



# In Search of Data - Fishing Creek Hydro Watch Summer 2016

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## ABSTRACT

The Fishing Creek Hydro Watch project spent Summer 2016 acquiring information to form the basis of a hydrologic monitoring and flood forecasting system for Fishing Creek in Columbia County, PA, a flood prone but data-poor watershed. Precipitation data from a variety of sources in and around the watershed, including personal weather stations, were downloaded and tidied up in preparation for precipitation pattern analyses. Stage-only data from two USGS gages were compiled. Discharge data collection at three staff gage locations continued in order to develop ratings curves and to track stream response to precipitation events. The staff gages now have instructions which allow citizen scientists to text water level data to a publically viewable webpage. In addition, a wide variety of geologic, topographic, geographic, and hydrologic data were assembled in a GIS-based hydrologic atlas.

## INTRODUCTION

Fishing Creek watershed encompasses a large portion of northern Columbia County, parts of southwestern Luzerne County, and southern Sullivan County, PA (Fig. 1). The headwaters of the 385 square mile watershed are located in Sullivan and Luzerne counties and include parts of Rickett's Glen State Park, and the watershed drains into the Susquehanna River near Rupert, PA. Early settlers in the region took advantage of the water, food, and power provided by the Creek, and many communities remain nestled along its banks and those of its tributaries. This means many communities were hit hard during the September of 2011 flooding caused by Tropical Storm Lee. The flooding was intensified by saturated conditions from the week prior, which came with Hurricane Irene's torrential rains. Concerned citizens called out for some way of mitigating floods and flood damage. Flood forecasting in the Fishing Creek Watershed is presently based on decades-old observations, and the data are in analog form, making forecasts difficult to update in the face of changing land use and climate. This brings up the need for more hydrologic data collection and digitization. More information on rainfall and stream discharge will help future hydrologist predict stream response to precipitation events.

The Fishing Creek Hydro Watch project brings together students, faculty, and community members working to collect and compile data to improve our ability to provide appropriate warning for events like the 2011 flood. In the past, the group has collected rainfall data and discharge data at a single site. The group has recently expanded to having three research sites collecting discharge/stage and has assembled rainfall data from over 25 personal weather stations in and around the Fishing Creek watershed. These data are currently being analyzed, and some of the resulting maps and charts are presented here.

## LOCATION

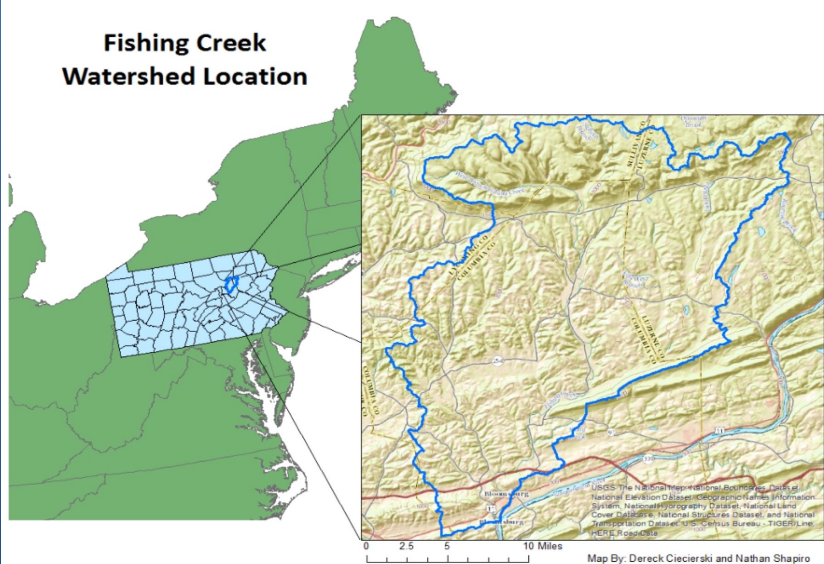


Figure 1. Location of the Fishing Creek watershed

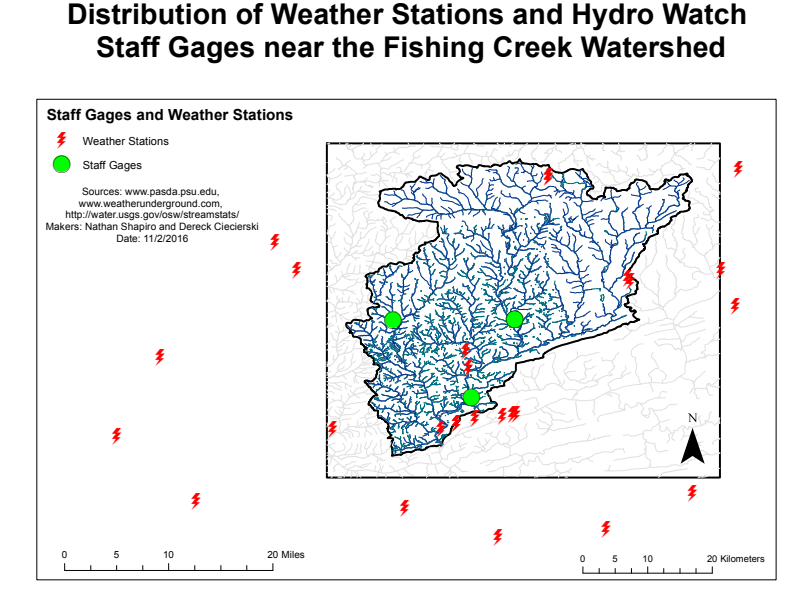


Figure 2. Locations of weather stations used in rainfall analysis and Hydro Watch staff gages

## RAINFALL DATA

Prior to about 2014, rainfall data for the Fishing Creek watershed were scarce to non-existent. There were only two-three weather stations in the watershed, and those were near the Creek's confluence with the Susquehanna, not a helpful location for determining the amount of rainfall over the entire watershed. Since that time, community members have been purchasing personal weather stations and putting the data online. The rainfall data presented here are the first ground-based rainfall interpolations from these recently available data. Precipitation dates selected for interpolation were based on the size of the precipitation event (larger was preferred), and the number of weather stations reporting data on that day (more stations were preferred). The dates selected were June 30, 2015, September 9, 2015, and February 24, 2016.

### Continuous Rainfall Distribution throughout Fishing Creek Watershed on June 30th, 2015

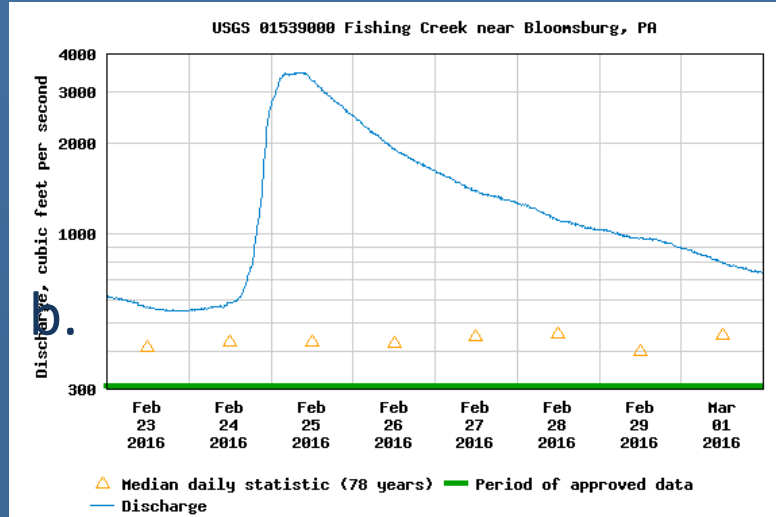
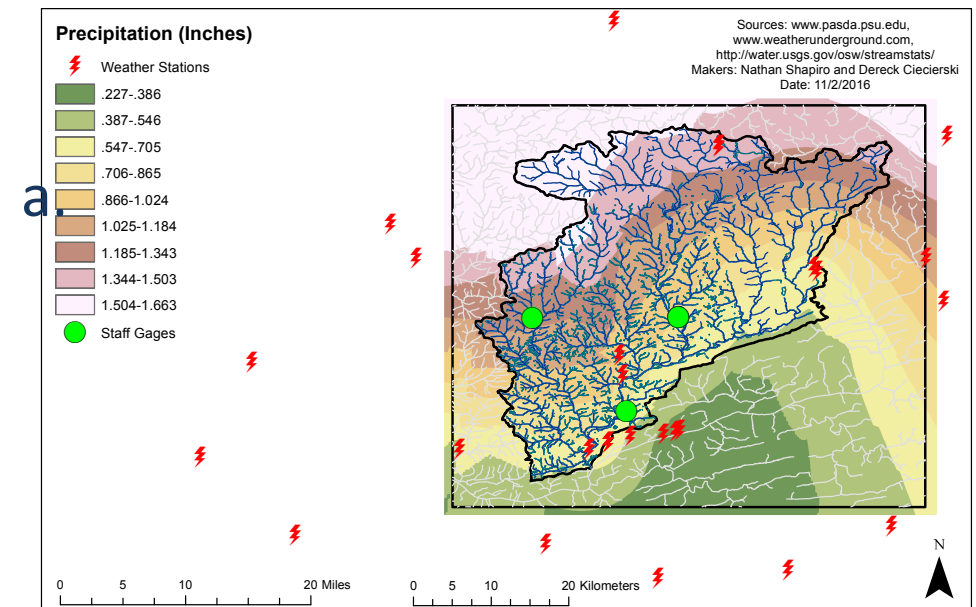


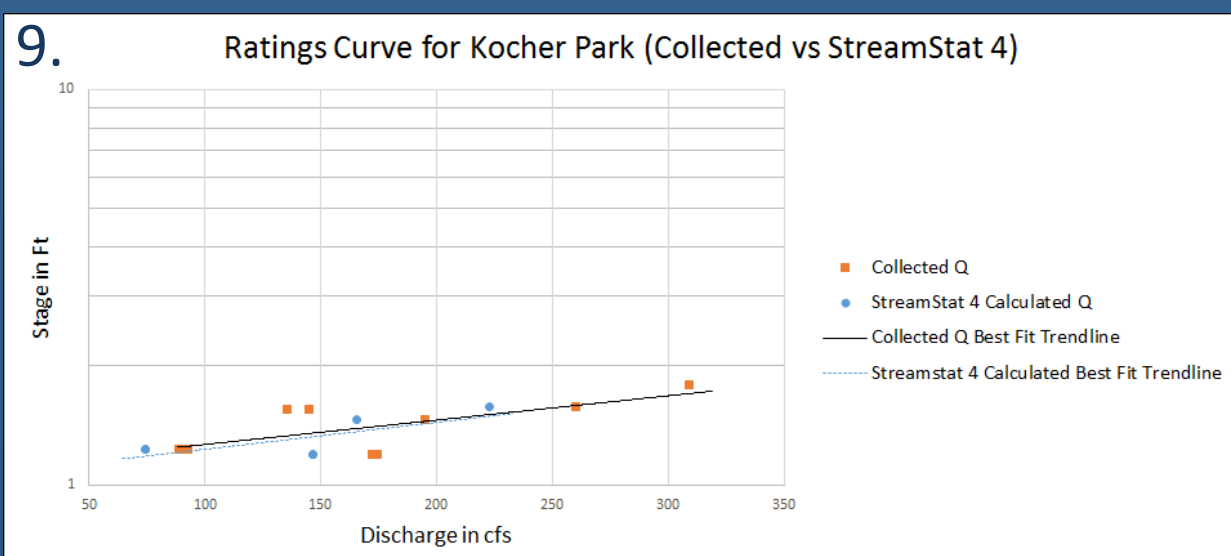
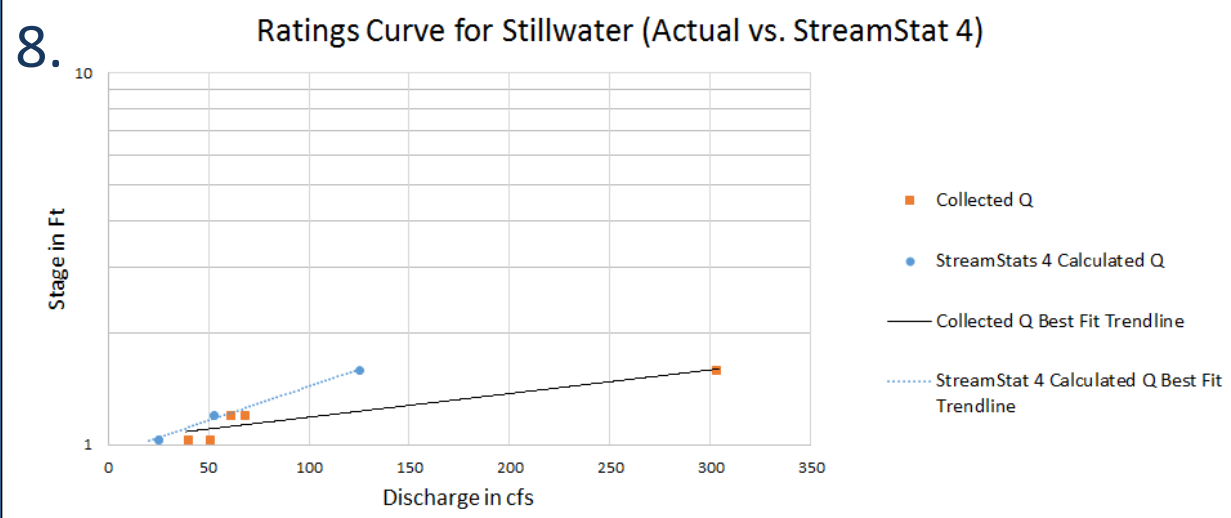
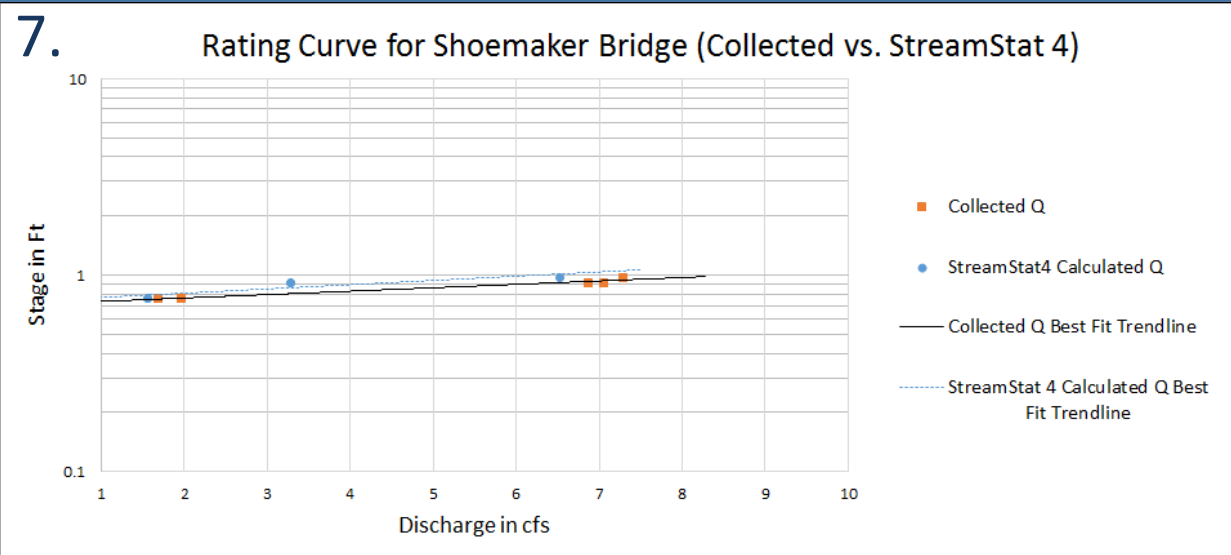
Figure 11 . a. Interpolated rainfall distribution for June 30, 2015. b. Hydrograph showing discharge in Fishing Creek at the USGS gage in Orangeville, PA, both before and after precipitation on June 30, 2015.

## RATINGS CURVES

A major part of the work done in Summer 2016 was collection of discharge and water height at three staff gages placed throughout the watershed. These data were used to create ratings curves for future use with stage data provided by citizen scientists through CrowdHydrology (Figures 3 and 4). CrowdHydrology allows anyone with a cell phone to text staff gage heights to a publically accessible website (Fig. 5). Stream height information will then be combined with the ratings curves to generate real-time discharge data for segments of stream where it is impractical to install expensive United States Geological Survey (USGS) stage-only or discharge gages. Discharge data were collected during baseflow conditions to assure that stream discharge did not vary during discharge measurements, which may take as much as an hour at our Stillwater and Kocher Park locations. The areas contributing to each of the sites were determined using StreamStat4 (USGS) (Fig. 6), and Figures 7, 8, and 9 show the current ratings curves for each of our sites.



Figure 3. Stillwater Bridge gage site (left) and Shoemaker Bridge gage site (right), where Nate and Dereck are collecting a discharge measurement.



Figures 7, 8, and 9. Ratings curves for 7) Shoemaker Bridge staff gage site on the west side of the Fishing Creek Watershed, 8) the Stillwater Bridge staff gage site in the middle of the main branch Fishing Creek, and 9) Kocher Park, just downstream from the USGS gage at Orangeville, PA.

### Area Contributing to stream flow at Hydro Watch Staff Gage locations

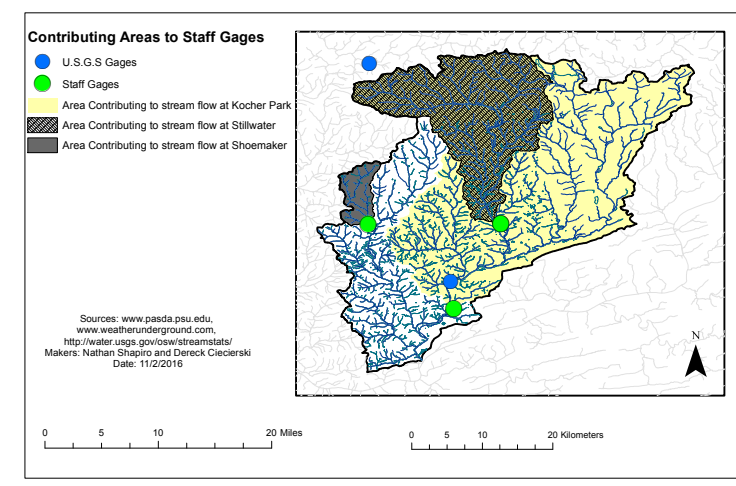


Figure 6. Areas contributing to stream flow at Fishing Creek Hydro Watch staff gage locations, as determined by StreamStat4 (USGS).

## RATING CURVE DISCUSSION AND FUTURE WORK

A comparison of our collected data and that calculated by StreamStat4 and BaSE (USGS) shows that the software calculations are closer to the collected data at times of low flow. When the discharge is higher there is a divergence from field measurements. More research needs to elicit the disparity at the higher flows. Such investigations are a part of the program's future. In the near future, flood stage models will be created using two-dimensional hydrodynamic stream modeling software can be used to calculate such models. Continuing our high level of public engagement is a priority for our group. The Fishing Creek Hydro Watch Program is working to expand the network of staff gages in way to have multiple representations in each sub-watershed as well as gages in critical areas (upstream of high population areas and businesses), and the goal is to have thorough coverage. Along with staff gages, there are plans to create a rain gage and weather station network throughout the watershed that is associated with the Fishing Creek Hydro Watch Program.

Figure 10. Former Fishing Creek Hydro Watch intern Aaron Stephens with Don Hess of Dancing Hen Farm after installation of the first Hydro Watch weather station. The station is located near Benton, PA.



## HYDROLOGIC ATLAS

A key component of our effort to better understand Fishing Creek watershed is assembly of existing available hydrology-related data into an easily accessed central location. Nate Shapiro worked during summer 2016 to download and compile essential data layers such hydrology, soil, bedrock geology, land use, base flood elevation, weather station locations, staff gage locations, municipal boundaries, transportation routes, and a digital elevation model into a GIS-based hydrologic atlas.

The hydrologic atlas will be used to assess the potential impacts of bedrock geology, surficial geology, changing land use, and other parameters on stream response.

## DATA SOURCES

Weather Underground, Location and weather data for area weather stations, *online resource*: [www.weatherunderground.com](http://www.weatherunderground.com), dates accessed- various.  
United States Geological Survey- Streamstat-Beta 4-Contributing Areas to Hydro Watch Staff Gages and Calculated Discharge Data, *online resource*: <http://water.usgs.gov/osw/streamstats/>, date accessed - 7/29/2016.  
Pennsylvania Spatial Data Access- Hydrology, Watershed Boundary, *online resource*, <http://www.pasda.psu.edu/>, date accessed- 6/8/2016.

## ACKNOWLEDGEMENTS

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- Columbia County Covered Bridges Association
- Fishing Creek Watershed Association
- Joan and Don Hess - Dancing Hen Farm
- Kocher Park
- Tim Pelton - Civic Engagement Coordinator, Bloomsburg University.
- Dana Xiao - Bloomsburg University Department of Environmental, Geographical, and Geological Sciences



### Continuous Rainfall Distribution throughout Fishing Creek Watershed on September 9th, 2015

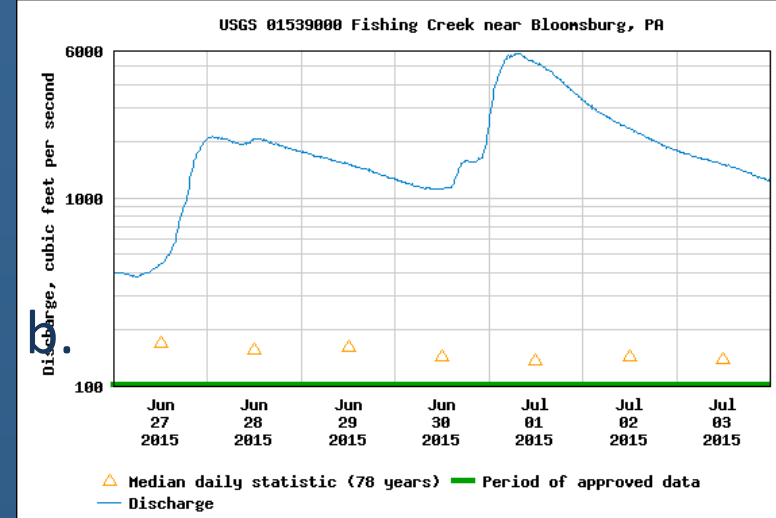
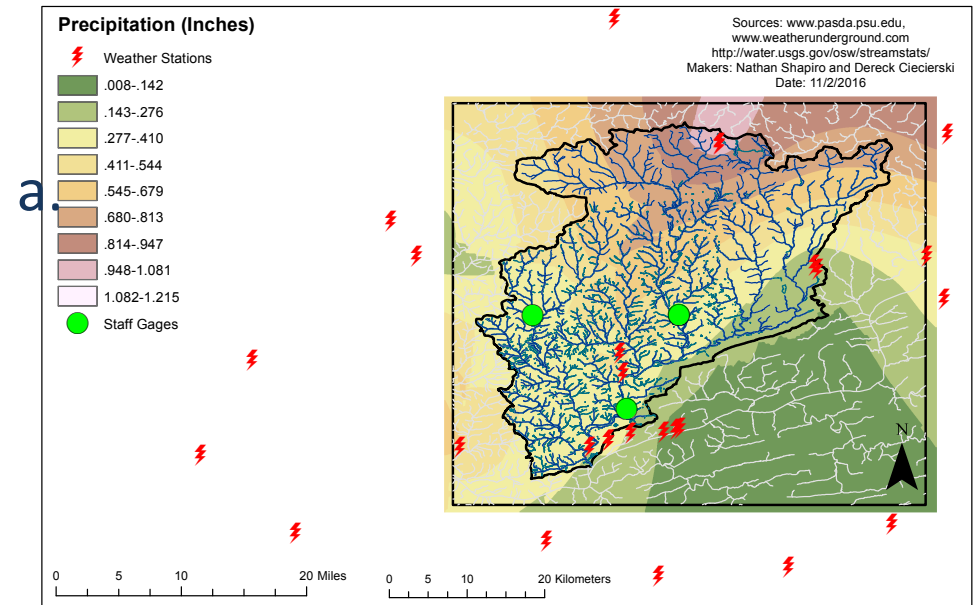


Figure 12 . a. Interpolated rainfall distribution for September 9, 2015. b. Hydrograph showing discharge in Fishing Creek at the USGS gage in Orangeville, PA, both before and after precipitation on September 9, 2015.

### Continuous Rainfall Distribution throughout Fishing Creek Watershed on February 24th, 2016

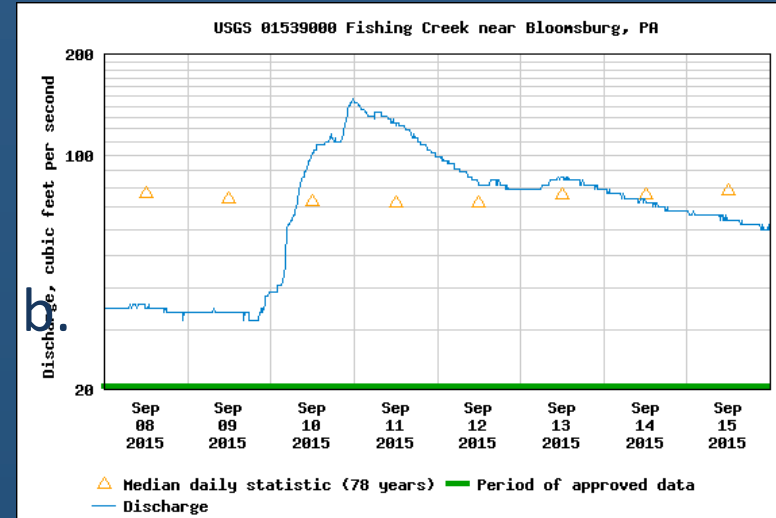
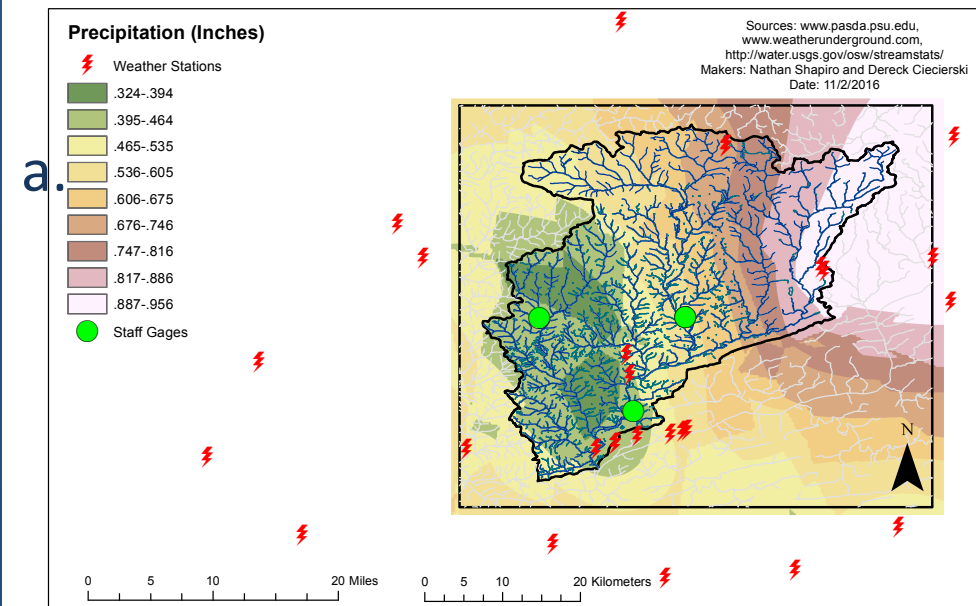
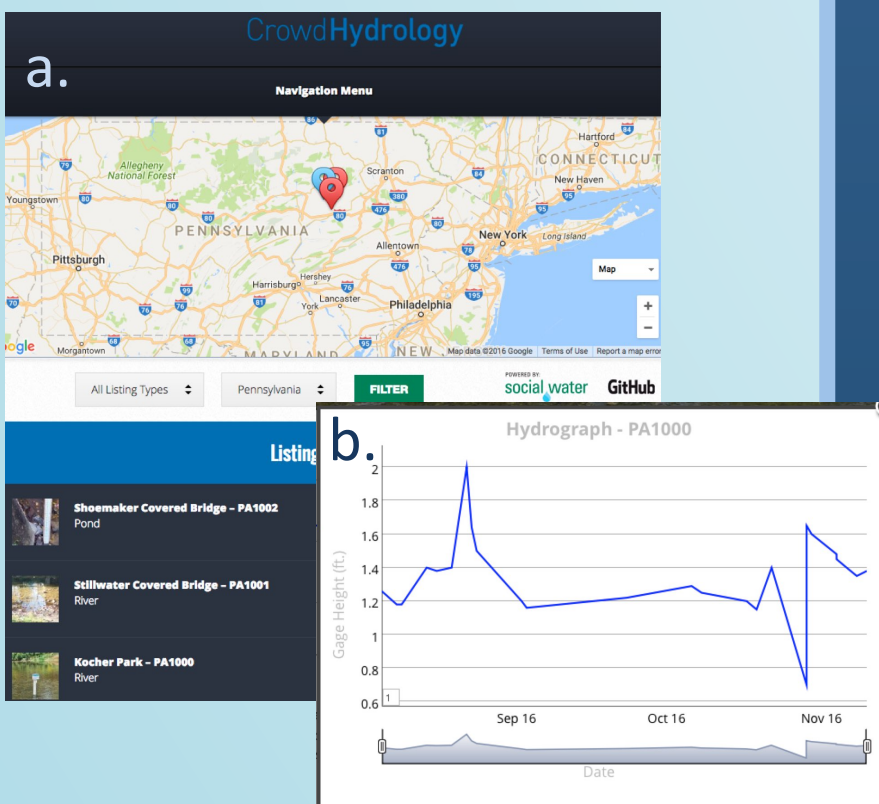


Figure 13 . a. Interpolated rainfall distribution for February 24, 2016. b. Hydrograph showing discharge in Fishing Creek at the USGS gage in Orangeville, PA, both before and after precipitation on February 24, 2016.



Figures 5a and 5b. a. CrowdHydrology website hosts crowd-sourced stream height data from three Hydro Watch site in the Fishing Creek watershed. b. Crowd-sourced stream height data for Summer 2016 at Kocher Park.



Figure 4. Hydro Watch staff gage location at Kocher Park with instructions for data upload.