



BOARD OF EXAMINERS

EXAMINATION INFORMATION HANDBOOK FOR CANDIDATES

**WHO ARE REGISTERED AS LAND
SURVEYORS IN A PROVINCE OF CANADA
AND WHO WISH TO OBTAIN A
COMMISSION AS A CANADA LANDS
SURVEYOR
PURSUANT TO LABOUR MOBILITY
LEGISLATION**

AUGUST 1, 2011

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General Information

Effective August 1, 2011, candidates wishing to obtain a Commission as a Canada Lands Surveyor (CLS) from the Association of Canada Lands Surveyors (ACLS), and who are registered as land surveyors in a Province of Canada will no longer be required to attend an examination centre in the Spring or Fall, as well as write and pass three of the three-hour professional examinations pertaining to the CLS areas of practice. For these candidates, the three examinations have been replaced by one four-hour Professional Examination which will be written online and which may be written at any time of the year. The on-line system generates exams by random selection of questions from a database that is kept up to date on a regular basis.

Furthermore, since Hydrographic Surveying is no longer on the list of core subjects in the new National Syllabus, the ACLS has to take steps to ensure that candidates have the required academic training in that subject.

All candidates must have academic training in Hydrographic Surveying so the Registrar may require documented proof. In general terms, candidates with a Certificate of Completion from the WCBELS or the APBELS meet this requirement. Holders of a Certificate of Completion from the CBEPS prior to August 2010 or after that date but with mention of E2 Hydrographic Surveying on the certificate are deemed to have met the ACLS hydrographic surveying requirement. Members of the Ordre des Arpenteurs-Géomètres du Québec meet the Hydrographic Surveying requirement.

Candidates who do not meet this requirement will have to write a three-hour exam on Hydrographic Surveying.

Composition of the Professional Examination

The topics covered by the four-hour CLS Professional Examination are the following:

- Acts, Regulations and General Instructions for Surveys
- Property Rights on-shore
- Property Rights offshore
- Aboriginal Government Issues

Hydrographic Surveying Examination

Candidates who do not meet the above mentioned Hydrographic Surveying requirement will have to write and pass an examination on that subject before writing the Professional Examination. This is a three-hour examination to be written online. The learning outcomes for this examination are on page 18. A study guide for the subject is available on the CBEPS website at the following URL: <http://cbeps-cceag.ca/cms/?q=en/system/files/E+2+Hydrographic+Surveying+Study+Guide.pdf>

The Examination Process

Making the Application

Land surveyors licensed in a Canadian province who wish to become candidates for a Commission as a CLS must complete and submit the application form that is posted on the ACLS Web site, along with the registration fee. They must also provide a copy of their

licence or commission and arrange to have their home association provide a “Certificate of Conduct” directly to the ACLS. The candidate must hold a license that is not encumbered or restricted in any way within the home association. In the cases of licensed land surveyors who are holders of a CBEPS, APBELS or WCBELS Certificate of Completion, they must also provide a copy of their Certificate so that the ACLS may determine whether or not the applicant is required to write the Hydrographic Surveying Examination.

Candidates may choose to become a Student member of the ACLS (see eligibility for Student membership) but this is not a requirement to write the examination for a Commission. One of the advantages of becoming a Student member is that it ensures that the candidate receives ACLS newsletters and current information on ACLS activities.

Once the ACLS has received the application form, the copy of the licence or commission, the “Certificate of Conduct” letter from the home association, the CBEPS/APBELS/WCBELS Certificate, if applicable, and the registration fee, and is satisfied that the applicant is not required to write the Hydrographic Surveying Examination, the candidate is eligible to write the ACLS Professional Examination.

Invigilation

Critical to the success of the program of writing examinations online is the invigilation process. It is important that the examinations be impartially and fairly invigilated. For these reasons the Invigilator chosen by the candidate cannot be a relative or an employee of the same firm as the candidate, or a business colleague. The Invigilator must be a Canadian professional surveyor and must provide an affidavit to the ACLS before being accepted as an Invigilator. Similarly, the location chosen to write the examination cannot be the home or the business premises of the candidate. A suggestion for an Invigilator would be a business competitor and a suggested location would be his/her business premises. Another suggestion is the office of a surveying association where the writing of the examination can be supervised.

If the exam requires the candidate to provide one or more sketches, the Invigilator is responsible for scanning the sketch(es) using a colour scanner and e-mailing them to the ACLS office.

Applying to Write an Examination

After a person has been accepted as a candidate for a Commission, it is the responsibility of the candidate to apply to write an examination(s) and to pay the examination(s) fee.

The application form is available at: <http://www.acls-aatc.ca/en/node/82> . *Note that the application form requires that candidate specify the name of the person who will be invigilating the examination and the location where the examination will be written. If applicable, the candidate must succeed in writing the Hydrographic Surveying Examination before attempting to write the Professional Examination.*

Within 30 days of receipt of the application and approval of the details of invigilation, the ACLS will issue the candidate a user name, password and link to access the examination site. **Do not click on this link before the time set with your Invigilator for the start of the exam.** This information will be provided by an e-mail. Upon issuance of the user name and password, the candidate has the following 30 days within which to write the examination.

Writing an Examination

The online examination is a live Web page and a space is provided after each question for the candidate to enter an answer.

Candidates must bring the following to the examinations in case they have to draw one or more sketches:

- Coloured pencils (at least 3 colours)
- Straightedge and scale

For examination questions that require them, candidates are to supply their own electronic calculators. Calculators used are to be hand held and battery operated. The use of electronic translators or smart phones (I-phone, Blackberry, etc.) is not allowed. The Invigilator may inspect any calculator brought for the examination and may forbid use of those which do not meet the requirements of this section.

All exams are closed book. No information or notes may be brought to the exam. **Any attempt to leave the on-line system window during the exam will cause a notification to be sent to the Registrar unless it is to view and print an attachment to a question. Leaving the exam window may result in a failing grade.**

To begin the examination, candidates must click on the Internet link shown on the e-mail and log into the examination site using the provided user name and password. **This must be done in presence of the Invigilator.**



Examination for Admission as a Canada Lands Surveyor

Examiner's Note: The purpose of this exam is to assess the candidate's understanding of the topic and not to assess the candidate's ability to write out sections of Acts, Regulations, Rules or other written materials. Please answer in your own words.

When you are ready to begin the exam, please fill in the login information supplied to you and then click the Start Exam button.

Please review the system requirements before proceeding.



Note: Once the exam process has started, you will have a set time to complete it.


Username	<input type="text"/>	Password	<input type="text"/>	<input type="button" value="Start Exam"/>
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Once the candidate clicks on the “**Start Exam**”, button the next window lists the sections of the examination, how many questions there are in each section and how many have been answered at any time. The clock countdown begins as soon as the candidate clicks on an examination section title. The remaining time left is displayed at the top of the screen. When the candidate chooses a section to begin answering, the questions are displayed sequentially, along with the point value of the question.

In some cases, questions may have an attachment. This will be clearly indicated under the answer space by an icon with the note: “**View Attachment**”.

Some questions require that a sketch be submitted or a candidate may wish to provide a sketch to further clarify his or her answer. At the end of the Examination, the candidate must indicate, **at the top of the sheet of paper containing the sketch, the user name provided by the ACLS, the date of the writing of the exam and the applicable question number and give it to the Invigilator**. The Invigilator is responsible for scanning the paper using a colour scanner and for e-mailing it to the ACLS Examination Administrator who will attach it to the appropriate question of the examination.

A few questions in the database have multiple choice questions. The system shows the answers in a random order. So candidates may see a list that does not follow the alphabetic order.




Time Remaining: 03:59:55

Main Page
(Click on a Section to Proceed) 105 Points

Sections	Answered / Total
101 - Acts, Regulations and General Instructions for Surveys	0 / 5
102 - Property Rights - on-shore	0 / 3
103 - Property Rights - offshore	0 / 3
104 - Aboriginal Government Issues	0 / 3
Total	0 / 14

When all questions have been answered the following window is displayed. At this point, the candidate submits the examination for marking by clicking on “**Finish Exam**”. Note that after four hours (or three in the case of a Hydrographic Surveying Examination) the examination is automatically closed and submitted.



Time Remaining: 03:48:59

Main Page
(Click on a Section to Proceed) 105 Points

Sections	Answered / Total
101 - Acts, Regulations and General Instructions for Surveys	5 / 5
102 - Property Rights - on-shore	3 / 3
103 - Property Rights - offshore	3 / 3
104 - Aboriginal Government Issues	3 / 3
Total	14 / 14

The following window is then displayed asking the candidate to confirm the submission of the exam.



Time Remaining: 03:24:25

Exam Submission Confirmation
Time Spent: 00:35:35

You have answered 14 out of 14 questions.

Are you sure you want to submit this exam for final grading?

[Return to Section List](#)

[Submit Exam for Grading and Logoff](#)

Marking the Examination

The examination will be marked by one or more members of the Association's Board of Examiners or by one or more Special Examiners. The results of the marking will be provided to the candidate as soon as possible according to availability of examiners. The pass mark for the Professional Examination is seventy percent (70%) of the total value of marks for the examination and the pass mark for the Hydrographic Surveying Examination is sixty percent (60%) of the total value of marks for the examination.

Appeals

A candidate may appeal to the Association for a review of an examination result provided a notice of an intent to appeal is received within fifteen (15) days after the issuance of the result and the written appeal is received within another thirty (30) days. The appropriate fee for an appeal must be submitted along with the appeal. The Association will respond to the appeal within 30 days of receiving the written documentation.

Re-writing Examinations

A failed examination may be re-written by submitting a new application and paying the examination fee.

First Attempt:

The examination will be made available within a maximum 30 calendar days of receiving the completed application.

Second Attempt:

The examination will be made available within a maximum 30 calendar days after the appeal period for the first attempt expires, or if the right to appeal is waived by the candidate within a maximum of 30 calendar days following receipt of the notice waiving the right to appeal.

Third and Subsequent Attempts:

The examination will be made available within a maximum 90 calendar days after the appeal period for the previous attempt expires, or if the right to appeal is waived by the candidate within a maximum 90 calendar days following receipt of the notice waiving the right to appeal.

Fees

- (a) Application to become a candidate for a CLS Commission\$100.00
- (b) Application to write the ACLS Professional Examination\$350.00
- (c) Application to write the ACLS Hydrographic Surveying Examination\$150.00
- (d) Application for an appeal of the results of an examination.....\$100.00
- (e) Penalty for NSF cheque or declined credit card.....\$ 30.00

The Board may amend this schedule of fees from time to time.

Refunds

Candidates who have paid the examination application fee and then wish to withdraw from writing the examination **before** the user name and password have been provided to them will receive a full refund of the examination fee. No other refunds will be provided.

CLS Commission

The ACLS Board of Examiners will notify the Registrar when a candidate has successfully completed the ACLS Professional Examination and has met any other requirements necessary to be eligible to receive a commission.

CLS Professional Examination Learning Outcomes

A. Acts, Regulations and General Instructions for Surveys

Questions for the above-noted topic for this examination are based on the following modified syllabus, differing from the syllabus that applies to and is published for CLS candidates in the normal examination stream.

Candidates are required to have knowledge of the prescribed sections of the following federal and territorial acts, regulations and agreements. Where no section numbers have been specified, the entire document is examinable.

Candidates are responsible for amendments related to the prescribed sections that have been enacted and posted electronically up to the date on which application in acceptable form is made to write the Professional Examination. Where applicable, answers based on both the previous and subsequent versions will be accepted where revisions have been posted after the date of application. Candidates are encouraged to monitor the Latest Updates section of the Survey Standards section of the *General Instructions for Surveys, e-Edition*. Candidates may also find it useful to use the following Websites at:

- for Canada <http://laws-lois.justice.gc.ca/eng/>
- for Yukon <http://www.canlii.org/en/yk/>

Federal Acts and Regulations

- *Canada Lands Surveyors Act*
ss. 1-9, 19-32, 42-62, 71-74
- Canada Lands Surveyors Regulations
ss. 1, 38
- *Canada Lands Surveys Act*
- *Canada National Parks Act*
ss. 1-10; Schedules 1 and 2 for park names only
- *First Nations Land Management Act*
ss. 1-7, 15, 16, 18-21
- *Indian Act*
ss. 1-5, 18-29, 37-41
- Northwest Territories and Nunavut Mining Regulations
ss. 2-58
- *Territorial Lands Act*
ss. 1-6, 8-19, 23-24
- Territorial Lands Regulations
ss. 1-10

- Canada Oil and Gas Land Regulations
ss. 1-22
- *Yukon Act*
ss. 1-5, 19-20, 24-26

Yukon Acts and Regulations

- *Condominium Act*
ss. 1-10, 25
- *Land Titles Act*
ss. 1-3, 14, 26, 36, 46-48, 51, 67, 72, 77-82, 189
- Land Titles Plans Regulations
ss. 1-14
- *Placer Mining Act*
ss. 1-7, 16-30, 34-36, 38-42, 48, 50, 52-53, 92, 95-96
- *Quartz Mining Act*
ss. 1-3, 7-8, 12-48, 50-60, 65-67, 70-72, 74-76, 78-79, 86-94, 99-100
- *Subdivision Act*
ss. 1-18, 20-21, 26-27
- Subdivision Regulations
ss. 1-5
- *Territorial Lands (Yukon) Act*
ss. 1-2, 6-9, 11-14
- Territorial Lands Regulation
ss. 1-9, 11

General Instructions for Surveys, e-Edition

- <http://clss-satc.nrcan-rncan.gc.ca/standards-normes/index-eng.asp>

Chapters C1 to C6
Chapters D1 to D12
Appendices E1 to E4 and E6

B. Property Rights on-shore

LEGISLATION AND ADMINISTRATIVE AGREEMENTS

Candidates are required to have a good understanding and knowledge of the land tenure and property rights of on-shore Canada Lands.

The textbooks identified below provide the necessary information which should be supplemented with the appropriate sections of the various federal and territorial acts and regulations listed below that are relevant to land tenure and property rights.

Candidates are responsible for amendments related to these acts and regulations that have been enacted 60 days prior to the examination date. Exam answers that are based on more recent amendments will be marked in accordance with those amendments.

Candidates may also find it useful to use the following Websites for accessing the latest versions of acts and regulations:

- for Canada <http://laws-lois.justice.gc.ca/eng/>
- for Yukon <http://www.canlii.org/en/yk/>
- for Northwest Territories <http://www.canlii.org/en/nt/>
- for Nunavut <http://www.canlii.org/en/nu/>

Textbooks:

- General Instructions for Surveys, e-Edition (GIS-e) published by Surveyor General Branch, Natural Resources Canada at: <http://clss.nrcan.gc.ca/standards-normes/index-eng.asp>
- Surveys, Parcels and Tenure on Canada Lands, edited by Dr. Bryan Ballantyne published by Surveyor General Branch, Natural Resources Canada at: <http://clss.nrcan.gc.ca/ballantyne-pub-eng.php>

References:

Federal Acts and Regulations

- *Canada National Parks Act*
- *Canada Oil and Gas Land Regulations*
- *Canada Oil and Gas Operations Act*
- *Canada Petroleum Resources Act*
- *Constitution Acts, 1867 to 1982*
- *Indian Act*
- *Northwest Territories Act*
- *Northwest Territories and Nunavut Mining Regulations*
- *Nunavut Act*
- *Territorial Dredging Regulations*

- Territorial Land Use Regulations
- *Territorial Lands Act*
- Territorial Lands Regulations
- Land Claims Agreements and acts – each land claim agreement has specific elements addressing land, title, management of lands, resources, etc. and the creation of institutions to oversee certain areas in each land claim region:
 - The Western Arctic Claim - Inuvialuit Final Agreement as amended (<http://fishfp.sasktelwebhosting.com/publications/IFA.pdf>)
 - *Western Arctic (Inuvialuit) Claims Settlement Act*
 - Gwich'in Comprehensive Land Claim Agreement (<http://www.gwichin.nt.ca/documents/GCLCA.pdf>)
 - *Gwich'in Land Claim Settlement Act*
 - Nunavut Land Claims Agreement (<http://nlca.tunngavik.com/>)
 - *Nunavut Land Claim Agreement Act*
 - Sahtu Dene and Metis Comprehensive Claim Agreement (<http://www.ainc-inac.gc.ca/al/ldc/ccl/fagr/sahtu/sahmet/sahmet-eng.pdf>)
 - *Sahtu Dene and Metis Land Claim Settlement Act*
 - Tlicho Agreement (<http://www.ainc-inac.gc.ca/al/ldc/ccl/fagr/nwts/tliagr/tliagr-eng.asp>)
 - *Tlicho Land Claims and Self-Government Act*
 - Umbrella Final Agreement Between The Government Of Canada, The Council For Yukon Indians And The Government Of The Yukon (<http://www.ainc-inac.gc.ca/al/ldc/ccl/fagr/ykn/umb/umb-eng.asp>)
 - *Yukon First Nations Land Claims Settlement Act*
 - *Yukon First Nations Self-Government Act*

Yukon Acts and Regulations

- *Condominium Act*
- *Land Titles Act*
- *Lands Act*
- *Subdivision Act*
- Lands Regulations
- Land Titles Plans Regulation
- *Placer Mining Act*
- *Quartz Mining Act*

Northwest Territories/Nunavut Acts and Regulations

- *Territorial Lands Act (NT & NU)*
- Northwest Territories and Nunavut Mining Regulations
- *Commissioner's Lands Act, (NT)*
- Commissioner's Land Regulations (NT)
- *Land Titles Act (NT)*
- Land Titles Plans Regulations (NT)
- Lands Regulations (NT)

Administrative Requirements and General Instructions for Surveys

Candidates are required to have knowledge of all sections reproduced in the GIS-e for the following:

- Chapters C1 to C6

Property Rights and Boundary Systems on Canada Lands

Videotapes of a seminar presented in Ottawa, Ont. in May 1990, by the Legal Surveys Division. 4 hours. Available from the Association of Canada Lands Surveyors.

CLS Subjects Overview Seminar

Videotapes of the Property Rights portion of a seminar presented by the Association of Canada Lands Surveyors in January 1993. The segment provides an overview of the concepts and differences in the Property Rights systems on Canada Lands. Available from the Association of Canada Lands Surveyors.

C. Property Rights offshore

MARITIME INTERNATIONAL LAW PRE-UNCLOS

- Background to International Law of the Sea
- Historical Development of International Law of the Sea to 1945
- Historical Development of International Law of the Sea from 1945

UNITED NATIONS LAW OF THE SEA, 1982 (UNCLOS)

- Introduction
- Baselines
 - Bays and River Mouths
 - Archipelagic Waters
- Internal Waters and Territorial Sea
- Contiguous Zone
- Exclusive Economic Zone (EEZ)
- Continental Shelf
- High Seas
- The Area
- Administration of UNCLOS
- Innocent Passage, Transit Passage, and International Straits
- Marine Scientific Research

INTERNATIONAL BILATERAL OFFSHORE BOUNDARIES

- Introduction
- Equidistant Lines and Modification by Agreement and Special Circumstances
- The 1958 Geneva Conventions
- The Doctrine of Equity
 - North Sea Continental Shelf Cases and Anglo/French Arbitration
 - United Nations Convention on the Law of the Sea, 1982
- Judicial Trends in Equitable Boundaries
- Natural Prolongation
- Partial Effect
- Proportionality
- Enclavement
- Other factors

DETERMINING OFFSHORE LIMITS AND BOUNDARIES

- Land Based Water Related Boundaries
- Territorial Sea
- Contiguous Zone
- Exclusive Economic Zone
- The Continental Shelf
 - Continental Shelf - Typical Situation
 - Continental Shelf - Where the Geological Shelf is Greater Than 200 Nautical Miles
- Graphical Methods of Determining and Depicting Offshore Limits
 - Straight Lines
 - Equidistant Lines

CANADA'S OFFSHORE JURISDICTION

- Federal Jurisdiction in Canada's Offshore
- Pacific Coast
- Atlantic Coast - Newfoundland and Labrador
- Arctic Coast

ADMINISTRATION OF CANADA'S OFFSHORE OIL AND GAS RESOURCES

- Legislation Related to Offshore Oil and Gas
- Pacific Coast
- Atlantic Coast - Nova Scotia
- Atlantic Coast - Newfoundland and Labrador
- Nova Scotia-Newfoundland & Labrador Offshore Resources Arbitration
- Northwest Territories and Nunavut
- Yukon

Textbooks:

Canada's Offshore: Jurisdiction, Rights, and Management, 3rd Edition, Bruce Calderbank, Alec M. MacLeod, Ted L. McDorman, and David H. Gray. Association of Canada Lands Surveyors and the Canadian Hydrographic Association, 2006. Available from the Association of Canada Lands Surveyors. The Offshore Property Rights part of the exam covers chapters 2, 3, 4, 5, 7, sections 8.1 to 8.4 of chapter 8 and sections 9.1 to 9.7 of chapter 9.

References:

Offshore Management

Videotapes of a seminar presented in Nanaimo, BC in January 1990, by Captain P. K. Mukherjee. 5 hours. Available from the Association of Canada Lands Surveyors.

Canada's Unresolved Maritime Boundaries

David H. Gray, Canadian Hydrographic Service, Geomatica Vol 40 No. 2. Available from the Association of Canada Lands Surveyors.

Scientific and Technical Guidelines of the Commission on the Limits of the Continental Shelf

UN Commission on the Continental Shelf. Internet:

http://www.un.org/Depts/los/clcs_new/commission_documents.htm#Guidelines

The Law of the Sea, United Nations Convention on the Law of the Sea

United Nations, New York 1983.

Internet:

http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

A Manual on Technical Aspects of the U.N. Convention on the Law of the Sea – 1982

International Hydrographic Organization Special Publication No. 51. Available from the Association of Canada Lands Surveyors. \$70.00

The Canada Petroleum Resources Act

Internet: <http://laws.justice.gc.ca/en/c-8.5/234461.html>

Canada-Nova Scotia Offshore Petroleum Resources Implementation Act

Internet: <http://laws.justice.gc.ca/en/c-7.8/233899.html>

The Canada-Newfoundland Atlantic Accord Implementation Act

Internet: <http://laws.justice.gc.ca/en/c-7.5/233481.html>

Petroleum Operations on the Canadian Continental Margin, The Legal Issues in a Modern Perspective

Gault, Ian T. 1983, Faculty of Law, the University of Calgary, 2500 University Drive, NW, Calgary Alberta. Report No. Fund 56111. ISBN 0919269052

D. Aboriginal Government Issues

- History of Canada's Indian peoples
- British colonial policy and the Royal Proclamation of 1763
- Early treaties and treaty policies
- The Robinson treaties
- The Imperial Orders in Council of 1870
- *Indian Act 1876*
- Numbered Treaties 1-11
- Residential Schools and other assimilation strategies
- Aboriginal title and rights
- The St. Catherine's Milling Case; the Calder Case; the Guerin Case; the Sparrow Case; the Delgamuukw Case (Trial and Appeal)
- Specific and comprehensive claims policies evolution
- The James Bay and Northern Québec Agreement
- The Inuvialuit Final Agreement
- Active comprehensive claims
- *The Constitution Act 1982*; Bill C-31; the First Ministers Conferences on aboriginal rights; aboriginal issues in the Charlottetown Accord
- The 1987 Comprehensive Claims Policy
- Administration of Indian lands
- Systems of tenure on Indian reserves and "lands set aside"; Settlement Lands
- The Indian Land Registry system
- Nisga'a Treaty 1999
- The British Columbia Treaty process; highlights of recent treaties such as Tsawwassen First Nation and Maa Nulth First Nations Treaties
- Duty to Consult and related Supreme Court of Canada cases: Taku, Haida, Mikisew Cree, Little Salmon/Carmacks

Textbooks:

Native Government Issues. A compilation of assorted former textbooks and references. Includes: **A History of Native Claims Processes in Canada, 1867-1979.** Richard C. Daniel for Indian and Northern Affairs Canada, Ottawa, 1980; **Outstanding Business - A Native Claims Policy,** Specific Claims, Indian Affairs and Northern Development, Ottawa, 1982; **In All Fairness - A Native Claims Policy,** Comprehensive Claims, Indian Affairs and Northern Development, Ottawa, 1981; **Comprehensive Land Claims Policy,** Indian Affairs and Northern Development, Ottawa, 1987; **The Canadian Indian,** Indian Affairs and Northern Development, Ottawa, 1986.

Available from the Association of Canada Lands Surveyors

Indian and Northern Affairs Canada on the Internet: selected information on Indian policy, historical treaties, current comprehensive claim/treaty negotiations status, etc. www.inac.gc.ca/

Other Textbooks

BC First Nations Studies 12 Student Text, BC Ministry of Education, 2003. To order: <http://www.crownpub.bc.ca/pubdetail.aspx?nato=7530879109>

Price, Richard T. Legacy: Indian Treaty Relationships, 2nd ed. Saskatoon: Office of the Treaty Commissioner, 2008.

http://www.otc.ca/LEARNING_RESOURCES/Publications/Legacy_%E2%80%93_Indian_Treaty_Relationships/

Treaties in Canada, Manitoba Education, April 2010,

http://www.edu.gov.mb.ca/k12/iru/library_publications/bibliographies/treaties_canada_2010_04.pdf

References:

Native Government Issues. Videotapes of a seminar held in Toronto, Ontario in June 1993. 3 tapes, 5 hours. Available from the Association of Canada Lands Surveyors

Current BC Treaties: www.treaties.gov.bc.ca/treaties.html

Hydrographic Surveying Learning Outcomes

The Hydrographic Surveying syllabus covers all aspects of Hydrographic Surveying. The emphasis is placed on charting surveys given that, in most cases, they have the most stringent requirements. The learning outcomes are a subset of the outcomes defined in the IHO M5 document “Standards of Competence for Hydrographic Surveyors”. The learning outcomes are divided into several sections including acoustics, bottom determination (singlebeam, sidescan sonar, multibeam and non-acoustic), water levels, water flow, horizontal positioning, vertical positioning and hydrographic survey practice and standards.

The acoustics section covers all aspects of sound propagation through the water column, including the physical properties of water that affect that propagation. Bottom determination sections include the use of singlebeam echosounders, side scan sonars, multibeam sonars and non-acoustic depth determination techniques.

Vertical positioning includes tidal and non-tidal water level variations, datums as well as vessel orientation (heave, pitch, roll and heading). The primary horizontal positioning technique in hydrography is GPS. Acoustic positioning techniques are addressed here. Programmable calculators may be used in the examinations of this item; however, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted for the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct. A collection of formulae are provided with the examination questions.

Learning Outcomes:

In order to fulfill the requirements of this syllabus item, candidates should be able to demonstrate knowledge of:

1. Underwater Acoustics

- **Acoustic Velocity:** Describe effects of the physical properties of water on the calculation of sound speed. Calculate sound speed from measurements of temperature, pressure (depth), and salinity (conductivity).
- **Ray Tracing:** Describe the basic principles of ray path development and analysis. Predict shadow zones and sound channels.
- **Acoustic System Parameters:** Define frequency, beamwidth, pulse-length, pulse repetition rate, detection threshold, bandwidth, and resolution.
- **Acoustic Devices:** Describe the purpose and operation of acoustic devices such as: transponders, pingers, tripping devices and sound speed meters, acoustic Doppler current profilers.

2. Single-beam Echosounders

- **Transducers:** Discriminate between the following types of transducers: narrow beam, wide beam, parametric.
- **Recording:** Differentiate between analogue and digital recording systems and media.
- **Sounder Calibration:** Evaluate and select appropriate echosounder calibration methods and equipment for specific applications.
- **Sounding Reduction:** Explain and apply the reductions to measured depths due to water level variations, draft, dynamic draft (settlement, sinkage, squat, fuel

depletion, and buoyancy changes) and transducer separation. Evaluate and apply all appropriate factors affecting depth reductions for specific applications.

- Sounding Accuracy: Calculate and assess the uncertainty in soundings due to errors in the positioning system, echo-sounder, water level measurement, vessel motion and seabed topography. Evaluate and select appropriate methods for controlling or reducing sounding uncertainty for specific applications.
- Acoustic Sweeps: Explain the design of boom systems and the effect of transducer spacing and survey speed on full ensonification. Specify the transducer spacing and survey speed for a boom system, to ensure full sonar coverage for specific applications.
- System selection: Identify echo sounder characteristics that affect performance in varying survey applications. Specify appropriate echo-sounder characteristics (e.g. resolution, depth capability, frequency, bandwidth, beamwidth) for specific applications.

3. Sidescan Sonar

- Side Scan Systems: Explain the effect on sidescan sonar performance of frequency, beam angle, resolution, gain, towing speed, and deployment (deep tow, shallow tow, pole mount). Evaluate and select appropriate sidescan frequency, features and deployment, for specific applications.
- Side Scan Data Interpretation: Explain sonar signatures of such items as debris from wrecks, pipelines, gas, fish and fresh water.

4. Multibeam Sonar

- Multibeam Transducers: Explain the basic principles of multibeam sonar transmit and receive beam forming, steering, shading and focussing, using flat or curved transducers. Describe the differences between the various methods of bottom detection (amplitude or mean time, bearing direction indicator, split-aperture differential phase, and fast Fourier transform).
- Coverage and Accuracy: Explain the dependence of depth coverage and uncertainty on bandwidth, beam-width, beam elevation angle, depth, ping rate, sound speed uncertainty, vessel attitude and motion (speed, heave, roll, pitch, heading and yaw). Describe motion compensation techniques. Estimate depth coverage and uncertainty, taking all factors into account.
- Multibeam Calibration: Explain the effects on depth and position uncertainty of errors in sensor locations and alignments within the vessel reference frame. Define the "patch test". Establish the vessel reference frame and sensor offsets and alignments. Select test area and lines to be run for "patch test". Calibrate the misalignments between transducer and motion sensor.
- Multibeam Data Management: Describe issues affecting acquisition, processing, storage and retrieval of multibeam data. Explain methods for managing data quality. Specify and design a multibeam data management strategy, for specific applications.

5. Non-acoustic Bathymetric Techniques

- Laser Bathymetry: Explain the principles, capabilities and limitations of laser bathymetry. Select survey areas suitable for laser bathymetry.
- Remote Sensing Bathymetry: List remote sensing techniques applicable to bathymetry. Describe the basic principles of airborne and satellite techniques.
- Mechanical techniques: Describe wire and bar sweeps.

6. Water Levels and Flow

- Tidal Fundamentals: Describe tide generating forces and the static and dynamic tidal theories. Describe the major harmonic constituents. Identify and recognize the different types of tide. Explain the concept of amphidromic points and cotidal charts. Define different tidal levels. Classify tidal regimes.
- Tidal Measurements: Explain the principles of various types of water level gauges and poles. Describe characteristics of river, coastal and offshore water level gauges. Evaluate and select appropriate instruments and sites for water level monitoring.
- Tidal Streams and Currents: Describe the relation between streams and tides. Describe methods for measuring tidal streams and currents, including log ship, pole and current meters.
- Non-tidal Water Level Variations: Describe the temporal and spatial effects on water level caused by: atmospheric pressure, wind, seiches, and precipitation. Identify water level variations occurring in rivers and lakes and due to dam operations. Evaluate and select appropriate locations for water level gauges in rivers, lakes, and near dams, for specific applications.

7. Horizontal Positioning

- Acoustic Positioning Concepts: Describe the principles of long, short and supershort baseline acoustic positioning system modes. Describe the deployment and calibration, signal structure, sources of error, and expected uncertainties for each mode. Specify the deployment and calibration method. Predict and evaluate sources of error and expected uncertainties for each system and appropriate application (towed bodies, autonomous underwater vehicles, remotely operated vehicles).

8. Vertical Positioning

- Vertical Positioning Fundamentals: Explain and describe the characteristics of height systems (e.g. dynamic, orthometric and normal heights). Differentiate between gravity related and ellipsoidal heights.
- Datums: Describe the role of, and methods of establishing, the various vertical datums used in hydrographic operations (e.g. Chart, Sounding, MSL, LAT, LW, and HW datums). Select, establish, interpolate and transfer datums in oceans, coastal waters, estuaries, rivers, and lakes for soundings and elevations.
- Elevation Measurements and Computations: Describe methods for determining differences in elevation (e.g. by spirit level, vertical angle, and GNSS). Correct for effects of curvature and refraction, where appropriate. Describe the principles of satellite altimetry. Compare and evaluate the observing methods and procedures for the determination of elevation (e.g. by spirit level, theodolite, and satellite systems). Select an appropriate system for specific applications. Describe how bathymetry can be predicted from satellite altimetry.
- Heave: Describe the principles and limitations of heave compensation systems. Describe the role of filtering in making heave measurements. Evaluate and select appropriate heave compensation systems for specific applications.
- Orientation: Describe the operation of heading sensors (e.g. flux-gate and other magnetic, fibre-optic and gyro compasses). Explain the principles of inertial roll and pitch sensors. Describe the principles and limitations of GNSS attitude sensors. Evaluate and select appropriate heading, roll and pitch sensors, for specific applications. Describe field alignment checking procedures.

9. Types of Hydrographic Surveys and Specifications

- Nautical Charting Surveys: Describe the purposes of nautical charting surveys - all essential data to ensure safety of navigation. Define the components of a nautical charting survey (general depths, wrecks and obstructions, shorelines, navigation aids, etc.). Explain IHO survey specifications.
- Surveys in Support of Port Management and Coastal Engineering: Describe and distinguish between surveys for dredging, environmental monitoring and hydraulics, including surveys at a large scale. Describe the methods and instruments used (e.g. geotechnical, magnetic, diving, and cameras).
- Instrumentation: Compare specifications of bathymetric systems (single beam echosounders, multibeam echosounders, interferometric sidescan sonar, and Lidar). Explain the importance of the correct installation and determination of the attitude and position of each sensor.
- Operations: Describe the roles of the following survey parameters: scale, positional accuracy, survey speed, line orientation, interlines, cross lines, fix interval, data coverage. Explain methods for quality control of survey data, and the quality assurance of surveys. Describe cost estimating, and project scheduling. Create specifications for specific surveys, including appropriate requirements for scale, positional accuracy, survey speed, line orientation, interlines, cross lines, fix interval, and data coverage. Specify methods to be used for quality control of survey data, and the quality assurance of surveys.

Essential Reference Material:

All of the listed materials are available online.

1. International Hydrographic Organization (IHO):

http://www.iho.shom.fr/PUBLICATIONS/IHO_Download.htm

a. M-13 Manual on Hydrography, 1st Edition, May 2005,

http://www.iho.shom.fr/PUBLICATIONS/download_M13.htm

A comprehensive treatment of hydrographic Surveying

b. S-44 IHO, 5th Edition, Standards for Hydrographic Surveying,

http://www.iho.shom.fr/publicat/free/files/S-44_5E.pdf

International standards for hydrographic data collection

2. US National Oceanic and Atmospheric Administration (NOAA):

<http://tidesandcurrents.noaa.gov/pub.html>

a. NOS Hydrographic Surveys Specifications and Deliverables,

<http://www.nauticalcharts.noaa.gov/hsd/docs/Specs2009.pdf>

A comprehensive treatment of hydrographic Surveying

b. Tidal Datums and Their Applications, NOAA Special Publications NOS CO-OPS 1,

http://tidesandcurrents.noaa.gov/publications/tidal_datums_and_their_applications.pdf

c. Computational Techniques for Tidal Datums Handbook, NOAA Special Publications NOS CO-OPS 2,

http://tidesandcurrents.noaa.gov/publications/Computational_Techniques_for_Tidal_Datums_handbook.pdf

d. Understanding Tides, by Steacy Dopp Hicks,

http://tidesandcurrents.noaa.gov/publications/Understanding_Tides_by_Steacy_finalFINAL11_30.pdf

e. Tidal Currents, Educational Pamphlet #4,

<http://tidesandcurrents.noaa.gov/publications/TidalCurrentsEducationalPamphlet4.pdf>

- f. Co-Ops Specifications And Deliverables For Installation, Operation, And Removal Of Water Level Station,
http://tidesandcurrents.noaa.gov/publications/COOPS_Specifications_and_Deliverables_for_installation_operation_and_removal_of_water_level_stations_updated_November2008.pdf
3. US Army Corps of Engineers (USACE): Hydrographic Surveying,
<http://140.194.76.129/publications/eng-manuals/em1110-2-1003/toc.htm>
A comprehensive treatment of hydrographic Surveying
4. University of New Brunswick (UNB):
 - a. GGE 3353, Imaging and Mapping II, Sub Marine Acoustic Imaging Methods,
http://www.omg.unb.ca/GGE/SE_3353.html
A comprehensive treatment of hydrographic Surveying
 - b. GGE 5013, Oceanography and Tides for Hydrographic Surveyors,
http://www.omg.unb.ca/GGE/GGE5013_Current.html
Hydrographic applications of oceanography and tides
 - c. The Calibration of Shallow Water Multibeam Echo-Sounding Systems, TR190, Andre Godin, 1998, <http://gge.unb.ca/Pubs/TR190.pdf>
A comprehensive treatment of Multibeam patch test calibration techniques
5. Canadian Hydrographic Service:
 - a. Standards for Hydrographic Surveys, 2005, <http://chs-shc.gc.ca/datagestion/hydrographic/standards-normes-eng.pdf>
A comprehensive treatment of hydrographic Surveying
 - b. Canadian Tidal Manual, Forrester, W.D., Hydrographic Chart Distribution Office, DFO, 1675 Russell Road, Ottawa, ON. K1G 3H6 ISBN 0-66—11341-4. Also available in PDF online at:
http://www.pol.ac.uk/psmsl/training/canadian_manual/index.html
A comprehensive description of tides and water level transfer techniques for hydrographic surveying

Supplementary Reference Material:

1. International Hydrographic Organization (IHO):
http://www.iho.shom.fr/PUBLICATIONS/IHO_Download.htm
S-32 Hydrographic Dictionary, 5th Edition,
<http://www.iho.shom.fr/publicat/free/files/S-32-eng.pdf>
A listing of hydrographic terms and acronyms