



# Land Use Change in Union County 1930-2002 and the Increased Risk of Urban Flooding

Dr. Feng Qi  
Melissa Hansen  
Alicja Trzopek

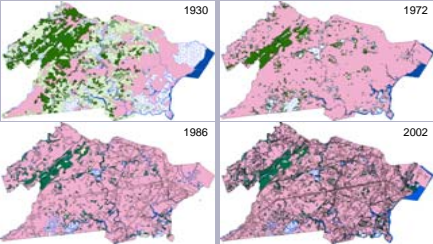


## Land Use Mapping

Union County, New Jersey is one of the most densely populated counties in the U.S with more than 5,000 people/mile<sup>2</sup>.

Rapid urbanization has caused drastic changes of the land over the past 70 years. In the 1930s, urban land, agriculture and forest/wetland were evenly distributed at 30% each (total ~ 90%, water = 10%) of the county. As of 2002, agriculture has nearly disappeared, forested areas experienced noticeable coverage reductions and the majority of wetlands were developed for other purposes.

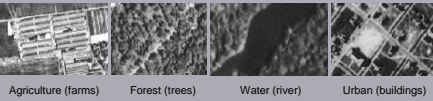
In order to visualize the land use changes in response to rapid urbanization of Union County, we compiled land use maps of a series of years: 1930, 1972, 1986, 2002.



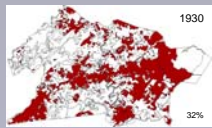
## Image Interpretation

The land use map of 1930 was interpreted from black and white aerial photographs obtained from the NJDEP.

Land use types were interpreted based on the color and texture of the photo. Topographic maps were also used as reference layers. Polygons of different land uses were digitized using a Geographic Information System (GIS) called Arc GIS. We differentiated seven types of land use from the 1930 photo tiles: urban, agriculture, forest/wetland, forest, water, wetland and barren land.

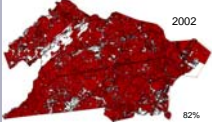


## Land Use Changes 1930-2002



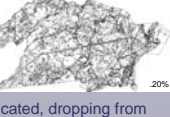
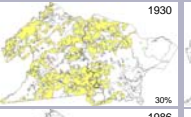
### Urban

Since 1930, urban areas have been steadily increasing as population (ppl) increased.



1930 – 305,209 ppl  
1970 – 543,116 ppl  
1980 – 504,094 ppl  
2000 – 522,541 ppl

### Agriculture



Agriculture has been eradicated, dropping from 30% to .20% from 1930 to 2002.

### Wetland/Forest



Forest and wetland areas decreased in 1930-1986; yet remained relatively stable at 14% through 2002 due to preservation efforts and expansion of parkland areas.



## Urban Flooding

Flooding occurs after intense rainfall over a short period of time or after a long rain fall, when soil is saturated and water does not infiltrate very well.

In natural environment cases, soils are able to absorb water into the ground and prevent flooding.

Increased impervious surfaces such as roads, rooftops and buildings cause more run-off, since there is less soil that absorbs the rain water—increasing the risk of flooding of urban rivers and streams.

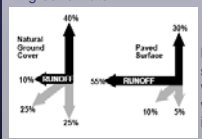


In a watershed, upstream development without detention, can lead to increased frequency of high flows downstream. Drainage systems may become inundated causing flooding in the immediate area. Urban flash flooding occurs often during these intense rainfall events.

## Land Use and Stream flow

Stream flow (the flow of water in rivers and streams) is a major component of the hydrologic cycle.

Precipitation (1) falls to the ground, (2) runs off into lakes and streams or (3) infiltrates into the ground and travels as ground water.

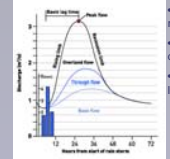


Naturally, stream flow will increase after a heavy rainfall but it will go back to its normal level due to the infiltration and supply of ground water.

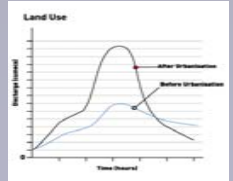
As impervious surfaces increase, runoff increases and infiltration into the ground decreases. During rain fall, streams and rivers become preoccupied with run off due to the lack of infiltration caused by excessive urbanization.

## Land Use and Hydrograph

A hydrograph is a graph that represents the measure of discharge (volume of stream flow) vs. time.

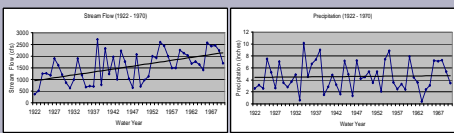


- Base flow represents normal discharge of the river that results from the flow of ground water into the water table
- Rising limb represents a rapid increase of the discharge due to heavy rainfall.
- Peak flow occurs when the river reaches its highest level.

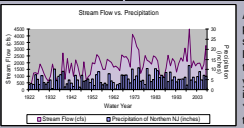


Impermeable surfaces in urban areas cause more run-off into rivers, streams, gutters and drains, thus carrying water quickly to the nearest river, rapidly increasing the peak of stream flow.

## Stream flow changes 1920-2002



Above: Stream flow has increased steadily between the years 1922–1970.



Above: the precipitation chart shows that there is little to no change in the trend during the years that stream flow increased.  
\*Stream flow data taken from Elizabeth River

## Conclusion

Urbanization has occurred rapidly starting from the 1930s in Union County. The majority of urbanization took place during the period from 1930-1970. The increase of impervious surfaces has caused disturbances in the hydrologic cycle in the local watershed. Less efficient infiltration has led to a noticeable increase in stream flow during the same period, which has increased the risk of urban flooding.

## Acknowledgements

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