1. Given:

Solid wastes from a large broiler production facility are land applied to nearby crop fields. The broiler operation can house 250,000 birds and operates at an average capacity of 95%. The litter from the broiler houses is removed annually. The cropland on which the litter is applied is used for growing sunflower seed for oil production and has nutrient requirements of $N = 150$ lb/ac, $P_2O_5 = 75$ lb/ac, $K_2O = 290$ lb/ac. Wastes are applied by broadcast application with immediate incorporation. Assume 5% application losses for nitrogen.

Required:

For sunflower oilseed cropland:

a. Calculate the amount of phosphorus required for crop production (lb P/ac)

b. Calculate the amount of potassium required for crop production (lb K/ac)

For phosphorus-based applications:

a. Calculate the land area required.
   i. Calculate the total manure produced annually (lbs).
   ii. Calculate the plant available nitrogen (PAN) in lbs.
   iii. Calculate the phosphorus (P) available in lbs.
   iv. Calculate the land area required based on crop requirements in acres.
   v. Calculate the manure application rate (ton/ac).

b. The required application rate for supplemental nitrogen fertilizer
   i. Calculate the amount of nitrogen applied in the manure (lb/ac).
   ii. Calculate the amount of additional nitrogen fertilizer required (lb/ac).

For nitrogen-based application:

a. Calculate the land area required.
   i. Calculate the land area required based on crop requirements in acres.
   ii. Calculate the manure application rate (ton/ac).
   iii. Calculate the amount of phosphorus applied (lb/ac).
   iv. Calculate the amount of over-application of phosphorus (lb/ac).

Hint: Use Land Application handout.
Hint: Use ASAE D384.2 Manure Production and Characteristics handout.

2. Given:

A swine producer has a farrow-to-finish operation that houses 300 sows (300 day/yr gestating and 65 day/yr lactating) and produces 1,500 pigs (they are nursery pigs for 36 days and grow-finish pigs for 120 days) annually. The animals are kept in enclosed buildings on slatted floors. No bedding is used in the operation and about 200 gallons of fresh water are spilled in
the swine houses daily. The waste is flushed to a covered anaerobic lagoon using 3,500 gal/day fresh water. Effluent from the covered lagoon is stored in an open lagoon which is applied on ryegrass for irrigation approximately 4 times per year. Nitrogen loss in the covered lagoon is about 10% and in the open lagoon, about 15%. Nitrogen loss during irrigation is about 25%. Nutrient requirements for ryegrass: N = 125 lb/ac, P₂O₅ = 35 lb/ac, K₂O = 100 lb/ac.

**Required:**

Find the acreage required for irrigation application based on phosphorus requirements, the volume of waste to apply per acre (gal/ac), and the excess or deficit for N (lb/ac).

For ryegrass cropland:

- a. Calculate the amount of phosphorus required for crop production (lb P/ac)
- b. Calculate the amount of potassium required for crop production (lb K/ac)

For 300 gestating and lactating sows and 1,500 pigs (nursery pigs to start with then they are grow-finish pigs after that):

- a. Calculate the total annual manure (TM) production in lb/yr.
- b. Calculate total nitrogen in manure (lb/yr).
- c. Calculate plant available nitrogen (PAN) taking into account nitrogen losses in lb/yr.
- d. Calculate total phosphorus in manure (lb/yr).
- e. Total annual manure volume (TMV) in ft³ and gallons.
- f. Calculate total annual waste volume (TV) in gallons. Hint: Include flushed and spilled water.
- g. Calculate the acreage required for irrigation application based on phosphorus requirements (ac).
- h. Calculate the application rate (gal/ac).
- i. Calculate the nitrogen application rate (lb/ac).
- j. Calculate the nitrogen deficit (lb/ac). Hint: Deficit = required – applied.

Hint: Refer to Table 1.b for Swine – Gestating sows (300 days) and Swine – Lactating sows (65 days).

Hint Refer to Table 1. For Swine – Nursery pigs (1,500 pigs) and Swine – Grow-finish (1,500 pigs).

Hint: Use Land Application handout.

Hint: Use ASAE D384.2 Manure Production and Characteristics handout.
3. Given:

Within approximately 30 miles of Hereford, TX, there are 50 beef feed yards. These vary in size from a few thousand cattle to over 50,000 head. For this problem, assume the average size is 20,000 head and each feed yard averages 90% capacity over the year. In a feedlot operation, the manure usually is removed once or twice a year. It may contain substantial amounts of soil and will have relatively low moisture content. Some of the nitrogen will have been lost as ammonia. Assume broadcast application is used to apply the manure with immediate incorporation. Plant nutrient requirements for corn: N = 125 lb/ac, P₂O₅ = 25 lb/ac, K₂O = 25 lb/ac.

Required:

Estimate the amount of corn cropland required for disposal of the manure based on nitrogen application.

a. Calculate the average number of cows near Hereford, TX.

b. Calculate the amount of phosphorus required for crop production (lb P/ac)

c. Calculate the amount of potassium required for crop production (lb K/ac)

d. Calculate the amount of manure from each cow in lb/head-day.

e. Calculate the total amount of manure that is land applied per year in lb.

f. Calculate the total amount of plant available nitrogen (PAN) in the manure per year in lb.

Hint: Assume 5% application losses.

Hint: Assume 50% TKN is plant available.

g. Calculate the area required for N-based applications in ac.

h. Calculate the manure application rate (ton/ac).

i. Calculate the amount of phosphorus applied in the manure (lb/ac).

j. Calculate the amount of excess phosphorus applied (lb/ac).

Hint: Use Land Application handout.

Hint: Use ASAE D384.2 Manure Production and Characteristics handout.