Who Uses Stream Gauge Data?

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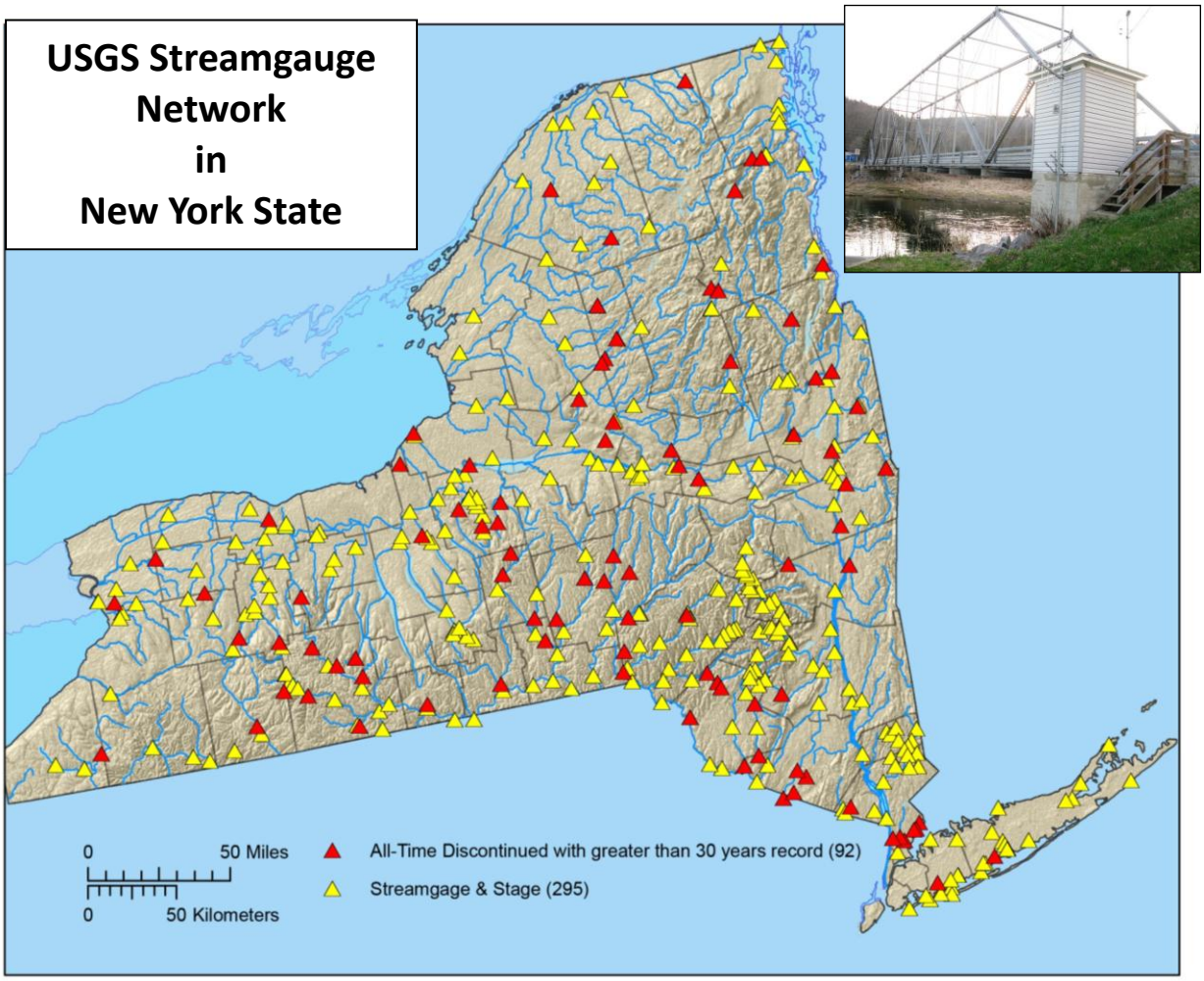
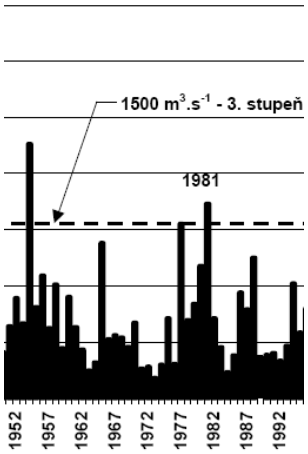


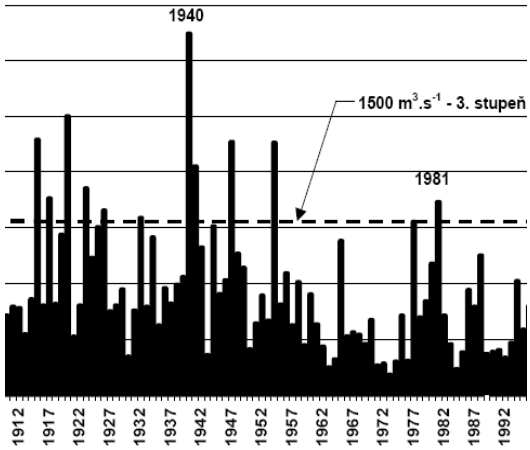
The current US Geological Survey (USGS) stream gauge sites in New York State are shown in yellow. This network changes over time as new gauges are added and others are discontinued. Many of the gauges that have been discontinued because of funding difficulties are sites that are important because they have a long period of record. The red sites on this map represent gauges that have 30 or more years of record, but are no longer active. When these gauges were discontinued, the value of that long-term record was lost forever.

I am going to share some examples of how people in my region use stream gauge information, but first let's look at some data.

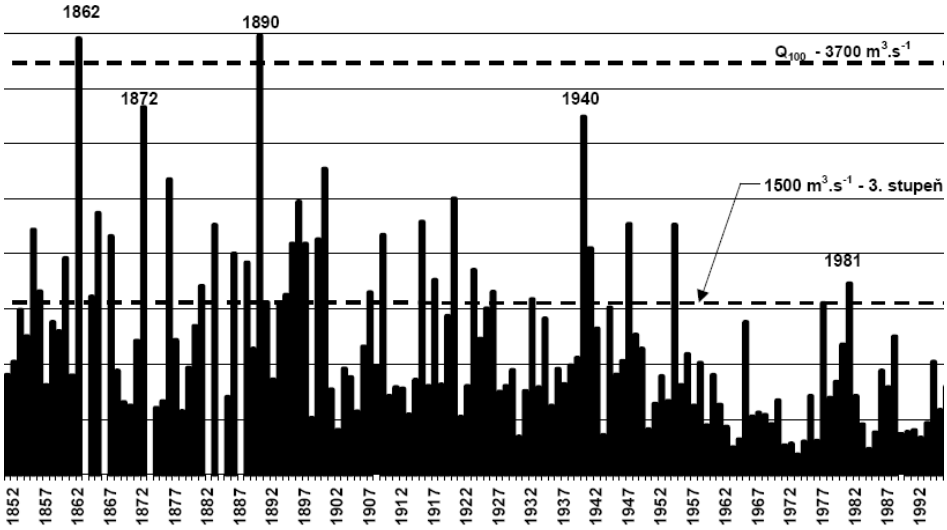
This shows 45 years of annual high flows for the Vltava River in Prague, Czechoslovakia (courtesy of Bo Juza, DHI). We would generally consider this to be a pretty good period of record for understanding and analyzing the high flows.

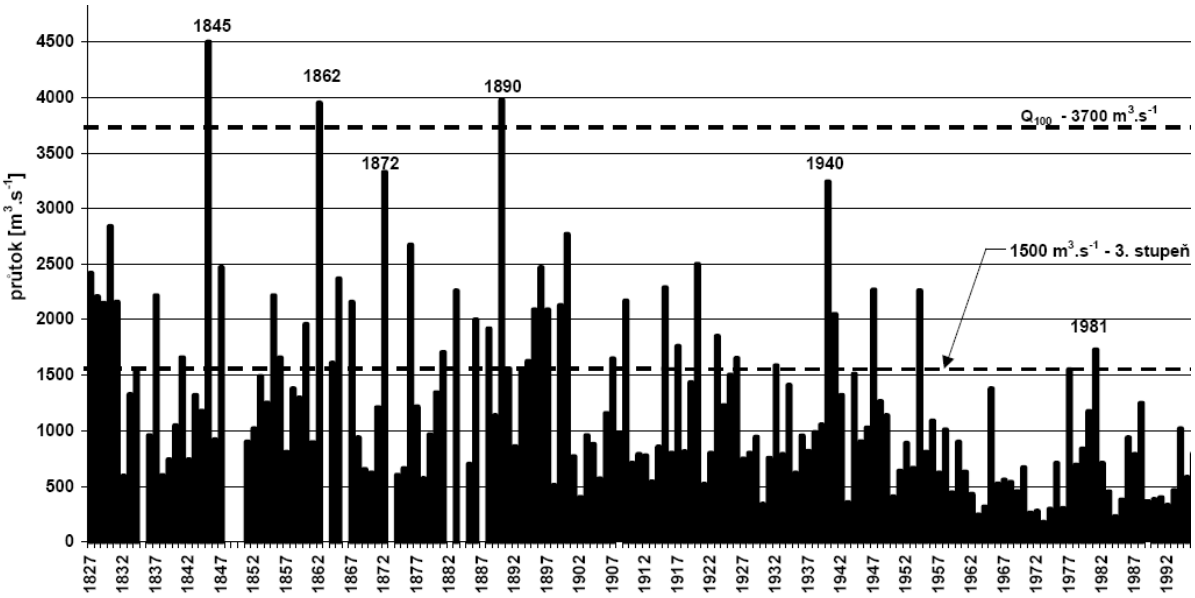


If we have 85 years of data, that's even better. We see that there were some floods during that time.

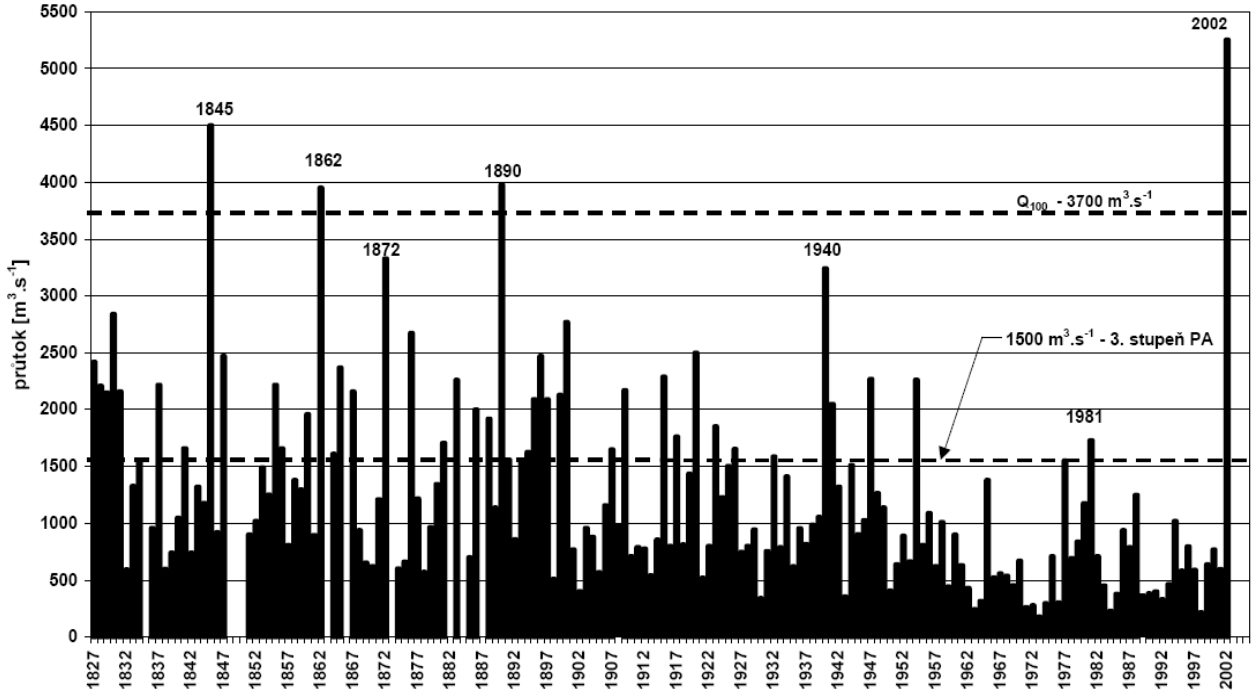


135 years is more data than we have for any site in the United States. The longest period of record for any gauge in New York State is 111 years.





With 165 years of peak flow data, it looks like there might be a trend of declining high flow events.

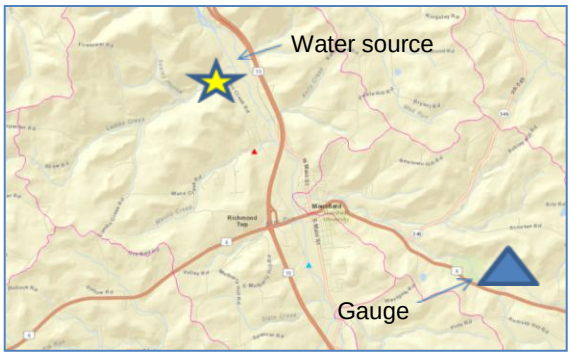


There was a major flood in 2002. If data were only available for 40 to 50 years—which is what we consider to be a good historical record—then this volume of water would have been unimaginable.

If we want to understand long-term trends or extreme events—such as floods and droughts—then we need as much historical data as we can get. This is why it is so important to maintain those gauge sites that have been active for many years.

Water Withdrawals

Gauge data with a long period of record is just as important for understanding low flow conditions as floods. We use water for public water supplies, power generation, agriculture, manufacturing, irrigating golf courses, hydrofracking, and many other purposes. Each user needs to evaluate water availability and anticipate low flow conditions so that water is there when it's needed. And the permitting agencies need to ensure that water isn't taken from the river at times when it could adversely impact aquatic ecosystems and other water users. The permit conditions may require that withdrawals stop below certain flow thresholds at a nearby gauge.



Municipal water system

Because we don't have gauges on every stream, information is often extrapolated based on data from a nearby gauge site. In this example, the yield analysis for a municipal water system was conducted using limited data from the withdrawal site and 50 years of data from a nearby gauge, which is on a different stream. The accuracy of this type of analysis is affected by how far away the reference gauge is, how long the period of record is, and how recent the data are.

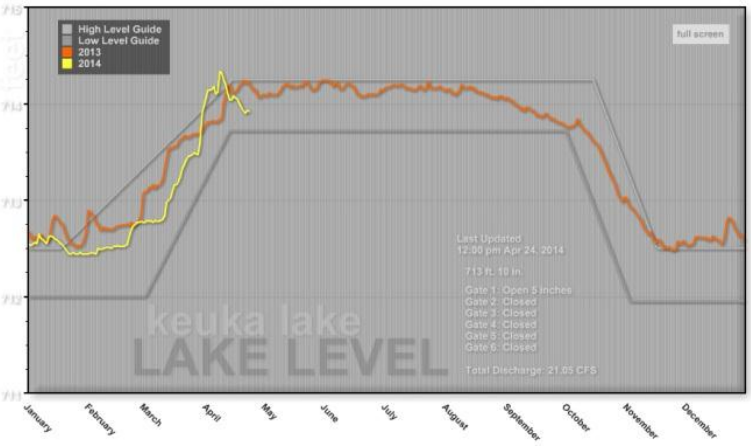
Recreation and Navigation

Major improvements in the technology for accessing gauge data lead to more people using the information for more purposes.

- The River Friends (Friends of the Chemung River Watershed) website lists optimal river levels for boating and provides links to the real-time data. This isn't just about having more fun. It also helps people to stay off the river when water levels are high or rising. When boaters have the information they need to make smart decisions, it reduces the need for emergency rescues.

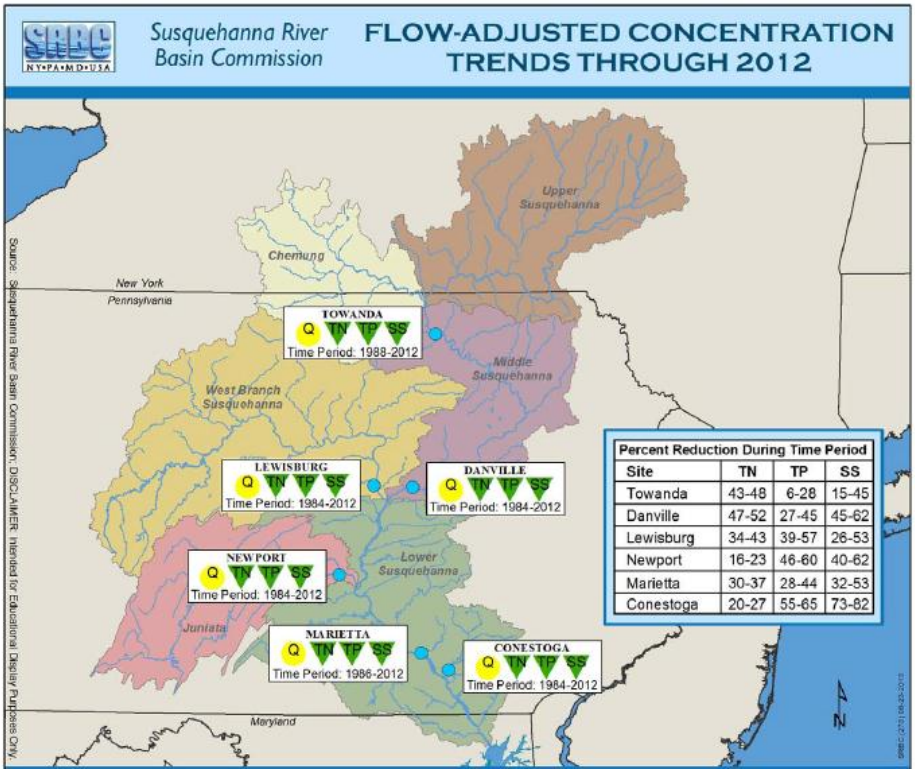
Swift Water Rescue Team

- Lake level management is a data-driven balancing act between recreation, lakeshore flooding, downstream flooding, and in some cases power generation.
- The Canal Corporation is modifying some of the Erie Canal dams to enable removal of gate supports from the water so they don't catch debris and cause increased flood damage. These operational improvements require a significant expansion of the gauge system and flood warning capabilities.



Target and actual lake levels (Jan. to Dec.).

Water Quality



Flow conditions affect water quality, partly because of dilution and also because increased runoff can wash more pollutants into the water. When water quality monitoring is done at gauge sites, the measurements can be interpreted and adjusted based on flows. This graphic shows flow-adjusted trends of pollutants of concern for the Chesapeake Bay, which is an impaired waterbody.

Wastewater treatment plants and other facilities require a minimum flow in the rivers so that discharges can be diluted. Flows in the receiving waterbody are considered when establishing permit limits and in some cases releases are restricted during low flow conditions based on gauge levels.

Land Use

Flood resilience requires that we know in advance what areas are prone to flooding. The basic tool for managing new development in floodplains is the FEMA Flood Insurance Rate Map. In order to determine the amount of water for the so-called 100-year flood, FEMA relies on gauge data, either directly for modeling floodplains along gauged streams or indirectly using statistical techniques to extrapolate to areas without stream flow data. So it's important to have nearby gauges and also important to have a long period of record that includes major high flow events.

Communities that want to direct development away from flood-prone areas generally use FEMA mapping information as a guide for future land use planning.

We also need good data to effectively mitigate existing development. If someone is elevating a flood-prone building, how high should it be?

After a flood, it's important for people to know whether what they just experienced was an extremely rare event or something that's likely to occur again. Historical gauge data can be used to determine the recurrence frequency of an event and thus provide some perspective to help with recovery and mitigation decisions. This information is used for the benefit cost analysis in mitigation grant applications and for the engineering design of mitigation projects.

Infrastructure

Infrastructure is designed based on anticipated conditions, so good data are essential for good design decisions.

Every time a bridge is built, the design engineer needs to determine how big it should be. If it's too small, the road will need to be closed during high flows, the structure can be damaged, or it may back up water and cause flood damage. On the other hand, a bigger structure is likely to be a more expensive structure.

Once water management structures are built, gauge data are essential for day-to-day operating decisions. A dam operator needs real-time information about how much water is flowing into the reservoir, reservoir levels, outflows, and water levels downstream in the protected areas. Some reservoirs are also used to supplement flows during low flow conditions, using gauge data to trigger low-flow releases.

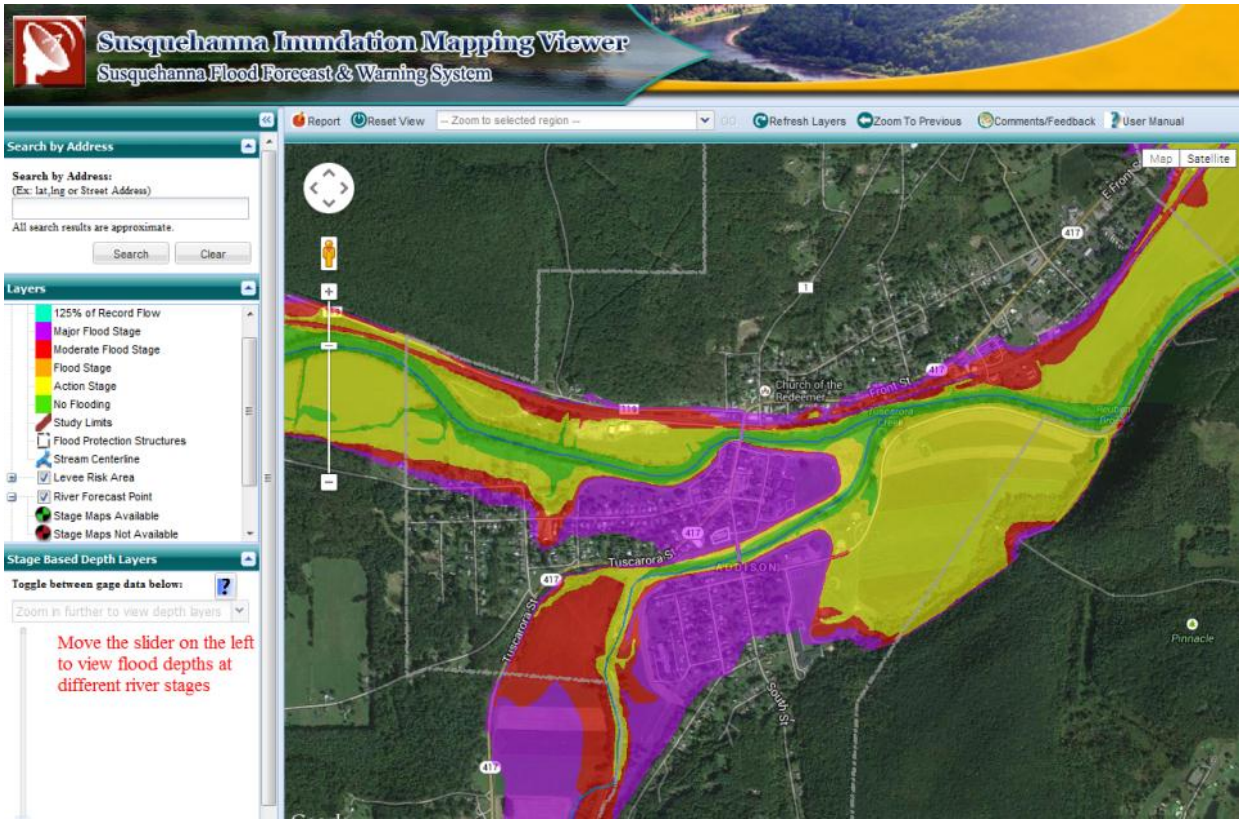
Tioga-Hammond Dam Project.

Flood control levees include locations where closure structures need to be installed before flood waters reach that level. It takes time to detour traffic, stop trains, deploy crews, and install these structures. The emergency operation procedures are triggered by gauge data and forecasts.

Installation of a levee closure structure.

Flood Warnings and Response

Flood warnings save lives. Emergency managers rely on both the real time gauge data and National Weather Service forecast products.



In some areas we have inundation mapping. This is a means of illustrating what observed and forecast gauge levels mean on the ground. These differ from the FEMA maps in that they show the areas that will be inundated for a range of river levels. And they are tied to water levels at a particular gauge. Using current gauge levels and forecasts, emergency managers and the public can see what areas are or will be flooded and respond accordingly. Inundation mapping for my area includes a set of maps that are no longer useful because they are keyed to a gauge that has been discontinued.

Flood warning time and information about the affected areas is essential for deploying portable signs, closing roads and other emergency operations.

The stream in this picture has no gauge. It would have been much better if this evacuation decision could have been made sooner.

Stream Gauge Funding

There are many users of stream gauge data. Funding is currently provided through three programs:

- The Cooperative Water Program relies on cost-sharing between the USGS and non-federal partners. The costs borne by state and local partners have increased over the years, so that they now bear almost 80% of the burden in New York State. This patchwork funding strategy has led to repeated funding crises and the loss of more gauges every year.
- 14% of the funding for New York gauges is currently provided by other federal agencies, though the USGS is responsible for the gauges. Fluctuating funding from any source causes instability in network operations.
- Because of this vulnerability to fluctuating budgets, Congress established the National Streamflow Information Program to provide long-term, sustainable funding for a backbone network of priority gauges. The proposed network was chosen to support 5 national purposes and includes about 1/3 of the current gauge sites in New York State. Although funding for this program has increased, less than 10% of the gauges in New York are currently fully funded by the USGS.

River gauge used for dam operations, levee operations, river forecasts, and other purposes.

Stream gauges are like stetho-scopes on our rivers. They collect basic behind-the-scenes data that are needed for so many things that we take for granted, like good bridge design, floodplain mapping, flood warnings, and flood response. Without these data, we would continue to do these things—but we wouldn't be nearly as good at it. Long-term gauge data are needed to take the guesswork out of these activities that are so essential for our economy and public safety. This is a federal responsibility for which the benefits far exceed the costs.