Updated Proposal for Team 9: Water Spillway for Lake Ralph Hall
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Water shortage in Texas is an ongoing issue. Denton County predicts that it will run out of water by 2025, which is in just ten years (Dallas Tribune 2013). Figure 1 shows how the population in the Upper Trinity Regional Water District is growing faster than both the existing water supply and the water needs. To combat this problem, the city has proposed to create a new reservoir called Lake Ralph Hall that will collect and store water to ensure that the demands of future populations are met. The man-made lake will be located approximately 80 miles northeast of Dallas in Fannin County (Figure 2). The project has been going on for nearly a decade with the Upper Trinity Regional Water District, who wishes to collect 30 to 45 million gallons of water per day for its increasing population (Dallas Tribune 2013). In order to create this lake, the government must buy up all of the houses and businesses that are currently in the proposed dam region because they will be submerged once the project is completed.

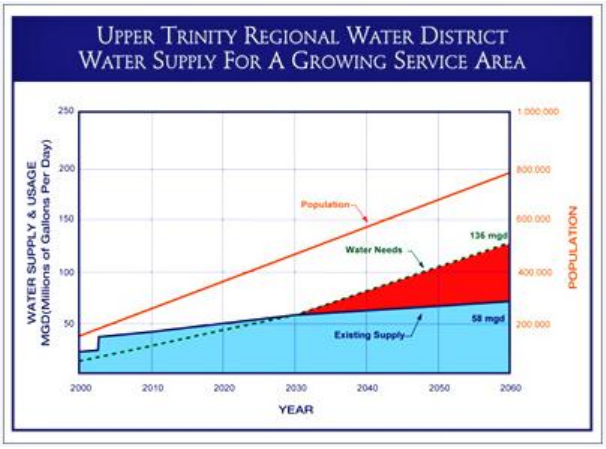

Figure 1: Water Supply for the Upper Trinity Regional Water District (Upper Trinity Regional Water District)

Figure 2: Map of the Proposed Lake Ralph Hall (Dallas Observer 2013)

In order to model this real world application, our team plans to design the lake using a 100 year storm using HEC-HMS where we will route the hydrograph through structured outlets. By creating a basin model, a simulated streamflow can be calculated and used to design the dam. In order for the HEC-HMS model to run accurately, we must determine the curve number and lag time for each sub-basin. The team will create a new meteorological model with a 100-year precipitation frequency storm. We will use the Dallas Public Works Website to find the 5 minute, 15 minute, and 1 hour intensities in inches per minute for a 100 year storm. Upon obtaining the accurate information and creation of the models, we will design a spillway to effectively collect the water as well as release some downstream for subsequent municipalities to use as well to preserve the downstream environment. The team will look at different design options for the spillway: the amount and diameter of orifices as well as the weir height and weir length, freeboard, and overtop height. The quantities of water travelling through the orifice and through the weir will need to be taken into consideration in order to regulate the amount of water being released from the dam. The dam's output per design will be analyzed in a similar process to that of homework 5. It is to note however that this is a retention project rather than a detention because it consists of long-term water storage. We plan on evaluating various scenarios based on differing return periods and differing freeboards.

Some additional information:

The longest water path is 18,700 meters, as calculated by using stream network analysis in Arc-GIS. The necessary volume the dam will need to hold is approximately 180,000 acre feet which will cover a surface area of 7,605 acres (Figure 3). Upon completion of construction, it has been estimated that it will take about three years to fill the reservoir. The reservoir will collect its water from the current stream, Red River. The team has acquired gage data from the USGS for mean daily discharge for five years. This data consists of the time versus flow rate from January 1st 2009 to December 31, 2013. The team also has computed elevation versus area data. The goal is to discharge from the dam's outlet a daily average of 191.4 cubic feet per second, which is the equivalent of 123.7 million gallons/day and 1431.6 gallons per second.

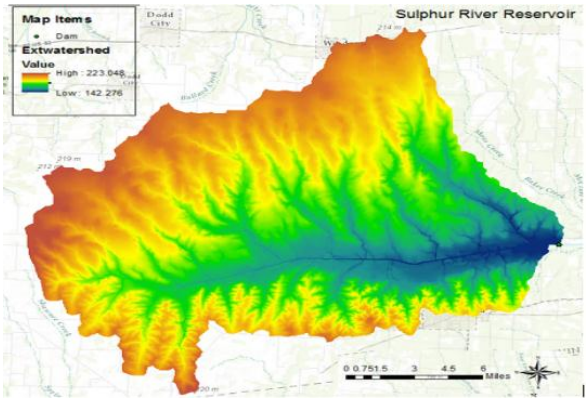

Figure 3: Watershed that will contribute to the dam (Created with Arc-GIS)