Lateral Structures, Storage Areas, and SA Connections Workshop

Introduction

This workshop will help students learn how to use HEC-RAS to create storage areas, lateral structures with gates, and storage area connections. Students will learn how to connect storage areas to river reaches and other storage areas using Storage Area Connections. *While this data is from a USGS study, the model and results of this workshop do not represent current or future conditions of the river.*

Background

The stream for this example is a section of Beaver Creek located near Kentwood, Louisiana. The bridge crossing is located along State Highway 1049, near the middle of the river reach. The bridge, cross section geometry, and high-water flow data were used to evaluate the flood that occurred on May 22, 1974 with a peak of 14,000 cfs. Figure 1 displays a map of the area with the surveyed cross sections.

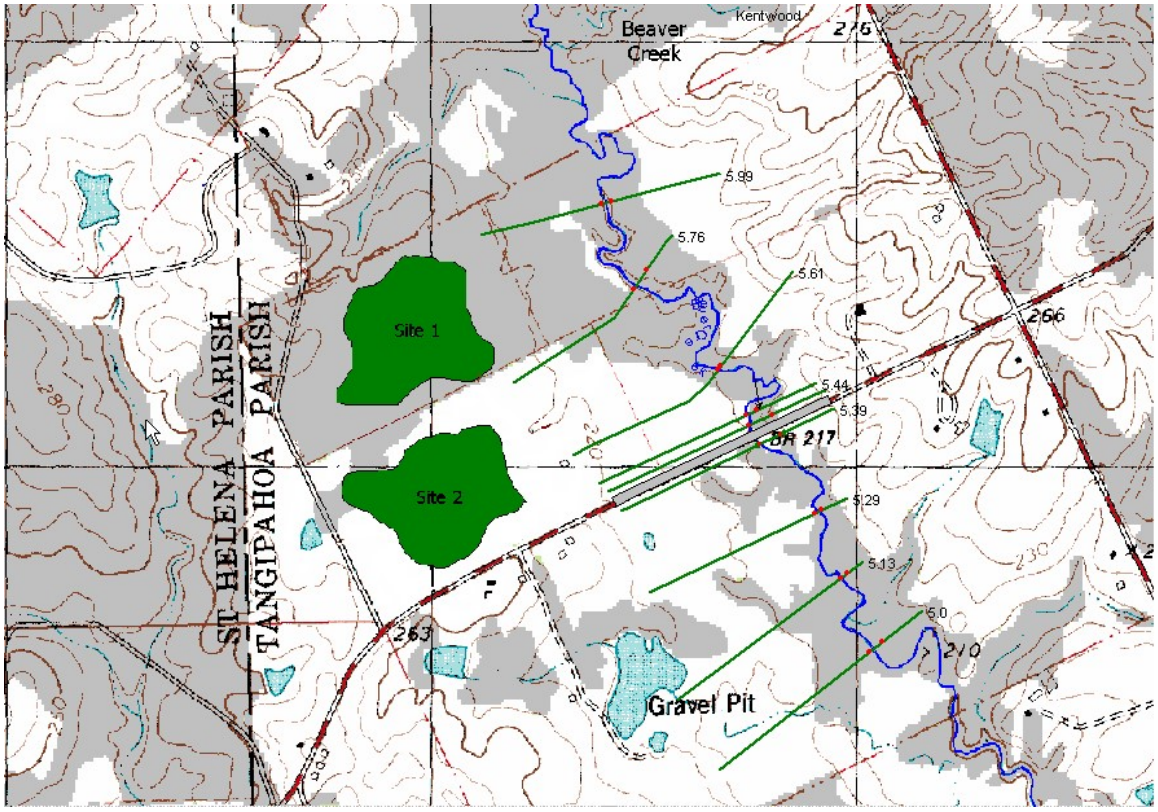

Figure 1. Beaver Creek Located Near Kentwood, Louisiana

Problem Description

A project file (**BeaverSA.prj**) with the title "**Beaver Cr. SA - and SA Connection**" is provided. The project contains all the data for this workshop. The goal of this workshop is to evaluate a proposed plan to stop the overtopping of the bridge located at River Station 5.4 during a design event that peaks at 14,000 cfs. It is proposed that two areas located to the west of Beaver Creek, labeled Site 1 and Site 2, be used for off-stream storage during peak flood events to prevent the bridge from overtopping. Site 1 is 80 acres and Site 2 is 85 acres. Each storage area will be connected via a lateral structure to Beaver Creek. The storage areas will be connected to each other with a storage area connection. The downstream lateral structure will be equipped with gates to control the release of stored water. The unsteady flow file already contains the design hydrograph.

Tasks

The following is a summary of the required tasks for each group:

1. **Run and Evaluate the Existing Conditions**

    a. Run the existing plan.

    b. Analysis the results including the bridge overtopping.

2. **Develop Storage Areas, Lateral Structures, and SA Connections**

Utilizing the storage area, lateral structure, and storage area connection options within HEC-RAS evaluate the proposed plan to develop the available area to the west of Beaver Creek for off-stream storage. Remember that the goal of the design is to prevent the highway bridge from being overtopped. Some design information is unknown and should be evaluated by the modeler.

a. Create a new geometry called **Beaver Cr with Storage Areas**.

b. Draw the approximate extent of storage areas for Site 1 and 2. Edit each storage area and select the **Area times depth** method for the storage-elevation curves. Site 1 has an area of **80 acres** and an average minimum elevation of **209 ft**. Site 2 has an average minimum elevation of **207 ft** and an area of **85 acres**.

c. Save the **Unsteady Flow Data** as "**May 22, 1974 Event with SA"** and set the initial water surface elevations of the storage areas to begin dry.

d. Connect the storage areas to each other with a storage area connection and call it "**SA Transfer**". The connection should consist of a weir and

culvert. The proposed weir length and elevation are **100 ft** and **217 ft**, respectively. The weir width is **20 ft**. The culvert is a concrete pipe with a square edge entrance from the headwall, **7 ft** in diameter and **30-ft** long. The culvert is located along the centerline of the weir with an upstream invert elevation of **209 ft**.

In the **SA Connection Data** editor select the **HTAB Parameter** button, set the maximum headwater elevation to **220 ft**.

e. Connect the two storage areas to the reach with lateral structures. (Note: Do not try to use a storage area connection to connect the lateral structures from the reach to the storage areas.)

The proposed upstream weir is located at River Station 5.9 and is **400 ft** in length. The proposed downstream weir is located at River Station **5.570** and is **200 ft** in length. The correct elevation of the weirs in unknown and must be evaluated by the modeler. The height of each weir will most likely fall within the range of **213** to **218 ft**.

f. Save the plan with the new geometry and unsteady flow data as "**Storage Areas and Lateral Structures**" and run it.

g. Evaluate the bridge for weir flow by viewing the output tables, or by examining the **Profile Plot** to see if the energy grade line rises above the bridge deck. Make adjustments to the weir elevations and storage areas until the bridge is not overtopped.

3. Place Gates on the Downstream Lateral Structure

After the flood wave has passed, re-route the stored water back into Beaver Creek. To accomplish this task, place gates along the downstream weir. (The upstream storage area should empty into the downstream storage area through the storage area connection).

a. Save the geometry as "**Beaver Cr with Storage Areas and Gates**".

b. Construct sluice gates along the downstream lateral structure. The sluice gates have a **discharge coefficient** of **0.6**.

c. Save the **Unsteady Flow Data** as "**Unsteady Flow with Gate Openings**" and develop a time series of operation for the gates that will release the water in the downstream storage area after the flood wave.

d. Save the new plan and run it.

Questions

1. Did your design meet the requirement to prevent weir flow over the highway bridge?

2. When did the maximum flow occur in the storage areas? What was the maximum stage of both storage areas? What was the maximum flow between the two storage areas? What was the maximum flow over the lateral structure located at River Station 5.9?

3. How did the stage and flow hydrographs change when the gates were added? Did any numerical oscillations occur in the stage and flow hydrographs? If so, how can these oscillations be smoothed?

4. What are some other alternatives, besides off-stream storage areas, to keep the bridge from being overtopped?