

**WASTEWATER TREATMENT  
"NEED-TO-KNOW" CRITERIA**

## **FORWARD**

This guide was created to help trainers, supervisors and operators determine what topics to review while studying for operator certification exams. The guide breaks each exam into numerous topics and indicates the level of knowledge required for each exam.

In 1995-96 a committee of experienced operators and supervisors reviewed the Association of Boards of Certification standard North American “Need-To-Know”. From this review several revisions were made to reflect Ontario’s operational needs. From the new, revised “Need-To-Know” the committee developed new certification exams.

The following individuals were members of the Wastewater Treatment Exam Review Committee:

Bill DeAngelis - American Water Services  
Doug Fulton - City of Toronto  
Brian Gildner - Ministry of the Environment  
Eric Joudrey - Ontario Clean Water Agency  
Agnes MacKillop - Ministry of the Environment  
Dan Maki - City of Greater Sudbury  
Tony Puim - Ontario Clean Water Agency  
Cordel Samuels - City of Toronto  
Ian Smith - City of Toronto  
John Thompson - Region of Durham  
Eldon Wallis - City of Orillia

## **ABOUT THE ASSOCIATION OF BOARDS OF CERTIFICATION**

The Association of Boards of Certification (ABC) has been involved in developing water and wastewater operator certification programs, exams and support materials since 1966. ABC is a North American organization with members in 48 states and 9 provinces. Ontario became a full member of ABC in 1986 to support the introduction of the province's voluntary certification program. ABC provides the province with testing services, support materials and expertise from across North America.

Ontario exams are developed with assistance from the ABC and are fully recognized by the ABC. For details on reciprocity of Ontario exams outside of the province, contact the authority responsible for certification in the province/state which you are interested. Be sure to forward a copy of this “Need-To-Know”.



## INTRODUCTION

Before writing an exam, operators should be aware how each exam is developed. By understanding how the exams are made, it will be easier to study for the exam.

It is important to know that the exams are cumulative. This means that the knowledge required at a lower class is also required at higher classes. For example, a Class IV operator must know all Class IV topics as well as the Class I, II, and III topics. Generally, questions on a Class IV exam will be more difficult than questions on the same topic on lower class exams. In some cases technologies which are only used in Class I facilities will not be addressed at higher classes (i.e. wastewater stabilization ponds).

Although the exams are cumulative, each exam will emphasize different topics. For example in the "Processes Module" of Wastewater Treatment exams, Class I will emphasize lagoon systems; Class II will focus on primary treatment facilities; Class III secondary treatment; and Class IV full process/advanced treatment. Some questions dealing with processes normally found in higher Class facilities will be included in lower Class exams. These questions will be asked at a very basic knowledge level. At the top level, a Class IV operator is expected to master all topics. Since each exam emphasizes different topics an operator is not allowed to 'skip' exam levels (i.e. go from a Class I to a Class IV without first going through Class II and III).

Developing fair exams for wastewater operators is a challenge in a province containing relatively simple, small facilities along side large complex ones. Technologies which may be common in one size of facility may be absent in another. However, an operator who holds any Class of wastewater treatment licence may operate in any wastewater treatment system in the province. For this reason even at a Class I level operators will be expected to have a basic level of understanding or awareness in some of the common advanced processes or technologies (i.e. activated sludge). For this reason some of the questions on the exam may cover processes or technologies not used in the operator's facility. Although the question may not apply to your facility, it will be relevant for many other operators in the province.

The exams which are written in Ontario are similar to those in other provinces and states. Ontario uses the same format (multiple choice), same length (100 questions) and the same source of questions (the ABC question bank). By keeping the exams similar to the industry standard, the marks obtained by Ontario operators will be more readily accepted in other provinces and states.

## HOW TO USE THE "NEED-TO- KNOW"

## GENERAL EXAM MODULES

The "Need-to-Know" is designed as an aid for operators and supervisors. It contains three sections to help users determine the topics and level of training required to meet the requirements of certification examinations. The three sections are:

- \* “**General Exam Modules**”, provides a broad overview of the exams (*page 3*).
- \* “**Detailed Topic Breakdown**”, provides a detailed breakdown of the topics covered on each exam. It also provides an indication of the level of knowledge required for each topic (*pages 6-9*).
- \* “**Task Analysis**”, provides a further definition of the tasks and knowledge required for each topic at each Class (*pages 14-22*).

Together these three sections will help guide the operator while studying. For more information on study materials and course offerings refer to the booklet entitled “*Resource Guide for Water & Wastewater Utility Operators*”, available free from the Certification Office.

Every exam is divided into 4 different modules. Each module is further divided into topics. Every question on the exam will fit into one of the topics. The 4 different modules are:

**General Module:** This module includes basic background knowledge and skills which are required by an operator to perform his/her duties. Some of the skills and knowledge may be obtained prior to becoming an operator, in school or at other work experiences. Others will be specific to the water/wastewater industry. This knowledge is applied on a daily basis by the operator to complete his/her job (i.e. arithmetic calculation of chemical feed rates).

**Support Systems Module:** This module includes the equipment/materials necessary to perform water/wastewater processes. Pumps, compressors and engines are some of the equipment covered. The module also includes conveyance (piping, fittings, valves joints etc.) and measuring and control systems. Operators will be expected to be familiar with the operation and troubleshooting aspects of this equipment. Detailed maintenance of the equipment is not covered in the exam.

**Processes Module:** This module focuses on the processes involved in wastewater treatment. This module is the main focus for the exams, requiring the operator to demonstrate knowledge in the day to

day operation of the processes at a facility. Included in this module are equipment specific to processes (i.e. comminutors, chlorinators, vacuum filters, RBCs, etc.). Operators will be expected to know how to operate this equipment, its relationship to the overall treatment process and basic troubleshooting. Detailed

maintenance of this equipment is beyond the scope of the exams.

**Administration Module:** This module covers administrative functions which support the on-going operation of a facility. Depending on the class of exam, operators will be expected to demonstrate basic knowledge and understanding of supervision, finance, communication, site security, information systems and emergency response procedures.

Below is a table indicating the percentage of questions in each of the modules.

| PERCENTAGE BREAKDOWN FOR EACH EXAM MODULE           |                 |              |               |                |               |
|---|-----------------|--------------|---------------|----------------|---------------|
|   |                 | CLASS I EXAM | CLASS II EXAM | CLASS III EXAM | CLASS IV EXAM |
| GENERAL MODULE                                      |                 |              |               |                |               |
|   | GENERAL MATH    | 10%          | 5%            | 0%             | 0%            |
|   | SAFETY          | 10%          | 5%            | 5%             | 5%            |
|   | APPLIED SCIENCE | 9%           | 8%            | 5%             | 4%            |
| SUPPORT SYSTEMS MODULE                              |                 | 14%          | 8%            | 10%            | 10%           |
| PROCESS MODULE                                      |                 | 49%          | 66%           | 66%            | 66%           |
| ADMINISTRATION MODULE                               |                 |              |               |                |               |
|   | MANAGEMENT      | 2%           | 3%            | 8%             | 7%            |
|   | ADMINISTRATION  | 6%           | 5%            | 6%             | 8%            |
| <b>TOTAL:</b>                                       |                 | 100%         | 100%          | 100%           | 100%          |
| PERCENT QUESTIONS REQUIRING ARITHMETIC CALCULATIONS |                 |              |               |                |               |
| CALCULATING   |                 | 5 - 10%      | 5 - 10%       | 10 - 15%       | 10 - 15%      |
| NON-CALCULATING                                     |                 | 90 - 95%     | 90 - 95%      | 85 - 90%       | 85 - 90%      |

## DETAILED TOPIC BREAKDOWN

The above table also indicates the number of questions which require arithmetic calculations. These questions will be scattered throughout the various modules. In Class I and II exams most of the questions will be in the General Module (General Math Section). In higher Classes the questions will be in the Support Systems Module (i.e. pump, chemical feeder questions), the Process Module (i.e. activated sludge, disinfection questions), or the Administration Module (i.e. finance questions). Generally the Class III and IV questions which require calculations are more difficult. These questions require problem solving abilities in addition to arithmetic skills.

## TASK ANALYSIS

The ***Detailed Topic Breakdown*** lists the skills, knowledge, equipment, processes, laboratory analysis, and administrative components of the operator's job. It is a table containing all of the examination topics. Each topic is also given a 'mastery rating'. This rating will give operators some indication of the level of difficulty for each topic. The mastery ratings are:

- Basic:*** Operators must understand the importance of the topic; and how it relates to the overall operation of the system. Basic terminology and concepts are covered.
- Intermediate:*** Operators must have working or functional knowledge/skill in the topic.
- Advanced:*** Operators must be able to evaluate the topic and fully understand the interaction of the topic with the overall operation of the system.

Intermediate levels include all *basic* levels. *Advanced* levels include all *intermediate* and *basic* levels.

Most of the topics in the ***Detailed Topic Breakdown*** have footnotes. On pages 11-13 the footnotes provide a more detailed description of the topic. Further detail is provided in the ***Task Analysis***.

The ***Task Analysis*** listings, which follows the ***Detailed Topic Breakdown***, lists the performance objectives for each topic. The performance objectives are broken down into Basic, Intermediate and Advanced levels. These are the same levels of mastery which are listed in the ***Detailed Topic Breakdown***. The ***Task Analysis*** provides operators with greater detail on the learning objectives for each topic.

**Using the *Detailed Topic Breakdown* and the *Task Analysis* listings:**

The objectives listed in the *Task Analysis* are used in combination with the topics in the *Detailed Topic Breakdown*. These will help to define what an operator needs to know in each topic. The *Detailed Topic Breakdown* indicates the level of mastery of the exam topics. The *Task Analysis* state performance objectives for each topic by the difficulty level (Basic, Intermediate and Advanced).

To successfully complete an ABC examination, an operator must demonstrate knowledge of the *Task Analysis* performance objectives for each *Detailed Topic Breakdown* topic according to the rating assigned to the topic. Following is an example of how to use the *Detailed Topic Breakdown* and *Task Analysis*.

An operator would like to know what information is required to pass the topic called Hydraulic Concepts on a Class II exam.

1. First the operators should look in the *Detailed Topic Breakdown* (the table starting on page 6) for the topic entitled “Hydraulic Concepts”.
2. For a Class II exam the rating assigned to Hydraulic Concepts is *Intermediate*.
3. The operator must know how to perform all *Intermediate* tasks for Hydraulic Concepts.
4. Next, the operator observes that a number <sup>6</sup> appears after the topic heading. This indicates that a more detailed description of the topic is given at the end of the *Detailed Topic Breakdown*. The operator turns to page 11 to read the description.
5. The operator now refers to the *Task Analysis* section.
6. In the left column of the General Module (page 14) it states that:  
“A: The operator must complete the following performance objectives as indicated”:
7. Under Hydraulic Concepts (page 15-16) the *Intermediate* objectives are:
  - 6.3 Calculate pumping head, pressure head, static head
  - 6.4 Using hydraulic concepts and terms explain how a pump functions
8. The operator must also meet all of the objectives stated under the *Basic* level:
  - 6 1 Define basic hydraulic concepts (head, pressure, rate of flow).
  - 6.2 Explain the movement and properties of liquid under pressure.
9. The operator must be able to meet all of the stated objectives for the topic.



| <b>DETAILED TOPIC BREAKDOWN</b> |   |                                       |                 |                  |                 |
|---------------------------------|---|---------------------------------------|-----------------|------------------|-----------------|
| <b>GENERAL MODULE</b>           |   | <b>Class I</b>                        | <b>Class II</b> | <b>Class III</b> | <b>Class IV</b> |
| 100                             | General Math Section  |                                       |                 |                  |                 |
| 101                             |   | Basic & Applied Math <sup>1</sup>     | Intermediate    | Advanced         | Advanced        |
| 102                             |   | Units of Expression <sup>2</sup>      | Advanced        | Advanced         | Advanced        |
| 110                             | Applied Science Section                                       |                                       |                 |                  |                 |
| 111                             |   | Basic & Applied Science <sup>3</sup>  | Basic           | Intermediate     | Advanced        |
| 112                             |   | Public Health Principles <sup>4</sup> | Intermediate    | Advanced         | Advanced        |
| 113                             |   | Electrical Concepts <sup>5</sup>      | Basic           | Intermediate     | Intermediate    |
| 114                             |   | Hydraulic Concepts <sup>6</sup>       | Basic           | Intermediate     | Intermediate    |
| 115                             |   | Maps & Plans <sup>7</sup>             | Basic           | Intermediate     | Intermediate    |
| 120                             | Safety Section  |                                       |                 |                  |                 |
| 121                             |   | Safety Procedures <sup>8</sup>        | Advanced        | Advanced         | Advanced        |
| 122                             |   | Safety Equipment <sup>9</sup>         | Advanced        | Advanced         | Advanced        |
| <b>SUPPORT SYSTEMS MODULE</b>   |   | <b>Class I</b>                        | <b>Class II</b> | <b>Class III</b> | <b>Class IV</b> |
| 201                             | Electrical Controls <sup>10</sup> / Transformers              |                                       | Basic           | Intermediate     | Advanced        |
| 202                             | Battery Banks   |                                       | Basic           | Intermediate     | Advanced        |
| 203                             | Motors <sup>11</sup> / Drives <sup>12</sup>                   |                                       | Intermediate    | Advanced         | Advanced        |
| 204                             | Pumps   |                                       |                 |                  |                 |
|                                 |   | Air Lift                              | Advanced        | Advanced         | Advanced        |
|                                 |   | Centrifugal                           | Intermediate    | Advanced         | Advanced        |
|                                 |   | Positive Displacement <sup>13</sup>   | Intermediate    | Advanced         | Advanced        |
|                                 |   | Screw                                 | Advanced        | Advanced         | Advanced        |
|                                 |   | Turbine                               | Intermediate    | Advanced         | Advanced        |
| 205                             | Blowers & Compressors <sup>14</sup>                           |                                       | Intermediate    | Advanced         | Advanced        |
| 206                             | Generators <sup>15</sup>                                      |                                       | Intermediate    | Advanced         | Advanced        |
| 207                             | Engines <sup>16</sup>   |                                       | Intermediate    | Advanced         | Advanced        |
| 208                             | Pipes   |                                       | Intermediate    | Advanced         | Advanced        |
| 209                             | Joints <sup>17</sup>  |                                       | Intermediate    | Advanced         | Advanced        |
| 210                             | Valves <sup>18</sup>  |                                       | Intermediate    | Advanced         | Advanced        |
| 211                             | Fittings <sup>19</sup>  |                                       | Intermediate    | Advanced         | Advanced        |
| 212                             | Cathodic Protection Devices <sup>20</sup> / Corrosion Control |                                       | Basic           | Intermediate     | Advanced        |
| 213                             | Hydrants  |                                       | Basic           | Basic            | Basic           |

|                         |   |                |                 |                  |                 |
|-------------------------|---|----------------|-----------------|------------------|-----------------|
| 214                     | Measuring & Control Systems <sup>21</sup> | Basic          | Intermediate    | Advanced         | Advanced        |
| 215                     | Chemical Feeders <sup>22</sup>            | Intermediate   | Advanced        | Advanced         | Advanced        |
| 216                     | Rolling Stock <sup>23</sup>               | Intermediate   | Advanced        | Advanced         | Advanced        |
| 217                     | HVAC <sup>24</sup>                        | Basic          | Intermediate    | Advanced         | Advanced        |
| 218                     | Cross-Connection & Backflow               | Intermediate   | Advanced        | Advanced         | Advanced        |
| <b>PROCESSES MODULE</b> |   | <b>Class I</b> | <b>Class II</b> | <b>Class III</b> | <b>Class IV</b> |
| 301                     | Sources & Characteristics <sup>25</sup>   | Intermediate   | Intermediate    | Advanced         | Advanced        |
| 302                     | Quality Control & Assurance <sup>26</sup> | Advanced       | Advanced        | Advanced         | Advanced        |
| 303                     | Compliance <sup>27</sup>                  | Advanced       | Advanced        | Advanced         | Advanced        |
| 304                     | Flow Equalization                         | Intermediate   | Advanced        | Advanced         | Advanced        |
| 305                     | Screening <sup>28</sup>                   | Advanced       | Advanced        | Advanced         | Advanced        |
| 306                     | Grinding <sup>29</sup>                    | Advanced       | Advanced        | Advanced         | Advanced        |
| 307                     | Grit Removal <sup>30</sup>                | Advanced       | Advanced        | Advanced         | Advanced        |
| 308                     | Aeration                                  | Advanced       | Advanced        | Advanced         | Advanced        |
| 309                     | Chemical Pretreatment                     | Basic          | Intermediate    | Advanced         | Advanced        |
| 310                     | Clarification <sup>31</sup>               | Advanced       | Advanced        | Advanced         | Advanced        |
| 311                     | Trickling Filters <sup>32</sup>           | Basic          | Intermediate    | Advanced         | Advanced        |
| 312                     | Activated Sludge                          |                |                 |                  |                 |
|                         | Conventional                              | Basic          | Intermediate    | Advanced         | Advanced        |
|                         | Step Feed                                 | Basic          | Intermediate    | Advanced         | Advanced        |
|                         | Sequential Batch Reactor (SBR)            |                | Basic           | Intermediate     | Advanced        |
|                         | High Rate                                 | Basic          | Basic           | Basic            | Basic           |
|                         | Contact Stabilization                     | Basic          | Intermediate    | Advanced         | Advanced        |
|                         | Extended Aeration                         | Basic          | Intermediate    | Advanced         | Advanced        |
|                         | Tapered Aeration                          | Basic          | Intermediate    | Advanced         | Advanced        |
|                         | Complete Mix                              | Basic          | Intermediate    | Advanced         | Advanced        |
|                         | Pure Oxygen                               |                | Basic           | Basic            | Basic           |
| 313                     | Waste Stabilization Ponds <sup>33</sup>   | Advanced       | Advanced        | Advanced         | Advanced        |
| 314                     | Rotating Biological Contactors            | Intermediate   | Intermediate    | Advanced         | Advanced        |
| 315                     | ABF Systems (Activated Biofilter)         |                | Basic           | Intermediate     | Advanced        |
| 316                     | Disinfection                              | Advanced       | Advanced        | Advanced         | Advanced        |
| 317                     | Filtration <sup>34</sup>                  | Basic          | Intermediate    | Advanced         | Advanced        |
| 318                     | Microscreen                               |                | Basic           | Intermediate     | Advanced        |
| 319                     | Coagulation & Flocculation                | Basic          | Intermediate    | Advanced         | Advanced        |

| PROCESSES MODULE |                                   | Class I      | Class II     | Class III    | Class IV     |
|------------------|-----------------------------------|--------------|--------------|--------------|--------------|
| 320              | Adsorption                        | Basic        | Intermediate | Advanced     | Advanced     |
| 321              | Nitrogen Removal                  | Intermediate | Advanced     | Advanced     | Advanced     |
| 322              | Phosphorus Removal                | Intermediate | Advanced     | Advanced     | Advanced     |
| 323              | Effluent Disposal                 |              |              |              |              |
|                  | Discharge                         | Advanced     | Advanced     | Advanced     | Advanced     |
|                  | Direct Reuse                      |              | Basic        | Basic        | Basic        |
| 324              | Sludge Conditioning               | Intermediate | Advanced     | Advanced     | Advanced     |
| 325              | Sludge Thickening                 | Intermediate | Advanced     | Advanced     | Advanced     |
| 326              | Sludge Aerobic Digestion          | Intermediate | Advanced     | Advanced     | Advanced     |
| 327              | Sludge Anaerobic Digestion        | Intermediate | Advanced     | Advanced     | Advanced     |
| 328              | Sludge Drying Beds                | Basic        | Basic        | Basic        | Basic        |
| 329              | Sludge Vacuum Filters             | Basic        | Basic        | Basic        | Basic        |
| 330              | Sludge Filter Press               | Basic        | Intermediate | Advanced     | Advanced     |
| 331              | Sludge Belt Press                 | Basic        | Intermediate | Advanced     | Advanced     |
| 332              | Sludge Centrifuges                | Basic        | Intermediate | Advanced     | Advanced     |
| 333              | Solids Disposal                   |              |              |              |              |
|                  | Solids Incineration <sup>35</sup> |              | Basic        | Intermediate | Intermediate |
|                  | Landfill Solids                   | Intermediate | Advanced     | Advanced     | Advanced     |
|                  | Land Application of Solids        | Intermediate | Advanced     | Advanced     | Advanced     |
|                  | Composting Solids                 | Basic        | Basic        | Basic        | Basic        |

| PROCESSES MODULE |  | Class I      | Class II     | Class III | Class IV |
|------------------|--|--------------|--------------|-----------|----------|
| 334              | Laboratory - Plant Process Tests <sup>36</sup> |              |              |           |          |
|                  | BOD  | Advanced     | Advanced     | Advanced  | Advanced |
|                  | Chlorine Residual                              | Advanced     | Advanced     | Advanced  | Advanced |
|                  | COD  | Basic        | Intermediate | Advanced  | Advanced |
|                  | Dissolved Oxygen                               | Advanced     | Advanced     | Advanced  | Advanced |
|                  | Microexam                                      | Intermediate | Advanced     | Advanced  | Advanced |
|                  | pH   | Advanced     | Advanced     | Advanced  | Advanced |
|                  | Phosphorus                                     | Basic        | Intermediate | Advanced  | Advanced |
|                  | Solids   |              |              |           |          |

|                              |                                 |                                      |                      |                |                 |                  |                 |
|------------------------------|---------------------------------|--------------------------------------|----------------------|----------------|-----------------|------------------|-----------------|
|                              |                                 |                                      | 30 Minute Settleable | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 |                                      | SS                   | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 |                                      | TDS                  | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 |                                      | Total                | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 |                                      | VSS                  | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 |                                      | Settleability (SVI)  | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 | Temperature                          |                      | Advanced       | Advanced        | Advanced         | Advanced        |
|                              |                                 | Turbidity                            |                      | Basic          | Basic           | Intermediate     | Advanced        |
|                              |                                 | Volatile Acids                       |                      | Intermediate   | Advanced        | Advanced         | Advanced        |
| 335                          | General Lab Tests <sup>37</sup> |                                      |                      | Basic          | Basic           | Intermediate     | Advanced        |
| <b>ADMINISTRATION MODULE</b> |                                 |                                      |                      | <b>Class I</b> | <b>Class II</b> | <b>Class III</b> | <b>Class IV</b> |
| 410                          | Management                      |                                      |                      |                |                 |                  |                 |
| 411                          |                                 | Planning <sup>38</sup>               |                      | Basic          | Intermediate    | Advanced         | Advanced        |
| 412                          |                                 | Personnel <sup>39</sup>              |                      | Basic          | Intermediate    | Advanced         | Advanced        |
| 413                          |                                 | Finances <sup>40</sup>               |                      | Basic          | Intermediate    | Advanced         | Advanced        |
| 420                          | Administration                  |                                      |                      |                |                 |                  |                 |
| 421                          |                                 | Maintenance Management <sup>41</sup> |                      | Basic          | Intermediate    | Advanced         | Advanced        |
| 422                          |                                 | Information <sup>42</sup>            |                      | Basic          | Intermediate    | Advanced         | Advanced        |
| 423                          |                                 | Emergency Response <sup>43</sup>     |                      | Advanced       | Advanced        | Advanced         | Advanced        |
| 424                          |                                 | Public Relations <sup>44</sup>       |                      | Advanced       | Advanced        | Advanced         | Advanced        |
| 425                          |                                 | Security <sup>45</sup>               |                      | Basic          | Intermediate    | Advanced         | Advanced        |

In each exam, certain topics in the Processes Module are emphasized. In the table below the main topics for each class of exam are given. Only topics with at least 2 questions are included. The topics are listed in order of importance. For example on a Class 1 exam there are more questions on waste stabilization ponds than questions dealing with laboratory knowledge. Likewise there are more questions on disinfection than there are on compliance.

| PROCESSES MODULE - PRIORITY TOPICS |                                       |                    |                    |                    |
|------------------------------------|---------------------------------------|--------------------|--------------------|--------------------|
|                                    | CLASS I                               | CLASS II           | CLASS III          | CLASS IV           |
|                                    | ◆ Waste stabilization ponds (lagoons) | ◆ Activated sludge | ◆ Activated sludge | ◆ Activated sludge |

|  |   |  |   |  |
|--|---|--|---|--|
|  | <ul style="list-style-type: none"> <li>◆ Laboratory</li> <br/> <li>◆ Disinfection</li> <br/> <li>◆ Compliance</li> <br/> <li>◆ Grit removal</li> <br/> <li>◆ Activated sludge</li> <li>◆ Sources &amp; characteristics</li> </ul> | <ul style="list-style-type: none"> <li>◆ Aeration</li> <br/> <li>◆ Laboratory</li> <li>◆ Sludge digestion (Aerobic)</li> <br/> <li>◆ Disinfection</li> <li>◆ Solids disposal</li> <li>◆ Compliance</li> <li>◆ Sludge dewatering</li> <li>◆ Grit removal</li> <li>◆ Sludge digestion (Anaerobic)</li> <li>◆ Clarification</li> <li>◆ Sources &amp; characteristics</li> </ul> | <ul style="list-style-type: none"> <li>◆ Sludge digestion (Aerobic)</li> <li>◆ Solids disposal</li> <li>◆ Aeration</li> <li>◆ Laboratory</li> <li>◆ Advanced treatment</li> <br/> <li>◆ Sludge dewatering</li> <li>◆ Disinfection</li> <br/> <li>◆ Filtration</li> <li>◆ Sludge digestion (Anaerobic)</li> <li>◆ Clarification</li> </ul> | <ul style="list-style-type: none"> <li>◆ Advanced treatment</li> <li>◆ Solids disposal</li> <li>◆ Sludge digestion (Aerobic)</li> <br/> <li>◆ Laboratory</li> <li>◆ Sludge conditioning/thickening</li> <li>◆ Aeration</li> <li>◆ Sludge dewatering</li> <li>◆ Disinfection</li> <br/> <li>◆ Filtration</li> <li>◆ Nitrogen removal</li> <li>◆ Phosphorus removal</li> </ul> |
|--|---|--|---|--|



## ENDNOTES: TOPIC DESCRIPTIONS

### General Module

The numbers below refer to the topics listed in the above table entitled “**Ontario Wastewater Treatment Exam Detailed Topic Breakdown**” (pages 6-9). The below endnotes provide a greater description of the topic, by providing an indication of the equipment and processes involved.

- 1 **Basic and Applied Math** - Calculating volume, area, flow rates, feed rates, percentages, ratios, squares, cubes, roots, ability to calculate water/wastewater formulas.
- 2 **Units of Expression** - Imperial, metric, conversion between imperial and metric, common metric prefixes.
- 3 **Basic & Applied Science** - Chemistry (common water/wastewater chemicals, chemical reactions, basic chemistry terms: [pH and related concepts, oxidation/reduction, ionization etc], mixtures and solutions) physical properties of liquids, solids and gases, BOD, COD.
- 4 **Public Health Principles** - Microbiology (pathogens, wastewater organisms), microbiological testing (coliform testing), effects of effluent on public and environmental health.
- 5 **Electrical Concepts** - Electrical units (volt, amperes, ohms, watts), electrical circuits, electrical terminology.
- 6 **Hydraulic Concepts** - Rate of flow, pressure, head (static, friction, pressure), pump hydraulics (work, power, horsepower, efficiency).
- 7 **Maps and Plans** - Maps, blue prints, site diagrams, equipment specifications.
- 8 **Safety Procedures** - Occupational Health and Safety Act, WHMIS, owner/operator responsibilities, construction safety, plant safety, electrical safety, infections and infectious diseases, hazardous gases, chemical handling, chemical labels, confined space entry.
- 9 **Safety Equipment** - Personal protection gear, traffic control/public safety (warning devices, barricades), hazard detection, first aid/hygiene, gas detection equipment

### Support Systems Module

- 10 **Electrical Controls** - Electrical circuits, circuit testing, fuses, protective devices, circuit breakers, overload relays, motor starters.
- 11 **Motors** - Single Phase, Poly Phase, Variable Speed
- 12 **Drives** - Coupled, Direct (Shaft, Gear), Speed Reducer (Fixed, Variable), Right Angle
- 13 **Positive Displacement Pumps** - Piston Plunger, Progressive Cavity, Diaphragm
- 14 **Blowers & Compressors** - Centrifugal, Positive Displacement (Rotary, Piston)

## Processes Module

- 15 **Generators** - AC, DC
- 16 **Engines** - Gasoline, Diesel, Gas
- 17 **Joints** - Flanged, Compression, Dresser, Victaulic, Fused, Threaded
- 18 **Valves** - Ball, Check, Globe, Gate, Plug Petcock, Pressure Control, Vacuum Relief, Aud, Butterfly, Multiport, Telescoping Sluice Gate, Air Release , Foot, Altitude
- 19 **Fittings** - Coupling Union, Plug/Caps, Special
- 20 **Cathodic Protection Devices** - Anode Rod/Bags, Cathode Rod/Bags, Rectifiers, Potentiometers
- 21 **Measuring and Control** - Signal Generators (Kennison Nozzle, Magnetic Flowmeter, Parshall Flume, Proportional Weir, Rectangular Weir, Venturi, Propeller Meter, Ultrasonic, Pitot Tube), Signal Transmitters (Electric, Pneumatic, Hydraulic, Mechanical, Telemetry), Signal Receivers (Counters, Indicators, Log Scale Indicators, Totalizers, Recorders, Combination Recorders), Meters (Hydraulic-Rotameter, Electrical-Amp, Electrical-Watt [Watt Hour Meter], Electrical-Multitester VOM], Electrical-Megger, Mechanical-RPM), Alarms, Controls (Pneumatic, Float, Hydraulic, Electrical, Telemetry, Timers)
- 22 **Chemical Feeders** - Solids, Liquids, Evaporators, Gas, Slurry
- 23 **Rolling Stock** - Service Vehicles, Fork Lifts, Trucks, Tractors, Trailers, Lawn Mowers, Loaders, Portable Pumps, Generators
- 24 **HVAC** - Heat Exchangers, Dehumidifiers, Fans, Compressors, Condensers, Boilers
- 25 **Sources & Characteristics** - Typical types of waste effluent from various industries, chemical, biological and physical characteristics of industrial, commercial and domestic effluent, municipal flow patterns (infiltration, storm and daily flows).
- 26 **Quality Control & Assurance (QA/QC)** - Indicators of process/effluent quality, quality control procedures.
- 27 **Compliance** - Ontario environmental legislation affecting wastewater treatment plants, scope and authority of certificates of approval, owner/operator responsibilities.
- 28 **Screening** - Hand Cleaned Bar Screens, Mechanically Cleaned Bar Screens, Static Screens
- 29 **Grinding** - Grinders, Communiters, Barminuters
- 30 **Grit Removal** - Hand cleaned, mechanically cleaned, aerated.
- 31 **Clarification** -- Primary Clarifiers (Rectangular, Circular), Imhoff Tank
- 32 **Trickling Filters** - Standard Rate, High Rate, Roughing
- 33 **Waste Stabilization Ponds** -- Aerobic, Facultative, Anaerobic, Aerated, Discharging, Total Containment
- 34 **Filtration** -- Rapid Sand Filters, Mixed or Multi-Media Filters, Pressure Filters, Intermittent Filters

**Administration Module**

- 35 ***Solids Incineration*** - Fluidized bed, multiple hearth, wet oxidation
- 36 ***Laboratory - Plant Process Tests*** - Tests routinely conducted on site by operators, often using portable equipment. Includes BOD, residual chlorine, dissolved oxygen, pH, solids, phosphorus, temperature, turbidity and volatile acids.
- 37 ***General Lab Tests*** - Lab tests conducted by laboratory technicians (Alkalinity, ammonia, arsenic, cadmium, calcium, centrifuge test, chloride, chlorinated organics, chromium, COD, coliforms, colour, conductance, copper, cyanide, iron, Kjeldahl nitrogen, manganese, mercury, nickel, nitrate, nitrite, oil and grease, pesticides, phenol, potassium, selenium, silver, sodium, sulphate, sulphide, sulphite, surfactants, total organic carbon, zinc), basic understanding of test purpose, acceptable ranges, meaning of lab results.
- 38 ***Planning*** - Facility planning, decision making.
- 39 ***Personnel*** - Supervision/management, hiring, disciplining, interviews, communication,
- 40 ***Finances*** - Budgets, procurement, purchasing, inventory control/management.
- 41 ***Maintenance Management*** - Maintenance procedures (general),
- 42 ***Information*** - Record keeping, computer systems, reports.
- 43 ***Emergency Response*** - Spill response, fire, explosion, bomb threat, natural emergencies, hydraulic overload, slug loads, process failure.
- 44 ***Public Relations*** - Communication with public, complaint investigation, disclosure of information.
- 45 ***Security*** - Security of facility and property, prevention of vandalism, theft, security of staff, security of product.



## TASK ANALYSIS

The listing below provides more detail on the types and level of knowledge required for each of the topics for each Class of exam.

A. Operator must  
complete the following  
performance objectives  
as indicated:

### General Module

#### **Basic and Applied Math (Topic 101)**

##### **Basic & Intermediate Tasks**

- 1.1 Perform addition, subtraction, multiplication and division of whole numbers and decimals
- 1.2 Square and cube whole numbers, proper fractions, improper fractions, mixed numbers and decimals
- 1.3 Using conventional formulas, calculate area of rectangles, triangles, and circles; surface area and volume of cylinders, cones, and spheres

##### **Advanced Tasks - Basic tasks plus:**

- 1.4 Convert fractions to percentage and vice-versa
- 1.5 Plot and interpret graphs, including line, bar, percentage, and broken line
- 1.6 Develop and read tables
- 1.7 Using conventional formulas, solve for direct and inverse proportions
- 1.8 Using conversion reference, convert from English to metric and vice-versa
- 1.9 Calculate percent removal
- 1.10 Interpret word problems, obtaining the required values and formulas
- 1.11 Use standard water/wastewater formulas

#### **Units of Expression (Topic 102)**

##### **Basic, Intermediate & Advanced Tasks:**

- 2.1 Define terms of expression, such as ppm, mg/L, MG/d
- 2.2 Convert from one unit to another using appropriate references or formulas; convert from imperial to metric units

#### **Basic and Applied Science (Topic 111)**

##### **Basic Tasks:**

- 3.1 Define concepts in basic chemistry
- 3.2 Identify and describe chemicals used in wastewater treatment
- 3.3 Define and describe the significance of basic concepts in wastewater chemistry
- 3.4 Define and describe the significance of basic concepts in microbiology, including viruses, bacteria, and protozoa

**Intermediate Tasks - Basic tasks plus:**

- 3.5 Read common wastewater chemical formulas and equations
- 3.6 Explain and describe the significance of microbiological organisms in biological treatment

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 3.7 Describe and explain the significance of common chemical reactions in wastewater treatment
- 3.8 Describe the properties and movement of gas under pressure.

**Public Health Principles (Topic 112)****Basic & Intermediate Tasks:**

- 4.1 Describe public health principles, laws, and regulations

**Advanced Tasks - Intermediate tasks plus:**

- 4.2 Identify chemicals contained in wastewater or effluent which are hazardous to human health
- 4.3 Explain how wastewater or wastewater effluent can effect stream/lake environmental health

**Electrical Concepts (Topic 113)****Basic Tasks:**

- 5.1 Identify the basic electrical units and explain their meaning
- 5.2 Identify the safety requirements when working on electrical equipment
- 5.3 Using basic electrical concepts explain the safety hazards associated with electricity

**Intermediate Tasks - Basic tasks plus:**

- 5.4 Identify the types of electrical circuits found in wastewater facilities.

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 5.5 Explain the basic principles of common electrical circuits
- 5.6 Identify the electrical requirements of different types of equipment

**Hydraulic Concepts (Topic 114)****Basic Tasks:**

- 6.1 Define basic hydraulic concepts (head, pressure, rate of flow).
- 6.2 Explain the movement and properties of liquid under pressure.

**Intermediate Tasks - Basic tasks plus:**

- 6.3 Calculate pumping head, pressure head, static head
- 6.4 Using hydraulic concepts and terms explain how a pump functions

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 6.5 Describe the relationship between pumping head, horsepower and pump efficiency
- 6.6 Calculate horsepower and pumping efficiencies
- 6.7 Understand the basic hydraulic principles behind common flow measurement devices

**Maps and Plans (Topic 115)****Basic Tasks:**

- 7.1 Interpret and use maps and plans

**Intermediate and Advanced Tasks - Basic tasks plus:**

- 7.2 Calculate grades and changes in elevation

**Safety Procedures and Equipment (Topic 121/122)****Basic, Intermediate & Advanced Tasks:**

- 8.1 Identify basic categories of safety hazards
- 8.2 Identify basic safety procedures
- 8.3 Identify violations of personal hygiene
- 8.4 Describe personal safety procedures
- 8.5 Describe fire safety procedures
- 8.6 Describe chemical safety procedures
- 8.7 Describe confined space safety procedures

**Support Systems Module**

A: Perform operating procedures associated

with the normal and abnormal conditions for support systems/

**Support Systems Modules (Topics 201-220)****Basic Tasks**

- 9.1 Identify safety hazards
- 9.2 Identify correct safety procedures
- 9.3 Perform necessary calculations
- 9.4 Record necessary information
- 9.5 Describe purpose of system/equipment/components
- 9.6 Relate necessary information to others

**Intermediate Tasks - Basic tasks plus**

- 9.7 Recognize indicators of normal and abnormal conditions
- 9.8 Perform actions at appropriate time, location and frequency
- 9.9 Use necessary tools/test equipment/reference manuals

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B. Perform  
start-up/shut-down  
procedures on support  
systems/equipment

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### **Processes Module**

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A. Operator must  
complete the following  
performance objectives  
as indicated:

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**Advanced Tasks** - Intermediate tasks plus

- 9.10 Identify causes of abnormal conditions using proper troubleshooting techniques
- 9.11 Explain reasons for taking these actions, including

- consequences of not taking action
- 9.12 Explain interaction with other support systems/equipment and the total treatment process
- 9.13 Identify the applicable standards imposed by process parameters, laws, and regulators

**Basic Tasks**

- 10.1 Identify safety hazards

B. Perform operating procedures associated with normal and abnormal conditions for processes/units

- 10.2 Identify correct safety procedures
- 10.3 Perform necessary calculations
- 10.4 Record necessary information
- 10.5 Relate necessary information to others

**Intermediate Tasks** - Basic tasks plus

- 10.6 Identify conditions requiring start-up/shut-down of the support system/equipment
- 10.7 Perform necessary actions at appropriate the, location and frequency
- 10.8 Use necessary tools/test equipment/reference manuals

**Advanced Tasks** - Intermediate tasks plus

- 10.9 Explain reasons for taking these actions including consequences of not taking action
- 10.10 Explain interaction with other support systems/equipment and the total treatment process
- 10.11 Identify the applicable standards imposed by process parameters, laws, and regulations

**Sources and Characteristics (Topic 301)**

**Basic & Intermediate Tasks**

- 11.1 Identify sources
- 11.2 Describe source quality and quantity

**Advanced Tasks** - Intermediate tasks plus:

- 11.3 Identify physical, chemical, and biological characteristics
- 11.4 Identify physical, chemical and biological characteristics

**Quality Control and Assurance (Topic 302)****Basic, Intermediate & Advanced Tasks:**

- 12.1 Perform quality control and assurance procedures

**Compliance (Topic 303)****Basic, Intermediate & Advanced Tasks:**

- 13.1 List the relevant regulations, acts and other legal documents  
 13.2 Perform all tasks in compliance with legislation and Certificates of Approval

**Unit Processes (Topics 304 - 333)****Basic Tasks**

- 14.1 Identify safety hazards  
 14.2 Identify correct safety procedures  
 14.3 Perform necessary calculations  
 14.4 Record necessary information  
 14.5 Sketch and describe each element  
 14.6 Describe purpose of the process/units/components  
 14.7 Relate necessary information to others

**Intermediate Tasks - Basic tasks plus**

- 14.8 Recognize indicators of normal and abnormal conditions  
 14.9 Perform necessary actions at appropriate the location and frequency  
 14.10 Use necessary tools / test equipment/reference manuals

**Advanced Tasks - Intermediate tasks plus**

- 14.11 Identify causes of abnormal conditions using proper trouble shooting techniques  
 14.12 Explain reasons for taking these actions, including consequences of not taking action  
 14.13 Explain interaction with other processes/units and the total treatment process  
 14.14 Identify the applicable standards imposed by process parameters, legislation and Certificate of Approval

C. Perform start-up/shut-down procedures on processes/units

**Basic Tasks**

- 15.1 Identify safety hazards/safety procedures  
 15.2 Perform necessary calculations  
 15.3 Record necessary information  
 15.4 Relate necessary information to others

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D. Perform construction  
and installation  
procedures for  
processes/units

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E. Operator must  
complete the following  
performance objectives  
as indicated:

**Intermediate Tasks** -  
Basic tasks plus

- 15.5 Identify conditions requiring start-up/shut-down of the process/unit
- 15.6 Perform necessary actions at the appropriate location and frequency
- 15.7 Use necessary tools/test equipment/reference manuals

**Advanced Tasks** -  
Intermediate tasks plus

- 15.8 Explain reasons for taking these actions, including consequences of not taking action
- 15.9 Explain interaction with other processes/units and the total treatment process

- 15.10 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

**Basic Tasks**

- 16.1 Identify safety hazards
- 16.2 Identify correct safety procedures
- 16.3 Perform necessary calculations
- 16.4 Record necessary information

**Intermediate Tasks** - Basic tasks plus

- 16.5 Perform actions at appropriate time, location and frequency
- 16.6 Use necessary tools/test equipment/reference manuals

**Advanced Tasks** - Intermediate tasks plus

- 16.7 Interpret plans specifications, and other references
- 16.8 Explain reasons for taking these actions including consequences of not taking action
- 16.9 Explain interaction with other processes/unit and the total treatment process
- 16.10 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval
- 16.11 Perform inspection procedures

**Laboratory - Plant Process Tests (Topic 333)****Basic Tasks:**

- 17.1 Interpret chemical labels and standard shipping label of chemicals
- 17.2 Label containers
- 17.3 Describe proper use and care of laboratory/sampling/testing equipment
- 17.4 Take samples using proper procedures
- 17.5 Transport samples using proper procedures
- 17.6 Store samples using proper procedures
- 17.7 Identify safety hazards
- 17.8 Identify correct safety procedures
- 17.9 Perform necessary calculations
- 17.10 Record necessary information on all required logs/reports
- 17.11 Relate necessary information to others

**Intermediate Tasks** - Basic tasks plus:

- 17.12 Prepare sample containers using proper procedures
- 17.13 Specify time and frequency for taking samples
- 17.14 Select sample location using proper procedures



17.15 Analyse sample using proper procedures

17.16 Interpret test results

17.17 Use lab/sampling/testing equipment and related manuals

17.18 Describe purpose of test/procedure

**Advanced Tasks - Basic and Intermediate tasks plus:**

17.19 Prepare or obtain reagents using proper procedures

17.20 Make appropriate decision(s) concerning results which indicate abnormal conditions

A. Develop master plan to include objectives (short and long term, review, update), strategies, financial support and presentation to key personnel; prepare management practices to implement the master plans objectives and strategies; implement the management practices to accomplish master plan objectives to organize, coordinate, and direct and control; and evaluate the effectiveness of the master plan and

17.21 Explain reasons for using proper procedures and the consequences of not using these procedures

17.22 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

### **General Lab Tests (Topic 335)**

#### **Basic Tasks:**

18.1 Label containers

18.2 Take samples using proper procedures

18.3 Transport samples using proper procedures

18.4 Store samples using proper procedures

18.5 Identify safety hazards

18.6 Identify correct safety procedures

18.7 Perform necessary calculations

18.8 Record necessary information on all required logs/reports

18.9 Relate necessary information to others

#### **Intermediate Tasks - Basic tasks plus:**

18.10 Prepare sample containers using proper procedures

18.11 Specify time and frequency for taking samples

18.12 Select sample location using proper procedures

18.13 Interpret test results

18.14 Describe purpose of test/procedure

### **Administration Module**

**Advanced Tasks - Basic and Intermediate tasks plus:**

- 18.15 Make appropriate decision(s) concerning results which indicate abnormal conditions
- 18.16 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

**Management (Topics 411-413)****Basic Tasks**

- 19.1 Perform necessary financial calculations (basic budget, accounts payable, calculation of unit costs)
- 19.2 Describe the importance of documenting meetings, management decisions, dealings with staff
- 19.3 Describe the purpose of good management practices
- 19.4 Describe the elements of an effective office communication strategy
- 19.5 Define and use basic financial/purchasing terms and concepts
- 19.6 Define and differentiate basic management/supervisory terms and concepts
- 19.7 Describe the components of a short/long term plan

**Intermediate Tasks - Basic tasks plus**

- 19.8 Recognize indicators of good management practices
- 19.9 Relate management systems to others within the plant
- 19.10 Evaluate the effectiveness of master plans for meeting facility objectives
- 19.11 Describe good task coordination and delegation techniques/methods

**Advanced Tasks - Intermediate tasks plus**

- 19.12 Differentiate between appropriate and inappropriate actions with subordinates and the consequences of each
- 19.13 Explain the interaction of different management practices
- 19.14 Set facility objectives based upon facility performance and resources
- 19.15 Set goals, overall objectives and identify methods to obtain the goals/objectives

**Administration (Topics 421-425)****Basic Tasks**

- 20.1 Take appropriate actions to maintain facility security
- 20.2 Record necessary information
- 20.3 Use necessary reference materials

- 20.4 Communicate effectively with the public
- 20.5 Describe the appropriate actions which should be completed during various types of emergency situations
- 20.6 Explain the purpose for maintaining logs and records
- 20.7 Explain the purpose of an effective maintenance management system
- 20.8 Describe routine maintenance procedures for common facility processes

**Intermediate Tasks - Basic tasks plus**

- 20.9 Develop an effective public relations policy
- 20.10 Develop an effective maintenance management program
- 20.11 Perform necessary actions (reporting, maintenance management, planning) at appropriate time, location and frequency

**Advanced Tasks - Intermediate tasks plus**

- 20.12 Conform with all legislation and Certificates of Approval during a spill or abnormal discharge