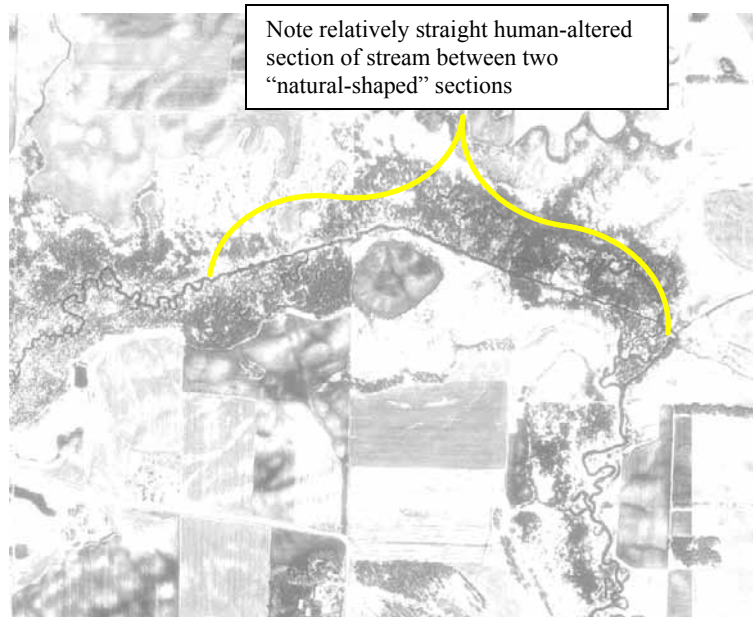


## Determining Altered Streams – Methodology

The following is a suggested set of procedures and criteria (i.e. methodology) for determining human-constructed or human-altered streams as opposed to natural, unaltered streams in the National Hydrographic Dataset (NHD) using ArcMap 9.2.

The most important concept to remember is the adage: “there are no straight lines in nature”. A natural, unaltered stream will not follow a straight line except for a very short distance (<20 stream widths). (Figure 1)



## ArcMap Setup

The following are the layers, toolbars and map scale to be used in ArcMap for Altered/Unaltered stream designation. (Figure 2)

### Feature Layers

**NHDFlowline:** categorized by FType; line width = 1 (also include network)

**Altered Events:** categorized by altered/unaltered designation; line width = 3 to 4

**NHDArea:** single symbol; background transparent

**NHDWaterbody:** categorized by FType;

background transparent

**DNR & USGS Dams:** Point symbols

**GNIS:** Line and point symbols with labels visible

### Imagery Layers

**DRG layers:** 1:24k is most important; set transparency to ~ 75% for entire group

**1991 DOQs:** B/W often shows best contrast between water and dry land

**2003 color FSA:** Although not as recent as 2006 color FSA imagery, is more complete and has better resolution (1m vs. 2m)

**2006 color FSA:** Most recent imagery, although not as high resolution as 2003-04 color FSA (2m vs. 1m) and not complete throughout the state

### Toolbars

**Hydro Event Management (HEM) Tools**

**Altered Events**

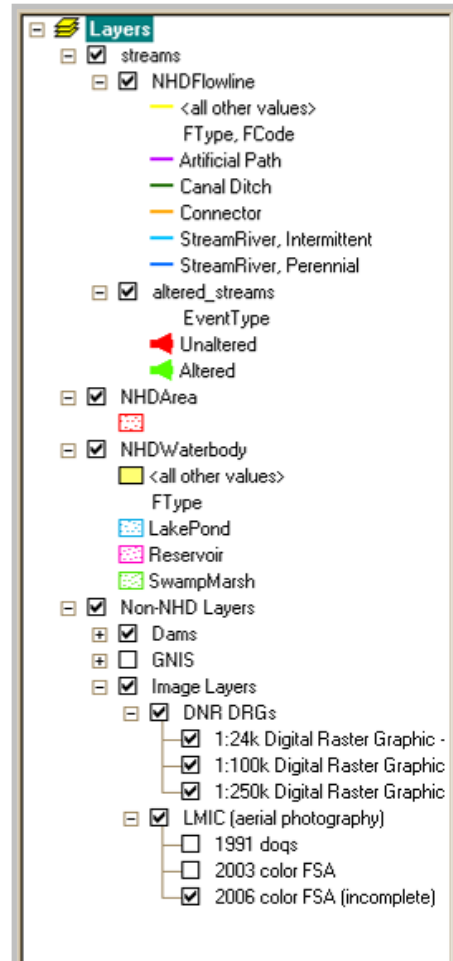
**Editor**

**Main Menu**

**Standard**

**Tools**

**Utility Network Analyst**

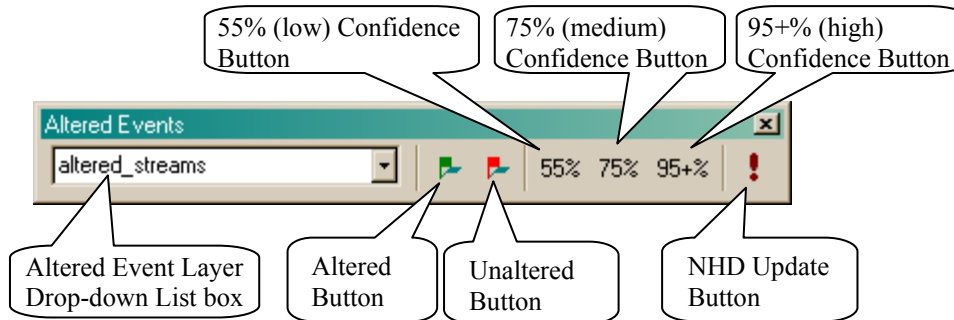


**Map Scale:** Working within 1:5000 to 1:10,000 seems to work best. Scales less than 1:10,000 generally do not show enough detail on the imagery and much greater than 1:5000 tends to make the imagery too grainy and indistinct for differentiation of altered from unaltered streams.

## Procedure

Designating NHD streams as Altered/Unaltered Events involves using the **Altered Events** toolbar on **Altered Events** records created by the **Hydro Event Management (HEM)** toolbar. (See *PNW Hydrography Framework Event Management Tools User Guide* for procedure on creating line events). The **Altered Events** toolbar may be used after each **Altered Stream** feature has been created or at the end after all of them have been created. The major steps are listed below:

1. If it's not loaded already, load the **Altered Events** toolbar (Figure 3) into ArcMap.



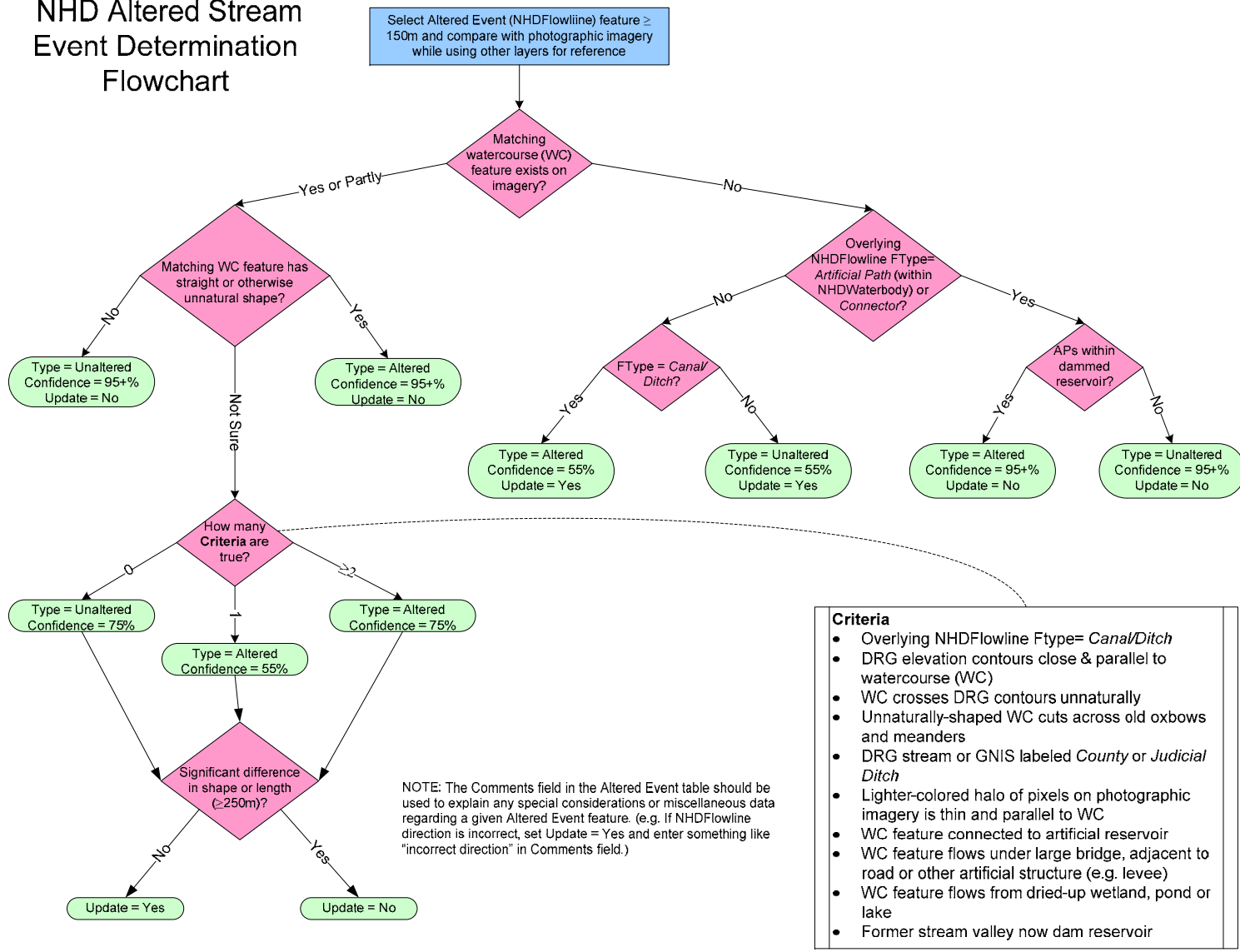
2. Add the following fields to the **Altered Events** layer:

Name	Type (width)
NeedUpdate	Short Integer
Confidence	Short Integer
Comments	Text (150)

3. Start an edit session, if necessary.
4. In the **Altered Events** toolbar select the **Altered Events** layer from the drop-down list box.
5. Proceed with steps shown in the flowchart below for each **Altered Event** feature of interest. The blue box at the top is the starting point, the red diamonds represent decision points in the diagram and the flattened green ovals represent actions by the technician while using the **Altered Events** toolbar (e.g. *Type = Unaltered* means the technician should click the Unaltered button<sup>1</sup>). Note that a matching watercourse is a feature on the imagery that generally follows the same shape and length of the overlying **Altered Event** (NHDFlowline) feature.

<sup>1</sup> Note that when *Update = No* the technician should not click anything since there is no NHD No Update button.

# NHD Altered Stream Event Determination Flowchart

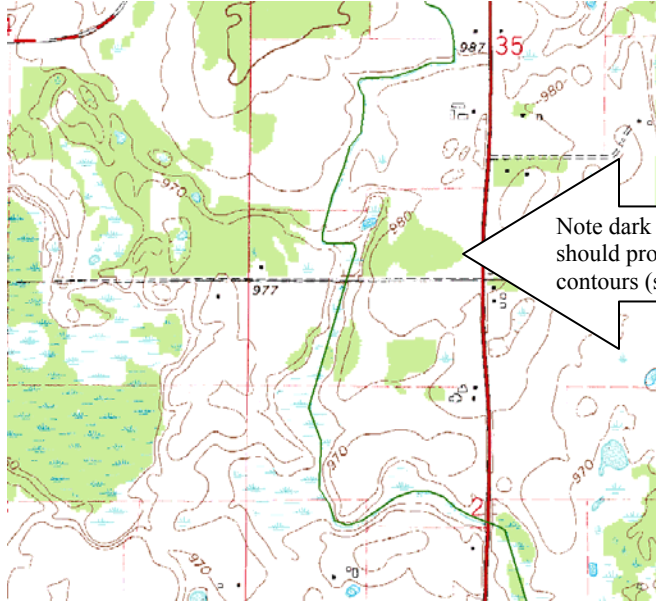


## Explanation of the Criteria for Altered Stream Determination

The following should be used as “Rules of Thumb” for helping to determine if a given flowline is an altered stream when it is not immediately obvious.

### **Overlying NHDFlowline Ftype= Canal/Ditch**

The FTypes (e.g. stream/river, canal/ditch) designations of the NHDFlowlines are generally accurate but should not be depended upon exclusively for determination of altered stream events.



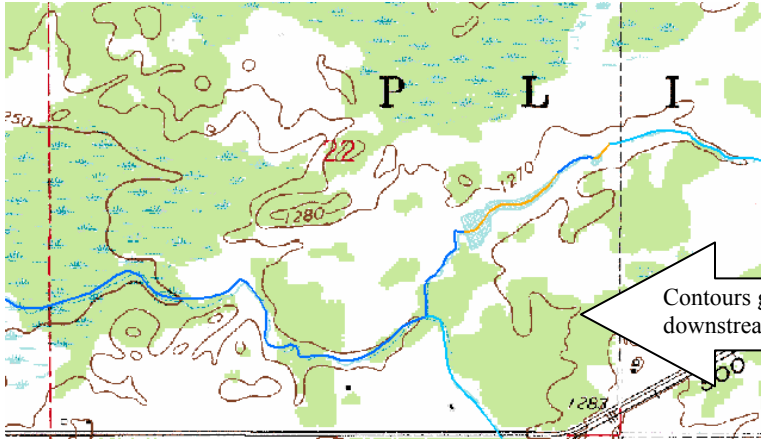
Note dark green line designated as Ftype canal/ditch should probably be Ftype stream/river given DRG contours (see next criteria explanation)

### **DRG elevation contours close & parallel to watercourse (WC)**

Many ditch/canals have close-in, straight-edged elevation contours on the DRG that stay with them much of their length.



Elevation contour close and parallel to ditch



Contours that cross natural streams tend to move farther apart and become more irregular in shape as they travel downstream.

Contours get wider and more irregular downstream after crossing natural streams

**Watercourse crosses DRG contours unnaturally**

Altered streams (especially those newer than the DRG) may cut across elevation contours at unnatural places or even appear to go uphill. Natural streams tend to cross at the V-shaped notches of contours and, of course, travel only downhill.



Note ditches crossing contour at unnatural locations

**Watercourse cuts across older meanders and oxbows and is unnatural (e.g. straight) in shape.**

An altered portion of a natural stream often cuts directly across the former meanders and oxbows of the original channel in an unnatural (i.e. straightened and direct) way.



Note straightened channel cutting through old meanders and oxbows



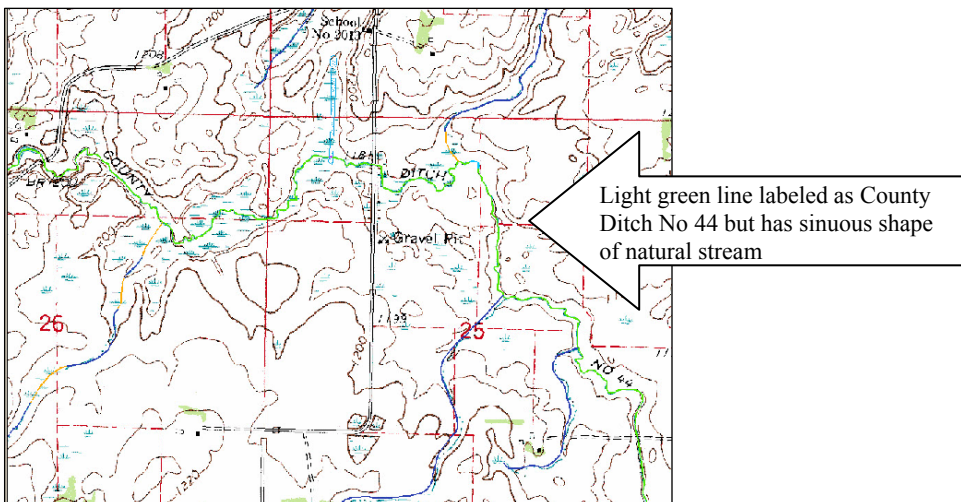
**But, be careful channel is not a natural cut-off of a meander.**

These will likely be shorter and more natural appearing than an artificial channel and, since they are by definition not dredged, may show development of their own meanders over time in the photos.



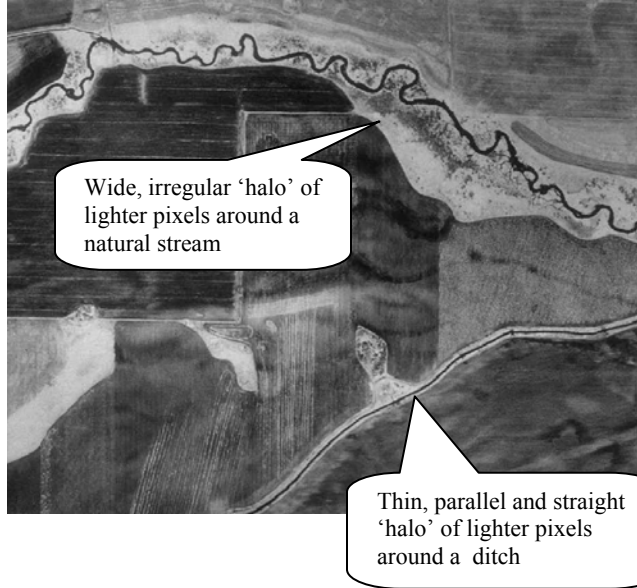
**DRG stream or GNIS labeled *County Ditch* or *Judicial Ditch***

The County or Judicial ditch labels on the DRG (and in the GNIS files) are generally accurate but should not be relied upon exclusively to designate a watercourse as an altered stream event.



**Lighter-colored halo of pixels on photographic imagery is thin and parallel to watercourse**

The photographic imagery sometimes displays watercourses with a ‘halo’ of lighter-colored pixels around the channel of darker-colored pixels. The relative shape and width of these halos may be used to help determine if the watercourse is natural or altered. Halos that are thin, parallel to and the same shape as the watercourse itself are probably around an altered stream. If a natural watercourse has such a halo, it tends to be wider, less distinct in color from adjacent areas and more irregular in shape.



**Watercourse features connected to man-made reservoir**



Portions of watercourses flowing into and out of man-made reservoirs are usually altered (see watercourses pointed to by white arrows in photo). Reservoirs may be found using the FType of the NHDWaterbody layer, labeled as such on the DRG or seen on the imagery as a darker polygon with a regular (e.g. rectangle or circle) or otherwise non-natural shape.



**Watercourse feature flows under large bridge, adjacent to road or other human-made structure (e.g. levee)**



Watercourses that flow under large bridges or adjacent to roads or other man-made structures are often altered. These include streams adjacent to levees.

Note how stream straightens as it flows under bridge

**Watercourse feature flows from dried-up wetland, pond or lake**

Dried-up wetlands, ponds and lakes visible on the imagery or DRG often have altered watercourses draining out of them.



Note ditches evidently draining former lake

**Former stream valley now a dam reservoir**

A dam on a stream may alter a watercourse by creating a reservoir that inundates a portion of the old stream valley upstream of it.



## Confidence Scoring Guidelines

Determining whether a given watercourse is altered or unaltered may require some subjectivity on the part of the technician but, hopefully, this will be minimized and most of his/her decision will be based on the objective procedures and criteria given above. Once decided, the technician then needs to posit his/her level of confidence in that determination. The three confidence values and their descriptions are given below:

- **95+% (High) Confidence**  
Using the procedures and criteria listed above the technician is certain (or nearly so) that the selected watercourse is either altered or unaltered (natural). If questioned, the technician should be able to defend the reasoning used to come to his/her determination. This confidence level should involve the least amount of subjectivity by the technician.
  
- **75% (Medium or Moderate) Confidence**  
Using the procedures and criteria listed above the technician has a moderate amount of confidence in his/her altered/unaltered stream determination. Some of the criteria used in the determination may be ambiguous or contradictory or involve a certain amount of subjectivity but the technician should still be reasonably justified in his/her determination.
  
- **55% (Low) Confidence**  
Using the procedures and criteria listed above the technician has a low amount of confidence in his/her altered/unaltered stream determination (i.e. just above 50/50). This confidence level involves the greatest amount of subjectivity from the technician. Of course, watercourses given this level of confidence should be scrutinized most closely in the QA/QC process.

## Questions

1. Are we supposed to designate altered/unaltered waterbodies as well as watercourses?  
**No, but APs are important esp. between two altered streams.**
2. How closely should a given watercourse on the 1991-92 DOQ or 2003-04 FSA conform to its Altered Event flowline in order to call it a match? (i.e. use buffers around flowlines that watercourses must fall within to be considered a match?)
3. Any more criteria that would be useful in determining whether a watercourse is altered/unaltered?
4. Do locks, dams and dredging count as altered?
5. Other data available that may help (e.g. county ditch maps)?