CE 3372 – Water Systems Design
Exercise Set 14

Purpose: Demonstrate application of SWMM for analysis of a detention pond as a stormwater control strategy.

Objectives:

- Compute depth and discharge in a detention pond using SWMM

- Introduction to use of professional software (SWMM)

- Develop expertise in interpreting output to answer specific hydraulic questions

Exercise

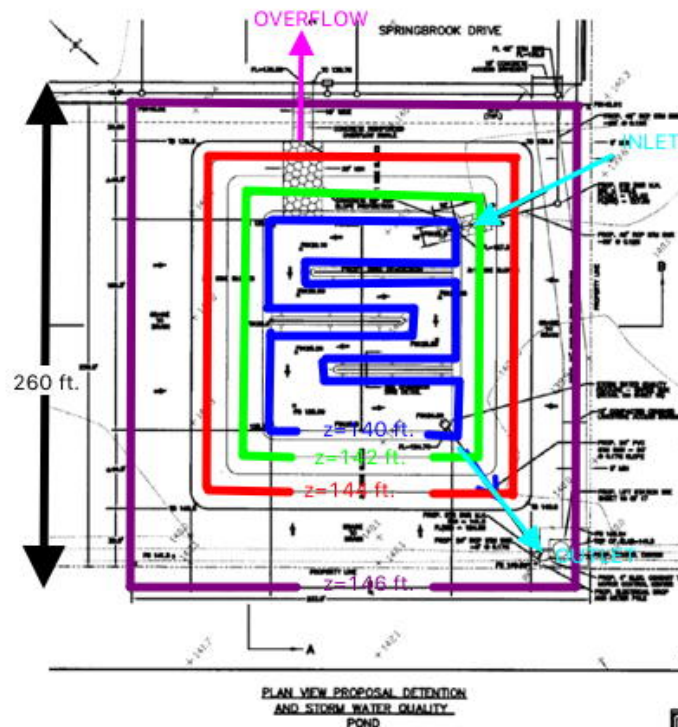Figure 1 is a plan view of a rectangular detention pond.

Figure 5. 36 Engineering Drawing for Permit 8-262-4 (Harris County) SWQ Pond

Figure 1: Harris County, 8-262-4, Storm Water Quality Pond.

The bottom of the pond is at elevation 139 feet. Several rectangular contour lines are shown. If the pond has one foot of water in storage, the blue line represents the pool elevation, and the volume would be the product of the area enclosed by the blue contour and the depth (1 foot). At depths greater than one foot, the pond sides are sloped and not vertical.

The inlet is a 1-foot diameter culvert that drains a 9-acre light-industrial complex. The invert elevation of this culvert at the pond is 139 feet.

The outlet works is a riser pipe which activates when the stage in the pond is 141 feet. The diameter of the outlet pipe is 8-inches. A secondary outlet pipe, also 8-inches activates at elevation 145 feet.

A small 4-inch drain pipe is at the pond bottom so that the pond drains completely after a storm.

If the pond stage exceeds 146 feet, the emergency overflow is a rectangular swale 25 feet wide and 2 feet deep which drains directly into a nearby bayou.

1. Figure 2 is a profile (elevation view of the pond). Create your own sketch and label the inlet pipe, outlet pipe(s), and overflow swale; indicate the elevations of the pond bottom, inlet pipe invert (bottom) and soffit (top), the outlet pipe(s) invert(s) and soffit(s), and the invert elevation of the emergency overflow structure.
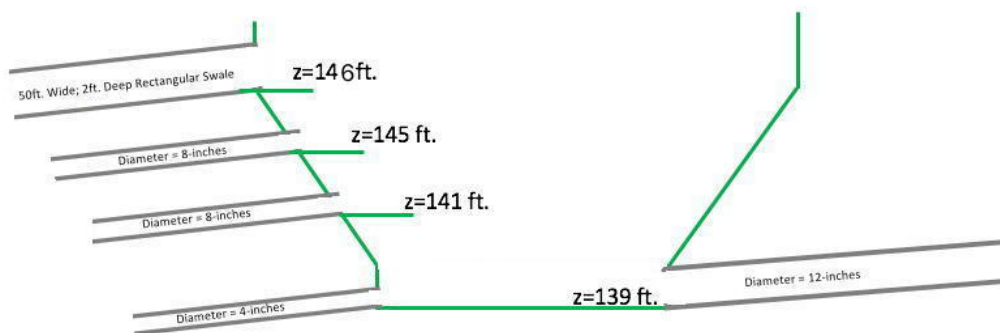

Figure 2: Schematic elevation-view sketch of pond.

2. Determine from Figure 1 the depth-area relationships for pond stages of 0,1,2,3,4,5,6, 7 and 8 feet. For the 8 foot stage, you can assume vertical walls extending upward from the z=146 feet contour line. Prepare a table that lists water pool elevation, and water surface area.

3. Build a SWMM model of the detention pond (Storage Node; Tabular Depth-Area). The catchment that drains to the pond can be modeled as a 9-acre square region, with

an overland slope of 0.05%. Use an appropriate value for runoff coefficient. The inlet pipe is a 1-foot diameter, 200-foot long RCP, laid on a slope of 0.05%. The outlet pipes and overflow swale are also at slope 0.05%; they are also 200 feet long.

The multiple outlets will need to connect to a common junction node 200 feet from the pond, which will then connect to an outfall. The connection to the outfall should be a 6-foot diameter conduit, 200 feet long. Set the outfall as a `FREE` outfall boundary condition.

4. Run the SWMM model using a constant intensity of 3-inches per hour for 6 hours. Prepare output plots of pond depth versus time, pond inflow versus time, and pond outflow versus time.

Determine:

a) If the pond overflows with this particular rainfall input?

b) The maximum constant-intensity, 6-hour storm that the pond can accommodate without activating the overflow spillway.

c) The pond's effective (without activating the overflow spillway) annual recurrence interval (ARI) given that the time of concentration for the contributing area is 15 minutes.