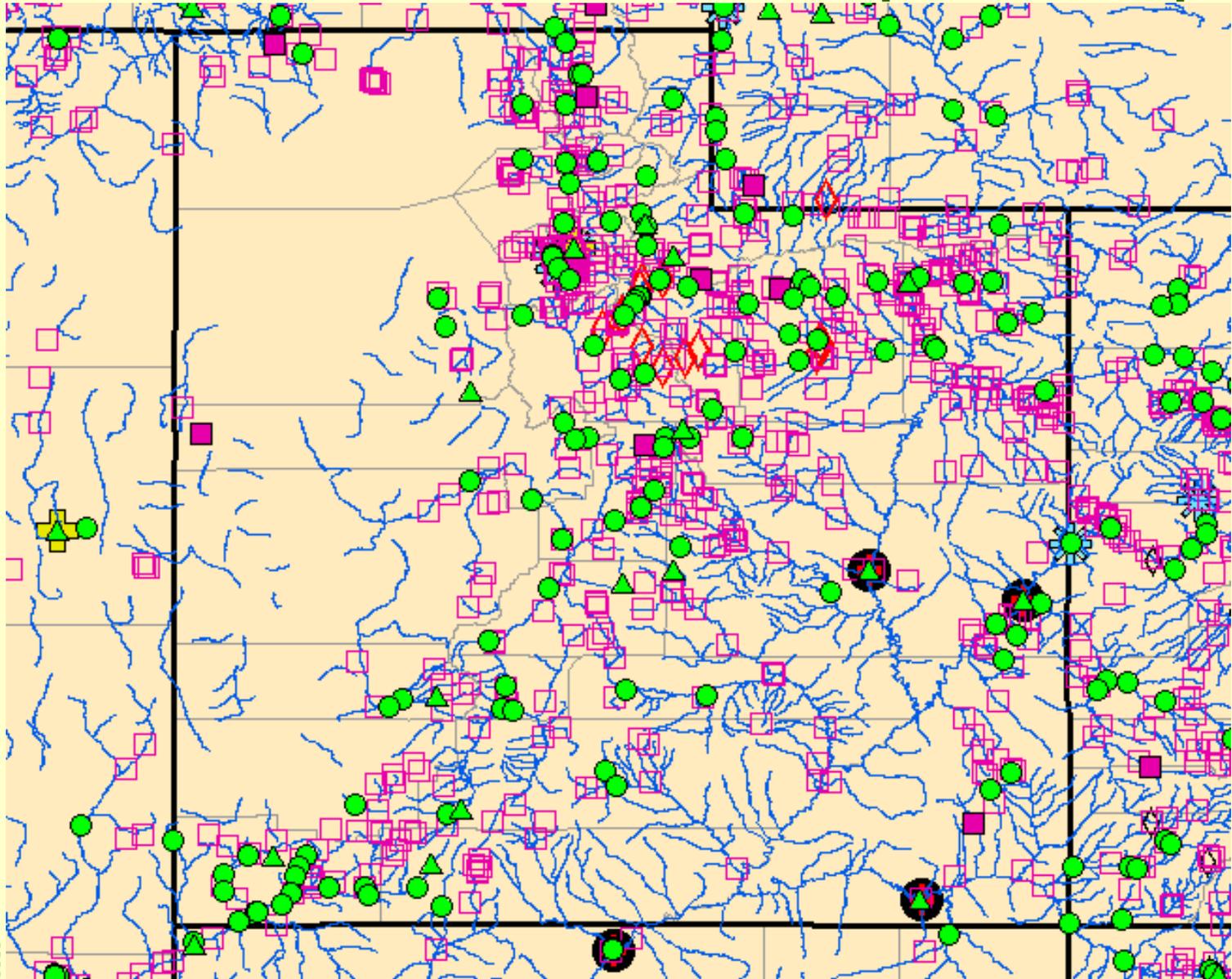
Trinity R A Hoopa Ca	DA_MI2	40.5
Little R Nr Trinidad Ca	SGRF1_ID	58046
Sacramento R A Delta C	REALTIME	0
Redwood C Nr Blue Lak	NONET_REALTM	0
Trinity R A Lewiston Ca	ACTIVE2	1
Sf Trinity R Bl Hyampom	FIRSTYEAR	1956
Clear C Nr Igo Ca	YEARSREC	44
Fal R A Scotia Ca	HCDN	1
	URM	0

12. Save & Repeat 2-11 using the **Active Non-HCDN** layer

# Goal 1 --USGS QW Networks



# Goal 1 – Initial State Map Example



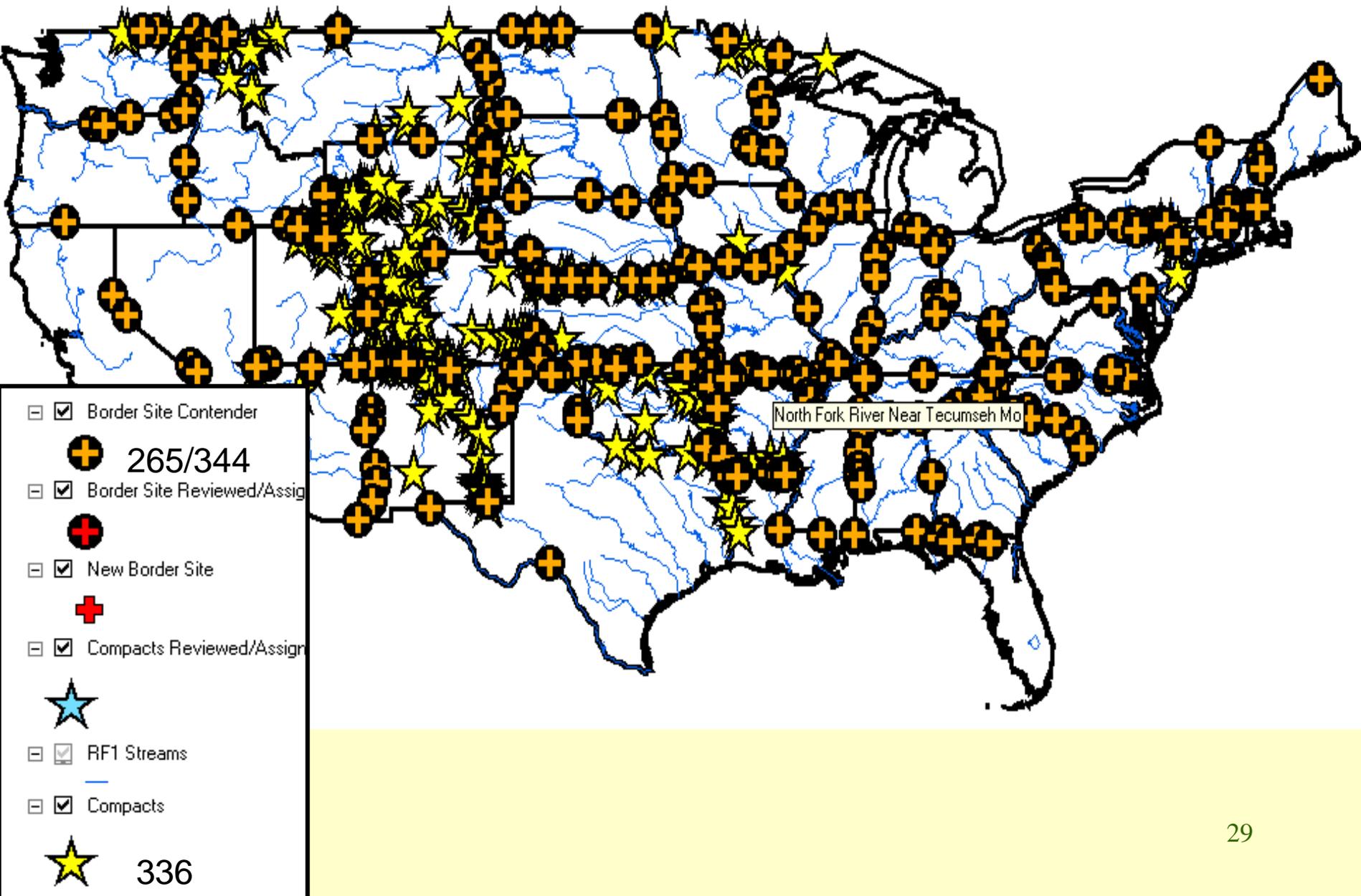
# Goal 1 -- Task

- 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](mailto:jrkolva@usgs.gov) with corrections.

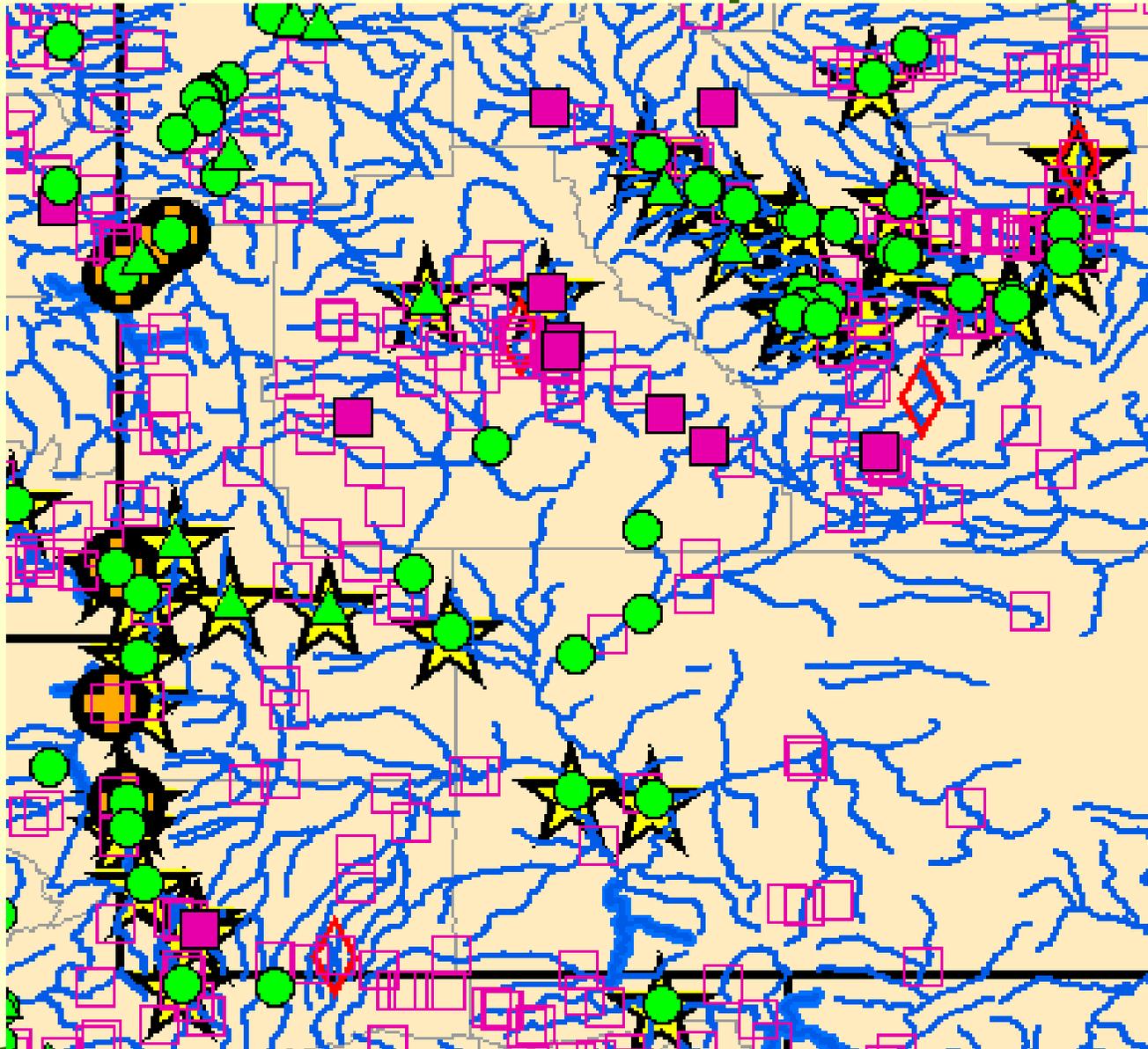
# Goal 2 -- Compacts & Border Crossings

1. Open goal\_2.mxd from **your hard disk**
2. Reset Map Layer Pathnames
3. Zoom in to your State

# Goal 2 - Initial Map



# Goal 2 --Example Map



# Goal 2 Tasks

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

# Goal 2-4 Tasks

- Verify contender station
- Reject contender and pick alternative existing station
- Select a new station

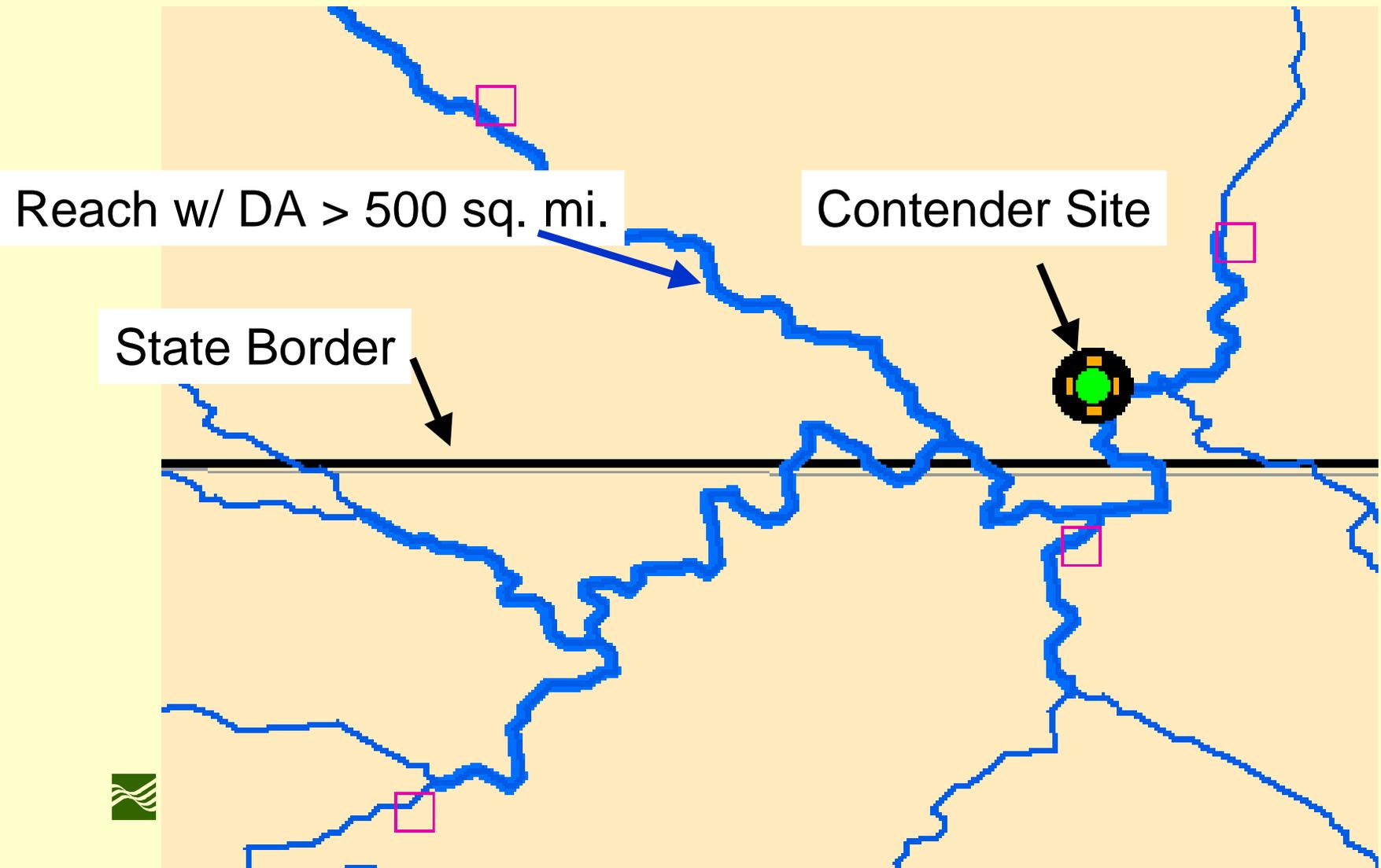
# Border Crossing Process

- Reaches with drainage areas greater than 500 sq. miles and adjacent reaches are shown in thick blue lines
- “Contender” stations are shown with an orange cross in a black circle



# Border Crossing Process, cont'd

## 1. Zoom in to the thick blue reaches



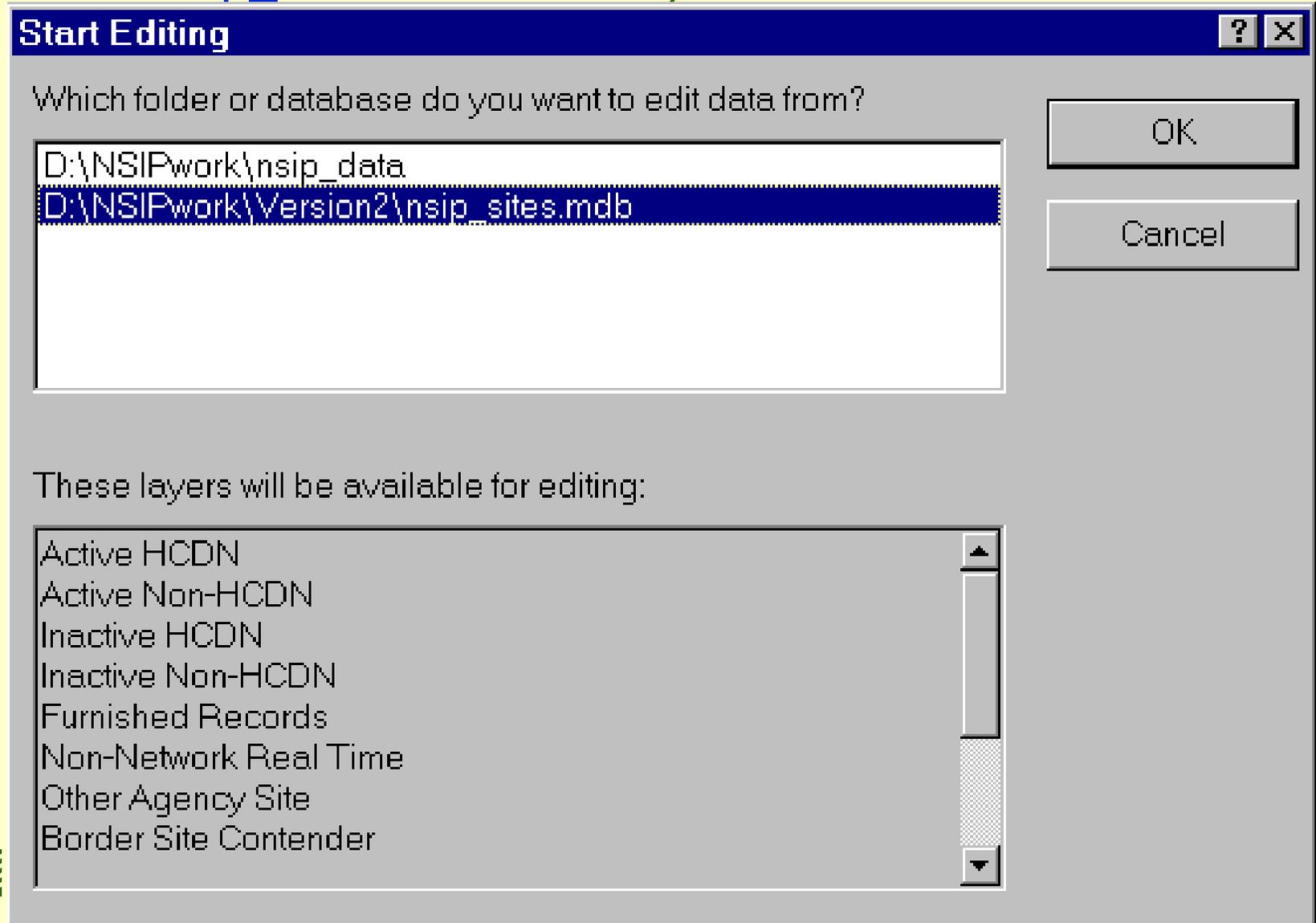
# Border Crossing Process, cont'd

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 listing the attributes of all other nearby stations
4. Click **Editor** in the Editor toolbar, then click **Start Editing**



# Border Crossing Process, cont'd

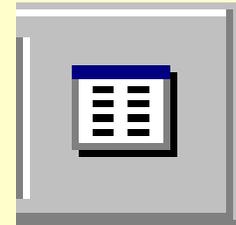
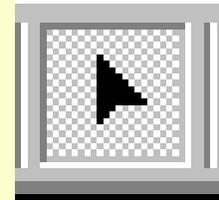
5. Select the [nsip\\_sites.mdb](#) file on your hard drive & Click OK



# 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 to select, making it turn blue
- c. Click on the **Attributes button** in the Editor Toolbar, Attributes table will appear



# Border Crossing Process, cont'd

6 d. Click in the Value field of the BORDER\_STATUS Attribute and change the Value from 0 to 1.



Property	Value
HCDN	0
HBM	0
DISTRICT	WY
STATE	MT
AGENCY	USGS
NASQAN2	0
BENCHMRK	0
NAWQALIP	0
ONREACH	1
MATCHID	15162
COMPACT	0
COMPACT_SITE_ID	
COMPACT_STATUS	0
BORDER	1
BORDER_STATUS	<input type="text" value="0"/>

# Border Crossing Process, cont'd

- e. Set **BORDER** attribute to 1 if not already set,  
(orange cross will turn red)



- f. Click on the Editor button in the Editor Toolbar again  
and Click on **Save Edits**



## 7. If the **contender station is incorrect**

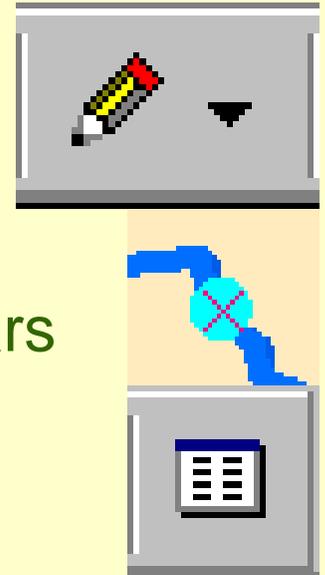
- a. Select the station you feel is most appropriate and edit its **BORDER** attribute from 0 to 1 and **BORDER\_STATUS** attribute to 2
- b. Select the original contender station, then change its **BORDER** and **BORDER\_STATUS** attributes to 0

# Border Crossing Process, cont'd

8. If no contender station was selected, either
  - a. Select the station most appropriate and change its **BORDER** attribute to 1 and **BORDER\_STATUS** attribute to 2,

**OR**

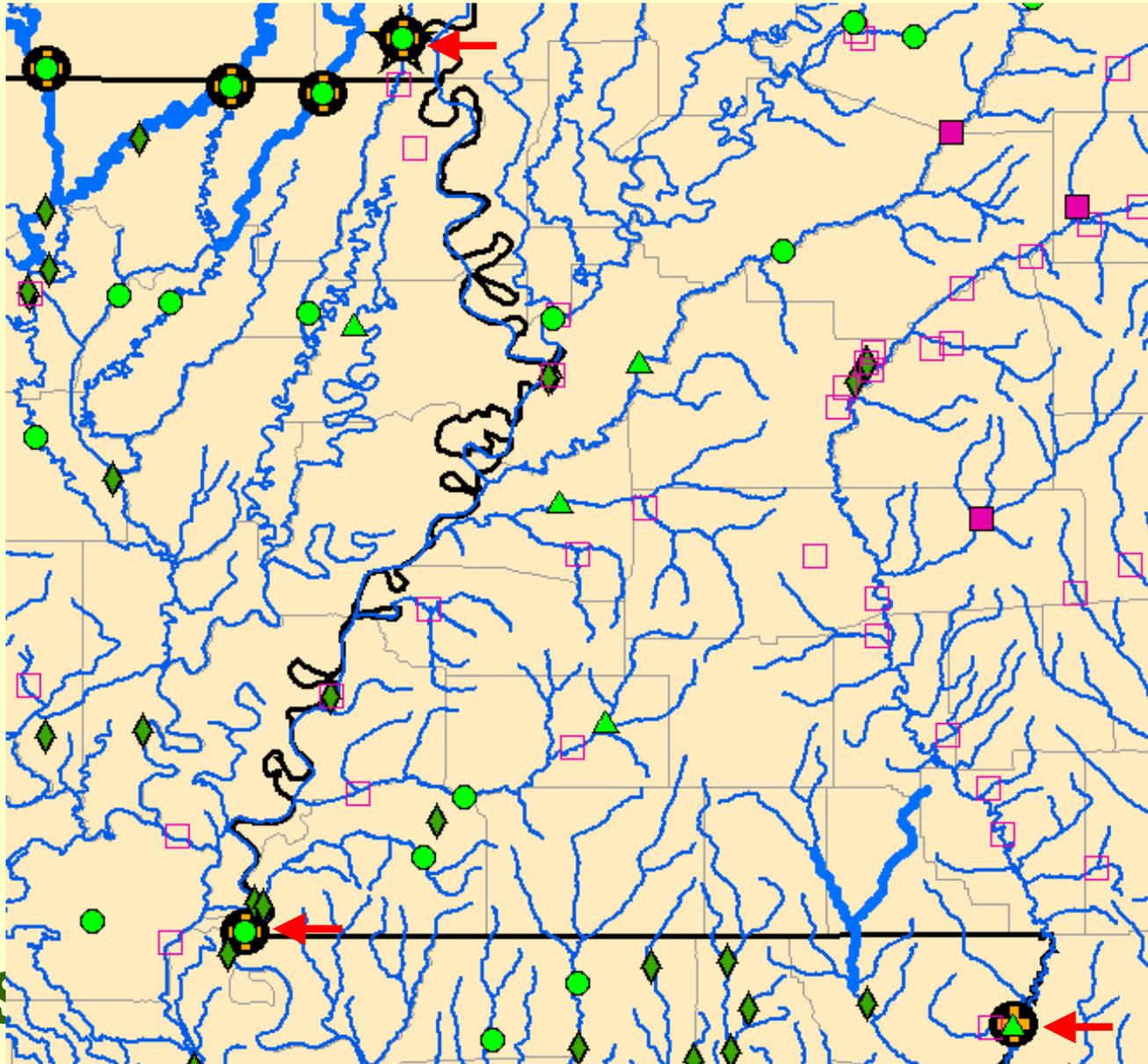
- a. Create new site using New Feature button in the Editor toolbar. Click on map to specify new location and a blue circle appears
- b. Click on the Attributes button in the Editor Toolbar to display attributes table
- c. Set the **BORDER** to 1 and **BORDER\_STATUS** attribute to 2, and add any other attributes for the new station



# 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

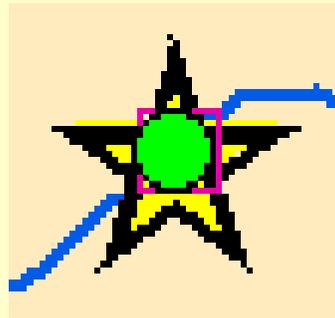


# Rivers That Form Borders, cont'd

- 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

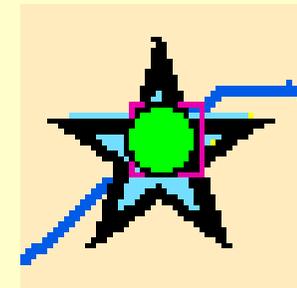
# Compacts Process

- 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



# Compacts Process, cont'd

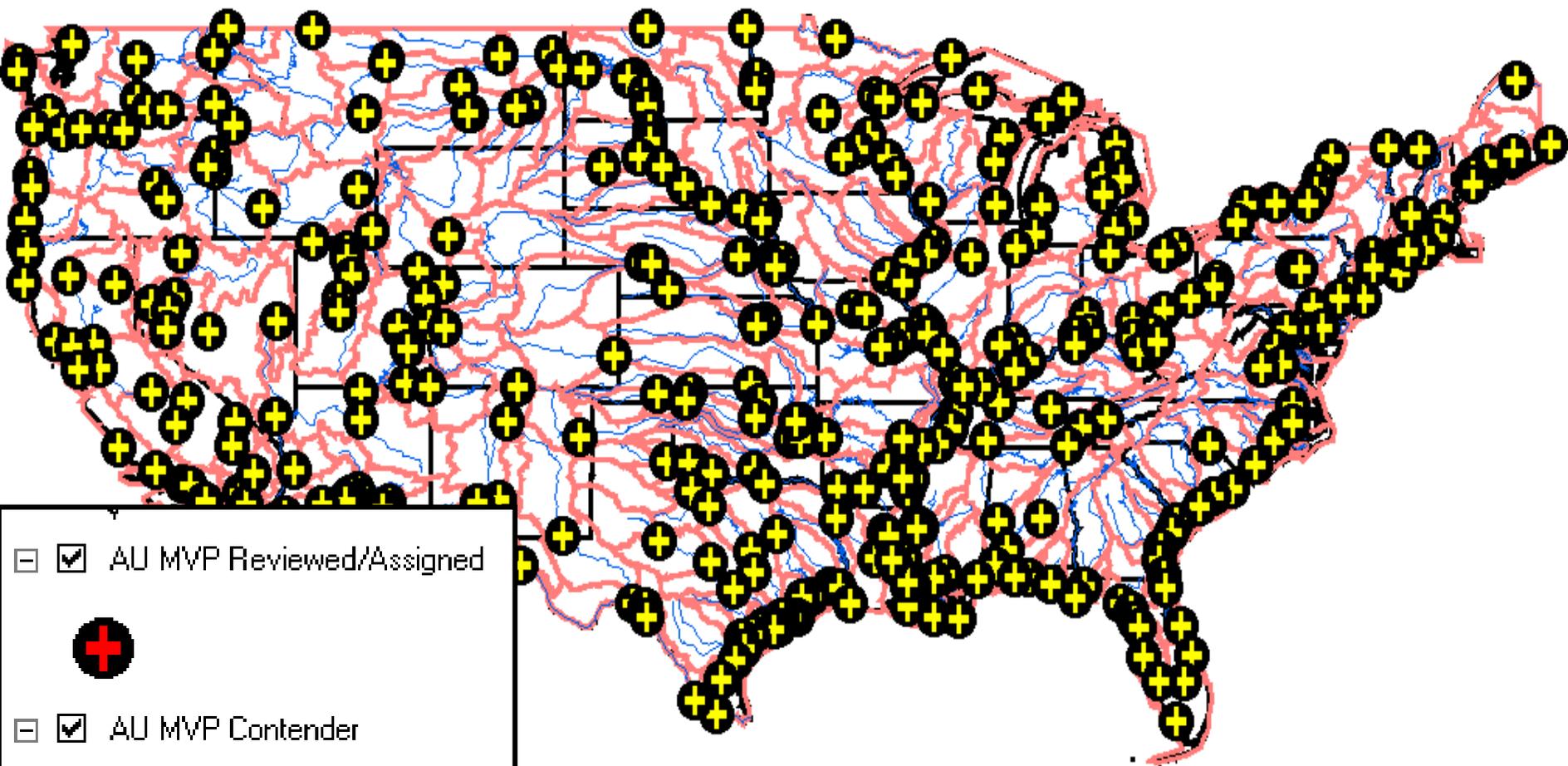
1. Edit the following attributes using the same procedures used for Border sites
2. Set attributes **COMPACT\_STATUS** and **COMPACT** values to 1 in the attribute table
4. Specify a station number in the **COMPACT\_SITE\_ID** attribute value if a different station provides information for the compact location
4. The star will turn from yellow to blue



# Save Files

- Save your Edits to the Site Attributes using the **Save Edits** option which is under the Editor drop-down menu on the Editor Toolbar.
- Save the goal\_2.mxd file on **your hard drive** using the Save option under the File menu.

# Goal 3 --Hydrologic Accounting Units



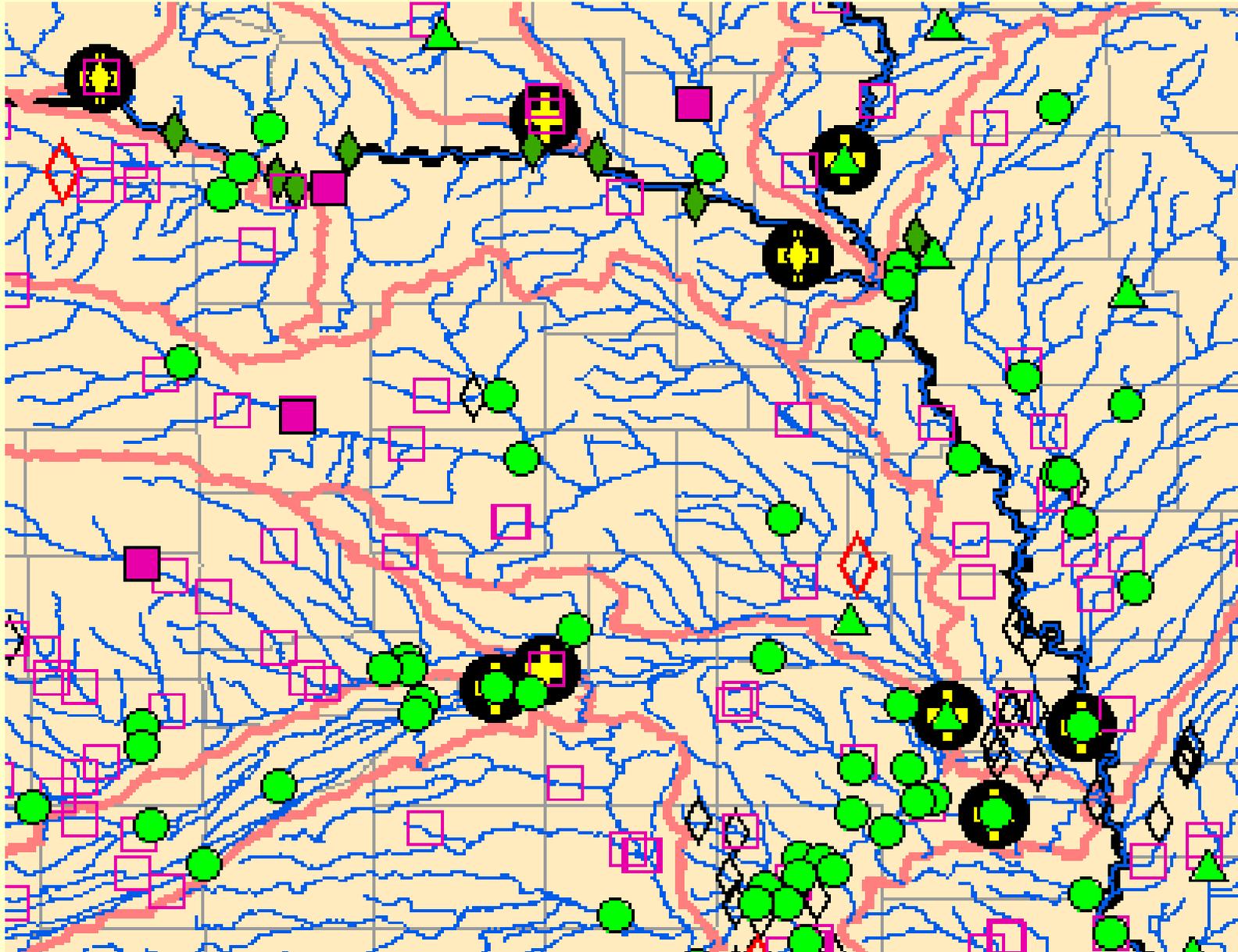
# Goal 3 -- Task

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

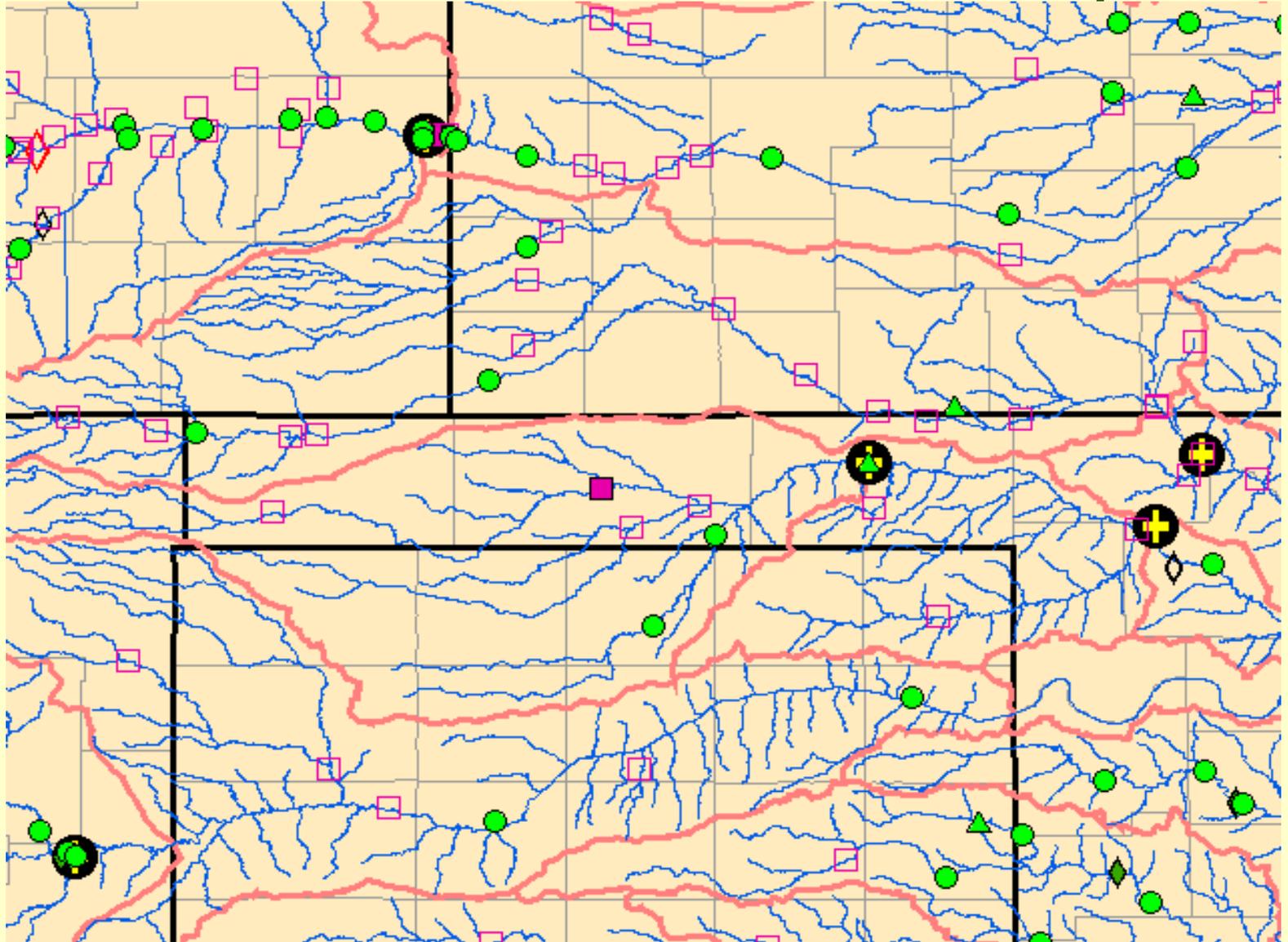
# Goal 3 --Hydrologic Accounting Units -- Criteria

- **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.

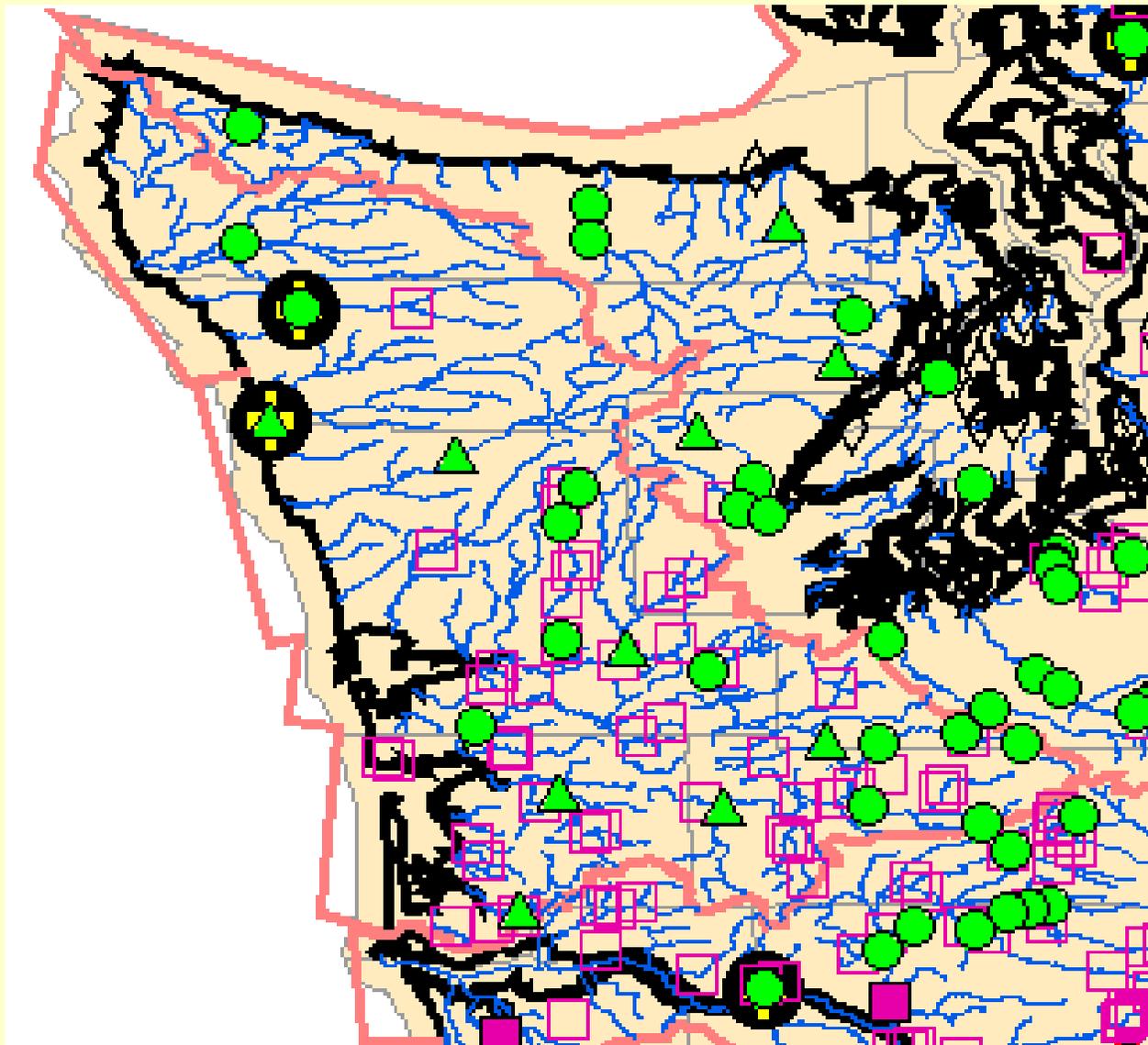
# Goal 3 – Main Stem Accounting Units



# Goal 3 – Headwater Accounting Units



# Goal 3 – Coastal or Closed Basin Accounting Units



# Goal 3 – Edit procedures

- Edit the following attributes using the same procedures used in Goal 2

- HUC6\_MVPSITE\_A

- HUC6\_MVPSITE\_B

- MVP\_HUC6A

- MVP\_HUC6B

- HUC6\_MVPSTATUSA

- HUC6\_MVPSTATUSB

# 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.

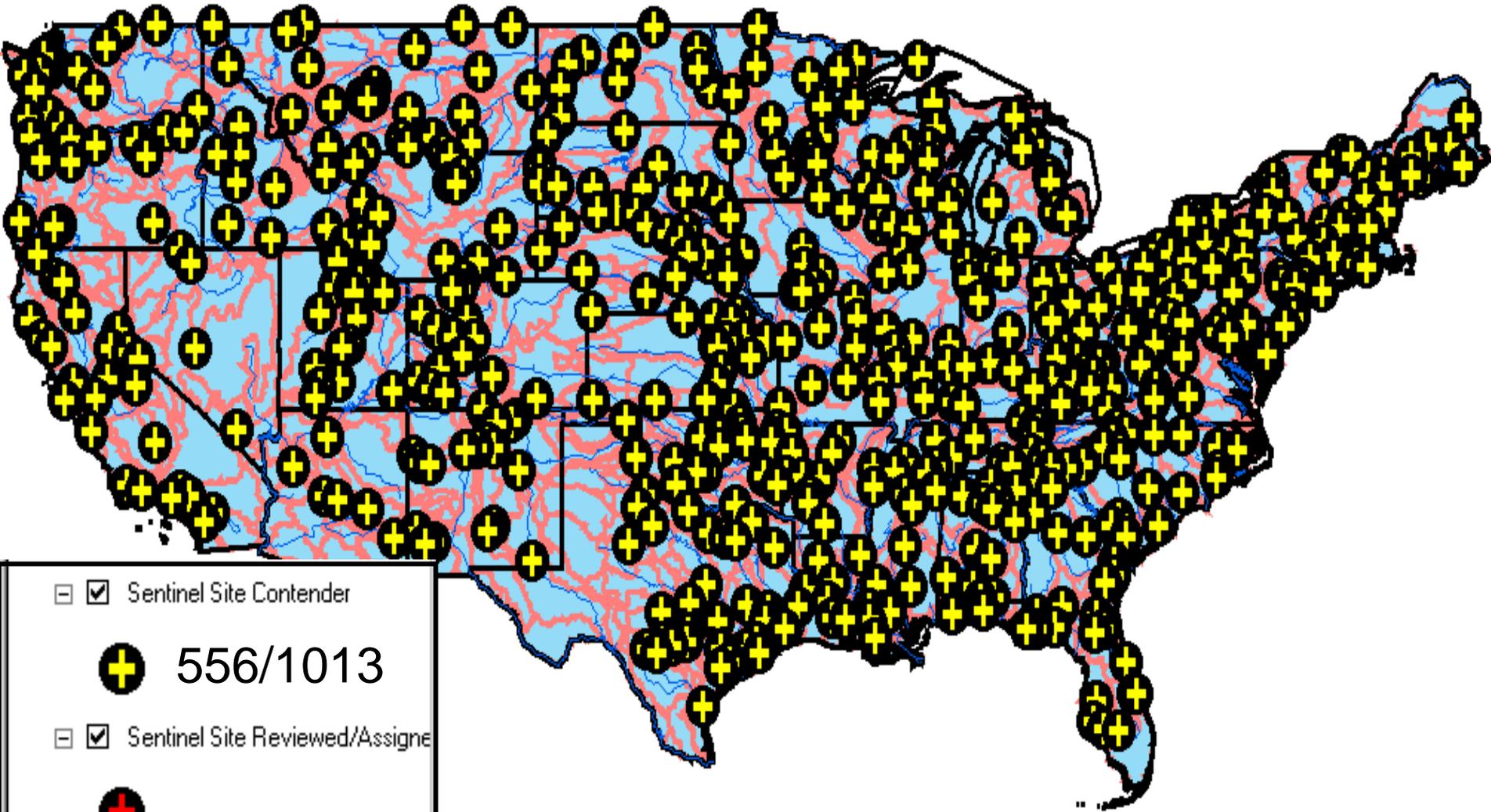
# Goal 3 -- ArcMap Attributes (cont'd)

- **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 (cont'd)

- **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, or rejected first cut selection and replaced with this station.

# Goal 4 – Sentinel Stations



Sentinel Site Contender

**+** 556/1013

Sentinel Site Reviewed/Assigned



New Sentinel Site

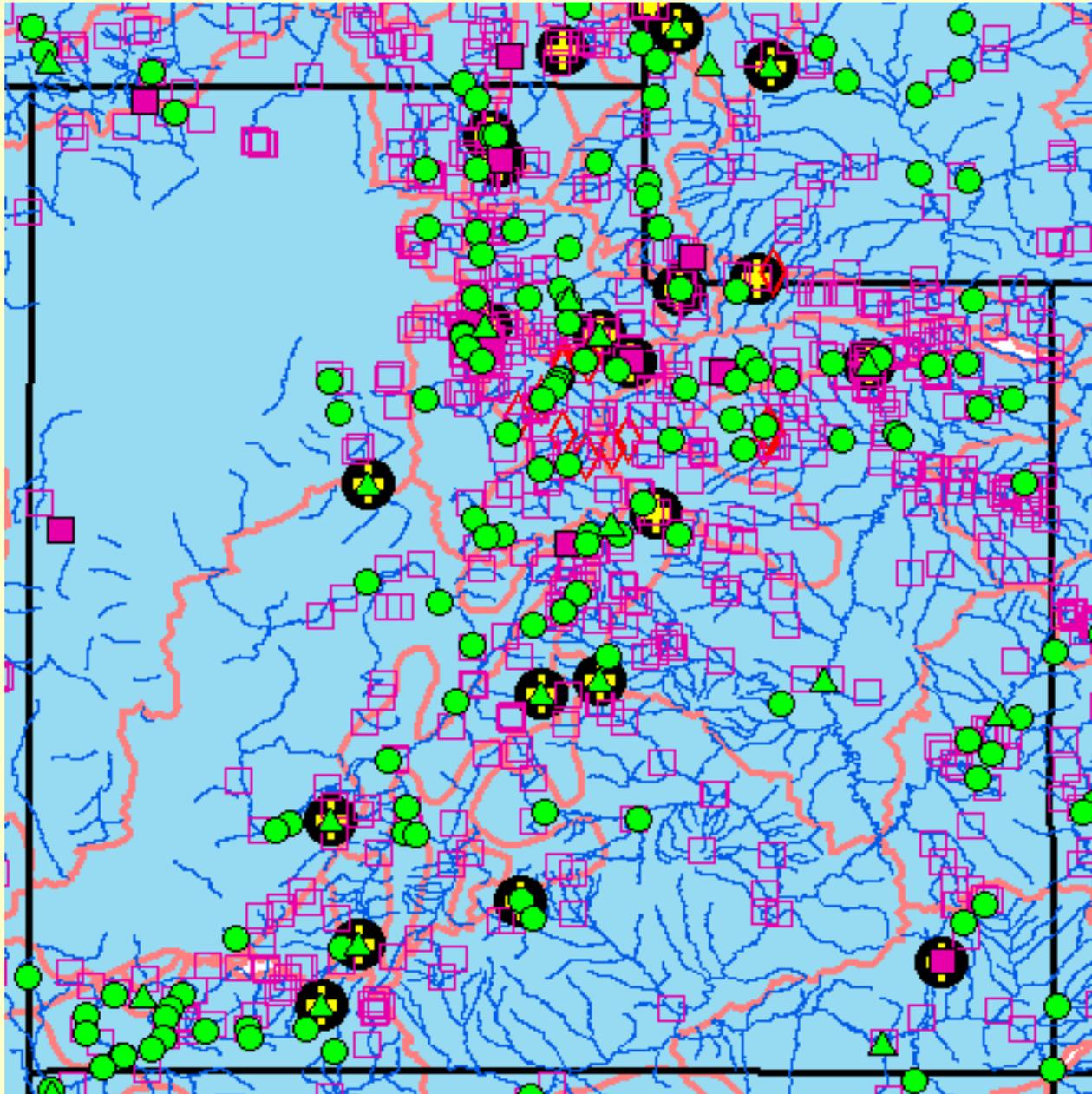


# Goal 4 -- Task

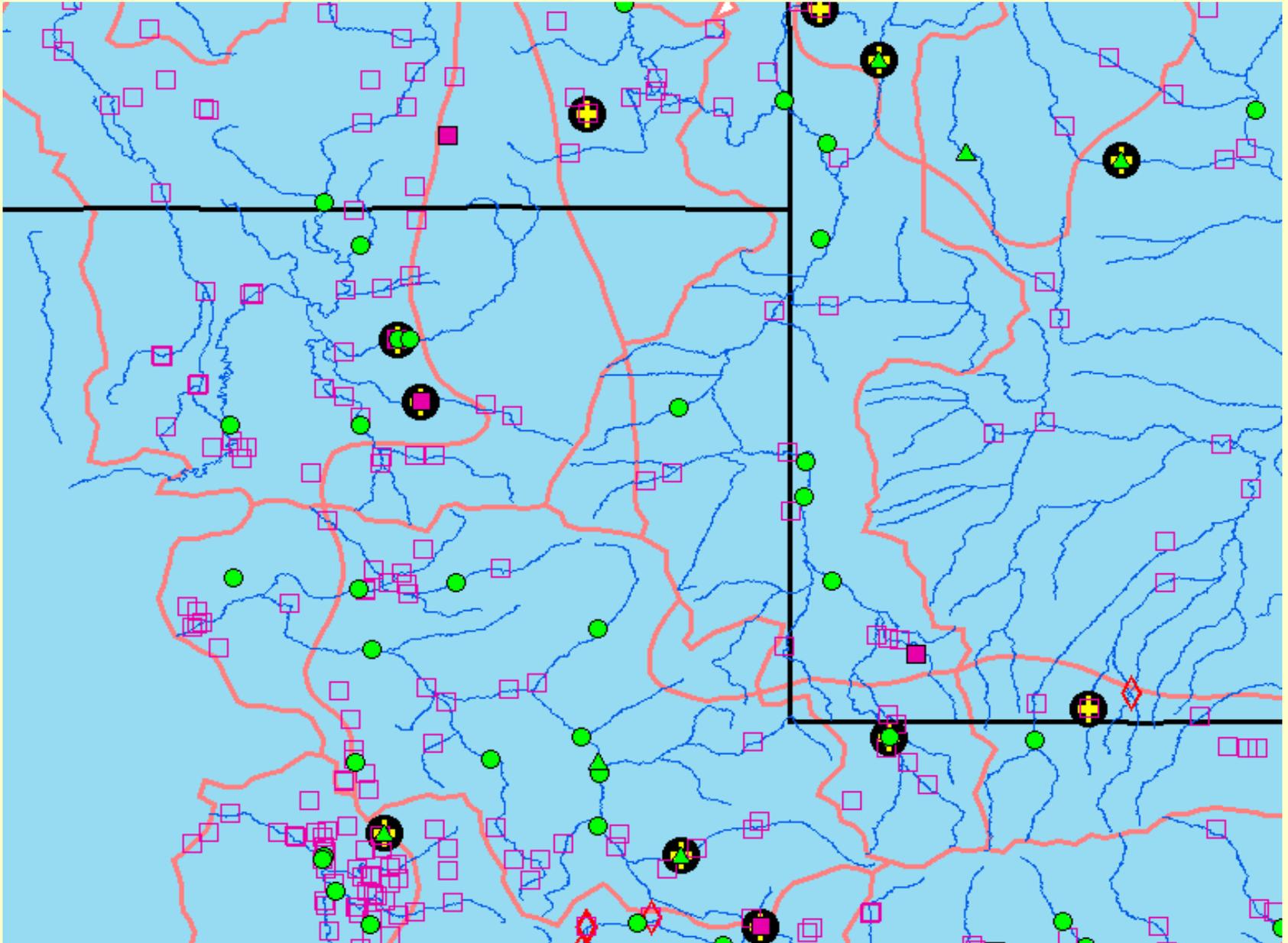
- Determine the best “Sentinel Station” for an ECO-HUC. The station best for determining long term trends in flow for that particular area. Station should have at least 80% of its drainage area within the eco-huc it represents.

“ECO-HUC” – Intersection of Hydrologic Accounting Units (HUC 6) and EPA Ecological Regions (76 in lower 48 states).

# Goal 4 – Sentinel Stations



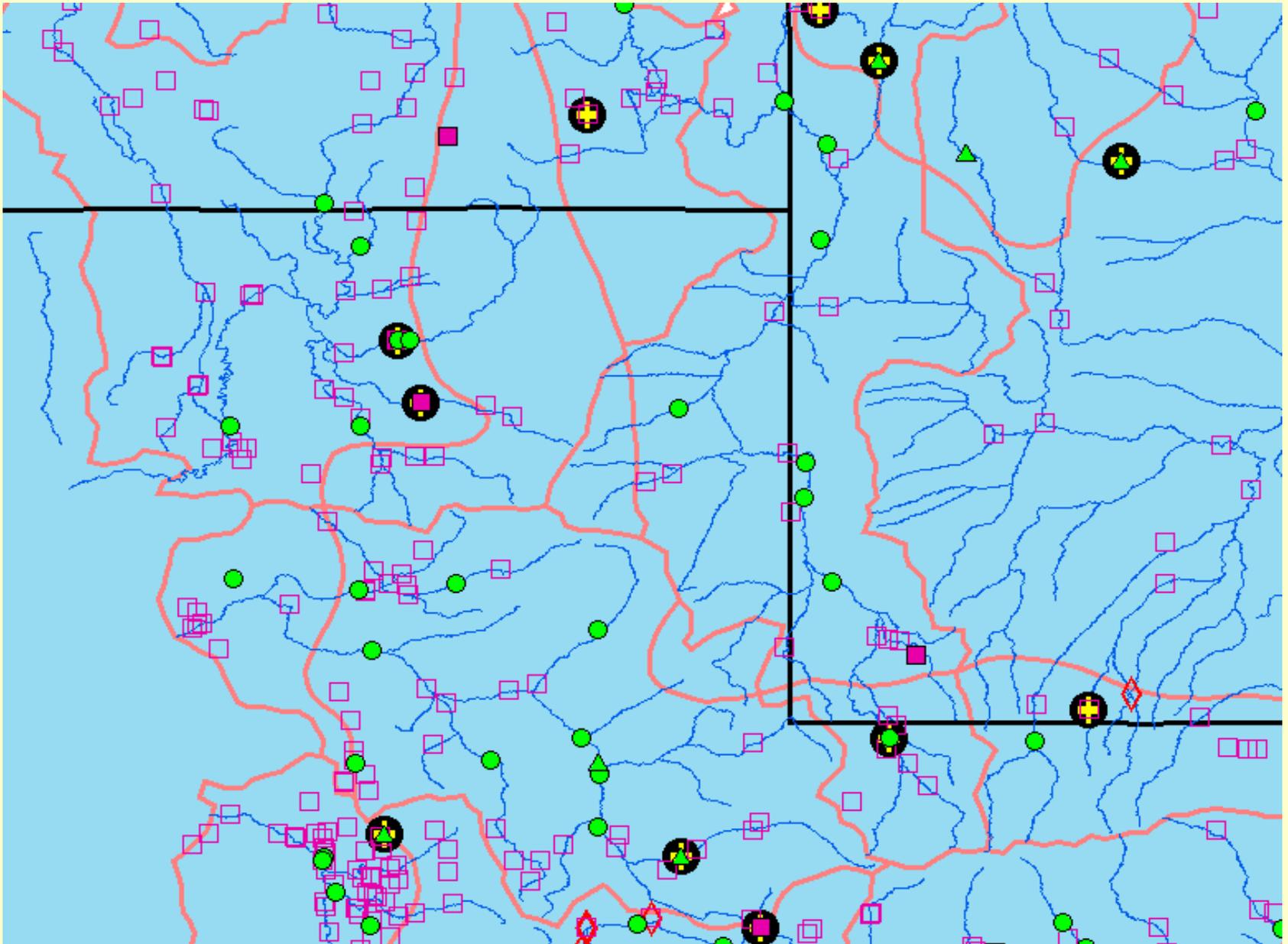
# Goal 4 – Sentinel Stations



# 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.

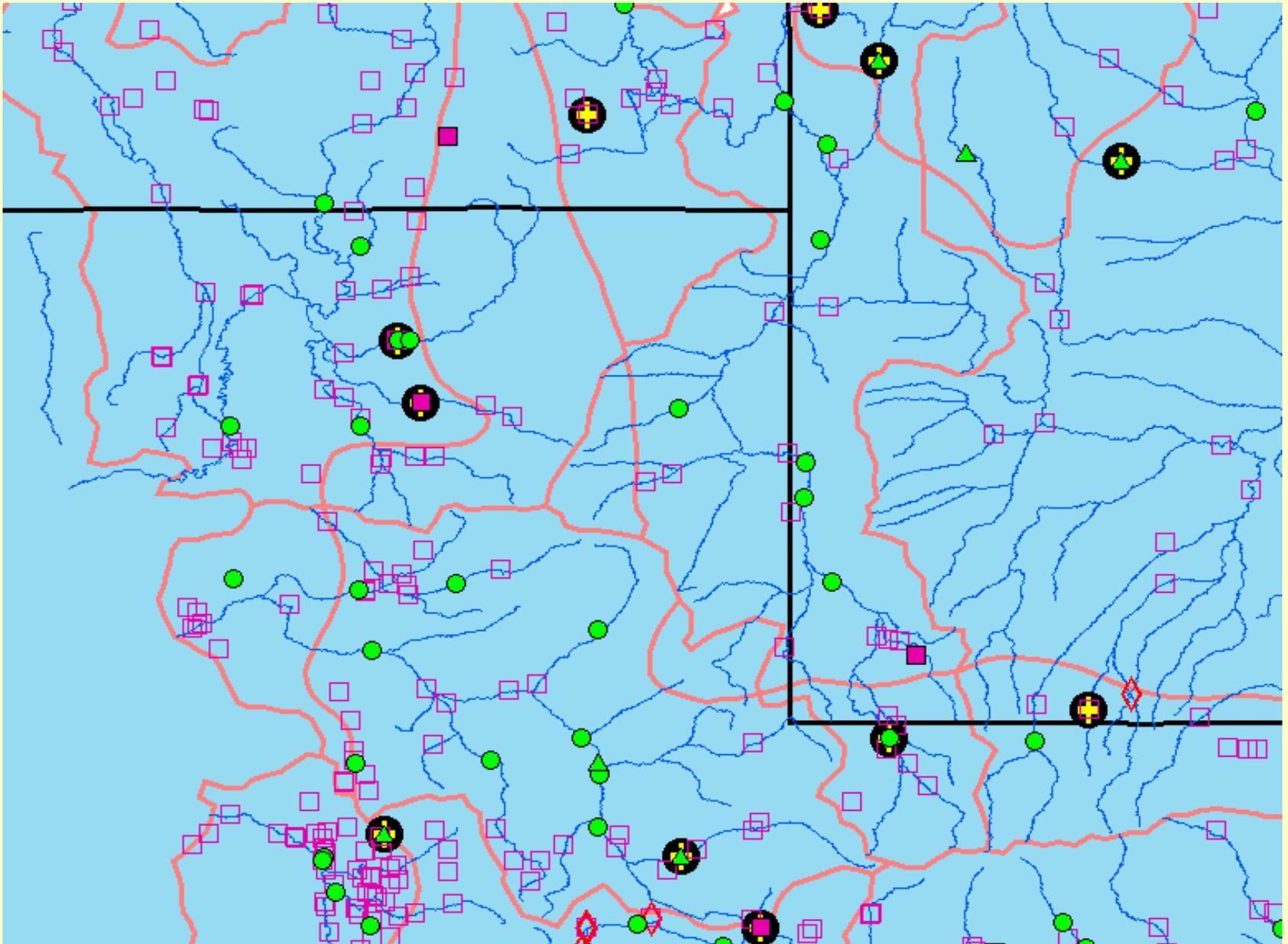
# Goal 4 – Sentinel Stations



# Goal 4 – Sentinel Stations

- Station should have at least 80% of the drainage area in the “ECO-HUC” it represents.
- Station should have the longest period of record possible. (Active HCDN stations preferred.)
- Every “ECO-HUC”, over 100 square miles should have a Sentinel Station.

# Goal 4 – Sentinel Stations

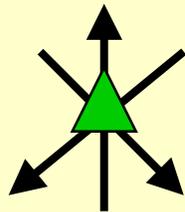
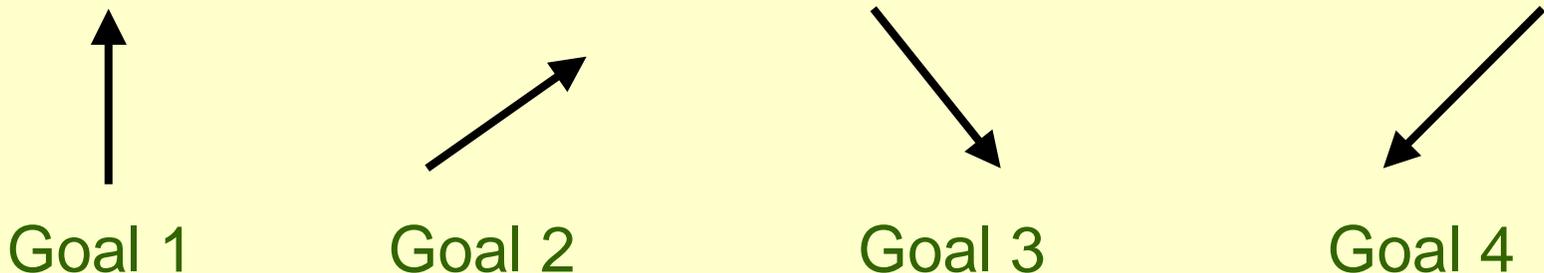


# Goal 4 – Edit Procedures

- Edit the following attributes using the same procedures as in Goal 2.
- **SENTINEL\_SITE**
  - 0 – Not a Sentinel Site
  - 1 – Is a Sentinel Site
- **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.

# Sites Meeting Goals

- Goal files 2-4 contain layers that show sites that have met other goals, using arrows
- Helps in selecting sites that have met other goals



Active HCDN that has met goals 1, 3 & 4

# When The Analyses Are Complete

- Zip the [nsip\\_sites.mdb](#) and [nsip\\_sites.ldb](#) files together
- Email compressed file to Dave Stewart at [dwstewar@usgs.gov](mailto:dwstewar@usgs.gov)

# Contacts

- Web Site <http://water.usgs.gov/osw/programs/nsip>
- Dave Stewart 703-648-4879 [dwstewar@usgs.gov](mailto:dwstewar@usgs.gov)
- Jim Kolva 703-648-5225 [jrkolva@usgs.gov](mailto:jrkolva@usgs.gov)
- Kernell Ries 703-648-5307 [kries@usgs.gov](mailto:kries@usgs.gov)

**THANKS!**