WATER QUALITY AND URBAN DEVELOPMENT

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Streams and rivers located in areas of urban development are often associated with increased sediment load, trash, degraded water quality, and increased flooding. The purpose of my research is to find out if the urbanization along Schillinger Road has or has not degraded the water quality of the Second Creek Tributary System that is located in the Dog River Watershed. I conducted water sampling at two sites within the Second Creek Tributary System. My first site is the middle stream, of the three stream system, upstream of Schillinger Road, primarily residential drainage, and my second site is the northern stream, primarily commercial drainage, located downstream of Schillinger Road. I conducted water quality testing for water temperature, pH levels, alkalinity, hardness, dissolved oxygen levels, and turbidity levels. I used GIS to produce maps that showed development within the area and the specific drainage boundaries for each of my two study sites. The results that I found lead me to the conclusion that water quality of the Second Creek has been affected very little by the construction and development that is taking place along Schillinger Road and the BMP's such as detention ponds, gabions, and silt fences that are in place have been working properly to limit the flow of silt and excess water into the river water of Second Creek.

Keyword: water quality, Watershed-dog river, urban.

Introduction:

Urbanization in and around a watershed can lead to multiple problems due to changes that occur to a river's topography and the urban contaminants that may make their way into the water that flows within its boundaries. Pheasant Branch, a river in Wisconsin, illustrates one such example. During the 1970's the streambed was lowered in elevation by almost two feet and the channel was widened by 35%. A model developed to show the effects of these changes in the rivers topography showed that annual flooding along the river will now double because of these changes (Urbanization and Streams - Case Studies 2009). Located in the western suburbs of Boston, Massachusetts is the

Nashua River. This river has been affected by urbanization of the surrounding area so badly that it has been, in the past, listed as one of the top ten worst rivers in the entire country. The river contained so much sludge, industrial waste, and trash that small animals could walk across the debris of the river to get to the other side (Nashua River Watershed 5 Year Action Plan 2003-2007). These are just a few of the problems that urbanization has caused to rivers and their watersheds.

My area of interest is the Second Creek tributary system located at the northwestern boundary of the Dog River Watershed in Mobile, Alabama (**Fig. 1**). This area has seen extensive development over the past 12 years mostly between Airport Boulevard to the north and Cottage Hill Road to the south along Schillinger Road. The development along Schillinger Road has been mainly commercial resulting in large areas of impermeable surfaces. Impermeable surfaces are paved areas such as parking lots, roads and roof tops. Since urban areas are designed with rapid water movement in mind and with the construction of cement drainage areas and sewer systems, the pollutants that accumulate during dry periods are transported at a rapid rate into the river and water systems within the area instead of being allowed to enter the ground and recharge the ground water (Whipple et al. 1983). Groundwater recharge is important not only to trees and grasses but also to our drinking supply and building foundations. Case in point, Boston is an old city and most of the older building foundations were built on wooden pilings and driven into the clays and mud in the ground. Since sewers, storm pipes and subway tunnels were constructed they developed leaks and lowered the ground water table thus exposing the wooden pilings to the air and allowing dry rot to set in and threaten the integrity and safety of buildings in that area (Weiskel et al. 2005).

Fig. 1

The yellow outline shows the entire boundary of the Dog River Watershed and the red out line shows the drainage basin of Second Creek's two northern tributaries.

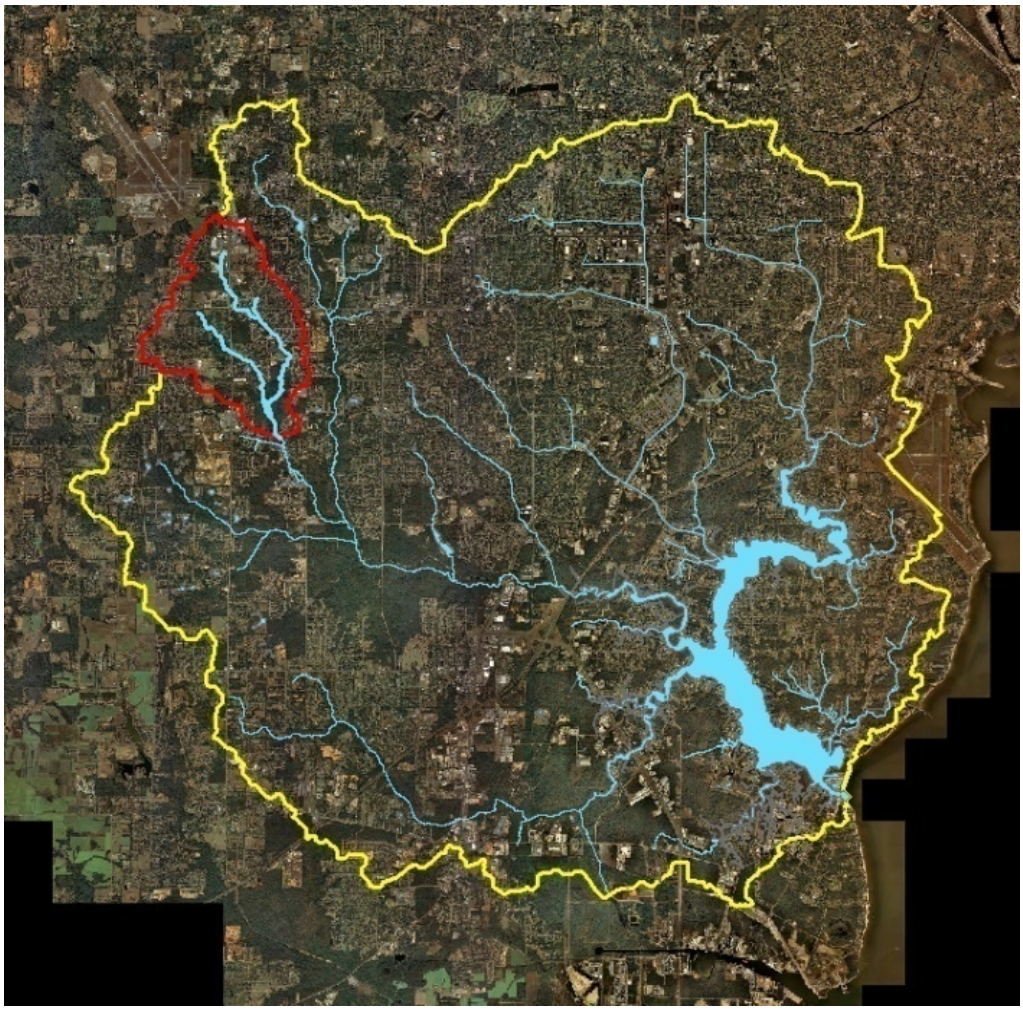

Fig. 1 Dog River and Second Creek Watersheds (ArcMap 9.2) (Cochrane 2009)

The research that I have conducted on the two tributaries of Second Creek will inform the residents living within its boundaries of the effects that the urbanization of Schillinger Road has had on Second Creek. Information will be given on the current condition of the tributaries, whether altered or natural, water quality status, and possible

impending dangers to the tributary system of Second Creek. The evidence that I have located shows that eventually urban development does cause damage to the water quality of river systems that flow nearby. Methods to slow or prevent this known as BMP's, Best Management Practices, have been implemented by the Federal Water Pollution Control Act of 1972 in order to prevent or reduce the movement of sediment, pesticides, and other pollutants from the land to the ground water of a watershed (Watershed Protection and Management Program 2009).

Research Question:

Has the development and current construction along Schillinger Road had an effect on the water quality of the two northern tributaries of Second Creek within the Dog River Watershed?

Methods:

I used multiple measures to gain information on my research topic, from actual hands on work to computer work. The first thing that I did was obtain a road map for the city of Mobile and a topographic map of the Springhill quadrangle to map out the drainage basin for the two tributaries of the Second Creek system. I followed the middle of the contour lines at the highest elevations to trace the drainage basin for the two rivers and then traced that area to my road map to understand the exact boundaries for my site. I rented a Cessna 172 RG Cutlass aircraft and flew four ovals around the site at an altitude of 1,000 feet to obtain aerial photographs for the area and my sites. I used those photographs to compare with the 2006 satellite photographs that I obtained from the City of Mobile website (www.cityofmobile.org) to look for any new construction that had

taken place between now and 2006. I drove around the boundaries of my site and took photographs to try and locate any BMP's and construction sites that I could find. I went to the college library and obtained books that dealt with urbanization and water quality information and also used online sources to obtain additional information.

Fig. 2

The yellow outline is the boundary of the watershed for Second Creek and the two red circles are the locations of my two study sites.

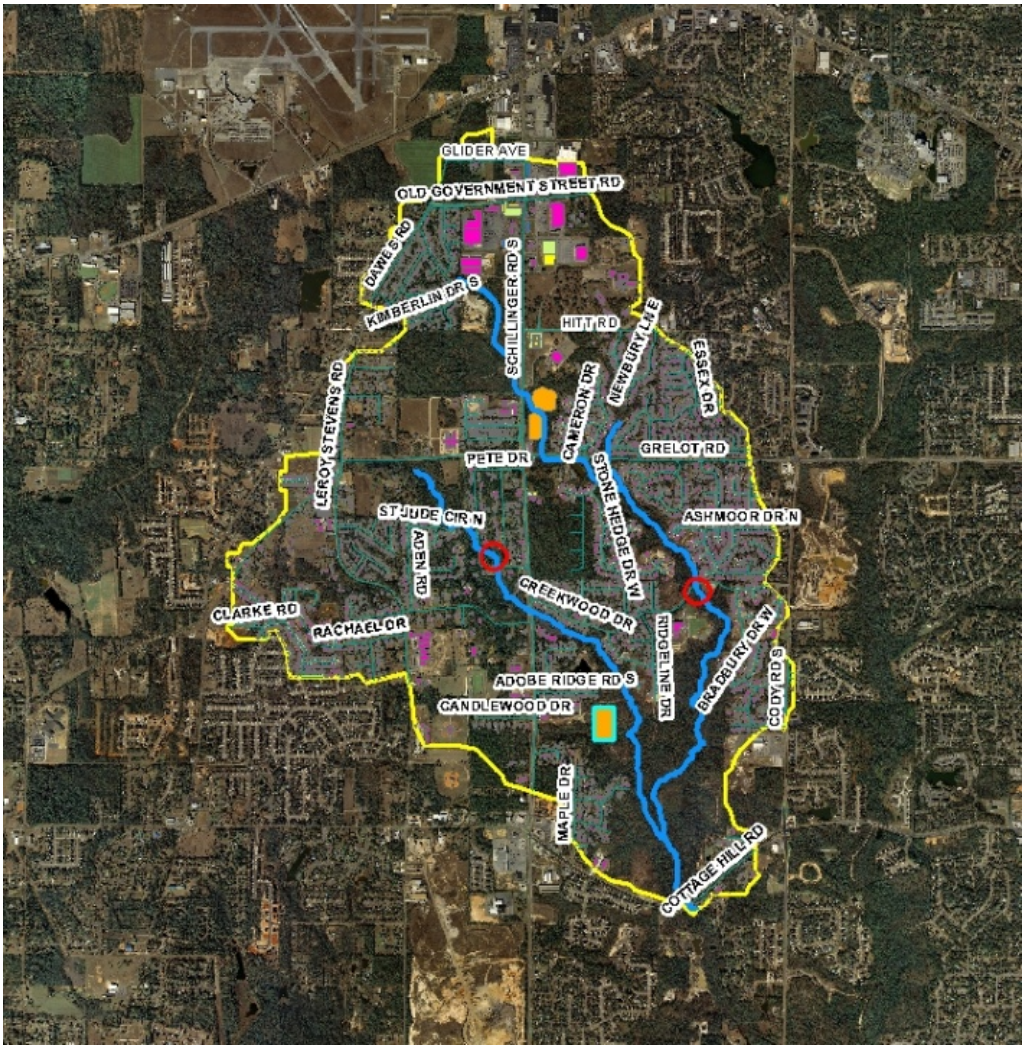

Fig. 2 Second Creek Watershed (ArcMap 9.2) (Cochrane 2009)

I produced three maps of my area using GIS (Geographic Information Systems), one that showed the location of my site in contrast to the entire Dog River Watershed (**Fig. 1**), one showing the contour lines within the drainage basin in different colors based on elevation, and another that showed the development and new development that had taken place within the boundaries of the Second Creek Watershed (**Fig. 2**). Geographic Information Systems is a computer system that is used to capture, integrate, manipulate, and display data related to positions on the Earth's surface (Stanford University 2006).

Site one or the middle tributary is located at 7910 Terry Drive Mobile, Al. approximately 50 yards through the woods behind the house located at that address. The stream at this location is narrow and approximately two feet deep on any given day, however after a rain storm the stream swells in size in the area near my study site to over five feet deep. Small fish were always swimming within a few feet of the study site, which indicated to me that the water was in fairly good condition. Site two, or the northern tributary is located exactly 7/10ths of a mile off Schillinger Road on Creekwood Drive. I pulled off the road just in front of a 25mph speed limit sign that was right past Cottage Hill Christian Academy School on the right side of Creekwood Drive. The tributary was about 100 to 150 yards through thick woods and plant cover. The stream at site two was on average two to three feet deep and consisted of a wide flow of approximately five to six feet from one bank to the other. This stream would also swell to about six to seven feet deep after a heavy rain.

The actual hands on field work for my research was conducted every Friday between 9am and 12pm for a period of six weeks, except during two occasions. The first week I began sampling was Saturday the 28th of February between 1230pm and 330pm.

The second time I was out of sequence was Friday the 6th of March because after taking samples at my site along the northern tributary I locked my keys in my car and was not able to start sampling at my next site, the middle tributary, until 2:45pm, finishing at 3:52pm. I had to gain approval to operate at one of my sample sites because both sites are located in highly developed areas and one was in a resident's backyard.

Results:

The results that I obtained over my six weeks of testing on the middle and northern tributaries of Second Creek indicate that both tributaries appear to have been affected very little by the development along Schillinger Road and contain fair to good water quality that is able to support fish and other aquatic life (Alabama Water watch 2009). My results for the middle tributary of the Second Creek system **(Fig. 3) (Fig. 4)** were pH levels between 5.5 and 6.5, slightly acidic, dissolved oxygen levels between 6.4 ppm and 7.9 ppm, % dissolved oxygen saturation between 68% and 86%, alkalinity levels between 20 mg/L and 30 mg/L, hardness levels between 20 mg/L and 30 mg/L, and turbidity levels between 2 JTU and 25 JTU. The results remained fairly constant throughout the study process. The only spike in results came just after a rain storm on the 26th and 27th of March that dumped about four inches of rain over a 36 hour period, the turbidity was the only test that came up higher than normal, due mainly to the stream over flowing its banks and picking up the dry sediment that usually rests outside of the water. Results for the northern tributary **(Fig. 3)** (**Fig. 4**) were pH levels between 6.0 and 6.5, dissolved oxygen levels between 6.7 ppm and 8.1 ppm, % dissolved oxygen saturation between 72% and 79%, alkalinity levels between 25 mg/L and 35 mg/L, hardness levels between 30 mg/L and 40 mg/L, and turbidity levels between 2 JTU and

70 JTU. The only spike of abnormality was the turbidity level reading of 70 JTU obtained after the same storm on the 26th and 27th of March that led to the turbidity increase in the middle tributary. I investigated the reason for the spike in turbidity since this reading was so much higher than the turbidity increase at site one. The results of my investigation concluded that some sediment was seeping out of a construction site, located approximately a mile upstream of site two and right on top of the stream its self, that combined with dirt that is normally dry out of the streams normal water flow is what led to the increase of turbidity on that day.

Fig. 3

Figure three is a graph showing the results of tests that I conducted on pH, Water Temperature, and Average D.O. at the middle and northern tributaries of Second Creek over six weeks beginning on February 28th and ending April 10th 2009.

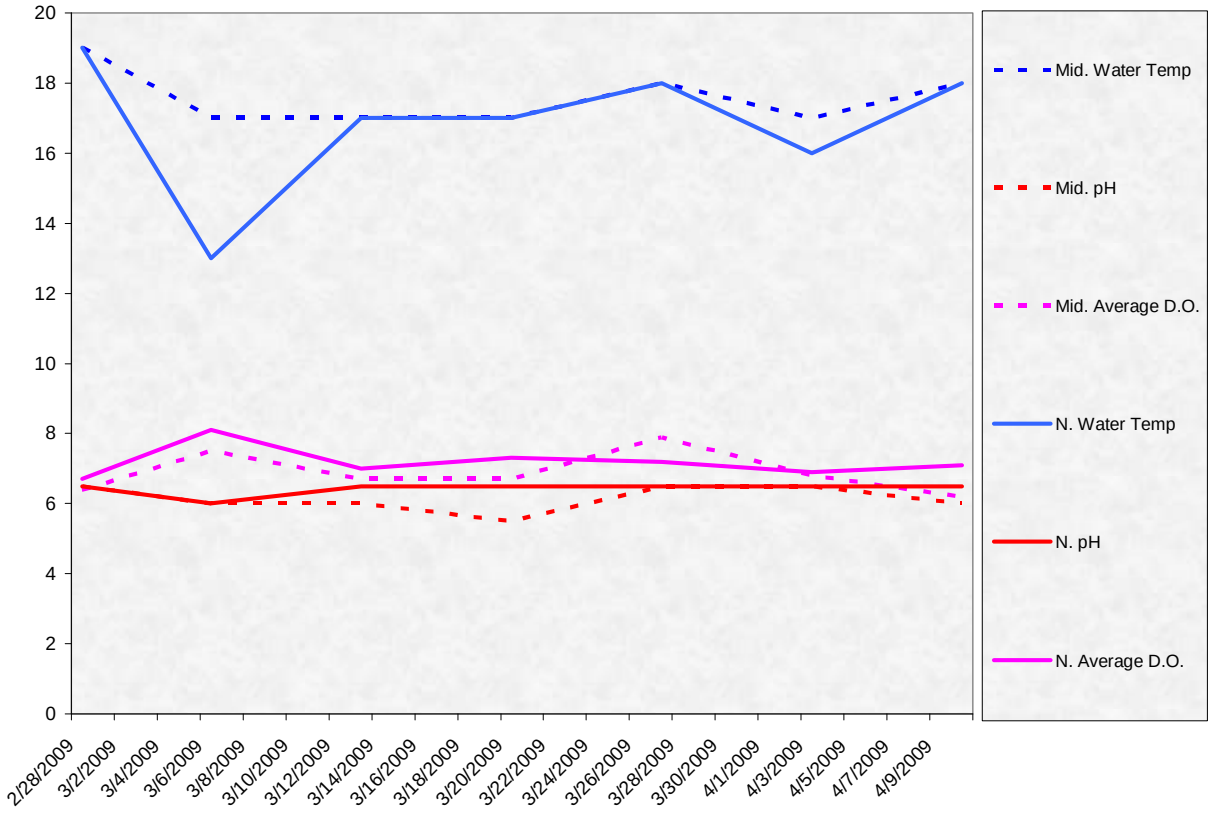

Fig. 3 Test results for Water Temperature, pH, and Average D.O. of the middle and northern tributaries of Second Creek (Excel 2009)

Fig. 4

Figure four is a graph showing the results of tests that I conducted on the Alkalinity, Hardness and Turbidity levels at the northern and middle tributaries of Second Creek over six weeks beginning on February 28th and ending April 10th 2009.

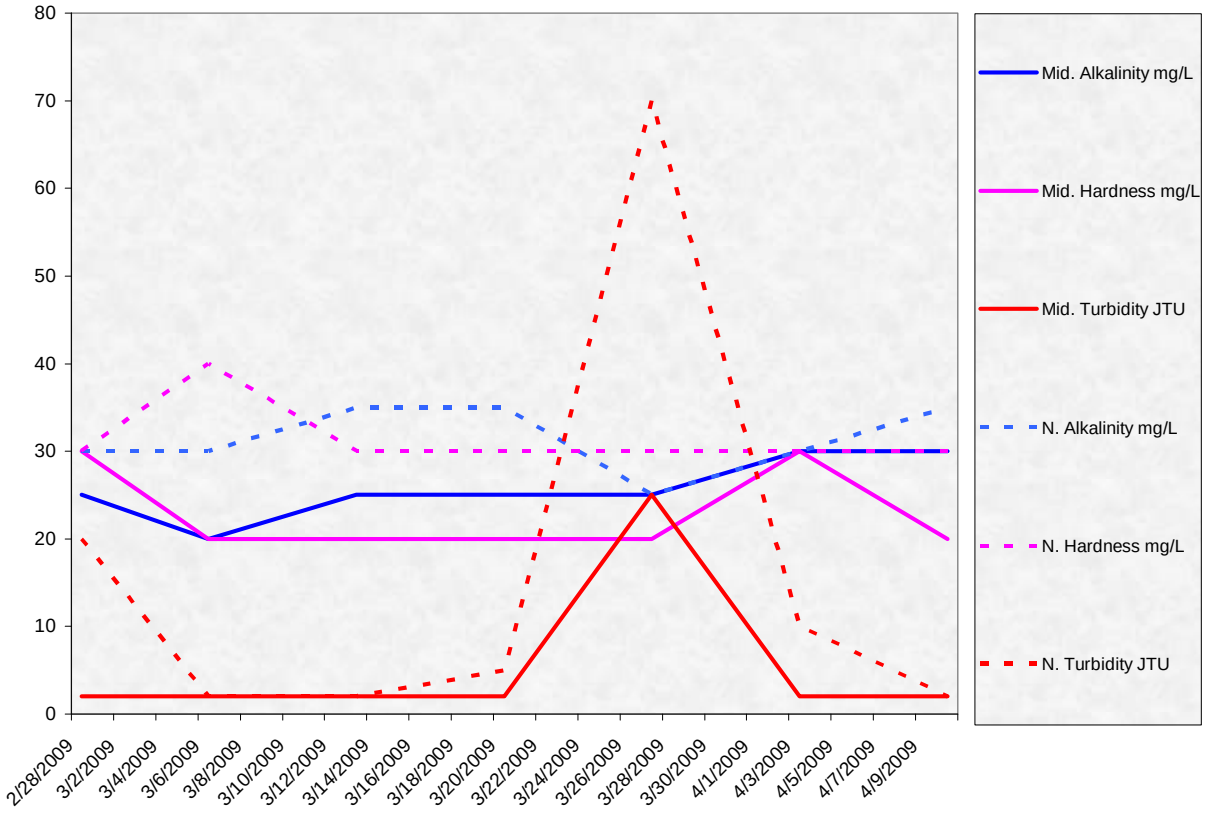

Fig. 4 Test results for Alkalinity, Hardness, and Turbidity of the middle and northern tributaries of Second Creek (Excel 2009)

Conclusion:

The results of my water quality tests of the middle and northern tributaries of Second Creek show three important results to the local community and Dog River Clearwater Revival. The water quality of the two tributaries are in a non polluted state, the BMP's set in place are working properly, and the urban development around the streams is not causing significant damage at any of the two tributaries or their eco-systems. Two very important aspects of the Second Creek tributaries are; they both contain large buffer areas of riparian vegetation and they both continue to flow in a natural/unaltered state. This is important because tributaries in their natural state that contain riparian vegetation are able to filter out urban pollutants, allow water to enter the ground water table, and through natural bends and depth changes, able to slow the flow of water and limit the amount of flooding, a luxury that channelized or altered rivers do not possess.

The only negative effect of my research would be the time allowed to conduct, at only six weeks, the results only show a small time frame and therefore may prove to be inaccurate over a longer period of time. I believe that if the area could be monitored over a year or two, the results could provide more accurate information about urbanization and its effects along Schillinger Road. I would like to see future water quality tests conducted for the two tributaries of Second Creek in another five or 10 years to see and better understand any changes that may or may not take place. I would like to see a more in depth approach to water quality testing for the urban stream environment. Are streams that contain their riparian vegetation and natural flow more pollution resistant within an urban environment than streams that have been altered or channelized?

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