



**ALBERTA INSTITUTE
OF AGROLOGISTS**

2017

***Contaminated Lands - Assessment, Remediation and Management
Practice Standard***



Approved by AIA Council

5/18/2017

Preface

This practice standard is part of the continuing effort by the Alberta Institute of Agrologists (AIA) to meet its mandate as outlined in the *Agrology Profession Act*. The *Act* specifies that the Institute must establish, maintain and enforce standards of practice as part of the profession's obligation to protect the public in matters related to agrology.

This document was created by the AIA with assistance from a Practice Area Expert Committee (PAEC) consisting of five members of the AIA. Members were selected for their expertise and long standing practice in contaminated land management.

This practice standard is the basis upon which practice reviews will be conducted by the AIA. This document will assist members in ensuring that their professional practice meets the standards for education, work experience, skills and performance required for professionals practicing in contaminated land management.

This document will be reviewed on a periodic basis to ensure it is up to date with current standards and state of knowledge for the practice area.

Acknowledgments

The AIA wishes to acknowledge the following people for their contribution to this Practice standard as members of the PAEC for the *Contaminated Lands - Assessment, Remediation and Management* practice area:

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Acronyms

AEP	Alberta Environment and Parks
APEC	Area of Potential Environmental Concern
CoPC	Chemicals of Potential Concern
CSA	Canadian Standards Association
ESA	Environmental Site Assessment
PA	Practice Area
PAEC	Practice Area Expert Committee

1. INTRODUCTION

This practice standard applies to regulated members of the Alberta Institute of Agrologists (AIA) who practice or intend to practice in the "*Contaminated Land - Assessment, Remediation and Management*" practice area (PA). It defines expectations and outlines requirements regarding professional practice within this area. Documentation of these requirements provides necessary assurance to the public that AIA has specific requirements for professional practice. This practice standard provides members a benchmark upon which to assess their practice and identify potential learning needs in their continuing competence program.

This practice standard is based on the premise that assessment, remediation and management of contaminated land are multidisciplinary activities. Practitioners are expected to understand the limit of their knowledge, skills and experience and seek the expertise of other professionals where necessary.

Professional Agrologists and Registered Technologists are knowledgeable about various types of land use, particularly agricultural and natural areas land use. They bring a variety of knowledge, experience and skill sets to the practice of contaminated land assessment, remediation and management. These include:

- Distinguishing natural background concentrations versus anthropogenic sources of contaminants (especially salts, metals and petroleum hydrocarbons)
- Soil chemical, physical and biological properties and processes
- Plant-soil interactions
- The contribution of the land base to human and ecological health
- Landscape-scale analysis of contaminant fate and transport pathways
- Bioremediation principles and practices
- Selection and management of site remediation technologies and soil handling equipment
- Sampling of soils, plants and water
- Classification and evaluation of soils, plants and wetlands
- Identification of disturbed vs. undisturbed soil profiles
- Chemical and physical properties for soil series and geological material.

This practice standard forms the basis for implementation of a practice review protocol for this PA. Members working within this PA will be able to request a review of their professional practice based on this practice standard. The intent of practice reviews is to provide members with a mechanism for feedback on their professional practice and identify areas for improvement if any.

1.1. Objectives

The objectives of this practice standard include the following:

- Identify and define the knowledge, skills, experience and performance requirements for professional practice within the PA;
- Provide documentation of the requirements indicated above so that regulated members of AIA may assess their practice against this standard and thereby identify learning needs to ensure they meet the standard;
- Provide a standard against which a member's professional practice may be reviewed by AIA to assist the member in identifying areas of their practice that may need improvement;
- Provide a mechanism whereby AIA can demonstrate that members within the profession are managed in a manner to protect the interests of the public in matters related to contaminated land assessment, remediation and management.

1.2. Definitions

Competence: The ability to perform certain tasks in one's professional practice based on educational training, skills and work experience in a manner that meets performance objectives as defined in a practice standard.

Core Knowledge Area: A general area of knowledge consisting of one or more specialized subject matter areas that are required for practicing within a particular practice area.

Direct Supervision: Guidance provided by a competent professional who accepts responsibility for work conducted by a less experienced professional.

Experience: Knowledge, practical wisdom or skills gained from observation and doing.

Performance: The exercise of knowledge in a professional practice that demonstrates the required ethical conduct and wise judgment as specified within a practice standard.

Practice Area: A unique functional area of professional practice within the agrolgy profession that requires specialized knowledge, based on education, work experience and skill sets.

Practice Area Expert Committee: A committee of experts who have demonstrated through their professional practice that they have a comprehensive understanding of the requirements for professional practice in a particular practice area.

Practice Review: A process whereby a peer review panel examines a regulated member's professional practice against a practice standard, with the intent of providing input on practice improvement.

Practice Standard: A document that outlines the requirements and expectations for professional practice within a particular practice area.

Professional Practice: The competent and ethical provision of specialized knowledge, recommendations and assessments based on educational training, work experience and skill sets while being accountable to peers as a regulated member of a professional regulatory organization.

Regulated Member: A member in good standing with the Alberta Institute of Agrolgists who holds one of the following designations: PAg, RTAg, AIT or ATT.

Skill: An ability developed over multiple years of work experience.

Subject Matter Area: A specialized area of knowledge such as soil chemistry, plant physiology or hydrology required for professional practice within a practice area.

2. SCOPE OF THE PRACTICE AREA

The Contaminated Lands - Assessment, Remediation and Management PA involves activities related to identifying, assessing, managing and remediating contaminants found within environmental media to facilitate the return of a site to a desired end land use. It is a multidiscipline area of practice that includes recognizing, sampling and delineating contaminated environmental media and developing site management plans. Practitioner activities may include recommending and implementing appropriate remediation strategies and technologies based on site and contaminant characteristics, exposure pathways and risk management that consider both human and ecological health. Competent practitioners are fully conversant with relevant legislation, standards, directives and guidelines and provide ethical recommendations to their clients based upon sound scientific principles.

This PA does not include the area of Land Reclamation. Land reclamation is the stabilization, contouring, maintenance, conditioning, reconstruction or revegetation of the land surface to a

state that permanently renders the land with a capability equivalent to its pre-disturbed state or for an alternate designated land use. Whether reclamation is required on contaminated lands after remediation or risk management is dependent upon the desired land use. Land reclamation is required for all mandatory activities defined in the *Environmental Protection and Enhancement Act* (EPEA) and in areas where the final land use requires a soil growth media for revegetation.

The Contaminated Lands - Assessment, Remediation and Management PA involves a complex assemblage of activities. The main activities, outlined below, involved in this PA include:

- Understanding Drivers and Planning
- Phase 1 Environmental Site Assessments (ESA)
- Phase 2 ESA
- Remediation
- Risk Assessment
- Exposure Control (Risk Management)
- Validation and Closure

These activities vary in the type and depth of knowledge and level of experience required to be proficient in each activity and therefore practitioners may be involved in one or more of these activities depending on their knowledge, experience and skill sets.

2.1 Understanding Drivers and Planning

Understanding the drivers responsible for contaminated site assessment, remediation and management is essential to effective project planning. Drivers may include, but are not limited to, regulatory requirements, socioeconomic considerations, government policy, real estate transactions, etc. An understanding of contaminants and environmental media is essential for identifying project objectives and how to achieve desired outcomes.

2.2 Phase 1 Environmental Site Assessments

Phase 1 ESAs are conducted to identify potential areas of contamination at a site. The activity involves reviewing current and historical records, conducting a site visit and interviews with personnel knowledgeable of site history, conditions and infrastructure. It is conducted as a first step in determining actual or potential contamination on- and off-site. Essential for conducting Phase 1 ESAs is an understanding of the susceptibility of the infrastructure to leak or fail, the likely contaminants and their properties (volatility, solubility, etc.), environmental media and how the contaminants move through the media. Phase 1 ESA standards and work scope are defined by Alberta Environment and Parks¹. Phase 1 ESA for energy activities (oil and gas, coal and oil sands sites) is regulated by the Alberta Energy Regulator, while Phase 1 ESA for non-energy activities is regulated by Alberta Environment and Parks. Phase 1 ESA for energy activities requires more understanding of soil handling for drilling waste and site construction and reclamation procedures specific to this industry and does not usually include assessment of hazardous building materials. Areas of potential environmental concern (APECs) and associated CoPCs may be identified through a Phase 1 ESA and historical review. A Phase 1 ESA usually does not include a sampling and analysis component.

2.3 Phase 2 Environmental Site Assessments

Phase 2 ESAs are assessments to determine the type and extent of contamination at a site. The AEP ESA Standard² describes a Phase 2 ESA as:

¹ Alberta Environment and Parks (AEP), 2016. Alberta Environmental Site Assessment Standard. Land Policy Branch, Policy and Planning Division. 31pp.

² Alberta Environment and Parks (AEP), 2016. *Alberta Environmental Site Assessment Standard*. Land Policy Branch, Policy and Planning Division. 31pp.

A Phase 2 ESA must determine, through intrusive sampling, the presence or absence of CoPC(s) at a site, and the type, extent, degree, and approximate volume of contamination at the APEC. Where CoPC(s) and APEC(s) are identified through an initial Phase 2 investigation, a more detailed Phase 2 ESA involving full delineation of the contaminated area(s) [and media affected] is required as defined in Alberta Tier 1 and Tier 2 guidelines. The main components of a Phase 2 ESA are: reviewing existing Phase 2 ESA, previous Phase 2 ESAs and any other background information, developing a Conceptual Site Model (CSM), planning a site investigation including development of sampling plans, conducting site investigations, interpreting and evaluating the data gathered during investigations and summarizing conclusions...At the completion of a Phase 2 ESA, the Professional must be able to conclude, at a minimum, that either:

- the ESA has provided sufficient information to support that there is no reasonable basis to suspect a substance release has occurred at the site that has caused, is causing, or may cause adverse effect; or*
- the ESA has confirmed a substance release has occurred at the site, and that further assessment, remedial measures or exposure control measures are required.*

The Canadian Standards Association Phase 2 Standard³ refers to a Phase 2 as:

Phase 2 studies are undertaken to confirm the presence [or absence] of substances of concern [potential contaminants]. The key technical feature that distinguishes Phase 1 and 2 ESAs is the use of quantitative sampling and analytical techniques in Phase 2 studies.....Phase 2 assessments may be much more expensive and time-consuming than a Phase 1 ESA. Furthermore, Phase 2 assessments usually require contributions from specialized environmental professionals.

2.4 Remediation

Remediation is the treatment of contaminated media or its removal from a site. The main components of remediation are planning (assessing the risk and urgency), remedial option evaluation, preparation and implementation of Remedial Action Plans (RAPs), confirmation sampling and chemical analyses, and remediation completion documentation. If the type of contamination and media affected has well documented technologies for treatment then remediation can proceed; however, new technologies usually require lab scale and pilot evaluations before being implemented. Also, remediation planning requires quotes and management of the site assessment professionals and contractors or construction companies with the equipment. Public construction contracts usually require writing of engineering specifications. An understanding of liability one takes on and professional liability insurance “errors and omissions, general comprehensive and pollution insurance” is critical whenever undertaking work related to remediation.

2.5 Risk Assessment

Risk assessment evaluates information on the potential toxic effects of contaminating substances on biological systems (receptors) in contact with contaminated soil, air, water and food through various exposure routes (pathways). Risk exists only when contaminant's receptors and pathways intersect. Risk assessment framework includes problem formulation, exposure and toxicity analysis and risk characterization. Federal guidance documents exist for conducting human and ecological risk assessments and identify three levels with increasing scope of work:

³ Canadian Standard Association (CSA). 2013. *Phase II Environmental Site Assessment*. CSA Z768-00.

screening, preliminary quantitative and detailed quantitative^{4,5,6}. Risk assessments can be used on contaminated sites to set site-specific guidelines. The site-specific guidelines can be used to set remediation objectives based on physical or land use variations from those in the generic models or to demonstrate acceptable risk.

2.6 Exposure Control (Risk Management)

Rather than relying solely on treating or removing contaminants to mitigate risk, exposure control mitigates risk to receptors by removing or altering an exposure pathway or receptor, or controlling a contaminant source. This may be done as an interim step until remediation objectives can be met, or where remediation is not an immediately viable option, or is not in the best interests of the environment. Exposure control can be achieved by implementing physical or chemical barriers to prevent exposure to receptors and/or by placing administrative controls on a property. These options require continued care and control by responsible parties and may limit land uses. Professionals involved in exposure control must be experienced in developing detailed conceptual site models, and have a strong understanding of the principles of risk assessment and contaminant fate and transport and general contaminant behavior.

2.7 Validation and Closure

Validation and closure is the process whereby regulatory compliance is obtained. It utilizes knowledge of current and potential future liability; land use management tools; and legally defensible scientific data. The process is often different for sites that fall under different legislative controls or regulations, for example brownfield, waste management and industrial sites. This activity does not include oilfield sites where the reclamation certificate process includes addressing contamination within each of the previous defined activities. Instead, it refers more to other sites, like industrial sites, where a remediation certificate is mandatory, or to re-development of former contaminated sites. Experience in all the previously defined contaminated land activities is usually a requirement to assess whether all the data gaps at each step have been addressed and remaining uncertainties are clearly stated and quantified. A statistical (probability) approach may be required for the final assessment. Communication throughout the process with stakeholders, regulators, property owners and their lawyers is often required.

3. KNOWLEDGE REQUIREMENTS

Knowledge requirements are technical or scientific areas of knowledge that are essential to professional practice within the PA. These requirements consist of core knowledge areas that consist of one or more specialized subject matter areas that are foundational to the PA. Without this knowledge, members must recognize the limits of their expertise and either upgrade their knowledge or seek advice and direction in those subject matters where their knowledge is lacking.

The specification of subject matters within each required core knowledge area provides assurance that members working within the PA have the necessary fundamental knowledge to practice. The subject matters within each core knowledge area represent specific scientific or technical knowledge relevant to the PA activities. Subject matter knowledge is usually obtained through educational training in a degree or diploma program; however, subject matter knowledge may also be attained via work experience, self-study or non-adjudicated industry courses (i.e. short courses). To assure the public that practitioners have indeed acquired knowledge outside

⁴ CCME. 2016. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment. Volumes 1 to 4.

⁵ Health Canada. 2004. Federal Contaminated Site Risk Assessment in Canada. Parts 1 to V. Prepared by Environmental Health Assessment Services Safe Environments Programme.

⁶ Environment Canada 2012. Ecological Risk Assessment Modules 1 to 4.

of an educational degree or diploma program, such knowledge needs to be validated through a challenge exam process implemented by the AIA.

A description of each of the main activities identified in Section 2 and the knowledge requirements for each of these activities follows in Tables 1 through 7. Members are expected to work toward updating their knowledge where they are lacking specific subject matters for the activities related to their practice. Where regulated members do not meet a knowledge requirement for those main activities within which they work, they will be required to address the deficiency by doing one of the following three things:

1. Seek Advice and Direction: Members lacking specific knowledge in required subject matters must recognize the limits of their expertise and seek advice and direction from a qualified professional depending on the nature of the work being conducted.
2. Complete Challenge Exam(s): To validate that subject matter knowledge has been gained through work experience, self-study or non-adjudicated industry courses, a member will be required to either (i) write a professional practice examination supplied by the AIA; or, (ii) to appear before a panel of peers to complete an oral examination supplied by the AIA;
3. Pursue Formal Education and Training: Obtain credit in a formal course from an appropriate educational institution or from an industry course approved by the AIA. Such courses must have an adjudicated examination to document knowledge attained;

Knowledge requirements for the PA are described in the following tables for each of the main activities identified in Section 2. The variation in knowledge requirements by activity reflects the complexity of this PA. It is important to realize that the knowledge requirements are stratified by main activity. Members should refer only to those activities within which they actively work and assess their knowledge against the required knowledge for those activities. For example, if a member does not conduct “Risk Assessments”, then those knowledge requirements do not apply to them unless they wish to begin to work within that activity.

Table 1. Knowledge Requirements for Understanding Drivers and Planning

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A knowledge of the fundamentals of both inorganic and organic chemistry is necessary to understand contaminant behavior within environmental media and the potential risk to receptors.	<ul style="list-style-type: none"> • Inorganic Chemistry • Organic Chemistry 	<ul style="list-style-type: none"> • Soil Chemistry • Geochemistry • Environmental Chemistry
Soils and Landforms	A knowledge of soil science or surficial geology is necessary to understand the physical, chemical and biological properties of a site that may affect ESAs and management.	<ul style="list-style-type: none"> • Soil Science OR Quaternary Geology 	<ul style="list-style-type: none"> • Geomorphology
Water	A knowledge of hydrologic processes and how they vary spatially and temporally is	<ul style="list-style-type: none"> • Hydrology OR Hydrogeology 	<ul style="list-style-type: none"> • Soil Physics

	necessary to understand contaminant fate and migration.		
Ecology	A knowledge of how ecosystem components (e.g. soil, water, air, vegetation, wildlife) interact with each other is necessary to understand the potential effect of contaminants on the ecosystem.	<ul style="list-style-type: none"> Ecology 	<ul style="list-style-type: none"> Ecosystem Management
Socioeconomics and Policy	A knowledge of legislation, economics, and environmental policy is necessary to understand drivers for ESAs and project planning.	<ul style="list-style-type: none"> <i>One of the recommended subjects for Socioeconomics and Policy</i> 	<ul style="list-style-type: none"> Environmental Policy Environmental Planning Environmental Impact and Mitigation Environmental Law Land Use Planning

Table 2. Knowledge Requirements for Phase 1 Environmental Site Assessments

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A knowledge of the fundamentals of both inorganic and organic chemistry is necessary to understand contaminant behavior within environmental media and the potential risk to receptors.	<ul style="list-style-type: none"> Inorganic Chemistry Organic Chemistry 	<ul style="list-style-type: none"> Soil Chemistry Geochemistry Environmental Chemistry

Table 3. Knowledge Requirements for Phase 2 Environmental Site Assessments

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A knowledge of the fundamentals of both inorganic and organic chemistry is necessary to understand contaminant behavior within environmental media and routes of exposure to receptors. In addition, understanding knowledge of statistically valid sampling	<ul style="list-style-type: none"> Inorganic Chemistry Organic Chemistry 	<ul style="list-style-type: none"> Contaminant Behavior Environmental Sampling Design Statistical Analysis

	designs and analysis of data is required.		
Soils and Landforms	An advanced knowledge of soil processes and behavior, and ability to describe soil and geology according to standard classification systems for communicating site characteristics is necessary to understand and interpret contaminant fate and behavior when conducting Phase 2 ESAs.	<ul style="list-style-type: none"> • Soil Science • Soil Classification 	<ul style="list-style-type: none"> • Soil Chemistry • Quaternary Geology • Geomorphology • Geochemistry
Water	Knowledge of surface and subsurface water behavior and the dynamics of hydrologic processes at a given site is necessary to understand how these influence contaminant fate and transport.	<ul style="list-style-type: none"> • Hydrology OR Hydrogeology 	<ul style="list-style-type: none"> • Soil Physics
Vegetation	A knowledge of plant science is necessary for understanding and recognizing indicators of contaminant effects on vegetation.	<ul style="list-style-type: none"> • Plant Science • Vegetation Identification 	<ul style="list-style-type: none"> • Weed Science • Plant Physiology • Plant-Soil Relationships

Table 4. Knowledge Requirements for Remediation

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A knowledge of the fundamentals of both inorganic and organic chemistry is necessary to understand contaminant behavior within environmental media and routes of exposure as well as understanding chemical reactions and biological activity potentially involved in remedial technologies and strategies.	<ul style="list-style-type: none"> • Inorganic Chemistry • Organic Chemistry • Remediation Strategies 	<ul style="list-style-type: none"> • Soil Microbiology • Biotreatment • Toxicology
Soils and Landforms	An advanced knowledge of soil processes and behavior in relation to contaminant fate and behavior is necessary to select and implement appropriate remedial technologies and strategies and for	<ul style="list-style-type: none"> • Soil Science • Soil Classification • Soil Chemistry 	<ul style="list-style-type: none"> • Geochemistry

	understanding how technologies react differently with different site conditions.		
Water	A knowledge of surface and subsurface water behavior and the variability of hydrologic processes is necessary to understand and evaluate contaminant fate and transport spatially and temporally.	<ul style="list-style-type: none"> Hydrology OR Hydrogeology 	<ul style="list-style-type: none"> Soil Physics

Table 5. Knowledge Requirements for Risk Assessment

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A comprehensive knowledge of contaminant properties and behavior, toxicology, and risk assessment protocols are required for understanding and conducting risk assessments for human and ecological health.	<ul style="list-style-type: none"> Inorganic Chemistry Organic Chemistry Contaminant Behavior Ecological and Human Health Risk Assessment Toxicology Statistical Analysis 	
Soils and Landforms	An advanced knowledge of soil chemistry and surficial geology stratigraphy is essential for understanding risk and potential for exposure.	<ul style="list-style-type: none"> Soil Science OR Quaternary Geology Soil Chemistry 	
Water	A knowledge of surface and subsurface water behavior and the variability of hydrologic processes at a given site is necessary to understand how these influence contaminant fate and transport.	<ul style="list-style-type: none"> Hydrology Hydrogeology 	
Vegetation	A knowledge of plant science is necessary to understand and recognize indicators of contaminant effects on vegetation.	<ul style="list-style-type: none"> Plant Science Plant Nutrition Plant Physiology 	
Ecology	A knowledge of how ecosystem components (e.g. soil, water, air, vegetation, wildlife) interact with each	<ul style="list-style-type: none"> Ecology 	<ul style="list-style-type: none"> Ecosystem Management

	other is necessary to understand the potential effect of contaminants on the ecosystem.		
Animals	A knowledge of animal nutrition and physiology is necessary to understand the potential effects of contaminants on animal health.	<ul style="list-style-type: none"> • Animal Nutrition • Animal Physiology 	
Socioeconomics and Policy	A knowledge of the regulatory, economic, and environmental drivers for environmental site management is required.	<ul style="list-style-type: none"> • <i>One of the recommended subjects for Socioeconomics and Policy</i> 	<ul style="list-style-type: none"> • Environmental Policy • Environmental Planning • Environmental Impact and Mitigation • Land Use Planning

Table 6. Knowledge Requirements for Exposure Control (Risk Management)

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A knowledge of the fundamentals of both inorganic and organic chemistry is necessary to understand contaminant behavior within environmental media and the potential risk to receptors.	<ul style="list-style-type: none"> • Inorganic Chemistry • Organic Chemistry • Contaminant Behavior 	
Soils and Landforms	A basic knowledge of landforms and soil properties and behavior is necessary to understand their effects on contaminant fate and transport.	<ul style="list-style-type: none"> • Soil Science OR Quaternary Geology 	<ul style="list-style-type: none"> • Physical Geography
Water	A knowledge of surface and subsurface water behavior and the variability of hydrologic processes is necessary to understand and evaluate contaminant fate and transport spatially and temporally.	<ul style="list-style-type: none"> • Hydrology • Hydrogeology 	<ul style="list-style-type: none"> • Soil Physics

Table 7. Knowledge Requirements for Validation and Closure

Core Knowledge Area	Rationale	Required Knowledge	Recommended Knowledge
Contaminants	A knowledge of the fundamentals of both inorganic and organic chemistry is necessary to understanding contaminant behavior within environmental media and the potential risk to receptors. In addition, an understanding of statistically valid sampling designs and analysis of data is required.	<ul style="list-style-type: none"> • Inorganic Chemistry • Organic Chemistry • Environmental Sampling Design • Statistical Analysis 	
Soils and Landforms	An advanced knowledge of soil processes and behavior is necessary to understand their effects on contaminant fate and behavior on- and off-site.	<ul style="list-style-type: none"> • Soil Science • Soil Classification 	<ul style="list-style-type: none"> • Soil Chemistry • Geochemistry • Quaternary Geology
Water	A knowledge of surface and subsurface water behavior and the variability of hydrologic processes at a given site is necessary to understand how these influence contaminant fate and transport.	<ul style="list-style-type: none"> • Hydrology • Hydrogeology 	<ul style="list-style-type: none"> • Soil Physics
Vegetation	A knowledge of basic plant science is necessary to understand and recognize indicators of contaminant effects on vegetation.	<ul style="list-style-type: none"> • Plant Science 	
Ecology	A knowledge of how ecosystem components (e.g. soil, water, air, vegetation, wildlife) interact with each other is necessary to understand the potential effect of contaminants on the ecosystem.	<ul style="list-style-type: none"> • Ecology 	<ul style="list-style-type: none"> • Ecosystem Management
Socioeconomics and Policy	A knowledge of the regulatory, economic, and	<ul style="list-style-type: none"> • <i>One of the recommended</i> 	<ul style="list-style-type: none"> • Environmental Policy

	environmental drivers for environmental site management is required.	<i>subjects for Socioeconomics and Policy</i>	<ul style="list-style-type: none"> • Environmental Planning • Environmental Law • Land Use Planning
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4. WORK EXPERIENCE

Work experience represents an additional source of knowledge gained through professional practice. Such experience facilitates development of skill sets needed to be competent within one's practice. Development of these skill sets takes time while working in an environment where feedback is available to hone skills and experiential knowledge. With progressive experience comes a breadth of knowledge and perspective that facilitates strategic thinking and problem solving within the PA. Practitioners that have experience with multiple main activities gain valuable insight compared with those who restrict their practice to a single main activity (for example, obtaining Phase 1 ESA experience to complement Phase 2 ESA experience).

4.1 Skill Sets

Certain skill sets and capabilities enhance proficiency within a given PA (Table 8). Application of scientific or technical knowledge requires skill sets which are identified within this practice standard. Skill sets are essential to effective functioning within the PA and are generally developed during work experience, mentoring and/or gained through professional development courses.

In addition to these skill sets, practitioners are advised to consult the competencies table for contaminated land management as published in the document "Competencies for Remediation and Reclamation – Advisory Committee Recommendations Report" (Alberta Environment 2006).⁷

Table 8. Skill Sets Relevant For The Practice Area

Skill Sets	Description
Industry and infrastructure knowledge	This skill set involves the appropriate knowledge with the site specific information to be able to identify, for the applicable industry, the appropriate potential contaminants of concern and where they are typically located on site. This skill set also allows the professional to adequately identify associated infrastructure and hazards.
Safety and hazard assessment	This skill set is usually obtained through short courses on safety pertinent to the hazards at the site and the activities being conducted (like H2S, WHMIS, TDG, ground disturbance, equipment or construction safety, hazard assessment, ATVs, fire control, respirators, protection of assessors from contaminant exposure)
Regulatory understanding and application	Understand the legal framework, including legislation, standards, guidelines, and policies, that establish the regulatory context for contaminated land assessment,

⁷ Alberta Environment 2006. Competencies for Remediation and Reclamation. Advisory Committee Recommendations Report. Alberta Environment, Edmonton, Alberta, 16 pp.

	remediation and management.
Project planning and management	This skill set is required to ensure all stakeholders expectations are met. It includes proposal and budget preparation, development and implementation of a project plan, ongoing assessment of alignment with project plan and objectives; change and cost management; project integration and completion.
Land locating and information	This skill set includes the use of various tools to locate and identify land location such as land titles, surveys, zoning and remote sensing (aerial photographs or satellite imagery). It can be achieved by post-education courses or short courses on GPS, GIS or remote sensing and/or being mentored on the many land information or zoning or environmental records whether it be AER, AP, drilling records, Environmental Site Repository, Environmental Law Centre or municipal databases and/or maps.
Relationship building, management and communication with clients, stakeholders and regulators	This skill set relates to establishing and maintaining relationships and communications with regulators, clients and other stakeholders. Communication is essential to ensure that remediation drivers are accounted for and incorporated into project objectives and stakeholder and regulator expectations are met.
Site interpretation and conceptual site model development	Interpreting contaminant information in the context of site and receptor characteristics to develop an understanding of contaminant fate and behaviour, exposure pathways, and potential risks. This is done with an understanding of regulatory requirements and in order to develop contaminant management options.
Sampling, data collection, management and validation	This skill set is required to ensure data meets quality standards by using documented sampling protocols (e.g. sample handling, chain of custody, data analysis and QA/QC) and analytical protocols and data management protocols to ensure data is credible and defensible.
Understanding earth moving, soil handling activities, efficiencies and equipment capabilities	This skill set is developed through in-field interaction with contractors responsible for earth moving and soil handling. An understanding of equipment limitations and capabilities in the context of the site is fundamental to site management.
Contractor management	Working with contractors and understanding the sequence and logistics of site management activities is a critical skill for professionals.
Choosing appropriate remedial technologies and strategies based on applicability and efficacy	Evaluate remediation options by weighing ability to meet site management objectives, cost factors, environmental risks, safety considerations, schedules, and other factors, to choose the most appropriate technologies for the project.
Database use, modelling and statistics	Use of risk assessment and contaminated site databases, spreadsheet use, specific tools and software for statistics, ecological and human health and learning specific models for vapor migration, groundwater, wildlife diet and climate.
Documentation and reporting	Documentation of rationale for decisions made and conclusions drawn is a key requirement of professionalism.

	Clearly expressing results and professional opinions based on supporting data in an appropriate format is an important skill for the practitioner.
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4.2 Years of Experience

Three levels of work experience are recognized within this practice standard (Tables 9 and 10). A practitioner must progress from junior to intermediate to senior levels of experience for each main activity within the PA. It is common to have junior level experience in one main activity and intermediate or senior level experience in another main activity. It is important that practitioners recognize the limitations of their expertise and do not accept work duties and responsibilities that are beyond their experience level unless the work is conducted during training under direct supervision of a qualified professional.

Junior level (< 5 years of experience). The junior level of experience typically coincides with entry level personnel. This work experience is conducted under the supervision of a qualified professional within the PA. Practitioners at the junior level are not considered to have sufficient experience to sign-off on reports, maps and other work products. The junior experience level has work experience of less than 5 years in a main activity within this PA (see Table 9). This is consistent with expectations of the Government of Alberta with respect to professional sign-off on regulatory documents.

Intermediate level (5 to < 10 years of experience). The intermediate practitioner no longer requires direct supervision and has developed the necessary skills and obtained the necessary experiential knowledge to take responsibility for their unsupervised work. They often play a supervisory and training role to more junior personnel and are able to sign-off on some reports, regulatory applications and other work products. The intermediate experience level typically corresponds with 5 to <10 years of relevant work experience in this PA. It is important that intermediate practitioners recognize the limitations of their expertise and do not accept work duties and responsibilities that are beyond their experience level (e.g. complex sites that are multi-matrix, require a multi-professional approach and use of Tier 2 guidelines should be guided by senior level personnel).

Senior level (> 10 years of experience). Senior level practitioners are those that have typically > 10 years of work experience and provide supervision and training to intermediate and junior personnel. They are recognized as knowledge experts and are responsible for project quality assurance and quality control. Senior level involvement should occur at the initial planning/scoping phase, data evaluation and final review project milestones.

Table 9. Work Experience

Experience Level	Years of Experience	Examples of Typical Job Duties	Supervision and Professional Sign-off
Junior	< 5 years	<ul style="list-style-type: none"> Follow standard operating procedures: sampling, data entry, analysis and reporting; Desktop and literature review for project; Field data collection; Receive mentorship; Data entry and analysis; Data interpretation with guidance; Reporting under supervision; 	<ul style="list-style-type: none"> Junior personnel are supervised directly by intermediate or senior personnel; Professional sign-off is not permitted for this experience level.

		<ul style="list-style-type: none"> • Participate in project planning and project execution with more senior staff; • Develop an understanding of their own capabilities and seek advice from more senior professionals. 	
Intermediate	Typically, 5 to 10 years	<ul style="list-style-type: none"> • Review and recommend changes to standard operating procedures; • Make recommendations on project execution; • Decision-making in field operations; • Project planning, developing work plans and project execution; • Stakeholder engagement; • Regulatory communications; • Stakeholder relationships and management; • Contractor management; • Field data collection; • Data analysis and interpretation; • Reporting; • Provide mentorship; • Receive mentorship; • Aware of their own expertise limitations and seek advice from other professionals. 	<ul style="list-style-type: none"> • Intermediate personnel may play a supervisory and management role. • Intermediate personnel may sign-off on reports and regulatory applications.
Senior	Typically, > 10 years	<ul style="list-style-type: none"> • Data interpretation and reporting • Act as technical advisor • Develop, review and sign off on standard operating procedures; • Understand and represent both public and client interests; • Act as a key representative for their organization; • Responsible for overall project execution, completion and client satisfaction; • Act as regulatory liaison; • Responsible for strategic planning, business development and decision making; • Responsible for financial decisions; • Provide expert technical advice; • Provide mentorship; • Receive mentorship; • Aware of their own expertise limitations and seek advice from other professionals. 	<ul style="list-style-type: none"> • Senior personnel are responsible for senior review, QA/QC and sign-off on reports and regulatory applications. • Senior personnel play key supervisory and management roles.

Table 10. Appropriate Activities Based On Experience Level

Main PA Activity	Junior Level	Intermediate Level	Senior Level
Understanding Drivers and Planning		√	√
Phase 1 ESA	*	√	√
Phase 2 ESA	*	√	√
Remediation	*	√	√
Exposure Control (Risk Management)		*	√
Risk Assessment		*	√
Validation and Closure		*	√
√ Experience level sufficient to be responsible for the activity			
* Under direct supervision only			

5. PERFORMANCE REQUIREMENTS

In addition to the General Practice Standard that applies to all AIA members (see Appendix 1), specific performance requirements have been developed for this PA. This practice standard not only identifies educational, work experience and skill set requirements for competent practice but also defines the performance expected of regulated members participating in the PA.

The following performance requirements outline the expectations of the professional practicing within the *Contaminated Lands - Assessment, Remediation, Management* PA. Failure to comply with these expectations may be considered as constituting unprofessional conduct under the *Agrology Profession Act*.

The regulated member stays current with contaminated land management research, legislation, directives, guidelines, industry standards and other reference documentation related to contaminated land management.

Regulated members:

- regularly review the currency of documentation and reference material used to support their practice and obtain most current versions when available.
- attend conferences, workshops and updates related to contaminated land management.
- communicate with regulators, research scientists, educators and other practitioners to ensure they remain current with current contaminated land management knowledge and trends.

The regulated member understands the limits of his/her knowledge, skills and experience and seeks the expertise of other professionals where necessary.

Regulated members:

- make appropriate scientific, technical, practical and logistical decisions based on their education and experiential knowledge in contaminated land management.
- apply their skills and use sound judgement in an ethical manner.
- seek advice and input from other professionals when their expertise is insufficient to make competent decisions and recommendations.

- do not accept contaminated land work that is beyond their expertise and work experience level unless they conduct the work under the direct supervision of a qualified regulated professional.

Regulated members clearly understand their role within the practice area

Regulated members:

- clearly understand their role in a contaminated land project, represent themselves as such and do not exceed the boundaries of that role.
- only accept responsibility for another professional's work when they are confident that the professional has completed the work in a competent manner.

Regulated members clearly understand the project's scope and terms of reference and ensure alignment with a project execution plan

Regulated members:

- understand the objectives, scope and deliverables for the project and work within the terms of reference for the project.
- use a consistent and thorough process for management of the project.
- regularly review the project execution plan to ensure alignment with project goals and objectives.

The regulated member reviews the requirements of this practice standard and addresses any practice deficiencies through his/her ongoing continuing competence program.

Regulated members:

- conduct self-assessments based on the education, work experience, skill set and performance requirements indicated within this practice standard.
- review their self-assessment with a senior qualified professional.
- identify any deficiencies and develop a plan to address them.
- regularly participate in the AIA continuing competence program as required by the *Agrology Profession Act*.

6. RECOMMENDED READING MATERIAL

The following is a list of some recommended reference material for the Contaminated Lands PA in Alberta. It is not intended to be an exhaustive list.

Alberta Energy Regulator (AER) 2001. Directive 055. Storage Requirements for the Upstream Petroleum Industry. 78 pp.

Alberta Energy Regulator (AER) 2006. Directive 058. Oilfield Waste Management Requirements for the Upstream Petroleum Industry. 232 pp.

Alberta Energy Regulator (AER) 2016. Application Submission Requirements and Guidance for Reclamation Certificates for Wellsites and Associated Facilities. Specific Enactment Direction (SED) 002. 42pp.

Alberta Energy Regulator (AER) 2016. Directive 050. Drilling Waste Management. 167 pp.

Alberta Environment (AENV) 2001. Salt Contamination Assessment and Remediation Guidelines. Environmental Services, Environmental Sciences Division. 88pp.

Alberta Environment (AENV) 2006. Competencies for Remediation and Reclamation. Advisory Committee Recommendations Report. Alberta Environment, Edmonton, Alberta, 16 pp.

Alberta Environment and Sustainable Resource Development (ESRD). 2014b. Contaminated Sites Policy Framework. Land and Forestry Policy Branch, Policy Division. Edmonton, Alberta. October 31, 2014. http://esrd.alberta.ca/lands_forests/land_industrial/documents/ContaminatedSitesPolicy_C_Oct31_2014.pdf

Alberta Environment and Parks (AEP), 2016. Alberta Environmental Site Assessment Standard. Land Policy Branch, Policy and Planning Division. 31pp.

Alberta Environment and Parks (AEP), 2016. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Land Policy Branch, Policy and Planning Division. 197 pp.

Alberta Environment and Parks (AEP), 2016. Alberta Tier 2 Soil and Groundwater Remediation Guidelines. Land Policy Branch, Policy and Planning Division. 150 pp.

Alberta Environment and Parks (AEP), 2016. Alberta Exposure Control Guide. Land Policy Branch, Policy and Planning Division. 20 pp.

Alberta Environment & Sustainable Resource Development (ESRD). 2014. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Policy Division. Edmonton. 48 pp.

Canadian Council of Ministers of the Environment (CCME), 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN 1332.

Canadian Council of Ministers of the Environment (CCME), 2008. Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (2008). 8 pp.

Canadian Council of Ministers of the Environment (CCME), 2008. Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: User Guidance (2008). 162 pp.

Canadian Council of Ministers of the Environment (CCME), 2016. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 1 Guidance Manual 343 pp; Volume 2 Checklists 39 pp; Volume 3 Suggested Operating Procedures 217 pp; Volume 4 Analytical Methods 195 pp.

Canadian Standards Association 2012. Phase I Environmental Site Assessment. CSA A768-01.

Canadians Standard Association (CSA). 2013. Phase II Environmental Site Assessment. CSA Z768-00.

Carter M.R. and Gregorich E.G. 2007. Soil Sampling and Methods of Analysis, 2nd Edition. CRC Press, Boca Raton FL, USA. 1262 pp.

Environment Canada 2012. Ecological Risk Assessment Modules 1 to 4.

Health Canada. 2004. Federal Contaminated Site Risk Assessment in Canada. Parts 1 to V. Prepared by Environmental Health Assessment Services Safe Environments Programme.

Province of Alberta 2014. *Public Lands Act*. Revised Statutes of Alberta 2000, Chapter P-40. Queen's Printer, Edmonton, Alberta

Province of Alberta 2014. *Water Act*. Revised Statutes of Alberta 2000, Chapter W-3. Queen's Printer, Edmonton, Alberta

Province of Alberta 2015. *Agrology Profession Act*. Revised Statutes of Alberta 2005, Chapter A-13.5. Queen's Printer, Edmonton, Alberta

Province of Alberta 2016. *Remediation Certificate Regulation*. Alberta Regulation 154/2009. With amendments up to and including Alberta Regulation 102/2016. Queen's Printer, Edmonton, Alberta

Province of Alberta 2016. *Environmental Protection and Enhancement Act*. Revised Statutes of Alberta 2000, Chapter E-12. Queen's Printer, Edmonton, Alberta

7. SUMMARY

This document describes the knowledge requirements, work experience, skill set and performance expectations for professional practice within the Contaminated Lands – Assessment, Remediation and Management PA for the Agrology profession. It provides direction to members of the Alberta Institute of Agrologists who are practicing or who wish to practice within this PA to ensure they are qualified to conduct work in this area.

Members practicing within this PA are required to review this document and assess their educational background, work experience, skill sets and performance against the requirements and expectations herein. Where deficiencies are noted it is expected that members will develop a plan to address these deficiencies through their individual continuing competence programs. Members are expected to understand the limits of their own knowledge and expertise and seek additional advice and professional support as required.

This practice standard will form the basis of ongoing practice reviews conducted by the Institute as well as the basis for review should a member be subject to a complaint. It is the responsibility of the member to be aware of the contents of this practice standard.

APPENDIX 1

The following General Practice Standard applies to all registered members of the AIA. This General Practice Standard is to be adhered to as well as this detailed practice standard for the *Contaminated Land – Assessment, Remediation and Management* PA.

General Practice Standard for All Registered Members of the Alberta Institute of Agrologists

The General Practice Standard applies to all registered members of the Alberta Institute of Agrologists. The purpose of the document is to describe the duties and responsibilities that are incumbent upon each member of the profession. It is the responsibility of each registered member to conduct themselves in accordance with these standards. Registered members will be measured against these standards by the Institute, the public, employers, clients and colleagues. The Standard describes the values of the Institute and the profession, and the expectation for each registered member.

Professional Responsibility

Each registered member of the Alberta Institute of Agrologists (AIA) is required to uphold the standards and reputation of the agrology profession and professional principles.

Indicators

The registered member has a duty to protect the public and to conduct his or her work with an appropriate standard of care.

Standard of care

Standard of care is the legal duty to exercise the watchfulness, attention, caution and prudence that a reasonable professional in the same circumstances would exercise. If a professional's actions do not meet this standard the professional may be found negligent or to have committed unprofessional conduct.

The registered member is personally responsible and accountable for ensuring that his or her agrology practice and conduct meet the requirements of the practice area(s), practice standards, current legislation, regulations and policy.

The registered member will practice with honesty, integrity and respect, and comply with the AIA's Code of Ethics.

The registered member will sign or co-sign a report only if he or she is willing to accept full responsibility for the contents of the report.

The registered member may delegate portions of the work to competent practitioners under the registered member's direct supervision. The registered member will accept responsibility for that work and provide additional quality assurance/quality control to determine the sufficiency of that work. Registered members will not sign any document for which they will not take full responsibility for the contents of the document.

The registered member will hold the public interest paramount and endeavour to put service above gain and excellence above quantity.

Competency

The registered member will practice only in an area(s) where the member has demonstrated competence.

Indicators

The registered member will only practice unsupervised in the practice area(s) where the member's education, skills, and experience fulfill the practice area qualifications and the registered member believes he or she is competent. If a registered member's education, skills, and experience do not meet the requirements of the practice area, the member will practice *only* under the direct supervision of a qualified, registered professional who is competent to do the work and who will give appropriate direction to the registered member.

The registered member, if called upon by the profession, a judicial review or a court ordered request, must be able to clearly demonstrate the knowledge and skillsets gained to enable them to practice in any practice area(s) in which the member deems himself or herself competent to practice.

The registered member will undertake continuing professional development (CPD) with the majority of the CPD hours directly relevant to his or her practice area(s). The registered member commits to reporting his or her CPD activities on the member profile as activities are completed.

The registered member will continually update his or her scientific and standard industry practice knowledge related to the member's practice area(s).

The registered member will demonstrate critical thinking when planning, implementing and evaluating all aspects of the work and making any recommendations as a professional.

The registered member is able to show his or her reasoning in reaching decisions through accurate and clearly written documentation.

The registered member will advise the AIA of any changes to his or her practice area(s), particularly when a new practice area is chosen. The registered member will specify the knowledge and skills that have been acquired to support work in the new practice area.

Provision of Service to the Public, a Client or an Employer

The registered member will promote the qualified, competent and ethical professional role and accountability of agrologists to the public, other professionals, and themselves.

Indicators

The registered member will prepare accurate, concise and clearly written reports and correspondence that are appropriate for the intended audience.

The registered member will communicate clearly and respectfully with a variety of people, including his or her employer, colleagues, clients, members of the public and regulators.

The registered member will advise the client if the work is outside of his or her practice area(s) and if the member will be unable to fulfil the terms of reference for the work.

The registered member will make a referral to seek advice, and enter into collaborations with other professionals in situations which require expertise that extend beyond the member's competence.

The registered member will avoid situations where a conflict of interest exists or where the duties and loyalty owed by a member to one party likely will be, is, has been, or perceived to be, in conflict with the duties or loyalties the member owes to another party.

The registered member will extend public knowledge of their area of expertise whether it is in agriculture, the environment, food sciences or life sciences, and promote factual and accurate statements on matters regarding these areas.

Stewardship

The registered member will advocate and practice good stewardship of all agricultural and environmental resources based on sound scientific principles.

Indicators

A registered member will consider monetary issues, social values, rational application of sound science, lesson of valid experiences, economic impacts to the geographic region, and impacts on future generations when conducting his or her work.

A registered member will inform the client or employer of any action planned or undertaken by the client or employer that he or she believes is detrimental to good stewardship or in breach of known legislation, regulations or policies.

Safety

The registered member understands his or her obligation for promoting public and worker safety and considers the health of the environment, health of the consumer, industrial safety, construction safety and the general operational safety of projects.

Indicators

A registered member will demonstrate concern for the immediate and long-term direct effects of agricultural and environmental practices on the safety of workers by being aware of, and evaluating risks.

A registered member will balance the claims of producers and needs and wants of a consuming public against the potentially competing claims for safety of the environment and the interests of individuals and businesses affected by their proximity to agricultural operations. The registered member is aware that the public expects and demands a safe supply of food, not only for current use but also for future generations.