NC STATE UNIVERSITY

ENGINEERING ONLINE

Lecture Notes

Course Number: PE Exam Review - Civil Engineering

Instructor: Russell Briggs, PE

Lecture Number: 04 Water Resources & Environmental 01

P.E. Review

Water Resources
&
Environmental

- <u>Introduction</u>
- Expectations of this review
- How many problems do you need to know to pass?
- The one page in Lindeburg that you need to know
- Topics we will cover

Russell Briggs, P.E.

BSCE, MSCE NC State

P.E. Registration No. 11889 (1984)

Current Registration #s are 39000+

> 2/3 of all PE registrations ever conferred after 1984.

Principal in B&F Consulting.

I use the material from this review daily.

- Introduction
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What this course is:

A review of Water Resources & Environmental

A means to prepare by illustrating typical problems you may encounter.

What this course isn't:

A high school algebra class

A means to show every problem you may see on the exam.

An exhaustive treatment of the topics selected that we will review.

- Introduction & Contact information
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Passing Rate is +/- 70%

80 Problems, means you must score correctly on
70% x 80 = 56 Problems

Multiple choice, so if you “know” 48 problems, and guess on the remaining 32, you should score correctly

48 + (25% X 32) = 56 Problems

Then, actually, 48/80, or 60% is the number of problems you must “know”.

Strategy: get all the morning problems, then, after you do 8 problems in the afternoon, you can leave early… say around 2 p.m.

How many problems would a 1st grader score correctly?

20 out of 80

Correct from guessing	8
First-grader score	20
"4 years of experience & 16 years of education"	28
	56

The State of North Carolina will confer upon you the title of Professional Engineer if you "know" 28 more problems than a first-grader answers correctly on an 80 problem test.

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Page 28-2

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The Engineer sees:

Words, words words..... Lots and lots of words. Words here, words there... When will all these words quit?? More words and more words.

Another bunch of words, and more words following that. Words words words. Words to the right of me, words to the left of me. More words. Words, words words.

Here a word, there a word, everywhere a word, word.

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Table 29.1 **NEAT! A Table!!!**

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daily minimum	4 to 5 A.M.	treatment plant	40%
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seasonal peak	late summer		125%
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The Test-Maker sees:

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- A Municipality has an aggressive infiltration and inflow program that minimizes stormwater and groundwater flow into the sewer system. Therefore, what is the most likely size of a wastewater treatment plant for a municipality that has a 2 MGD water treatment plan?

a) 1.0 MGD
b) 1.4 MGD
c) 2.0 MGD
d) 2.8 MGD

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2 MGD Water Treatment X 75% return

= 1.5 MGD Wastewater Treatment

- What is the best estimate, in MGD, of sewer flow for new development for 2300 people?

a) 0.2 MGD
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2300 people X 100 gpd/person = 230,000 gpd

= 0.23 MGD

- Combined sewer systems occur most often in

a) Planned developments
b) Older cities
c) California
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Civil Breath (AM) Exam

EIGHT Questions from

Water Resources and Environmental

including:

A. Hydraulics - Closed Conduit
B. Hydraulics - Open Channel
C. Hydrology
D. Wastewater Treatment
E. Water Treatment

A. Hydraulics – Closed Conduit

- Energy and/or Continuity Equation
- Pressure Conduit (e.g. force mains)
- Closed pipe flow equations
  - Hazen-Williams, Darcy-Weisbach
- Friction/Minor Losses
- Pipe network analysis
  - e.g. pipeline design, loop networks
- Pump application and analysis

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B. Hydraulics – Open Channel

- Open-channel flow (e.g. Manning's eq.)
- Culvert design
- Spillway capacity
- Energy dissipation (hydraulic jump)
- Stormwater collection (inlets, gutter flow, street flow, storm sewer pipes)
- Flood plains/floodways
- Flow measurement – open channel

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C. Hydrology

- Storm characterization
- Storm frequency
- Hydrographs application
- Rainfall intensity, duration and frequency
- Time of concentration
- Runoff analysis (Rational & NRCS)
- Erosion
- Detention/retention ponds

Civil Breath (AM) Exam

EIGHT Questions from *Water Resources and Environmental* including:

A. Hydraulics – Closed Conduit
B. Hydraulics – Open Channel
C. Hydrology
D. Wastewater Treatment
E. Water Treatment

D. Wastewater Treatment

- Collection systems
  - lift stations, sewer networks
  - infiltration and inflow

<u>Civil Breath (AM) Exam</u>

<u>EIGHT</u> Questions from *Water Resources and Environmental* including:

A. Hydraulics – Closed Conduit
B. Hydraulics – Open Channel
C. Hydrology
D. Wastewater Treatment
E. Water Treatment

E. Water Treatment

- Hydraulic loading
- Distribution system

Transportation Depth (PM) Exam
Ten Questions from *Other Topics*

A. Hydraulics
- Flow measurement – closed conduits
- Open channel, sub & supercritial flow

B. Hydrology
- Hydrograph development & synthetic

C. Engineering properties of soils & materials

D. Soil mechanics analysis

E. Engineering Economics

F. Construction operations and methods
- NPDES permitting

G. Temporary structures

Geotechnical Depth (PM) Exam
Five Questions from *Other Topics*

A. Groundwater and well fields
  - Well logging and subsurface properties
  - Aquifers
  - Groundwater flow (Darcy's law)
  - Well analysis (steady flow only)
  - Groundwater control (drainage, deh20)

B. Loadings

C. Construction operations & methods

D. Temporary structures

E. Worker health, safety and environment

Structures Depth (PM) Exam

NO Questions from *Water Resources & Environmental* topics

Water Resources &Environmental (PM) Exam

39 questions

A. Hydraulics – Closed Conduit
B. Hydraulics – Open Channel
C. Hydrology
D. Groundwater and well fields
E. Wastewater Treatment
F. Water Quality
G. Water Treatment

A. Hydraulics – Closed Conduit (+/-6 questions)

- Energy and/or Continuity Equation
- Pressure Conduit (e.g. force mains)
- Closed pipe flow equations
  - Hazen-Williams, Darcy-Weisbach
- Friction/Minor Losses
- Pipe network analysis
  - e.g. pipeline design, loop networks
- Pump application and analysis
- Cavitation
- Transient analysis (e.g. water hammer)
- Flow measurement – closed conduits
- Momentum equation (thrust block)

B. Hydraulics – Open Channel (+/- 6 questions)

- Open-channel flow (e.g. Manning's eq.)
- Culvert design
- Spillway capacity
- Energy dissipation (hydraulic jump)
- Stormwater collection (inlets, gutter flow, street flow, storm sewer pipes)
- Flood plains/floodways
- Flow measurement – open channel
- Gradually varied flow

C. Hydrology (+/-6 questions)

- Storm characterization
- Storm frequency
- Hydrographs application
- Rainfall intensity, duration and frequency
- Time of concentration
- Runoff analysis (Rational & NRCS)
- Erosion
- Detention/retention ponds
- Hydrograph development, synthetic
- Depletions (transpiration, evap, infiltration)
- Sedimentation

D. Groundwater and Well Fields (+/- 3 quest.)

- Aquifers (e.g. characterization)
- Groundwater flow (Darcy’s law)
- Seepage analysis
- Groundwater control, drainage, dewatering
- Water quality analysis
- Groundwater contamination
- Erosion
- Detention/retention ponds
- Hydrograph development, synthetic
- Depletions (transpiration, evap, infiltration)
- Sedimentation

E. Wastewater Treatment (+/- 6 questions)

- Collection systems
  - lift stations, sewer networks
  - infiltration and inflow
- Wastewater flow rates
- Unit operations and processes
- Primary & Secondary treatment
- Secondary clarification
- Biological & Physical treatment
- Solids handling (thickening, drying)
- Disinfection, nitrification, denitrification
- Operations (e.g. odor & corrosion cntl)
- Advanced treatment, etc. etc. etc.

F. Water Quality (+/- 6 questions)

- Stream degradation (e.g. thermal, base flow, TDS, TSS, BOD, COD)
- Oxygen dynamics (oxygen sag curve)
- Risk assessment and management
- Toxicity
- Biological contaminants (algae, mussels)
- Chemical contaminants (organics, metals)
- Bioaccumulation
- Eutrophication
- Indicator organisms and testing
- Sampling and monitoring (eg QA/QC, laboratory procedures)

G. Water Treatment (+/- 6 questions)

- Hydraulic loading
- Distribution system
- Demands
- Storage (raw and treated water)
- Sedimentation
- Taste and odor control
- Rapid mixing
- Coagulation and flocculation
- Filtration
- Disinfection
- Advanced treatment (membranes, activated carbon, desalination)