Manual Method

The manual method provides a means to measure migration without the use of GIS and extensive photo-rectification.

Step 1: Enlarge or reduce maps and photos to a common working scale. The scale of the most recent map or photo should be used since it will be the basis for making and comparing historical meander pattern changes and estimating the future position of a given channel location. Scanning is more accurate than using photocopiers. An error analysis on reduction or enlargement is advised.

Aerial photo image distortion, which increases from center to edge of photo, is one of the more common sources of error in the manual method. Scale and distortion problems can be lessened by measuring distances between reference points on air photos and related base map or photo multiple times and then averaging the distance to obtain the scale of the photos. The following relationship i0s used to determine the scale of aerial photos relative to the base scale of the base map or photo:

$$\frac{\text{Length between aerial photo (or map) reference points}}{\text{Length between same reference points on base}} \times \text{Base Scale} = \text{Aerial Photo (or map) Scale}$$

Step 2: Identify reference points that are common to each photo/map being compared, for example roads, vegetation, structures, rock outcrops and register to a common base map or aerial photograph. Registration points that bracket the site on both sides of the stream and at both ends of the reach are most useful because they reduce the amount of potential error within the bracketed area. Intermediate points between the end points are helpful in accurately registering the middle sections of the reach. More than five or six registration points can make registration difficult because of the difficulty in aligning all the registration points among the various aerial photos and maps used.

While it is preferable to use a standard set of reference points common to one base map, the reference points may not exist for all map years. In these cases, the registration points do not need to be common to all the maps and photos, only to the subsequent map or photo to which it is being compared, since comparisons can be performed in pairs. There will be instances where very few identifiable registration points are common to between photos. These sites may have the potential for significant error.

Step 3: Map the active channel, deposition, and floodplain with high flow and relic channels on a transparent overlay for each set of aerial photographs using a stereoscope.

Step 4: Transfer these maps to the base aerial photo or map (preferably geo-referenced orthophotos or maps)

Step 6: For each record of channel position, calculate:

- The total area of the active channel
- The area of the channel outside the area of previous record
- The area of channel outside all past channel locations.
- The area of floodplain that includes high flow and relic channels

Additional calculations may include:

- Area of deposition features (bars)
- Number of LWD structures

Step 7: List the measurements by photo and map years and calculate rates for each time span, for the entire record, and most recent rates.

Step 8: Calculate migration rate for at least 100 years (average rate x years).