Title of Proposal: Watershed Protection Plan Development for the Geronimo Creek Watershed

Focus Categories: Water Quality, Hydrology, Models

Keywords: GIS modeling, Geronimo Creek, Flow Duration Curves, Load Duration Curves

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Abstract:
The Spatially Explicit Load Enrichment Calculation Tool (SELECT) and Load Duration Curves (LDCs) will both be used to develop watershed protection plans for the Geronimo Creek watershed that is impaired due to *E. coli* bacteria. Watershed protection plans are difficult to implement in rural watersheds because stream flow and water quality data are often sparse and not distributed across the watershed. SELECT is an automated Geographical Information System (GIS) tool that can assess pathogen loads in watersheds using spatial factors such as land use, topography, source-population density, and soil type. LDCs will be used to determine the Total Maximum Daily Loads (TMDLs) under different stream flow conditions. The U.S Geological Survey (USGS) program LOAD ESTimator (LOADEST) will be used to estimate the *E. coli* loads in each stream at each monitoring location in relation to flow rate. The LOADEST loads will then be compared with the TMDLs and observed loads to calculate percent reduction for each flow condition. SELECT will be used to identify the non-point sources most likely contributing to *E. coli* bacteria contamination.

The limited amount of data collected in Geronimo Creek makes it difficult to assess the degree of bacterial contamination. Daily stream flow data is needed to simulate flow conditions in the creek and to determine a percent reduction *of E. coli* needed within the watershed. Estimating daily flow data in an ungauged watershed with traditional models is expensive and time consuming. I plan to develop a statistical model to estimate daily flow data from available monthly flow data using spatial data.

Statement of Critical Regional Water Problems:
Geronimo Creek, located across Comal County and Guadalupe County in Texas, is monitored and managed by the Guadalupe-Blanco River Authority (GBRA). Geronimo Creek is near the cities of New Braunfels and Seguin, which are located near the outskirts of San Antonio. Geronimo Creek is a tributary of the Guadalupe River, a major recreational river for surrounding residents. The land use surrounding Geronimo Creek is mainly agricultural. Geronimo Creek is classified as impaired due to bacterial contamination.

A lack of flow and water quality data is a reoccurring problem for many small watersheds in Texas. Small watersheds are listed as impaired due to bacterial contamination but the data available to assess the problem and develop watershed protection plans is lacking. The flow and water quality data available for Geronimo Creek was collected monthly and covers a short duration. Daily data is needed to not only assess the degree of bacterial contamination but to determine a percent reduction of contaminates needed within the watershed. The percent load reductions are difficult to accurately calculate for this watershed with limited data.

Nature, Scope, and Objectives of the Research:
The main goal of this project is to develop a Watershed Protection Plan (WPP) for Geronimo Creek watershed. The specific objectives of this project are to
    (1) create a spatial model to estimate daily flow data at unguaged stations and
    (2) determine potential sources contributing to the bacterial contamination using SELECT
The model developed in specific objective 1 will be used to develop more accurate LDCs and results from objective 2 will be used to develop Best Management Practices.

In order to achieve creating a model to estimate daily flow data, pertinent information must be gathered. The data collected by three USGS gauges located near the watershed will be used to develop and calibrate the model. Precipitation, land use, and the previously collected stream flow data for Geronimo Creek may be used in combination with the USGS gauge data to create a more accurate model. The information collected will be input into a GIS application to spatially develop the model. The daily flow data estimated by the model will be used in addition to the water quality data collected from Geronimo Creek to develop LDCs and calculate percent load reductions for the watershed.

To achieve the goal regarding SELECT, data must be gathered about possible bacterial contributors such as livestock, wildlife, dogs, and waste water treatment plants. For livestock and wildlife, the appropriate densities and land uses must be known to properly spatially distribute their expected load contribution. The watershed must also be delineated into sub-watersheds to aggregate the possible loads. SELECT enables the stakeholders to be able to focus on a specific contributor that is shown to highly contribute to the bacterial contamination within the watershed. The model also spatially distributes the potential load showing areas that are at a high risk due to land use of contributing to the bacterial contamination. The percent load reductions calculated from LDCs will be better focused on a particular potential contamination source and a specific area in the watershed.

One personal goal that I expect to achieve over the duration of the project is to better understand the process behind a watershed protection plan. I also wish to obtain skills in water modeling and GIS applications. These skills will provide to be valuable as I pursue a career in environmental engineering with a focus on water resources. Once my Masters degree is completed, I plan to either join a consulting firm or to work with a governmental agency such as USDA NRCS to gain work experience and to continue finding solutions to water resource problems. I also aspire to earn my professional license so that I may have a greater impact on the field of environmental engineering. By achieving these goals, I hope to impact future watershed protection plans to make them more cost efficient and to increase the safety of surface water bodies for the public.

Results Expected from this Project:
The results from this project will provide valuable information to develop a watershed protection plan for the Geronimo Creek watershed with the ultimate goal of lowering the level of *E. coli* bacteria in the watershed to an acceptable level. A more effective watershed protection plan will be developed because more accurate percent load reductions will be applied to specific contributors and high risk areas. I also anticipate that future watershed projects in Texas will be less costly and time intensive because these methods are simpler than traditional models. Additionally, these methods can be applied to future Texas watersheds impaired with bacteria and other waterborne contaminants.