Implementation of a Personal Geodatabase for the District of Pitt Meadows

Final Project for Geography 452
Presented to:

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Table of Contents

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Darrin provided useful weekly guidance and technical support through out the entire project.

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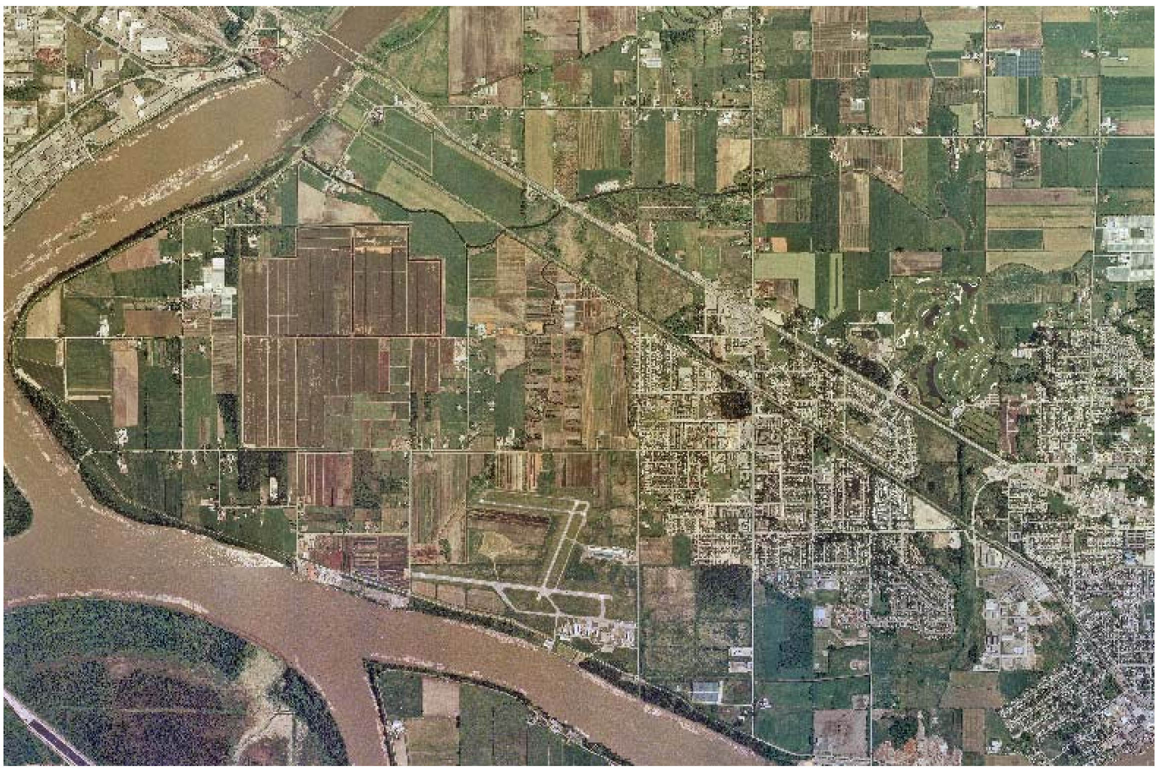
Jasper provided informative technical assistance during the entire project.

Linda MawWhinnie (GIS Technologist, District of Pitt Meadows)

Linda provided the project data, important information about project requirements, and also helped with technical support.

Introduction

Staff from the District of Pitt Meadows met with Staff of the Geography department at Simon Fraser University, to discuss the possibility of using data from Pitt Meadows for a student GIS project for Geography 452. It was agreed that a group of students would attempt to implement a GIS database solution for Pitt Meadows during the Spring 2003 semester. Five Geography students, collectively known as Operation:Data (OD), communicated with the staff of Pitt Meadows GIS and Engineering departments in an attempt to better understand the GIS data and the particular business requirements of the District. After numerous meetings and e-mails, a Data Model was developed and entered by individuals of OD into a personal Geodatabase for ArcGIS.



Orthophoto mosaic of Highway 7 entering the District of Pitt Meadows from the Northwest

Pitt Meadows is small municipality of approximately 14,700 people located in the northeast section of the GVRD. Traditionally, it has been an agricultural community. However, it is now facing urbanization pressures with some fairly significant commercial development occurring within its confines. The District's use of GIS throughout the past few years has been limited to using arc shapefiles and coverages, with little formal structure. The completion of this GIS implementation project will not only mark a significant improvement in the structure of Pitt Meadow's GIS data, but also increase its ability to use GIS as an analytical tool to better manage urban growth.

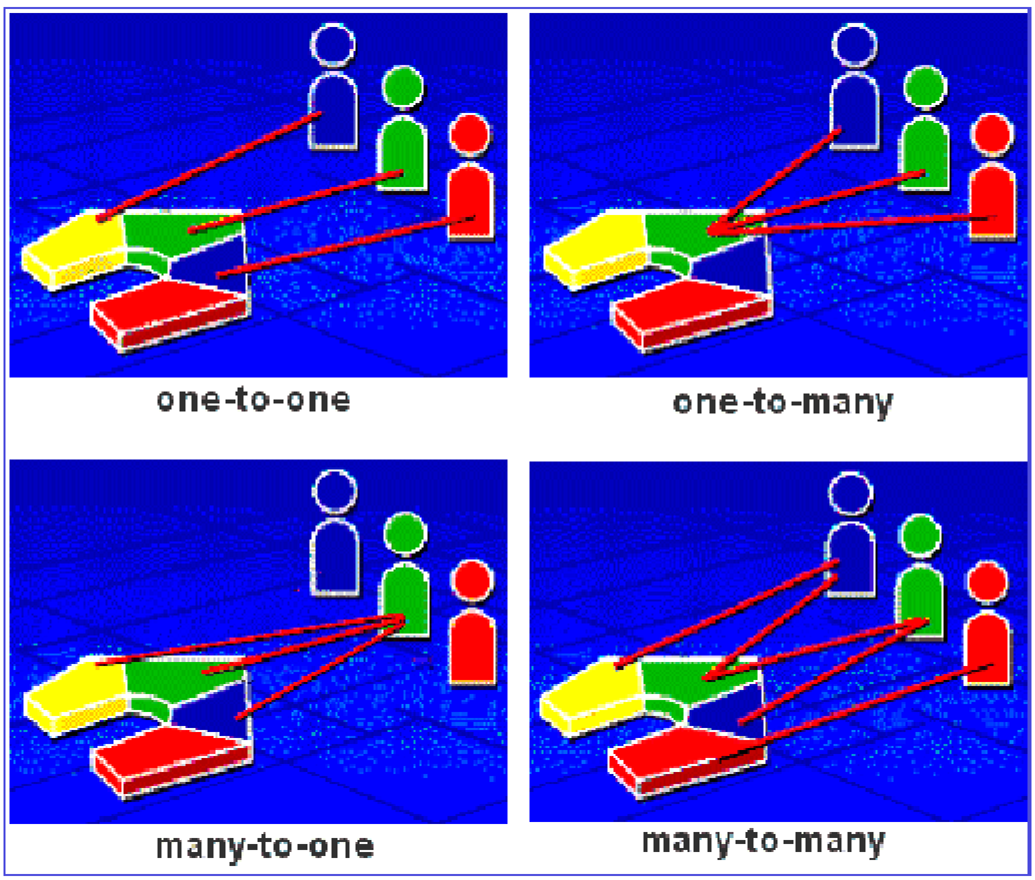
Objective

This project can be thought of as a good initial Geodatabase for the District of Pitt Meadows. This GIS Database Solution, as it is termed, will integrate and organize the spatial data in a manner that is both useful to the District and wary of its business requirements, standardizing the data set in the process. While it may not solve all of the data 'problems' for Pitt Meadows, it can be considered a reasonable start to a substantial, multi-phase project. Wherever possible, procedures and data standards were chosen to comply with the Integrated Cadastral Initiative.

Background and Preliminary Research

Geodatabases and Relationships

A Geodatabase is a relational database that contains both vector and raster tables along with other GIS data and the various 'relationships' between the data. Its hierarchical structure uses "primary" and "secondary" keys as a way of relating various feature classes and attribute tables. These relationships can be one-to-one, one-to-many, or many-to-many depending on how various variables are related.



Relationships in geodatabase structure.

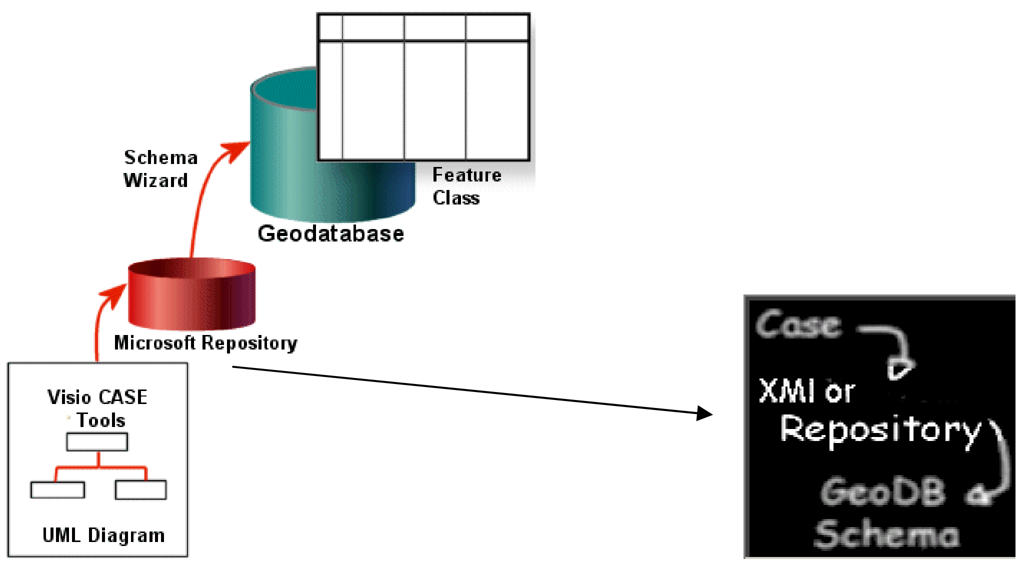
Essentially, the geodatabase allows one to define relationships between various geographical objects, and provides rules for maintaining these relationships.

Geodatabases and Data Modeling

Data Modeling is the process of defining GIS data in terms of its inherent relationships and characteristics. This requires definition of the general scope and business requirements of a database (Lo, C.P. and Yeung, K.W. 2002). This modeling approach is supported by ArcGIS during Geodatabase creation.

The data model is first entered as *Unified Modeling Language (UML)* into *Microsoft Visio* with all geographical object relationships being defined. Programs known as Computer Aided Software Engineering *(CASE) tools* (incorporated to ArcCatalog) help to generate a *geodatabase schema* from the UML model by developing *XMI (XML Metadata Interchange) files*. XMI or Microsoft Repository files are intermediate formats for CASE Tools in creating the geodatabase schema. XMI format creates personal geodatabases while Microsoft Repository creates personal or multiuser geodatabases.

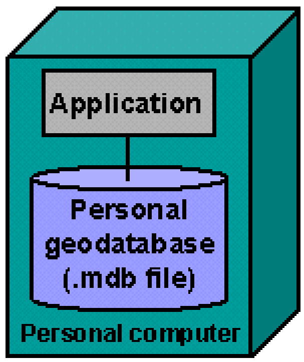
The XMI file format is preferred because it is faster and preferred to the Microsoft Repository. The XMI file is imported through the CASE Tools *schema wizard*, which creates empty feature class layers, attribute class tables, relationship class tables, and the associated relationships originally established in the UML data model. ArcCatalog now contains an empty geodatabase. Feature layers are keyed in as ESRI Feature Classes in Visio while attribute tables are keyed in as ESRI Object Classes. The relationships between layers, as well as the attribute column names and length are mapped. After exporting the UML model to XMI or Microsoft Repository database file, *semantic checks* are performed to finalize the geodatabase.



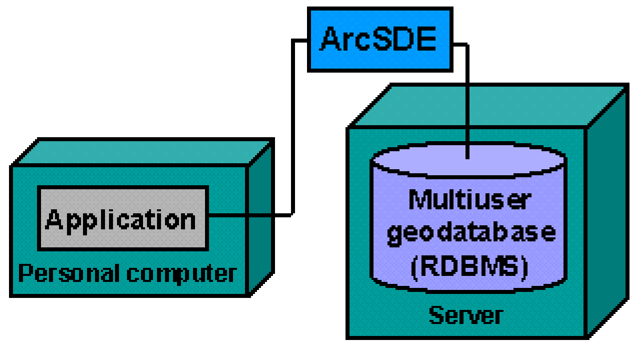
Creation of the UML diagram and its transfer into the Geodatabase.
Note the choice between using XMI or a Microsoft Repository.

Personal and Multiuser Geodatabases

A Geodatabase data model can be either personal or multiuser (enterprise). Personal Geodatabases are stored as Microsoft Access database files and allow many readers, but with a single editor. Multiuser Geodatabases, also known as ArcSDE Geodatabases, are used with relational database management systems (RDMS) such as Microsoft SQL Server or Oracle, which can be read and edited by many users (hence multiuser). The product provided to the District is a Personal Geodatabase, but can be readily converted to Multiuser Geodatabase by a series of simple steps.
Note: Since District of Pitt Meadows uses ArcGIS and Microsoft Sequel (SQL) Server, the selection of the database format is limited to that of an ArcGIS Geodatabase.



Personal Geodatabase



Multiuser Geodatabase

Data Standardization

One of the members of OD contacted a majority of GVRD municipalities to try to determine any existing municipal standards for data or data models. It was determined that essentially none exist, and that each municipality typically develops their own standards originating from historic data organization and drafting standards/naming conventions. For now, universal naming and structuring of municipal data is not a reality.

In the past few years, however, the *Integrated Cadastral Initiative* (ICI) was launched as an attempt to standardize data collection, attribute names, metadata, and geodatabase structure. The ICI is defined as 'a partnership among local governments, utility companies, and provincial agencies for establishing, maintaining, and distributing the ICI database'. The ICI database contains province-wide data for the integrated parcel fabric and related parcel links (i.e. utilities), and permits easier data sharing between participating groups. Until now, of Lower Mainland municipalities, only Pitt Meadows and Surrey have joined the ICI family.

Data standardization was a high priority for OD. In an attempt to standardize the data, OD followed the ICI naming attribute convention (data name, data type and data size), and more generally the "Integrated Cadastral Fabric (ICF) Standards and Specifications" standards, wherever possible. Metadata standards were based on the ArcCatalog FGDC/ESRI metadata structure, currently used by the Victoria Capital Regional District under the guidance of the Integrated Cadastral Initiative Society (ICIS).

Methodology

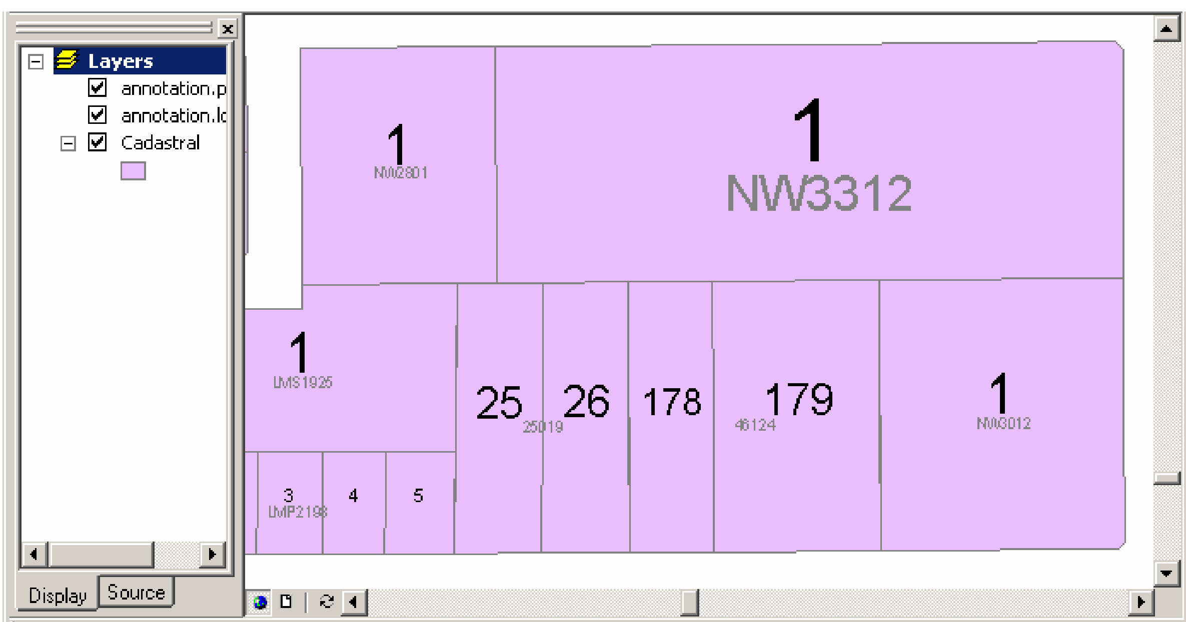
The fundamental backbone of this project is the design and populating of the Geodatabase, which involves several stages typical to designing databases with organization and management in mind. They are as follows:

Stage 1: Data Collection and Justification

Most of the spatial data for the Geodatabase originated from the District of Pitt Meadows, with some of it being provided by the B.C. Provincial Government. The data was given to OD in the following formats from the District: Arc/Info, PC Arc/Info coverages, AutoCAD, ArcGIS coverages, ArcView shapefiles, DBF and Excel spreadsheets. The majority of the data was originally stored as shapefiles, PC Arc/Info coverages or e00. Data originating from the Ministry of Agriculture, Fisheries and Food (i.e. soil and capability data) was compiled. While most of the data was contained in the District of Pitt Meadows, some attribute table fields corresponded to areas outside the District.

Discrepancies among identical GIS themes were carefully observed and corrected where possible (i.e. OCP_RURAL, OCP_URBAN, Utilities). Cadastre and crops data needed to be revised due to distortions caused by previous rubber-sheeting processes, causing mismatches to the original cadastral references. AutoCad files were not used because they contained feature elements not present in ArcGIS format, (such as North Arrows, GRID lines and latitude/longitude values) that would have required manual deletion. Due to time constraints, OD used AutoCad files strictly for reference purposes.

To facilitate ease in linking or relationships, roll number values in some feature and attribute layers were formatted using ArcView 3.2 according to the format in the cadastral feature layer. Also, zoning codes were added to cadastral feature layer. New data generated included the zoning definition attribute table and the parcel lot and plan number annotations through AML scripts. The AML scripts contributed by Darrin Grund were modified such that the annotation text sizes increased with increasing parcel area. Furthermore, since plan numbers are not unique, the AML script created plan numbers in common areas.



Cadastral lot & plan annotation

Stage 2: Conceptual Data Modeling

The Integrated Cadastral Fabric data model was deemed as a good reference for creating the Visio UML data model for Pitt Meadows. The general goal for data model construction followed by OD was to link all data to the *cadastre* layer, which was a similar format to the ICF data model. The following were the steps involved in creating the data model:

a) *Identifying feature and attribute layers*

Due to time constraints, not all data available could be incorporated into this initial phase, and priorities were made according to the District's business requirements.

With that guideline in mind, the following layers were listed as highest priorities:

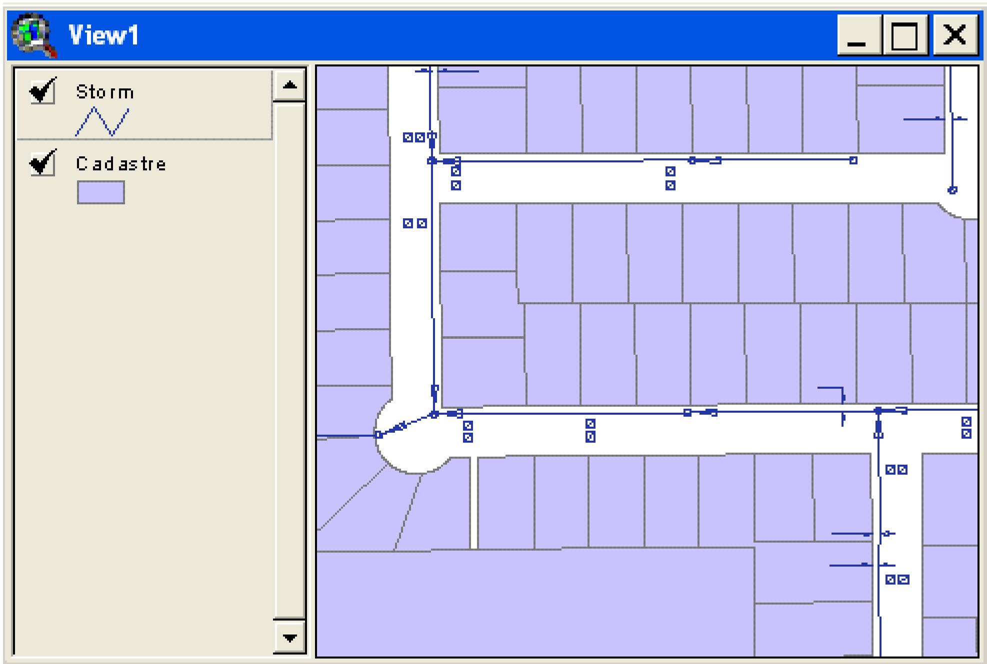
- Cadastre (including parcel annotations and related attribute tables)
- Utilities (water, sanitary, storm, water services, Pitt Meadows septic system)
- Land use and zoning
- Transportation (Roads)
- Agriculture (soils, crops, capability and related attribute tables)

b) *Identifying the attributes*

All attributes in the selected data layers were looked over before incorporation to the final geodatabase. A few fields were deemed meaningless, including the attributes that were generated automatically when converting source data to coverages or shapefiles, and included Arc/INFO IDs, Area and Hectares. More specifically, Area and Hectares (associated with shapefiles) were rejected because they are immediately outdated when the data is manipulated.

Once all valid attributes were identified, a list of the attribute columns and associated length were created for keying into Microsoft Visio. A 'primary key attribute', the common attribute column between linked layers, was selected in each layer. Since all feature layers are linked to the cadastre in the data model, the primary key attribute is confined to the attributes available in the cadastral feature layer, such as *Jurisdiction roll numbers* (JUROL or PCLLINKSID), *zoning code* and *addresses*. The address field was used to link roads to the cadastre zoning code both ocp_rural and ocp_urban were linked through zoning codes and *landuse* information. The other layers were linked through their *roll numbers*.

In some data layers, there was simply no attributes common to the cadastre, and to solve this, a *unique id* was created for each parcel in cadastre (See c., Unique ID). This unique ID was then populated into an intermediate table and used for linkage (See e. Intermediate Table). However, for the Storm and Sanitary feature layers, this type of linkage was not possible. To populate the road centerlines and other line features of these layers with the parcel unique id, they needed be segregated by parcel segments, which will have to be done in the future. To illustrate, following is a screenshot of the Storm layer.



Storm.Sewers

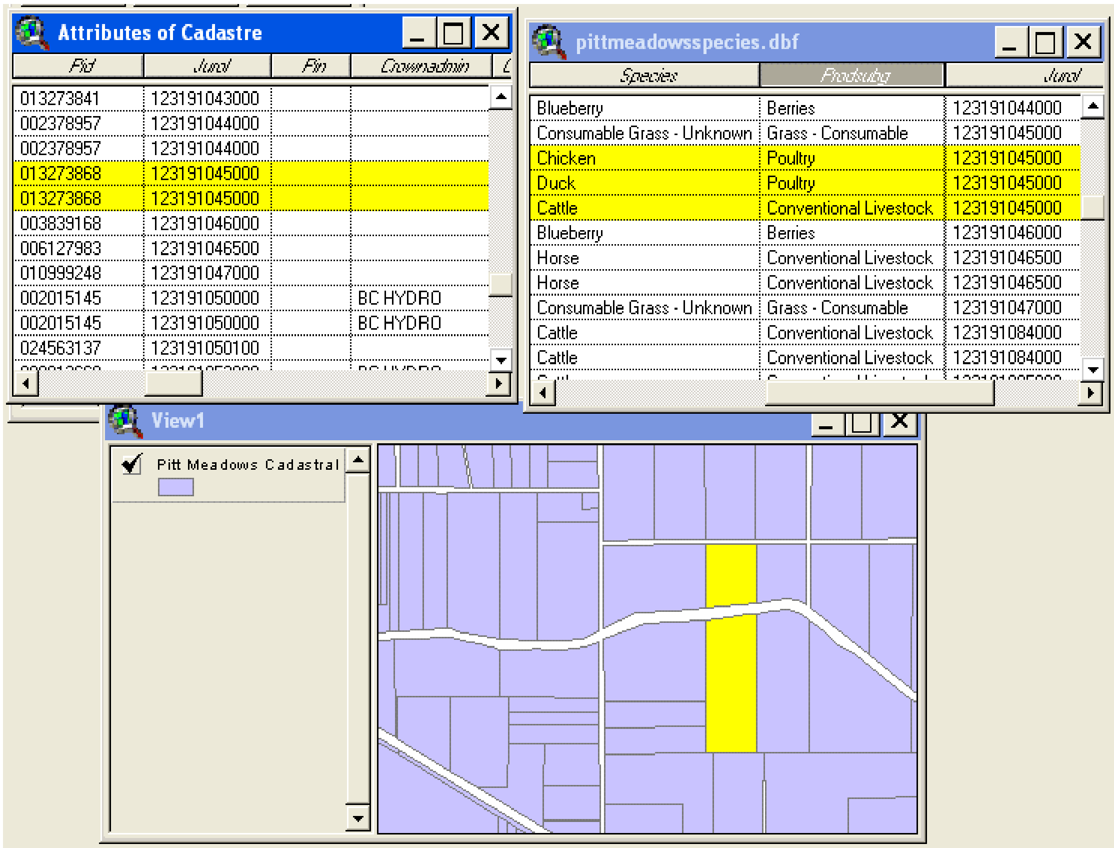
c) Creation of Unique ID

The Unique ID was created by combining the JUROL and PID values in each Cadastre layer record, using the calculator function of ArcGIS. Unique ID works well for linking the cadastre to polygon feature layers without common attribute fields when defined polygon boundaries don't match those of the cadastre. This was the case for the soil and capability layers, and required an intermediate table for linkages (See *e. Intermediate Table*).

Note: Unfortunately, due to time constraints, no Unique ID was used in the final data model. This should be a relatively quick assignment for future enhancements.

d) Determining relationships

The Geodatabase compiled for this project uses one-to-many relationships. Some of the data (e.g. soils and capability) provided by the District relate to the cadastral feature class through many-many relationships. However, no many-to-many relationships were inputted into the Geodatabase for this project, due to time constraints. Most data layers were linked to cadastre through roll numbers JUROL or PCLLINKSID. These were roll numbers that were not unique, since one person can own many parcels. Some resulting linkage had records with the same roll number but differing attribute values. For example, many species with identical roll number linked to numerous parcels having the same roll number in the cadastre layer.



Example of a many-to-many relationship.

Road layers, on the other hand, could be linked through address as one-to-one relationships, under the rule that parcels have unique address house numbers. Ocp_rural and Ocp_urban used the ocp landuse definition field, linking to the cadastre's zoning codes. As shown in the table below, this relationship is one to many. However, due to time constraints, Roads, Ocp_rural and Ocp_urban were not incorporated into the final data model.

Zone Code	Zoning Definition	Rural_OCP	Urban_OCP
AF	Agriculture and Farm Industrial	Industrial	
AG	Agricultural	Agricultural Land	
AP	Airport Zone	Airport	Airport
CD1	Comprehensive Development I		Comprehensive Development Zone
CD3	Comprehensive Development II		Comprehensive Development Zone
CD4	Comprehensive Development III		Comprehensive Development Zone
CD10	Comprehensive Development X		Comprehensive Development Zone
CD12	Comprehensive Development XII		Comprehensive Development Zone
CD14	Comprehensive Development XIV		Comprehensive Development Zone
CD15	Comprehensive Development XV		Comprehensive Development Zone
CD16	Comprehensive Development XVI		Comprehensive Development Zone
CD19	Comprehensive Development IXX		Comprehensive Development Zone
CD20	Comprehensive Development XX		Comprehensive Development Zone
CS1	Service Commercial		Service Commercial
CS2	Service Station		Service Commercial
CS3	Tourist Commercial		Service Commercial
LC	Local Commercial		Local Commercial
LUC	Land Use Contract		
LUC13	Land Use Contract		
LUC15	Land Use Contract		
LUC18	Land Use Contract		
LUC2	Land Use Contract		
LUC3	Land Use Contract		
LUC9	Land Use Contract		
M1	Service Industrial	Industrial	Industrial
M2	General Industrial	Industrial	Industrial
M3	Waterfront Industrial	Industrial	Industrial
M4	Clean Industrial (Business Park Zone)	Industrial	Industrial
MC	Marine Commercial		Service Commercial
P1	Neighbourhood Institution		Public Use
P2	Park and Public Institution		Park
R1	One Family Residential I		Residential
R2	One Family Residential II		Residential
R3	One Family Residential III		Residential
R4	One Family Residential IV		Residential
R5	One Family Residential V		Residential
RC1	Compact One Family Residential		Compact Housing
RD1	Two Family Residential I		Residential
RD2	Two Family Residential II		Residential
RM1	Multiple Family Residential I		Townhouses
RM2	Multiple Family Residential II		Townhouses
RM3	Multiple Family Residential III		Townhouses
RM4	Multiple Family Residential IV		Apartments
RR1	Rural Residential I	2.0 Hectare Lot	
RR2	Rural Residential II	1.0 Hectare Lot	
RR3	Rural Residential III	1.0 Hectare Lot	
RS	Suburban Residential		Residential
RS1	Suburban Residential		
TC	Town Centre Commercial		Town Centre Commercial

An example of one-to-many relationships.

e) Intermediate Tables

Layers linked by Unique ID and zoning code required intermediate tables. The values of these could then be populated into the relationship class table of the geodatabase. For layers linked by Unique ID (i.e. soil or capability), the intermediate values was created through an *overlaying technique* using the workstation ARC/INFO INTERSECT command, 'between' the updated cadastre with unique ID and the corresponding data layer. The ARC/INFO INTERSECT command creates a new data layer populated with an attribute field contained in both the cadastre and the linked data layer.

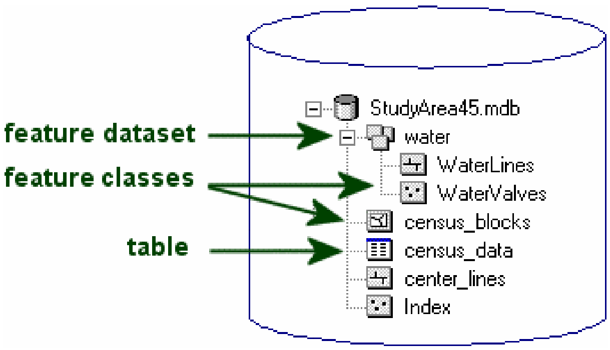
Note: Due to time constraints no intermediate tables were utilized in the final data model.

Stage 3: Data Standardization

For easier manipulation in some feature data layers (i.e. performing INTERSECT in ARC/Info), all feature layers were converted to Arc/Info coverage format through AML script. Data was projected according to the Universal Transversal Mercator (UTM) Zone 10 NAD 83 coordinate system. The metadata created for the final dataset in the data model was based on the FGDC (Federal Geographic Data Committee)/ESRI metadata structure in ArcCatalog because of its use by the ICIS (Integrated Cadastre Information Society that distributes the ICI database).

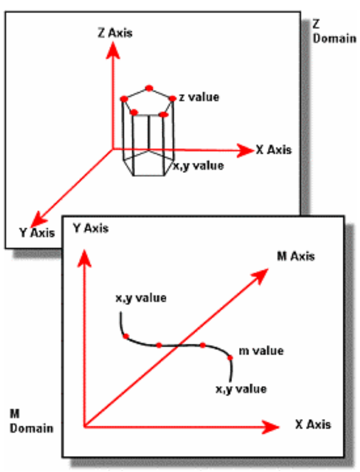
Stage 4: Geodatabase creation and set up

The geodatabase is created to reflect the relationships that exist between the various feature classes and tables within the feature data set as described previously. Once this important step has been executed information can be imported into the Geodatabase.



Geodatabase components

For coordinate system information, UTM Zone 10 NAD 83 is imported from existing coverage projection information. For spatial reference extent, the XMIN, YMIN, XMAX and YMAX values are determined by arbitrarily drawing a boundary box and finding the corresponding UTM values which are shown in the diagram. This arbitrarily boundary box is buffered beyond the cadastre actual extent. It was found that this spatial reference extent must be keyed in or else default values will be used that are not within any of extent of the data layers.



Spatial extent values.

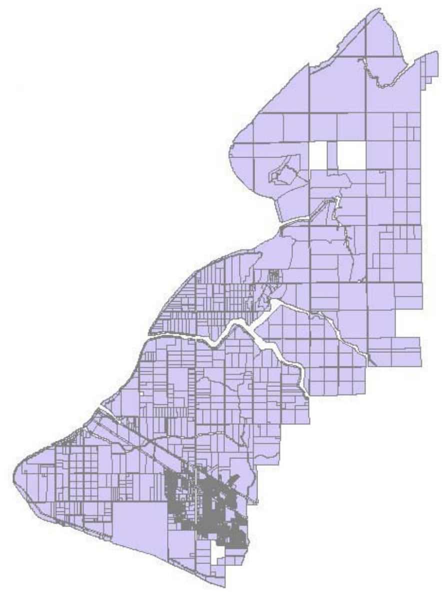
The actual data in these layers/tables can be loaded before or after schema is created. It was found that attribute tables were better loaded before creating schema (into an empty geodatabase) because values can only be added manually or through ArcObject scripts to the established empty attribute table (in a similar maaner to the relationship class tables). Feature class layers can be loaded to the geodatabase before or after applying Case Tools schema. Both ways can be loaded using Simple Data Loader in ArcCatalog (while the Data Loader in ArcMap can be used only afterwards). Simple Data Loader only loads data without behaviour or relationship classes which can be accomplished if loading data before creation of geodatabase schema using CASE Tools. Since the proper method described by ESRI to load data is after the creation of geodatabase schema, the Data Loader in ArcMap was used.

Stage 5: Database Testing

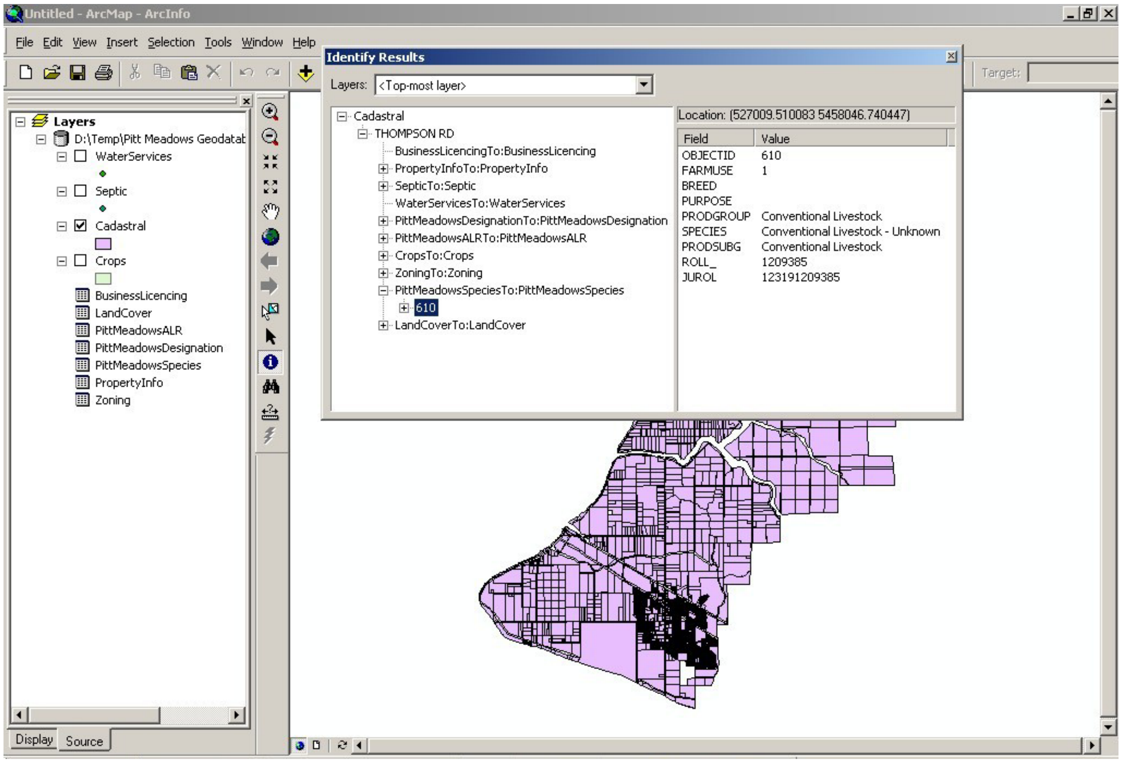
The relationships established in the data model are tested for functionality. Then the personal geodatabase is converted to ArcSDE spatial database for testing simply by copying and pasting data and relationship files in geodatabase to ArcSDE.

Results

The Geodatabase was successfully modeled, inputted and finally populated. One-to-many relationships were modeled between the feature classes and attribute tables and the cadastral feature layer because they did not require the use of an intermediary relationship class (which require significant time to implement). When it was finally created, the Geodatabase contained the following feature classes and attribute files: C*rops, Septic, Water services, Cadastral, Pitt Meadows Species, Land Cover, Business Licensing, Pitt Meadows ALR, Property Information, Zoning*, and *Pitt Meadows Designation*. The type of modeling used produced the results we had intended for all of the attribute tables and for the crops, septic, water services, and cadastral feature layers. The feature layers were linked using PCLLINKSID, the Zoning attribute table was linked using ZONING, and the rest of the attribute tables were linked using JUROL.



Finalized Cadastral shapefile.



Perusing the Geodatabase in ArcCatalog.

Methodological Problems and Limitations

At first, OD attempted modeling many-to-many relationships to link parcels in the cadastral layer to every other feature layer or attribute table to the cadastral layer. However, many-to-many relationships must be modeled using an intermediary relationship class that holds data values necessary to link the data tables together. Populating the relationship class data tables required either manual data entry or the use of a visual basic script. Both of these options were too time intensive considering the deadline date, so other methods of data modeling had to be considered (e.g. use of one-to-many relationships where appropriate, and the dropping of feature classes from data model if required).

Soils, capability, and OCP_Urban did not contain any fields with which they could link to any other feature layer or attribute table in the data set. The original plan was to link soils and capability to the cadastral feature layer by populating a relationship class with values determined by using the intersect command in ArcInfo. These classes could not be joined to the model due to the complexity of populating the relationship class data attribute table, as described above. OCP_Rural was not added because there was no way to link OCP_Rural to the zoning code. Also OCP_Rural is out of date; it doesn't contain all parcels in the rural area. Furthermore, there are many OCP land use definitions that do not match the zoning code.

The Water utility (line layer) was not added because the original GIS file generated from AutoCad does not contain any attributes. The District's engineering department has attributes for this data in their water model, but we understand the only way to add these attributes into the GIS file is manually. It can only be added manually because the geocode information in these attributes only applies to the water valves point data, not the Water Utilities feature class.

Zoning codes for each parcel was added to the cadastre layer by Pitt Meadows GIS staff during this project. The zoning attribute table is actually a table that contains the actual zoning code definition. The original zoning feature class layer is out of date (plus only for urban area) with arbitrary (miscellaneous) lines running through parcels. Therefore, the zoning feature class layer was not added to the data model.

The roads layer was not added because the Cadastral layer (used to link to Road layer) was missing many addresses or house numbers. Furthermore, some of the street names are different between Roads and Cadastral layers (e.g. there are over 600 records to re-name in the Cadastral layer alone). The Storm and Sanitary sewer layers (in AutoCad drawing format only) lacked attribute data which caused a problem for linking to the data model. Essentially, for the Storm and Sanitary feature classes there was no data to add to the geodata model.

In general, there was a lack of common attributes in the feature classes and attribute tables to make easy linkages, between primary and secondary keys. Also, there was a poor match between ICI attributes and Pitt Meadows attributes. In other words, the Pitt Meadows attributes do not show up in the ICI data model, and vice versa. In addition, there was a general lack of metadata.

Future Enhancements

Phases beyond the current model should consider integrating more feature classes and conversion from personal to mulitiuser Geodatabase in ArcSDE. This is possible and would be relatively easy [1].

Many-to-many relationships should be link parcels in the cadastral layer to other feature layers and attribute tables that were not included in the current project. A many-to-many relationship must be modeled using an intermediary relationship class that holds data values necessary to link the data tables together. Populating the relationship class data tables will require the use of a Visual Basic script. The Soils, Capability, and OCP_Urban intermediate tables could be added in this manner. Soils and Capability could be linked to the cadastral feature layer by populating a relationship class with values, determined by using the ARC/INFO INTERSECT command. OCP_Rural could be updated so it contained all parcels in the rural area. Also, OCP land use definitions need to be updated in order to match the zoning code.

Attribute data for the Water Utility, Storm, and Sanitary sewer require geocoding. The District's engineering department may have attributes for this data, but we understand the only

[1] Migration was been shown to be possible by a member of OD and the SFU SIS lab administrator

way to add these attributes into the GIS file is to do it manually. The original zoning feature class layer needs to be updated (adding plus only for rural areas) and arbitrary (miscellaneous) lines running through parcels need to be removed. The Roads layer could be linked to the Cadastral layer after missing addresses or house numbers are added, and the street names between the two layers has been standardized. After the above problems have been corrected, the Roads and Cadastral layers, can easily create an intermediate table to link these two layers, using the ARC/INFO ADDRESSMATCH command.

Newly collected attribute data for the Storm, Sanitary and Water Utility feature classes should be ICI compliant (with GPS). This would improve on the poor matching of ICI and Pitt Meadows attributes. In addition, more metadata should be collected and wherever possible. It is thought that linkage to Vadim Finance Database would be beneficial to the business function of the District. Finally, the data model should be updated to include "date stamping" capabilities, and refined in order to minimize effort on the part of maintenance.

Conclusion- Policy Implications

The District's GIS department is encouraged to continue with its forward thinking GIS initiatives, and encouraged to partner again with SFU students in order to implement the various suggested future upgrades in a timely manner. In order to enable easy integration into the Geodatabase model, OD suggests that the District develop standards for data collection and AutoCad related files, and wherever possible to comply with ICI standards.

Group member contributions

Carol Cheuk- **Co-Project Manager, Data Compilation & Standardization, Data Model Design, Geodatabase Loading, Final Report**

Perry Holmes- **Co-Project Manager, Data Model Design, Final Report, Research, Data Model Standardization**

Kim Liske- **Data Model Design, UML Modelling, Geodatabase Loading, Technical Writing, Final Report**

Geoff Archibald- **Presentation, Technical Writing & Editing, Standardization, Final Report, OD Logo**

Winnie Lau- **Data Compiling and Standardization, Technical Writing, Website Design, Final Report Design**

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Appendix A- Glossary

ADDRESSMATCH: Arc command. It uses to match addresses in an INFO data file against an address coverage and creates a point coverage containing locations of matched addresses.

AML: ARC Macro Language. It is a proprietary high-level algorithmic language for generating end-user applications in ArcInfo Workstation. AML allows you to create onscreen menus, use and assign variables, control statement execution, and get and use map or page unit coordinates. AML includes an extensive set of commands that can be used interactively or in AML programs (macros), as well as commands that report on the status of ArcInfo environment settings.

ArcCatalog: ArcCatalog allows users to browse, manage, create, and organize geographic and tabular data. In addition, ArcCatalog comes with support for several popular metadata standards to allow users to create, edit, and view information about the data. There are editors to enter metadata, a storage schema, and property sheets to view the data. With ArcCatalog users can view GIS data holdings, preview geographic information, view and edit metadata, work with tables, and define the schema structure for geographic data layers.

ArcGIS: ArcGIS is a comprehensive, integrated, scalable system introduced by ESRI that design to meet the needs of a wide range of GIS users.

ArcInfo: ArcInfo is the most powerful and functionally rich application in the ArcGIS product family by ESRI. In addition to all the functionality included in ArcView and ArcEditor, ArcInfo includes a complete ArcToolbox application and a full version of ArcInfo Workstation (ARC, ArcEdit, ArcPlot, AML, and all extensions). ArcInfo is the complete GIS data creation, update, query, mapping, and analysis system.

ArcMap: ArcMap is the application for viewing and editing geographic data and creating professional-quality maps, graphs, and reports.

ArcObjects: ArcObjects is a set of components developers use to programmatically enhance and extend ArcInfo, ArcEditor and ArcView. ArcObjects technology is based on the Component Object Model (COM). With ArcObjects, developers can add new tools or work flows to ArcInfo, ArcEditor, or ArcView software or extend the ArcGIS data model by adding new custom feature types.

ArcSDE: ArcSDE is a client/server software program that enables spatial data to be stored, managed, and quickly retrieved from leading commercial database management systems (DBMS).

ArcView: ArcView is a powerful GIS data visualization, query, analysis, and map creation solution. It provides interactive tools for exploring, selecting, displaying, editing, analyzing, symbolizing, and classifying data as well as for automatically creating, updating, and managing metadata.

CAD: Computer Assisted Drafting. A set of computer programs designed to assist in the process of drafting. It is normally used for architectural purposes but can also be used for drafting maps and as an input to GIS.

CASE Tools: CASE stands for Computer Aided Software Engineering. Case Tools in ArcCatalog of Arc/Info 8 is used for the purpose of creating geodatabase schema from the UML model design.

Coverage: An ArcInfo data file in which geographic features are stored as points, lines, and polygons, and feature attributes are stored in associated INFO tables.

DBF: dBase file. It is a file format native to dBASE database management software. ArcView can read, create, and export tables in dBASE format.

e00: Arc Export File Format.

FGDC/ESRI: An organization established by the United States Federal Office of Management and Budget responsible for coordinating the development, use, sharing, and dissemination of surveying, mapping, and related spatial data. The committee is comprised of representatives from federal and state government agencies, academia, and the private sector. The FGDC defines its spatial data metadata standards in its Content Standard for Digital Geospatial Metadata and manages the development of the National Spatial Data Infrastructure (NSDI).

Geodatabase: A relational database that stores geographic data. It is an object-oriented data model introduced by ESRI that is used to store spatial and attribute data and the relationships that exist among them. Basically, a geodatabase is a container for storing spatial and attribute data and the relationships that exist among them. Vector data such as point, line, and polygon features; tabular data; and raster data formats can work together as an integrated system using rules, relationships, and topological associations. It allows you to represent the real world with creation of a data model.

ICF: Integrated Cadastral Fabric.

ICI: Integrated Cadastral Initiative, also termed ICIS.

ICIS: Integrated Cadastral Initiative Society (formerly known as ICI) is a partnership among local governments, utility companies and provincial agencies for the establishment, maintenance and distribution of a database that consists of the integrated parcel fabric and related parcel links on a province-wide basis.

INTERSECT: Arc command. It computes the geometric intersection of two coverages. Only those features in the area common to both coverages will be preserved in the output coverage.

JUROL: Jurisdiction roll numbers.

Many-to-many relationship: A relationship between tables in which many given records have the same value in the origin table and each record value corresponds to many records in a source table. An example of a many-to-many relationship is that between a table of mall parking lots and a table of mall stores, a store may have convenient parking in more than one parking lot while a parking lot may offer convenient parking to more than one store. An intermediary relationship class is required to hold the attributes in the origin class and the attributes to which each one links.

Metadata: Data about data. Metadata for geographic data may include the source of the data; its creation date and format; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard.

Microsoft Enterprise Visio: Visio provides templates for various diagrams including Entity-Relationship Diagrams and Data Flow Diagrams. Entity-Relationship Diagrams, Decomposition Process Diagrams and different levels of Data Flow Diagrams can be drawn in these templates.

Multiuser Geodatabase: Multiuser geodatabases are suitable for large workgroups and enterprise GIS implementations; they can be read and edited by multiple users at the same time. Multiuser geodatabases require ArcSDE and a DBMS (database management system) such as IBM DB2, Informix, Oracle, or SQL Server. ArcSDE provides the interface that allows you to store and manage spatial data in a DBMS (Database Management System). Both vector and raster data can be stored in a multiuser geodatabase.

NAD 83: North American Datum 1983 Projection

One-to-many relationship: A relationship between tables in which a given record in a destination table may correspond to many records in a source table. An example of a one-to-many relationship is that between a table of office buildings and a table of building occupants. Tables in a one-to-many may be linked, but should not usually be joined.

One-to-one relationship: A relationship between tables in which a given record in a destination table corresponds to no more than one record in a source table, and in which each correspondence is unique (no two destination table records correspond to the same source table record). An example of a one-to-one relationship is that between a table of states and a table of state capitals. Tables in a one-to-one relationship may be joined or linked.

PCLLINK SID: Parcel Links Identification Field. It is made to standardize the parcel roll numbers into a common format for use in linking tables using relationships.

Personal Geodatabase: A personal geodatabase has the .mdb file extension (a format used by Microsoft Access) and can be read by multiple people at the same time, but edited by only one person at a time. A personal geodatabase has a maximum size of 2 gigabytes (GB). Currently, it can store only vector data.

Shapefile: A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

SQL: Structured Query Language. It is a standard interactive and programming language for getting information from and updating a relational database. Queries take the form of a command language that lets you select, insert, update, find out the location of data, and so forth.

UML: Unified Modeling Language. It is the industry-standard language for conceptual data modelling of software or database design. It acts as a "blueprint" for construction.

UTM: Universal Transversal Mercator Projection Coordinate System.

Vadim Finance Database: A financial database of District of Pitt Meadows.

VBA: Visual Basic Application.

XMI: XML Metadata Interchange

XML: Extensible Markup Language. It is a set of rules for designing text formats, XML was created and is maintained by the World Wide Web Consortium (W3C) to facilitate more standardized and structured user documents for the World Wide Web. It has now moved beyond the World Wide Web and is adopted by organizations around the world as the standard for producing both digital and analog documents.

Glossary sources:

- Understanding GIS The Arc/Info Method, ESRI Press, 1997
- Getting to know ArcView GIS the geographic information system (GIS) for everyone, ESRI Press, 1999
- ESRI Virtual Campus Glossary
  http://campus.esri.com/

Appendix B- Data Dictionary

This document is intended as an index for the Feature Classes and Attribute Tables within the District of Pitt Meadows Geodatabase. Its format is roughly modeled after the Standards and Specifications document of the Integrated Cadastral Fabric (October 2002).

Feature Data Layers

Cadastre

Attribute Name	Type	Length	Description
ACCURACY	esriFieldTypeString	32	
ACTUSECODE	esriFieldTypeString	4	
ADDRMUNIC	esriFieldTypeString	50	
ADDRNOTES	esriFieldTypeString	30	
ADDRSOURCE	esriFieldTypeString	50	
ADDRTYPE	esriFieldTypeString	12	
BLOCK	esriFieldTypeString	16	
COMMENTS	esriFieldTypeString	255	Comments
CROWN_ADMIN	esriFieldTypeString	32	
DATA_OWNER	esriFieldTypeString	50	
DESCRIPT	esriFieldTypeString	255	
DIRECTION	esriFieldTypeString	2	
FREE_FORM	esriFieldTypeString	32	
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
LABSYM	esriFieldTypeDouble	20	
LAND_DIST	esriFieldTypeString	50	
LOT	esriFieldTypeString	16	
METHOD	esriFieldTypeString	32	
PARCEL	esriFieldTypeString	16	
PCLLINKSID	esriFieldTypeString	50	Data owner's unique parcel identifier
PID	esriFieldTypeString	30	
PIN	esriFieldTypeString	30	
PLACE_NAME	esriFieldTypeString	32	
PLANDEFDOC	esriFieldTypeString	32	
PRIMARY_FIELD	esriFieldTypeString	50	
ST_NAME	esriFieldTypeString	40	
STREETNUM	esriFieldTypeString	15	
STREET_TY	esriFieldTypeString	8	
STRNUMSUF	esriFieldTypeString	10	
UNIQUEID	esriFieldTypeString	60	Unique number generated by OD
UNITNUMBER	esriFieldTypeString	10	
XTRAC_DATE	esriFieldTypeDate	8	
ZONING	esriFieldTypeString	5	

Crops

ALEG	esriFieldTypeInteger	2	
BLUE	esriFieldTypeInteger	2	
BRAM	esriFieldTypeInteger	2	
COLE	esriFieldTypeInteger	2	
CORN	esriFieldTypeInteger	2	
CRAN	esriFieldTypeInteger	2	
CREL	esriFieldTypeInteger	2	
GRAS	esriFieldTypeInteger	2	
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
PCLLINKSID	esriFieldTypeString	50	Data owner's unique parcel identifier
POTENTIAL	esriFieldTypeInteger	2	
RCV	esriFieldTypeInteger	2	
SRAV	esriFieldTypeInteger	2	
STRW	esriFieldTypeInteger	2	
TFRT	esriFieldTypeInteger	2	
TREE	esriFieldTypeInteger	2	

Pitt Meadows Septic

ADDRESS	esriFieldTypeString	26	
COMMENT	esriFieldTypeString	41	
NAME	esriFieldTypeString	26	
PCLLINKSID	esriFieldTypeString	50	Data owner's unique parcel identifier
ROLL_NUMBER	esriFieldTypeString	12	Business Index
WXX	esriFieldTypeString	5	

Water Services

ADDRESS	esriFieldTypeString	25	
ARC_STREET	esriFieldTypeString	60	
DATE_INST	esriFieldTypeDouble	17	
DOCID	esriFieldTypeInteger	4	
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
PAGECOUNT	esriFieldTypeDouble	12	
PCLLINKSID	esriFieldTypeString	50	Data owner's unique parcel identifier
PLAN	esriFieldTypeDouble	10	
ROLL	esriFieldTypeString	12	Business Index
SCORE	esriFieldTypeInteger	4	
STATUS	esriFieldTypeString	1	
UTIL_TYPE	esriFieldTypeString	16	

Attribute Tables

Business Licensing (buslic.dbf)

Attribute Name	Type	Length	Description
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
CUSTOMER_2	esriFieldTypeString	40	Business Type line 2
CUSTOMER_3	esriFieldTypeString	30	Address line 2
CUSTOMER_4	esriFieldTypeString	30	Address line 3 (municipality)
CUSTOMER_5	esriFieldTypeString	6	
CUSTOMER_6	esriFieldTypeString	24	Roadway Location
CUSTOMER_A	esriFieldTypeString	30	Address line 1
CUSTOMER_D	esriFieldTypeString	40	Business Type, further information
CUSTOMER_F	esriFieldTypeDouble	16	
CUSTOMER_H	esriFieldTypeString	1	
CUSTOMER_L	esriFieldTypeString	40	Contact Name
CUSTOMER_N	esriFieldTypeString	40	Business Name
CUSTOMER_P	esriFieldTypeString	7	Address line 4 (postal code)
CUSTOMER_S	esriFieldTypeString	1	
ROLL_NO	esriFieldTypeString	52	Business Index

Pitt Meadows ALR (pmalr.dbf)

ALREDGE	esriFieldTypeSmallInteger	0	Considered at the edge of the ALR (T/F)
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
IN_ALR	esriFieldTypeSmallInteger	0	In Agricultural Land Reserve (Y/N)
PARTALR	esriFieldTypeSmallInteger	0	Partly in ALR (T/F)
ROLL_	esriFieldTypeDouble	12	Business Index

Pitt Meadows Cover (pmcover.dbf)

CONDITION	esriFieldTypeString	50	Level and type of interaction with land, updated
COVERCOUNT	esriFieldTypeInteger	6	
COVERENTIT	esriFieldTypeString	60	Specific type of land use
COVERGROUP	esriFieldTypeString	20	General classification of physical land type
COVERSUBGR	esriFieldTypeString	40	Classification of land use
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
ENCLOSURET	esriFieldTypeString	50	Level of cover
PERCENTOFP	esriFieldTypeDouble	11	
ROLL_	esriFieldTypeDouble	16	Business Index
COVERSIZE	esriFieldTypeString	20	Size
SURVEYID	esriFieldTypeDouble	11	

Pitt Meadows Designation (pmdesignation.dbf)

JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
DESCLASS	esriFieldTypeString	9	Designates Farm, Non-Farm, or Unknown
DESGROUP	esriFieldTypeString	30	Classification of physical land type
DESUSE	esriFieldTypeString	32	Specific land-use type
FARMUSE	esriFieldTypeSmallInteger	1	Farm Use (Y/N)
DESIGNPERCENT	esriFieldTypeInteger	7	
ROLL_	esriFieldTypeDouble	12	Business Index
SIGNIFICAN	esriFieldTypeString	11	

Pitt Meadows Species (pmspecies.dbf)

BREED	esriFieldTypeString	12	Livestock Type
PURPOSE	esriFieldTypeString	18	Production Type
JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
FARMUSE	esriFieldTypeSmallInteger	0	Farm Use (Y/N)
PRODGROUP	esriFieldTypeString	30	General type of land-use
PRODSUBG	esriFieldTypeString	50	Specific Type of land-use
ROLL_	esriFieldTypeDouble	11	Business Index
SPECIES	esriFieldTypeString	50	Product Type

Property Info (gisinfo.dbf)

JUROL	esriFieldTypeString	30	Concatenation of BC Assessment area, jurisdiction and roll number.
ADDRESS_1	esriFieldTypeString	35	Address line 1
ADDRESS_2	esriFieldTypeString	35	Address line 2
ADDRESS_3	esriFieldTypeString	35	Address line 3
ASSESSMENT	esriFieldTypeDouble	16	
FREE_FORM_	esriFieldTypeString	51	
IMPROVEME2	esriFieldTypeDouble	16	
IMPROVEMEN	esriFieldTypeDouble	16	
LAND_EXEMP	esriFieldTypeDouble	16	
LAND_TAXAB	esriFieldTypeDouble	16	
LEGAL_BLOC	esriFieldTypeString	5	
LEGAL_DIST	esriFieldTypeString	5	
LEGAL_LAND	esriFieldTypeString	2	
LEGAL_LOT	esriFieldTypeString	5	
LEGAL_MERI	esriFieldTypeString	1	
LEGAL_PLAN	esriFieldTypeString	8	
LEGAL_RANG	esriFieldTypeString	2	
LEGAL_SECT	esriFieldTypeString	4	
LEGAL_TOWN	esriFieldTypeString	4	
LOT_SIZE	esriFieldTypeString	14	
OWNER_NAM2	esriFieldTypeString	35	Secondary Owner Name
OWNER_NAME	esriFieldTypeString	35	Owner Name
POSTAL_COD	esriFieldTypeString	7	Postal Code
PROPERTY_I	esriFieldTypeString	11	
ROLL_NO_	esriFieldTypeInteger	9	Business Index
TELEPHONE	esriFieldTypeString	10	Area code
ZIP_CODE	esriFieldTypeString	10	Zip Code

Zoning

DEFINITION	esriFieldTypeString	50	
ZONING	esriFieldTypeString	5	