



## EXAMINATION GUIDE FOR EXAM CANDIDATES

### ROSTER OF APPROVED PROFESSIONALS EXAMINATION TECHNICAL – NUMERICAL STANDARDS ASSESSMENT

#### Roster Qualifications and Functions

The Roster of Approved Professionals (the Roster) is a roster of individuals who have proven, through examination and experience, their expert knowledge in contaminated site assessment, management, and remediation.

Members of the Roster are authorized, under section 49(1) of the Contaminated Sites Regulation (CSR), to recommend to the British Columbia Ministry of Environment (MOE) issuance of Approvals in Principle, Certificates of Compliance, Determinations that a site is or is not contaminated, Contaminated Soil Relocation Agreements and approval of background release exemptions (based on Table 1 of Protocol 4) for low to moderate risk sites.

There are two categories of Approved Professionals: Standards Assessment Specialists, whose recommendations are based on application of the numerical standards of the CSR; and Risk Assessment Specialists, whose recommendations are based on application of the risk-based standards of the CSR.

The qualifying examination is offered in three parts: Technical – Standards Assessment, Technical – Risk Assessment, and Regulatory. To be appointed to the Roster, candidates must achieve a pass in both the regulatory part and the technical part associated with the category in which they seek appointment. Candidates must satisfy all minimum requirements in the year of appointment.

More information on the Roster is available at [www.csapsociety.bc.ca](http://www.csapsociety.bc.ca).

#### Examination Format

**The examination is offered in a computer-based format and is held in a computer lab.** The Technical – Standards Assessment part of the examination consists of approximately **70 multiple-choice questions** worth 1 point each. Candidates will be given **5 hours** to complete the Technical – Standards Assessment part of the examination. A formula sheet containing some required formulas will be provided to, and retrieved from, candidates with their examination paper. A basic, non-programmable calculator (Texas Instruments TI-30Xa Solar), a #2 mechanical pencil, an eraser, writing papers and a package of page markers (e.g. *Post-it Brand* flags) will also be provided to, and retrieved from, candidates with their examination paper. Candidates will not be permitted to use their own calculator or writing instruments.

A reference binder will **NOT** be supplied for the examination. Candidates will be provided with a list of reference materials (*see Attachment 2*) to help prepare for the examination. Candidates are expected to prepare their own reference materials which can be brought into and used during the examination. The examination is not limited to testing knowledge of only those materials in the reference list.

## **Objectives of the Technical - Standards Assessment Part of the Exam**

The objectives of the Technical – Standards Assessment part of the examination include the testing of knowledge in the combined aspects of soil science, environmental engineering, hydrogeology, environmental chemistry, basic risk assessment principles; and assessment of the candidates' ability to apply this knowledge in the review of contaminated site investigation and remediation.

While candidates are expected to be familiar with risk assessment principles (particularly with respect to exposure pathways as this is an integral part of the screening assessment protocol) detailed risk assessment review is carried out by Roster members qualified as Risk Assessment Specialists and is the subject of a separate test.

## **Examination Content and Guide to Preparation**

This Guide to Examination Candidates is intended to give candidates guidance in their preparation for the exam. The information contained in this document and its attachments is to assist only and is subject to change. Areas and materials not specifically mentioned may also be examined.

## **Information useful in preparing for the exam is included in the following attachments**

1. Syllabus
2. List of Reference Materials

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## ATTACHMENT 1 – SYLLABUS

Candidates should read the Guide to Examination Candidates – Roster of Approved Professionals Examination – Technical – Standards Assessment Part before reading this syllabus. The syllabus has been divided into the common stages of contaminated site investigation and remediation work and provides an indication of what level of knowledge is expected (i.e. what the Approved Professional should be capable of doing). The percentage in brackets indicates the approximate percentage of the examination that will cover each major content area. Particularly important areas of knowledge include:

### **A. Historical and Visual Site Information (5%)**

1. APEC and PCOC: Identify all applicable potential APEC and PCOC based on review of existing information from various sources and based on assessment of site conditions observed during a site reconnaissance.

### **B. Assessment of Affected Media and Migration Pathway (20%)**

1. Soil: Interpret site geology and soil stratigraphy.
2. Hydrogeology: Assess groundwater flow and contaminant transport (dissolved and Non-aqueous phase liquids - NAPL).
3. Surface hydrology: Interpret significance of precipitation on a contaminated site in terms of contaminant transport (surface water, groundwater, soil and sediment).
4. Sediment: Interpret sediment characteristics and its significance for contaminant distribution and release.
5. Soil vapour: Understand soil vapour concentrations and migration.
6. Air: Understand impact on indoor and outdoor air quality by dust and vapours from site contamination.
7. Biota: Understand significance of food-chain transfers and the significance of observations such as stressed vegetation and effects on aquatic life.

### **C. Contaminant Characteristics (15%)**

1. Chemistry and biochemistry: Interpret physical, chemical and biological properties of contaminants and their significance on fate, transport, treatment and relative human health and ecological risks.
2. Chemical composition of mixtures: Understand the significance of chemical compositions of common types of contamination substances including but not limited to: fuels, lubricants, solvents, paints, wood preservatives, coal tar, metal plating, and landfill leachate.
3. Sources of Contamination: Be familiar with common residential, commercial and industrial activities that may result in site contamination including but not limited to: Fuel storage and handling, metal fabrication, wood preservation, solvent cleaning, coal gasification, and landfilling.

### **D. Investigation Approach and Methods (15%)**

1. Sampling rationale: Interpret available information to develop a defensible sampling rationale that will satisfy the investigation objectives.
2. Sampling plans: Assess sampling plans to determine whether they are consistent with the investigation objectives and sampling rationale.
3. Sampling techniques: Understand the significance of the use of proper equipment and methods for sampling of soil, sediment, groundwater, surface water and soil vapour.
4. Field observations and records: Assess field records in terms of adequacy for data interpretation included but not limited to: Borehole logs, well installation details, visual/olfactory signs of contamination, sampling details, etc.

## SYLLABUS CONT'D

5. Laboratory testing methods: Understand applicability and limitations of common laboratory sampling methods including but not limited to: Gas chromatography, gas chromatography/mass spectroscopy, infrared spectroscopy, petroleum analytical methods (e.g. LEPH/HEPH vs. EPH).
  6. Field screening techniques: Understand applicability and limitations of common laboratory sampling methods including but not limited to: soil vapour headspace, immunoassay, colorimetric, pH/conductivity/temperature, X-ray fluorescence.
  7. QA/QC practices: Assess field and laboratory work in terms of acceptable QA/QC methods and interpretation.
- E. Data Synthesis and Interpretation (15%)**
1. Data integration and presentation: Assess the investigation data in terms of adequate presentation in tables and figures.
  2. Adequacy of testing: Review sampling programs to assess the adequacy of the testing performed (number, type and location of samples).
  3. Nature and extent of contamination: Assess APEC and AEC: number, types, characteristics, PCOC, delineation.
  4. Nature and extent of migration pathways: Assess migration pathways: types, characteristics, preferential routes, relative importance.
  5. Background conditions: Assess regional and local background conditions.
- F. Risk Assessment Principles and Screening (5%)**
1. Problem formulation: Identify/screen sources, exposure pathways, receptors
  2. Acceptable risk: Carcinogens Non-carcinogens.
  3. Exposure scenarios: Interpret current and future site uses.
  4. High risk: Recognize imminent and high risk to human health and environment, and immediate risks to public welfare (e.g. explosion hazard, etc.).
- G. Remediation Design, Implementation and Confirmation (25%)**
1. Remediation techniques: Be familiar with common soil, sediment, groundwater, water and soil vapour remediation methods.
  2. Remedial design: Understand technical, regulatory and cost aspects of common remediation methods, and be able to evaluate the selection of appropriate alternatives.
  3. Remediation implementation: Understand health and safety standards, construction techniques/constraints, monitoring requirements, and requirements associated with off-site transport and disposal of contamination and record keeping.
  4. Remediation Confirmation: Assess confirmatory sampling program and results in terms of adequacy to demonstrate the site meets the applicable requirements of a remediated site.

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## ATTACHMENT 2 – LIST OF REFERENCE MATERIALS

Candidates should read the **Guide to Examination Candidates – Roster of Professional Experts Examination – Technical – Standards Assessment Part** before reading this attachment. This list of reference materials includes materials upon which some, but not all, of the exam questions have been developed. Other questions are drawn from the general principles to be tested and, in some instances, what is considered to be general knowledge. In addition to those materials listed here, candidates should study generally accepted, up-to-date texts in the subject matter areas to be tested.

1. American Society for Testing and Materials. (2006). *ASTM D2487-06e1: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soils Classification System)*.
2. BC Ministry of Environment. *All Technical Guidance Documents on Contaminated Sites*
3. BC Ministry of Environment, S. Horvath (editor). (2009). *British Columbia Environmental Laboratory Manual. Water and Air Monitoring and Reporting*, Environmental Quality Branch, Ministry of Environment, Victoria, BC. <http://www.env.gov.bc.ca/epd/wamr/labsys/lab-man-09/index.htm>
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5. BC Ministry of Environment. *All Protocols, Procedures and Policies*
6. BC Ministry of Water, Land and Air Protection, M.J.R. Clark. (2003). *BC Field Sampling Manual*. Water, Air and Climate Change Branch, Ministry of Water, Land and Air Protection, Victoria, BC, Canada. 312 pp.  
[http://www.env.gov.bc.ca/air/wamr/labsys/field\\_man\\_pdfs/fld\\_man\\_03.pdf](http://www.env.gov.bc.ca/air/wamr/labsys/field_man_pdfs/fld_man_03.pdf)
7. CCME (Canadian Council of Ministers of Environment). (1994). *Subsurface Assessment Handbook for Contaminated Sites*. Report: CCME-EPC-NCSR-48E, March 1994. Prepared by the Waterloo Centre for Groundwater Research, University of Waterloo for the CCME Hazardous Waste Management Branch.  
[http://www.ccme.ca/assets/pdf/pn\\_1144\\_e.pdf](http://www.ccme.ca/assets/pdf/pn_1144_e.pdf)
8. CCME (Canadian Council of Ministers of Environment). (1996). *A Framework for Ecological Risk Assessment: General Guidance*. Prepared by the CCME Subcommittee on Environmental Quality for Contaminated Sites. March 1996. [http://www.ccme.ca/assets/pdf/pn\\_1195\\_e.pdf](http://www.ccme.ca/assets/pdf/pn_1195_e.pdf)
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10. CCME (Canadian Council of Ministers of Environment). (2001). *Reference Method for the Canada Wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method*.  
[http://www.ccme.ca/assets/pdf/final\\_phc\\_method\\_rvsd\\_e.pdf](http://www.ccme.ca/assets/pdf/final_phc_method_rvsd_e.pdf)
11. CCME (Canadian Council of Ministers of Environment). (2006). *A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines*.  
[http://www.ccme.ca/assets/pdf/sg\\_protocol\\_1332\\_e.pdf](http://www.ccme.ca/assets/pdf/sg_protocol_1332_e.pdf)
12. Cedergren, H. R. (1989). *Seepage, Drainage and Flow Nets*. New York, John Wiley and Sons, Inc.

13. Christensen, J.S., J. Elton. (1996). *Soil and Groundwater Pollution from BTEX*. Groundwater Pollution Primer. Civil Engineering Dept., Virginia Tech.  
<http://www.cce.vt.edu/ewr/environmental/teach/gwprimer/btex/btex.html>
14. Crow, E. L., F. Davis, and M. Maxfield. (1960). *Statistics Manual*. Mineola, New York: Dover Publications.
15. Department of Fisheries and Oceans Canada. (1985). Fisheries Act (R.S., 1985, c. F-14).
16. Domenico, P. A., & Schwartz, R. W. (1998). *Physical and Chemical Hydrogeology*. New York, John Wiley and Sons.
17. Environment Canada – Ontario Region. *TAB #2: Site Assessment Procedures*. Prepared for the Federal Facilities operating in Ontario. 2002.  
<http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab02-e.html>
18. Environment Canada – Ontario Region. *TAB #16: Risk Assessment-Exposure Model, Toxicity Analysis and Evaluation*. Prepared for the Federal Facilities operating in Ontario. 2002.  
<http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab16-e.html>
19. Environment Canada – Ontario Region. *TAB #19: Intrinsic Remediation - An Introduction*. Prepared for the Federal Facilities operating in Ontario. 2002.  
<http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab19-e.html>
20. Environment Canada – Ontario Region. *TAB #20: Intrinsic Remediation – Biodegradation*. Prepared for the Federal Facilities operating in Ontario. 2002.  
<http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab20-e.html>
21. Environment Canada – Ontario Region. *TAB #22: In-Situ Remediation Technologies for Contaminated Sites*. Prepared for the Federal Facilities operating in Ontario. 2002.  
<http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab22-e.html>
22. Federal Remediation Technology Roundtable (FRTR). 2002. *Remediation Technologies Screening Matrix and Reference Guide*, 4<sup>th</sup> Edition. January 2002. <http://www.frtr.gov/matrix2/section1/toc.html>
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32. Kruseman, G. P., and de Ridder, N. A. (1990). *Analysis and Evaluation of Pumping Test Data* (2nd Ed). Wageningen, The Netherlands: International Institute for Land Reclamation and Improvement. (Publication 47).
33. Kuo, J., (1999). *Practical Design Calculations for Groundwater and Soil Remediation*. Boca Raton, FL: Lewis Publishers, p. 179-180
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<http://epa.gov/nerlesd1/factsheets/soil-gas.pdf>
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