

Analysis of the Water Distribution System in Martin County, Kentucky

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Abstract

Over 90% of Americans receive their drinking water from a public drinking water system, however the American Society of Civil Engineers has given the United States' Water Infrastructure a D rating. Martin County, Kentucky has one of the worst water distribution systems in the nation, with 113 boil-water notices and 48 water system violations in twelve years, not to mention the fact that residents will often go for days without water due to leaking pipes ("The Water Crisis in Martin County, Kentucky"). In order to aid the residents of Martin County, we developed a computer model of the water distribution system and conducted steady state, transient, and water age analyses. The steady state analysis allowed us to calibrate the system based on the age and material of the pipes obtained from Martin County. Then, the transient analysis allowed us to detect areas of negative pressure in the system where a vacuum could be created, sucking untreated groundwater into the system through leaks and breaks in the pipes. Finally, through the water age

analysis, we were able to study the chlorine concentrations that have led to several water system violations. Based on our findings, we were able to provide the Martin County Water District with recommendations on how to improve the system.



Picture from Martin County Water Warriors Facebook Page

Introduction



Picture from Martin County Water Warriors Facebook Page

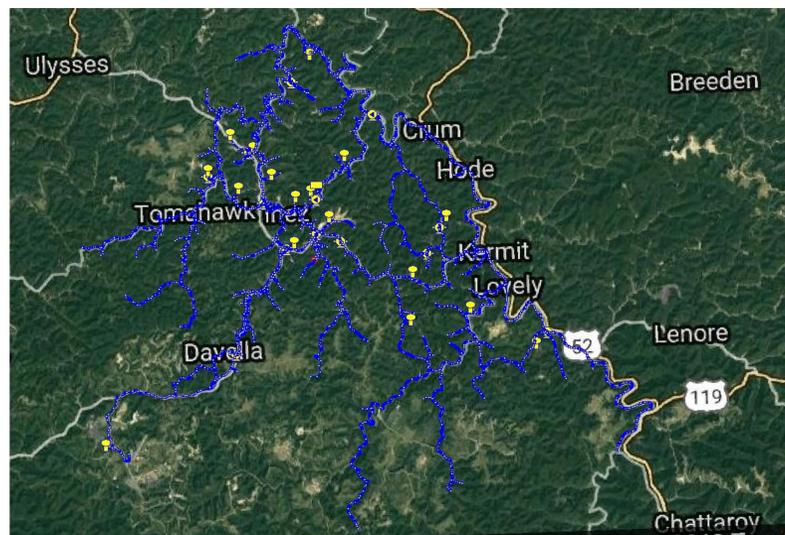
- Water infrastructure in Martin County, Kentucky has been in decline for years, with the rate of its water loss climbing to an alarming rate of 64 percent in 2016
- This has caused the county to have to shut off water flow to certain areas, including a shut off in which 1,000 residents went without water in January 2018 (Wright 2018).

- From a transcript of the Water District's response to public comments last August, it is evident that one of the failings of the district is that the system was designed for a population of 600, and the water district now has 3,550 customers, at the time of that meeting (Cumbo, 2017).

iPad showing CNN Video

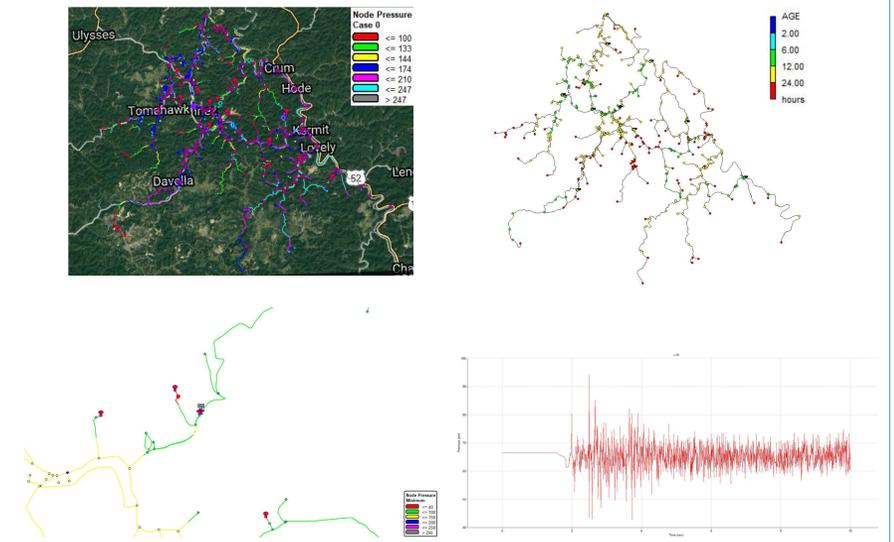
Methodology

The first step in analyzing a water distribution system is to obtain a map of the system. We worked with the Martin County Water District to obtain information about their system, and we input that into KYPipe. Then we added a map with elevations to ensure that our digital maps accurately reflected the system, and we ran tests to ensure that the system was properly connected. We compared the results of these tests to real world tests such as fire flow tests.



Once we had the model of the system, we were able to use KYPipe to run various analyses on the system. First we ran a steady state analysis with the demands that we obtained from the Kentucky Infrastructure Authority's website. Then we ran a transient analysis to detect areas of negative pressure. Finally we ran a water age analysis to analyze the chlorine levels in the system, which are some of the biggest issues that residents of Martin County deal with.

Results



Conclusions

The water crisis in Martin County is a result of many different factors. Through the solid state and transient analyses, we were able to identify areas in the physical system where there are major problems. Using this data, we were able to identify high-priority issues that can be reported to the Martin County Water District to help them make the most important repairs first. Through the water age analysis, we were able to see how long water is sitting in the tanks, which could be where the chlorine concentrations are building up, resulting in the violations. We were also able to use pressure analyses to pinpoint leaks in the pipes, which are also places where contaminants are potentially being sucked in.

References

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