

Repeat Photography Documents Landscape Change 75 Years After An Horrendous Flood

STANLEY MANN, Elizabeth¹, HILKE, Jens¹, BIERMAN, Paul¹, and WORLEY, Ian², (1) Geology Department, University of Vermont (2) Environmental Studies, University of Vermont



Montpelier, 1927. Photo shows flood damage at state capitol. Note variation in color on tree trunks indicating height of flood waters.

Every year, floods change landscapes adjacent to rivers. In order to properly manage such landscapes, we need to know how riverine landscapes recover. Pairing historic and modern photographs of the same location provides a means of evaluating landscape change over time.

In Vermont, the 1927 flood dwarfs all others in recorded history. The flood occurred in November; storm rainfall ranged from 10 to >20 cm. The flood took out 1285 bridges, kilometers of roads and railroads, and countless buildings. Lt. Governor Jackson and 84 others died in the flood. Shortly after the flood, 90 oblique aerial photographs were taken of which 68 survive, some of the earliest aerial photos of a major flood and the landscape change it caused. These images are a subset of the thousands available at uvm.edu/perkins/landscape.

We documented landscape change through re-photography of 1927 flood images. The aerial images represent four major rivers in Vermont, the Black, Lamoille, White and Winooski. To determine the flight lines of the original aerial photographs, we marked the four corner points of the image on topographic maps (1:24,000 scale), which created an image trapezoid. Once in the plane (a four seat Cessna), we oriented the camera by using landmarks, either man-made or natural, in the historic photograph. The most useful landmarks included bridges, roads, buildings, and the river itself. When pairing the historic and current aerial photos, it is important that the current photo not only show the same area as the historic photo, but that the angle from which both were taken is similar. One of the best indicators of such similarity were ridgelines, as these have not changed appreciably.

We considered each image pair in terms of landscape change over the past 75 years. Roughly 8% of images show changes in the river channel, 4% are unchanged or show very little change, 24% show road building, and 64% show suburban development. An interesting contrast is the relationship between reforestation and suburban development. It appears that the two are directly correlated, 85% of photos show reforestation and 75% of reforestation photos show suburban development.

This project demonstrates remarkable changes that have taken place since the 1927 flood throughout the state of Vermont. Re-photography of historic images allows us to document this landscape change.



St. Johnsbury, 1927. Photo of two men canoeing down a street after the flood.

Aerial Re-Photography: Vermont from the Air

Channel Change: Width

Richmond, 1927

Richmond, 2004

This image pair shows the narrowing over time of the river channel since the 1927 flood. The graph below indicates that on the whole the river channels represented in the photographs have not changed appreciably, but approximately 12% have narrowed and 5% have widened.

| Degree of Change | Percent Changed |
|------------------|-----------------|
| Narrower Today | 12 |
| No Change | 83 |
| Wider Today | 5 |

Channel Change: Route

Randolph, 1927

Randolph, 2004

This set of images represents changes in the route of the Stevens Branch over the last 77 years. The graph below shows that in general most photographs showed little change in channel route, 25% showed some change, and 2% showed a lot of change.

| Degree of Change | Percent Changed |
|------------------|-----------------|
| No Change | 75 |
| Some Change | 25 |
| A Lot of Change | 2 |

Methods:

- We scanned the images at 600 dpi, standard archive quality.
- For each image we took an 8.5 x 11 topographic map (1:24,000 scale) and marked the four corner points of the image, creating a trapezoid on the map showing the area of the historic photograph.
- When it came time to fly, we grouped the pictures by river, the Winooski, White, Black and Lamoille rivers. Burlington, Colchester, and Winooski were grouped with the Lamoille river.
- Once in the air, to frame the image we used landmarks, either man-made or natural, that were in the historic photograph. This included bridges, roads, buildings, and the river itself.

These photos have been evaluated in terms of eight criteria: change in forestation, urban and suburban development, riparian vegetation, road building and channel change (including width, route, mid-channel island, and abandoned oxbows). Change in forestation, urban and suburban development, riparian vegetation and road building were evaluated on the scale of less change, no change, or more change. Channel changes were evaluated differently, with width being either narrower or wider today, or no change. Change in channel route was based on the scale of no change, some change, or a lot of change. Mid-channel islands were scaled as loss of island, no change or no island, and new island. The criteria for abandoned oxbows were similar: abandoned pre-1927, no change or no oxbow, and abandoned post-1927.

Channel Change: Mid-Channel Island

Sharon, 1927

Sharon, 2004

While many photos did not have mid-channel islands in them, those that did show that many were created after the flood. Perhaps high flows eroded many islands that slowly came back over time.

| Degree of Change | Percent Changed |
|-------------------------------|-----------------|
| Loss of Island (or no island) | 10 |
| No Change | 55 |
| New Island | 35 |

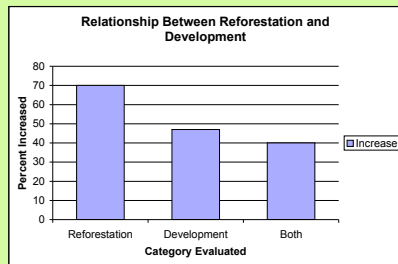
Abandoned Oxbows

Williston, 1927

Williston, 2004

This photo pair shows an oxbow abandoned before the flood. This photo also shows the magnitude of flood waters as the fields throughout the photo were washed over. Very few photos had abandoned oxbows, those that did showed approximately 5% abandoned pre-1927, and 7% abandoned post-1927.

| Degree of Change | Percent Changed |
|-------------------------|-----------------|
| Abandoned Pre-1927 | 5 |
| No Change (or no oxbow) | 90 |
| Abandoned Post-1927 | 7 |



This graph shows the relationship between reforestation and development seen through the 1927 flood aeriels. Over the last 77 years both forest cover and development have increased.

Reforestation

Colchester, 1927

Colchester, 2004

Development

Waterbury, 1927

Waterbury, 2004

Road Building

Barre, 1927

Barre, 2004

Riparian Vegetation

Hartford, 1927

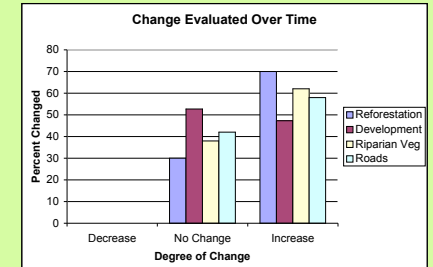
Hartford, 2004

Photo pair shows reforestation in the greater Burlington area. Lake Champlain is in the background, and an abandoned oxbow is in the foreground of the current photo. Winooski River.

This set of photos shows the development that has taken place over the last 77 years. Note bare, eroding ground in upper right of historic photo. Winooski River.

Considerable road building has taken place in the last century in Vermont. This includes the widening of current roads, the creation of new state routes and the building of Interstate 89 (at right). Winooski River.

Almost all rivers in Vermont have shown an increase in riparian vegetation over the past 20 years. This photo pair shows the riparian corridor along the Connecticut River (White river at left).



The graph above shows the general trends of forestation, development, riparian vegetation, and road building over the last 77 years in Vermont. None of the photos showed a decrease in any of the categories. The greatest increase is seen in forestation and the least increase in development.