Concepts, Rationale and Suggested Standards for the

Yukon Ecosystem Classification and Mapping Framework - First Approximation

DRAFT (ver. 1.3)

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SUMMARY

Ecosystems are increasingly being used as a framework for integrated resource management, protected areas planning and environmental / cumulative effects assessment. Ecosystem mapping is well suited to assisting sustainable resource management activities. While ecosystem classification and mapping is acknowledged as an important activity, Yukon does not currently have an accepted or standardised system of ecological classification and mapping. There is currently no single "ecosystem classification and mapping framework" to describe the range of physiographic and biological diversity within Yukon at scales that are meaningful for the purposes of land management. The lack of a standardised ecosystem classification and mapping framework is therefore a major barrier to many territorial initiatives including protected areas planning, forest management planning, environmental and cumulative effects assessment, land use planning and wildlife habitat management. In order to facilitate integrated resource planning and management, or ecosystem-based planning and management, the development of a standardised ecosystem classification and mapping framework for Yukon is required.

This document presents the concepts, rationale and standards for a proposed ecosystem classification and mapping framework for Yukon. This document attempts to accomplish two major objectives:

1) Develop the rationale and classification and mapping concepts for a potential Yukon ecosystem classification and mapping framework; and
2) Propose preliminary standards and mapping conventions for the developing framework

The framework presented in this document has become known as the Yukon Ecosystem Classification and Mapping Framework (YECMF). The Yukon Ecosystem Classification and Mapping Working Group (YECMWG) has developed this framework over a period of approximately three years, through a series of workshops and exploratory mapping projects. A substantial amount of preliminary mapping completed during this period of development has validated many of the proposed framework concepts contained within this draft document. Elements of the YECMF are considered to be in an advanced stage of development. However, several important classification and mapping issues remain to be validated, and require further discussion. This draft framework document is intended to facilitate this discussion, with the intention of advancing the development and acceptance of the YECMF.

Key Issues

1) At this stage in the YECMF development, the key issue is the formalisation of classification concepts associated with ecosystem units at both Regional and Local scales. There is agreement that terrain conditions should lead in the determination of these units. Terrain classification concepts and proposed standards are currently in a more advanced stage of development and agreement than vegetation classification concepts. However, two fundamental questions remain:

- What system or model for vegetation classification should be used?
- Should the terrain and vegetation classification components be able to be used independently, or, are the terrain and vegetation conditions inherent in the classification and description of the ecosystem units? Given the developmental nature of the framework, it is the general opinion of the YECMWG that independent terrain and vegetation classifications will, at least initially, be required in the development of discrete ecosystem units. The framework is currently recommending that a generalised suite of vegetation communities occur as different phases when occupying different terrain conditions, potentially allowing future development of discrete ecosystem units with different management interpretations. Clear vegetation and ecosystem classification concepts are required.

2) Having worked to develop the classification at both Regional and Local scales, new mapping technologies may require that the YECMWG revisit the current model of two distinct classification and mapping scales. The major goal in this assessment would be to determine whether a scale-independent framework is possible. While technological advancements may make a "scale-independent" mapping system possible, the YECMWG feels strongly that valid ecological concepts should drive the development of the framework; retaining different scales of interpretation may therefore be necessary.

3) Regionally distinct ecosystems occur in Yukon, with the latitudinal gradient between the Boreal Cordillera and Taiga Cordillera / Southern Arctic Ecozones being a primary determinant of this regionalisation. It is possible that a single classification framework may not be adequate for all regions. While this issue requires discussion, it is the opinion of the YECMWG that a single, comprehensive ecosystem classification and mapping framework for Yukon can be developed for the entire territory and is a desirable goal.

ACKNOWLEDGEMENTS

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1.0. INTRODUCTION

1.1. PROBLEM STATEMENT

Yukon is a geographically large and ecologically diverse region of Canada. Along a north-south latitudinal gradient, Yukon spans sub-boreal coastal, interior continental and sub-Arctic climate zones (Wahl et al. 1987). Major physiographic regions include the Coast Mountains, Cordillera, Interior Plateau and Arctic Slope (Bostock 1948). Significant areas of western Yukon remained unglaciated during successive Pleistocene glaciations (Duk-Rodkin 1999), a situation unique within Canada, and an important determinant of ecosystem distribution and development in Yukon. Elevation gradients, slope and soil conditions within each of these broad climatic and physiographic regions create ecological gradients that provide the primary level of ecological pattern for Yukon landscapes. The synthesis of these broad climatic and physiographic regions and more localised elevation, terrain and vegetation patterns create and maintain a diverse array of ecological conditions that can be described and mapped at different spatial scales. Describing and mapping Yukon's ecological diversity is an important component of all resource management activities.

Ecosystems are increasingly being used as a framework for integrated resource management, protected areas planning and environmental / cumulative effects assessment. Ecosystem mapping is well suited to assisting sustainable resource management activities. Resource management issues generally fall into three broad categories: 1) quantitative, 2) qualitative and 3) spatial distribution. Typical questions that a resource manager must answer include the following:

1) Quantitative
- How much of a particular ecosystem type is within a planning area?
- How much of a particular ecosystem type will a certain activity impact?
- Is this ecosystem type rare within a particular planning area, or is it rare locally but relatively abundant regionally?

2) Qualitative
- Is a localised planning area representative of the regional landscape?
- What are the economic and non-economic values associated with a particular ecosystem type (e.g. wildlife, forestry, or suitability for residential development)?
- Does the same ecosystem type in different stages of development contain different wildlife values (i.e. habitat quality)?
- What is the sensitivity of a particular ecosystem to disturbance from various forms of human activities?

3) Spatial Distribution

- Where does a particular ecosystem type occur on the landscape?
- Does the ecosystem type occur in small, geographically separated patches, or is it distributed within a few, large patches?

While ecosystem classification and mapping is acknowledged as an important activity, Yukon does not currently have an accepted or standardised system of ecological classification and mapping. There is currently no single "ecosystem classification and mapping framework" to describe the range of physiographic and biological diversity within Yukon at scales that are meaningful for the purposes of land management. With the existing mapping and information sources, many of the resource management questions outlined above cannot be answered in Yukon. The lack of a standardised ecosystem classification and mapping framework is therefore a major barrier to many territorial initiatives including protected areas planning, forest management planning, environmental and cumulative effects assessment, land use planning and wildlife habitat management. In order to facilitate integrated resource planning and management, or ecosystem-based planning and management, the development of a standardised ecosystem classification and mapping framework for Yukon is required.

1.2. WHY ECOSYSTEM MAPPING?

Ecosystem classification and mapping provides a number of important advantages over traditional vegetation, forest cover or land cover mapping:

- Ecosystem classification and mapping develops a common language that allows multiple natural resource management agencies and industries to communicate with increased clarity, fostering better communication and ultimately integration of activities – it is not sector specific;
- In contrast to sector-specific mapping that is potentially difficult to use outside of that specific discipline, ecosystem mapping results in a common base map that can be utilised by multiple resource management agencies and industries;
- Common classification and mapping standards result in mapping efficiencies and ultimately cost savings;
- Ecosystems deal with abiotic (climate, hyrdology, terrain and soil) and biotic (biological) landscape elements. Ecosystem mapping integrates abiotic and biotic information on one map. Also, classifying and mapping terrain and soil components of ecosystems extends the longevity of map products, again resulting in cost savings, and also increases the potential interpretations of ecosystem mapping versus traditional forest cover – vegetation mapping.

1.3. PURPOSE AND STRUCTURE OF DOCUMENT

This document presents the concepts, rationale and standards for a proposed ecosystem classification and mapping framework for Yukon. This document attempts to accomplish two major objectives:

3) Develop the rationale and classification and mapping concepts for a potential Yukon ecosystem classification and mapping framework; and
4) Propose preliminary standards and mapping conventions for the developing framework

For the remainder of this document, the proposed framework is referenced as the "Yukon Ecosystem Classification and Mapping Framework" (YECMF). Due to the developmental nature of the YECMF, this document is structured somewhat differently than a conventional 'standards guidebook'. The rationale and concepts for the YECMF had to first be developed and documented, and then proposed mapping standards and conventions described. In this document, the following sections are included:

- Section One – introduction, problem analysis and project history.
- Section Two – background on ecological classification and mapping concepts, and potential approaches. Section Two provides necessary background and rationale for the proposed YECMF.
- Section Three - guiding principles, classification and mapping concepts, definitions and overview of the proposed YECMF.
- Section Four – proposed Regional and Local ecosystem mapping and digital data standards.
- Section Five – potential interpretations of Regional and Local ecosystem mapping.
- Section Six – references.

At several points in this document, important questions or decisions are highlighted, to allow for future focused discussion. Therefore, the primary purpose of this document should be viewed as an advanced 'discussion paper' to focus further development and to provide a forum to refine the proposed YECMF. This draft, version 1.3, builds on the November 19, 2002 version 1.2 framework document, and includes major revisions to the document structure and content.

Appendix One contains a potential geographic organizational framework for a series of future Yukon regional ecosystem guidebooks. During the development of the version 1.2 framework document, a large amount of existing terrain, vegetation and mapping data was synthesized and reviewed for the development of the YECMF classification and mapping concepts. A number of preliminary ecosystem units / types resulted from this exercise but are not currently presented in Appendix One.

1.4. PROJECT HISTORY

The requirement for a documented and standardised ecosystem classification and mapping framework for Yukon has become apparent over the past several years. Many factors contributed to this recognition:

- A number of forest cover, vegetation and landcover mapping projects have been completed throughout Yukon at different scales, using different terminology and developed with different mapping concepts. Many have been produced for project-specific requirements. While the various mapping initiatives have generally suited the needs of the specific project it was created for, integrating and reconciling the various mapping concepts and mapping units has been extremely problematic for uses other than what the original mapping was intended, or when attempting to develop regional databases.
- In some areas of Yukon, the intensity of land use pressures and management in Yukon compared to neighbouring jurisdictions is relatively low. Correspondingly, the amount of resources available for base line data collection is smaller. Resource managers are frequently tasked with using whatever information is available within a geographic area of interest. Deriving interpretations such as woodland caribou habitat suitability from a forest cover map or timber merchantability from a habitat suitability map is difficult and in many instances, not readily possible. Therefore, a common mapping methodology that would serve the needs, to as large extent as possible, of multiple resource agencies and industries was recognised as a necessary requirement of future data collection efforts. Fiscal realities of data collection and mapping efforts dictate that such an approach must occur.
- The legislated requirement of the Canadian Environmental Assessment Act for cumulative environmental effects assessments to occur on all major development projects has highlighted the recognition that a regional context must be established in which to interpret the potential significance of environmental impacts occurring from multiple projects. With our current disparate Yukon mapping sources and the absence of a higher-level ecological framework to interpret the information, this is currently very difficult, if not impossible.

Based on project experiences ranging from forest management to protected areas planning, a discussion paper created by Francis (2000), and further developed by Loewen (2001) initiated the development of this first approximation ecosystem classification and mapping framework for Yukon. The first major framework documentation was produced in November, 2002. An ad hoc group of recognised Yukon vegetation, terrain and information management specialists, collectively termed the Yukon Ecosystem Classification and Mapping Working Group (YECMWG), further contributed to the development of this framework. Many initial concepts and applications were developed during large scale ecosystem mapping exercises completed within the City of Whitehorse and during protected area regional planning technical assessments in support of the Yukon Protected Areas Strategy.

2.0. ECOSYSTEM CLASSIFICATION AND MAPPING CONCEPTS

This section provides a background on ecosystem classification and mapping concepts. Development of the first approximation YECMF occurred through both exploratory mapping projects and through literature review and knowledge of ecosystem classification and mapping frameworks used in other jurisdictions. Information contained in this Section provides the rationale and context for the currently proposed YECMF.

2.1. DEFINING ECOSYSTEMS

The term "ecosystem" was first proposed by Tansley (1935) and is a generally accepted term in all disciplines throughout the world. However, ecosystems have been defined in numerous ways by many authors. The broad meaning of the term "ecosystem" is any natural system in which biotic and abiotic components interact, and which can exist at any spatial scale (Ponomarenko and Alvo 2001). Several popular definitions have included "*a self-regulating association of living plants, animals and their non-living physical and chfemical environment*", "*the sum of the plant community, animal community and environment in a particular region or habitat*" or "*any community of interacting organisms, including their physical and chemical environment, energy fluxes, and the types, amounts and cycles of nutrients in the various habitats within the system*". While definition of scale and ecological process differ slightly, the concept of integration between biotic and abiotic components is central to all definitions.

Ecosystems, as defined in the Biogeoclimatic Ecosystem Classification system of British Columbia (Pojar et al. 1987), are defined as "*a volume of earth-space that is composed of non-living parts (climate, geologic materials, groundwater and soils) and living or biotic parts, all constantly in a state of motion, transformation and development*". Within this definition, no size or scale is inferred. For the purposes of Terrestrial Ecosystem Mapping, as used in British Columbia (RIC 1998), "*ecosystems are characterised by a plant community (a volume of relatively uniform vegetation) and the soil polypedon (a volume of relatively uniform soil) upon which the plant community occurs*". This definition closely matches the concept for "ecosystem" used throughout this report.

2.2. BACKGROUND ON ECOSYSTEM CLASSIFICATION AND MAPPING

Ecological classification and mapping refers to an integrated approach to land survey in which areas or units of land are classified and mapped according to their ecological unity, or similarity (Rowe 1979; within this document, ecosystem classification is used synonymously with the term "ecological land classification" as described by Rowe 1979). The aims of ecosystem classification and mapping are to provide primary information on the biological and physical characteristics of various landscape components in order to facilitate a range of interpretations (Rowe and Sheard 1981). Interpretations may include renewable productivity (eg. forestry and wildlife), conservation management and planning (eg. representation, quantifying the distribution of various ecosystem components) and land use planning. In the past 30 years, ecosystem classification and mapping has played a major role in environmental impact assessment and cumulative effects assessment for both individual and multiple development projects.

2.2.1. A HISTORY OF ECOSYSTEM CLASSIFICATION AND MAPPING IN CANADA

A detailed history of ecosystem classification and mapping in Canada is provided by Ponomarenko and Alvo (2001). The formal beginnings of ecological land classification (ecosystem classification) and mapping in Canada were developed in the 1960s during the initial stages of the Canada Land Inventory (Wiken and Ironside 1977). In 1964 the National Committee on Forest Land established an interdisciplinary subcommittee to explore possible alternatives to land survey for large geographic regions which resulted in the publication of "*Guidelines for Bio-Physical Land Classification*" (Lacate 1969). This document developed a framework to classify and map "ecologically-significant units of land" as expressed through their inherent biological and physical components. These included geomorphology, soils, vegetation and to a lesser extent, climate. The 1969 "Guidelines" document was based primarily on the work of earlier Australian (Christian 1958), Russian (Sukachev and Dylis 1964), English (Bourne 1931, Beckett and Webster 1965) and Canadian (Hills 1961) scientists who attempted to provide integrated frameworks for land surveys in large, inaccessible areas (Wiken and Ironside 1977, Bastedo and Theberge 1983).

Many different vegetation and ecosystem classification systems are in use throughout Canada and the world. Based on the review of Ponomarenko and Alvo (2001), at least 50 different ecological or vegetation classifications are currently being used in Canada. Due to existing management regimes or geographic adjacency, three systems or frameworks have major relevance to Yukon. These include the National Ecological Framework (ESWG 1995), the British Columbia Biogeoclimatic Ecosystem Classification (Pojar et al. 1987) and its associated Terrestrial Ecosystem Mapping guidelines (RIC 1998), and the developing Canadian National Vegetation Classification (Ponomarenko and Alvo 2001). A guiding principle of the developing YECMF is that is should integrate, to as large extent as possible, with existing or ongoing national / international efforts. A review of potentially relevant frameworks was completed during the development of the YECMF.

2.2.2. A HISTORY OF ECOSYSTEM CLASSIFICATION AND MAPPING IN YUKON

A variety of vegetation and landcover mapping exercises have been completed in Yukon. Most have been produced for specific purposes and have utilised different classification concepts, mapping scales and terminology. This has created many problems when attempting to integrate the various mapping sources. While a large number of "ecosystem map-like" products have been produced over the years, the two projects that perhaps best embrace the concepts of ecosystem classification, and that were based on well defined criteria and concepts, are the Southern Lakes Vegetation Inventory (Boyd et al. 1982) and the Yukon Forest Ecosystem Classification for Southeast Yukon (Zoladeski et al. 1996). Both were examined closely during the framework development. Two additional products, an ecosystem map completed for a portion of the City of Whitehorse in the Southern Lakes region (AEM 2000), and an ecosystem map for the Kaska Forest Resources Timber Harvest Area in Southeast Yukon (AEM 2001), were were important pilot projects in the development of mapping concepts. Regional ecosystem mapping using the higher levels of the proposed YECMF has been completed for approximately 1/3 of Yukon as a result of Yukon Protected Area Strategy initiatives; this mapping was instrumental in the development of the overall framework and mapping concepts. Each project is discussed below.

2.2.2.1. Southern Lakes Vegetation Inventory

A series of 1:100,000 scale vegetation maps was prepared for the Yukon Southern Lakes region as part of the Yukon Southern Lakes Resource Inventory (Boyd et al. 1982). This mapping was a "hybrid" of forest cover mapping techniques and ecosystem mapping. There are several georeferencing issues associated with this map product and the classification system and nomenclature was not explicitly designed to be used in a GIS environment. However, the Southern Lakes Vegetation Inventory is of great use to future ecosystem mapping in the Southern Lakes area as a number of **"vegetation communities"** have been described and received field verification. The mapping also identified boreal, subalpine and alpine zones within the project area.

2.2.2.2. Southeast Yukon Ecosystem Classification

An ecosystem classification was created for Southeast Yukon (Zoladeski et al. 1996) but this classification appears to have four major limitations:

- The classification was never intended to be map-based. The ecosystem classification was intended to be used as a field classification guide for site-specific applications, primarily forestry, and therefore is not well suited for spatial applications and polygon-based interpretations.
- The classification system does not incorporate hierarchical concepts (i.e. there is no differentiation between boreal and subalpine forests, nor is there differentiation between ecological conditions within the Liard Basin, Hyland Highland or Muskwa Plateau Ecoregions).
- The classification does not contain seral/structural stages. Many of the V-Types described in the classification appear to be different seral or structural stages of the same V-Type;
- The classification is not based on physiographic (soil/terrain) information. The primary parameters used to classify V-Types are leading tree species and canopy closure. Ecological land classification should explicitly incorporate surficial materials and landscape position.

Vegetation Types (V-Types) created through the project have been reinterpreted in a variety of ways in an attempt to create mappable ecological units for the purposes of woodland caribou management and related wildlife habitat applications. The V-Types have a large amount of utility in the description of vegetation communities or ecological map units within the developing YECMF.

2.2.2.3. City of Whitehorse Ecosystem Mapping

To be completed

2.2.2.4. Ecosystem Map for Kaska Forest Resources Timber Harvest Area

To be completed

2.2.2.5. Regional Ecosystem Mapping for Yukon Ecoregions

To be completed.

Figure 2.1 displays completed projects utilising YECMF Regional Ecosystem Levels 1-5.

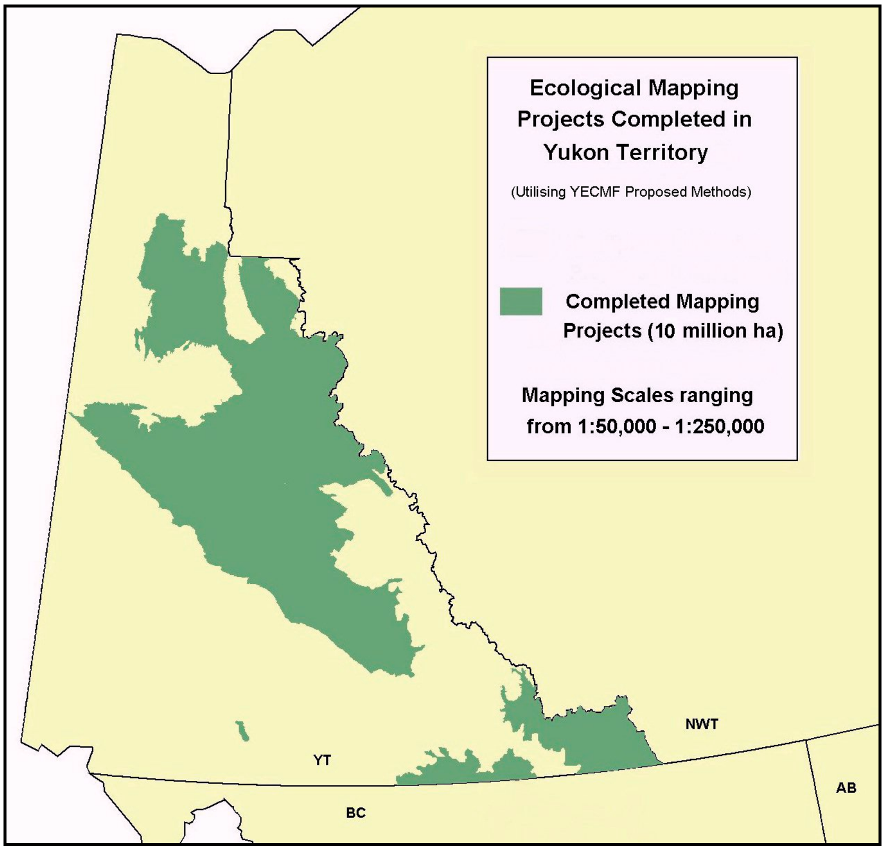


Figure 2.1. Regional Ecosystem mapping initiatives completed within Yukon using the proposed YECMF Levels 1-5. A recently initiated Regional Ecosystem mapping project is being completed in the Yukon Southern Lakes and Pelly Mountains Ecoregions of southern Yukon.

2.3. POTENTIAL ECOSYSTEM CLASSIFICATION AND MAPPING APPROACHES

A key consideration in the development of the YECMF was potential ecosystem classification and mapping approaches. This Section provides background on the major approaches that were reviewed during the framework development. Ponomarenko and Alvo (2001) provide an overview and comparison of the many different systems and approaches to vegetation and ecosystem classification currently being applied in Canada, North America and internationally. While a diversity of methods and approaches exist, most systems encompass one of two major concepts, division (regionalisation) or classification, or combine elements of both approaches. A brief overview of both approaches is listed below.

2.3.1. DIVISION (REGIONALISATION)

Division is the process by which spatial entities (i.e. geographic areas) are divided into parts by applying certain criteria (Ponomarenko and Alvo 2001). Using Canada as an example, the nation is divided into 10 provinces and 3 territories. Each political jurisdiction may be further subdivided into management regions or municipalities. The National Ecological Framework (ESWG 1995) is an ecological land classification framework based on division, where higher levels in the framework (e.g. Ecozones) are subdivided into smaller units (e.g. Ecoregions) based on increasing ecological similarity. The requirement for a well-defined classification is not required to perform division.

2.3.2. CLASSIFICATION

Classification is generally considered to be the process of using some orderly, well-defined process or criteria to “classify” different elements into various “classes”. A classification requires well-defined concepts for “placing” different elements into those classes, and a comprehensive classification will classify all possible elements. Describing all potential elements is the major goal of classification. The scientific discipline of biological taxonomy uses an “element-based classification” (Ponomarenko and Alvo 2001) to place different species into different groups based on well-defined criteria. Similarly, the Canadian System of Soil Classification (Soil Classification Working Group 1998) employs the concepts of classification to create soil Orders, Great Groups, etc. Each is classified based on specific criteria (e.g. diagnostic soil horizons, colour and climatic definitions).

For the purposes of ecological land (ecosystem) classification, classification systems can generally be considered as one of two major approaches, either “site-based” or “polygon-based”; some systems attempt to utilise both approaches.

2.3.2.1. "Site-based" Ecosystem Classification

"Site-based" ecosystem classification is used to classify a very small land area (e.g. a plot or quadrat) with a high level of detail using consistent, well-defined criteria. Site-based ecosystem classifications have been used widely for forestry applications to design silvicultural prescriptions based on detailed site conditions (e.g. Beckingham and Archibald 1996). Site-based ecosystem classification approaches are utilised extensively by forest management agencies, as perhaps best represented by the British Columbia Ministry of Forests Biogeoclimatic Ecosystem Classification "Site Series" (e.g. Banner et al. 1993). While a site-based ecosystem classification may have many specific uses for forest management applications, it is difficult to apply in a map-based format where "polygons" or land units of vegetation or soil conditions require classification. The amount of fine-scale variability within an individual map polygon may make it very difficult to utilise a site-based classification for mapping purposes.

2.3.2.2. "Polygon-based" Ecosystem Classification

"Polygon-based" ecosystem classification is used to classify land units (map polygons) with a general level of detail using well-defined criteria. Polygon-based classifications are based on the concept of "observable features". This form of classification is intended for use within a mapping framework and classification criteria is designed to be performed using readily observable characteristics. Polygon-based ecosystem classification will therefore have an inherently more generalised level of detail than "site-based" classification approaches. It may be possible to extrapolate the results of a site-based classification to a map polygon, as has been done in the British Columbia Terrestrial Ecosystem Mapping (RIC 1998) system. However, achieving high levels of mapping reliability using such an approach is often very difficult and expensive due to the high levels of field verification that are required. For the majority of land management applications, polygon-based classification approaches, due to their utility for mapping, will be of greater use to a wider range of resource managers.

3.0. OVERVIEW OF PROPOSED YUKON ECOSYSTEM CLASSIFICATION AND MAPPING FRAMEWORK

3.1. FRAMEWORK DEVELOPMENT

Development of the YECMF has occurred sporadically over the past four years, with 2002 being a period of focused framework development. As discussed in Section 2.2, above, a number of local and regional mapping projects completed during this period have utilised the proposed YECMF classification and mapping concepts, and each has contributed to the advancement of the framework. The YECMF has been developed with consideration of the Yukon ecological setting, Yukon data availability and quality, Yukon resource management needs and the requirement for a practical framework that can be readily implemented in a cost-effective manner. To date, the higher levels of the framework and components of the lower framework levels have proven robust and have aided in ecological interpretations at a range of scales for a variety of purposes. However, several important concepts related to the integration of mapping scale and the nature of the vegetation classification component of the proposed framework remain. This section presents the currently proposed YECMF and highlights areas where potentially key issues require consensus and refinement. Major elements of the YECMF proposal are summarised after each section in a green bar; major issues or decisions are identified in yellow. Detailed YECMF mapping conventions and standards (proposed) are presented in Section 4.

3.1.1. GUIDING PRINCIPLES IN THE DEVELOPMENT OF THE YECMF

Several guiding principles provided direction during the development of the YECMF. These included the following:

- **An ecosystem classification and mapping framework for Yukon must be developed through the use of existing data, knowledge and expertise.** The development of a YECMF should build on existing data, knowledge and expertise, and not require the collection of large amounts of new, primary field data. The financial resources available and the general intensity of resource management activities in Yukon preclude the development of a system that is data intensive. The system must be adaptable to allow for the incorporation of new information as it is collected through future initiatives.

- **Ecosystem mapping should provide a single, comprehensive map base for most resource management activities in Yukon.** Ecosystem mapping should be designed with input from a variety of Yukon resource managers. Eventually, ecosystem mapping should replace, or at least provide linkage, between the many disparate forms of mapping currently in use. Standard nomenclature should be developed and adopted by all resource agencies.

- **Ecosystem mapping should integrate, to as large extent as possible, with existing or ongoing national / international efforts.** Yukon is a partner in national commitments and initiatives. Many Yukon policies and management regimes are tied to the existing National Ecological Framework (ESWG 1995). Therefore, any detailed ecosystem classification and mapping framework for Yukon should integrate with the higher level regionalisation of this existing framework. To as large extent as possible, ecosystem mapping methods should draw upon methods and established criteria from neighbouring jurisdictions.

- **Ecosystem mapping should be based on valid ecological principles and performed using defined criteria.** Incorporating our knowledge of Yukon ecosystems and landscape ecology should be a primary consideration in the development of a territorial ecosystem classification and mapping framework. Relevant ecological gradients, terrain conditions, locally important disturbance processes and local vegetation ecology should be major considerations in the development of this system – directly adopting an ecological classification and mapping system that was developed in another ecological setting may therefore not be appropriate. However, elements and concepts from complimentary systems should be used for guidance. Documented criteria for defining and delineating regional and local ecosystems will provide rigour to the developing framework.

3.2. YECMF CLASSIFICATION AND MAPPING CONCEPTS

Within the proposed YECMF, the term "*ecosystem*" carries the following definition:

Ecosystem: *"An observable unit of the landscape defined through the synthesis of characteristic climate, soil and vegetation conditions".* Ecosystems are scale independent but the concept of "observable" at meaningful management and mapping scales is central to the definition used in the YECMF.

Based on a review of potential approaches and existing national ecological classification and mapping systems, and considering the local situation, the following classification and mapping concepts were determined to be the major requirements of the developing Yukon Ecosystem Classification and Mapping Framework:

- **Ecosystem mapping should be able to be performed and interpreted at multiple scales.** Most management activities require two levels of interpretation: 1) **Regional** and 2) **Local**. Describing the regional setting for a project allows the local effects of a specific activity to be put in a landscape context. Regional planning activities also necessitate a more generalised description of the landscape. Within Yukon, the two most readily available sources of base mapping data, 1:250,000 and 1:50,000 NTDB, will generally dictate the two scales of ecosystem mapping chosen. In Yukon, most management activities are carried out at one of these two scales. Describing and delineating ecosystems at two scales also allows for different levels of interpretation.

- **Ecosystem classification and mapping should be based on the principle of "ecologically significant, observable features".** Providing an accurate, quantified description of the Yukon landscape is a major goal of ecosystem mapping. Minor variations in plant species composition or abundance should not constitute the identification of a new "ecologically significant" feature. Instead, the description and delineation of mapping units should be based on readily "observable" features, both on the ground and through aerial photograph / satellite image-based interpretation. Due to the active disturbance regime found in much of Yukon, predictive-climax concepts as used in British Columbia (Krajina 1965; Pojar et al. 1987) may have limited utility in boreal and sub-arctic systems. Young, early-successional, post-disturbance ecosystems are a conspicuous and important component of Yukon landscapes, and must be recognised as such. Therefore, "*map what is there, not what will be*", has become an important principle for the description and delineation of the vegetation component of Yukon ecosystems. This principle will also favour "polygon-based" classification concepts versus "site-based" classification.

- **The YECMF should incorporate the concepts of both division and classification**. Land units created through the process of division (regionalisation) within the National Ecological Framework (ESWG 1995) create broad geographic areas based on general climatic, physiographic and vegetation similarity. Classification of ecological "elements" is required to provide an adequate level of detail to describe the landscape for management purposes. Within the YECMF, classification will therefore be used to map detailed land units based on accepted levels of ecological hierarchy/organisation. The broad land units developed through the process of division will be used to interpret the more detailed classification elements within the YECMF. Incorporating the concepts of both division and classification will result in a framework that does not incorporate a spatially-nested hierarchy of map units, which is desirable.

- **Ecosystem classification and mapping should incorporate relevant ecological gradients.** In Yukon, important elevational and latitudinal gradients exist. These gradients exert important control over vegetation distribution and composition, and are generally recognisable through differences in vegetation expression. Mapping and describing these important ecological zones will assist in the interpretation of more detailed terrain, vegetation and ecosystem mapping and provide context for the organisation and interpretation of the detailed map units.

- **Ecosystem map units should be terrain-based.** Mappable ecosystem elements consist of two major components: 1) soil/terrain features, which are relatively static, and 2) vegetation communities, which are dynamic. Using observable, ecologically-meaningful terrain units as the basis for the delineation of ecosystem units will create ecological maps with a longer life-span, as generally only the vegetation components will require updating due to disturbance or succession. The National Ecological Framework (ESWG 1995) Terrestrial Ecozones and Ecoregions recognise the importance of climate in the delineation of areas with regional similarities. However, at scales that are more meaningful to resource managers, elevation gradients, local landforms and surficial materials provide much of the underlying pattern that influences the distribution of most vegetated and non-vegetated ecosystems. Surficial geology conditions, major slope and aspect breaks, and topography should therefore form the basis for detailed ecosystem mapping. Higher level mapping, as represented through the National Ecological Framework (ESWG 1995), incorporates the concepts of broad climatic and physiographic regions.

- **Ecosystem mapping must be designed for use in a GIS environment.** All land resource management questions have an inherent spatial component. Geographic Information Systems (GIS) allow the display, storage, retrieval and analysis of large amounts of spatial and aspatial information. Therefore, a method for describing and mapping ecosystems that can be used efficiently in a GIS environment is a fundamental requirement for any ecosystem classification and mapping framework for Yukon.

3.3. FRAMEWORK OVERVIEW (PROPOSED)

The proposed YECMF encompasses elements of both division, or regionalisation, provided by the existing National Ecological Framework (ESWG 1995), and a new system of classification based on an accepted hierarchy of ecological organisation. The general framework remains similar to that originally proposed by Francis (2000) and further developed by Loewen (2001). The proposed framework structure has many similarities to the existing Biogeoclimatic Ecosystem Classification (Pojar et al. 1987; Meidinger and Pojar 1991) and Terrestrial Ecosystem Mapping (RIC 1998) systems used in British Columbia but is based on different vegetation and ecosystem classification concepts. The classification component of the proposed YECMF is not based on a spatially-nested hierarchy of classifications (i.e. each level in the classification framework can be delineated and interpreted independently of any other, allowing for maximum flexibility). An overview of the proposed YECMF is illustrated in Figure 3.1. Based on a recent review of ecological classification and mapping systems in Canada, Ponomarenko and Alvo (2001) concluded that a system similar to the proposed YECMF combines the best elements of division and classification approaches for the purposes of classifying, delineating and describing ecological communities. Such a system is being proposed by Ponomarenko and Alvo (2001) as a national standard for the description of ecological communities.

Within the YECMF, two distinct classification and mapping scales are proposed: 1) **Regional Ecosystems**, defined and delineated at a scale of 1:250,000, or smaller, and 2) **Local Ecosystems**, defined and delineated at scales of 1:100,000 – 1:50,000, or larger. Both are based on the concepts illustrated in Figure 3.1, with Local Ecosystems receiving a more detailed level of terrain and vegetation classification and mapping, and generally requiring moderate – high intensity field surveys. Specific Regional and Local Ecosystem classification and mapping framework elements are described in Section 4.1 and 4.2, respectively. Key framework components common to both classification and mapping scales are described in this Section, 3.3.

Proposed Yukon Ecosystem Classification and Mapping Framework:

FRAMEWORK OVERVIEW
(General Classification and Mapping Concepts)

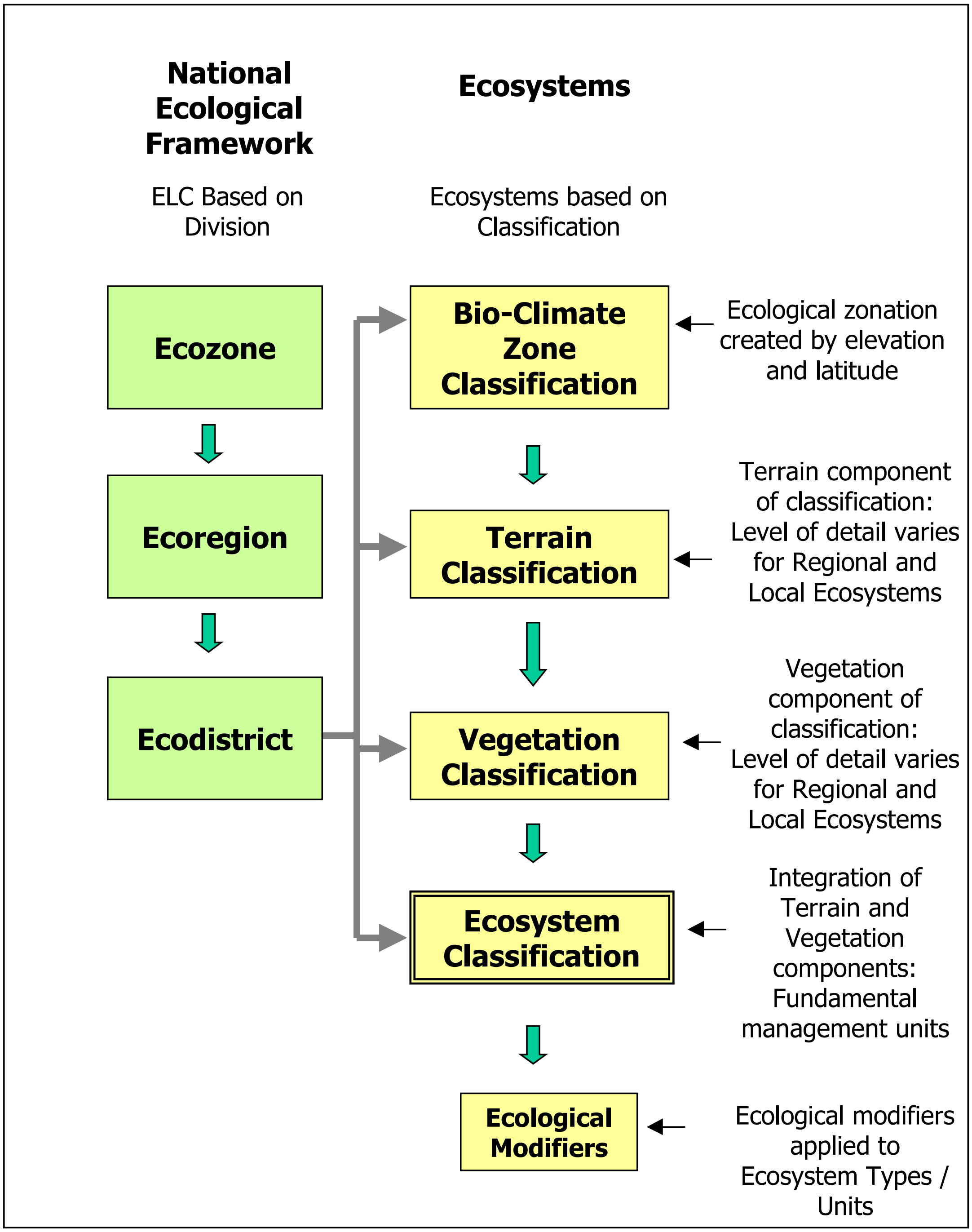


Figure 3.1. Overview of proposed Yukon Ecosystem Classification and Mapping Framework.

3.3.1. DIVISION COMPONENT OF PROPOSED YECMF

The first three levels of National Ecological Framework (ESWG 1995) – Ecozones, Ecoregions and Ecodistricts comprise the division component of the YECMF (Figure 3.1). The National Ecological Framework delineates the broad geographic areas of Yukon that are climatically and physiographically similar, and in doing so, provides the territorial context in which to interpret, relate and compare different ecosystems. Ecozones, Ecoregions and Ecodistricts of the National Ecological Framework are currently delineated at a scale of 1:1,000,000 in Yukon. The YECMF proposes to refine these map units to a scale of 1:250,000. Maintenance of the National Ecological Framework within the YECMF will allow integration of the developing system with an established national framework and will not impact existing Yukon management strategies tied to Ecoregion-based planning and reporting units. Refining the mapping resolution to 1:250,000 scale will allow more ecologically-meaningful boundaries to be created, in comparison to the coarse scale of the existing 1:1,000,000 mapping.

NATIONAL ECOLOGICAL FRAMEWORK PROPOSAL

1) Ecozones and Ecoregions to be re-mapped at 1:250,000 scale but with maintenance of existing distribution and concepts.
2) Ecodistricts to be re-mapped at 1:250,000 scale; new Ecodistricts may be formed or existing Ecodistricts modified.
3) Consideration should be given to the inclusion of the Muskwa Plateau Ecoregion in Southeast Yukon with the Boreal Plains Ecozone (currently included in Taiga Plains Ecozone). This would require a major revision of the National Ecological Framework and must therefore be discussed with ESWG (1995).

NATIONAL ECOLOGICAL FRAMEWORK ISSUE

1) Should the YECMF incorporate Ecosections (ESWG 1995) as a mapping level below Ecodistricts? The inclusion of Ecosections within the YECMF would potentially provide for the delineation of more homogenous physiographic/climatic land units within broad Ecodistricts. This approach would provide a similar level of interpretation as the Biogeoclimatic subzones within the British Columbia Biogeoclimatic Ecosystem Classification (Pojar et al. 1987, Meidinger and Pojar 1991).

3.3.2. CLASSIFICATION COMPONENTS OF PROPOSED YECMF

3.3.2.1. Bio-Climate Zone

The delineation of Bio-Climate zones, or ecological zones, in landscapes that exhibit elevational or latitudinal zonation is an important concept in many ecological classification and mapping systems. The term "**Bio-Climate zone**", as used in the proposed YECMF is adopted from Holland (1976) and was originally used for biophysical mapping in Jasper and Banff National Parks of Alberta. The delineation of Bio-Climate zones provides a method for stratifying the landscape based on the observable vegetation expression created through elevation or latitudinal gradients. Five major terms and concepts are suggested for the definition and delineation of the major Bio-Climate zones occurring within the Taiga Cordillera, Boreal Cordillera and Taiga Plains Ecozones of Yukon (Table 3.1 – Pacific Maritime and Southern Arctic Ecozones have not been addressed in this first approximation framework document, although the term “Icefield” would be applicable to Pacific Maritime Ecozone, with “Tundra” potentially being appropriate for the Southern Arctic).

The use of the terms Boreal / Subalpine and Wooded Taiga / Shrub Taiga were originally intended for use only within the Boreal Cordillera and Taiga Cordillera / Taiga Plains Ecozones, respectively. However, during the completion of Regional ecosystem mapping through recent YPAS initiatives, it was found that some Ecoregions bordering the Taiga Cordillera / Boreal Cordillera Ecozones contain elements of both the Boreal / Subalpine and Wooded Taiga / Shrub Taiga Bio-Climate zones (e.g. Mackenzie Mountains Ecoregion). Therefore, it may be possible for distinctly transitional Ecoregions to contain elements of both Boreal and Taiga Bio-Climate zones.

Future development of the proposed YECMF for the Southern Arctic Ecozones (ESWG 1995) may include the development of new Bio-Climate zones such as Tundra. The use of the Icefield Bio-Climate Zone would be appropriate for use within the Pacific Maritime Ecozone.

Table 3.1. Proposed Bio-Climate zone terms and definitions for use within the Taiga Cordillera, Boreal Cordillera and Taiga Plains Ecozones (ESWG 1995) of Yukon.

Ecozone	***Bio-Climate Zone Code***	***Bio-Climate Zone Description***
Boreal Cordillera Ecozone	**BOR**	**Boreal.** Continuously forested areas at low and middle elevations of all mountain valley and plateau Ecoregions of southern and central Yukon. Tree species differences may result in the formation of "upper" and "lower" boreal forested areas along an elevation gradient. However, at this time it is not proposed that these areas be further separated based on Bio-Climate Zone delineation. Areas influenced by cold air drainage are identified by a process modifier or at the vegetation/ecosystem unit level of the framework.
	SUB	**Subalpine.** Sparsely forested areas at moderate – high elevations. Subalpine areas form a transitional zone between forested boreal valley bottoms/mountain slopes and the non-forested, high elevation Alpine Bio-Climate Zone. Open canopy conifer forest and tall shrub communities are characteristic vegetation types. Bio-Climate Zone delineation between the boreal and subalpine zones is determined by "where the continuous forest ends".
	ALP	**Alpine.** Highest elevations of mountain regions; dwarf shrub, herb/cryptogram and low stature, scattered krummholtz trees are the dominant vegetation type. In very high elevation areas, large areas may include bare rock, colluvium or scattered ice patches.
Taiga Cordillera / Taiga Plains Ecozones	**WTA**	**Wooded Taiga.** Primarily coniferous forested areas with an open forest canopy. Wooded Taiga generally occurs in valley bottoms and lower slopes of mountain valleys or on plateaus and plains. The distribution and depth of permafrost is a major influence of vegetation distribution and dynamics. In steep terrain, active slope processes (rock slides, slumps, talus cones) play a major role in the actual distribution of forested areas.
	STA	**Shrub Taiga.** High elevation Shrub Taiga replaces the term "Subalpine" in North Yukon. These areas are tall or low shrub-dominated areas with sparse or sporadic tree cover. Shrub Taiga generally occurs at high elevations in northern mountain systems. However, the distribution of Shrub Taiga in some areas of North Yukon appears to be influenced to a large degree by arctic weather systems (eg. along the east slopes of the Richardson Mountain foothills).
	ALP	**Alpine.** Highest elevations of mountain regions; dwarf shrub, herb/cryptogram and low stature, scattered krummholtz trees are the dominant vegetation type. In very high elevation areas, large areas may include bare rock, colluvium or scattered ice or relatively permanent snow patches – the extent of unvegetated areas within the Alpine Bio-Climate Zone of North Yukon is generally more extensive than in the Boreal Cordillera.

Table 3.1 (continued). Proposed YECMF Bio-Climate zone terms and definitions for use within the Boreal Cordillera, Taiga Cordillera and Taiga Plains Ecozones (ESWG 1995) of Yukon.

Ecozone	*Bio-Climate Zone Code*	*Bio-Climate Zone Description*
All Ecozones	**ICF**	**Icefield.** Highest elevations of mountain regions with extensive icefields. Most areas are covered by ice and bare rock; vegetated areas are very limited. Due to regional precipitation regimes, the Icefield bio-climate zone in Yukon is limited to the Kluane Region of southwest Yukon and isolated areas within major mountain ranges (Mackenzie and Selwyn Mountains).

BIO-CLIMATE ZONE PROPOSAL

1) Bio-Climate zones be adopted as the highest level of the classification component of the YECMF to provide an ecological context for lower classification levels.
2) Bio-Climate zones should be mapped for the entire Yukon at a scale of 1:250,000, with potential consideration given to 1:50,000.
3) Consideration for new Bio-Climate zones will be given as required.

3.3.2.2. Terrain Classification

Terrain and soil conditions, in addition to atmospheric and hydrologic inputs and processes, form the abiotic component of ecosystems. The terrain classification component of the proposed YECMF attempts to describe and delineate the relatively static, ecologically meaningful abiotic components of the landscape. Due to the general physiographic similarities between Yukon and British Columbia, some terms and concepts from well established British Columbia terrain mapping methods and nomenclature (Howes and Kenk 1997) are proposed for use within the YECMF. Concepts used in Terrestrial Ecosystem Mapping (RIC 1998) are especially relevant.

The goal of terrain mapping within the YECMF is not to create a detailed terrain map as would be required through an independent terrain mapping exercise, but to identify terrain characteristics that are ecologically-meaningful in the sense of influencing ecosystem processes, distribution and pattern. The term "**Bio-Terrain**" mapping is therefore more appropriate within the YECMF. In Local Ecosystem mapping, the production of a detailed terrain map would provide the same results to the YECMF but at higher cost due to increased mapping intensity and survey levels. Terrain mapping produced through the YECMF could be used as a basis to develop more detailed terrain mapping and interpretations, if required, generally through the use of additional modifiers. For Regional Ecosystem mapping, detailed terrain mapping is not appropriate due to issues associated with mapping scale and the variability that may occur within map units.

Within the YECMF, two levels of terrain classification are proposed: 1) general terrain conditions, termed "**Landscape Types**", and 2) detailed terrain conditions, termed "**Bio-Terrain Units**". Landscape Types form the generalised terrain classification component and are used to represent terrain conditions within Regional Ecosystem Mapping. Both Landscape Types and

Bio-Terrain Units are classified and mapped for Local Ecosystems. Bio-Terrain Units are sub-units of Landscape Types and are nested within Landscape Types.

3.3.2.2.1. General Terrain Classification – Landscape Types

Within the YECMF, **Landscape Position** incorporates the concepts of broad-scale topographic position and site processes. Landscape Position provides information on the major physical processes influencing the development and dynamics of ecosystems; it also provides an ecologically-meaningful method to rapidly stratify forested and non-forested landscapes with subdued topography (e.g. Liard Basin or Eagle Plains). Two general Landscape Positions are recognised: upland and lowland. General Landscape Position, when combined with appropriate modifiers, produce **Landscape Types**. Two major Landscape Types, **Upland** and **Lowland**, with currently recognised sub-types are described fully in Table 3.2. General definitions for Upland and Lowland Landscape Types are listed below:

Upland: Sites not influenced by the groundwater regime/flooding regime of adjacent lowland areas. Parent materials generally consist of morainal, glaciofluvial, eolian, lacustrine or colluvial materials. Upland landscapes form the majority of the Yukon landscape. Poorly drained, topographically depressed areas that occur within the matrix of upland landscapes are termed **Upland Depressional (Ud)**. Lake basins are also considered to be Upland Depressional Landscape Types.

Lowland: Significant riparian corridors of fluvial or glaciofluvial origin within the matrix of upland landforms, and lake basins. In the case of riparian corridors, this Landscape Type is characterised by active fluvial processes (flooding / deposition / erosion / transport). Lowland environments generally comprise a small proportion of the Yukon landscape but are ecologically significant features in terms of biodiversity and material/nutrient/energy transport. They may also have different disturbance regimes compared to Upland Landscape Types. Areas that experience active flooding and deposition are termed **Lowland Riparian (Lr)**. Inactive sites (no or very infrequent flooding and deposition) include terraces or benches (**Lowland Terrace - Lt**) and wet oxbows or back channels (**Lowland Depressional - Ld**).

Within the YECMF, **Landscape Type** is recommended to replace the term "Landscape Position". <u>Landscape Types, when combined with Bio-Climate Zones, provide the primary ecological framework in which to classify and describe ecological conditions for the purposes of terrain, vegetation and ecosystem classification and mapping at the detailed mapping levels</u>. Landscape Types are proposed to be used as the terrain component of the classification and mapping for YECMF Regional Ecosystems (1:250,000 scale).

Table 3.2. Proposed Landscape Types for use within the YECMF (proposed codes are included in brackets following the general Landscape Type and Sub-Type).

Landscape Type	*Sub-Type*	*Description*
Upland (U)	Any upland landform that is not or has not been influenced by the fluvial processes of flooding, transport and deposition. Parent materials generally consist of morainal, glaciofluvial, eolian, lacustrine or colluvial sediments. Exposed bedrock may also be important in some areas.	
	Depressional (d)	Poorly drained, depressional topographic features occurring in a predominantly upland environment. This landscape type generally occurs in defined basins such as kettles or old glacial melt-water channels. Upland Depressional types are usually moist or under the influence of a fluctuating water table. They are influenced by local groundwater flow and may be saturated periodically. However, unlike Lowland Riparian areas, Upland Depressional sites are not affected by active flooding and sediment deposition. These areas may contain mineral parent materials that have resulted from a number of different depositional and erosional processes but are usually comprised of organic parent materials. Lakes and major wetlands and wetland complexes are considered Upland Depressional landscape features.
	Terraced (t)	Major glacial fluvial terraces or outwash plains with coarse textured parent material. These areas may be flat or associated with complex ice stagnant terrain and eskers.
	Unclassified (u)	Any Upland Landscape Type not classified as one of the above listed types. In most situations, the majority of a mapping area will be composed of unclassified Landscape Types and will be composed of glacial (morainal) till.

Table 3.2 (continued). Proposed Landscape Types for use within the YECMF (proposed codes are included in brackets following the general Landscape Type and Sub-Type).

Landscape Type	*Sub-Type*	*Description*
Lowland (L)	Any major lowland landform that is or has been influenced by the active fluvial processes of erosion, transport and deposition. Lowlands are delineated using the heights of land containing the entire feature (tops of the highest banks) and then stratified into fluvial and non-fluvial components.	
	Braided (b)	Areas governed by aggrading river processes, with high rates of erosion and deposition. Landscape Types in braided river environments are very dynamic due to constant flooding, deposition, erosion and channel diversion. Large areas of exposed gravels and sediments are common.
	Depressional (d)	Poorly drained, depressional topographic features occurring within the lowland environment. These usually consist of backwater channels, shallow oxbow lakes and related wetland features.
	Riparian (r)	Lowland areas adjacent to rivers (including the river channel) that experience active flooding and depositional processes.
	Terraced (t)	Elevated terraces or benches within the Lowland environment that are rarely if ever affected by fluvial processes. Many terraces were formed by glacial fluvial processes and are characterised by coarse textured soils with rapid drainage.
	Unclassified (u)	Any Lowland Landscape Type not classified as one of the above listed types. In most situations, unclassified Lowland landscape components will be composed of steep colluvial slopes forming containing fluvial features.

3.3.2.2.2. Detailed Terrain Classification – Bio-terrain Units (Local Ecosystems)

The classification and delineation of detailed Bio-terrain units is only used in Local Ecosystem mapping. In Local Ecosystem mapping, Bio-terrain units provide the primary map unit for vegetation units and their resultant ecosystem units. Bio-terrain units are proposed to be described and identified based on the modified methods of Howes and Kenk (1997) and those used in British Columbia Terrestrial Ecosystem Mapping (RIC 1998). Proposed Bio-terrain mapping standards for use within the YECMF are described in Section 4.2.6.

TERRAIN CLASSIFICATION PROPOSAL

1) Two levels of terrain interpretation are proposed within the YECMF: a) Landscape Types and b) Bio-terrain units. Landscape Types are used exclusively in Regional Ecosystem mapping to represent terrain conditions. Both Landscape Types and Bio-terrain units are used to describe terrain conditions within Local Ecosystem mapping, with Bio-terrain units nested within Landscape Types.
2) Landscape Types, when combined with Bio-Climate Zones, provide the primary ecological framework in which to classify and describe ecological conditions for the purposes of terrain, vegetation and ecosystem classification and mapping at the detailed mapping levels.
3) Consistent Landscape Type mapping should be completed for all of Yukon at a scale of 1:250,000, with consideration given to 1:50,000.

TERRAIN CLASSIFICATION ISSUE

1) Do the currently defined Landscape Types incorporate an adequate range of descriptors to provide a meaningful level of interpretation? Based on Regional Ecosystem mapping projects completed to date, additional Landscape Type descriptors may be required for Upland Landscapes.

3.3.2.3. Vegetation Classification

The synthesis of underlying terrain / soil conditions and vegetation conditions results in the formation of ecosystems. Therefore, maintaining a standardised vegetation classification component within the YECMF is a necessary requirement to the creation of Ecosystem Units / Types. The proposed YECMF approach to vegetation classification is based on the concept of observable vegetation communities at scales of interpretation relevant to mapping. Given this requirement for a "polygon-based", mappable classification, the vegetation classification component of the YECMF will potentially be more generalised than would be produced through a "site-based" classification. A large amount of project specific vegetation classification and mapping work has been completed in Yukon; deriving a list of standardised vegetation communities or types from this work was initiated for Guidebook Regions 1, 2 and 6 through this project (Appendix One). The general concepts for vegetation classification are similar for both Regional and Local Ecosystem mapping, but will differ in the detail of description.

3.3.2.3.1. Vegetation Types (Regional Ecosystems)

Regional ecosystem mapping requires the classification and delineation of broad vegetation community types; detailed vegetation communities cannot be identified accurately at scales of 1:250,000. Vegetation Types will be defined based on broad physiognomic classes and major leading species.

3.3.2.3.2. Vegetation Units (Local Ecosystems)

Vegetation Units are the vegetation community classification component for YECMF Local Ecosystems. Within the context of the YECMF, the term "vegetation community" is considered to be "*a relatively uniform, distinct and identifiable composition of vegetation species occurring together*". The YECMF proposes that similar vegetation communities can occupy a range of site conditions based on multiple post-disturbance processes. Defining a standardised list of Vegetation Units will be a major undertaking in the development of regional ecosystem guidebooks based on the YECMF (Appendix One).

VEGETATION CLASSIFICATION PROPOSAL

1) Two levels of vegetation interpretation are proposed within the YECMF: a) Vegetation Types and b) Vegetation Units. Vegetation Types are used exclusively in Regional Ecosystem mapping to represent general vegetation conditions based on major leading species or physiognomic class. Vegetation Units are the vegetation community component of Local Ecosystem mapping, and are used only at detailed mapping scales to represent Local Ecosystems.
2) The YECMF approach to vegetation classification will be based on the concept of observable vegetation communities at scales of interpretation relevant to mapping. Given this requirement for a "polygon-based", mappable classification, the vegetation classification component of the YECMF will potentially be more generalised than would be produced through a "site-based" classification.
3) A standard set of Vegetation Types / Units will require development for all of Yukon, and will be derived from existing data and knowledge.

VEGETATION CLASSIFICATION ISSUE

The vegetation classification component of the YECMF is not currently well developed and is considered to be the most problematic portion of the developing framework. Several fundamental issues need to be addressed:

1) Should vegetation classification be a distinct level in the YECMF, or should this level be removed and only "ecosystems" described? Such an approach would produce a similar system as used in the British Columbia Terrestrial Ecosystem Mapping framework (RIC 1998). Different approaches for Regional and Local ecosystems are detailed in Section 4.1 and 4.2.
2) If a distinct vegetation classification level is maintained in the YECMF, should this vegetation classification be based on a currently established system? (this issue is probably most relevant to the description of vegetation communities at detailed mapping levels within Local Ecosystems).

3.3.2.4. Ecosystem Classification

Ecosystems are defined and created through the synthesis of underlying soil / terrain conditions and vegetation communities. One of the fundamental factors that initiated the development of the YECMF was the desire to incorporate explicit soil, terrain and landscape context information in the classification and spatial representation of Yukon ecological conditions. To accomplish this, additional information other than vegetation must be considered. Based on this rationale, the ecosystem level of the proposed YECMF, both at the Regional and Local scale, is considered to be the preferred level of interpretation for Yukon ecological conditions. For Regional Ecosystems, Ecosystem Types will be derived from Landscape and Vegetation Types; for Local Ecosystems, Ecosystem Units will be derived from Terrain and Vegetation Units.

ECOSYSTEM CLASSIFICATION PROPOSAL

1) Two levels of ecosystem interpretation are proposed within the YECMF: a) Ecosystem Types and b) Ecosystem Units. Ecosystem Types are used exclusively in Regional Ecosystem mapping to represent general ecosystem conditions based on a physical synthesis of Terrain and Vegetation Types. Ecosystem Units are used at the Local Ecosystem mapping level and are formed from the physical integration of Bio-terrain Units and Vegetation Units.
2) Ecosystem Types/Units will be mapped by first identifying terrain polygons and then nesting vegetation conditions within the terrain polygons.

ECOSYSTEM CLASSIFICATION ISSUE

A limited amount of developmental work has been completed at the Ecosystem Classification level of the proposed YECMF. Many of the currently outstanding issues associated with this level are associated with the vegetation classification concepts, or currently lack of well defined vegetation classification concepts. Several fundamental issues need to be addressed:

1) <u>How should Ecosystem Types / Units be created and described</u>? If the vegetation classification level of the framework is maintained, it then becomes possible to form ecosystem units through a physical integration a generalised set of vegetation communities occurring on underlying terrain conditions. This is currently the preferred model. Detailed concepts are described in Sections 4.1 and 4.2.
2) <u>In the description of Ecosystem Types / Units, should the terrain and vegetation conditions that "define" the ecosystem unit be explicit to the description of the Ecosystem Unit.</u> This approach leads to the loss of potential terrain information about the map polygon, as occurs in British Columbia Terrestrial Ecosystem Mapping (RIC 1998). An alternate approach would be to create ecosystem units through a physical integration of vegetation and terrain conditions; this approach will result in a potentially large number of vegetation-terrain combinations. However, combining similar vegetation and terrain conditions through the use of a look-up table or similar mechanism could reduce the large number of units. The latter approach is currently recommended within the YECMF, and is described in Sections 4.1 and 4.2.

3.3.2.5. Ecological Modifiers

A variety of ecological modifiers will be used to describe and assist in the interpretation of ecological conditions for specific ecological conditions. Many of the methods and terminology contained in the standards for British Columbia Terrestrial Ecosystem Mapping (RIC 1998) have potential application for the description of Local Ecosystems within YECMF. Concepts used within the British Columbia Broad Ecosystem Inventory (RIC 1999) may have application for the description of YECMF Regional Ecosystem conditions, as would potential Broad Forest Type concepts developed for use in Southeast Yukon (AEM, unpublished). The description of vegetation structure is considered to be the most important ecological modifier; special soil or site conditions (e.g. cold air drainage, permafrost-related processes, slope and aspect and special soil conditions) proposed to be described within the Terrain Classification component of the YECMF.

4.0. MAPPING STANDARDS (PROPOSED)

Methods and standards for classifying and mapping ecological conditions ecosystems within the YECMF are currently developmental. However, Levels 1-5 of both the Regional and Local Ecosystem mapping frameworks, and Level 6 (Bio-Terrain mapping) of the Local Ecosystem mapping framework, have been utilised extensively on various projects and are considered to be in an advanced stage of development. Standards for describing and displaying mapped Vegetation Type / Units and Ecosystem Type / Units are not well developed. Fundamental classification and mapping concepts associated with the proposed YECMF will affect the final mapping standards and methods of the vegetation and ecosystem components of the framework.

The purpose of this Section is not to provide a methodology document, but to provide a first approximation of standards and definitions for use within the Regional and Local Ecosystem mapping framework. The YECMF must first be developed and adopted prior to detailed methodology being documented.

4.1. REGIONAL ECOSYSTEMS

Regional Ecosystems are delineated and mapped at scales of 1:250,000 scale, or smaller. The most common mapping scale is anticipated to be 1:250,000. The YECMF provides for seven levels of ecological description for Regional Ecosystems. Figure 4.1 displays the three levels of regionalisation (Ecozones, Ecoregions and Ecodistricts) and four levels of classification (Bio-Climate Zone, Landscape Type, Vegetation Type and Ecosystem Type) used to describe Regional Ecosystems. Levels 1-5 used to describe Regional Ecosystems are common with Local Ecosystems, but Bio-Climate Zones and Landscape Types are represented at smaller and more generalised mapping scales (spatial resolution). Level 5 (Landscape Type) is used to represent the terrain component of Regional Ecosystems; no further detailed terrain mapping is completed. Levels 6 and 7, Vegetation Type and Ecosystem Type, are the most detailed descriptive levels of Regional Ecosystems, and are used to provide interpretations for general ecological and wildlife habitat characteristics. Levels 6 and 7 of Regional Ecosystems are differentiated from Local Ecosystems through the use of different nomenclature; generalised vegetation communities and ecosystems are described as "**Vegetation Types**" and "**Ecosystem Types**", respectively. Each Level of the Regional Ecosystem Framework is described below.

Classification and mapping for Regional Ecosystems relies to a large extent on satellite imagery. Landsat 7 is the preferred satellite image format for interpretation of major Landscape and Vegetation Types. Satellite imagery is used in conjunction with 1:250,000 scale and 1:50,000 scale NTDB contours or a 30m digital elevation model (DEM) to identify major slope breaks for the identification of Landscape Types based on parent material, process and landform differences.

4.1.1. LEVEL 1 – ECOZONE

Ecozones form the highest level of regionalisation and are described through the National Ecological Framework (ESWG 1995). Ecozones are proposed to be re-mapped at a scale of 1:250,000. This level is common with Local Ecosystems; the same units and linework should be utilised for both Regional and Local Ecosystem mapping. For the majority of Yukon, no major changes to Ecozones are proposed. However the Muskwa Plateau Ecoregion of Southeast Yukon is recommended to be included in the Boreal Plains Ecozone versus the current designation of Taiga Plains.

4.1.2. LEVEL 2 – ECOREGION

Ecoregions are nested within Ecozones and are described through the National Ecological Framework (ESWG 1995). Ecoregions are proposed to be re-mapped at a scale of 1:250,000. This level is common with Local Ecosystems; the same units and linework should be utilised for both Regional and Local Ecosystem mapping. Beyond a larger mapping scale, no major changes to Ecoregions are proposed.

4.1.3. LEVEL 3 – ECODISTRICT

Based on increased ecological similarity, Ecodistricts are sub-divisions of Ecoregions and are described through the National Ecological Framework (ESWG 1995). Ecodistricts are proposed to be re-mapped at a scale of 1:250,000. Based on work to date, major revisions to Ecodistricts are expected; new Ecodistricts will be identified and others revised. This level is common with Local Ecosystems; the same units and linework should be utilised for both Regional and Local Ecosystem mapping.

Proposed Yukon Ecosystem Classification and Mapping Framework:

REGIONAL ECOSYSTEMS
(1:250,000 mapping scale)

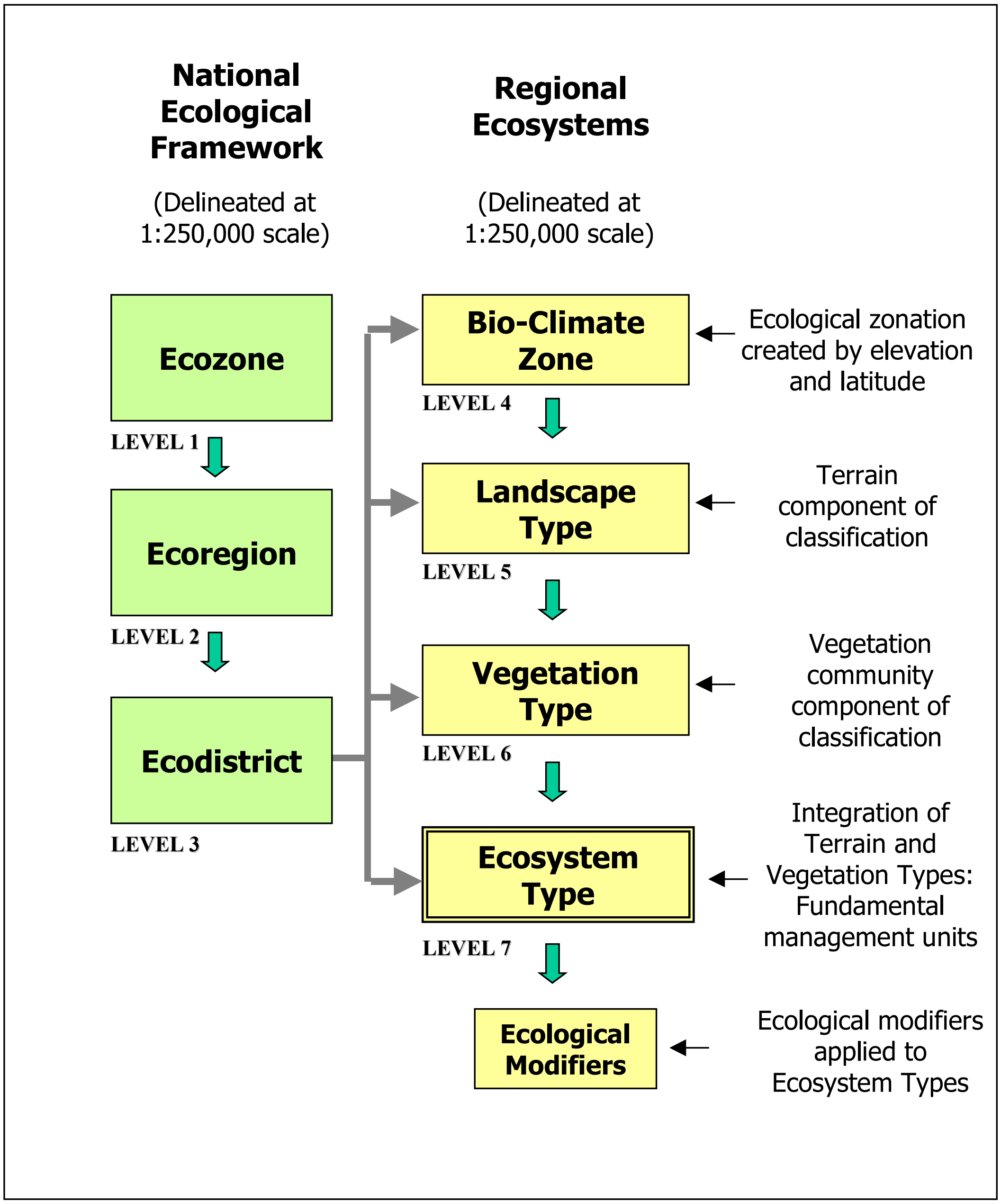


Figure 4.1. Overview of Regional Ecosystem classification and mapping components.

4.1.4. LEVEL 4 – BIO-CLIMATE ZONE

The concepts and nomenclature for Bio-Climate Zones are common between Regional and Local Ecosystems but are mapped at a more generalised level of detail (decreased spatial resolution) in Regional Ecosystem Mapping. Bio-Climate Zones proposed for use within the YECMF are described fully in Table 3.1. The recommended scale of Bio-Climate Zone mapping for Regional Ecosystems is 1:250,000. This scale matches the detail of the 1:250,000 scale NTDB topographic base mapping, and will eventually result in a consistent Bio-Climate Zone map for all of Yukon.

4.1.5. LEVEL 5 – LANDSCAPE TYPE

Landscape Types are common between Regional and Local Ecosystem Mapping but Regional Ecosystems are mapped at a more generalised level of detail (spatial resolution). Landscape Types proposed for use with the YECMF are described fully in Table 3.2. Landscape Types provide a generalised level of terrain classification for Regional Ecosystems, and are designed to provide a method to rapidly stratify large geographic areas. Landscape Types provide an appropriate level of ecological characterisation for the purposes of regional landscape management.

4.1.6. LEVEL 6 – VEGETATION TYPE

Within YECMF Regional mapping, Vegetation Types are used to describe the general vegetation characteristics of an area. Vegetation Types proposed for use within Regional Ecosystem mapping are similar to "Landcover Types" that may be delineated through a remote sensing exercise. Definitions and nomenclature for Vegetation Types require development, but are envisioned to be represented by a two-letter code, such as SF – Spruce Forest, or MF – Mixed Forest. Major physiognomic characteristics and primary vegetation species will be used to develop general Vegetation Types.

VEGETATION TYPE PROPOSAL

The vegetation classification component of Regional Ecosystems, Vegetation Type, is currently not well developed but the following concepts are considered central:

1) General Vegetation Types will be created through examination of major physiognomic characteristics and primary vegetation species.
2) Vegetation Types should be able to be identified and classified primarily through the use of remote sensing / satellite imagery, requiring the development of general Vegetation Types similar in nature to land cover classes.
3) Vegetation Type map units will be represented by a standardised set of two-letter codes.
4) The Vegetation Type classification component of Regional Ecosystems will be able to be used independently.

VEGETATION TYPE ISSUE

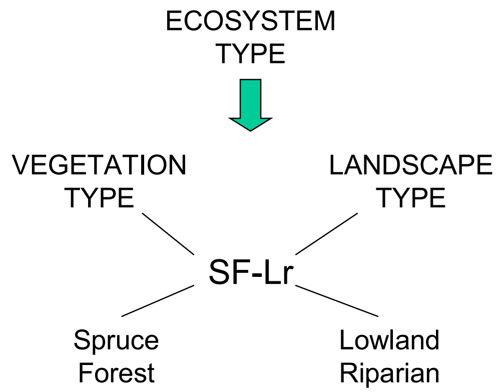
1) As with the overall framework, should vegetation classification be a distinct level in Regional Ecosystem mapping, or should this level be removed and only "ecosystems" described? Such an approach would produce a similar system as used in the British Columbia Broad Terrestrial Ecosystem Classification and Mapping framework (RIC 1998b).
2) If a distinct vegetation classification level is maintained within the Regional Ecosystem mapping framework, should this vegetation classification be based on a currently established system? A large amount of work has recently been completed in Yukon using satellite imagery to classify and map land cover; these or associated national projects may have relevance to the development of standardised Vegetation Types.

4.1.7. LEVEL 7 – ECOSYSTEM TYPE

Through the physical integration of Landscape Type and Vegetation Type, Ecosystem Types are formed. Ecosystem Type allows a broader range of interpretations than can be gained from Vegetation Types alone; through the additional information provided by Landscape Type, information on broad landscape position, general parent material and major physical processes is conveyed. General Vegetation Types may exist on different Landscape Types; for example spruce forest (e.g. SF) may occur on both Upland Unclassified (Uu) and Lowland Riparian (Lr) Landscape Types. Within this example each Ecosystem Type may have inherently different characteristics, productivity, habitat values and environmental constraints. Definitions and nomenclature for Ecosystem Types require development, but are currently envisioned to be represented through the combination of the two-letter Vegetation Type code and the Landscape Type code. In the above example, this may be represented by SF-Lr (Lowland Riparian Spruce Forest). Alternately, distinct coding could be developed to describe a unique combination of a Vegetation Type occurring on a specific Landscape Type (e.g. SR - Spruce Riparian). These two classification / naming Options are displayed in Figure 4.2.

Option 1:

"Physical Integration of Vegetation Type and Landscape Type"



Option 2:

"Unique Ecosystem Type where Landscape Type and Vegetation Type conditions are implicit within the definition of the Ecosystem Type"

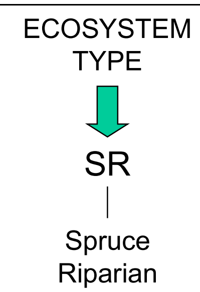


Figure 4.2. Two potential Regional Ecosystem Type naming conventions.

ECOSYSTEM TYPE PROPOSAL

<u>Given the relatively large amount of developmental work that would be required to create unique Ecosystem Types for Yukon, it is currently recommended that Option 1 (Figure 4.1), the "Physical Integration" approach, be used</u>. Such an approach will allow for maximum flexibility as new information is collected or the framework modified. Over time, as mapping progresses, unique Ecosystems Types <u>may</u> be developed. Unique combinations of Landscape and Vegetation Types and can be queried through the use of GIS and consensus can be built within the YECMWG on which combination of Landscape and Vegetation Types result in "distinct" Ecosystem Types. Adopting Option 1 will allow mapping work to proceed without the necessary requirement for having a complete list of Ecosystem Types developed prior to the initiation of mapping. This will also allow different combinations to be evaluated in an objective framework, without that information being lost in the synthesis. Option 1 will still require the development of a standardised set of Vegetation Types.

ECOSYSTEM TYPE ISSUE

The goal to develop "unique" Ecosystem Types, as illustrated in Option 2, requires careful examination and may not be a desirable or practical goal. The current concept for YECMF Regional Vegetation Types is generalised landcover types that would be interpreted through the use of satellite imagery or existing coarse-resolution mapping. Landcover vegetation classes that result from such an approach may be as general as "mixed forest", "conifer forest", or "shrub". Creating unique Ecosystem Types from such information may not be ecologically meaningful. The proposed YECMF Regional Mapping framework would provide a framework where "shrub" occurring on an "Upland terraced" Landscape Type within the Boreal Bio-Climate zone could be described and quantified. Such a classification approach also fits better with the over-riding YECMF classification concept of "observable ecological conditions" not based on predictive climax vegetation concepts.

4.1.8. ECOLOGICAL MODIFIERS

Ecological modifiers are not a distinct Level of the YECMF for Regional Ecosystems, but instead are a set of modifiers used to describe special Landscape Type conditions or provide information on the structural characteristics of Vegetation Types. Regional Ecosystem mapping ecological modifiers require development, but are anticipated to include general forest age-classes or similar descriptors for the purpose of describing vegetation development, with an emphasis on structural characteristics. The potential use of aspect or special soil conditions to provide additional interpretations for Landscape Type requires discussion. To date, specific Landscape Types have been developed to describe special conditions, versus the use of modifiers. However, examination of the use of slope_aspect or surface form modifiers may be considered for use.

4.1.8.1. Landscape Type Modifiers

Landscape Type modifiers, if required, have not yet been developed for Regional Ecosystem mapping. All terrain-related information has to date been described through the development of additional, specific Landscape Types.

4.1.8.2. Vegetation Type Modifiers

Generalised structural descriptions are considered to be the most important vegetation modifiers. Table 4.1 displays potential Vegetation Type modifiers that may provide generalised forest structure information. Such an approach would be most useful for the Boreal Cordillera of Southern and Central Yukon and has been used with some degree of success in Southeast Yukon during previous Regional Ecosystem mapping initiatives (AEM, unpublished). This "forest age class" approach would require examination for application in North Yukon; structural stage descriptions as displayed in Table 4.1 may not be applicable to the complex taiga forest environment of North Yukon.

Table 4.1. Potential Vegetation Type structural stage modifiers (modified from AEM, unpublished).

Structural Stage	Age (years since disturbance)	Description	Notes
1	10-40	Young Forest	Young, post-disturbance forests. Depending on the site type, a large amount of CWM may still be standing. Variable post-disturbance regeneration can result in a variety of forest conditions ranging from dense, "dog-hair" pine to aspen to open spruce-willow.
2	41-80	Mid-Seral Forest	Mid-seral forests; internal self-thinning beginning. Morainal pine forests may be recruiting spruce in understory.
3	81-120	Mature Forest	Mature, relatively even-aged forests; possible understory re-initiation. Lowland stands may be moderately-highly structured by 100 years in age.
4	121-160	Old Forest	Old forests that may be experiencing individual tree or patches of senescence but canopy dominant trees are still generally "even-aged". Lowland stands may be highly structured by 121-160 years in age.
5	161 - 250	Very Old Forest	Very old forests that are beginning to experience gap dynamics. Moderate-highly structured forests.
6	≥ 251	Relict Forest	Internal gap dynamics dominant stand process. Highly structured forests with multiple cohorts of tree ages, diameters and heights.
0	NA	Shrub	Any shrub-dominated area, either as a result of recent fire disturbance or due to Bio-Climate Zone influences (e.g. Subalpine or Shrub Taiga)

4.1.9. MAPPING STANDARDS

Mapping standards for Regional Ecosystems have not been fully developed. Standards for British Columbia Terrestrial Ecosystem Mapping (RIC 1998) and Broad Terrestrial Ecosystem Classification and Mapping (RIC 1998b) have potential application. However, the YECMF proposes to show both the "vegetation classification" and "terrain classification" components within the map unit ecosystem label. Such a system follows with the recommendation for adoption of "Option 1" for defining and describing Regional Ecosystem Types as described in Section 4.1.7 and displayed in Table 4.2. This mapping standard will allow for flexibility yet maintain consistency; using such a system a single ecosystem map could be used for a range of purposes with either or both of the vegetation and terrain components being displayed. The digital database guidelines for Regional Ecosystem mapping outlined in Section 4.3 support this recommended mapping standard.

Major Regional Ecosystem mapping standards (proposed) are described below, and displayed in Figure 4.3.

- Maximum of two Ecosystem Types per map polygon.
- Two letter upper case codes used to represent Vegetation Types (standarised set of Vegetation Types and codes to be developed).
- Two letter upper and lower case code used to represent Landscape Types (standardised set of Landscape Types and codes to be developed; first approximation listed in Table 3.2.
- Vegetation Type and Structural Stage should be displayed first followed by Landscape Type.

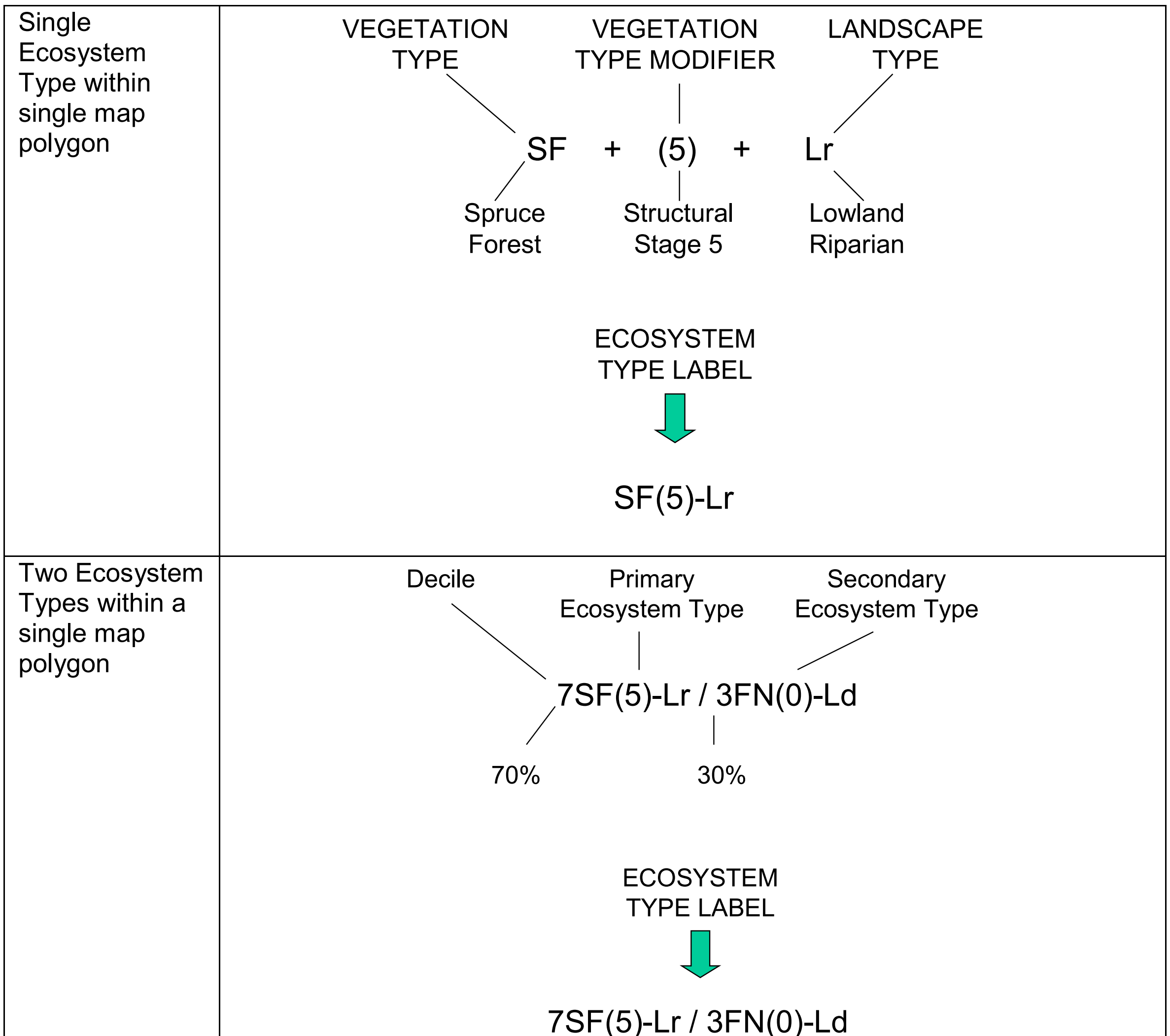


Figure 4.3. Potential Regional Ecosystem map labeling conventions for use within the YECMF.

4.2. LOCAL ECOSYSTEMS

Local Ecosystems are delineated and mapped at scales of 1:100,000 scale, or larger. The most common mapping scale is anticipated to be 1:50,000. Classification and mapping of Local Ecosystems requires detailed aerial photograph interpretation. Some level of field sampling should be included in any Local Ecosystem mapping project.

The YECMF provides for eight (8) levels of ecological description for Local Ecosystems. Figure 4.4 displays the three levels of regionalisation (Ecozones, Ecoregions, Ecodistricts) and five levels of classification (Bio-Climate Zone, Landscape Type, Bio-Terrain Unit, Vegetation Unit, Ecosystem Unit) used to describe Local Ecosystems. Levels 1-5 of the Local Ecosystem are common with the Regional Ecosystems, but are identified at with increasing detail (spatial resolution). Levels 6-8 include a more detailed description of ecosystem conditions, use different nomenclature (Levels 6-8 are identified as “Units” versus “Types”) and incorporate a Bio-terrain mapping component (Level 6). Each Level is described below.

4.2.1. LEVEL 1 – ECOZONE

Ecozones form the highest level of regionalisation and are described through the National Ecological Framework (ESWG 1995). Ecozones are proposed to be mapped at a scale of 1:250,000. This level is common with Regional Ecosystems; the same units and linework should be utilised for both Local and Regional Ecosystem mapping. For the majority of Yukon, no major changes to Ecozones are proposed. However the Muskwa Plateau Ecoregion of Southeast Yukon is recommended to be included in the Boreal Plains Ecozone versus the current designation of Taiga Plains.

4.2.2. LEVEL 2 – ECOREGION

Ecoregions are nested within Ecozones and are described through the National Ecological Framework (ESWG 1995). Ecoregions are proposed to be mapped at a scale of 1:250,000. This level is common with Regional Ecosystems; the same units and linework should be utilised for both Local and Regional Ecosystem mapping.

4.2.3. LEVEL 3 – ECODISTRICT

Based on increased ecological similarity, Ecodistricts are sub-divisions of Ecoregions and are described through the National Ecological Framework (ESWG 1995). Ecodistricts are proposed to be re-mapped at a scale of 1:250,000. Based on work to date, major revisions to Ecodistricts are expected; new Ecodistricts will be identified and others revised. This level is common with Regional Ecosystems; the same units and linework should be utilised for both Local and Regional Ecosystem mapping.

Proposed Yukon Ecosystem Classification and Mapping Framework:

LOCAL ECOSYSTEMS
(1:100,000 - 1:50,000, or larger mapping scale)

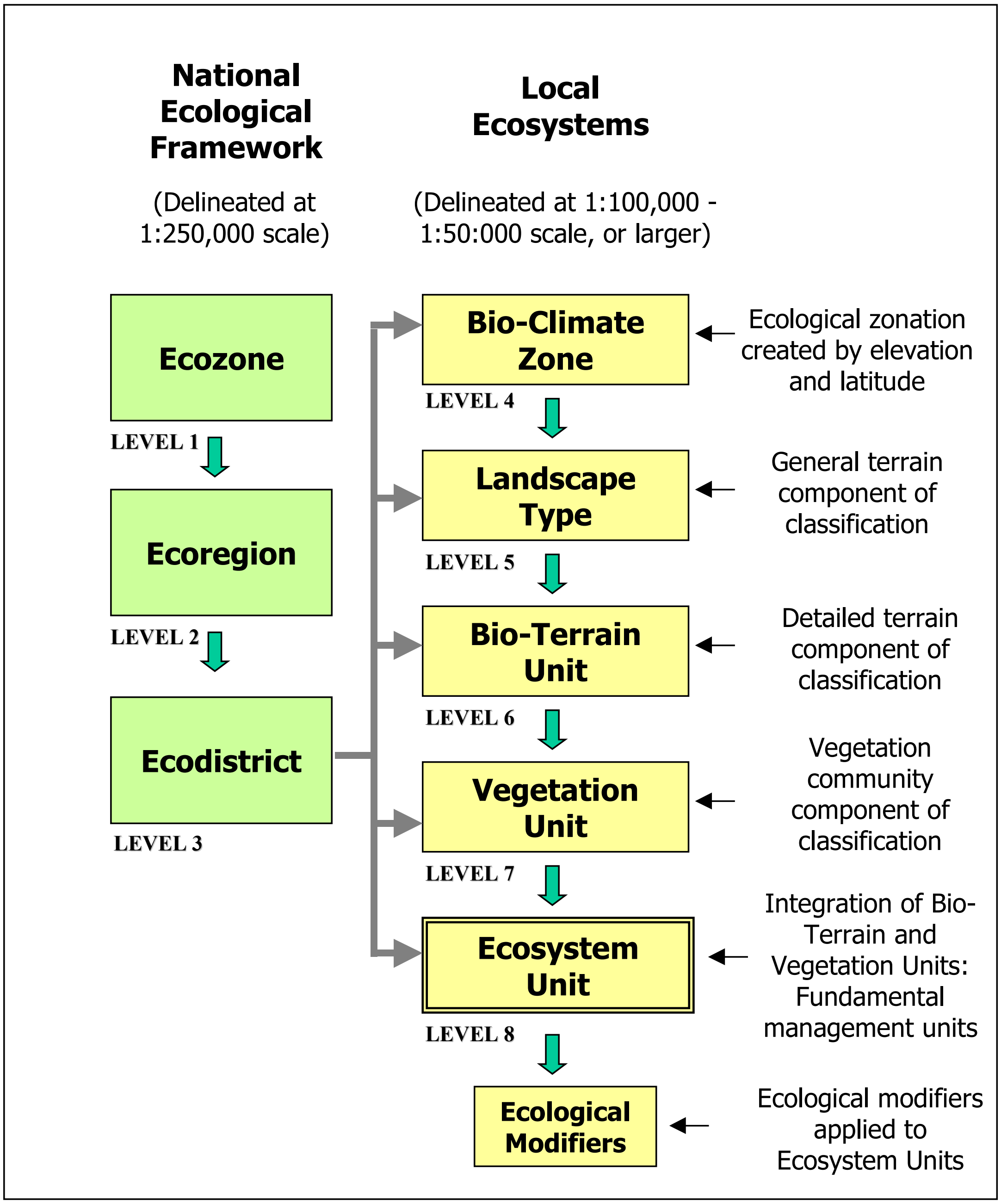


Figure 4.4. Overview of Local Ecosystem classification and components.

4.2.4. LEVEL 4 – BIO-CLIMATE ZONE

The concepts and nomenclature of Bio-Climate Zones are common between Local and Regional Ecosystem Mapping but are mapped to a higher level of detail (spatial resolution) in Local Ecosystem Mapping. Bio-Climate Zones proposed for use with the YECMF are described fully in Table 3.1. The recommended scale of Bio-Climate Zone mapping for Local Ecosystems is 1:50,000. This scale matches the detail of the 1:50,000 scale NTDB topographic base mapping, and will result in a consistent Bio-Climate Zone map for large geographic areas.

4.2.5. LEVEL 5 – LANDSCAPE TYPE

Landscape Types are common between Local and Regional Ecosystem Mapping but are mapped to a higher level of detail (spatial resolution) in Local Ecosystem Mapping. Landscape Types proposed for use with the YECMF are described fully in Table 3.2. Landscape Types should be retained within Local Ecosystem Mapping to provide commonality between the YECMF and other data sets, such as the Yukon Forest Inventory. Detailed Bio-terrain mapping is achieved by further stratifying the general Landscape Types. Landscape Types provide an appropriate level of ecological characterisation for the purposes of landscape management.

4.2.6. LEVEL 6 – BIO-TERRAIN UNIT

Bio-terrain mapping is unique to Local Ecosystem mapping; this Level is not used to describe Regional Ecosystems. Bio-terrain units are nested within the various Landscape Types to provide a more detailed ecological description of the physical site characteristics. The term "**Bio-terrain**" mapping has been adopted from the British Columbia Terrestrial Ecosystem Mapping standards (RIC 1998) to describe a modified mapping approach to detailed terrain mapping described by Howes and Kenk (1997). Within the YECMF, the goal of Bio-terrain mapping is to describe important landform and surficial material conditions that influence the ecological characteristics, productivity and processes of an area. A minimum of four Bio-terrain attributes are proposed to be described for Local Ecosystems: 1) primary parent (surficial) material, 2) soil drainage, 3) slope and aspect conditions, 4) special soil conditions. Each is described below.

4.2.6.1. Primary Parent (Surficial) Material

Primary parent (surficial) material provides a description of the dominant material comprising soils, the growth medium for terrestrial vegetation. Primary surficial material, when combined with knowledge of local terrain conditions, can also provide important information about anticipated landform, slope/aspect and soil drainage conditions, plus potential management considerations. Table 4.2 lists the proposed parent material types and codes for use within the YECMF.

Table 4.2. Parent material types and codes proposed for Bio-terrain Unit (Level 6) description of YECMF Local Ecosystems.

Parent Material [1]	*Parent Material Code*	*Description* [1]
Anthropogenic	A	Anthropogenic materials are any human-disturbed or transported materials such as gravel pits, roads, landfills, etc. Cultivated areas are not considered Anthropogenic parent materials.
Colluvium	C	Colluvium is gravity eroded material existing along or at the base of slopes. Colluvium may consist of unsorted sediments, broken rock or any combination of material. Due to the length of time North Yukon has remained unglaciated, colluvium is the dominant parent material.
Weathered Bedrock	D	Weathered Bedrock is degraded (broken) bedrock. Soil development on these sites occurs in-situ within the weathered rock materials.
Eolian	E	Eolian landforms are wind transported and deposited parent materials generally consisting of medium-to-coarse textured sediments. The most common eolian landforms are sand dunes.
Fluvial	F	Fluvial landforms are water transported and deposited parent materials. Fluvial materials are found on active floodplains and may be composed of variable materials (silts, sand, gravels, cobbles, etc).
Glacial Fluvial	G	Glacial Fluvial landforms are composed of coarse textured, rapidly drained materials. Glacial Fluvial landforms were formed by flowing post-glacial meltwater, which sorted and deposited large amounts of material; most fine materials have been removed. Surface expression is variable.
Waterbodies	H	Water bodies include any surface water feature that can be mapped at the scale of interpretation (lakes and rivers).
Ice	I	Ice includes any surface exposed, multi-annual ice body that is relatively persistent from year-to-year. Ice parent materials are generally considered to be glaciers.
Glacial Lacustrine	K	Glacial Lacustrine landforms are composed of sediments that were deposited in post-glacial standing water environments, generally post-glacial lakes. Glacial lacustrine sediments are typically fine-sandy and/or silty in texture.
Lacustrine	L	Lacustrine landforms are composed of lake sediments deposited following the post-glacial period (differentiated from Glacial Lacustrine). Some lakes may drain rapidly exposing lake bottom sediments. Other situations would include slow processes of eutrophication converting an aquatic environment to a terrestrial landform.
Glacial (Morainal) Till	M	Glacial (Morainal) Till landforms are composed of unsorted sediment, gravel and rocks that were transported and deposited by glaciers. Sediment texture, stoniness and drainage are highly variable. Till is the dominant parent material for most Upland Landscape Types in South and Central Yukon.

Table 4.2 (continued). Parent material types and codes proposed for Bio-terrain Unit (Level 6) description of YECMF Local Ecosystems.

Parent Material [1]	***Parent Material Code***	***Description*** [1]
Organic	O	Organic landforms are composed of poorly decomposed organic materials greater than 40 cm in thickness. Organic landforms generally occur in low-lying, poorly drained depressional sites. Organic materials originate primarily from slowly decomposing plant material.
Bedrock	R	Bedrock landforms may occur throughout the landscape and are defined anywhere bedrock is exposed at the surface. Shallow, weakly developed soils are commonly associated with Bedrock.
Glacial Marine	S	Glacial Marine landforms typically occur where glaciers enter the ocean. Unsorted glacial materials are deposited as a result melting glacial ice. Glacial Marine parent materials are rare in Yukon.
Undifferentiated	U	Undifferentiated landforms are identified where multiple landforms / parent materials occur together, resulting in a complex landform / parent material that is difficult to classify.
Volcanic	V	Volcanic landforms are typically lava flows and/or pumas that were deposited during volcanic eruptions.
Marine	W	Marine parent materials are typically found near oceans, where the isostatic rebound of land following de-glaciation has exposed marine-deposited sediments. Marine sediments are generally extremely clay rich. Marine parent materials are rare in Yukon.

[1] Parent Material type and definitions modified from Howes and Kenk (1997) and Soil Classification Working Group (1998).

4.2.6.2. Soil Drainage

Soil drainage is defined as "the time required to remove excess water from a soil" (Soil Classification Working Group 1998). Soil drainage is an ecologically-meaningful description of soil moisture as it provides direct information about both soil texture and the potential for summer moisture deficit. Table 4.3 describes Soil Drainage Classes proposed for use within the YECMF. Some consideration may be given towards reducing the current seven drainage classes to five, particularly at the extremes of the drainage class scale (eg. combine very rapidly and rapidly drained).

Table 4.3. Proposed soil drainage classes used to describe Bio-terrain Units (Level 6) of YECMF Local Ecosystems.

Drainage Class [1]	*Drainage Class Code* [1]	*Description* [1]
Very Rapidly Drained	x	Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually < 2.5 cm) within the control section and are usually coarse textured, or shallow, or both. Water source is precipitation.
Rapidly Drained	r	Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the control section and are usually coarse textured, or shallow, or both. Water source is precipitation.
Well Drained	w	Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes, subsurface flow may occur for short duration but additions are equaled by losses.
Moderately Well Drained	m	Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to slow perviousness, shallow water table and lack of gradient or some combination of these. Soils have intermediate to high water storage capacity (54 cm) within the control section and are usually medium to fine-textured. Precipitation is the dominant water source in medium to fine textured soils; precipitation and significant additions by subsurface flow are necessary in coarse textured soils.
Imperfectly Drained	i	Water is removed from the soil sufficiently slowly in relation to supply to keep soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is the major supply. If subsurface water or groundwater, or both, is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups.
Poorly Drained	p	Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the growing season. Subsurface flow or groundwater flow, or both, in addition to precipitation are the main water sources; there may also be a perched water table with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.
Very Poorly Drained	v	Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are the major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture, and depth, and are either Gleysolic or Organic.

[1] Soil drainage class, codes and definitions from Canadian Soil Classification System, 3rd Edition (Soil Classification Working Group 1998)

4.2.6.3. Slope and Aspect Conditions

In moisture and energy-limited environments, slope and aspect is a major determinant of vegetation pattern, composition and growth. A description of slope conditions can also provide important management-related interpretations. In traditional terrain mapping (e.g. Howes and Kenk 1997), a large number of slope classes and slope process modifiers are used to stratify landscapes into detailed slope types, primarily for the purpose of terrain evaluation (terrain hazards, stability, processes, etc.). However, ecologically, a smaller number of slope conditions influence the energy and water balance of a site. When combined with aspect, a single ecologically meaningful "Slope-Aspect" descriptor can be developed. Similar concepts are used in the British Columbia Terrestrial Ecosystem Mapping system (RIC 1998); Slope-Aspect classes proposed for use within the YECMF are modified from RIC (1998). Table 4.4 describes the slope and aspect classes proposed to describe Bio-terrain Units for Local Ecosystems within the YECMF.

Table 4.4. Proposed slope and aspect classes used to describe Bio-terrain Units (Level 6) of YECMF Local Ecosystems.

Slope_Aspect Class	***Slope_Aspect Code***	***Description*** [1]	
Gentle	g	no ecologically-meaningful aspect	< 25% slope
Warm	w	135° – 285° aspect (southerly and westerly-facing aspects on moderate-steep slopes)	25 – 100% slope
Very Steep, Warm	z	135° – 285° aspect (southerly and westerly-facing aspects on very steep slopes)	> 100% slope
Cool	c	285° – 135° aspect (northerly and easterly-facing aspects on moderate-steep slopes)	25 – 100% slope
Very Steep, Cool	k	285° – 135° aspect (northerly and easterly-facing aspects on very steep slopes)	> 100% slope
Variable	v	Complex topography with moderate-very steep slopes of no dominant aspect. Topography is often hummocky with steeply contrasting warm and cool aspects.	≥ 25% slope

[1] Slope and aspect class codes and definitions modified from Howes and Kenk (1997) and RIC (1998)

4.2.6.4. Special Soil and Site Conditions

Special soil conditions are described when a particular soil condition, such as permafrost, plays a major role in influencing vegetation development and dynamics. Special soil conditions may also have important management implications and can be used to guide management decisions, such as the presence or absence of permafrost for the purposes of construction or forest harvesting. Currently, a limited number of special soil conditions are being considered for use within the YECMF, with the understanding that additional conditions will be developed as required (Table 4.5).

Table 4.5. Special soil and site conditions proposed to describe Bio-terrain Units (Level 6) of YECMF Local Ecosystems.

Special Condition [1]	***Code***	***Description***
Anthropo-genic	a	Soils that have been severely modified by anthropogenic activities. Dense urban developments, gravel pits, graded surfaces, road cuts, mine sites and tailings are examples of anthropogenic features. Clearings and forest harvest blocks that have not experienced major soil disturbances would not be considered anthropogenic soils.
Shallow Soil (Lithic)	l	Shallow soils often associated with bedrock (B) or weathered bedrock (W) parent materials. Vegetation growth and pattern is strongly influenced by shallow soil condition and bedrock outcrops.
Permafrost	p	Permafrost occurs within 1 m of surface and has important influence on vegetation pattern, soil drainage and site ecological processes. The presence of permafrost can be difficult to confirm; in the absence of field sampling, presence is often inferred. If presence is inferred, this should be noted in a comments database field.
Saline / Calcareous	s	Soils that contain a high concentration of salts or calcium may be moisture limited and can be dominated by halophytic (salt tolerant) or rare plant species (eg. orchids associated with marl fens). Vegetation growth and species composition on these sites is strongly influenced by the presence of salts or large amounts of calcium.

[1] Additional special soil condition definitions will be developed as required.

4.2.7. LEVEL 7 - VEGETATION UNIT

Level 7 (Vegetation Unit) is the **vegetation community** classification component for YECMF Local Ecosystems. Within the context of the YECMF, the term "vegetation community" can be considered "*a relatively uniform, distinct and identifiable composition of vegetation species occurring together*". This is similar to the concept of "**vegetation association**", which carries the more specific definition "*vegetation of a relatively fixed species composition exhibiting a relatively fixed physiognomy occurring in a relatively consistent type of habitat.*" While the two concepts, community and association, are similar, the YECMF proposes that similar vegetation communities can occupy a range of site conditions. YECMF Vegetation Units will therefore be more generalised than vegetation associations.

VEGETATION UNIT PROPOSAL

Within the YECMF, the following concepts are proposed for the description of Vegetation Units (vegetation communities) for Local Ecosystem mapping:

1) Vegetation communities must be observable – they should not be "hypothetical" developmental units based on successional concepts such as used in the British Columbia Biogeoclimatic Ecosystem Classification (Krajina 1969; Pojar et al. 1987). This is an important foundation principle of the YECMF.
2) Vegetation communities should be described through a combination of their major floristic and physiognomic features. Forested units should be described by the major tree species, or mixture of species, followed by an associated understory or groundcover component. The goal of the vegetation unit nomenclature is to capture the "essence" of that vegetation community, and to provide a brief description of its major characteristics. The desire to have the YECMF based on a "mappable", "polygon-based" classification system will result in the description of more generalised vegetation communities than would be provided through a detailed "site-based" classification. The use of very specific vegetation associations, as proposed through the Canadian National Vegetation Classification (Ponomarenko and Alvo 2001), is not proposed for Local Ecosystems of the YECMF.
3) Vegetation Unit map symbols are proposed to be represented by a 2-letter code (e.g. SF = Spruce-Feathermoss, or PL = Pine-Lichen). Over time, descriptions and documentation for each recognised Vegetation Unit (and Ecosystem Unit) would be prepared for use within Regional Guidebooks. This work was initiated for Guidebooks 1, 2 and 6 with a preliminary Guidebook organisation provided in Appendix One.
4) It is recommend that Landscape Types, in conjunction with Bio-Climate zones, be used as an organisational framework for the description and delineation of Vegetation Units.
5) Based on the development of "generalised" vegetation communities, the same or similar plant communities may occur in multiple Ecoregions or Bio-Climate Zones. Higher levels of the YECMF will be used to differentiate these different Vegetation Units from one another.
6) A large amount of project specific vegetation classification and mapping work has occurred in Yukon, with many "common" vegetation communities already in use. Working within the YECMWG, a standard set of vegetation communities will require description and formalisation; once the YECMF framework is formalised and adopted, this activity will be the primary development activity. The majority of this work is anticipated to be able to be completed through the use of existing information and local knowledge, with ongoing mapping initiatives being used for testing and refinement.

VEGETATION UNIT ISSUE

1) As with the overall framework, should vegetation classification be a distinct level in Local Ecosystem mapping, or should this level be removed and only "ecosystems" described? Such an approach would produce a similar system as used in the British Columbia Broad Terrestrial Ecosystem Classification and Mapping framework (RIC 1998b).
2) If a distinct vegetation classification level is maintained within the Local Ecosystem mapping framework, should this vegetation classification be based on a currently established system? A large number of completed mapping projects and literature describe vegetation communities but in an inconsistent manner; results from completed projects may have relevance to the development of standardised Vegetation Units. However, the desire to maintain compatibility with existing national and international systems may require adoption of an existing classification.

4.2.8. LEVEL 8 – ECOSYSTEM UNIT

Through the combination of Bio-Terrain Unit and Vegetation Unit, Ecosystem Units are formed. Landscape Types provide an organisational framework that allows linkage between Regional and Local ecosystem conditions. Ecosystem Units allow a broader range of interpretations than can be gained from Vegetation Unit alone; through the additional interpretations provided by Landscape Type and Bio-terrain conditions, information on general landscape position, parent material, soil drainage and major physical processes is conveyed. The same Vegetation Unit may occur on different Landscape Types or Bio-terrain Units; for example, a spruce-feathermoss forest (SF) may occur on both Upland Unclassified (Uu) Morainal materials and Lowland Riparian (Lr) Fluvial materials. Within this example, the Upland spruce-feathermoss would have inherently different characteristics, productivity, habitat values and environmental constraints versus the Lowland spruce-forest.

Definitions and nomenclature for Ecosystem Units require development. There are currently two major options to naming and classifying Ecosystem Units (Figure 4.5). Option 1 (Figure 4.5) would include the physical combination of the two-letter Vegetation Unit code the Bio-Terrain Unit label. A second option (Option 2, Figure 4.5) would develop distinct coding and definitions to describe a unique combination of a Vegetation Unit occurring on a specific Bio-Terrain Unit or Landscape Type (e.g. SF = spruce-feathermoss forest occurring on upland morainal materials; SR = spruce-feathermoss forest occurring on upland colluvial materials; SJ = spruce-juniper forest occurring on upland glaciolacustrine materials). In this second example, the terrain component of the map label is not displayed but is implied through the definition of the ecosystem unit). Option 2 assumes a predictable and directional development of a particular site condition to some predetermined state.

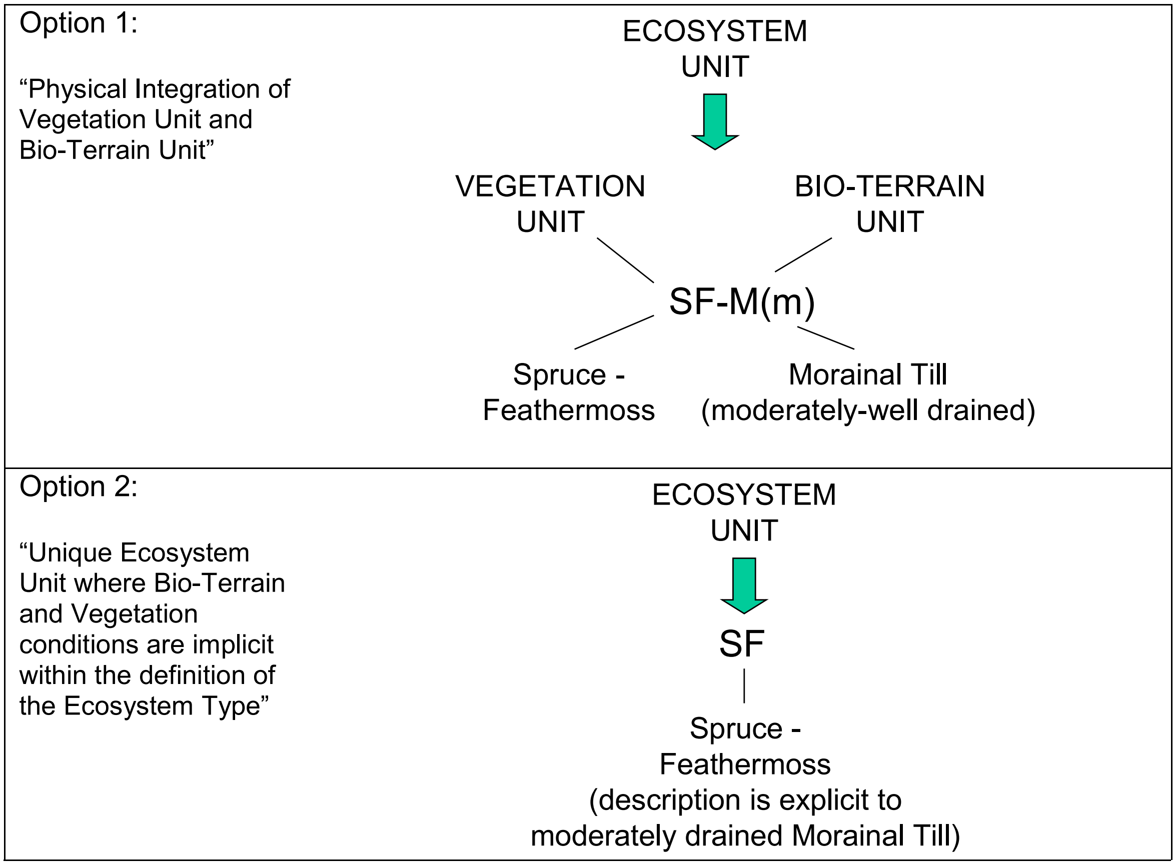


Figure 4.5. Two potential Local Ecosystem Unit naming conventions.

ECOSYSTEM UNIT PROPOSAL

1) Given the relatively large amount of developmental work that would be required to create unique Ecosystem Units for Yukon, it is currently recommended that Option 1 (Figure 4.5), the "Physical Integration" approach, be used. Such an approach will allow for maximum flexibility as new information is collected or the framework modified. Over time, as mapping progresses, unique Ecosystems Units may be developed. Unique combinations of Bio-terrain and Vegetation Unit (communities) can be queried through the use of GIS and consensus built within the YECMWG on which combination of Bio-terrain and Vegetation Units within particular Landscape Types result in "distinct" Ecosystem Units. Adopting Option 1 will allow mapping work to proceed without the necessary requirement for having a complete list of Ecosystem Units developed prior to the initiation of mapping. This will also allow different combinations to be evaluated in an objective framework, without that information being lost in the synthesis. Option 1 will still require the development of a standardised set of Vegetation Units (communities), a significant undertaking.

2) Assuming the model of detailed Ecosystem Units being created through the physical integration of Bio-Terrain Unit and Vegetation Unit as displayed in Option 1 (Figure 4.5), some organisational mechanism must be developed to provide management interpretations for similar Ecosystem Units. The vegetation community classification

concept used within the YECMF allows for similar vegetation communities (in terms of species and physiognomic composition) to occur on a range of Bio-Terrain Units (conditions). The term "PHASE" is proposed for use to describe a particular Vegetation Unit occurring on a range of multiple parent materials. Example:

SF-M = Spruce Feathermoss occurring on Morainal till (Morainal Phase)

SF-L = Spruce Feathermoss occurring on Lacustrine sediments (Lacustrine Phase

A variety of naming conventions could be developed to describe the different Ecosystem Unit Phases. For GIS applications, a simple look-up table could be created to group similar Ecosystem Units for a variety of management applications. Within this definition of Ecosystem Unit, the Bio-Terrain component of the classification can be used to provide more information on the general Vegetation Unit conditions due to soil and landform differences. This system is well suited to a map-based structure and will provide maximum flexibility for future revisions and refinement.

ECOSYSTEM TYPE ISSUE

The goal to develop "unique" Ecosystem Units, as illustrated in Option 2, requires careful examination and may not be a desirable or practical goal. While Option 2 is certainly the most "simple" method of describing Ecosystem Units, the assumptions behind this classification concept are not supported within the YECMF. Given the complex relationship between site conditions, disturbance and post-disturbance recovery, the development of "unique" ecosystem units may not ultimately be possible, or desirable within a "mappable" classification framework as proposed within the YECMF. The current concept for YECMF Local Vegetation Units is general, observable vegetation communities that can primarily be interpreted through the use of aerial photographs or high-resolution satellite imagery. The concept of "unique" ecosystem units infers that a predictable vegetation community will result on specific site types in the long-term absence of disturbance. This may not be true in all cases. If Option 1 is chosen, at least initially, ecosystem mapping work can proceed without the necessary requirement for having a complete list of ecosystems developed prior to the initiation of mapping. This will also allow different combinations to be evaluated within an objective framework, without that information being lost in the synthesis. Such a classification approach also fits better with the over-riding YECMF classification concept of "observable ecological conditions" not based on predictive climax vegetation concepts.

4.2.9. ECOLOGICAL MODIFIERS

Ecological modifiers are not a distinct Level of the YECMF for Local Ecosystems, but instead are a set of modifiers used to provide additional Bio-terrain information and describe Vegetation Unit structural characteristics. Bio-terrain unit descriptors and modifiers are currently in a more advanced stage of development (Section 4.2.6) than Vegetation Unit modifiers. Vegetation Unit structural stage definitions are expected to be modified from Terrestrial Ecosystem Mapping structural stage descriptions (RIC 1998). The concept of "vegetation structure" is considered to be the most important vegetation descriptor within the YECMF.

4.2.9.1. Terrain Modifiers

Proposed Bio-terrain codes and definitions are described in Section 4.2.6. The YECMF proposes that soil drainage and slope_aspect information are not "modifiers" of terrain conditions, but instead are "core" components of the Bio-terrain information. However, soil drainage, slope_aspect and special soil conditions do provide additional terrain information to assist in the interpretation of parent material and its potential effect on vegetation community pattern, productivity and composition. However, terrain modifiers are proposed to be used differently than in the British Columbia Terrestrial Ecosystem Mapping standards (RIC 1998) where terrain modifiers are used to describe "atypical" terrain and soil conditions for a particular ecosystem unit (Site Series).

4.2.9.2. Vegetation Modifiers

The concept of "vegetation structure" is considered to be the most important vegetation descriptor within the YECMF. Vegetation Unit structural stage definitions are expected to be modified from Terrestrial Ecosystem Mapping structural stage descriptions (RIC 1998). However, the RIC (1998) structural stage concepts will require examination as many of the successional concepts implied through their use are not core classification and ecological concepts within the YECMF.

4.2.10. MAPPING STANDARDS

Mapping standards for Local Ecosystems have not been fully developed. Standards for British Columbia Terrestrial Ecosystem Mapping (RIC 1998) and Broad Terrestrial Ecosystem Classification and Mapping (RIC 1998b) have potential application. However, the YECMF proposes to show both the "vegetation classification" and "terrain classification" components within the map unit ecosystem label. Such a system follows with the recommendation for adoption of "Option 1" for defining and describing Local Ecosystem Units as described in Section 4.2.8 and displayed in Figure 4.5. This mapping standard will allow for flexibility yet maintain consistency; using such a system a single ecosystem map could be used for a range of purposes with either or both of the vegetation and terrain components being displayed. The digital database guidelines for Local Ecosystem mapping outlined in Section 4.3 support this recommended mapping standard.

General Local Ecosystem mapping standards (proposed) are described below, and displayed in Figure 4.6.

- Maximum of two Ecosystem Units per map polygon.
- Two letter upper case codes used to represent Vegetation Units (standarised set of Vegetation Units and codes to be developed).
- Bio-terrain component of label should contain single upper case primary surficial material designation (standardised set of surficial material codes are contained in Table 4.2 and maximum of two terrain modifiers (slope_aspect, drainage, special conditions – Tables 4.3 – 4.5)
- Vegetation Unit and Structural Stage should be displayed first followed by Bio-terrain Unit and modifiers.

Single Ecosystem Unit within single map polygon	VEGETATION UNIT — VEGETATION UNIT MODIFIER — BIO-TERRAIN UNIT (Parent Material) — BIO-TERRAIN UNIT MODIFIERS SF + (5) + M + (cm) Spruce - Feathermoss — Structural Stage 5 — Morainal Till — Cool Slope, Moderately-well Drained ECOSYSTEM UNIT LABEL SF(5)M(cm)
Two Ecosystem Units within a single map polygon	Decile — Primary Ecosystem Unit — Secondary Ecosystem Unit 7SF(5)M(cm) - 3FN(2b)O(p) 70% — 30% ECOSYSTEM UNIT LABEL 7SF(5)M(cm) - 3FN(2b)O(p)

Figure 4.6. Potential Local Ecosystem map labeling conventions for use within the YECMF.

4.3. DIGITAL DATA STANDARDS (PROPOSED)

Digital data standards described in this document will be dependent on finalisation of ecosystem classification and mapping concepts through the YECMWG. A detailed discussion regarding data models and structure had not yet occurred, but proposed digital standards as described in this section have been used with a high degree of success on several recent mapping projects.

4.3.1. INTENDED USERS OF THE DIGITAL DATA STANDARDS

This document is technical in nature, and is intended for a specialist audience or persons that might be involved in compiling, managing and using the ecosystem mapping digital dataset(s). The intent is for these digital data specifications to be used by three major groups:

- Government staff managing contracts for the collection of ecosystem mapping data;
- Private-sector contractors and government staff actively involved in the collection, storage and maintenance of ecosystem digital data sets;
- End-users seeking to understand the meaning and structure of ecosystem mapping datasets for use in analysis and graphic display.

4.3.2. PHYSICAL DATA DESCRIPTION

The physical format of the data will be contained entirely within the GIS data format. The physical data will initially consist of two separate datasets:

- *Regional Ecosystem Mapping* – 1:250,000 Regional Ecosystem mapping layer for Yukon containing seven levels of YECMF for Regional Ecosystem Mapping as described in Section 4.1.
- *Local Ecosystem Mapping* – a 1:50,000 (or larger) data layer containing all YECMF Local Ecosystem components and Levels (Levels 1 to 8) as described in Section 4.2.

Regional Ecosystem mapping is appropriate to provide an overview of regional Yukon ecosystems, whereas the Local Ecosystem map units will be used for more specific information at larger scales. Future derivative data layers may include a comprehensive coverage of Bio-Climate Zones for Yukon, or potentially Bio-Climate Zones and Landscape Types.

4.3.2.1. Spatial

4.3.2.1.1. Format

The spatial data will be developed in ESRI's ArcInfo coverage format. ArcInfo uncompressed export (.e00) file will be the data distribution format.

4.3.2.1.2. Topology Implementation

The ecosystem stratification layer and the ecosystem unit layer will have topology generated for:

- Polygons
- Arcs
- Labelpoints

4.3.2.1.3. Scale

Mapping data standards are outlined based on two scales: Regional Mapping (1:250,000) and Local Mapping (1:50,000, or larger). Similar data models and standards for both Regional (1:250,000 scale) and Local (1:50,000 scale) mapping standards are proposed.

4.3.2.1.4. Geographical Organization

Data are proposed to be divided geographically according to 1:250,000 scale Ecoregions, produced through the development of the YECMF. Presently the National Ecological Framework (ESWG 1995) has mapped Ecozones, Ecoregions and Ecodistricts at a scale of 1:1,000,000. Several Ecoregions in Southeast Yukon and North Yukon have now been remapped at a scale of 1:250,000 through Yukon Protected Area Strategy initiatives.

Other potential options include:

- Seamless – All data in one seamless dataset; however, this dataset might become very large.
- 1:250,000 NTS Mapsheets – The data would be broken by non-ecosystem based units.
- Watersheds – A 1:250,000 coverage does not currently exist for the entire territory.

4.3.2.1.5. Layer Names

Layer naming conventions have not yet been determined. Two potential models are currently being considered, ecoregion organisation and NTS mapsheet organisation.

- **Ecoregion organsiation** would consist of a letter designation for mapping scale followed by a standard three letter code (to follow ESWG 1995). Local Ecosystem Mapping would be further differentiated from Regional Mapping through the inclusion of either "l" or "r", respectively. Examples are shown in Table 4.6, below.

Table 4.6. Potential layer-naming system for ecosystem mapping utilising Ecoregion codes.

Layer	Coverage Name	Topology
Regional Ecosystem Mapping (1:250,000)	qreco_"ecoregion code" *e.g. qreco_ysl (Yukon Southern Lakes)*	poly
Local Ecosystem Mapping (1:50,000)	fleco_"ecoregion code" *e.g. fleco_ysl (Yukon Southern Lakes)*	poly
Local Ecosystem Mapping (1:20,000)	tleco_"ecoregion code" *e.g. tleco_ysl (Yukon Southern Lakes)*	poly

- **NTS mapsheet organistation** would reference ecosystem mapping by NTS mapsheets (e.g. fleco_105D). Similarly, Regional mapping would be named by qreco_105D.

4.3.3. ATTRIBUTES

A detailed attribute list has not yet been completed and will be dependent on the finalized YECMF classification and mapping standards; however, attribute database structure is proposed to be a similar format to that listed in Table 4.7 (Regional Ecosystems) and Table 4.8 (Local Ecosystems). Proposed database structures differ from digital data guidelines used in BC Terrestrial Ecosystem Mapping, primarily in the concept of maintaining explicit linkage between the terrain, vegetation and resultant ecosystem classification components.

Table 4.7. Potential list of attributes for Regional Ecosystem map coverage (1:250,000).

ATTRIBUTE	DESCRIPTION	TYPE	WIDTH	N.DEC
POLYGON INFORMATION				
AREA	Area	Numeric	4	3
PERIMETER	Perimeter	Numeric	4	3
"poly"#	ARC Polygon Internal ID	Numeric	4	
"poly"-ID	ARC Polygon User ID	Numeric	4	
ECOREG-ID	Ecoregion ID	Integer	2	
POLY_ID	Unique polygon ID within Ecoregion ("Ecoregion ID"-"Polygon ID")	Character	8	
LEVELS 1-3 (National Ecological Framework)				
ECOZONE	Ecozone code	Character	3	
ECOZONE_NAME	Ecozone name	Character	20	
ECOREG	Ecoregion code	Character	3	
ECOREG_NAME	Ecoregion name	Character	20	
ECODIST	Ecodistrict code	Character	3	
ECODIST_NAME	Ecodistrict name	Character	20	
LEVEL 4 (Bio-Climate Zone)				
BIO_ZONE	Bio-Climate zone code	Character	3	
LEVEL 5 (Landscape Type)				
LAND_POS	Landscape Position (Upland/Lowland)	Character	1	
LAND_SUBTYPE	Landscape Sub-type	Character	1	
LAND_TYPE	Landscape Type (Landscape Position + Landscape Sub-type)	Character	3	

Table 4.7 (cont). Potential list of attributes for Regional Ecosystem map coverage (1:250,000).

LEVELS 6 AND 7 (VEGETATION TYPE AND ECOSYSTEM TYPE)**				
ECO_DEC1	Proportion of map polygon encompassed by Ecosystem Type 1 (decile, 1-10, 10 = 100%)			
ECO_1	Primary Ecosystem Type (derived from Landscape Type and Vegetation Type 1)	Character	5	
ECO_MOD1	Eco_1 modifier			
VEG_1	Primary Vegetation Type	Character	2	
VEG_STR1	Veg_1 structural stage	Integer	1	
VEG_SMOD1	Veg_1 structural stage modifier	Character	1	
ECO_DEC2	Proportion of map polygon encompassed by Ecosystem Type 2 (decile, 1-10, 10 = 100%)			
ECO_2	Secondary Ecosystem Type (derived from Landscape Type and Vegetation Type 2)	Character	5	
ECO_MOD2	Eco_2 modifier			
VEG_2	Secondary Vegetation Type	Character	2	
VEG_STR2	Veg_1 structural stage	Integer	1	
VEG_SMOD2	Veg_1 structural stage modifier	Character	1	
Associated Attributes				
REF_YEAR	Date of information used to determine classification (photo date, sample year).	Character	4	
COMMENT	general info and comments, sample site information, etc.	Character	50	

**Database structure and codes for Levels 6 and 7 are expected to change due to anticipated refinements in overall YECMF. Examination of the use and attributing for LANDSCAPE TYPE requires discussion.

Table 4.8. Potential list of attributes for Local Ecosystem map coverage (1:50,000).

ATTRIBUTE	DESCRIPTION	TYPE	WIDTH	N.DEC
POLYGON INFORMATION				
AREA	Area	Numeric	4	3
PERIMETER	Perimeter	Numeric	4	3
“poly”#	ARC Polygon Internal ID	Numeric	4	
“poly”-ID	ARC Polygon User ID	Numeric	4	
ECOREG-ID	Ecoregion ID	Integer	2	
POLY_ID	Unique polygon ID within Ecoregion (“Ecoregion ID”-“Polygon ID”)	Character	8	
LEVELS 1-3 (National Ecological Framework)				
ECOZONE	Ecozone code	Character	3	
ECOZONE_NAME	Ecozone name	Character	20	
ECOREG	Ecoregion code	Character	3	
ECOREG_NAME	Ecoregion name	Character	20	
ECODIST	Ecodistrict code	Character	3	
ECODIST_NAME	Ecodistrict name	Character	20	
LEVEL 4 (Bio-Climate Zone)				
BIO_ZONE	Bio-Climate zone code	Character	3	
LEVEL 5 (Landscape Type)				
LAND_POS	Landscape Position (Upland/Lowland)	Character	1	
LAND_SUBTYPE	Landscape Sub-type	Character	1	
LAND_TYPE	Landscape Type (Landscape Position + Landscape Sub-type)	Character	3	

Table 4.8 (cont). Potential list of attributes for Local Ecosystem map coverage (1:50,000).

LEVELs 6, 7 and 8 (Bio-Terrain Unit, Vegetation Unit and Ecosystem Unit)				
ECO_DEC1	Proportion of map polygon encompassed by Ecosystem Type 1 (decile, 1-10, 10 = 100%)	Integer	2	
ECO_1	Primary Ecosystem Type (derived from Landscape Type and Vegetation Type 1)	Character	5	
ECO_MOD1	Eco_2 modifier	Character	1	
VEG_1	Primary Vegetation Type	Character	2	
VEG_STR1	Veg_1 structural stage	Integer	1	
VEG_SMOD1	Veg_1 structural stage modifier	Character	1	
TER_PM1	Eco_1 parent material	Character	1	
TER_DRN1	Eco_1 soil drainage	Character	1	
TER_SLAS1	Eco_1 slope and aspect	Character	1	
TER_SITE1	Eco_1 special soil condition	Character	1	
ECO_DEC2	Proportion of map polygon encompassed by Ecosystem Type 2 (decile, 1-10, 10 = 100%)	Integer	2	
ECO_2	Secondary Ecosystem Type (derived from Landscape Type and Vegetation Type 2)	Character	5	
ECO_MOD2	Eco_2 modifier			
VEG_2	Secondary Vegetation Type	Character	2	
VEG_STR2	Veg_2 structural stage	Integer	1	
VEG_SMOD2	Veg_2 structural stage modifier	Character	1	
TER_PM2	Eco_2 parent material	Character	1	
TER_DRN2	Eco_2 soil drainage	Character	1	
TER_SLAS2	Eco_2 slope and aspect	Character	1	
TER_SITE2	Eco_2 special soil condition	Character	1	
Associated Attributes				
REF_YEAR	Date of information used to determine classification (photo date, sample year).	Character	4	
COMMENT	general info and comments, sample site information, etc.	Character	50	

**Database structure and codes for Levels 6, 7 and 8 are expected to change due to anticipated refinements in the overall YECMF. Examination of the use and attributing for LANDSCAPE TYPE requires discussion.

4.3.4. GEOREFERENCING INFORMATION

The projection of all ecosystem mapping digital data will be compiled in standard Yukon Albers Equal Area Conic projection with the following parameters:

- 1st Standard Parallel = 61° 40’ 0”
- 2nd Standard Parallel = 68° 0’ 0”
- Central Meridian = –132 ° 30’ 0”
- Reference Latitude = 59° 0’ 0”
- False Easting = 500000
- False Northing = 500000

Horizontal datum will be NAD83 - North American Datum 1983, earth-centered ellipsoid derived from Geodetic Reference System 1980 (GRS80).

Although the ecosystem mapping data will be compiled using Yukon Albers, the data will be distributed in Geographic projection. This will allow users more flexibility to decide which format they want to use the data in.

4.3.5. REGISTRATION

Regional Ecosystem Mapping must be registered to existing 1:250,000 National Topographic Database (NTDB). Local Ecosystem Mapping is recommend to be registered to existing 1:50,000 National Topographic Database (NTDB). Where more detailed topographic base mapping exists, and is determined to be reliable, this may be utilized.

4.3.5.1. Use of Hydrology

For Regional Ecosystem Mapping, all linework must be snapped to the 1:250,000 scale NTDB hydrology.

For Local Ecosystem Mapping, all linework must be snapped to the 1:50,000 scale NTDB hydrology.

4.3.5.2. Associated Data

Numerous data sets should be consulted in the development of the ecosystem mapping data, including, but not limited to:

- Any existing ecosystem or vegetation mapping
- Yukon Forest Inventory 1:50,000
- Geology 1:250,000
- Any existing soils mapping
- Landsat 7 Imagery (preferred)

4.3.6. DIGITAL DATA CAPTURE RULES / REQUIREMENTS

Ecosystem mapping digital data will follow standard digital data capture rules for polygons and coverages, including:

- **Polygon Integrity Rule -** Polygonal feature classes must not contain undershoots or overshoots (i.e. 1-nodes, or nodes that touch only one arc).
- **Single Inside Point Rule -** A polygonal feature must contain at most one inside point for attribute linkage.
- **Self-Intersection Rule** - Arcs must not intersect (i.e. touch or cross) themselves except at their end nodes. This includes the component arcs of polygons.
- **Inter-Feature Intersection Rule** - Arcs in a feature class with coverage or network topology must intersect (i.e. touch or cross) each other only at mathematically exact nodes.

4.3.6.1. Quality of Digital Data Capture

Quality of digital data capture will be determined in terms of level of accuracy and resolution.

4.3.6.2. Minimum Feature Size

Minimum feature sizes for Regional and Local ecosystem mapping have yet to be determined, but will conform with minimum polygon sizes of approximately 0.5 cm^2 (12.5 ha at 1:50,000 scale)

4.3.7. METADATA

The ecosystem mapping digital layers must conform with and be entered into the Yukon Metadata directory: http://metadatayukon.gov.yk.ca/

5. INTERPRETATIONS

To be developed.

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end

Appendix One

Yukon Ecosystem Guidebooks – Proposed Framework

Yukon Ecosystem Classification and Mapping Framework –
First Approximation (Draft ver. 1.3)

January 27, 2003

Appendix One:

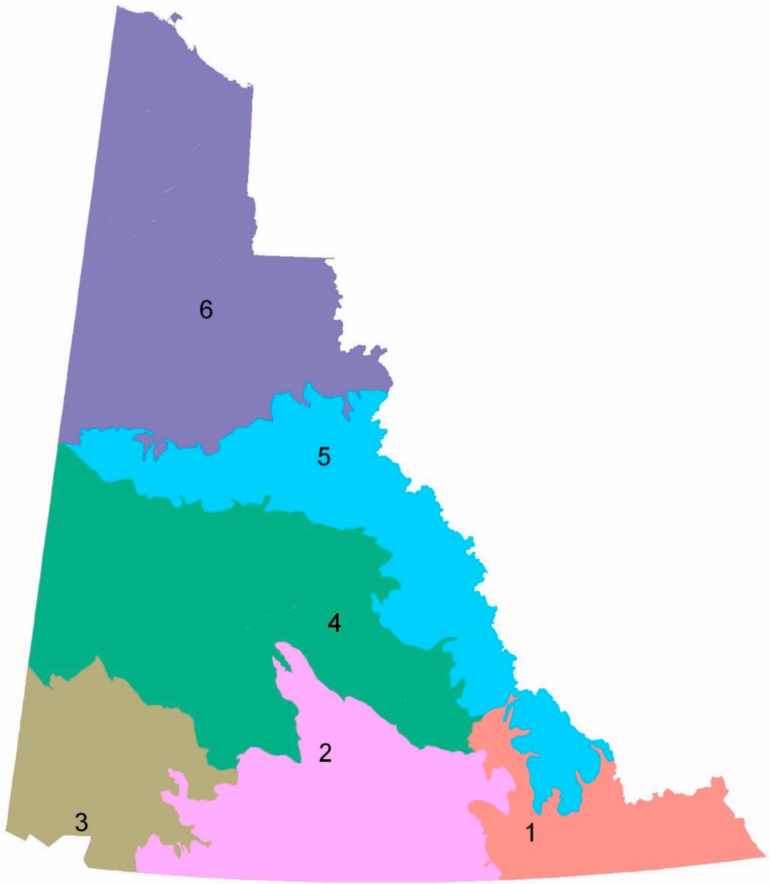
Yukon Ecosystem Guidebooks – Proposed Framework

After the Yukon Ecosystem Classification and Mapping Framework (YECMF) becomes finalised and mapping issues resolved, it is anticipated that a series of regional ecosystem guidebooks will be completed for Yukon. These guidebooks will include a description of the important terrain and vegetation conditions associated with the resultant ecosystems types (regional mapping, 1:250,000 scale) and ecosystem units (local mapping, 1:50,000 scale or larger), and important ecological or management interpretations. A potential geographic organisational framework for the Yukon regional ecosystem guidebooks is displayed in Figure A-1. This framework is structured by the National Ecological Framework (ESWG 1995) Terrestrial Ecozones and Ecoregions, and is organised based on our current understanding of similar ecological conditions within Yukon.

During the development of the *YECMF – First Approximation (Draft ver 1.2 and 1.3*), a large amount of ecological data was synthesized to assist in the formulation of classification and mapping concepts. Three priority areas representing ecosystems from both North and South Yukon were examined, including:

- Guidebook One – Southeast Yukon (Muskwa Plateau, Hyland Highland and Liard Basin)
- Guidebook Two – South-Central Yukon (Pelly Mountains, Yukon Southern Lakes and Boreal Mountains and Plateau)
- Guidebook Six – North Yukon (Eagle Plains and Peel Plateau – additional constituent Ecoregions not addressed)

Guidebook Three, (Southwest Yukon), Guidebook Four (Klondike – Central Plateau) and Guidebook Five (Mackenzie – Selwyn Mountains) were not addressed in this first approximation. The development of preliminary ecosystem units for Southeast, South-Central and North Yukon was a necessary exercise that aided in the development of proposed YECMF concepts and mapping standards. Detailed Guidebook development cannot occur until the YECMF concepts and methods have been formalized and accepted.



Guidebook 1: Southeast Yukon (Muskwa Plateau, Hyland Highland and Liard Basin)

Guidebook 2: South-Central Yukon (Pelly Mountains, Yukon Southern Lakes, Boreal Mountains and Plateaus, and Yukon-Stikine Highlands)

Guidebook 3: Southwest Yukon (Ruby Ranges, St. Elias Mountains and Mount Logan)

Guidebook 4: West-Central Yukon (Klondike Plateau, Yukon Plateau-Central and Yukon Plateau-North)

Guidebook 5: Yukon Cordillera (Mackenzie Mountains, Selwyn Mountains)

Guidebook 6: Northern Interior and Arctic Coast (remaining Yukon Ecoregions).

Figure A-1. Proposed geographic areas for ecosystem guidebooks of Yukon. The development of preliminary ecosystem types/units for Guidebook areas 1, 2 and 6 was initiated during the development of the YECMF, a necessary step aiding in the development of classification and mapping concepts.