CE 3372 – Water Systems Design
Exercise Set 2

Purpose: Reinforce use of authoritative documents as sources of design criteria.
Reinforce reading and interpreting plan and profile drawings
Review of closed conduit hydraulics and use of energy equation for systems analysis

Exercises

1. Locate TCEQ Rules and Regulations for Public Water Systems (RG-195). Use the document to answer the following questions

   (a) What is the minimum required pressure in a distribution system under normal operating conditions?
   290.44(d) 35 psi at all points within the distribution network at flow rates of at least 1.5 gallons per minute per connection.

   (b) What is the minimum required pressure in a distribution system under combined fire and drinking water operating conditions?
   290.44(d) When the system is intended to provide fire fighting capability, it must also be designed to maintain a minimum pressure of 20 psi under combined fire and drinking water flow conditions.

   (c) What is the minimum distance that waterlines can be located relative to septic tank drainfields?
   290.44(e)(8) ... Waterlines shall not be installed closer than ten feet to septic tank drainfields.

   (d) What is the minimum required residual of free chlorine in milligram per liter?
   290.46(d)(2)(A) a free chlorine residual of 0.2 milligrams per liter (mg/L).

   (e) What is the minimum required residual of chloramine residual for systems that feed ammonia?
   290.46(d)(2)(B) a chloramine residual of 0.5 mg/L (measured as total chlorine) for those systems that feed ammonia.

2. Locate Chapter 217 "Design Criteria for Domestic Wastewater Systems" of the Texas Administrative Code. Download and print Subchapter C "Conventional Collection Systems". Use the subchapter to answer the following questions.

   a) What four components of flow calculations are to be included in a gravity collection system?
   Average dry weather; dry weather peaking factor; infiltration; inflow

   b) What time frame are these flow calculations to be considered?
   Completion of construction and 50 years post-construction

   c) Collection system pipes may be installed in the same trench as a pressurized water supply pipe. True or false?
   False, should not be in same trench

   d) What is the minimum structural design life for wastewater collection facilities?
   50 years; explicit in "Structural Analysis (k) ..... "

   e) What is the minimum allowable gravity collection pipe diameter, in feet?
   1/2 foot (6 inches)

   f) What is the minimum allowed flow velocity when a collection system component is flowing full?
   2 feet per second

   g) What is the maximum allowed flow velocity when a collection system component is flowing full?
   10 feet per second

   h) What is the head loss formula is used in the gravity collection portion of the subchapter?
   Manning's equation

   i) What is the head loss formula used in the lift station (pumping) portion of the subchapter?
   Implied Hazen-Williams based on use of C for friction coefficients

   j) Collection system warning labels must be provided in what languages ?
   ENGLISH on pipes; both ENGLISH and SPANISH on storage tanks and faucets

3. Using the City of Houston Infrastructure Design Manual on the class website, summarize backfill requirements as pertaining to wastewater collection systems.

   Page 8-7: Section E(4) – Back fill excavated areas and trenches under or within one foot of existing or proposed pavement with cement-stabilized sand from the top of the pipe embedment zone up to one foot below the paving sub-grade. Cement-stabilized sand must develop 100 psi minimum compression at 48 hours. Backfill shall be compacted to 95 percent standard Proctor density.

4. A 5-foot diameter, enamel coated, steel pipe carries 60^oF water at a discharge of 295 cubic-feet per second (cfs). Estimate the head loss in a 10,000 foot length of this pipe using the Hazen-Williams head loss model.

5. Water is pumped from a supply reservoir to a ductile iron water-transmission line as shown in Figure 1. The high elevation of the line is at point A, 1 kilometer downstream of the pump station, and the low elevation is at point B, 1 kilometer downstream of point A. If the discharge in the pipeline is 1 cubic-meter per second (cms), the diameter of the pipe is 750 millimeters (mm) and the pressure at point A is 350 kilopascals (kPa). Determine

   (a) The added head supplied by the pump station.

   (b) The water pressure at B.

   (c) The mechanical power supplied by the pump.

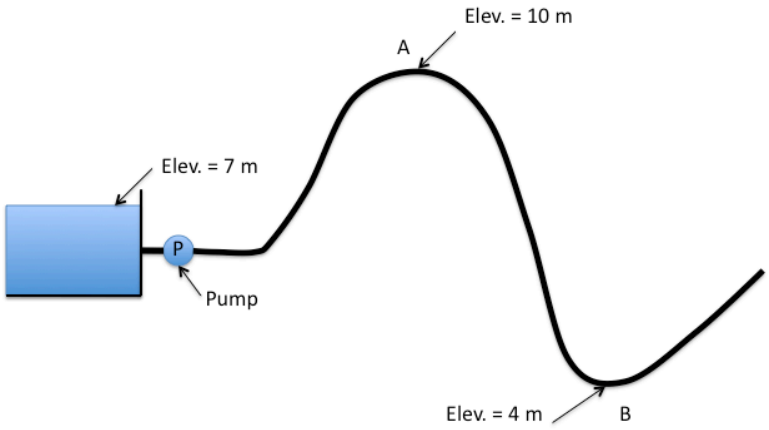

Figure 1: Reservoir-Pump-Transmission System Schematic