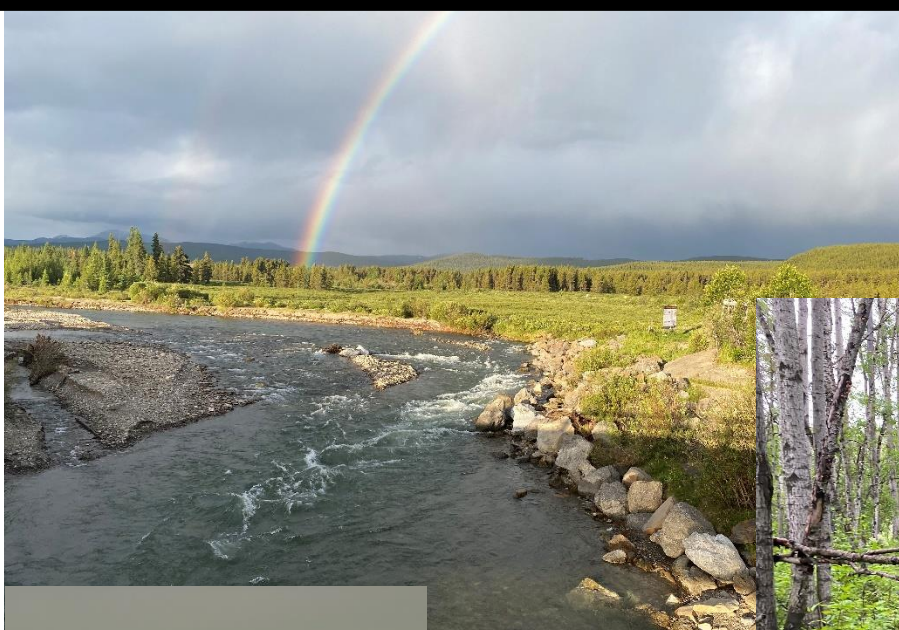
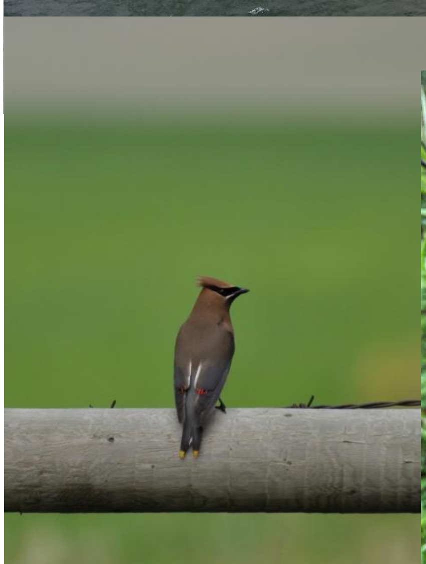
ALBERTA INSTITUTE
OF AGROLOGISTS

2022

Biophysical Classification and Evaluation Practice Standard





Adopted by AIA Council

Date: November 30, 2022

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.

A significant portion of this document is based on the document titled "*Report of the Expert Committee on the Soil and Terrain Classification and Mapping Practice Area for the Alberta Institute of Agrologists*" (2013). This report was an early version of a practice standard for the *Soil and Terrain* practice area. This document provided the foundation for much of the content of this current practice standard, particularly related to soil and terrain classification, mapping, and evaluation. The merger of the *Soil and Terrain* practice area with practice areas focused on Vegetation and Water resulted in the formation of the current *Biophysical Classification and Evaluation* practice area. This merger required the development of a practice standard that defines qualifications to practice within the new practice area. This current practice standard follows the procedures and formats used to create practice standards for the Agrology profession which was implemented in 2017.

This document was created by a Practice Area Expert Committee (PAEC) consisting of five regulated members of the AIA. Members were selected for their expertise and long-standing practice in biophysical classification and evaluation.

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 knowledge, work experience, skills and performance required for professionals practicing in the Biophysical Classification and Evaluation practice area. It 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 Practice Area Expert Committee for the Biophysical Classification and Evaluation practice area:

Dennis O'Leary	Golder Associates Ltd. (Retired)
Kelly Ostermann	Matrix Solutions Inc.
Konstantin Dlusskiy	Paragon Soil & Environmental Consulting Inc.
Samantha Mackay	Alberta Institute of Agrologists
Valerie Coenen	Golder Associates Ltd.

The committee was chaired by Les Fuller, P.Ag. (AIA) and assisted by Cassie Hayes, P.Ag. (AIA).

The AIA wishes to acknowledge the work of the Soil and Terrain Expert Committee who developed an early version of a practice standard for the *Soil and Terrain* practice area. The new *Biophysical Classification and Evaluation* practice standard incorporates much of the text from the earlier *Soil and Terrain* practice standard. The AIA thanks the following for their contribution to the earlier work: Dr. Wayne Pettapiece P.Ag, Mr. Len Leskiw P.Ag, Mr. Dennis O'Leary P.Ag, Mr. Larry Nikiforuk P.Ag, and Dr. Larry Turchenek P.Ag.

The Alberta Institute of Agrologists wishes to thank the members of the AIA who reviewed the draft documents and provided feedback to the PAEC. The AIA would like to acknowledge the following people for their review of the first draft of the practice standard and for providing valuable feedback:

Anne Sommerville	Golder Associates Ltd.
Darrin Nielson	Future Flora Inc.
Dayle Soppet	Lacuna Ecological
Larry Nikiforik	Soil-Info Ltd.
David Novak	SepaCon Environmental

Front Page Photo Credits:

Samantha Mackay	Alberta Institute of Agrologists

Table of Contents

List of Tables

Acronyms

BC&E	Biophysical Classification and Evaluation
CKA	Core Knowledge Area
GIS	Geographic Information System
KR	Knowledge Requirement
PA	Practice Area
PAEC	Practice Area Expert Committee
SIL	Survey Intensity Level

1. INTRODUCTION

This practice standard applies to regulated members of the Alberta Institute of Agrologists (AIA) who practice or intend to practice in the "*Biophysical Classification and Evaluation*" 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. The document provides members a benchmark to assess their practice and identify potential learning needs in their continuing competence program.

Biophysical classification and evaluation are multidisciplinary activities, and thus, practitioners must understand the limitations of their knowledge, skills, and experience and seek the expertise of other professionals where necessary.

This document forms the basis for the implementation of a practice review protocol for this PA. Members working within this PA may be subject to or request a review of their professional practice based on this practice standard. Such a review will provide valuable feedback to members for areas of improvement.

1.1. Objectives

The objectives of this practice standard include the following:

- To provide a mechanism whereby AIA can demonstrate that members within the profession are regulated to protect the interests of the public in matters related to biophysical classification and evaluation.
- To identify and define the knowledge, skills, experience, and performance requirements for professional practice within the PA;
- To provide documentation of the requirements indicated above, such that regulated members of AIA may assess their practice against this standard and thereby identify learning needs to ensure they comply with the standard;
- To provide a standard against which AIA may review a member's professional practice to assist the member in identifying areas of their practice that may need improvement;

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 is required for practicing within a PA.

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 agrology 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 PA.

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 PA.

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 Agrologists 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 PA.

2. SCOPE OF THE PRACTICE AREA

The *Biophysical Classification and Evaluation* (*BC&E*) practice area involves the investigation and integration of biophysical resources (terrain, water, soil, vegetation) and their properties, including identifying, classifying, analyzing, mapping, evaluating and interpreting, and developing biophysical resource descriptions, maps and reports. The BC&E practice area demands practitioners have specific knowledge required to investigate terrain, water, soil, and vegetation resources. Understanding, planning, and managing land resources and their integration with the surrounding environment is a fundamental part of Agrology in Alberta, as landscapes touch all aspects of the profession. Land is a critical factor to all areas of Agrology; therefore, needs to be part of the thinking, analysis, and decision-making of all Agrologists.

In northern latitudes, including Alberta, the earth's surface, including the terrain (landforms), soil, and vegetation reflect how natural systems developed over the past 10,000 years. Landforms are the result of glacial and post-glacial activities (erosion and deposition), and the materials deposited by glaciers, lakes, and rivers. Soils have developed within these substrate materials and reflect the interaction of climate, water, and the nature of these glacial and non-glacial materials (texture, coarse fragment content, chemistry, etc.) over time. The vegetation communities we see today result from the interaction of landform processes, soil formation, water availability and distribution, natural and human-induced changes (e.g., timber harvesting, fire, disease, agricultural cultivation, urban development, etc.), climate, and time.

The Agrologist conducting biophysical inventories must develop a conceptual landscape model that integrates the various land components in a spatial context (e.g., terrain, water, soils, and vegetation). Understanding the spatial controls on the distribution of natural resources and their interaction within a three-dimensional landscape is critical (Figure 1). Terrain and water directly affect soil development and distribution, which in turn influence vegetation communities found in a landscape area. Vegetation, in turn, affects ongoing soil development processes and plays a vital role in influencing hydrologic processes. Thus, inventories of terrain, soils, vegetation, and water are mutually dependent. A soil inventory that does not consider terrain and water has limited use and is prone to errors. Likewise, a vegetation inventory that does not consider terrain, water, and soils will be of limited use. Therefore, an integrated approach to biophysical inventories is essential if the inventory is to provide information necessary for evaluation, interpretation, and decision-making for various land-use types.

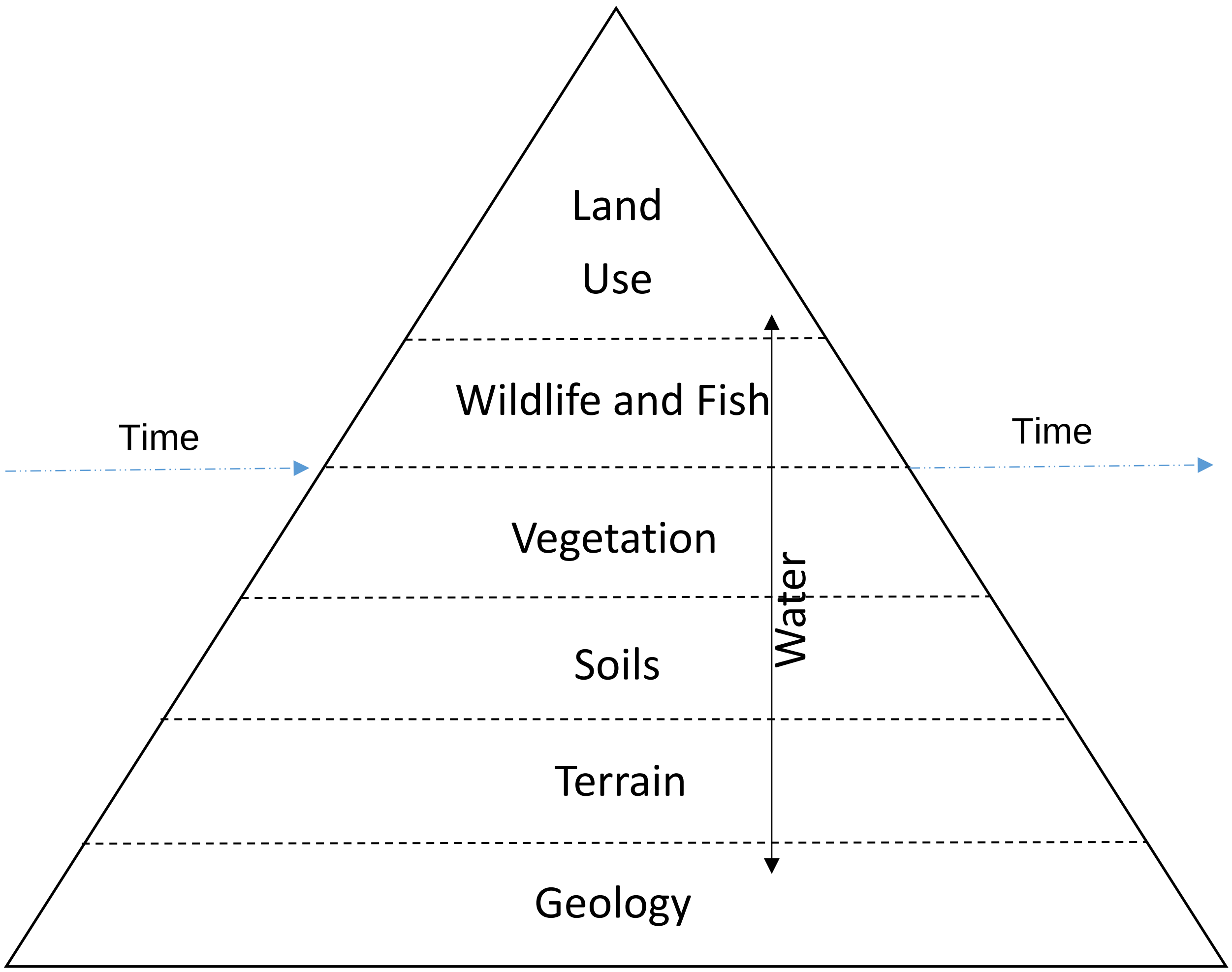


Figure 1. The interaction of various natural resource components comprising land and supporting end land use.

Another driver of the terrain/soil/vegetation interaction is climate. Climate has a strong influence on land capability, including limitations on forestry and agricultural options, or the development of reclamation strategies. Climate, either directly or indirectly, has a profound influence on our terrain, soils, and vegetation resources. As climate changes, changes can be anticipated to occur to terrain (through erosion) and soils (loss or input of organic input). It is important to include climate in any discussion of terrain and soil resources and to analyze the most recent data trends.

Mapping and classifying natural biophysical resources provide basic information for making decisions about managing these resources. Any decision that affects the land may modify the existing biophysical processes, and it is important to know the potential effects. The observed soil and terrain features which are the most stable and measurable components of our environment occurring at the earth's surface, reflect these biophysical processes. Hydrologic processes (surface and subsurface) act upon terrain (surficial geology and landform morphology) and directly influence soil development and the distribution of vegetation populations and communities, influencing wildlife and fish habitat quantity and quality across the landscape, and ultimately, land use decisions. It is important to note that each of the components in Figure 1 above vary over different time scales and landscapes. For example, geology and terrain tend to be more stable over longer time frames than soils, vegetation, wildlife and fish, and land use.

A biophysical mapping and classification program is implemented to inventory resources and develop numerous types of derivative or "evaluation" products. These products include, but are not limited to: maps depicting the distribution of terrain and surficial materials across a landscape; maps depicting terrain stability; erosion potential; land capability to support various land-use practices; biophysical interpretations for environmental impact assessments; ecological land classification; vegetation community and rare plant occurrence; water regime; and flooding potential, etc. All of these require the collection of, analysis, and presentation of biophysical resources within a spatial context.

Practitioners working in the *BC&E* PA play a vital role in describing the nature and characteristics of the land base. As land stewards, Agrologists play important roles in advising and educating users of this valuable resource. Agrologists working in this PA may work for government, industry, consulting firms, non-governmental and non-profit organizations. These professionals oversee the wise use of land among its many competing uses and strive to understand their potential effects and sustainability of the land resource as a whole. Some of the questions Agrologists working in this PA might consider include: Will a disturbance result in a sustainable ecosystem (economic, social, and environmental viability over the long term)? Will it affect or impact neighboring areas? What is the best way to mitigate or manage potential changes? What is the impact on terrain features (e.g., slope, drainage) and geomorphic processes (e.g., landslides, excessive groundwater seepage, etc.) or land management? What is the risk to vulnerable species habitat and how should it be managed? How can this land best be used?

Traditionally, the individuals conducting biophysical surveys, particularly soil surveys, were focused on agricultural productivity and expansion and evaluating the suitability of specific areas for that purpose. However, as other uses such as oil and gas exploration and development, forestry, and recreation became prevalent, the scope of land evaluation expanded, and different kinds of expertise were required. Soil, terrain, vegetation, water, and wildlife/fish expertise became essential to understanding land within a given area and how these resources determine an areas' capability for various uses. Those who work within this PA understand the multidisciplinary nature of mapping, classifying, and interpreting land resources and thus often work within biophysical teams where terrain, soil, vegetation, water, and wildlife/fish expertise are required.

Agrologists are unique among the natural resource professions. They have specialized education that integrates and applies the sciences of geology, soils, vegetation, and water within the context of landscape and land use capability. Agrologists may specialize in domesticated animal sciences, but they are not wildlife or fish specialists focusing on specific organism biology. However, Agrologists often work with Biologists to identify spatial conditions and resources that support wildlife and fish habitat and distribution and provide support to wildlife and fish habitat modeling and management. Agrologists may also have specialized education related to hydrologic processes, particularly at the watershed level. Understanding land-use effects on hydrologic processes over the landscape is a part of many Agrologist's expertise. While Agrologists do not have the expertise to design water storage and delivery systems, they do work closely with Engineers to provide input to the design of such systems. Agrologists working within the BC&E PA often provide professional support to, or may have some overlap with, Planners, Biologists, Developers, Engineers, Foresters, and other Agrologists working within various practice areas, including: *Environmental Impact Assessment*, *Land Conservation and*

Management, *Land Reclamation*, *Environmental Monitoring*, *Wetland and Riparian Areas and Rangeland and Pasture Management*.

2.1 Core Activities Within the PA

The primary roles of Agrologists within this PA fall under one or more of the following activities of inventory planning, identification and classification, mapping, data management and analysis, interpretation and evaluation, and policy development.

2.1.1 Inventory (Survey) Planning

Biophysical inventories require careful planning. An inventory that has collected more data than necessary has wasted financial resources. In contrast, an inventory that has collected insufficient data yet has spent the financial resources and not met the objectives of the inventory has also wasted financial resources. Both situations are not favorable and demonstrate the need for careful planning.

Planning must carefully define the inventory objectives and identify the appropriate scale of information and data to be collected. The inventory objectives determine the effort to be extended and define the scale of information to be collected. Thus, an understanding of the importance of data scale to the overall inventory is critical and cannot be stressed enough. For example, an inventory requiring general reconnaissance scale information requires a different approach to an inventory requiring site-specific, or local scale, information. These differences have implications for planning, field logistics and transportation, area accessibility, personnel and equipment needs, and of course, budgets and schedules. The importance of understanding the purpose and objectives of conducting an inventory before any effort is expended cannot be overstated.

The scale of data as defined by the objectives related directly to the survey-intensity-level (SIL)[1]. SIL levels and their objectives are defined in a number of reference documents including: Expert Committee on Soil Survey 1987; Mapping Systems Working Group 1981; Alberta Wetland Mapping Standards Guidelines 2020; Hydrographic Survey Management Guidelines (Section 6.1, Bathymetry) 2021; Guidelines and Standards to Terrain Mapping in British Columbia (Resource Inventory Committee 1996); and Alberta Sustainable Resource Development 2011, GVI Specifications, 5th Edition. Regulators require specific SIL for specific purposes. For example, a pre-disturbance assessment requires a much more intensive SIL than a reconnaissance level inventory within a widespread regional study area. It is important for the Agrologist to incorporate regulatory requirements regarding inventory protocols and standards as part of the planning process.

Using pre-selected GPS site coordinates can be useful when planning field data collection, however collecting all your data based on a grid system may be problematic as it may not represent the three-dimensional nature of the landscape. Biophysical resources are distributed spatially based on landscape controls and do not follow a grid distribution. Grid sample points that are not representative of the landscape, nor of the resources of interest, do not contribute meaningfully to understanding the spatial relationships and resource distribution in that landscape. The Agrologist responsible for planning a biophysical inventory must develop a conceptual landscape model based on fundamental terrain-water-soil-vegetation relationships in a three-dimensional landscape. The data collected must meet the project objectives and be representative of the variability in terrain, hydrology, soils, and vegetation.

In some cases, a grid sampling plan is necessary, particularly in human disturbed landscapes where the relationships between terrain, water, soils and vegetation have been altered from baseline conditions. Also, where resource information is collected at a very large scale (i.e. small

---

[1] Survey Intensity Level (SIL): SIL refers to the number of inspection points per unit area in a biophysical resource survey and is determined by the scale of map product to be produced.

research plots), grid sampling may be the preferred strategy because local variability is generally minimized at that scale.

It is also very important to collect, and review published reports and maps prior to starting a project. When reviewing these reports and maps, it is essential to consider how the data was collected, at what scale, and what the limitations of the data are. While most parts of the world, including Alberta have some type of soils, terrain or vegetation mapping, it is critical to consider the scale of the existing mapping and its implications for the project. Most publicly available background maps are completed at small scales (1:100,000 to 1:1,000,000) and the data, while providing a good starting point for the project, is not appropriate for most projects (e.g., Pre-Disturbance assessments). This background data is usually very general and is not based on extensive field surveys. For example, many of the early surveys in Alberta had anywhere from 1 to 150 inspections per township, with resultant maps at 1:750,000 to 1:125,000, respectively. However, the resultant map will display the spatial distribution of soil types. Similarly, surficial geology mapping is generally found at scales of 1:100,000 to 1:250,000. The term "ablation till" implies the unit is made up of "till", however upon careful reading of the definition of "ablation till" in the notes that accompany the map, ablation till will have or has the potential to have components of glaciofluvial and glaciolacustrine materials. Also, it is important not to use multiple large-scale maps (1:5000) in combination to produce small-scale maps for decision making purposes at these broader scales. The detailed data in the large-scale maps is intended to be used for local-scale decisions, and attempting to use multiple large-scale data to represent broad areas is costly, inefficient, and may lead to interpretive errors when used at an inappropriate scale.

2.1.2 Identification and Classification

BC&E Agrologists carry out the role of identifying and classifying terrain, water, soils, and vegetation resources and how they interact together to form a system. The creation of natural resource inventories requires specialized training in identifying the common features and behaviors of specific taxa (e.g., surficial geology and landforms, soil series, vegetation species, stream order, ecosite type, etc.). This includes organizing taxa into meaningful units that demonstrate spatial relationships between and within taxonomic map units. The ability to identify particular taxa and competently apply relevant taxonomic systems is fundamental to this activity.

Agrologists must be well versed in the classification of the resource they are mapping as well as understand the use of classification systems of other related biophysical resources. For example, an Agrologist who classifies soils must thoroughly know the *Canadian System of Soil Classification* (Soil Classification Working Group 1998) as well as understand the use of terrain classification systems (e.g. Howes and Kenk 1997) and the vegetation taxonomic systems (Budd's Flora: Minister of Supply and Services Canada 1979; Tannas, K.E., Common Plants of the Western Rangelands, 2001, 2003, 2004; and Kershaw and Allen 2020). However, classification skills can only be developed within the context of a comprehensive understanding of terrain morphology and Quaternary geology, soil development (soil genesis), vegetation structure and function in relation to population and community ecology, and the principles of hydrology and hydrogeology. Any biophysical product must have input from knowledgeable practitioners in these fields; these integrated products cannot be completed by one discipline only.

Technological advances in recent years have increased the utility of remotely sensed data to assist in identification of biophysical resources. Remote sensing is increasingly being used to provide initial predictions of vegetation communities in both forested and grassland regions, wetland type and extent, hydrologic features, and surficial geologic materials and soil types. Digital soil mapping continues to develop as relationships among terrain, materials and soils are established and algorithms developed to predict soil moisture indices, and soil type occurrence based on digital elevation models, Light Detection and Ranging (LiDAR), and other remotely sensed data including satellite imagery. Remotely sensed data is often used to direct field programs (e.g., ground-truthing) necessary to confirm predicted occurrence of the resource of interest.

2.1.3 Mapping

Identifying and classifying terrain, water, soils, and vegetation resources is the first step in gathering information for land use planning purposes. The data must then be presented in their spatial context to have any value for informed decision-making. Maps and associated products must then be developed using accepted principles, methods, and technical standards.

The Agrologist must develop and apply a conceptual landscape model that portrays the distribution of terrain, soil, drainage patterns, and taxa across a given landscape. Mapping the distribution of taxa is both a science and an art form and comes with practice under the supervision of a senior mapper. Mapping involves both a desktop exercise and collection of field data to ground-truth the conceptual model used to create the map. For this reason, resource maps are usually produced in conjunction with a field program. The accuracy and error associated with a published map without having ground-truthed data are impossible to determine. For this reason, regulators often require specific survey-intensity-levels (SILs) to ensure that the map products are based upon appropriate and reliable field data.

Mapping may be conducted using a variety of remotely sensed information obtained via satellite, fixed-wing aircraft, or drones. Mapping a three-dimensional landscape requires three-dimensional imagery and data such as stereo aerial photographs or satellite imagery and hillshade data created from LiDAR datasets. The use of two-dimensional imagery to represent a three-dimensional surface is fraught with potential problems and errors. It is essential to account for the vertical dimension (local and regional elevation). The vertical dimension controls gradients for water, energy, sediment, geomorphologic processes and directly affects the local water regime, internal soil drainage, and depth to water tables. Only senior experienced mappers who are already familiar with an area under study should attempt to use two-dimensional mapping to portray the spatial distribution of taxa. One of the most common errors in creating a biophysical map is using two-dimensional imagery (e.g., orthophotos) to represent the distribution of taxa controlled by processes acting in three dimensions. In all cases, three-dimensional mapping is the preferred and most reliable means of depicting resource variability in a landscape.

2.1.4 Data Management and Analysis

Identification, classification, and mapping requires collection and management of significant quantities of spatial data. While the mapping process and associated products can be conducted outside of a geographic information system (GIS)[2], GIS has become a commonly used mapping tool that facilitates management and display of spatial data. Biophysical resource inventories may collect vast quantities of geographically referenced data obtained from specific points or transects within a landscape or from remotely sensed data. This collected spatial and associated attribute data must be housed in a geographically referenced database to allow easy access, analysis, and linkage to a GIS and allow appropriate representation using vector and raster data mapping. Understanding the use of geodatabases and their use in working with spatial and attribute data in a GIS environment is essential to producing meaningful thematic maps and reports. At times an Agrologist will need to either interpolate or extrapolate site data to areas of the study area based on the conceptual landscape model and geostatistics.

Finally, a map should include an analysis of the reliability of the data portrayed therein and the resulting limitations of the data. The Agrologist must understand the relevance of "scale" and how it influences the data reliability and the potential for misuse of the map products. For

[2] Geographic Information System: A computer system that stores, manages, analyzes, and displays spatial data to produce various thematic maps.

example, maps produced using reconnaissance level surveys (e.g., a small-scale map, 1:250,000, SIL #5) do not have the adequate amount of field data to support land-use decisions at a local scale (e.g., a large-scale map, 1:5000 or greater, SIL 1). Land-use decisions must only be made using data that has been collected and presented at a scale equal to or greater than the scale of the land area under consideration.

2.1.5 Interpretation and Evaluation

Identifying, classifying, analyzing, and mapping biophysical resources provides the foundational data for evaluating and interpreting resource capabilities and/or vulnerabilities in relation to various land-use scenarios. The Agrologist working in the *BC&E* PA evaluates and interprets field and laboratory data to prepare reports outlining appropriate land uses and potential effects on and capabilities of biophysical resources within a study area. Practitioners collate material to address specific project objectives and often develop derivative maps to demonstrate risks (e.g., unstable terrain, saline or poorly to very poorly drained soils, etc.) to the long-term sustainability of the resources.

Land suitability or capability evaluations are conducted on map units and can include specific land uses like agricultural, forestry, recreational, or engineering. The evaluation can also be predictive, like suitability for reclamation. Equivalent land capability assessments are required by provincial legislation after specified disturbances and include evaluating the median and range of many detailed factors to assign a numerical and/or descriptive ratings that can be used for comparison between lands, either spatially or pre and post disturbance.

Evaluation and interpretation of resource data is a key part of biophysical reporting. These interpretive reports evaluate the potential response of the terrain, water, soil, and vegetation resources to land use types. This includes such evaluations as terrain stability, soil productivity and susceptibility to loss, resilience of natural vegetation and its role in supporting wildlife and fish habitat, water quality, quantity and activity (i.e., flooding potential), and the ability of these resources to withstand or buffer against the stressors associated with a particular land use type.

2.1.6 Policy Development

Ultimately, the objective of identifying, classifying, evaluating, interpreting and reporting biophysical inventories is to inform land-use decision making. Much of the data collected and presented by Agrologists working within the *BC&E* PA is used to inform decision-makers of the types, nature, and distribution of natural resources within a given area. This information provides insight into what resources are present, and in what proportions and combinations within a given study area. The work conducted by Agrologists in this PA often represents vital baseline information that is used to determine how land-use scenarios may affect terrain, water, soils, and vegetation resources either in terms of a single project or in terms of cumulative effects from multiple projects. Also, this information is vital to informing the feasibility of proceeding with a particular development within a study area (for example, is the terrain stable, is there evidence of excessive groundwater seepage, will changes result in the loss of highly productive soils, are there vulnerable plant communities present or vulnerable surface and groundwater resources, vulnerable wildlife and fish habitats, etc.).

The Agrologists working in this PA may not necessarily be responsible for gathering and interpreting biophysical data. Instead, they may be employed by a bank, a developer, a regulatory agency, or NGO to assist in understanding the implications of inventory results. However, most Agrologists working in this PA are involved directly in the collection, analysis, and evaluation of biophysical resource data to produce reports used by various stakeholders involved in making land-use decisions and developing policy.

3. KNOWLEDGE REQUIREMENTS

Knowledge requirements are technical and scientific areas of knowledge essential to professional practice within the PA (Table 1). These requirements consist of core knowledge areas consisting of specialized subject matter areas that are foundational to the PA.

The specification of subject matters within each required core knowledge area provides assurance that members have the necessary fundamental knowledge to provide professional services working within the PA. The subject matter within each core knowledge area represents specific scientific or technical knowledge relevant to the PA activities. The subject matters within each core knowledge area represent areas of study equivalent to a three-credit course in a post-secondary educational institution. Subject matter knowledge is usually obtained through education in a degree or diploma program; however, some subject matter knowledge may be obtained via industry courses, work experience, self-study, and mentorship. Validation of knowledge gained through these means is achieved through an examination process implemented by AIA. In this way, the AIA can assure the public that practitioners have indeed acquired the required knowledge.

It is the responsibility of members to review Table 1, conduct self-assessments, and identify how their knowledge and expertise align with the required subject matters. Members who do not meet a required subject matter within a core knowledge area are required to address the deficiency before practicing unsupervised in that core knowledge area. Members are expected to work toward updating their knowledge where they lack specific subject matters for the activities related to their practice. ***Where regulated members do not meet a knowledge requirement for a subject matter, they must address the deficiency in one of the following ways.***

1. <u>Seek Advice and Direction</u>: Members lacking specific knowledge in required subject matters must recognize the limits of their expertise in that subject matter and seek advice and direction from a regulated professional who takes responsibility for the member's work in these subject matters.
2. <u>Complete Challenge Exam(s)</u>: Subject matter knowledge attained through work experience, self-study or non-adjudicated industry courses must be validated through an examination process. The member may choose 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. <u>Pursue Formal Education and Training</u>: A member may choose to 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.

3.1 Core Knowledge Areas

Core knowledge areas consist of both <u>required</u> subject matters and <u>recommended</u> subject matters. Required subject matters represent the minimum credible knowledge required for the given core knowledge area and are mandatory for members who wish to provide professional advice or services related to the core knowledge area.

Recommended subject matters represent knowledge that is not mandatory but provides increased knowledge related to the core knowledge area. These subject matters are highly recommended and are identified to provide direction to members for their continuing competence program.

Several core knowledge areas are identified as being foundational to practice within the PA (Table 1). These include core knowledge in Terrain, Water, Soils, Vegetation, Ecology, Data, and

Socioeconomics and Policy. *BC&E* Agrologists may not have expertise in all Core Knowledge Areas of the PA, and should only practice unsupervised in the portions of the PA where they meet the knowledge requirements.

3.1.1 Terrain

As seen in Figure 1, terrain is one of the two foundational layers in the biophysical pyramid. Soils, and ultimately vegetation, wildlife habitat, and land use are all influenced by local or regional terrain conditions. This core knowledge area provides the underlying principles and factual information for understanding and describing surficial geological materials, their composition and form in the landscape, and how they formed or were deposited. It is the foundation of practice in terrain classification and mapping. Courses on geomorphic processes and surficial geology should provide the necessary background on glacial and post-glacial processes and how the resultant landforms were developed. These types of courses also provide essential subject matter on geomorphic processes such as erosion and mass wasting.

Terrain is the component of the earth's surface encompassing surficial materials, landforms, slopes and geomorphological processes. Terrain controls surface and subsurface water movement, and provides the foundation for soil development. As a result, terrain analysis can provide insight into soil types, geological features, hydrology and shallow ground water systems. The interaction of surficial materials, landform morphology, and geomorphological processes is fundamental to understanding soil development and distribution and establishment and maintenance of vegetation communities. Biophysical inventories must consider surficial geology and landform morphology as critical determinants of soil and vegetation distribution in the landscape.

In addition, the terrain itself plays a crucial role in determining the suitability of a land area to support various activities such as urban development, pipelines, powerlines, roads, rail lines, etc. Several geomorphic processes influence terrain stability, including landslides, slumping, mass flows, slope creep, and seepage. Terrain analyses for biophysical inventories include interpreting and evaluating risk to industrial developments based on terrain data collected and mapped by Agrologists working within this PA.

3.1.2 Water

Knowledge of properties of surface and subsurface water is essential in understanding soil/landscape properties and assessing the capability of the land to support activities such as agriculture, forestry, transportation, or oil and gas exploration and development. An understanding of processes such as: water movement through terrain and soil materials and the effect on soil properties; water movement in relation to landform processes such as erosion and slumping; drainage regimes and properties of wetlands; soil water as part of the hydrologic cycle and role in climate/meteorology; water availability for ecosystem support; and, ability to predict and map soil and terrain properties based on drainage characteristics and location in the landscape is required.

The materials and morphology of the terrain are partially responsible for the water table and are, at the same time, modified by the action of water. Both surface and subsurface water are determinants of local water regimes, internal soil drainage regimes, vegetation distribution, habitat, and the presence of gleyed, gleysolic, or organic soils within the landscape. As a result, the spatial distribution of soil-forming processes and the resulting patterns of soil types in the terrain are strongly correlated with local hydrology/hydrogeology. Moisture regimes and gradients also strongly influence the distribution of vegetation species and communities that are adapted to varying moisture conditions within the landscape. Therefore, biophysical inventories must be based upon a knowledge of both surface and subsurface hydrologic processes and their distribution in response to terrain materials and morphology.

This interaction of water with terrain is fundamental to understanding biophysical resource spatial distribution and the associated suitability of land to support particular activities such as agriculture, forestry, or oil and gas development.

3.1.3 Soils

Agrologists working with soils in the *BC&E* PA must have a knowledge of soils, their genesis, classification, properties, distribution, and function. It is important to understand the physical, chemical, and biological properties of soils and how these properties influence soil behavior and function under various land-use types (e.g. saline parent material, oilsands geological formations, acidic shales).

Land capability is dependent upon the interaction of climate, terrain, water, soils across the landscape. Evaluating soil resources to support various land use types requires an understanding of processes such as water movement into and through soils; landform processes such as erosion and slumping; drainage regimes and properties of poorly drained soils; soil water as part of the hydrologic cycle; and the ability to predict and map soil and terrain properties based on drainage characteristics and location in the landscape.

An understanding of soil physics provides the fundamentals of measurement and description of soil physical properties, with emphasis on soil water, while courses in hydrology, hydrogeology and water resource management consider surface and subsurface properties and water movement in landscapes.

BC&E Agrologists should have a solid understanding of pedogenic processes responsible for soil formation in the landscape. These processes responsible for soil development also play a vital role in environmental quality management and land productivity (e.g., leaching regimes and contaminant transport, contaminant attenuation in soil organic matter, nutrient regime, water-holding capacity, etc.). Understanding these processes and their spatial distribution within the landscape is the basis for delineating meaningful soil map units.

Understanding soil chemistry and the variability of soil chemical processes in the landscape is essential to understanding soil spatial variability. Many soil types are differentiated on the basis of chemical criteria (e.g. solonetzic vs chernoaemic soils), and in both terrain and soil sciences, materials are distinguished in terms of their mineral and chemical composition. While many soil chemical concepts are introduced in introductory soil science courses, considerably greater breadth and depth is required for application in the practice area.

3.1.4 Vegetation

Agrologists working with vegetation in this PA must have a knowledge of plants, their physiology, ecology, identification, classification, and factors controlling vegetation distribution (e.g., biogeography) in the context of terrain, moisture regime, fish and wildlife utilization, and soils within the landscape.

Vegetation inventories are conducted by Agrologists for a variety of purposes. These include baseline surveys for pre-development planning, operational and post-operation monitoring, ecological land classification for environmental impact assessments, rare plant or rare ecological community surveys to identify the presence or absence of vulnerable species or communities, waterbody bank and steep slope stabilization species, key wildlife and fish habitat species/features, and identification and control of invasive species and noxious/prohibited noxious weeds.

Identifying individual species and plant communities (e.g., ecosite types) are a key part of Ecological Land Classification (ELC) surveys. ECL surveys, along with soil types, soil moisture regime, and soil nutrient regimes, define the ecotypes of a particular locale. ELC surveys are often conducted to assess baseline conditions prior to the initiation of a particular human-use activity to provide a baseline that informs future reclamation and restoration efforts in an attempt to return land to an equivalent capability or to pre-disturbance conditions. Proper understanding of the growth strategy and effective planning/install timing of the plants required for reclamation or restoration programing, assist in obtaining successful seed mixes and planting efforts for these programs, while reducing the risk of invasive plants or high failure rates, which can be costly to the project.

Agrologists are often employed to conduct invasive species monitoring and to develop and implement appropriate control strategies as per the Alberta *Weed Control Act* and *Weed Control Regulation* and the *Agricultural Pests Act* and associated regulations.

Agrologists working in the *BC&E* PA with a focus on vegetation identification, classification and evaluation must have a solid plant science background that provides an understanding of basic principles of plant form and function and how these relate to both population and community ecology and distribution at the landscape scale.

3.1.5 Ecology

Ecology is an integrative discipline that studies interrelationships among biophysical components that support the function of an ecosystem as a whole. Application of ecological principles demands system-level thinking to develop an appropriate conceptual landscape model to capture the interactions among the various biophysical components of the ecosystem. Understanding community ecology and the drivers and gradients that separate plant communities in a three-dimensional landscape is fundamental to delineating vegetation resources in a study area and/or predicting the occurrence of rare plants or plant communities of interest (indigenous food sources, etc.) across the landscape.

An understanding of ecological principles is fundamental knowledge for the Agrologist who works with multiple biophysical resources. These Agrologists provide an integrated interpretation of all land components so that wise land use decisions are conducted with a holistic understanding of the land system. Agrologists are unique among natural resource professionals because of the depth and breadth of their training related to terrain, water, soils and vegetation and the interdependence of these at a landscape scale.

3.1.6 Data

Data collection, storage, management, and analysis are a fundamental part of working within this PA. The resulting products (i.e., reports and maps) are only as good as the data used to generate the product. The PA is very data-intensive and requires attention to quality assurance and quality control principles to ensure data is valid and coherent to ensure subsequent analyses use meaningful and quality data. Work in biophysical classification and evaluation includes the production, evaluation, and summary of data. Since practitioners are involved in the production of data, it is essential to understand how to appropriately manage, summarize and present data.

A basic understanding of database structure and function is necessary, particularly related to working with data in a geographic information system (GIS). All data collected for biophysical inventories must be geographically referenced to have any meaning to the distribution of resources in the study area. Data analysis and display is usually conducted within a GIS and thus, working knowledge of GIS is essential.

Understanding the fundamentals of statistical methods for analyzing data is part of the work conducted in evaluating and interpreting the biophysical data. Geostatistical analyses may be necessary to facilitate interpolating and extrapolating from observed point data to predicted data within the study area.

3.1.7 Socioeconomics and Policy

An understanding of legislation and policy in relation to biophysical classification and evaluation is important to assess what is legally required and possible given the regulatory framework within which development and implementation of projects and programs must operate (e.g., *Soil Conservation Act*). Timelines and scheduling may also be affected in this regard. Agrologists practicing within this practice area must be aware of and work with legislation, directives, policies and bylaws at the municipal, provincial and federal levels of government. The regulatory framework establishes the parameters which act as legal boundaries within which activities occur.

Biophysical classification and evaluation ultimately involves interactions among desired end land use/project objectives and understanding necessary natural processes. Competing interests with existing biophysical conditions and desired project outcomes as well as cross-cultural issues may result in conflict. Agrologists focusing in the *BC&E* PA need to have a strong understanding of the natural environment, role of the biophysical classification in the project area in the overall landscape and potential project impact on the landscape, the regulatory requirements associated with the biophysical classification for the area, and jurisdiction and associated regulatory bodies. *BC&E* Agrologists should also have effective communication skills that assists in guiding their clients, communicating with the regulator(s), and complying with Acts and Legislation in order to establish the terms of reference to which all parties agree. This requires a strong understanding of the regional, federal, and local policies unique to the project. In addition, strategic planning that includes an evaluation of environmental legislation, identifies the regulatory requirements, and identifies any potential barriers to successful completion of a project, goes a long way to circumvent conflict and assist in ensuring project schedules are achievable and/or maintained.

Table 1. Core knowledge areas, required subject matters, and recommended subject matters for the Biophysical Classification and Evaluation practice area.

Core Knowledge Area	Required Subject Matters	Recommended Subject Matters
Terrain	• Geomorphology • Surficial Geology OR Quaternary Geology	• Physical Geography OR Physical Geology • Sedimentology • Terrain Analysis • Glacial Geomorphology • Fluvial Geomorphology • Structural Geology • Mapping and Mapping Technologies (i.e., GPS, GIS, Manual Mapping, etc.) • Aerial Photograph Interpretation • Remote Sensing

Water	• Hydrology OR Watershed Management • Hydrogeology	• Wetland Ecology and Management OR Ecohydrology • Limnology • Soil Physics • Structural Geology • Geophysics • Climatology OR Meteorology OR Hydrometeorology • Aerial Photograph Interpretation • Remote Sensing
Soils	• Introductory Soil Science • Soil Genesis and Classification • Soil Chemistry OR Soil Physics OR Soil Fertility	• Soil Chemistry • Soil Physics • Geochemistry • Soil Conservation and Management • Soil Microbiology • Surficial Geology OR Quaternary Geology • Aerial Photograph Interpretation • Remote Sensing
Vegetation	• Introductory Plant Science OR Botany • Plant Taxonomy • Plant Physiology OR Plant Ecology	• Biogeography • Plant Physiology • Plant Ecology • Rare Plants • Invasive Species • Aerial Photograph Interpretation • Remote Sensing
Ecology	• Introductory Ecology • Community Ecology OR Population Ecology	• Plant Ecology • Rangeland Ecology • Forest Ecology • Wildlife Habitat • Aquatic Habitat • Aerial Photograph Interpretation • Remote Sensing
Data	• Introductory Geographic Information Systems • Statistics	• Database Management • Geostatistics • Mapping and Mapping Technologies (i.e., GPS, GIS, Manual Mapping, etc.)

		• Advanced Geographic Information Systems • Aerial Photograph Interpretation • Remote Sensing
Socioeconomics and Policy	• Environmental Policy OR Environmental Law	• Environmental Economics • Land-Use Planning • Environmental Ethics • Environmental Sociology • Environmental Philosophy
Knowledge of a subject matter area may be based on an individual course or be part of multiple courses. For example, knowledge in hydrology may be obtained via a hydrology course or through portions of other courses such as soil physics, soil and water conservation, or watershed management courses.		

4. WORK EXPERIENCE

Work experience represents a source of knowledge that is gained through professional practice rather than through education. Such experience facilitates the development of skill sets and knowledge needed to be competent within one's practice. Development of these skill sets and acquisition of knowledge takes time working in an environment where feedback is available to hone one's skills and acquire experiential knowledge.

The AIA Expert Committee on Soil and Terrain recommended the following regarding work experience and skill set development. While the emphasis is on Soil and Terrain, the same recommendations apply to the other biophysical resources, vegetation and water.

> *The Expert Committee recommends that members working in this practice area find a mentor who has expertise and several years of experience in this area. Ideally, the mentor will accompany them to sites to share their knowledge and describe soil and terrain classification and mapping practices as the work is being done. Based on the mentor's experience, they can also point out potential problems and how to avoid or mitigate them.*
>
> *To become competent in this practice area, the member needs to build competency by working on projects in different ecosystems throughout the province on a wide variety of soils and terrain. It is also important to gain exposure to different types of projects as the scale and varying levels of complexity will provide excellent learning opportunities. Working only on one type of project in the same geographic area will limit a member's ability to gain expertise.*
>
> *The successful completion of several projects is key to developing competency in this practice area. The member, working under the supervision of a competent professional, needs to be involved throughout a project to see the entire scope of work and how challenges are overcome and what a successful outcome looks like. When the member has sufficient experience to work unsupervised, they will have a comprehensive knowledge to draw on at all stages of the project.*

Three levels of work experience are recognized within the Practice Standard. These include:

Junior Level (0 to < 5 years) – The junior level of experience coincides with entry-level personnel who have recently graduated from an appropriate educational program or have recently begun offering professional services in the PA. This work experience is conducted under supervision by qualified practitioners within the PA. Practitioners at the junior level have limited experience to provide wholly unsupervised professional services.

Intermediate level (5 to < 10 years) – The intermediate practitioner no longer requires direct supervision and has developed skills and obtained the necessary experiential knowledge to take responsibility for their work. Intermediate practitioners may act as mentors for junior personnel and they also seek mentoring from senior-level personnel.

Senior level (≥ 10 years) – Senior level practitioners generally provide supervision to intermediate and junior personnel. They are often recognized as knowledge experts by their peers and are sought after for advice and counsel.

It is important to note that Agrologists within the *BC&E* PA may specialize in a particular resource or combination of resources. For example, some Agrologists may have expertise in terrain and soil science with limited expertise in vegetation ecology or hydrology and hydrogeology. Conversely, some agrologists may have expertise in vegetation ecology, with limited expertise in terrain or soil science, hydrology, or hydrogeology. For this reason, members will ensure they have sufficient expertise and work experience to conduct the work and accept responsibility for the work they do.

The time frames indicated in Table 2 are provided for guidance. Career progression and work experience may vary by individual.

Table 2. Typical years of work experience and examples of job duties and responsibilities.

Level of Experience	Examples of Typical Job Duties	Key Responsibilities
Junior (typically < 5 years)	• Learning mapping and remote sensing skills from senior or intermediate practitioners • Field monitoring, gathering data, and sampling • (Geo) database development • Part of a team conducting biophysical inventory and assessments under supervision • Learning the basic craft of characterizing and rating landscapes for various uses • Learning how to interpret data • Developing field skills • Conducting literature searches • Writing basic reports or sections of reports under supervision • Exposure to the Acts and Regulations governing resource management in the Province	• Assist with fieldwork, data collection, data entry and some supervised reporting • Supervised and mentored/coached by an intermediate or senior practitioner • Locate and summarize reconnaissance and other data sources under supervision

Intermediate (typically 5 to 10 years)	• Planning and budgeting for field programs and related office work. • Conduct aerial photograph interpretation in either hardcopy or softcopy formats • Utilize remotely sensed data to augment mapping • Application of the Acts and Regulations governing resource management in the Province • Increased role in analysis, evaluation and interpretation of data or information • Evaluating data and writing interpretive reports • Overseeing map and report production • Some personnel management may be part of their role • Conducting fieldwork unsupervised, often acting as a team lead • Responsible for field safety training and audits • Mentoring/training junior personnel • Working with senior personnel to report recommendations and results • Correspond with stakeholders and regulators while under the guidance of senior personnel	• Responsible for organizing fieldwork and ensuring data quality • Management planning and regulatory compliance • Are responsible to conduct independent, unsupervised, fieldwork • Analysis, evaluation and reporting of data • Professional sign-off as required
Senior (typically > 10 years)	• Fully familiar and ensuring compliance with the relevant Acts and Regulations governing biophysical resource management in the Province • Tools, technology and/or policy development • Final QA/QC review of reports • Planning and management; generally, less fieldwork (with exceptions) • Advisory roles for technical work and business development • Client and regulator relationship development and management • Training and mentoring junior and intermediate personnel	• Responsible for accuracy of analysis, evaluation and reporting of data • Responsible for professional sign-off as required • Overall personnel, program and budget management and supervision • QAQC for correct correlation and ID of map units to provincial standards (field and office)

4.1 Skill Set Requirements

Certain skill sets and capabilities enhance competency within a given PA. Application of technical knowledge requires skill sets which have been identified under this practice standard (Table 3).

Skill sets are tied to effective functioning within the PA and are usually developed through work experience. The skills needed to translate ecological knowledge to a map and then from the map to specific applications are based on scientific knowledge, developed through experience. These skill sets are usually developed under the supervision of a senior Agrologist with expertise in *BC&E*.

Members practicing in this PA must evaluate their skills and capabilities against the information in Table 3. If they identify deficiencies, they should target their individual continuing competence programs and seek work opportunities to address those deficiencies.

Table 3. Skill sets relevant to the practice area.

Skill Sets	Description
Identify survey objectives (to meet project objectives)	Agrologists must develop the ability to translate objectives into appropriate level of survey (scale, level of detail, density of field data collection, etc.). They need to understand pre-planning and scheduling, and be able to identify authority requirements, such as safety and area access and proper interpretation of the associated Acts and Regulations both federally and provincially. Practitioners will understand pre-mapping including literature review and preliminary legend development.
Interpretation of existing biophysical information	Reviewing and interpreting existing information, including but not limited to: physiographic and natural area maps; surficial or quaternary geology, topography, hydrogeology and hydrology information and maps; AGRASID; soil surveys and soil series information; ecological land classification; Alberta vegetation or grassland vegetation inventories, plant community guides, and provincial rare plant records.
Develop a budget, schedule, and work plan	Agrologists will be required to develop budgets, schedules and work plans. This includes judging personnel requirements (including time), equipment needs (transportation including vehicles, ATVs, helicopter, mobile drills, etc.), analytical requirements, client fiscal constraints, scheduling, natural ecosystem timelines and logistics.
Develop a sampling and analytical plan (to support objectives)	Practitioners will understand appropriate site selection methods (i.e., location, landscape representativeness, transect vs point sampling, sampling parameters, legal requirements etc.). Agrologists will also understand and identify analytical requirements for various applications such as chemical properties, physical properties, special handling, storage, and quality assurance/quality control and sample chain of custody.
Aerial Photograph Interpretation and Remote Sensing	Biophysical resources are usually mapped by viewing the landscapes using stereo aerial photographs in three-dimensions either in hardcopy (stereoscope) or softcopy (e.g., PurVIEW, Summit DAT/EM, etc.) format. Other approaches include the use of satellite imagery, hillshade and contour maps based on LiDAR, and other types of remotely sensed information to augment the mapping process. Features such as landscape patterns, drainage conditions (as expressed through

	vegetation), physiography, slope, elevation and on-going geomorphological processes (e.g., groundwater seepage, landsliding, inundation, etc.), distinguishing upland and wetland areas, forest or vegetation cover types, can be distinguished using such imagery. Stereo aerial photographs available from either government agencies (federal, provincial/state or municipal) or clients provide the basis for the majority of the operational mapping that is currently completed for various biophysical inventory projects in Alberta. Image interpretation also involves computer methods, which is generally combined with information management and analysis using geographic information systems (GIS). Selection of imagery requires an analysis of the applicability and usefulness of the data to the objective of a *BC&E* project and is a key part to success in a project. This could include but is not limited to: seasonality of imagery, appropriateness of scale, different types of satellite imagery, age of imagery, and when to consider using multiple images for a project, and how to compensate for the lack of stereo products on a project-by-project basis.
Use of Digital Mapping Systems (GIS)	Agrologists need to develop skills that include the use of GIS, digital soil-landscape and ecological community model development and incorporation of digital elevation models (DEM), LiDAR, and Global Positioning System (GPS) data. In addition, Agrologists working in this PA should become familiar with trends in digital resource mapping and inventory methods.
Biophysical Resource Mapping	Agrologists must have a solid understanding of mapping principles, including scale (e.g., 1:5,000 vs. 1:20,000 vs. 1:50,000 vs. 1:100,000, etc.) and its implications for budgeting, mapping and field inventory and final presentation. They must be able to identify soil, terrain, drainage/hydrology maps, and vegetation map units appropriate to scale and purpose and will include concepts of minimum size, contrasting, similar, limiting, dominant, etc. They must also be familiar with concepts of checking and correlation. Agrologists must develop the ability to create a conceptual landscape model to guide the mapping process using field data, digital elevation models, small scale, publicly available surficial geology and soil maps, hydrologic and groundwater well data, and remotely sensed vegetation data.
Fundamental field skills	*BC&E* Agrologists must understand soil-plant-landform-water relationships and be able to interpret imagery to assist in the identification and delineation of biophysical resources. Some of the field skills may include on-site identification and delineation of surficial materials and landforms, on-site soil profile description and classification, analyze and characterize drainage conditions, identify vegetation community types (e.g., ecosite types, identification and understanding of economic and ecological impacts of invasive weeds, regulated weeds and other invasive plants and species), know how and when to use

	vegetation quadrat or transect sampling techniques, identify surface hydrologic features (stream order, wetlands, etc.), predict groundwater conditions, prepare maps and legends, and apply standard practices and accepted field protocols. Agrologists need to develop field skills appropriate to their area of specialization within the practice area. For example, vegetation specialists primarily develop field skills related to vegetation identification and classification and rely upon the field skills of soil specialists to identify and classify soils and vice versa.
Biophysical Resource Evaluations	The Agrologist must understand the principles behind interpreting and evaluating biophysical resources for land use activities. The information gathered by Agrologists in this PA are used to determine land capability and how this conforms to regulatory requirements regarding equivalent land capability. For example, the Agrologist must understand which land capability system should be used in which circumstance and how the system is used to provide a land capability rating (e.g., Land Suitability Rating System (LSRS)). The Agrologist must also understand the use of Ecological Land Classification (ELC) principles and systems or other similar classification systems (e.g., Natural Regions and Subregions of Alberta (Natural Regions Committee, 2006)), Terrestrial Ecosystem Mapping (Resource Inventory Committee, 1996)), or appropriate classification systems (Canadian System of Soil Classification (Soil Classification Working Group, 1998), Terrain Classification System for British Columbia (Howes and Kenk 1997), etc.) and how these are applied to biophysical resource inventories (e.g., ecosite classification and implications for land use). Other evaluations include reclamation suitability, terrain stability, sensitivity to acid deposition, surface and wind erosion potential, sedimentation, species at risk and rare plant management plans, etc.
Report Writing	Reports must be appropriate for various audiences and/or objectives. Agrologists must develop suitable maps and legends and describe the limitations of those maps. Practitioners will provide interpretation details and applications and must be able to cite appropriate references as needed.
Ethical practice	Members adhere to the Code of Ethics for the profession as they make recommendations to their clients. The Code of Ethics states, "*The Profession of Agrology demands integrity, competence and objectivity in the conduct of its members while fulfilling their professional responsibilities to the public, the employer or client, the profession and other members*." (See Appendix B)

5. PERFORMANCE REQUIREMENTS

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, in addition to the General Practice Standard that applies to all AIA members (see Appendix A).

The following performance requirements outline the expectations of the professional practicing within the *Biophysical Classification and Evaluation* PA. Failure to comply with these expectations may be considered as constituting unprofessional conduct under the *Agrology Profession Act*.

Regulated members stay current with biophysical classification and evaluation research, legislation, directives, guidelines, industry standards and other reference documentation.

Regulated members:

- regularly review the currency of current documentation and reference material used to support their practice and obtain most current versions when available.
- attend and provide presentations at workshops and updates related to biophysical classification and evaluation including provincial, national and international conferences.
- communicate with regulators, research scientists, educators and other practitioners to ensure they remain current with current biophysical classification knowledge and trends as well as know and understand the legislative requirements they work within.

Regulated members understand the limits of their knowledge, skills and experience and seek 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 biophysical classification, mapping and evaluation.
- 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 conduct work beyond their expertise and work experience level unless they conduct the work under the direct supervision of a qualified professional responsible for the member's work.

Regulated members clearly understand their role within the practice area.

Regulated members:

- clearly understand their role in the practice area, represent themselves as such, and do not exceed the boundaries of that role.
- only sign and seal those plans, reports, and other documents for which the members are professionally responsible and which were prepared by or under the direction of the member.

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

Regulated members:

- document and understand the objectives, scope, and deliverables, and work within the terms of reference, legislative framework, or client contract.
- use a consistent and thorough process for management and evaluation.

- regularly review the management plan to determine changes needed in a dynamic system for ensuring alignment with goals, objectives, regulatory requirements and changing environmental and economic conditions.
- regularly engage with clients, stakeholders, and employer regarding the scope of work, and project objectives and adapt and document any changes as required.

Regulated members review the requirements of this practice standard and address any practice deficiencies through their 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 reading material and references relevant to the *Biophysical Classification and Evaluation* PA in Alberta. It is not intended to be an exhaustive list. The AIA Expert Committee on Soil and Terrain prefaced the list of references as follows,

> *As the Expert Committee proceeded through the process of identifying knowledge and skill requirements, the members often found themselves asking, "Where did I get that information?" or "What reference has that information?" It seemed appropriate to compile a list of all those publications that committee members had used over the years. The list is a guide to all practitioners wishing to show competence in this practice area or prepare for a practice area exam. The list of resource materials below should be viewed as a basic starting point and is not meant to be limiting. Additions are encouraged from practitioners with backgrounds that are different from Expert Committee members, as well as new publications that support this practice area.*

AGRASID 1.0: Soil Inventory Project Procedures Manual, Appendix A (https://open.alberta.ca/dataset/soil-inventory-project-procedures-manual (Accessed July 2021)

Agronomic Interpretations Working Group. 1995. Land suitability rating system for agricultural crops: 1. Spring-seeded small grains. Edited by W.W. Pettapiece. Tech. Bull. No. 1995-6E. Centre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, Ottawa. http://sis.agr.gc.ca/cansis/publications/manuals/index.html (Accessed July 2021)

Alberta Agriculture, Food and Rural Development. 2004. Procedures manual for the classification of land for irrigation in Alberta. Irrigation Branch, Lethbridge, AB. 90 pages. Website: https://open.alberta.ca/publications/procedures-manual-for-the-classification-of-land-for-irrigation-in-alberta-2004

Alberta Environment and Parks. 2017. *Ecological Sites of the Athabasca Plain Subregion*. Second Approximation – This is the second approximation of the Athabasca Plains subregion. Prepared by: Michael G. Willoughby, Marge Meijer and Dave J. Downing. 132

pp. ISBN No.: 978-1-4601-4905-8 (Online Editions). Available at: https://open.alberta.ca/dataset/946d38d4-d3e4-4b61-81fc-3e7efeee6369/resource/88ba4b1a-bc8e-4c34-8b7c-1387c5609c94/download/2017-ecological-sites-for-athabasca-plain-subregion-january-2017.pdf.

Alberta Environment and Parks. 2017. *Ecological Sites of the Boreal Subarctic Subregion*. First Approximation. Prepared by: A.J. Miller, M. G. Willoughby, D. J. Downing and M. Meijer. 121 pp. ISBN No.: 978-1-4601-3384-2 (Online Edition). Available at: https://open.alberta.ca/dataset/1853b93f-c31d-4abf-b0ab-dc95e562735e/resource/3cd92ffe-a523-4a67-8175-4175e162ad61/download/boreal-subarctic-subregion-guide-approx-1-march-2017.pdf

Alberta Environment and Parks. 2017. *Ecological Sites of the Kazan Upland Subregion*. First Approximation. Prepared by: M. G. Willoughby, M. Meijer and D. J. Downing. 99 pp. ISBN No.: 978-1-4601-3320-0 (Online Edition). Available at: https://open.alberta.ca/dataset/e04249ad-8144-43bf-95f0-3118d15c1bd8/resource/95eecccd-39be-40a4-9fd2-0891e758b7fb/download/kazan-upland-subregion-guide-approx-1-feb-2017.pdf

Alberta Environment and Parks. 2017. *Ecological Sites of the Northern Mixedwood Subregion*. First Approximation. Prepared by: A.J. Miller, M. G. Willoughby, D. J. Downing and M. Meijer. 93 pp. ISBN No.: 978-1-4601-3359-0 (Online Editions). Available at: https://open.alberta.ca/dataset/0dbc3124-c3fc-4035-9f38-9d1a07f462e0/resource/8c6f9c2c-6552-464b-86a8-ef43d7903733/download/nm-subregion-guide-first-approx-mar-2017.pdf

Alberta Environment and Parks. 2019. *Ecological Sites of the Central Mixedwood Subregion*. 2nd Approximation – This is a revision of the field guides to Ecosites of Northern Alberta for the Boreal Mixedwood. Prepared by: M.G. Willoughby, J.D. Beckingham, J.H. Archibald, D. Moisey, J. Young, D. Lawrence, C. Stone and A. Book. 226 pp. ISBN No.: 978-1-4601-4647-7 (Online Editions). Available at: https://open.alberta.ca/dataset/0224ef49-fb75-4da4-b81c-24e79519fd29/resource/aab57c9d-02ff-409b-a310-0845e378d6d6/download/aep-ecological-sites-of-the-central-mixedwood-subregion.pdf.

Alberta Environment and Parks. 2020. *Ecological Sites of the Lower Boreal Highlands Subregion*. Second Approximation – This is the second approximation of the Ecological Sites of the Lower Boreal Highlands subregion. Prepared by: Michael G. Willoughby, Dave J. Downing and Marge Meijer. 244 pp. ISBN No.: 978-1-4601-4897-6 (Online Editions). Available at: https://open.alberta.ca/dataset/b22fb290-abba-4307-95fb-57ac5d2b5ab2/resource/87e12ae2-2485-4a0d-9a1e-5300cff3f0ae/download/2016-guide-to-ecological-sites-of-lower-boreal-highlands-subregion.pdf.

Alberta Environment and Parks. 2020. *Ecological Sites of the Subalpine Subregion*. Second Approximation – This guide is a revision of the Ecosites of West-Central and Southwestern Alberta (1996) for the Subalpine subregion. Prepared by: Michael G. Willoughby, J.H. Archibald, G.D. Klappstein, I.G.W. Corns, J.D. Beckingham, and A..J. Gould. 348 pp. ISBN No.: 978-1-4601-4706-1 (Online Edition). Available at: https://open.alberta.ca/dataset/8b96de4f-4cc9-42b7-a102-cbcf90cb0600/resource/a388bfdf-4266-4e3b-b09d-dfb3da92015c/download/aep-subregion-guide-subalpine-second-approximation-2020-02.pdf

Alberta Environment and Parks. 2020. *Ecological Sites of the Upper Boreal Highlands Subregion*. Second Approximation. Prepared by: Michael G. Willoughby, D.J. Downing and Margaret Meijer. 128 pp. ISBN No.: 978-1-4601-4899-0 (Online Edition). Available at: https://open.alberta.ca/dataset/d63fdf80-df1b-411d-9798-91cdc665a9b3/resource/bce12d6a-4e1e-4134-b921-97336f5437cb/download/af-ecological-sites-of-upper-boreal-highlands-subregion-second-approximation.pdf

Alberta Environment and Parks. 2020. *Ecological Sites of the Upper Foothills Subregion*. Third Approximation – This guide reflects changes to the Ecological Sites of the Upper Foothills subregion (2018 Second Approximation). Prepared by: Michael G. Willoughby, J.H. Archibald, G.D. Klappstein, I.G.W. Corns, J.D. Beckingham, T.L. France, and D.J. Downing. 221 pp. ISBN No.: 978-1-4601-4726-9 (Online Edition). Available at: https://open.alberta.ca/dataset/f790bd3c-bcd1-4527-8e76-c3740458b196/resource/bc64fd60-3f76-4f81-b677-38ce3a1c8c74/download/aep-ecological-sites-upper-foothills-subregion-third-approximation.pdf

Alberta Environment and Parks. 2021. *Ecological Sites of the Alpine Subregion*. First Approximation. Prepared by: Michael G. Willoughby and A.J. Gould. 123 pp. ISBN No.: 978-1-4601-5057-3 (Online Editions). Available at: https://open.alberta.ca/dataset/79d02b60-2871-4f0a-882a-1627a3ef20ad/resource/20607574-e051-49ea-ade8-182097809301/download/af-ecological-sites-plant-communities-alpine-subregion-first-approximation-2021.pdf

Alberta Environment and Parks. 2021. *Ecological Sites of the Dry Mixedwood Subregion*. Third Approximation – This is a revision of the field guides to Ecosites of Northern Alberta for the Boreal Mixedwood. Prepared by: Michael G. Willoughby, John D. Beckingham, J.H, Archibald, D. Moisey, J. Young, D. Lawrence, C. Stone and A. Book. 235 pp. ISBN No.: 978-1-4601-5025-2 (Online Editions). Available at: https://open.alberta.ca/dataset/7786ea4b-06ba-439c-b82a-9311693636f8/resource/077726cf-b841-48ea-b7e2-33816ecec56a/download/af-ecological-sites-dry-mixedwood-subregion-third-approximation.pdf

Alberta Environment and Parks. 2021. *Ecological Sites of the Lower Foothills Subregion*. Fourth Approximation. Prepared by: Michael G. Willoughby, J.H, Archibald, G.D. Klappstein, I.G.W. Corns, John D. Beckingham, T.L. France. 251 pp. ISBN No.: 978-1-4601-4047-4 (Online Editions). Available at: https://open.alberta.ca/dataset/9ae7dab6-b4ce-46eb-991a-1165d832263c/resource/b7978a66-24d8-474f-98b8-ce295f9b432a/download/af-ecological-sites-lower-foothills-subregion-fourth-approximation-2021.pdf

Alberta Environment and Parks. 2021. *Ecological Sites of the Montane Subregion*. Fourth Approximation. Prepared by: Michael G. Willoughby, J.H, Archibald, G.D. Klappstein, I.G.W. Corns, John D. Beckingham, B.E. Wilson, C. DeMaere, H. Baker, M.J. Alexander, D. J. Downing.515 pp. ISBN No.: 978-1-4601-5016-7 (Online Editions). Available at: https://open.alberta.ca/dataset/ff78e497-9f68-4433-b881-fd32064e290e/resource/4662ed1b-e7a6-4f46-b46e-9f814367fb78/download/af-ecological-sites-montane-subregion-fourth-approximation-2021-03.pdf

Alberta Geological Survey. 20201 Open Data Portal. https://geology-ags-aer.opendata.arcgis.com (Accessed July 2021)

Alberta Range Plant Communities and Range Health Guidelines for Grassland and Parkland Natural Subregions. Published by Alberta Environment and Parks. https://www.alberta.ca/range-classification-and-survey-tools.aspx (Accessed January 7 2021)

ARC (Alberta Research Council). 1981. Guidebook for use with Soil Survey Reports of Alberta Provincial Parks and Recreation Areas. https://ags.aer.ca/publication/esr-1981-01

(ASAC) Alberta Soils Advisory Committee. 1987. Land Capability Classification for Arable Agriculture in Alberta. https://archive.org/details/landcapabilitycl00pett

Alberta Soil Survey Reports, Agriculture and Agri-Food Canada Open Portal. https://sis.agr.gc.ca/cansis/publications/surveys/index.html or Alberta Government Open Portal https://www.alberta.ca/soil-survey-reports-by-number-and-map.aspx (Accessed January 7 2021)

Alberta Sustainable Resource Development. 2003. Ecological Land Survey Site Description Manual (2nd edition). Ecological land survey site description manual (2nd edition) - Open Government (alberta.ca)

Alberta Sustainable Resource Development. 2011. Grassland Vegetation Inventory (GVI) Specifications. 5th Edition. http://www.albertapcf.org/rsu_docs/grassland-vegetation-inventory-specifications-5th-edition--june-29-2010-revised---november-9-2011.pdf

BC Ministry of Forests and Range and BC Ministry of Environment. 2010. Field Manual for Describing Terrestrial Ecosystems. 2nd edition. Land Management Handbook 25. https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/conservation-data-centre/field_manual_describing_terrestrial_ecosystems_2nd.pdf (Accessed July 2021)

Canadian Society of Soil Science. 2008. M.R. Carter and E.G. Gregorich (eds). Soil Sampling and Methods of Analysis, 2nd Edition. CRC Press, Taylor and Francis Group. Boca Raton, FL.

Canada Land Inventory Capability Maps: https://sis.agr.gc.ca/cansis/nsdb/cli/index.html

CEMA (Cumulative Effects Management Association). 2006. Land Capability Classification System for Forest Ecosystems in the Oil Sands. 3rd Edition. Alberta Environment Publication No. 1875. https://open.alberta.ca/publications/land-capability-classification-system

Coote, D.R. and W.W. Pettapiece. 1989. Wind Erosion Risk – Alberta. Canada-Alberta Soil Inventory, Land Resource Research Centre, Research Branch, Agriculture Canada.

Corns, I.G.W.; Downing, D.J.; Little, T.I. 2005. Field Guide to Ecosites of West-central Alberta: Supplement for Managed Forest Stands up to 40 Years of Age (first approximation). Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta. Special Report 15. https://d1ied5g1xfgpx8.cloudfront.net/pdfs/25327.pdf (Accessed Feb 4, 2022)

Ducks Unlimited. 2021. Alberta Wetland Classification System Field Guide. Edmonton, AB. 79 pages.

Ecological Stratification Working Group. 1996. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research, and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. Report and national map at 1:7 500 000 scale. http://sis.agr.gc.ca/cansis/publications/manuals/index.html (Accessed July 2021)

Environment and Parks. 2017. Guide to Ecological Sites for the Northern Mixedwood Subregion (first approximation). Prepared by A.J. Miller, M.G. Willoughby, D.J. Downing and M. Meijer. nm-subregion-guide-first-approx-mar-2017.pdf (alberta.ca) (Accessed Feb 4, 2022)

Environment and Parks. 2020. Ecological Sites of the Subalpine Subregion (second approximation). Prepared by M.G. Willoughby, J.H. Archibald, G.D. Klappstein, I.G.W. Corns, J.D. Beckingham and A.J. Gould. Ecological sites of the Subalpine subregion. Second approximation (alberta.ca) (Accessed Feb 4, 2022)

Environment Yukon. 2016. Flynn, N. and Francis. S., editors. Yukon Ecological and Landscape Classification and Mapping Guidelines. Version 1.0. Whitehorse (YT): Department of Environment, Government of Yukon. Natural Regions Committee 2006.

Expert Committee on Soil Survey. 1987. Soil Survey Handbook - Volume 1. Land Resource Research Centre Contribution No. 85-30. Technical Bull. 1987-9E. Agriculture Canada, Ottawa. http://sis.agr.gc.ca/cansis/publications/manuals/index.html (Accessed July 2021)

Government of Alberta. 2015. Alberta Wetland Identification and Delineation Directive. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Available at: https://www.alberta.ca/alberta-wetland-policy-implementation.aspx

Government of Alberta. 2015. Alberta Wetland Classification System. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Available at: https://www.alberta.ca/alberta-wetland-policy-implementation.aspx

Government of Alberta. 2016. Information System Data Users Manual

Government of Alberta – Alberta Environment and Parks (GOA: AEP). 2020. Alberta Wetland Mapping Standards and Guidelines: Mapping Wetlands at an Inventory Scale v1.0. Edmonton, Alberta

Guidelines and Standards to Terrain Mapping in British Columbia. 1986. Resources Inventory Committee Surficial Geology Task Group Earth Sciences Task Force British Columbia.

Holland, W.D. and G.M. Coen. 1982. Ecological (biophysical) land classification of Banff and Jasper National Park. Vol II: Soil and vegetation resources. Alberta Institute of Pedology. SS-82-44. U of A.

Howes, D. and Kenk, E. 1997. Terrain Classification System for British Columbia – Version 2. British Columbia Ministry of Environment, Victoria, BC. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/terclass_system_1997.pdf (Accessed July 2021)

Index to Soil Surveys in Alberta: https://www.agric.gov.ab.ca/soil/survey-reports

Kalra, Y.P. and D.G. Maynard. 1991. Methods manual for forest soil and plant analysis. Northwest Region, Information Report NOR-X-319. Forestry Canada, Northwestern Region, Northern Forestry Centre, Edmonton, Alberta. https://cfs.nrcan.gc.ca/publications?id=11845 (Accessed July 2021)

Kershaw L. and L. Allen. 2020. Vascular Flora of Alberta: An Illustrated Guide.

MacMillan, R. A. and W. W. Pettapiece. 2000. Alberta Landforms: Quantitative morphometric descriptions and classification of typical Alberta landforms. Technical Bulletin No. 2000-2E. Research Branch, Agriculture and Agri-Food Canada, Semiarid Prairie Agricultural

Research Centre, Swift Current, SK. https://open.alberta.ca/publications/0662295005 (Accessed July 2021)

Mapping Systems Working Group. 1981. A Soil Mapping System for Canada: Revised. Land Resource Research Institute Contribution No. 142. Agriculture Canada, Ottawa. 94 pp. http://sis.agr.gc.ca/cansis/publications/manuals/index.html (Accessed July 2021)

McKeague, J.A. 1978. Manual on Soil Sampling and Methods of Analysis. 2nd Edition. Canadian Society of Soil Science, Ottawa, ON.

National Wetlands Working Group. 1997. The Canadian Wetland Classification System, 2nd Edition. B.G. Warner and C.D.A. Rubec (eds). Wetlands Research Centre, University of Waterloo. Waterloo, ON. https://www.gret-perg.ulaval.ca/fileadmin/fichiers/fichiersGRET/pdf/Doc_generale/Wetlands.pdf (Accessed July 2021)

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta Pub. #. T/852. https://www.albertaparks.ca/media/2942026/nrsrcomplete_may_06.pdf (Accessed July 2021)

Pedocan. 1993. Soil Series Information for Reclamation Planning in Alberta, Vols. 1 and 2. Report RRTAC 93-7. Prepared for Alberta Conservation and Reclamation Council (Reclamation Research Technical Advisory Committee – RRTAC) by Pedocan Land Evaluation Ltd. Edmonton, AB. https://era.library.ualberta.ca/communities/e4fdd15f-c21d-4612-a2f7-bfec3fdfc1de/collections/5a153b61-f202-46f7-bd87-78822872de26?search=pedocan (Accessed July 2021)

Pettapiece, W.W. 1986. Physiographic subdivisions of Alberta. Agriculture Canada, Land Resource Research Centre, Ottawa. Map at 1:1.5 M.

Pettapiece, W. W. 2003. Landscape oriented sampling protocols. Pages 29-37 In Proceedings of the 40th Annual Alberta Soil Science Workshop, February, 2003. Available from Alberta Agriculture, Food and Rural Development, Edmonton, AB.

Resources Inventory Committee 1996. Guidelines and Standards to Terrain Mapping in British Columbia. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/012.pdf (Accessed July 2021)

RIC. 1996. Guidelines and Standards to Terrain mapping in British Columbia. Surficial Geology Task Group Earth Sciences Task Force, British Columbia.

Soil Classification Working Group. 1998. The Canadian System of Soil Classification. Agric. and Agri-Food Can. Publ. 1646 (revised). https://sis.agr.gc.ca/cansis/publications/manuals/1998-cssc-ed3/cssc3_manual.pdf (Accessed July 2021)

(SQCWG) Soil Quality Criteria Working Group . 1987. Soil Quality Criteria Relative to Disturbance and Reclamation (Revised). Published by Alberta Agriculture. https://open.alberta.ca/dataset/soil-quality-criteria-relative-to-disturbance-and-reclamation/resource/bd3a4e3d-126d-42fa-b1b2-e9a75edfbf54

Nikiforuk W.L. 1998. Soil Inventory Project Procedures Manual. Prepared by SLRI Consultants Ltd. for Canada-Alberta Environmentally Sustainable Agriculture Agreement (CAESA) https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag6170/$file/procedures_manual.pdf?OpenElement (Accessed July 2021)

Resources Inventory Committee. 1998. Standard for Terrestrial Ecosystem Mapping in British Columbia. Ecosystems Working Group, Terrestrial Ecosystems Task Force, Resources Inventory Committee. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/tem_man.pdf (Accessed July 2021)

Tajek, J, W.W. Pettapiece and K.E. Toogood. 1985. Water erosion potential of soil in Alberta: estimates using a modified USLE. Agriculture Canada Technical Bulletin No. 1985-29. Ottawa, Canada. https://open.alberta.ca/dataset/74286514-83c7-4a86-abc4-5b67e542e403/resource/4d2cfb3c-b608-48e0-bce1-70bd5ce2fbbb/download/af-msc-06-water-erosion-potential-soils-alberta.pdf (Accessed July 2021)

Tajek, J, W.W. Pettapiece and K.E. Toogood. 1989. Water supplying capacity of Alberta soils. Land Resource Research Centre Publ. 89-117 and Alberta Institute of Pedology Publ. M-89-2. Alberta Institute of Pedology, Edmonton, AB. https://open.alberta.ca/dataset/9fcc7dca-c331-4494-9f60-1c749a08842a/resource/6c1dac13-77e8-4127-b8eb-73a9da63d7f3/download/msc-01-water-supplying-capacity-of-alberta-soils.pdf (Accessed July 2021)

U.S. Department of Agriculture. 2021. Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242 (Accessed July 2021)

Watson, E.K., 2007. Soils Illustrated – Field Descriptions, First Edition. International Remote Sensing Surveys Ltd. Kamloops, BC.

Text Books

Buol, S.W., F.D. Hole and R.W. McCracken. 1997. Soil Genesis and Classification, 4th ed. Iowa State Univ. Press, Ames, Iowa.

Foth, H.D. 2009. Fundamentals of Soil Science. Edition 9. John Wiley & Sons. New York.

Hasset, J.J. and Banwart, W.L. 1992. Soils and their environment. Prentice Hall, N.J. 424 pp.

Hausenbuiller, R.L. 1985. Soil Science, Principles and Practices. 3rd Edition. Wm. C. Brown Publishers. Dubuque, Iowa.

Hole, F.D. and J.B. Campbell. 1985. Soil landscape analysis. 1985. Totowa Rowman & Allanheld.

Jenny, H. 1994. Factors of Soil Formation. A System of Quantitative Pedology. New York: Dover Press. (Reprint, with Foreword by R. Amundson, of the 1941 McGraw-Hill publication). https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1330210&ext=pdf (Accessed July 2021)

Tannas, K.E. 2001. Common Plants of the Western Rangelands – Volume 1: Grasses and Grass-Like Species. Olds College. Alberta Agriculture, Food and Rural Development. Edmonton Alberta. ISBN 0-7732-6154-0.

Tannas, K.E. 2003 Common Plants of the Western Rangelands – Volume 2: Trees and Shrubs. Olds College. Alberta Agriculture and Rural Development. Edmonton Alberta. ISBN 0-7732-6160-5

Tannas, K.E. 2004 Common Plants of the Western Rangelands – Volume 3: Forbs. Olds College. Alberta Agriculture and Rural Development. Edmonton Alberta. ISBN 0-7732-6162-1

Weil, R. R. & Brady, N. C. 2017. The nature and properties of soils. 15th ed. Columbus, Ohio: Pearson.

Wilding, L.P. and N.E. Smeck. 1983. Pedogenesis and Soil Taxonomy, Part 1: Concepts and Interactions; Part 2: The Soil Orders. Elsevier Science, New York.

7. SUMMARY

This document describes the knowledge requirements, work experience, skill set and performance expectations for professional practice within the *Biophysical Classification and Evaluation* 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 knowledge, 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 be one of the tools the Institute will use in conducting practice reviews or investigating a complaint about a member. It is the responsibility of the member to be aware of the contents of this practice standard.

APPENDIX A

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 *Biophysical Classification and Evaluation* 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.

APPENDIX B

CODE OF ETHICS

"The Profession of Agrology demands integrity, competence and objectivity in the conduct of its members while fulfilling their professional responsibilities to the public, the employer or client, the profession and other members."

Members should be aware of any other laws and responsibilities in regard to other business and voluntary activities which may impact their ethical conduct.

Guidelines to the Ethical Responsibilities of Agrologists

The purpose of the following guideline is to clarify the intent of the Code of Ethics and the understanding of the nature of the professional obligations that arise out of the document. Throughout, it is recognized that membership is a right granted by the public to the regulated member (member) to practice Agrology in such a way that the public interest is served. It is also understood that, just as the individual member has an obligation to conduct business in an ethical and competent manner, colleagues and the Institute share the moral responsibility of protecting their Agrologists and the field of agrology against any unfounded and unjust criticisms.

1) Among the regulated member's professional obligations to the public are the responsibilities:

a) To practice only in those practice areas where the member's training, ability, and experience make him/her professionally qualified.

The public has given a right to the Professional with the trust and expectation that those activities are undertaken with competence. A member will not make misleading statements regarding his/her qualifications. A member will actively pursue professional knowledge upgrading specific to their practice area(s) in order to remain competent in his/her field of expertise. A member will make referrals to seek advice, and enter into collaborations with other professionals in situations which require expertise that extend beyond the individual member's competence.

b) To express a professional opinion only when it is founded on adequate knowledge and experience, and where the member has an understanding of the situation and context in which this opinion is being offered.

Members must clearly distinguish among facts, assumptions and opinions in their preparation of reports and professional statements. Professional opinions should be clearly stated and should include clear indications of the constraints that apply to the opinion, and the relevant qualifying circumstances, facts and assumptions.

Members should exercise care that work they conduct cannot in any way be seen to support or make possible any morally suspect or illegal purposes. In the extreme, this caution might cause a member to refrain from association with enterprises or individuals whose objectives and probity are subject to questions.

Members who act as expert witnesses and provide opinion evidence for the purpose of litigation should not take a partisan position. Agrologists must provide evidence as impartial experts and must not do so as advocates of their client or employer. While acting as an expert witness, a member's role is to assist the judge/jury/panel with technical matters which are beyond the expertise of the tribunal.

c) To advocate and practice good stewardship of all agricultural and environmental resources based on sound scientific principles(s).

Stewardship requires making complex choices based on a variety of relevant but not necessarily compatible factors. Good stewards must consider, but not necessarily be limited to: monetary matters, social values, the rational application of sound science, the lessons of valid experience, impacts on the economic health of the community at large, and the impacts on future generations. Because of the position of public trust, a member's duty is to uphold professional principles above and beyond the demands of employment.

Conflict may arise between a member's duty to uphold professional principles and the duty to serve the needs of an employer or a client. Members must distinguish between the role they play as Agrologists and the role management plays. Managers have prerogatives and privilege for making decisions based on a wider range of constraints than those that might be appropriate for an Agrologist. The member must not confuse the role of providing others with information upon which to base a decision with the role of being responsible for making the decision him or herself.

If a member believes there is a serious conflict between the requirements of employment and a member's professional principles, a member should inform/or consult the Registrar or any other appropriate persons about the conflict. Members may seek advice and support for the position from the Institute.

d) To extend public knowledge of agriculture and the environment and to promote truthful and accurate statements on sustainable agricultural systems and environmental matters.

Members should strive to develop appropriate involvement with schools, agencies and organizations insofar as such outreach activities can help ensure the dissemination and discovery of sound and appropriate agricultural environment knowledge. Members should attempt to correct misleading or erroneous statements on agricultural matters whenever and wherever such statements are encountered.

e) To have proper regard for the safety of others in all work.

Members must understand their obligation for promoting safety. Members should consider the impact the exercise of their professional duties will have upon the health of the environment, industrial safety, and health of the consumer, construction safety and the general operational safety of completed projects. Members must 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.

The public expects and demands a safe supply of food, not only for current but also for future generations. Members must balance the claims of producers and 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.

2) A member's responsibility to the client or Employer is:

a) To act conscientiously and diligently in providing professional services.

Members should endeavour to put service above gain and excellence above quantity. If a member becomes aware of errors or omissions in his/her work, he/she must report the same to his/her client or employer, and immediately work to remedy such errors or omissions.

Expect as required by law, to maintain the confidentiality of client and employer information unless given the explicit consent of the client or employer.

b) A member should consider all information received from a client or employer as confidential unless such information is in the public domain.

Information obtained during and specific to a professional contract situation is confidential and must not be disclosed to others or used by the members outside that contracted situation without the consent of the client or employer. However, technical expertise gained by a member through work may be used in subsequent projects without consent from other parties.

c) To obtain a clear understanding of the client's or employer's objectives.

Members must clearly understand the objectives of the client or employer. Members must make inquiries regarding such objectives to ensure that professional services are provided in the context of complete and accurate information. It is recommended that all oral communication that is material to the delivery of professional services be confirmed in writing.

d) To inform the client or employer of any action planned or undertaken by the client or employer that a member believes is detrimental to good stewardship or in breach of known laws or regulations.

It is a member's duty to advise a client or employer of the consequence of questionable actions and inform the client or employer of the facts that lead the member's belief that the action is detrimental to good stewardship.

e) To refuse any assignment that creates a conflict of interest.

A conflict of interest exists where the duties and loyalty owed by a member to one party are, are likely to become, or to a reasonable, informed and objective observer would appear to be in conflict with the duties or loyalties the member owes to another party.

A member should not accept an assignment in which he/she has a personal or business interest unless that interest is disclosed and approved by the client or employer.

Where a member is in a position of providing professional services to more than one party with different interests in the same or related matter, the member must explain the significance of acting for more than one party to each of the affected clients or employer(s) (the parties) and obtain the written consent of the parties to continue working for more than one party. If any of the parties fail to give their consent the member must then determine whether it is possible to act on behalf of a subset of the parties without conflict. If conflict cannot be eliminated by acting only on behalf some of the parties, then the member should advise all the parties that he/she cannot continue to act for any of them in the matter that generates the conflict of interest.

Members must also advise the parties that no information received in connection with the common matter from the one can be treated as confidential so far as any of the other parties are concerned.

f) To not accept compensation from more than one employer or client for the same work, without the consent of all.

Members need to distinguish between the data or product, which becomes the property of the client; and the process or technical experience, which remains the property of the member.

3) The Agrologist's Responsibility to the Profession is:

a) To inspire confidence in Agrology by maintaining high standards in conduct and work.

A member must keep in mind that the work of an Agrologist is continuously open for public scrutiny and it is the responsibility of each individual to build and maintain a positive image of the field and the profession. Not only must a member perform his/her duties of employment to a high level of excellence, but the conduct of that member must also be of high standard.

b) To support activities for the advancement of the profession.

Members have an obligation to participate in the activities of the Institute (i.e., meetings, elections, holding office, mentoring) as the individual members situation and opportunities allow.

Members need to be constantly aware they are Agrologists and should, by their conduct, provide a positive image of the profession. Each member must be prepared to personally promote Agrology in personal contacts and communications, and to participate in specific promotional initiatives organized by the professional organizations.

c) Where a member believes another individual may be guilty of infamous or unprofessional conduct, negligence or breach of the Agrology Profession Act or bylaws:

to raise the matter with that individual and

if not resolved or if otherwise deemed necessary to inform the Registrar of the Institute in writing.

A member should ensure that the facts and understanding of the misconduct are correct. Consultation with a colleague or Registrar is encouraged if it may help clarify the issue. Members should make every effort to raise and resolve the issue in a candid and professional manner. Agrologists should note that only in exceptional circumstances is it inappropriate to raise such a matter with the other member if done courteously and politely.

d) To state clearly on whose behalf professional statements or opinions are made.

A professional opinion or statement prepared by an Agrologist is for a specific situation and set of circumstances. The content of a professional opinion should include the context in which it is made.

e) To sign and seal only those plans, reports, and other documents for which the members are professionally responsible and which were prepared by or under the direction of the member.

Members who affix their seal and/or signature assume responsibility for and understand the document. The responsible professional must have exercised sufficient control and association with the document so he/she can sign and seal the document based on personal knowledge. Members will not associate themselves with documents, reports or statements that misrepresent, distort or omit material facts. Members should familiarize themselves with information that details the procedures and protocols that are associated with the use and practice of sealing professional works.

4) A member's professional responsibility to other members is:

a) To abstain from undignified or misrepresentative public communication with or about members.

Conduct between members should be characterized by respect, courtesy, honesty, and good faith. Direct and honest criticism between professionals is acceptable and professional debate is encouraged when characterized by fairness and propriety.

Members should be courteous when criticizing the work of another member and be as careful with a colleague's reputation as they would be with their own. Members will advise another regulated member in advance if they are reviewing/critiquing the other's work for a specific project. An individual member will not make statements or representations on behalf of the Institute without prior authorization.

b) To give credit for professional work to whom credit is due.

Members should always acknowledge the work and contributions of others when directly using that work in whole or in part. Members should clearly understand and appreciate that the unpaid use of marketable processes and technology developed by another member could jeopardise that other member's livelihood.

Members will follow the rules and law of copyright. Members will secure releases for any data, process (es), and publication(s) obtained from written or electronic sources.

c) To share knowledge and experience with other members.

Each member has a duty to new members and to the future of the Institute to be available as a mentor for new members. Individual members should offer and seek out constructive professional discussion and debates with colleagues to maintain a vibrant and progressive profession.

Code of Ethics, Revised September, 2010