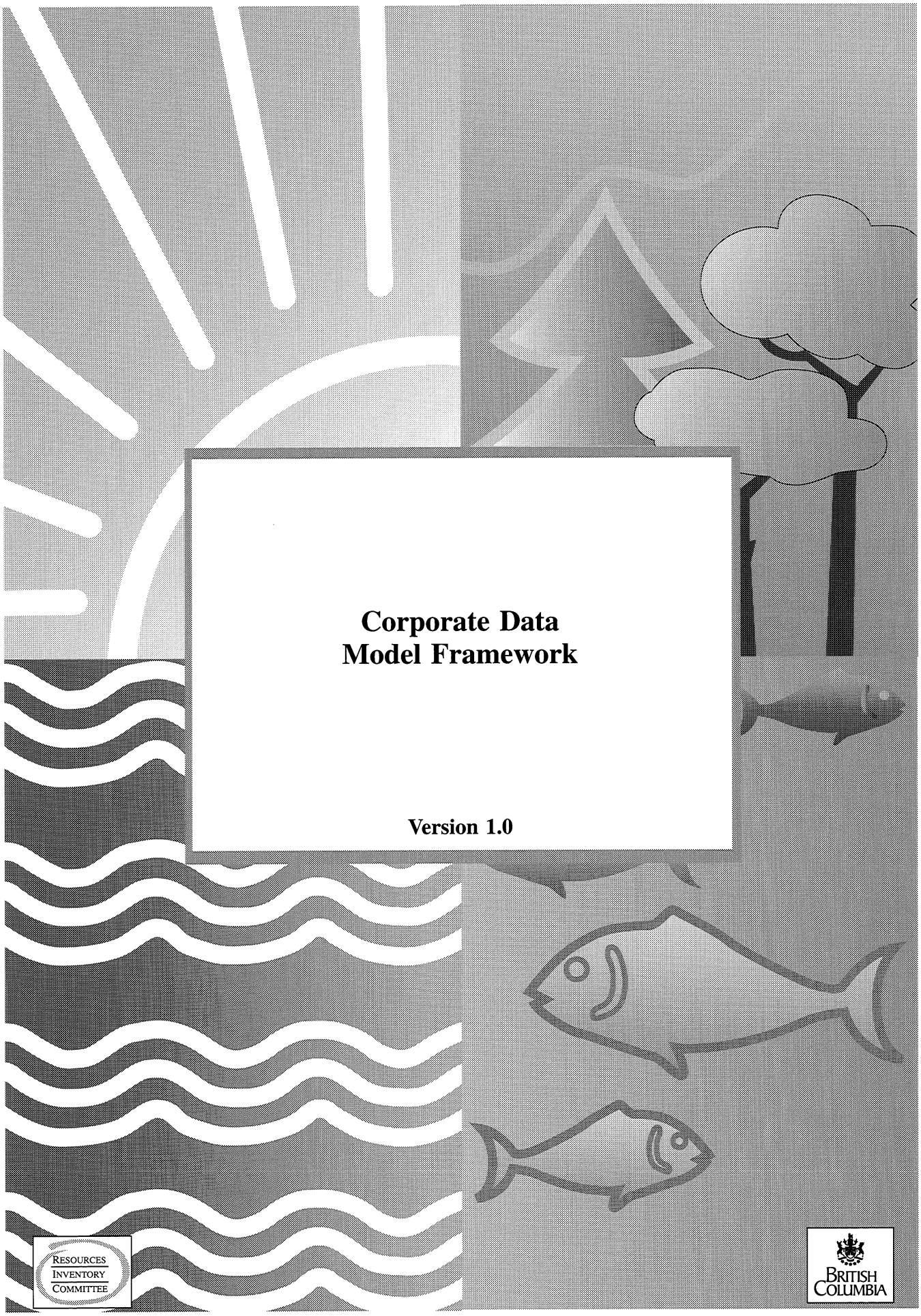

Corporate Data Model Framework

Version 1.0

RESOURCES INVENTORY COMMITTEE

BRITISH COLUMBIA

Resources Inventory Committee

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for the Land Use Task Force
Resources Inventory Committee

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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report “The Future of our Forests”.

For further information about the Resources Inventory Committee and its various Task Forces, please access the Resources Inventory Committee Website at: http://www.for.gov.bc.ca/ric.

Land Use Task Force

This document is based on an unpublished draft prepared for the Resources Inventory Committee (RIC) by Glenn Pope of MacDonald, Dettwiler and Associates Ltd. (MDA), with assistance from Ozzie Sawicki of MDA and Richard Lay of Context Consulting. Guidance and support in the development of this document has been provided by the RIC Data Model Committee (DMC), under the chairmanship of Evert Kenk. The document also benefited from assistance provided by Mark Sondheim and Peter Friesen of the Strategic Developments Unit.

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1. Introduction

This section introduces the LandData BC Corporate Data Model (CDM) and the CDM Framework (CDMF) governing its development and use. The terms "LandData BC CDM" and "CDM" are used interchangeably in this document.

1.1 LandData BC Corporate Data Model

This section provides a high level definition of the CDM and shows why it is a component of LandData BC.

1.1.1 CDM Overview

The CDM is a collection of data descriptions and supporting information which delineate land-related information, including resource and cultural data, used by the Province of British Columbia. It is used for:

- collecting information on existing databases and data models, including RIC Inventory Standards;
- storing this information in a repository in a standardized format;
- making information on resource data accessible to Business End Users and discipline experts, as well as information professionals; and
- providing standardized data modelling information to information professionals.

1.1.2 CDM Objectives

The main goal of the CDM is to support shared, location independent end user access to local ministry data, so users can easily obtain information from any LandData BC accessible database, located anywhere, from anywhere.

Other goals of the CDM are to:

- meet business information needs by making business model information easily accessible to Business End Users;
- support information management needs, such as:
  - data management including quality control, and
  - data modelling; and
- support local ministry database development.

1.1.3 CDM Scope

The CDM is used for modelling corporate data, which is data:

- that is used in Government processes (e.g., planning) or operations that cross ministry boundaries;
- that is used for registering other data; or
- defining legal encumbrance.

It is also defined as data which is considered to be permanent within government, with ministries being accountable for it (i.e., a Custodian is identified). Reader interested in this

topic are referred to the *Land Information Management Framework (LIMF), Volume 1, Section 1.3, Scope* [R-6],for a more comprehensive definition of corporate data.

1.1.4 Benefit of a CDM

Corporate data is currently stored in different files and databases. The problem with land-related information is that the various data stores exhibit varying degrees of insularity. This can make it difficult for users to locate and share data, and to obtain information. The main benefit of the CDM is to help reduce or eliminate this insularity by publishing a common directory.

1.1.5 CDM Vision

LandData BC, in its mission to provide a common window of access to land-related information in BC, is providing the CDM as a part of the LandData BC System. The LandData BC CDM covers resource, cadastral, topographic, and socio-economic land-related information.[1]

The CDM contains formal descriptions (also called meta-data) of the ways land-related data in the province are stored. Its purpose is to:

- capture database descriptions (i.e., database schemata) and data models (including RIC Inventory Standards Common Data Models) to improve our understanding of what land-related data there is;
- promote data integration and sharing by providing common views of data;
- reduce inconsistencies to promote LandData BC System interoperability;
- provide a federated capability, so it becomes possible to join (i.e., combine information from) different databases;
- resolve inconsistencies at the source, i.e., promote the development of databases using standardized nomenclature;
- support database development; and
- provide meta-data access to Business End Users and Information Professionals.

Figure 1.1 shows the context for the activities surrounding the CDM. Data for the CDM is stored in the LandData BC Repository, which is made accessible across Government through a set of products that describe individual models in ways ranging from overview diagrams with simple narratives to detailed definitions and specifications of model components. LandData BC houses, maintains, and provides access to the CDM and the Repository Management Tool Suite RMT). Federated (or common, consolidated) Model specifications from the repository can be utilized by tools within the LandData BC System for delivering land-related information on-line which is readily integrable. This will enable the development of common or corporate business applications such as land statusing, watershed assessment or decision support systems (e.g., oil spill response).

The CDM contains diagrams and descriptions of corporate data and data structures based on several types of models (model types are covered in detail in *Model Types*). CDM model types are shown in Figure 1.1 in the box labelled “LandData BC CDM Repository”. They are

---

[1] Taken from LandData BC Phase IIIA, CDM Support Plan, RIC Common Data Model, Executive Summary [R-7].

the types of models that, when instantiated in the repository, make up the CDM. Each model type consists of data structures as well as supporting documentation.

Since the CDM contains a common view of government wide data, it provides the models based on which “standardized” databases and external views can be developed. This permits a common view of corporate data, allowing data to be integrated and shared between databases.

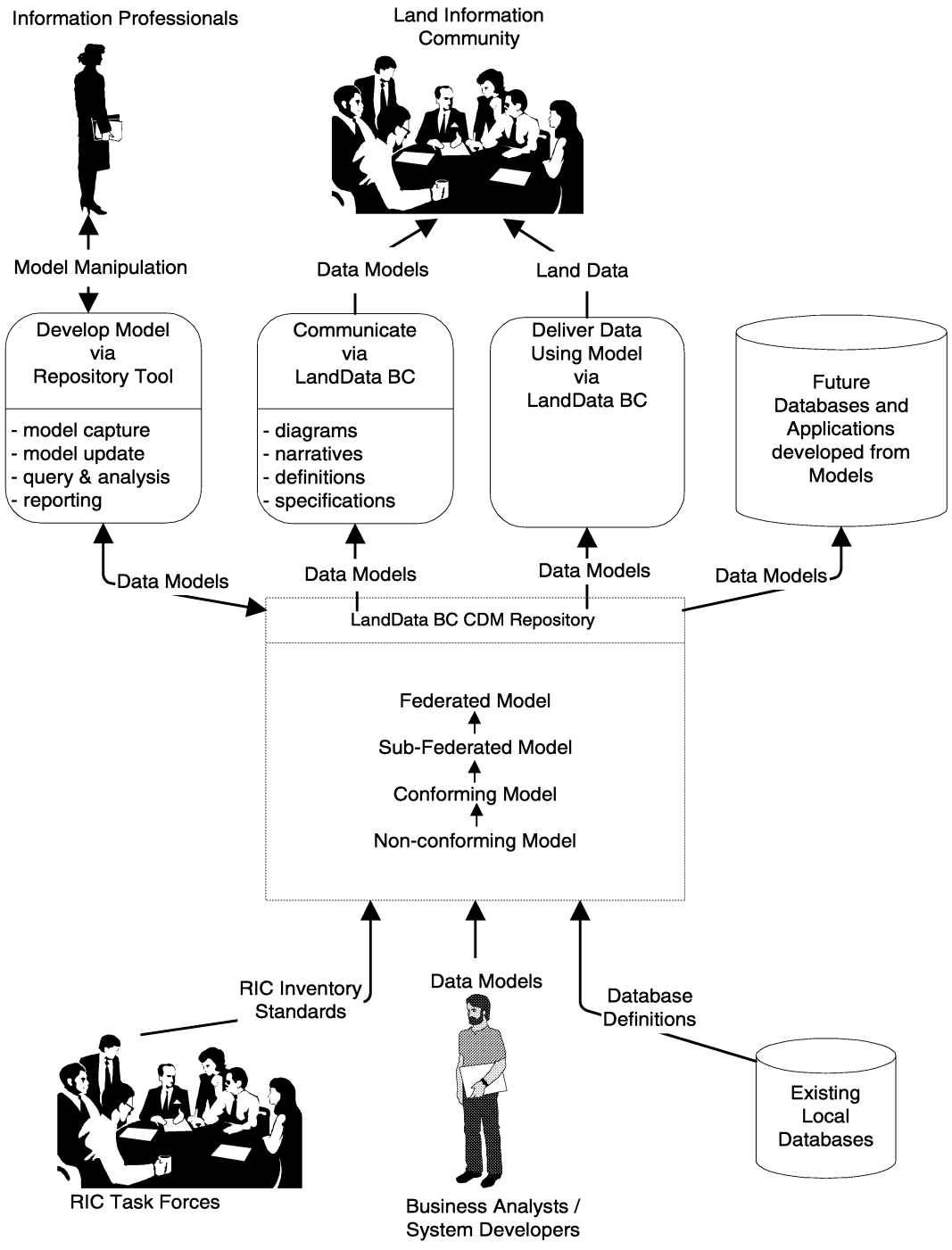

Figure 1.1 LandData BC Corporate Data Model Context

The process of transforming divergent standards, source models and database schemata into a standardized model involves a number of transformations (refer to Figure 1.1 and

Figure 1.2). This process is called corporate data modelling and involves the following activities:

- The source data is imported into the CDM Repository. At this point, the resulting model (it may be a data model, a schema, or a model based on a standard) is considered non-conforming, unless the source it came from is considered to be conforming to CDM standards.
- It is transformed into a standardized data model and spatiotemporal framework, and compared to other models at this stage (principally sub-federated models) to arrive at a comparative level of descriptive detail; at this point, the model is considered to be conforming to CDM standards. "Spatiotemporal" refers to data which contains spatial and temporal information; the meaning of the word is elaborated on further in *CDM Architecture*.
- It is compared to a suitable sub-federated model (in terms of where it belongs in the classification hierarchy, see *Classification Hierarchy*) for shared and distinguishing features, which are then added to the sub-federated model, i.e., the models are integrated.

The sub-federated model is compared to the federated model, and selected distinguishing features or changes are added to the federated model. The federated model is a "roadmap" to detail in the sub-federations, so only selected portions of the sub-federations are maintained at the federated level. This concept is described further in *CDM Architecture*.

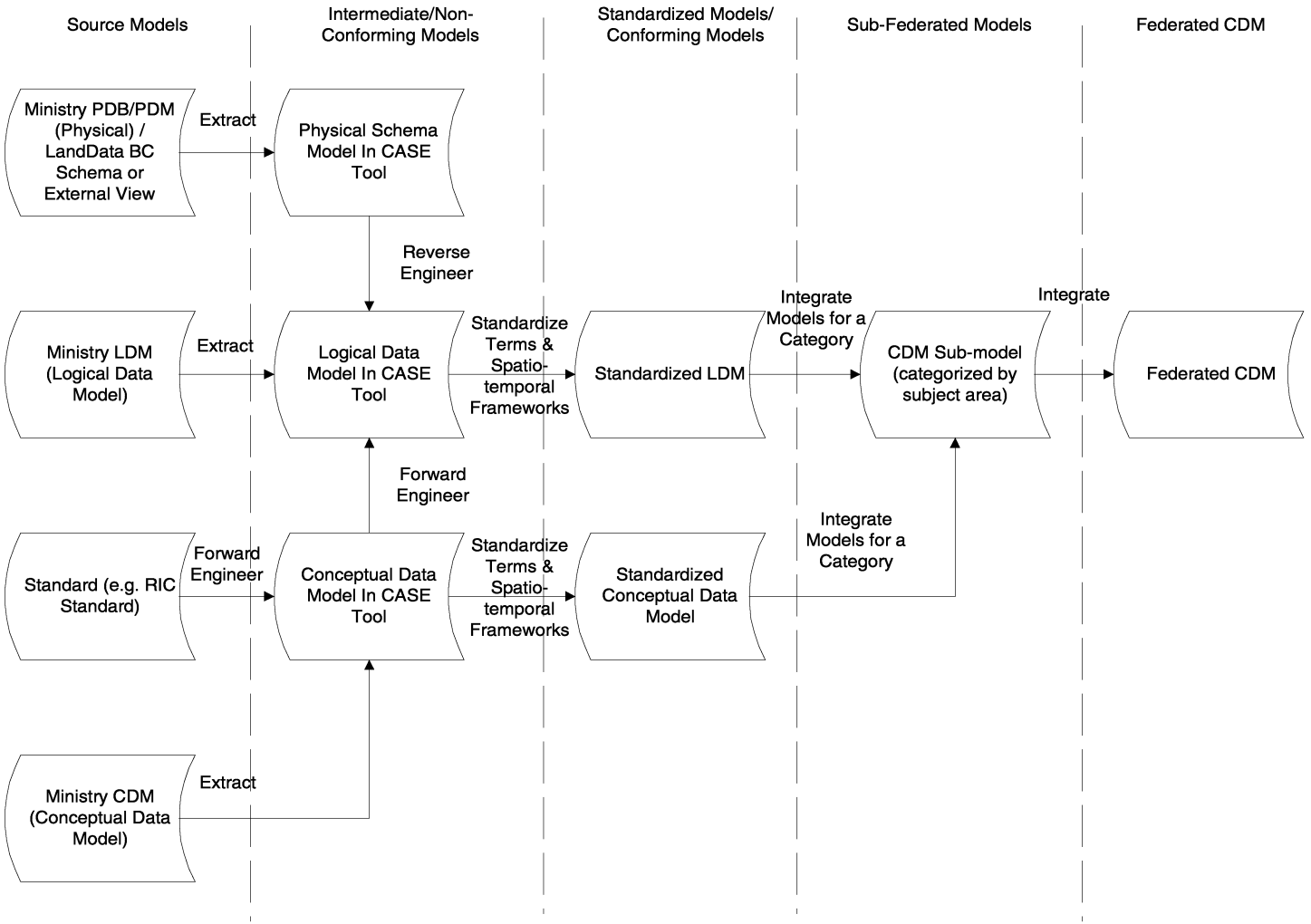

Figure 1.2 Corporate Data Modelling Process

The models at various stages of transformation are validated with Data Providers using LandData BC product access facilities. That is, the intermediate and sub-federated models are made available to contributors, so they are aware of what is going on and can provide input. More importantly, once the models reach a level where they can be published to a wider audience, they can be released on LandData BC, thereby communicating the common understanding of the structure of this province's land-related information to a wide audience.

The establishment and maintenance of information in the CDM is an evolving process. The LandData BC Repository Management Tool Suite (see Figure 2.1) enables information professionals to query, analyze, add, and update models to reflect current understanding of the CDM. Database Developers are also able to use the models when designing and implementing databases to house land-related data.

One of the key by-products of the corporate data modelling process is the development of a standard terminology. This terminology plays a role not only in modelling specific terms, but more importantly, in equating to terminology that relates to common components found within the source databases and standards (e.g., RIC Standards) which cross a variety of Subject-Areas (see *Classification Hierarchy*). This fact is reflected in the CDMF, as standardized terminology will become critical to Data Modellers and Database Developers attempting to conform to CDM requirements, as well as CDM end users who access the CDM.

For further information about the CDM, refer to Appendix A, *CDM QUESTIONS AND ANSWERS.*

1.1.6 Data Sharing

When end users access data via LandData BC, having access to shared data involves three key aspects:

- Firstly, end users must have a view of data that is known to them so they know what they are requesting. The use of a CDM with synonyms or spatiotemporal mappings will allow this. It will allow users to ask for information from different databases, without having to be familiar with the specific semantic idiosyncrasies of the database being accessed.
- Secondly, the data has to be available in the same format as it was requested. For example, for an attribute query, a transformation to a format with which the user is familiar has to take place. Again, a CDM with the appropriate attribute and spatiotemporal mapping facilities will allow this. The mappings may be both of a static nature, i.e., views, or a dynamic nature, i.e., dynamically generated queries.
- Thirdly, users should be able to issue requests for data which return data from multiple databases. The following sample query will require combining data from different, perhaps geographically distributed, data stores:

  > "Given a parcel identifier, return information on liens and encumbrances, mineral titles, or land use".

  Such a distributed query is satisfied by combining data using common identifiers, or keys. The data is "joined" for identical key values. In order for this to work,
  - all the data participating in such joins has to have identical keys, i.e., both the structure and contents of the key fields have to be the same, and/or
  - the keys have to be mapable to one another in terms of structure and values.

The CDM supports both of the preceding points, either

- through fostering an environment of commonality amongst databases being developed, with the CDMF as a guide and the CDM as an information resource for establishing such an environment, and/or
- through providing the tools and information required for analyzing distributed data so that keys can be compared and mapped to one another.

1.1.7 CDM Stakeholders

An essential requirement of the CDM is to receive acceptance by the program areas and data modelling community. This involves the following stakeholders:

- **RIC**: The RIC holds a defined interest in the CDM in that it is the primary group designated to create a unified ministerial agreement of the CDM. This group is also a prime driver behind the establishment of RIC Task Forces.
- **RIC Task Forces**: A directive for RIC Task Forces is to produce the various RIC Inventory Standards required to help in the development of individual data models, as well as to provide the RIC Common Data Model component as part of the LandData BC CDM. RIC Task Forces play a significant role in the development of the CDM because the discipline oriented RIC Inventory Standards they are developing and implementing will be of considerable influence in the development of resource related information systems at the local ministry level, which will contribute to the evolution of the CDM.
- **RIC Data Model Committee (DMC)**: From the CDM perspective, its role is primarily to provide guidance and direction
  - in the development of the CDM Framework and
  - to the Corporate Data Modellers.

  This guidance is provided primarily through development and publishing of the CDMF.
- **LandData BC**: As the repository of the CDM, LandData BC is the key link to Business End User and information professionals. LandData BC will also be involved in the on-line publication of information used in the creation of the CDM as well as the CDM itself.
- **Program Areas**: The various program areas, such as wildlife, vegetation, terrain, etc., are critical stakeholders in the CDM. It is these groups that will be the primary contributors to the CDM, as in many cases, they already have existing models that have been created for their own program areas. In some cases prototype databases have already been set up. The program areas will also become Stewards of the CDM as it continues to evolve as an integrated CDM covering the various ministry boundaries. Ultimately, these will become the Custodians of their relevant mandate information, responsible for ongoing improvement, update and issue resolution. Business End Users within the program areas have a vested interest in the CDM, as they are the "end users" of the databases to be developed from the CDM. This group includes domain experts, resource managers, planners, and regional co-ordinators.
- **Information Professionals:** This group includes Data Administrators (DAs), Data Modellers, Data Managers, and Database and Geographic Information System (GIS) Integrators and Developers.

The following figure shows these relationships diagrammatically.

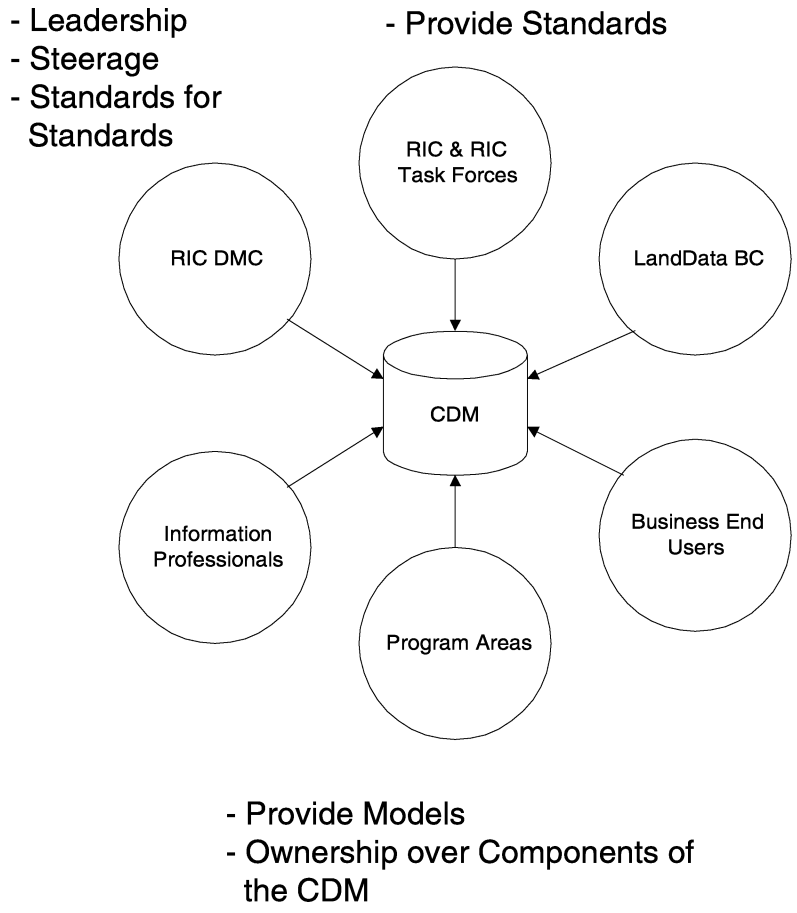

Figure 1.3 CDM Stakeholders

Another stakeholder, not shown in the figure, is **The Chief Information Officer**. It is proposed that the Custodian for the CDM is the Chief Information Officer (CIO) for BC.

It is important that the various stakeholders have input into the CDM throughout its creation and evolution. Although the level of input may vary from stakeholder to stakeholder, it is the synergy created from the combined effort of these stakeholders that will build a logical and usable CDM.

By involving these groups in the initial CDM stages of development, it promotes the ownership of the CDM to remain with the stakeholders. The significance of the "ownership" of the CDM in this way is that it delegates the responsibility for continued evolution of the model to the stakeholders. This includes keeping the CDM up-to-date, integrating future changes and publishing this information to allow open access to a variety of users.

1.2 CDM Framework

This section introduces the CDMF, which is a description of the goals, form, function and use of the CDM.

1.2.1 CDMF Overview

The CDMF defines:

- the vision and objectives of a CDM;
- the structure and form in which a CDM is to be created, organized and developed;
- CDM tools;
- access to meta-data in the CDM, including capture of source data models and on-line publishing of model information; and
- the steps involved in populating the CDM (the corporate data modelling process) and various standards and guidelines associated with this process and the contents of the CDM.

1.2.2 CDMF Objectives

The primary objective of the CDMF is to provide information and guidance to Business End Users and information professionals such as Data Managers and Corporate Data Modellers who will be accessing the CDM.

1.3 CDMF Document Description

This document has been created on behalf of the RIC DMC. The RIC DMC role in the CDMF is to provide guidance on issues relating to the creation and evolution of the CDM.

1.3.1 Purpose of Document

This document describes the CDMF. It outlines the various components of the CDM, how they will be used, and describes how the CDM is to be built. In addition, guidelines for the use of supporting tools for the CDM are included. It shows how data models, due for incorporation into the CDM, should be built to conform to CDM standards. It also includes the processes and responsibilities for the ongoing upkeep, refinement, and administration of the CDM.

1.3.2 Document Audience

The intended audience for this document consists of CDM stakeholders. See *CDM Stakeholders* for a list of stakeholders.

1.3.3 Document Outline

The document contains four major sections:

1. Introduction: Provides an introduction to the CDM, the CDMF, and this document. It contains the objectives and vision for the CDM, provides an overview of the CDMF along with a list of stakeholders, and describes the CDMF document.
2. CDM Architecture: Contains the framework details, including descriptions of the CDM architecture and specifications for meta-data.
3. Corporate Data Modelling Tools: Contains a list of the tools required for developing and maintaining the CDM.
4. CDM Operation: Lists and describes roles and responsibilities.

1.3.4 CDM Standards Conformance

The *Corporate Data Modelling Standards & Guidelines* [R-1] document provides detailed CDM standards and guidelines for Corporate Data Modellers and others involved in the development and evolution of the CDM. Conformance to CDM standards requires conforming to the architectures, guidelines and standards outlined in both the CDMF and [R-1].

1.3.5 Evolution of Document

This is an early version of the CDMF document. It is likely, therefore, that this document will go through a process of evolution as stakeholders become familiar with the CDM and provide feedback on the CDMF.

There are a number of standards relating to data modelling components and terminology in this document. Care has been taken in their specification to minimize any future changes, because it would be difficult or impossible to retrofit changes for any such standards into the CDM or databases developed from the CDM.

The corporate data modelling process may change, however. In fact, the application supporting the repository may change (as technology changes), so this in turn could foster modifications to this document.

Basically, the structure and contents of the CDM repository (the structure of the meta-data), as well as rules governing the repository contents, should remain stable, whereas the CDM application, as well as the way the CDM is utilized, may change. This document will evolve in concert with these changes.

1.3.6 Document Change Authorization

Any changes made to this document must be approved by the RIC DMC, or other designated authority as may be assigned in the future.

The *Document Change Authorization* section may not be altered without approval from such a designated authority.

2. CDM Architecture

This section describes the CDM from a structural perspective, i.e., it describes the components that make up the CDM and how they fit together. Usage of the CDM is described in *CDM Operation*.

The narrative in this section will follow a top-down approach, beginning with a conceptual view of the CDM and ending with a description of the functionality provided. The approach used is to break the CDM architecture into four sub-architectures:

- Conceptual Architecture: provides a high level view of the CDM and how it fits into the LandData BC System.
- Information Architecture: covers the structuring of meta-data inside the CDM.
- Repository Architecture: describes how the LandData BC Repository is used to implement the CDM information architecture.
- Application Architecture: provides a high level view of the application side of the CDM - what functionality is provided, and how is it implemented.

Since the CDM is part of the LandData BC System, its architecture is subsidiary to that of the LandData BC System Architecture. Where appropriate, the latter is reflected in the following sections.

2.1 Conceptual Architecture

The CDM is a collection of:

- data models represented by Entity Relationship Diagrams (ERDs) containing entities, attributes, and relationships, and
- associated background information,

which is used for modelling corporate data (see *CDM Scope* for a definition of corporate data).

The data models are captured and managed in LandData BC by the Corporate Data Model Management Tool[2]. This tool is part of the LandData BC Repository Management Tool Suite. The meta-data itself is stored in the LandData BC Repository. This repository contains both the LandData BC custom built Product Catalogue Repository components and the Oracle Repository. Access to the Oracle Designer/2000 Computer-Aided Systems Engineering (CASE) tool (which uses the Oracle Repository as a data store) is provided by the Corporate Data Model Management Tool. The tools and data stores used for managing the CDM are shown in Figure 2.1 (taken from [R-8]).

Other components, primarily textual data, are stored in electronic media such as word processors and spreadsheets, and are made accessible to the various CDM users via standard LandData BC web publishing facilities.

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[2] This information is taken from the LandData BC System Architecture document [R-8].

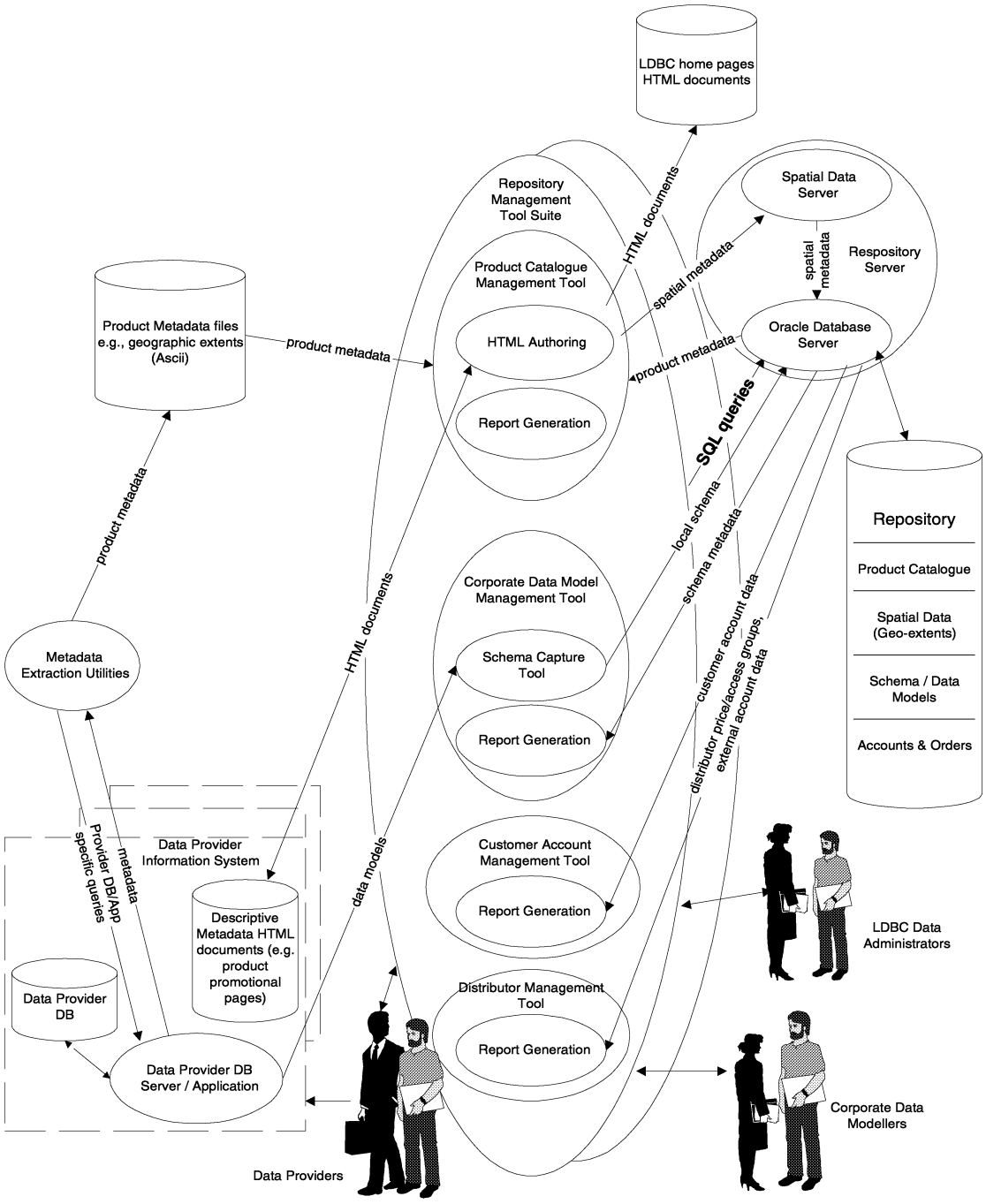

Figure 2.1 LDBC Repository Management Tool Suite

2.2 Information Architecture

2.2.1 Overview

Basic CDM modelling component types consist of

- data model, which includes components entity, attribute and relationship;
- business model; and
- supporting documentation which includes components document, contributor, term, issue, transformation, and subject category (see *Classification Hierarchy*) to provide more information in support of model development.

These components collectively make up a "model". Therefore models are the highest level of component type and contain the other components. *Generic Model Structure* contains a more detailed description of "model".

CDM data model components are typically parts of Entity Relationship (ER) models which are maintained in the Oracle Designer/2000 CASE tool. Because of the size and complexity of the CDM, the other modelling components have been added to:

- store CDM information in a consistent and an easily accessible form;
- help Data Management establish the quality of information in the CDM;
- identify who has provided input information and in what form; and
- track what transformations to the inputs and intermediate models were made during the consolidation of models into the federated CDM.

The models in the CDM are categorized from two points of view:

- from a business point of view, they are classified into subject categories; and
- from a data modelling viewpoint, they are organized into modelling components, typically ERDs, each expressing some key aspect of the model; given an entity, it is possible to located all ERDs containing that entity, so entities can be thought of as categorizing ERDs.

Figure 2.2 provides a diagrammatic overview of CDM components.

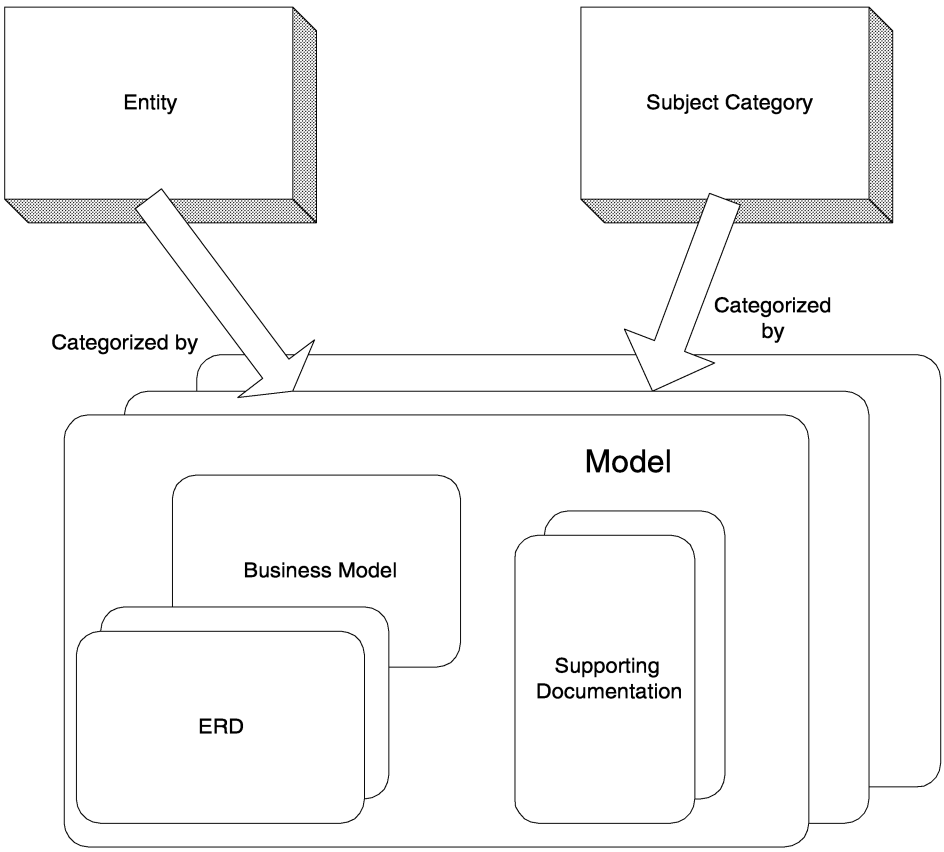

Figure 2.2 CDM Component Overview

Collections of entities, attributes, and relationships are aggregated into ERDs. An ERD is a unit of meta-data management, and as a rule, most entities within it will fall into one Subject-Area. Subject-Areas are described in *Classification Hierarchy*. Figures 2.3 and 2.4 show examples of ERDs. The components of an ERD are described in the following sections.

2.2.2 CDM Modelling Components

As part of the process of creating and extending the CDM, models at various levels of refinement are produced, from source models obtained from Data Providers to CDMF conformant consolidated models created by Corporate Data Modellers. This section describes all of the components involved in the creation of these models.

.Model Types

A model can exist as one of several types. Refer to Figure 1.1 and the description of the model types in *CDM Vision* for further details. The model types are:

- Source models, which are defined as pertaining to a specific subject category and which are either
  - a local (ministry) database schema, or
  - a standard (such as a RIC Inventory Standard), or
  - a data model.

  The contents of the models are those components which have been released to LandData BC by the Data Providers.

- Intermediate/non-conforming models, which are the same models imported into a common CASE tool and representation, such as ERDs in Oracle Designer/2000 for data models and Microsoft (MS) Word, MS Excel spreadsheets, or Visio drawing tool for supporting documentation.
- Standardized/conforming models, which have been transformed into CDMF conformant models via transformations that convert them to a common:
  - CDMF compliant terminology,
  - spatiotemporal framework (see *Spatiotemporal Modelling Approach* for a definition of "spatiotemporal"), and
  - common level of abstraction.

  At this stage, for schemata, the model type is a Component Schema[3] which contains component schema objects and the mappings between these and the local schema (ministry) objects or components.
- Sub-federated models, a model type for a single subject category (typically a Subject-Area) which either combines several of its subcategories or is simply an integration of multiple models for a given subject category. This integration is based on a comparison of shared and distinguishing features; it is an intermediate model prior to updating the Federated CDM. For schema models, the model type is a Component Schema. The model level is logical (see *Model Levels*).
- Federated CDM, which is an integration of all CDMF conformant and sub-federated models. This integration is based on a comparison of shared and distinguishing features, including data describing data distribution. The model level is largely conceptual (see *Model Levels*).
- Reference models for common terms and definitions, which are views into the CDM for specific end uses (i.e., external schemas).

Model Levels

In the data modelling approach used for the CDM, models represent three basic levels of abstraction:

- Conceptual Data Model, which consists of entities and relationships, and optionally, attributes. During top-down modelling, it is the first level modelled. Not all relationships need to be clarified or resolved, in particular, many-to-many relationships. The conceptual model is intended to provide an understanding at a high level of the entities and their relationships.

  The ERD[4] below shows a many-to-many relationship between the two entities shown - ECOLOGICAL INVENTORY SURVEY and SAMPLE UNIT TYPE. The relationship is based on entity instances.

---

[3] See *Federated Database Systems for Managing Distributed, Heterogeneous, and Autonomous Databases,* Seth & Larson, ACM Computing Surveys, Vol. 22, No. 3, September 1990 [R-9].

[4] Adapted from *Consolidated Wildlife Inventory Data Model Project*, Habitat Inventory Section, Wildlife Branch, Ministry of Environment, Lands and Parks (MELP), September 1995 [R-10]

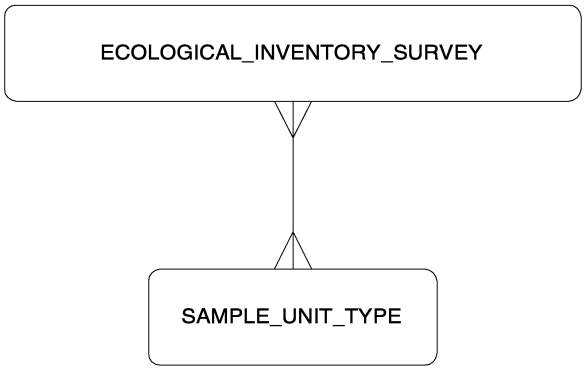

Figure 2.3 Conceptual Data Model ERD

- Logical Data Model (LDM), which consists of entities (also called "relations" at this level) and all attributes and relationships. In particular, it includes all relations that will become code tables. If the model has been developed from a Conceptual Data Model, it is usually normalized at least to Third Normal Form (3NF). This means that non-key attributes depend on the key, the whole key, and nothing but the key. The purpose of an LDM is to provide the full data schema, but without implementation details. Distributed data design is carried out at this level. Much of the data covered by the CDM is distributed, so from this perspective as well as the inherent simplicity of the model, the logical level of model is the best for modelling corporate data.

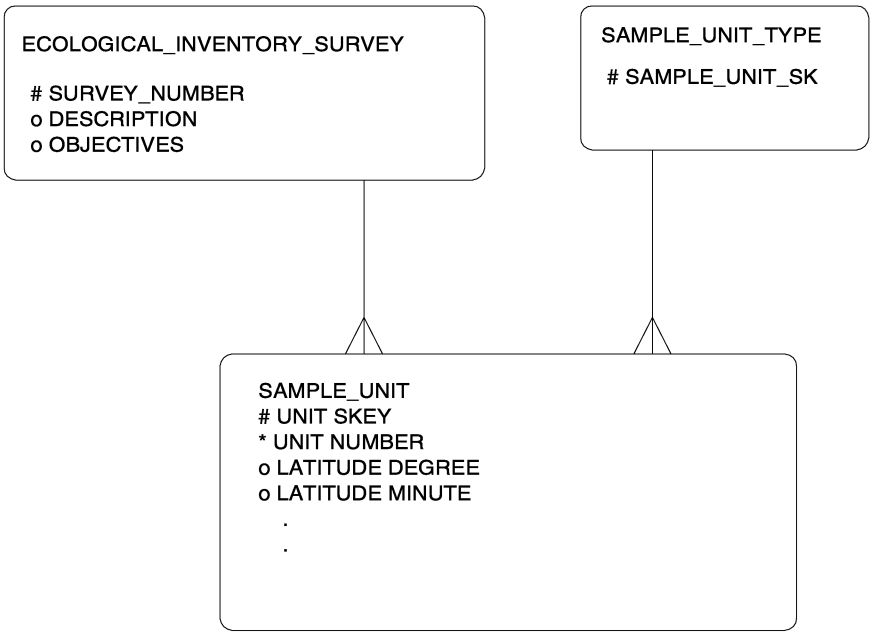

Figure 2.4 Logical Data Model ERD

The above ERD[5] shows how a many-to-many relationship is resolved by adding an associative entity, in this case SAMPLE UNIT. Both relationships are now one-to-many. The broken relationship line ends indicate optionality, i.e., it is not mandatory (or it is optional) that SAMPLE UNIT TYPE has any instances of SAMPLE UNIT. Conversely, solid relationship line ends indicate that a relationship is mandatory, i.e., SAMPLE UNIT must be associated with a SAMPLE UNIT TYPE. The names shown below the entity names are attributes. They are preceded by indicators which show whether they are key or non-key attributes.

- Physical, which consists of tables (converted from relations) and columns (transformed from attributes), as well as various kinds of keys, indices, physical domains, and so forth. Depending on performance and storage requirements, the model may be partially denormalized. The physical representation may be influenced by the database management or file system used for storing the data.

The descriptions above are very brief. The reader is directed to any one of a number of good data modelling textbooks available for further information. For Oracle Designer/2000 users, a good text to reference is Oracle *CASE*Method Entity Relationship Modelling* by Richard Barker, published by Addison Wesley [R-3]. A useful text for LogicWorks ERwin users is the *Methods Guide* [R-4], which is part of the documentation set delivered with the tool. The ERD notation shown above is that used in Oracle Designer/2000.

Model Levels and the CDM

Source data models may be provided at any one of the three model levels. Typically they are physical or logical, but can also be conceptual. In particular, schema that are derived from standards will start out at the conceptual level.

Models at the physical level have to be reverse engineered into logical models storable in Oracle Designer/2000. The tool used for doing this is the ERwin CASE tool.

At the logical level, attributes have keys and data-types specified. The logical models can be implemented with little change into databases, and while there may be some implementation issues (de-normalization for Structured Query Language (SQL) databases), the databases should be able to re-present (provide views of) the data in its logical form for business use.

Conceptual models provide a simplified understanding of the nature of the data. In the CDM they may not be fully attributed, and some entities usually implemented by code tables may not be included. The conceptual models allow for ease of communication of the data and allow scoping issues to be quickly resolved.

The details of transforming source models into federated models are described in the *Corporate Data Modelling Standards & Guidelines* document [R-1].

Generic Model Structure

The structure and content of all models produced during corporate data modelling are defined by a generic model, which has the following components:

- data models, which may be at either the conceptual or logical level, or both, and which are made up of:

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[5] Adapted from *Consolidated Wildlife Inventory Data Model Project*, Habitat Inventory Section, Wildlife Branch, Ministry of Environment, Lands and Parks (MELP), September 1995 [R-10]

    - entities, including any spatiotemporal parameters,
    - entity relationships,
    - entity subtypes,
    - attributes, including logical data types and enumerated domains,
    - business rules/procedural constraints, and
    - descriptive information;
- business models (optional) which contain business processes and process data flows;
- supporting documentation, consisting of:
    - identification of model sources and their contributors;
    - list of issues;
    - common terms and definitions (glossary);
    - list of transformations that have been applied to the various models;
    - reference documents (RIC Standards, Spatial Archive and Interchange Format (SAIF), etc.);
    - quality information, e.g., uncertainty about entity names or attributes; and
    - Subject-Areas or categories, which can also be mapped to sub-categories.

Data Model Components

Entities–

CDM entities are modelled in the same way as in traditional ER models. Specific modelling details are covered in the *Corporate Data Modelling Standards & Guidelines* document [R-1].

Entity Relationships–

Entity relationships are handled within the CDM in the same way as in traditional ER models.

Attributes–

Attributes are handled within the CDM in the same way as in traditional ER models.[6]

Classification Hierarchy–

Entities represent classes of objects that can be categorized from a business viewpoint. CDM entities are classified according to subject categories which are based on business domains. This facilitates both their manipulation within the overall CDM and ease of understanding of the models from a business viewpoint.

Subject categories are organized into a three level hierarchy called a "classification hierarchy". The three levels of categorization are:

- Supersubject-Area, for example:
    - Legal Data and Jurisdictional Boundary
    - Socio-Economic
    - Georeferencing
    - Environmental Inventory
    - Infrastructure

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[6] For specific details on the representation of attributes in Oracle Designer/2000, refer to the Designer/2000 User documentation or the ORACLE *CASE*METHOD Entity Relationship Modelling* text book, by Richard Barker, published by Addison Wesley [R-3].

    - Environmental Management
- Subject-Area, for example the "Environmental Inventory" Supersubject-Area is sub-divided into:
    - Topographic/Bathymetric
    - Soil
    - Geology
    - Water
    - Ecoregion
    - Terrestrial, Aquatic and Marine Ecosystems and Organisms
    - Cultural Heritage Resource
- Datagroup, for example, the Subject-Area 'Geology' is sub-divided into:
    - Bedrock
    - Surficial Geology
    - Minerals
    - Oil/Gas
    - Coal
    - Water

The subject category used for an entity will be determined by the Corporate Data Modeller in conjunction with the nature of the source material (e.g., Terrain Resource Information Management Program (TRIM), RIC Inventory Standards, Cadastral Data Management System (CDMS)) and the type of business which the modeller is describing. Appendix B contains a complete listing of the LandData BC Classification Hierarchy.

Spatiotemporal Modelling–

Spatiotemporal modelling in the CDM involves the creation of LDMs which model data normally found in GIS databases.

Spatiotemporal Entities–

Spatiotemporal entities have a spatial or locational nature, as well as a temporal component or context. That is to say, they will have attributes that express their location and/or time, or will have spatial relationships with other entities. Part, or all, of the data for these entities will typically be stored and manipulated in a GIS. They are modelled in Oracle Designer/2000 in the same way as regular (i.e., attribute data) entities, with some adaptations for handling the slightly more complex nature of the meta-data involved.

Spatiotemporal Modelling Approach–

The GIS schemas housing spatiotemporal data are fairly complex, and it is of benefit to utilize existing standards and templates to ease the task modelling this kind of data. Such an approach is offered by SAIF[7]. It offers an Object Oriented (OO) approach to modelling spatial and temporal data, with a predefined set of classes (entities), relationships, and predefined attribute values (enumerations). The base standard for SAIF is too rich, however, to be usable for corporate data modelling. Instead, there exists a subset of SAIF, called SAIFLite, which is well suited to corporate data modelling. SAIFLite is a functional standard

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7 Complete documentation for this standard is found in Spatial Archive and Interchange Format: Formal Definition, Release 3.2, January 1995, Surveys and Resource Mapping Branch, B.C. Ministry of Environment, Lands and Parks [R-5].

implementation of the SAIF base standard. It provides strong guidelines as to just how SAIF may be employed[8]. It restricts SAIF classes and how those classes may be used for modelling.

As noted in an Information and Technology Access Office (ITAO) Task Force report,[9]

> "Current GIS tools are so closely tied to the data that it is difficult to model the physical representation of spatial data independent of the GIS tool. Logical business models can therefore not easily be broken down into physical models. Similarly, existing physical models can not be readily abstracted to their intended logical business model."

The primary focus in the CDM is on modelling geographic objects, which are principally features, at an LDM level and leaving out the detail of physical shape construction. SAIFLite provides the necessary and sufficient standards infrastructure for this approach.

It should be noted that spatiotemporal reference details that are at a more physical level than in the CDM exist in the LandData BC Product Catalogue at a product level.

Corporate Data Modelling Using SAIFLite–

The SAIFLite standard provides a basis for corporate data modelling of spatiotemporal data using ERDs. Shape information is modelled using a restricted set of geometric object classes, and time information is modelled using a restricted set of time object classes. By extracting feature (i.e., business) information from GIS databases, which is feasible, and leaving the physical aspects of GIS schemas outside the CDM, it is possible to develop LDMs for spatiotemporal data. Further information on how SAIFLite is used and an example of a spatiotemporal model is provided in the *Corporate Data Modelling Standards & Guidelines* document [R-1].

Business Modelling

Business models, which are **optional**, describe the functioning of various discipline areas. They contain process information at varying levels of abstraction, for example:

- Conceptual Process Model (CPM), showing only high level business functions;
- Logical Process Model (LPM), showing detailed processes, both manual and automated, and data flows; and
- Physical Process Model (PPM), showing, for example, the menu command structure of an application, process control flows, etc.

The terms CPM, LPM, and PPM are generic, and may be named and treated differently in different information engineering methodologies and CASE tools. The goal is to simply publish this information, if made available by Data Providers. Interpretation of the process models, sofar as references to data are made (e.g., in data flow diagrams), is based on the schemas supplied by the Data Providers, i.e., no attempt to "reverse engineer" to a CDM will be made. However, since much of the CDM is in logical form, a Logical Process Modelling

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[8] Adapted from *Introduction, SAIFLite,* Release 1.1, March 1996 [R-11]

[9] ITAO, *Review of Spatial Data Management Capability in the Government of British Columbia* , January 8, 1996, page 15 [R-12].

approach to business modelling would be useful in providing a complete picture of how the discipline area modelled functions and uses data.

Supporting Documentation Details

Contributors–

Source information for the CDM models will come from documents and models, as well as discipline and data experts. To be able to justify modelling decisions and to make changes later, these sources must be cross referenced within the model, so they can be referred to. The contributors component tracks the people (or possibly institutions) who have provided input to the CDM. The approach taken is to attach contributors to source elements, either models or components of models, and to provide component traceability from the CDM through intermediate models to the source models.

Issues–

As the CDM is developed, a number of issues will arise that concern certain components and their instances. These issues provide significant information for further modelling efforts and for database builders. Examples include the controversy about the naming of an entity, or identification of a pair of entities which, upon further investigation with contributors, may be integrated into one.

Business Terms–

Users will want to find out whether entities they are familiar with are included in the CDM. The data is available in a form easily accessible by Business End Users.

Documents–

Any input documents (e.g., the RIC standards) should be listed and cross referenced.

A cross-reference that classifies and groups the CDM Entities should be provided, e.g., by Subject-Area.

Traceability

The supporting documentation describes the transformations which take place in terms of input components, output components, and changes made to the input to derive the output. This provides a measure of traceability. In addition, CDM data model components are linked via associations at the entity level, both intra-CDM (between the various types of models), and between the CDM and the Product Catalogue. See*Repository Architecture* for further information on the implementation of these associations. Traceability for attribute transformations are stored in a spreadsheet which is linked to the ERDs through entity names.

2.3 Repository Architecture

Figure 2.5 shows the architectural components of the LandData BC Repository. The two major components are:

- the Oracle Designer/2000 Repository, which contains a number of Application Systems that are grouped into
  - LDBC, which contains the schemas and external schemas supplied by the Data Providers, and the Repository Data Model (RDM) which describes the structure of the LDBC Catalogue; and
  - various CDM applications which contain the federated and sub-federated schemas;

- the LDBC Catalogue, which is the implementation of the Repository Data Model in an Oracle database. It contains product tables, and information related to data products (also referred to as 'product meta-data').

The expression "Application System" is an Oracle Designer/2000 specific term. They are used for grouping repository information, mainly for administrative purposes. From an ERD perspective, each Application System contains multiple ERDs grouped together. For example, each Data Provider physical schema is stored as an Application System. In the CDM, important subject categories are treated as Application Systems as shown in Figure 2.5.

2.3.1 Repository Access

An user can obtain product information by browsing the PRODUCT_TYPE table, which can be used to obtain PRODUCT information. PRODUCT_TYPE can also be used, via the DATA_SCHEMA table, to access schemas, either LDBC data provider ones or CDM ones. The output can be either dynamically generated, or obtained from pre-processed reports and figures in the SCHEMA_VIEW table.

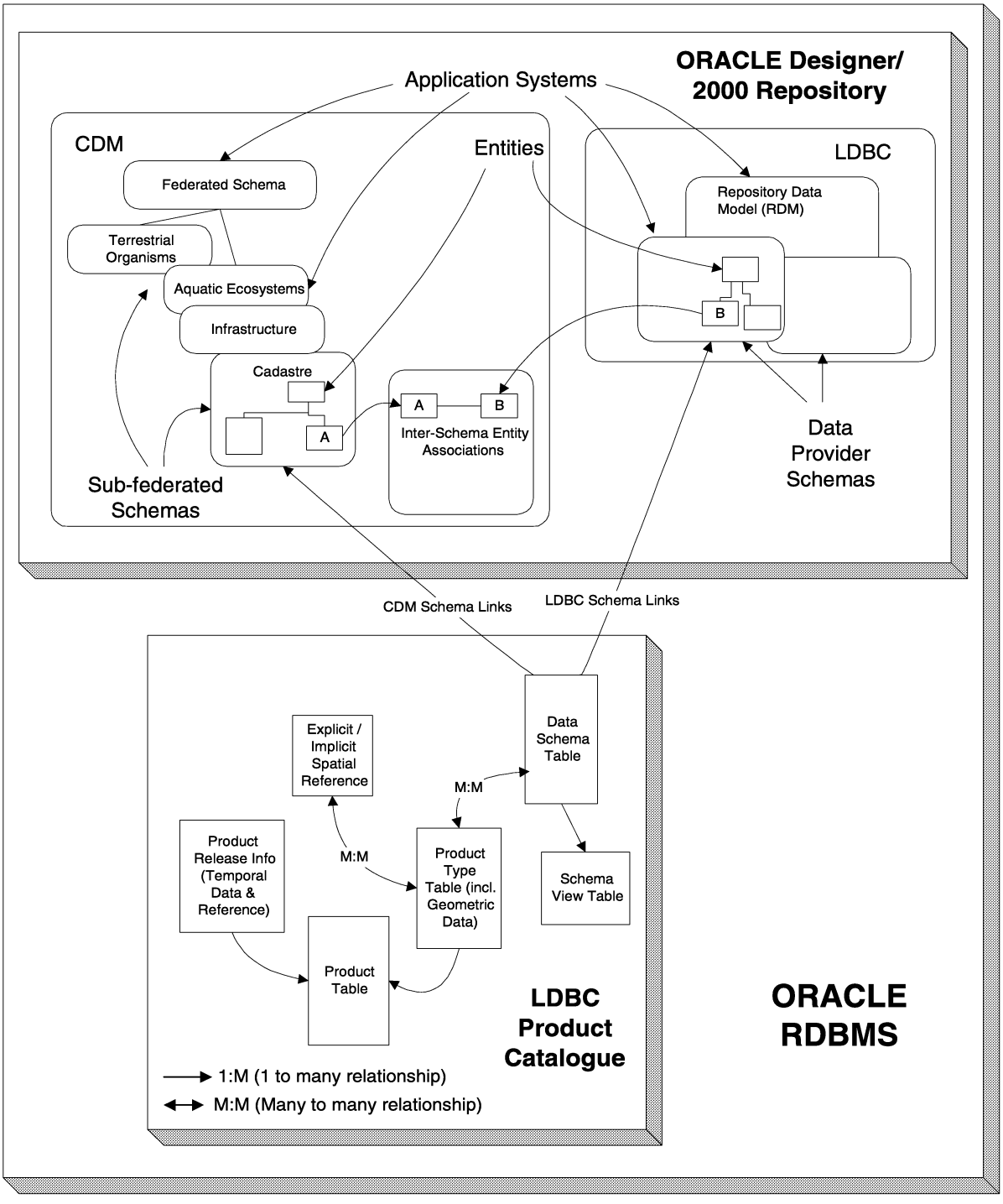

Figure 2.5 LDBC Repository Architecture

If a user navigates the CDM and wishes to obtain real world data, a link to an LDBC data provider schema is used for accessing LDBC product information. This is done via the INTER-SCHEMA ENTITY ASSOCIATION application in Designer/2000, where all entity links are maintained. Navigation in the other direction, i.e., LDBC to CDM, is also possible. If navigation at the attribute level is required, this is achieved by linking on a name basis where names are the same, or synonyms where they are not. That is, if an LDBC attribute name differs from the corresponding CDM attribute name, then the CDM attribute name is stored as a synonym in the LDBC repository, and can be used for navigational purposes.[10]

2.3.2 CDM Information Architecture

The structure of land-related attribute data is complex and often context dependent. There are semantic inconsistencies which can make it difficult to federate. This involves domain inconsistencies, naming inconsistencies (e.g., objects with the same names are semantically similar but not the same), and structural inconsistencies. For example, in one context, a 'Road' is an entity, in another, it is an attribute, or features that are subtyped in one context are simple entities in another (especially true for cadastral features).

It would be possible, through extensive use of subtyping, to build a federated CDM. However, the result would be so complex that end users, or for that matter, even information professionals, would have difficulty navigating it.

The following approach is used for the CDM:

The purpose of the federated schema is to function as a road map or an index to more context specific schema information. As such, it need not be a full federation of all sub-federated schemas. A user can navigate the less complex federated schema more easily, and then drill down into sub-federations for more detail.

Sub-federated schemas, on the other hand, are fully attributed LDMs. Each such schema supports a context, which at this time is based on subject categories, i.e., 'Supersubject-Area', 'Subject-Area' or 'Datagroup'. From a corporate data modelling perspective, each sub-federated schema is self contained, which simplifies modelling. However, there will be a certain amount of overlap between the various schemas, so care has to be taken to ensure redundancies are properly managed.

The federated schema contains all of the entities found in sub-federations, with the exception of context specific entity subtypes, which may be excluded. It is only partially attributed, i.e., it is a view of all the sub-federated schemas, with some common attribution. It is in fact closer to being a Conceptual Data Model than an LDM. The level of subtyping and attribution shall be at the discretion of Corporate Data Modellers, given that the purpose of the federated schema is to function as a road map.

Links between the federated and sub-federated schemas are at the entity level. Linkages are established implicitly using common entity names. That is, a 'Tree' is a 'Tree' wherever it may be, but its attributes, relationships with other entities and subtypes may be different depending on the context (the sub-federated schema in which it is stored). It is possible to implement this approach in Designer/2000 if each context is stored as an application and entity names are shared with the federated model.

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[10] These navigational features are planned for implementation in future phases of LandData BC.

2.4 Application Architecture

The CDM application architecture is based on the document entitled *LandData BC System Architecture* [R-8]. This describes the conceptual, hardware, software and dynamic architectures of the LandData BC System. In addition to architectural information, the document also provides information on tools and utilities, and how they are utilized by the user community. The following are some additional points. Detailed functionality is covered in LandData BC User Documentation.

2.4.1 End User Access

The section on *Repository Acces*, provides a simplified view of information access for end users and information professionals. There are drill-down facilities so users can trace through various model levels and details. Diagrammatic information and supporting documentation is published using Hypertext Markup Language (HTML) facilities on the Internet web. HTML information is fully navigable. Web metadata publishing details are available in Metadata Access Server documentation. The current implementation is that all metadata is prepublished and available as HTML.

2.4.2 Data Definition Reporting

Information professionals need to have full meta-data reporting, which is provided through Repository Reporting facilities. All reports as well as LDM schemas are available as products[11]. See Figure 2.1 for a functional overview of the RMT. All schema definition management and reporting is done using the Corporate Data Model Management Tool. Reports are available directly from the Corporate Data Model Management Tool or as pre-published HTML reports on LandData BC via Internet[12]. A variety of reports are available from both Designer/2000 and ERwin, covering all aspects of the ERDs in these CASE tools. Both textual and pictorial (i.e., ERD) reports are available.

2.4.3 Corporate Data Modelling Support

Corporate Data Modellers utilize the Corporate Data Model Management Tool for developing and maintaining the CDM. This tool contains all the required CASE tools (e.g., Oracle Designer/2000, ERwin, and any utilities and interfaces between them), as well as all reporting functions. Additional functionality specific to corporate data modelling is the ability to do global repository queries and be able to generate reports on differences between schemas (to assist with model integration). Access to Oracle Designer/2000 is via an Oracle client front-end. ERwin can be run directly on a modeller's PC. Data is moved from ERwin to Oracle via an Application Programming Interface (API) which is provided by LogicWorks (ERwin vendor). The operation of the interface is via a windows interface in Oracle Designer/2000. The *Corporate Data Modelling Standards & Guidelines* [R-1] document provides further details on the data flows involved. For further information on the CASE tools involved, see *CASE Tools*.

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[11] Planned for Phase III C of LandData BC.

[12] Future phases of LandData BC may implement dynamic repository queries and generation of schema products.

3. Corporate Data Modelling Tools

3.1 CASE Tools

3.1.1 Oracle Designer/2000

The container, and tool, for the ER Model is Oracle Designer/2000 CASE tool. Each sub-federated model is stored as a separate application in Designer/2000. Note that this tool as well as ERwin below were selected in a trade-off study.[13]

3.1.2 Logic Works ERwin

The ERwin CASE tool is used as a supporting tool. Its primary function, from a CDM perspective, is to reverse engineer locally developed schemata into logical data models. A bridge to Oracle Designer/2000 will be used to move the models into Designer/2000. In addition, it will serve as a local ministry data modelling tool where it is more cost effective than using Oracle Designer/2000.

3.2 LandData BC Tools

The primary tool for Corporate Data Modellers is the Corporate Data Model Management Tool, which is part of the Repository Management Tool Suite. This tool provides access to Designer/2000 and ERwin (the latter is part of the Schema Capture Tool, which is accessed from the Corporate Data Model Management Tool). For further details, refer to Figure 2.1, which diagrams the software architecture for these tools.

3.3 Documentation Tools

3.3.1 MS Word

Microsoft Word is used for capturing supporting documentation, such as diagrams, issues, glossaries, quality information, etc.

3.3.2 MS Excel Spreadsheet

Where it is effective to utilize a spreadsheet for cross-referencing information, MS Excel is to be used.

3.3.3 Visio Drawing Tool

Where it is effective to utilize a drawing tool, that is, for diagrams which cannot be drawn using the CASE tools, the tool used is Visio.

Both MS Excel spreadsheets and Visio drawings can be embedded in MS Word documents.

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[13] *LandData BC Data Modelling Tools Evaluation Report,* MacDonald Dettwiler, October 20, 1995 [R-13].

3.4 Communication Tools

In order to facilitate the exchange of models, a cost effective method of communicating them has to be used. Three tools available are:

3.4.1 File Transfer Protocol (ftp)

The approach for using this tool is to transmit documents to and from a common Land Information Infrastructure (LII) ftp site, which is currently located in Victoria. This is currently the preferred approach for transmitting softcopy and works well in any kind of network environment.

3.4.2 Electronic Mail (E-mail)

There are several E-mail tools available which permit attachments of softcopy files. During transmission, these are encoded using one of several standards, e.g., MIME or UNIX uuencode. This approach works if the receiving E-mail tool is capable of recognizing and decoding the message. Tools capable of doing this are MS Mail and Eudora. In the long term, E-mail is the preferred approach, because it permits point-to-point transmission of data. However, it has to be used with caution because of potential encode/decode problems. E-mail works best in a Local Area Network (LAN) environment.

3.4.3 Internet

E-mail can be sent via Internet, which is a very cost effective method of transferring softcopy. It requires, however, that both sender and receiver have Internet access, and is subject to potential encode/decode problems or loss of transmission. E-mail on the Internet works well in a Wide Area Network (WAN) environment, which is the environment in BC.

4. CDM Operation

4.1 When is the CDM to be Used?

The primary function of the CDM is to enable the creation of an environment in which data from differing subject areas can be integrated, and therefore shared. The CDM should be applied in any situation that involves corporate data which is meant to be shared.

4.2 Roles & Responsibilities

Figure 4.1 provides a visual relationship defining the CDM context and its key groups or individuals responsible for operation of the CDM[14]. Descriptions of the roles played by each group or individual listed below, and how they relate to the CDM and the CDMF, follow.

- LandData BC Data Administrator
- LandData BC
- Data Custodians
- Data Managers
- Data Administrators
- Corporate Data Modellers
- Database Developers

[14] Information for this list was in part obtained from *DATA RESPONSIBILITIES Policy and Standards*, Systems Services Branch, June 1993, published on internet as Data Administration Practice #3 [R-14].

LandData BC Data Administrator Access to the CDM

The LandData BC DA will have access to the CDM within the LandData BC Repository. To gain access, the LDBC DA uses the LandData BC Repository Management Tool Suite. The LDBC DA can provide CDM updates, as well as approve updates made by others.

4.2.2 LandData BC

LandData BC is the Steward of the repository which contains the CDM. However, the contents of the CDM are not necessarily provided by LandData BC, but rather by Data Modellers working for the various ministries or programs. Nonetheless, given the mandate of providing a shared view of data, LandData BC fosters the use of the CDM along with the CDMF during database development, to meet this goal.

4.2.3 Data Custodians

The Data Custodian is responsible for the organizational and business issues related to the collection, storage, and delivery of data. The Custodian fulfils the legislated responsibility or program mandate of ensuring quality, completeness, and integrity of data through the management of its creation and maintenance.

Data Custodians' Access to the CDM

A Data Custodian may want to access the CDM to obtain information relating to the definition and/or storage of data. This will be permitted through LandData BC web pages. Any summary reports that may be required can be prepared by a Data Modeller using Oracle Designer/2000, and be made available over the web.

4.2.4 Data Managers

The Data Manager is responsible for the capture, storage and delivery of the data, and for the delivery of the services defined by the organizational needs on an operational level. The level of responsibility is primarily at the physical level of data abstraction. The Data Manager is responsible for ensuring the integrity of the data, and therefore has a stake in the CDM. The Data Manager acts as a liaison between the Database Developers (who are a resource to the Data Manager) and the Corporate Data Modellers.

Data Managers' Access to the CDM

Data Managers will have access to the CDM through the LandData BC web interface. A Data Manager will have contact with both Corporate Data Modellers and Database Developers.

4.2.5 Data Administrators

DAs are responsible for providing a framework for defining and interpreting data and its structure, and assisting in the establishment of the scope of data responsibilities. They are responsible for storing and supplying, via a repository, information about the data, including data models and definitions.

Data Administrators' Access to the CDM

Data Administrators will have access to the CDM through the LandData BC web interface. They may query, but not update, CDM repository information (unless a DA also plays the role of a Corporate Data Modeller).

4.2.6 Corporate Data Modellers

The Corporate Data Modeller is responsible for populating the CDM in conformance with the CDMF. In general, corporate data modelling is carried out by Data Modellers who work for the Custodians of their various ministries or programs.

The CDMF directs Corporate Data Modellers to work in within the framework established by the CDMF and in accordance with the standards and guidelines in the *Corporate Data Modelling Standards & Guidelines* document [R-1]. The *Corporate Data Modelling Standards & Guidelines* document is an extension of the CDMF and has been created with Corporate Data Modellers as key users.

Existing databases and data models are expected to reflect CDMF standards to some degree, although many of them can be considered under "legacy" status, and have been developed prior to the existence of the standards. In these cases, some aspects of the CDMF standards may have been incorporated (since, in fact, they may have been used as input in defining the these standards) but many components may be missing, or components which are not necessary may be present.

In any case, the CDMF standards are the primary input considered by Corporate Data Modellers. This should be reflected in the modeller's assessment of any existing databases and data models.

Corporate Data Modellers' Access to the CDM

The Corporate Data Modeller will have access to the CDM within the LandData BC Repository. To gain access, the modeller uses the LandData BC Repository Management Tool Suite. The Data Modeller can provide CDM updates, however all federated model updates have to be approved by the LandData BC DA.

4.2.7 Database Developers

The Database Developer will be a contributor to the CDM, as well as a recipient of the work done by the Corporate Data Modeller.

As a contributor, the Database Developer is responsible for providing source models to the Corporate Data Modeller in the generic model structure described in *Generic Model Structure*. These models should also be syntactically and semantically conformant to the CDM, in order to facilitate CDM source model capture.

As a recipient, the Database Developer is responsible for applying the CDM to either:

- newly created, or
- revised and updated existing databases.

The CDM, and therefore the databases developed following the CDM paradigm, will reflect the integrated standards defined by the Corporate Data Modellers. The Database Developer therefore has a range of models to choose from (e.g., Wildlife model, Vegetation model, Tourism model, etc.), all of which are fully integrated in the CDM. Each model has been developed to conform to its respective business standards (e.g., RIC Standards), and has been standardized by the Corporate Data Modellers to allow for integration between the models in the CDM.

Databases that conform to the CDM can then be more easily linked via LandData BC to provide integrated information sharing between the various land-related data sources.

Database Developers' Access to the CDM

Access to the CDM for Database Developers will be through the LandData BC repository via Oracle Designer/2000, for exporting models for the purpose of major database development. Access will also be permitted through LandData BC web pages. This will allow for general search and inspection capabilities. For smaller database development, schemas published on the web can be used (and modified to allow file or Relational Database Management System (RDBMS) table creation).

4.3 CDM Repository Access

Access to the CDM repository for updating or reporting is via the Schema and Corporate Data Model Management Tool in the Repository Management Tool Suite. The people mainly responsible for these tasks are Data Providers, Corporate Data Modellers, and the LDBC DA.

Appendix A

CDM Questions and Answers

Typical Questions about the CDM

How would the CDM be used?

An understanding of how the CDM will be accessed will allow Data Modellers to produce a product that is useful and understandable.

As a search mechanism

Because the CDM is partitioned and categorized (see CDM Structure) it can be used as a way of finding data structures for those concerned with a specific class of data.

As a descriptive mechanism

The CDM describes the joint understanding of the meaning and structure of corporate data. It can be used by those unfamiliar with corporate data to gain an understanding of it. In addition those who deal with the data can compare their understanding to the CDM structure.

As a point for building databases which hold the data

A Data Manager who must handle resource information will be able to use the CDM to structure databases in such a way that data stored in that structure can be moved and shared with other Data Managers who use the structure.

As a cross reference for RIC Standards

Initially the CDM can provide a cross reference to the data covered in the RIC Standards. It can be used to answer the questions “Does this external data model provide a structure to transfer data to and from databases built using the CDMF Structure?”.

Does the CDM contain the data itself?

The CDM contains metadata, that is, data which describes corporate data. It does not contain corporate data. Separate databases will be built by Data Managers based on the CDM to store and deliver corporate data.

Will all the data be structured in this way?

Corporate data designed to be shared will be structured using the CDM. Existing databases with similar structures should evolve to this structure as enhancements are made.

Are data structure and data format the same?

For the purposes of the CDM, the structure is considered to be the corporate data modelled, independent of its storage. The CDM level of data abstraction is both conceptual and logical, whereas that of data storage is physical. The format is dependent on storage, and is determined by the proprietary software used to implement the data structure. Examples of

format would be Oracle Tables, dBase files, SAIF Object Syntax Notation (OSN). The structure, on the other hand, including Entities such as Taxa, Cover etc., is modelled in the relational model and is implemented in Designer/2000 and ERwin.

How will the CDM be changed and improved?

The CDM is a medium for expressing provincial understanding of land-related data. If the CDM is properly displayed, and can be easily searched, then CDM users can build data structures from it, and identify necessary alterations. Where it is inadequate, or needs changing, changes should be submitted to the CDM administrator.

Who are the contributors to the model?

Data Managers and Data Administrators concerned with the sharing and structure of data in the discipline areas will be the primary contributors to the model. Discipline authorities are also major contributors. These Data Managers may have Data Modellers preparing models for them.

Must all corporate databases be structured this way?

No, but any data handler who expects to communicate and share their data should use the CDM structure.

What if I want to show the data differently?

The basic data, when structured properly, can be viewed and displayed in a variety of forms. Data Managers are encouraged to display the data in any forms necessary for business use and understanding.

How does this relate to the LandData BC Repository?

This CDM expresses the structure of the data and is therefore metadata. The CDM and Repository will be integrated in the future.

Where do the RIC Standards fit?

It will be possible to find an area in the CDM that encompasses any particular RIC Standard. Within the CDM, entities that match RIC Standards will be identified and cross-referenced. While it may not be possible to map the terminology exactly, data captured in the field forms for RIC standards will fit within databases that are built based on the CDM.

How do I model to meet Corporate Data Modeling Standards?

This document provides the standards for submitting input models to the CDM.

CDM Risks

There are some risks associated with the creation and use of the CDM. It is a large repository of information, and it must provide easy access to end users, otherwise there is a chance that it will not reach its full potential. CDM users must be able to locate any information they need quickly, and it must be easily understood. An access mechanism will be made available, that provides the required access functionality and serves the CDM audience on a Province wide basis.

Appendix B

Classification Hierarchy

LandData BC Data Classification Hierarchy

Category Id	Category Name	Category Definition	Change Notes
D1	LEGAL DATA AND JURISDICTIONAL BOUNDARY	Legal data and jurisdictional boundary consists of two components. Legal Data is data which represents ownership, the right to carry on an activity or the right to access/use specified areas. Jurisdictional Boundary is the conceptual data representing jurisdiction or responsibility for a specified area.	NB - some Cat. Def. changes may not be indicated in this column
D101	CADASTRE	Data relating to the official register of the quantity, value, ownership, right to use or access of a portion of land.	NB - Category Ids in this column refer to Ph II Ids.
D10101	FOREST TENURE	Data relating to the right to harvest timber.	
D10102	LAND TITLES	Data relating to the ownership of land and the parcels into which the land has been subdivided. Includes the location and extent of registered titles, easements and utility rights-of-way, and surveyed highways and forest roads.	
D10103	LICENSES/LEASES/CLAIMS/PERMITS	Data relating to the right to access or use land for a specified purpose.	
D10104	LAND STATUS	Data relating to identifying whether a parcel of land is encumbered and if so provides encumbrance data.	
D10105	LAND ACT SURVEYS	Data relating to the location and extent of Crown land primary and subdivision parcels.	
D10106	MINERAL AND PETROLEUM SURVEYS	Data relating to the location and extent of mineral claims, placer claims and well sites.	
D102	JURISDICTIONAL BOUNDARY	Data relating extent and description of predefined areas over which an administrative body has the charge or direction.	
D10201	DISTRICTS	Data relating to the extent of areas which have been defined as districts for management purposes by various jurisdictional bodies of the province.	
D10202	PROVINCIAL PARKS	Data relating to the extent of an area which has been designated as a provincial park.	
D10203	ISLAND TRUST	Data relating to the preservation and protection of the Gulf Islands.	
D10204	ARCHEOLOGICAL SITES	Data relating to location/extent of areas which are of in prehistoric and historic times.	
D10205	FLOODING RESERVE	Data relating to areas that are in reserve due to high flood probability and therefore have restricted use.	
D10206	FEDERAL LANDS	Data relating to land which has been designated as being owned or under jurisdiction of the Federal Government.	
D10207	PROVINCIAL BORDERS	Data relating to the extent of the Province of British Columbia.	
D10208	AGRICULTURAL LAND RESERVES	Data relating to land which is to be used only for agriculatural purposes or compatible purposes.	
D10209	MUNICIPAL BOUNDARIES	Data relating to the extent of areas which have been defined as a Municipality.	

Category Id	Category Name	Category Definition	Change Notes
D10210	HERITAGE SITES	Data relating to the location/extent and description of areas which are designated as being of historical interest and value.	
D10211	INDIAN RESERVES	Data relating to the extent of areas which have been designated as Indian Reservations.	
D10212	FOREST ADMINISTRATION BOUNDARIES (JURISDICTION)	Data relating to the extent of areas designated as management units for the purposes of forest resource management.	
D10213	CROWN LANDS	Data relating to the extent of areas comprising the administration boundaries, cadastre as well as the land tenure boundaries with regard to various dispositions or B.C. Crown Lands.	
D10214	RESERVES	Data relating to local areas of land set aside for a particular land use or subject to the control of a regulating agency.	
D10215	INTEGRATED SURVEY AREA BOUNDARIES (JURISDICTION)	Data relating to the extent of designated urban areas containing network of control monuments to which all cadastral surveys must be tied.	
D103	REGULATIONS	Data relating to regulations governing the use of land.	New
D2	SOCIO-ECONOMIC	Data that is related to people, economic activities, health, status and land use within a designated area.	
D201	TAXATION	Data relating to the compulsory payment of monies by individuals or companies related to income or property use.	
D20101	ASSESSMENT	Data relating to the value placed against an individual or against a parcel of land for the purpose of defining the tax required to be paid.	
D20102	INCOME TAX	Data relating to the levying of tax based upon personal or corporate income.	
D20103	LAND TAX	Data relating to the levying of tax for land use either commercial, industrial or residential	
D20104	LAND VALUE	Data relating to the value placed against a land site for determining rental or sale price.	
D202	ACTIVITY (LAND USE)	Data relating to how the land is currently being utilized and exploited.	Name changed
D20201	RESIDENTIAL	Data relating to land which is used for residential purpose.	
D20202	COMMERCIAL	Data relating to land which is used for commercial purposes. e.g.: agriculture, forestry, tourism and mineral production.	
D20203	INDUSTRIAL	Data relating to land which is used for industrial purposes.	
D20204	RECREATION	Data relating to land used for recreational purposes.	
D203	DEMOGRAPHY	Data relating to the study of population and vital statistics.	
D20301	POPULATION	Data relating to the statistical analysis of human populations.	
D20302	VITAL STATISTICS	Data relating to statistical information for human populations such as number of births, deaths, marriages, diseases, etc.	
D204	DECLARED INTEREST	Data relating to an interest in using land for a certain activity.	New

Category Id	Category Name	Category Definition	Change Notes
D3	GEOREFERENCING	Data which aids in the locating of natural and man-made features, objects and phenomena on, under and above the earth's surface.	
D301	POSITIONING	Data relating to the accurate and precise location of reference points on the earth's surface.	
D30101	GEODETIC CONTROL	Data relating to the geodetic reference used for positioning within the province. The term geodetic meaning: concerned with the precise location of points and figures on the earth's surface.	
D30102	AERIAL TRIANGULATION	Data relating to photogrammetric control.	
D30103	AERIAL PHOTOGRAPHY	Data relating to air photo operations including aerial photography indices and film information.	
D302	REFERENCING	Data which provides reference frameworks for locating and displaying natural and man-made features on, in, and above the earth's surface.	
D30201	GRATICULES	Data relating to the theoretical grids which cover the earth's surface and are used as a reference for locating natural and man-made features and are used for dividing the earth's surface into mapping planes and map sheets. E.G.: Universal Transverse Mercator Grid; Latitude/Longitude Grid.	
D30202	MAP SYSTEM GRIDS	Data relating to the theoretical grids accepted as boundaries for standard map sheets and used for indexing of map sheets. E.G.: British Geographic System; National Topographic Series.	
D30203	METADATA	Data relating to the currency, accuracy, extent and collection methodology of georeferenced data.	
D30204	TOPONYMIC	Data relating to the official names associated with the spatial configuration of the Province.	
D4	ENVIRONMENTAL INVENTORY	Data about the physical, atmospheric, hydrological and biological components of the environment and the methodology used to gather those data	Name changed
D401	TOPOGRAPHIC/BATHYMETRIC	Data relating to the configuration of the earth's surface including its elevation.	Name changed
D40101	RELIEF	Data showing the configuration of the earth's surface, including the relative height (above a reference surface, usually sea level), of surface features e.g.: contour; DEM; T/N.	
D40102	TOPOGRAPHIC FEATURES	Data relating to unique characteristics of the landscape, e.g.: island.	
D402	SOIL	Data relating to the naturally occurring, unconsolidated mineral or organic material at least 10 cm thick that occurs at the earth's surface and is capable of supporting plant growth.	
D40201	SOIL SERIES	A conceptual classification of soils based on detailed features of the pedon.	
D40202	SOIL ASSOCIATION OR CATINAS	Data relating to the group of soils that are grouped together on the same apparent material to form a land pattern.	

Category Id	Category Name	Category Definition	Change Notes
D404	GEOLOGY	Data relating to the structure and composition of the earth, its physical and organic history, especially as evidenced by rocks and rock information.	
D40401	BEDROCK	Data relating to the solid rock underlying unconsolidated surface materials, such as soil.	
D40402	SURFICIAL GEOLOGY	Data relating to the non-lithified, unconsolidated sediments occurring on the earth's surface, including landforms and related geological processes.	
D40403	MINERALS	Data relating to the location, origin, structure, characteristics, properties and classification of minerals.	
D40404	OIL/GAS	Data relating specifically to petroleum or natural gas.	
D40405	COAL	Data relating specifically to coal.	
D405	WATER	Data relating to the inventory of surface and sub-surface water body's quantity and its associated physical/chemical properties.	
D40501	GROUND WATER	Data relating to water located beneath the earth's surface.	
D40502	SURFACE WATER	Data relating to water located on the earth's surface.	
D407	ATMOSPHERE	Data relating to general atmospheric conditions with regards to temperature, moisture, winds or other meteorological phenomena.	Name changed
D40701	METEOROLOGICAL	Data relating to forecasting and explaining surface weather.	
D40702	CLIMATE	Data relating to patterns of wind, temperature, precipitation, etc., over a period of time, for a specified area.	
D409	ECOREGION	Data relating to major physiographic, minor micro climatic or oceanographic differences within each ecoprovince. Ecoregions can be used to group Biogeoclimatic or marine zones for the determination of historical and potential distribution of vegetation and wildlife. As such they are useful in provincial level planning. There are 43 ecoregions in B.C.	D40803 + changed
D40901	BIOGEOCLIMATIC	Data relating to the classification of vegetation, e.g.: alpine; grassland; or wildife	Moved from D40802
D410	TERRESTRIAL ECOSYSTEMS	Relatively homogeneous systems of biotic and abiotic components on the land base, including wetlands and riperian systems. Resulting from interaction of terrestrial organisms and their environment over time (Forest Inventory Manual, Glossary of Terms 1988).	New
D41001	FOREST COVER	Data relating to forest inventory.	Moved from D40801
D41002	WILDLIFE HABITAT	Data describing, qualifying or quantifying the region or environment where animals or birds are normally found.	Moved from D40301
D411	TERRESTRIAL ORGANISMS	Data relating to a taxon which lives a critical part of its life in, on, or under land and relies on terrestrial ecosystems or constituents of that system, for its survival.	New
D41101	WILDLIFE POPULATION	Data relating to the number of wild animals or birds living in a given region.	New based on D40302

Category Id	Category Name	Category Definition	Change Notes
D412	AQUATIC ECOSYSTEMS	Any freshwater system that includes living organisms, non-living material and the functional processes that occur between them.	New based on D406
D41201	FRESHWATER FISH HABITAT	Data describing, quantifying or qualifying the region or environment where freshwater fish are normally found.	New based on D40601
D413	AQUATIC ORGANISMS	Data relating to a taxon which lives a critical part of its life cycle in, on, or under freshwater and relies on water or constituents of water and other organisms in the water, for its survival.	New based on D406
D41301	FRESHWATER FISH POPULATION	Data relating to the number of freshwater fish living in a given region.	New based on D40602
D414	MARINE ECOSYSTEMS	Any marine system that includes living organisms, non-living material and the functional processes that occur between them.	New based on D406
D41401	MARINE FISH HABITAT	Data describing, quantifying or qualifying the region or environment where marine fish are normally found.	New based on D40601
D41402	MARINE MAMMAL HABITAT	Data describing, quantifying or qualifying the region or environment where marine mammals are normally found.	New
D415	MARINE ORGANISMS	Data relating to a taxon which lives a critical part of its life cycle in, on, or under saltwater and relies on water or constituents of water and other organisms in the water, for its survival.	New based on D406
D41501	MARINE FISH POPULATION	Data relating to the number of marine fish living in a given region.	New based on D40602
D41502	MARINE MAMMAL POPULATION	Data relating to the number of marine mammals living in a given region.	New
D416	CULTURAL HERITAGE RESOURCE	Data relating to both human-made and natural physical features associated with past and present human activities including: archeological sites, structural features, traditional use sites and cultural landscapes.	New
D5	INFRASTRUCTURE	Data about human-made physical structures, which support economic and social activities. e.g.: utilities; communication; transportation; buildings.	
D501	ARCHITECTURAL STRUCTURE	Data relating to buildings and other structures used for the purpose of habitation, commercial activities, industrial activities, etc.	
D50101	COMMERCIAL STRUCTURE	Data relating to land which is used for commercial purposes.	
D50102	RESIDENTIAL STRUCTURE	Data relating to buildings used for residential dwellings.	
D50103	INDUSTRIAL STRUCTURE	Data relating to buildings which are used for industrial purposes. e.g.: saw mills; smelters.	
D50104	PUBLIC STRUCTURE	Data relating to buildings used to serve the public interest. e.g.: fire observation towers; weather stations, city halls.	
D502	TRANSPORTATION UTILITIES	Data relating to networks used for the purpose of transportation.	
D50201	ROAD (TRANSPORTATION UTILITIES)	Data relating to road networks.	

Category Id	Category Name	Category Definition	Change Notes
D50202	RAIL (TRANSPORTATION UTILITIES)	Data relating to railroad networks.	
D50203	AIR (TRANSPORTATION UTILITIES)	Data relating to air networks and supporting infrastructure used for air transportation.	
D50204	WATER (TRANSPORTATION UTILITIES)	Data relating to networks used for transportation on water.	
D503	COMMUNICATION UTILITIES	Data relating to networks used for communication.	
D50301	MICROWAVE (COMMUNICATION UTILITIES)	Data relating to communication utilities where microwave is the mode of transmission.	
D50302	SATELLITE (COMMUNICATION UTILITIES)	Data relating to communication networks where transmission is via satellite.	
D50303	CABLES/LINES (COMMUNICATION UTILITIES)	Data relating to communication networks where the transmission lines are above, below or submerged beneath the surface of the earth.	
D504	ENERGY UTILITIES	Data relating to networks and facilities which are used for the purpose of generating or transmitting energy. Energy can be of nuclear, hydroelectric, and electric energy from other sources plus gas and oil.	
D50401	TRANSMISSION (ENERGY UTILITIES)	Data relating to the transmission of energy. e.g.: electricity, oil and natural gas.	
D50402	GENERATION (ENERGY UTILITIES)	Data relating to facilities which generate electrical energy. e.g.: nuclear power plant, hydro electric dam.	
D505	WATER WORKS UTILITIES	Data relating to networks for the purpose of collecting, storing, and distributing water.	
D50501	PIPELINES (WATER WORKS UTILITIES)	Data relating to pipeline networks used for the distribution of water.	
D50502	RESERVOIRS (WATER WORKS UTILITIES)	Data relating to reservoirs used for the collection and storage of water.	
D50503	WATER CONTAINMENT STRUCTURE (WATER WORKS UTILITIES)	Data relating to structures which regulate the flow of water. Can be natural or man made, e.g.: dams/dikes.	
D506	SEWAGE UTILITIES	Data relating to the networks for the collection, treatment, and disbursement of waste matter from commercial, residential or industrial establishments.	
D50601	SEWERS	Data relating to the sewer networks.	
D50602	SEWAGE TREATMENT	Data relating to the treatment of waste matter from commercial, residential or industrial establishments.	
D6	ENVIRONMENTAL MANAGEMENT	Data relating to monitoring and managing the impact of humans on the natural environment. e.g.: water quality, soil quality and air quality.	
D601	TERRESTRIAL ECOSYSTEM MANAGEMENT	Data relating to the planning, monitoring, and managing needed to ensure the long term health and viability or terrestrial ecosystems and organisms associated with them.	Name changed
D60101	FOREST MONITORING	Data related to the recording of changes to forests over time.	

Category Id	Category Name	Category Definition	Change Notes
D60102	FOREST ENHANCEMENT	Data relating to improvement of forest growth.	
D60103	FOREST DISPOSITION	Data relating to controlled harvesting of timber.	
D60104	FOREST PLANNING	Data relating to future changes to forests. e.g.: planting, harvesting.	
D60105	FOREST RESEARCH	Data relating to the investigation of forest management techniques.	
D60106	WILDLIFE HABITAT ENHANCEMENT	Data relating to the improvement of wildlife habitat.	New based on D60701
D60107	WILDLIFE HABITAT PLANNING	Data relating to future changes to wildlife habitat.	New based on D60702
D60108	WILDLIFE HABITAT MONITORING	Data relating to the recording of changes to wildlife habitat over time.	New based on D60703
D60109	WILDLIFE HABITAT RESEARCH	Data relating to the investigation of wildlife habitat management techniques.	New based on D60704
D602	WATER MANAGEMENT	Data relating to the recording of changes in water quantity and quality over time.	
D60201	WATER PLANNING	Data relating to future requirements for water.	
D60202	WATER MONITORING	Data relating to the recording of changes in water quantity and quality over time.	
D60203	WATER ENHANCEMENT	Data relating to the improvement of water quality.	
D60204	WATER RESEARCH	Data relating to the investigation of water management techniques.	
D603	WASTE MANAGEMENT	Data relating to the management of waste.	
D60301	SOLID WASTE DISPOSAL	Data relating to the removal of solid waste.	
D60302	WASTE DISPERSAL	Data relating to the dissipation of solid waste.	
D604	AGRICULTURE MANAGEMENT	Data relating to monitoring and managing the impact of humans resulting from cultivation of the land.	
D60401	AGRICULTURE PLANNING	Data relating to future changes in agriculture.	
D60402	AGRICULTURE MONITORING	Data relating to the recording of changes to agriculture over time.	
D60403	AGRICULTURE ENHANCEMENT	Data relating to the improvement of agricultural growth.	
D60404	AGRICULTURE RESEARCH	Data relating to the investigation of agricultural management techniques.	
D605	SOILS MANAGEMENT	Data relating to changes in the soil over time.	
D60501	SOILS MONITORING	Data relating to the recording of changes to soils over time.	
D60502	SOILS PLANNING	Data relating to future changes to soils.	
D60503	SOILS RESEARCH	Data relating to the investigation of soil management techniques.	
D60504	SOILS REDISTRIBUTION	Data relating to the movement and placement of soils.	
D606	AIR MANAGEMENT	Data relating to the planning, monitoring, managing, and researching of air quality.	
D60601	AIR PLANNING	Data relating to the future changes to the air.	
D60602	AIR MONITORING	Data relating to the recording of changes to the air over time.	

Category Id	Category Name	Category Definition	Change Notes
D60603	AIR RESEARCH	Data relating to the investigation of air management techniques.	
D607	TERRESTRIAL ORGANISM MANAGEMENT	Data relating to the taking of actions calculated to result in the achievement of a predetermined goal related to the conservation of terrestrial organisms.	Name changed
D60701	WILDLIFE POPULATION ENHANCEMENT	Data relating to the improvement of wildlife populations.	Name & meaning changed
D60702	WILDLIFE POPULATION PLANNING	Data relating to future changes to wildlife populations.	Name & meaning changed
D60703	WILDLIFE POPULATION MONITORING	Data relating to the recording of changes to wildlife populations over time.	Name & meaning changed
D60704	WILDLIFE POPULATION RESEARCH	Data relating to the investigation of wildlife population management techniques.	Name & meaning changed
D608	FISHERIES MANAGEMENT	Data relating to the monitoring, regulating, managing and planning of commercial and recreational fishing for fish, crustaceans, and marine invertebrates.	Changed, also D60801 and D60804 have been deleted
D60802	FISHERIES PLANNING	Data relating to future changes to fisheries.	
D60803	FISHERIES MONITORING	Data relating to the monitoring of fishing activities and catches over time.	Def. changed
D60805	FISHERIES REGULATION	Data relating to the regulation and setting of quotas for recreational and commercial fishing.	New
D609	GEOLOGICAL RESOURCE MANAGEMENT	Data relating to the planning, management, and monitoring of the extraction and depletion of mineral, sand, gravel, coal and petroleum resources.	
D60901	MINING EXTRACTION	Data relating to the removal of sand, gravel, minerals and/or coal from beneath the earth's surface.	
D60902	MINING PLANNING	Data relating to the future changes for mining.	
D60903	MINING MONITORING	Data relating to the recording of changes as a result of mining over time.	
D60904	MINING RESEARCH	Data relating to the investigation of mining management techniques.	
D60905	MINERAL AND PETROLEUM SURVEYS	Data relating to the exploration for new mineral and petroleum sources.	
D60906	PETROLEUM AND NATURAL GAS EXTRACTION	Data relating to the extraction of petroleum and/or natural gas from beneath the earth's surface.	New
D610	RECREATION MANAGEMENT	Data relating to the planning, management, monitoring or protection of resources used for the voluntary pursuit of leisure activities or for mental or physical revitalization.	
D61001	RECREATION ENHANCEMENT	Data relating to creating or upgrading recreational areas.	
D61002	RECREATION PLANNING	Data relating to future changes for recreational areas.	
D61003	RECREATION MONITORING	Data relating to the changes in recreational areas.	
D61004	RECREATION RESEARCH	Data relating to the investigation of recreational area management techniques.	
D611	AQUACULTURE MANAGEMENT	Data relating to the harvesting and raising of aquatic plants and/or animals.	

Category Id	Category Name	Category Definition	Change Notes
D61101	AQUACULTURE PLANNING	Data relating to regulating the industry to ensure growth and development of resources. e.g.: fin fish and shell fish.	
D612	TOURISM MANAGEMENT	Data relating to the planning and management of tourism strategies and opportunities.	
D61201	TOURISM RESOURCES	Data relating to the natural resources and man-made events and attractions on which tourism is based.	
D61202	TOURISM MONITORING	Data relating to changes in tourism land-use and resources.	
D613	CULTURAL HERITAGE RESOURCE MANAGEMENT	Data relating to the planning, management, monitoring and preservation of cultural heritage resources.	New
D614	VISUAL RESOURCE MANAGEMENT	Data relating to the planning, management, monitoring or protection of scenic values.	New
D615	MARINE ECOSYSTEM MANAGEMENT	Activities that conserve the bio-diversity of marine organisms and maintain marine ecosystem functions and processes, including ecological services.	New
D616	MARINE ORGANISM MANAGEMENT	Data relating to the taking of actions calculated to result in the achievement of a pre-determined goal related to the conservation of marine organisms.	New
D617	AQUATIC ECOSYSTEM MANAGEMENT	Activities that conserve the bio-diversity of freshwater organisms and maintain freshwater ecosystem functions and processes, including ecological services.	New
D618	AQUATIC ORGANISM MANAGEMENT	Data relating to the taking of actions calculated to result in the achievement of a pre-determined goal related to the conservation of freshwater organisms.	New

References

R-1 BC-MA-50-7846 LandData BC Corporate Data Modelling Standards and Guidelines

R-2 Object Oriented Modelling & Design, James Rumbaugh et al, Prentice Hall, New Jersey, 1991

R-3 ORACLE *CASE*Method Entity Relationship Modelling* by Richard Barker, published by Addison Wesley, 1990

R-4 ERwin *Methods Guide,* Logic Works Inc., 1995

R-5 *Spatial Archive and Interchange Format: Formal Definition,* Release 3.2, January 1995, Surveys and Resource Mapping Branch, B.C. Ministry of Environment, Lands and Parks

R-6 *Land Information Management Framework* (LIMF), Volume 1, Section 1.3, Scope

R-7 LandData BC Phase IIIA, CDM Support Plan, RIC Common Data Model, Executive Summary

R-8 BC-MA-50-7367 LandData BC System Architecture, MacDonald Dettwiler, August 29, 1996

R-9 *Federated Database Systems for Managing Distributed, Heterogeneous, and Autonomous Databases,* Seth & Larson, ACM Computing Surveys, Vol. 22, No. 3, September 1990

R-10 *Consolidated Wildlife Inventory Data Model Project*, Habitat Inventory Section, Wildlife Branch, Ministry of Environment, Lands and Parks (MELP), September 1995

R-11 *Introduction, SAIFLite,* Release 1.1, March 1996, at Internet URL http://www.env.gov.bc.ca/gdbc/fmebc/comment4.htm

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R-13 BC-MA-50-7150 *LandData BC Data Modelling Tools Evaluation Report,* MacDonald Dettwiler, October 20, 1995

R-14 *DATA RESPONSIBILITIES Policy and Standards*, Systems Services Branch, June 1993, published on Internet as Data Administration Practice #3, at Internet URL http://ssbwww.env.gov.bc.ca/~datadmin/practices/dap3.html#toc

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