

ERRATA for
PE Civil: Water Resources and Environmental Practice Exam
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Revisions are shown in red.

Question 10:

This item was replaced with the following:

A hot-mix asphalt mix design consists of the following:

Aggregates:

Coarse = 42%

Fine = 54%

Mineral filler = 4%

Asphalt cement = 5.8%

The amount of coarse aggregate (tons) required to produce 3,000 tons of hot-mix asphalt is most nearly:

- A. 1,187
- B. 1,260
- C. 1,639
- D. 2,826

Question 12:

Select the **two** that apply.

Removed: **Option E: Ductile iron pipe–mortar lined (DIP)**

Question 18:

If the WWTF were to use equalization instead of expansion, which basins would provide adequate storage to meet the regulatory requirements?

Select the **three** that apply.

- A. Basin A: circular concrete basin 175 ft in diameter with a 10-ft side water depth
- B. Basin B: rectangular concrete basin 120 ft × 115 ft with a 12-ft side water depth
- C. Basin C: circular concrete basin 250 ft in diameter with a 16-ft side water depth
- D. Basin D: 0.65-acre earthen lagoon at average depth with a high water level of 8 ft
- E. Basin E: **0.76-acre** earthen lagoon at average depth with a high water level of **6 ft**

Option F was omitted.

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Question 21:

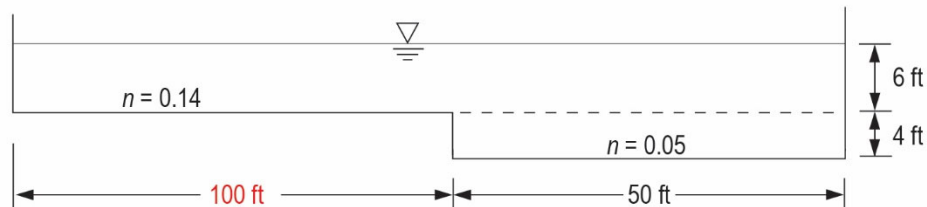
A western community uses a water treatment facility to treat raw well water for iron and manganese removal. The water plant is no longer allowed to direct discharge backwash waste to the local receiving stream. The facility has **four, 12-ft square** gravity filters. A new red water lagoon is proposed to contain all backwash waste. Assume the average backwash rate is 15 gpm/ft² and the facility backwashes each filter in a single day once per week for 25 min. each. According to TSS Water Works 2018, the minimum lagoon size (ft) required is most nearly:

Question 28:

A water system is replacing a 5,000-ft section of 48-in. cast iron discharge pipe from a **25-MGD** water treatment plant **with** C900 plastic. If the Hazen-Williams head loss coefficient for the cast iron is 100 while the C900 coefficient is 130, the **minimum new** line size (in.) **that would not result in added head loss is most nearly:**

Question 33:

The channel shown has a longitudinal slope of 0.001 ft/ft **and a 100-ft-wide** overbank section necessary to keep the water depth in the channel no greater than 10 ft under uniform velocity. **The maximum design flood (cfs) that this channel can support is most nearly:**



- A. 2,512.9
- B. 2,380.5
- C. 2,240.1
- D. 1,932.9

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Question 50:

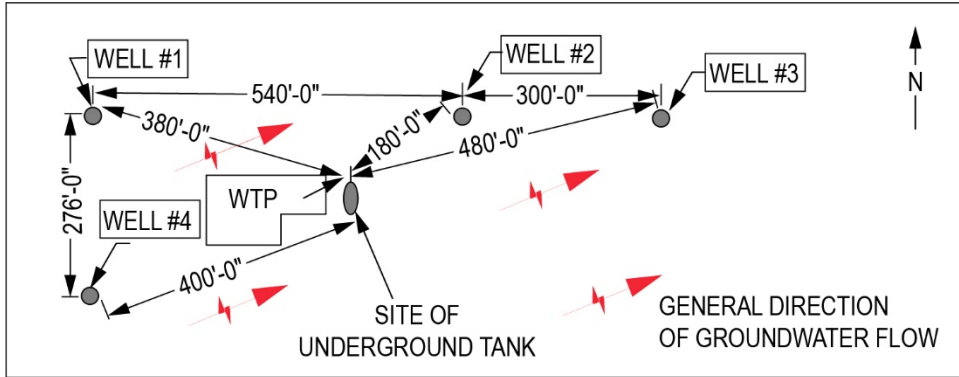
Description		Type of Aquifer
The well site will usually be within the recharge area.		Confined aquifer
The well site may not be within the recharge area.		Unconfined aquifer
The well should fully penetrate between two impervious (usually clay) layers.		
The yield is limited by the volume of water drained from the pores.		
Contamination is likely to reach the well water more quickly.		

Question 54:

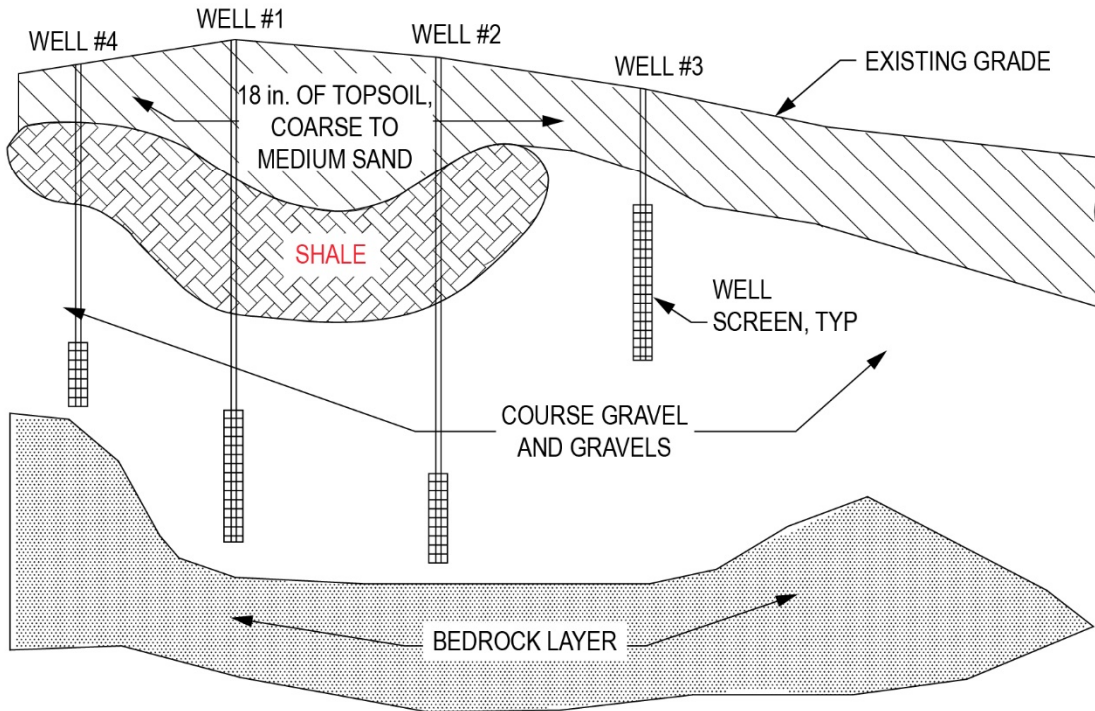
Select the **four** that apply.

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Question 56:



WATER TREATMENT SITE PLAN



HYDROGEOLOGIC CROSS-SECTION OF WELL FIELD

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Question 60:

Tank Design Parameters	System Requirements/Data
Maximum storage elevation	Fire-flow duration
	Chlorine residual
	Airport flight path
Minimum storage elevation	Service pressure
	Pump total discharge head (TDH)
Storage volume	Floodplain elevation
	Surface overflow rate

Question 66:

The primary clarifier of a trickling filter plant receives 1,000 lb of solids daily. The clarifier has a solids capture rate of 90% and produces an underflow sludge concentration of 9% (**SG = 1.05**). The volume of primary sludge (ft³/day) is most nearly:

- A. 2
- B. 80
- C. **150**
- D. 210

Question 70:

- C. **867.51**

Question 71:

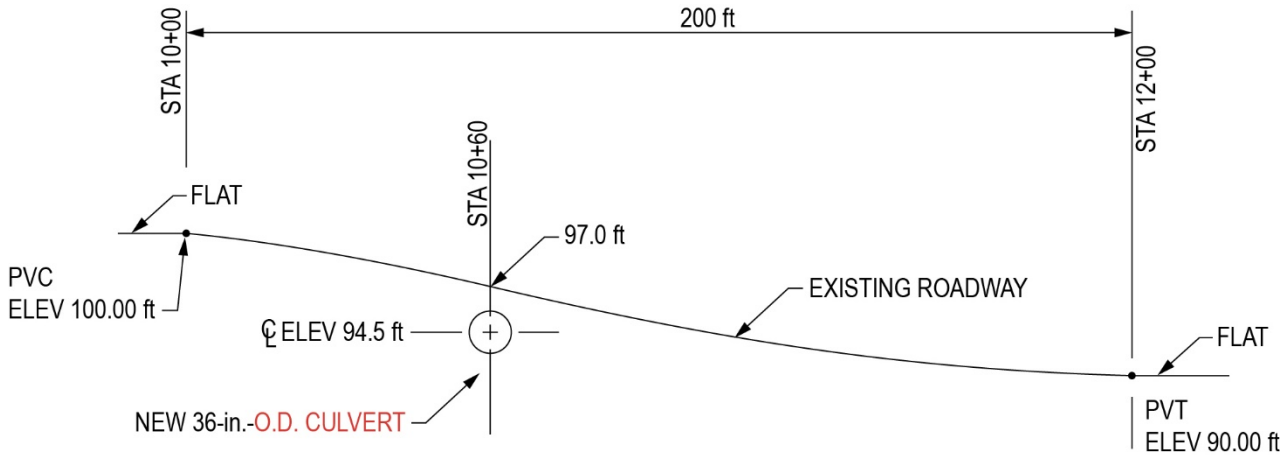
- A. **6.8**

Question 80:

A contractor is **replacing a culvert crossing under** an existing county road. The road has **shallow ditches** on either side, and the pipeline must be laid at a **centerline grade matching the pre-existing piping**. To increase the cover depth, it is proposed to replace a 200-ft section of the road using two **consecutive** vertical curves of equal length as shown in the figure. The **culvert** crosses at Station 10+60 **with** the road replacement between Stations 10+00 and 12+00. The depth of cover (ft) **of the culvert under the proposed roadway is** _____.

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Question 80 (continued):



Solution 10:

Weight of asphalt = 3,000 tons \times 0.058 = 174 tons

3,000 tons – 174 tons = 2,826 tons

2,826 tons \times 0.42 = 1,187 tons

THE CORRECT ANSWER IS: A

Solution 12:

The following options are correct.

Option B: Polyvinyl chloride pipe (PVC) is commonly used for small sewers.

Option D: Vitrified clay pipe (VCP) is old technology but could be used.

THE CORRECT ANSWERS ARE: B, D

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Solution 18:

Total flow to store: $0.552 \text{ MGD} - 0.500 \text{ MGD} = 0.052 \text{ MGD} \times 30 \text{ days} = 1.56 \text{ MG}$ or $209,040 \text{ ft}^3$

A. $(175 \times 3.14/4)\text{ft}^2 \times 10 \text{ ft} = 240,406 \text{ ft}^3$ —provides adequate storage

B. $120 \text{ ft} \times 115 \text{ ft} \times 12 \text{ ft} = 165,600 \text{ ft}^3$ — too small

C. $(250 \times 3.14/4)\text{ft}^2 \times 16 \text{ ft} = 785,000 \text{ ft}^3$ —provides adequate storage

E. $0.76 \text{ acres} \times 43,560 \times 6 \text{ ft} = 198,634 \text{ ft}^3$ —too small

Option F was omitted.

THE CORRECT ANSWERS ARE: A, C, D

Solution 28:

Use the Hazen-Williams equation for head loss.

$$Q = 25,000,000 \text{ gal/day} \rightarrow \frac{25,000,000}{7.48 \text{ g/ft}^3} \left(\frac{1}{24 \text{ hr/day} \times 60 \times 60} \right) = 38.68 \text{ cfs}$$

$$L = 5,000 \text{ ft}$$

$$C = 100$$

$$D = 48 \text{ in.}/12 = 4 \text{ ft}$$

$$\text{Existing } h_f = \frac{4.73(5,000)}{100^{1.852} 4^{4.87}} (38.68)^{1.852} = 4.762 \text{ ft}$$

$$\frac{4.73(5,000)(38.68)^{1.852}}{130^{1.852} 4^{4.87}} = 2.92 \text{ ft}$$

48-in. pipe is the smallest size that doesn't increase head loss.

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Solution 33:

$$n_1 = 0.14$$

$$S_1 = 0.001 \text{ ft/ft}$$

$$A_1 = 6 \times 100 \text{ ft}^2 = 600 \text{ ft}^2$$

$$P_{w1} = 6 + 100 = 106 \text{ ft}$$

$$R_{H1} = \frac{A_1}{P_{w1}} = \frac{600}{106} \text{ ft} = 5.66 \text{ ft}$$

$$Q_1 = \frac{1.49}{n_1} A_1 (R_{H1})^{2/3} (S_1)^{1/2} = \frac{1.49}{0.14} \times 600 (5.66)^{2/3} \times (0.001)^{1/2}$$

$$= 645 \text{ ft}^3/\text{sec}$$

$$n_2 = 0.05$$

$$S_2 = 0.001$$

$$A_2 = 50 \times 10 \text{ ft}^2 = 500 \text{ ft}^2$$

$$P_{w2} = 4 + 50 + 10 = 64 \text{ ft}$$

$$R_{H2} = \frac{A_2}{P_{w2}} = \frac{500}{64} \text{ ft} = 7.81 \text{ ft}$$

$$Q_2 = \frac{1.49}{n_2} A_2 (R_{H2})^{2/3} (S_2)^{1/2} = \frac{1.49}{0.05} \times 500 (7.81)^{2/3} \times (0.001)^{1/2}$$

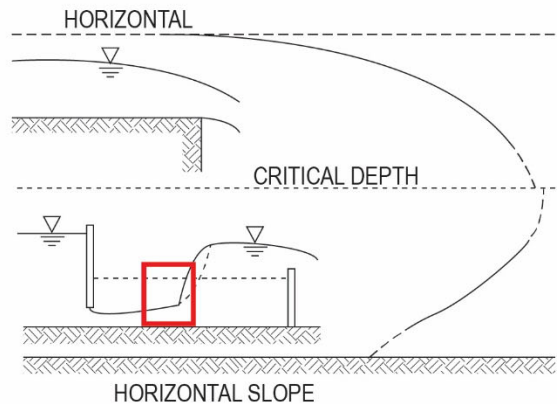
$$= 1,867.9 \text{ ft}^3/\text{sec}$$

$$Q = Q_1 + Q_2 = (645 + 1,867.9) \text{ cfs}$$

$$= 2,512.9 \text{ cfs}$$

THE CORRECT ANSWER IS: A

Solution 36:



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Solution 49:

Specific capacity = Q/D_w

Solution 50:

Description

The well site will usually be within the recharge area.

Unconfined
aquifer

The well site may not be within the recharge area.

Confined aquifer

The well should fully penetrate between two impervious (usually clay) layers.

Confined aquifer

The yield is limited by the volume of water drained from the pores.

Unconfined
aquifer

Contamination is likely to reach the well water more quickly.

Unconfined
aquifer

Solution 52:

$$\left[(6.2 - 5.5) \text{ mg/L} \right] \left(\frac{115 \text{ ft}^3}{\text{sec}} \right) \left(\frac{7.48 \text{ MG}}{\text{ft}^3 \times 10^6} \right) \left(\frac{86,400 \text{ sec}}{\text{day}} \right) \left(\frac{8.34 \text{ lb}}{\text{MG} \cdot \text{mg/L}} \right) = 433.9 \text{ lb/day}$$

Solution 54:

Option A: In a water/wastewater environment, red, green, and brown algae all contain chlorophyll.

THE CORRECT ANSWERS ARE: A, B, C, E

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Solution 60:

Tank Design Parameters

Maximum storage elevation

Airport flight path

Pump total discharge head (TDH)

Minimum storage elevation

Service pressure

Storage volume

Fire-flow duration

Chlorine residual

Solution 66:

Refer to the Sludge Production section in the *PE Civil Reference Handbook*.

Using equation $V_S = \frac{M}{P_S S_S g_w}$

Use SG of sludge = 1.05

$$M = 1,000 \text{ lb/day} (0.9) = 900 \text{ lb/day}$$

$$P_S = 0.09$$

$$S_S = 1.05$$

$$g_w = 62.4 \text{ lb/ft}^3$$

$$V_S = \frac{900 \text{ lb/day}}{(0.09)(1.05)(62.4 \text{ lb/ft}^3)} = 152.6 \text{ lb/ft}^3$$

$$V_S = 153 \text{ lb/ft}^3$$

Round to tens digits = 150 lb/ft³

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Solution 70:

$$v^2 = 1.056 \text{ (ft/sec)}^2 \rightarrow v = 1.028 \text{ ft/sec}$$

$$Q = VA$$

$$A = 5.41/1.028 = 5.26 \text{ ft}^2/2.5 \text{ ft wide} = 2.11 \text{ ft deep}$$

$$\text{Wet well elevation minimum} = 2.11 \text{ ft} + 865.40 = 867.51 \text{ ft}$$

Solution 71:

Determine the expected peak daily flow from the Fair and Geyer equation in TSS 2014, Figure 1:

$$\text{PF} = (18 + 80^{0.5})/(4 + 80^{0.5}) = 2.08 \text{ PF}$$

$$8 \text{ MGD} \times 2.08 = 16.64 \text{ MGD}$$

Subtract the recorded peak flow from the expected peak flow:

$$23.4 \text{ MGD} - 16.64 \text{ MGD} = 6.76 \text{ MGD probable infiltration and inflow flow}$$

Solution 80:

Added: Curve length, $L = (\text{Sta. } 12+00 - \text{Sta. } 10+00)/2$ since there are two consecutive curves in this section of roadway.