



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 & Climate Change Strategy (BC ENV) 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 (as per Table 1 and Table 2 of Protocol 6 - Eligibility of Applications for Review by Approved Professionals).

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. Please email admin@csapsociety.bc.ca for the Approved Professional Roster Pack.

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 **4 hours** to complete the Technical – Standards Assessment part of the examination. A formula sheet containing some required formulas will be provided by email previous to the exam. 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. Laptops or electronic materials are **NOT** permitted.

Candidates will be provided with a list of reference materials (*see Attachment 2*) to help prepare for the examination. The examination is not limited to testing knowledge of only those materials in the reference list.

A detailed list of the documents available in the exam's Reference Library will be sent to you. In general, you will have available the electronic version of the following documents:

From Ministry website: Administrative Guidance, Technical Guidance, External Guidance, Protocols, Procedures, Forms, Fact Sheets, Analytical and Field Methods, Discussion Papers and reports, and other Guidelines and Regulations.

From CSAP website: CSAP Membership Guidelines, Bylaws, PA Guidelines, Numerical practice Guidelines, Risk Assessment Practice Guidelines, Rules, Submissions Checklist, Screening Guidance and others.

Please take note that CSAP still encourages the examinees to bring hard copies of these documents to the exam.

Candidates are also expected to prepare their own printed reference materials which can be brought into and used during the examination.

Objectives of the Technical - Standards Assessment Exam

The objectives of the Technical – Standards Assessment 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 for 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

ATTACHMENT 1 – SYLLABUS

Candidates should read the Guide to Examination Candidates – Roster of Approved Professionals Examination – Technical – Standards Assessment Part before reading this syllabus. This 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 (17%)

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 (17%)

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 (17%)

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 (7%)

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 (17%)

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.

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. ALS Laboratory Group (2006). *Hydrocarbon Distribution Report Reference Library*, ALS Environment.
[http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads/North-America-Downloads\(Canada/Other Resources\)](http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads/North-America-Downloads(Canada/Other Resources)).
2. BC ENV. *Administrative Guidance* on Contaminated Sites Documents - up to and including August 31, 2020.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/administrative-guidance>
3. BC ENV. *Facts* on Contaminated Sites – up to and including August 31, 2020.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/fact-sheets>
4. BC ENV. *Procedure* Documents – up to and including August 31, 2020.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/procedures>
5. BC ENV. *Protocol* for Contaminated Sites Documents - up to and including August 31, 2020.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/protocols>
6. BC ENV. *Technical Guidance* on Contaminated Sites Documents - up to and including August 31, 2020.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources/technical-guidance>
7. BC Ministry of Environment (2001). *Analytical Method 7 for Contaminated Sites: Aliphatic/Aromatic Separation of Extractable Petroleum Hydrocarbons in Solids or Water by Silica gel Fractionation. Version 2.1.*
8. BC Ministry of Environment (2015). *British Columbia Environmental Laboratory Manual*. Updated April 2020. Environmental Monitoring, Reporting & Economics Section, Knowledge Management Branch, B.C., Ministry of Environment, including the BC ENV Sample Preservation & Holding Time Requirements table, December 20, 2019.
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10. CCME (Canadian Council of Ministers of the Environment), (2010). *Canadian Soil Quality Guidelines: Carcinogenic and Other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects) Scientific Criteria Document (Revised)*.
11. Canadian Standards Association (R2016). *Phase I Environmental Site Assessment. CSA Z768-01*.
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14. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2009). *Soil Vapour Advice and Practice Guidelines*.
15. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2015). *Numerical Practice Guidelines*.
16. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2018). *Potential Contaminants of Concern at Select Commercial and Industrial Land Uses*, prepared by PGL Environmental Consultants;
<https://csapsociety.bc.ca/wp-content/uploads/r-PCOC-Guidance-June-2018-V1.0-002.pdf>
17. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2015). *Bioaccumulation Research Project*, prepared by SLR Consulting (Canada) Ltd.

18. Contaminated Sites Approved Professionals of British Columbia (CSAP), (2019). *Guidance for the Assessment and Remediation of Per- and Polyfluoroalkyl Substances in British Columbia*, prepared by SLR Consulting (Canada) Ltd.
19. Craig, R.F. (1978). *Soil Mechanics*, Van Nostrand Reinhold Ltd., Ontario, Canada.
20. Department of Fisheries and Oceans Canada (1985). *Fisheries Act* (R.S.C., 1985, c. F-14), last amended 2019-08-28. <http://laws-lois.justice.gc.ca/eng/acts/f-14/>
21. Domenico, P. A., & Schwartz, R. W. (1998). *Physical and Chemical Hydrogeology*. New York, John Wiley and Sons.
22. Drever, James (2002). *The Geochemistry of Natural Waters: Surface and Groundwater Environments*. Third Ed. Prentice-Hall, Inc., New Jersey.
23. Federal Remediation Technology Roundtable (FRTR), (2002). *Remediation Technologies Screening Matrix and Reference Guide*, Version 4.0. http://www.frtr.gov/matrix2/top_page.html
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28. Golder Associates (2010). *Technical Guidance for Contaminated Sites: Groundwater Investigation in Site Assessment (2nd Edition)*. Prepared for BC Ministry of Environment.
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36. Moffitt, F. H. (1987). *Surveying* (8th Ed). New York: Harper and Row, p. 124.
37. Morrison, R. and Murphy, B. (2006). *Environmental Forensics*. Elsevier Academic Press.
38. Nyer, E et. al (1991). *Using the Properties of Organic Compounds, etc.*, Groundwater Monitoring Review.
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40. Province of British Columbia (2019). *Contaminated Sites Regulation (CSR)*, B.C. Reg. 375/96, includes amendments up to B.C. Reg. 13/2019, January 24, 2019.
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42. Province of British Columbia (2017). *Hazardous Waste Regulation (HWR)*, B.C. Reg. 63/88, including amendments up to B.C. Reg. 243/2016, November 1, 2017.
43. Puls, R.W. and Barcelona, M.J. (1996). *Low-flow (minimal drawdown) ground-water sampling procedures*, EPA/540/S-95/504.
44. Science Advisory Board for Contaminated Sites in BC (2011). *Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion*. Prepared by Golder Associates Ltd., Burnaby, BC.
[http://www.sabcs.chem.uvic.ca/a%20June%2015%202012%20SABCS%20Golder%20Soil%20Vapour%20Guidance%20Security%20Level%20for%20Posting%20May%2011%20\(2\).pdf](http://www.sabcs.chem.uvic.ca/a%20June%2015%202012%20SABCS%20Golder%20Soil%20Vapour%20Guidance%20Security%20Level%20for%20Posting%20May%2011%20(2).pdf)
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48. US EPA. Drinking Water Treatability Database. (Per- and polyfluorinated substances).
<https://iaspub.epa.gov/tdb/pages/contaminant/contaminantOverview.do>
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50. US EPA (2011). *An Approach for Evaluating the Progress of Natural Attenuation in Groundwater*. Office of Research and Development, National Risk Management Research Laboratory, Ada, OK. EPA 600/R-11/204.
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<https://www.epa.gov/ust/how-evaluate-alternative-cleanup-technologies-underground-storage-tank-sites-guide-corrective>
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58. ITRC (2005), *Permeable Reactive Barriers: Lessons Learned/New Directions*. PRB-4. Washington, D.C.
59. IPCS Inchem, International Programme on Chemical Safety (IPCS), Environmental Health Criteria No.116, World Health Organization, 1990.
60. *Dense Chlorinated Solvents and Other DNAPLs in Groundwater*, Pankow, J.F. and J.A. Cherry (eds.), 1996.
61. *Site Characterization Technologies for DNAPL Investigations*. U.S. Environmental Protection Agency (USEPA), 2004.
62. *Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA)*, Version 2.0 (2010) Revised 2012.
63. US EPA Reference Dose (RfD): Description and Use in Health Risk Assessments, Background Document 1A, March 15, 1993.

64. US EPA Treatment Technologies Screening Matrix, Table 3-2.
65. Federal Contaminated Sites Action Plan (FCSAP), Ecological Risk Assessment Guidance, Module 2: Development of Site-specific Toxicity Reference Values, March 2010.
66. US EPA, Contaminated Site Clean-up Information, Characterization and Monitoring Technologies; <https://clu-in.org/characterization/technologies>

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