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TO:
Ministry of Sustainable Resource Management

Attention: Rosa Munzer

Version 3.0

Integrated Land and Resource Registry Project (ILRR)

Data Integration Assessment - Supplement

DOCUMENT HISTORY

Version Number	Description of Change	Author	Date
1.0	Initial draft	Steve Spalding/Brendan Feary	Nov 25, 2003
2.0	Extensively revised	Brendan Feary	Feb 27, 2004
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GLOSSARY OF TERMS

The following table is a glossary of acronyms used throughout this report.

Acronym	Definition
ALTOS	Automated Land Title Office System
BCTS	BC Timber Sales
ICF	Integrated Cadastral Fabric (now called the Common Cadastral Fabric)
ICIS	Integrated Cadastral Information Society
ILRR	Integrated Land and Resource Registry
INCOSADA	Integrated Corporate Spatial and Attribute Database
LRDW	Land and Resource Data Warehouse
LRMP	Land Resource Management Plan
LWBC	Land and Water BC
MEM	Ministry of Energy and Mines
MiDA	Mineral Data System
MOF	Ministry of Forests
MSRM	Ministry of Sustainable Resource Management
OGC	Oil and Gas Commission
WLAP	Ministry of Water, Land and Air Protection
WLIS	Water Licensing Information System

REPORT SUMMARY

As part of the administration of legal land and resource rights in BC, staff from various government agencies carry out application processing, land statusing, tenure registration, and related management activities supporting the issuing of land and resource tenures. This report discusses the role of these agencies in the allocation and registration of land and resource interests, the major processes involved, current data used for these functions and issues they face in using the data.

The following agencies have statutory responsibilities for the administration of specific types of land and resource rights in BC:

- Ministry of Sustainable Resource Management;
- Ministry of Forests;
- Oil and Gas Commission;
- Ministry of Energy and Mines;
- Land and Water BC;
- Ministry of Water, Land and Air Protection; and
- Ministry of Transportation.

An important aspect of the Integrated Land and Resource Registry (ILRR) project has been the undertaking of an assessment of the key land and resource registry data sets. The overall purpose of this data assessment work is to investigate and document data quality issues applying to these key data sets, and to identify options for resolving the issues, in preparation for implementation of the Integrated Land and Resource Registry.

This document extends the earlier data assessment work performed by Fujitsu Consulting and documented in the report, Integrated Registry – Data Assessment, Version 1.4 (April 25, 2003) and associated supplements relating to Ministry of Transportation and Ministry of Forests. This report presents the results of two workshops, conducted in Ft. St. John and Kamloops with regional land and resource administration experts, concerning the quality of key sources of data that are used to support land and resource decision-making.

This project and report was initially intended to identify and assess issues relating to the integration of key registry data as the province moves towards an implementation of the ILRR. Consideration of integration-related issues (i.e. issues arising when two or more digital data sets from different business areas are combined) was not part of the earlier data assessment work. Moreover, the earlier assessment work involved consultation with Victoria-based staff and did not represent a regional user's view of the data. With this in mind it was decided to combine the purposes by attempting to assess integration issues by gathering input from a regional perspective.

To accomplish this dual purpose, two workshops with regional staff were held: one in Ft. St. John and one in Kamloops. In attendance at those workshops were business experts

from the key land and resource rights granting agencies in the respective regions. To centre the discussion on integration-related data issues a representative area (a single map-sheet) was chosen which presented the key data sets from electronic sources commonly used by the agencies, or so was originally thought.

It became evident, however, during both workshops, that discussion of integration-related issues would take a back seat to more pressing and profound issues affecting staff in the regions, and that most agencies will require significant enhancements to the accuracy, completeness and format of their data sources before they are in a position to be incorporated into the ILRR. This confirms earlier observations that the quality of electronic data supporting the administration of land and resource rights is one of the critical success factors for the implementation of the ILRR.

As a result, there was little discussion during the workshops about problems relating strictly to integration of electronic data. In place of electronic data integration, discussion was focused on the larger challenge of data integration of disparate data sets in different forms and in various stages of accuracy and currency. Most of the workshop participants later commented on how useful they felt the sessions had been in opening up the dialogue concerning the ILRR and its associated data requirements and quality management issues.

The key findings of this report are outlined as follows. A more detailed description of the general findings, and the findings by agency, is provided in Section 2.

1. **Reliance on hard-copy data.** Hard-copy data sources (particularly maps) are still used by agencies to support their operational decision-making.

2. **Accessing non-official sources.** Multiple sources exist for some data sets and there is uncertainty about which are official sources.

3. **Uncertainty regarding content of ILRR.** There are divergent views about what information should be held in the ILRR.

4. **Uncertainty regarding road information.** Access to quality road information in electronic form was identified by all agencies as being particularly problematic.

5. **Lack of accessible metadata.** The lack of accessible metadata for data sources makes it difficult determine the 'fitness for use' of a particular source in the operational decision-making process.

The recommendations of this report, described in more detail in Section 4, are to:

1. Develop agency specific plans to address data deficiencies and data quality issues in existing information targeted for inclusion in the ILRR.

2. Confirm the scope of legal interests, rights, designations and encumbrances to be included in the ILRR and review land use planning and designation data needs and status prior to designing the ILRR.

3. Assist agencies in the transition from the use of hard-copy reference maps to digital base maps.

4. Establish custodial responsibilities for ILRR data sources.

5. Establish metadata standards and management processes for ILRR sources.

6. Develop an integrated ILRR data model.

7. Data fitness for use in ILRR should be specific to MSRM standards.

1.   PROJECT APPROACH

A project team from the Ministry of Sustainable Resource Management (MSRM) and Fujitsu Consulting conducted two regional workshops: in Ft. St. John on September 23, 2003 and in Kamloops on September 25, 2003. Agency representatives were asked to share their knowledge and experience regarding issues relating to the access and integration of data required to make land-based business decisions.

The participating agencies in these workshops included:

- Land and Water BC Incorporated (LWBC);
- Oil and Gas Commission (OGC);
- Two survey firms (Fort St. John workshop);
- Ministry of Forests (MOF);
- Ministry of Energy and Mines (MEM);
- Ministry of Sustainable Resource Management (MSRM);
- Ministry of Water, Land and Air Protection (WLAP); and
- Ministry of Management Services (Government Agents).

The specific purpose of these regional workshops was to use the knowledge of these business and data experts to develop a strategy for integrating data by:

- Identifying and investigating the problems involved in integrating the key data sets and verifying the 'official' or 'best known' sources of information; and
- Identifying underlying causes of the integration problems and discussing options for resolving the issues.

During the workshops, and using prepared map sheets as a starting point, discussion with regional experts centred on the following:

- Identifying the 'official' or 'best' sources of data for each agency (e.g. Tantalis, INCOSADA, MSRM Land and Resource Data Warehouse, MiDA, regional sources, etc.);
- Identifying known errors within each of the data sets such as inaccurate, missing or incomplete data;
- Identifying problems with the data relative to other data sets (e.g. non-aligned or conflicting boundaries);
- Identifying the underlying causes of the data integration problems; and
- Assessing the business risk of not addressing the known data problems.

Data scope in this report is defined in terms of data sets currently in use. The following table identifies the scope of the data discussed during the workshops:

Table 1 - Data Scope

Registry Data Theme	Components
Crown survey and Interests	- Crown parcel fabric - Interest parcels - Reversions and acquisitions - Provincial parks - OIC ecological reserves - Protected areas - Land claim settlement areas - National Parks - Surveyed roads - Cadastral annotation
Private parcels	- Integrated Cadastral Fabric (ICF) - PID - Legal description - Roll #
Forests	- Tree Farm Licenses (additions and deletions) - Cutting Permits - Range areas - Special Use Permits - Timber Sale Areas - Grazing Leases - Forest Roads
Water	- Spatially represented Points of Diversion (PODs) - Water licenses - Scanned plats & licenses
Archaeology	Archaeology site extent and attribute information
Sub-surface – mineral, oil & gas	- Mineral tenures (claims & leases) - Mineral titles - Coal titles - Well site tenures, pipelines and facilities

These workshops, consistent with the earlier data assessment for the ILRR, focused on legal, registerable interests resulting in some form of land or resource tenure and the associated operational processes for handing tenure applications. This report does not discuss data sources and requirements regarding land use planning processes (such as LRMPs and landscape level plans), other than the legal designations arising from these planning processes, such as the establishment of parks and protected areas. However, during the Kamloops workshop, participants raised a number of relevant issues and questions relating to the identification and potential inclusion of land use zoning in provincial databases and suggested that these should be included in the ILLR. These matters should be discussed further by ILLR Project Team since they have the potential to significantly increase the scope of the ILRR.

1.1   Workshop Participants

Regional representatives from ministries and agencies involved in land and resource administration attended the workshops, consistent with the intent to discuss and understand data issues from a regional perspective. These representatives came from a variety of functional areas and levels in their organizations. Participants and their positions and agencies are listed below:

Table 2 - Fort St. John Workshop Participants

Participant	Position	Agency
Regional Business and Data Experts		
Marianne Novotny	Admin. Technician	Land and Water BC
Larry London	Director, Applications and Approvals	Oil and Gas Commission
Grant Fox	GIS Analyst	Oil and Gas Commission
Penny Buckler	Oil and Gas Program Manager	Oil and Gas Commission
Cynthia Cole	GIS Operator	Forest Service – BC Timber Sales
Elizabeth Hunt	Stewardship Officer	Forest Service
Craig Hartel	GIS Technician	Forest Service
Jason Kubian	GIS Technician	Water, Land and Air Protection
Greg Gale	Data Base Administrator	Sustainable Resource Management
Andy Fochuk	Surveyor	McElhanney – survey company
Glen Harvey	Surveyor	Waberski Darrow – survey company
Data Assessment Team		
Rosa Munzer	Senior Project Manager	Sustainable Resource Management
Sue Bergin	Business Analyst	Sustainable Resource Management
Ray Bonner	Data Administration Analyst	Sustainable Resource Management
Brendan Feary	Consultant	Fujitsu Consulting
Steve Spalding	Consultant	Fujitsu Consulting

Table 3 - Kamloops Workshop Participants

Participant	Position	Agency
Regional Business and Data Experts		
Wendy Neville	Tantalis Support	Land and Water BC
Tori King	GIS Technician	Land and Water BC
Kevin Johnston	Planner	Forest Service – BC Timber Sales
Penny Scott	Resource Tenures – LIM Operator	Forest Service
Mike Cathro	Regional Geologist	Energy and Mines
Walter Poohachoof	Gold Commissioner	Management Services/Govt. Agent
Deborah Lipscombe	Manager	Management Services/Govt. Agent
Michael Burwash	Senior Ecosystem Biologist	Water, Land and Air Protection
Laing Shimmin	Manager	Sustainable Resource Management
Wendy Pepper	Strategic Land Use Planner	Sustainable Resource Management
Kevin Kachanoski	GIS Analyst	Sustainable Resource Management
Data Assessment Team		
Rosa Munzer	Senior Project Manager	Sustainable Resource Management
Sue Bergin	Business Analyst	Sustainable Resource Management
Ray Bonner	Data Administration Analyst	Sustainable Resource Management
Brendan Feary	Consultant	Fujitsu Consulting
Steve Spalding	Consultant	Fujitsu Consulting

2.   WORKSHOP FINDINGS

The section of the report documents the data quality issues that emerged during the workshops and that impact regional staff in their day-to-day decision-making. While some issues relating to data integration are identified, issues of data completeness and accuracy dominate. The detailed findings are presented below. Findings that were commonly reported by participants in both sessions are presented first, followed by the findings by agency.

2.1   Summary of General Workshop Findings

Workshop findings that appeared to be generally shared by all right granting agencies are presented as follows:

1. **Reliance on hard-copy data.** One of the most significant issues to emerge during the workshops was the continued reliance on hard-copy data. Participants frequently cited problems with the accuracy and completeness of the data they use for land statusing and decision-making, and noted that they often rely on hard copy versions of data (particularly spatial data in the form reference maps) or local knowledge to complete this work. They also stated that quality problems with existing data would represent a major impediment in acceptance of the ILRR by them and their clients. If their clients are not confident that all pertinent interests are accurately recorded and accessible in the ILRR to support land statusing, they will continue to rely on other sources of data, such as hard copy maps.

2. **Confidence level in sources.** Agencies require access to a range of data sources in the course of processing a tenure application or disposition. While specific data is collected and managed directly by each agency responsible for managing particular types of rights, data collected by other agencies is also critical to their decision-making processes. When asked about the degree of confidence in the current data administered by other agencies, almost all agencies reported they had a higher level of confidence in data collected and maintained by other agencies, than in the data they collect and manage themselves.

3. **Accessing non-official sources.** Some agencies, and by extension their clients and partners, are not accessing appropriate or official sources to support their business. Instead they use cheaper or more expedient sources, some of which may be non-electronic. Participants also indicated that they lack knowledge in what information is available and how it can be accessed (refer to metadata finding below).

4. **Uncertainty regarding content of ILRR.** Workshop participants also sought clarification regarding the extent to which land use planning constraints would be reflected in the ILRR. They appeared to be unfamiliar with or were uncertain of the extent to which this data was available from other government databases, such as the Land and Resource Data Warehouse (LRDW).

5. **Uncertainty regarding road information.** Participants at both workshops acknowledged having difficulty in identifying road locations. They felt that data sources such as INCOSADA (for forest roads) and hard copy maps from the OGC, cannot be relied on for current information on road location, status of use and road management responsibilities.

Participants attributed this lack of confidence and inconsistency of accuracy to data collection practises where agencies piece together key road data from multiple sources, including government databases, orthophotos, ground truthing and maps from forest companies, land agents and surveyors. Much of the source data is inaccurate or incomplete. Representatives of all agencies agreed that there is likely an extensive amount of forest, oil and gas and other road development information (including older roads) that is not recorded accurately or at all, in electronic government databases.

In addition to missing information regarding roads, road information is often inaccurate, such as:

- The road location is accurate but its status (active, non-active, deactivated, etc.) is incorrect or out-of-date, or;
- Who is responsible for the road maintenance (Crown or licensee) or;
- Contact information is missing or inaccurate.

Attendees at both sessions noted the proliferation of data sources and confusion caused by conflicting road databases. For example, for forest sector use, road data is found in at least five databases: INCOSADA Forest Cover, Trim 1, FRAT (local Forest Service access restriction database) and forest company Forest Development Plans. This is of particular concern in the Ft. St. John area where oil and gas sector data sources, including data and maps produced by the OGC, land agents and surveyors, adds to the list of disparate data sources, and increases confusion regarding roads and access.

6. **Lack of accessible metadata.** Participants at both workshops identified the lack of available metadata as an impediment to decision making. Without access to accurate, reliable information it is difficult for regional staff to:

- Identify information sources relevant for decision-making;
- Discern the best available or official sources to be used; and
- Assess the fitness for use of a particular data source.

2.2 Workshop Findings by Agency

This section identifies the workshop finding by each rights-granting agency.

2.2.1 Land and Water BC

Table 4 - Land and Water BC Summary Table

Agency Role	• Management of the sale and disposition of Crown land • Issuance of water licenses
Major Activities	• Identify constraints, encumbrances and title claims on Crown and private land • Determine the nature and location of water sources, other water licences or use designations
Primary Data Sources for Crown land disposition and management	Tantalis, including components such as: • Registry Management for survey information and Crown parcel structure • Disposition Management used to manage the Crown land disposition process, interest parcels and administration of tenure • Registry Access Tool for accessing spatial and attribute information with simple data capture tools for application areas of interest • GATOR to query and report in survey and interest parcels and plans to support land statusing • Integrated Cadastral Fabric (ICF) to support land statusing and as reference base for new applications • ALTOS for performing title searches of private land and accessing Land Title Act survey plans

Primary Data Sources for Water Licensing	• Water Licensing Information System (WLIS) - attribute system only:
	   • Licensee information: name and address, client number
	   • Water Rights information: licence number, purpose, quantity, period of use and appurtenance (legal description of associated parcel)
	• Point of Interest System (POI) - relational, non-spatial):
	   • Point of Diversion (POD) information: POD number, stream name and code #, spatial location
	• Works to convey water from POD to place of use – spatial, hard-copy
	• Place of use information: legal description and parcel identifier (PID)

2.2.1.1 Crown Land Management and Statusing

Land and Water BC (LWBC) oversees the sale and disposition of provincial Crown land pursuant to the Land Act. Prior to issuing a new Crown land tenure, LWBC must determine the nature, if any, of legal interests, encumbrances or conflicts on the land.

LWBC uses the Tantalis system to record application specific information and as a key data source for performing a land status. Tantalis has known data problems, primarily resulting from the initial capture and conversion of data from its predecessor system. Many of these types of problems were identified and quantified in the earlier data assessment report. Regional users often refer to hard-copy records and sources, including map sources, when incomplete or inconsistent information is encountered.

LWBC, as do other agencies, verify private land title information through BC Online. This source is generally regarded as a high quality and reliable source. Where ICF data exists participants rated it highly for its usefulness, however, significant gaps exist because not all municipalities have signed data sharing agreement with ICIS. Depending on the pattern of land development in the area, LWBC also uses supplementary data sources (e.g. oil and gas, forestry, water).

Because of the nature of land and resource development in the southern interior region, there is much interspersing of private and Crown land. Participants in the Kamloops workshop cited the importance of identifying the correct boundaries, rights and encumbrances over all land parcels. As a result, the integration of Tantalis, ICF and Land Title information took on greater emphasis during the workshop in Kamloops than in Ft. St. John.

Participants noted that acquisitions and reversions of land (back to the Crown) are not always synchronized between provincial databases such as Tantalis and ALTOS. This issue has been previously identified in the earlier data assessment report and supplement. It appears to be largely an issue of lack of notification back to the Crown Land Registry that a crown acquisition or reversion has occurred, something that is required by statute of all crown acquiring agencies for consistent record keeping. For example, ALTOS (Land Title System) may show a parcel of land as being owned by the Crown, while Tantalis may show the parcel to be privately owned.

2.2.1.2   Water Licensing

Land and Water BC (LWBC) also manages the issuance of water licenses under the Water Act. The two main systems that support the water licensing process are WLIS (Water Licensing Information System) and POI (Point of Interest) database. During the workshops LWBC representatives discussed their information needs and data issues regarding the issuance of water licenses.

Participants in both workshops explained the requirement to access a number of data sources in order to determine the status and location of water licences, points of diversion and other water-related works. Data relating to attributes of existing water licences and wells is found on WLIS and point of diversion information is found on POI. However, the spatial (i.e. geographic) location of points of diversion and wells is not captured on these systems.

Efforts to automate the capture of points of diversion spatially were attempted some years ago, but floundered due to the lack of a complete and consistent parcel base. Water licenses are predominately associated with private parcels (known as the appurtenant parcel), and in the absence of a quality parcel base, it was difficult to adequately capture the point of interest locations. The result is that some regions do capture spatial location of points of interest digitally, and make them accessible through the LRDW, while other regions have abandoned digital capture entirely and have reverted back to manually recording locations on a special series of hard-copy water rights reference maps.

This problem has been well documented in the previous data assessment report along with estimates of the extent of the problem and the cost to convert and/or capture water license point of interest locations into a digital spatial form.

Other data quality problems reported:

- Inaccurate information resulting from points of diversion not being linked to a stream because the stream was not captured on the electronic base map. Hence, maps often present points of diversion on dry land away from stream. This is being addressed for new data by implementing a business practice requiring staff to link points of diversion to streams before tenure issuance;
- Inaccurate private land information. A high percentage of all water licences are linked to a private land parcel, known as the appurtenant parcel. However, due to the incompleteness of the private parcel data, LWBC has difficulty linking the point of diversion spatially to the location of the parcel associated with the licence;
- Incomplete information on works features attached to points of diversion. It is possible to have more than one water licence at a point of diversion however currently when users request the system to identify water licence references not all licences are identified; and
- Water licensees often locate a physical point of diversion on a stream at a location that differs from the point they indicate on the licence. Other users, e.g. forest companies, do not always identify these changes for updating the water rights mapping although company maps may show accurate locations.

2.2.1.3   Summary of Data Integration Issues

- Quality and completeness issues arising from the conversion process when Tantalis was implemented – substantially documented on the first data assessment report.
- Continued use of hard-copy maps to support operational decision-making – particularly for the water licensing process in some regions.
- Lack of private land parcel information.
- Integration and reconciliation of Tantalis Crown cadastral fabric with the private parcel fabric in the areas where the private parcel information exists.
- Synchronization of Crown reversions and acquisitions between Tantalis and ALTOS – already documented in earlier data assessment reports.
- Insufficient base mapping detail – particularly for stream information where association with Points of Diversion is required.

2.2.2   Oil and Gas Commission

Table 5 - Oil & Gas Commission Summary Table

Agency Role	Designed as a "one-window" for clearing applications for oil and gas exploration, drilling and pipeline construction
Major Activities	• Regulate oil and gas activities and pipelines in BC
	• Provide for effective and efficient processes for the review of applications related to oil and gas activities or pipelines, and to ensure that applications that are approved are in the public interest having regard to environmental, economic and social impacts
	• Encourage the participation of First Nations and aboriginal peoples in processes affecting them
	• Participate in planning processes
	• Undertake programs of education and communication in order to advance safe and efficient practices and the other purposes of the commission
Primary Data Sources	• Petroleum Titles System (PTS) – non-spatial
	• Petroleum Titles Mapping – accessible through MEM MapPlace
	• Tantalis – spatial and non-spatial
	• Regional hard-copy reference maps

2.2.2.1   Oil and Gas Tenures

Oil and Gas Commission (OGC) relies heavily on hard copy maps for tenure and statusing verification and to record new applications as they are received and approved. They recognize that these maps may not contain current and complete information on other tenures and encumbrances. As a result of this deficiency, they must rely on the applicants to identify and address these potential legal constraints on oil and gas development. OGC also refers some applications to other agencies to identify constraints although, over time, referral activities are being greatly reduced due to downsizing in other agencies.

Oil and gas exploration and drilling applications are processed within a very tight timeline (usually within two weeks, often within a day or two). Government has committed to meeting and improving on the two-week time frame and benchmarks performance to some extent against Alberta.

Due to the competitive nature of exploration, companies often do not disclose application areas until two to three weeks before they plan to begin exploration. This tends to create large "bubbles" of work prior to exploration seasons. As well, exploration activity applications tend to focus on a relatively concentrated area for a period of a few months. The OGC has developed a system that fits with this operating environment.

The OGC relies on applicants to identify land status and tenure issues and conflicts as part of the application submission process. Typically, oil and gas companies employ land (agent) companies and surveyors to complete their applications. These submissions include maps and construction plans reflecting the research by the land agents on the status of land ownership and tenures.

Discussions with private land surveyors who attended the Fort St. John workshop indicate that land agents and survey companies may not being using the best available sources, with the exception of Land Title information which they access from BC Online. Forest tenure and road data comes from Ministry of Forests databases and maps, which are not reliable (see MOF section below). As well, guide outfitting and trapping information tends to be captured from small-scale maps resulting poor definition of these boundaries (see WLAP section below). Surveyors acknowledge that they tend to use TRIM 1 rather than TRIM 2 since it is cheaper to obtain and contains a lower density of information (e.g. fewer mapped watercourses crossing a pipeline). When they have serious concerns about the accuracy of data, survey companies will use orthophotos to verify information that can be visually identified.

OGC's review of submissions is focused on checking the submitted maps and related data with the hard copy maps held by the Commission. The OGC then updates these hard copy maps frequently (often daily) to reflect the change in status related to oil and gas tenures.

OGC personnel do not check submissions against other Ministry databases, other than the Tantalis system to which they have access. This tends to create gaps in the completeness and timeliness of OGC hard copy maps with respect to tenures issued by other Ministries and agencies. Most significantly, the OGC finds that forest industry road locations and their status of use (active, deactivated, etc) is often not up to date. This creates risks that oil and gas tenures may be issued without knowledge of road location. Furthermore, oil and gas companies often do not report back on the nature and location of roads they construct during exploration and on the status of the roads (active, deactivated) causing a deficiency information necessary for the evaluation of new oil and gas tenures.

OGC and agencies attending the workshop acknowledged that poor road location and other tenure information resulting from current statusing capability is a significant issue. These agencies agreed there is likely a significant number of roads in the northeast region that are not identified accurately or at all on government databases. This is consistent with the findings documented in the Ministry of Transportation supplement produced in the earlier data assessment work.

The OGC also acknowledged that pipeline information lacks detail (e.g. OGC may not know how many pipelines were built within a pipeline corridor). They do not routinely follow-up with companies to obtain and record as-built plans.

Staff also noted that the Petroleum Act activities not requiring Special Use Permits are not always plotted and updated on the hard copy maps used by the Commission (e.g. camps, remote sumps, borrow pits are typically missed). However, formal gravel pits in right-of-way corridors and tenures that require a Special Use Permit are consistently noted.

OGC representatives discussed plans for enabling electronic client submission of applications to the commission and the construction of GIS databases and systems to support the submission process, but this is in the very early stages. While they did state

their intention to integrate access to data sources held by other agencies into their business processes, they did not discuss any plans for converting their existing hard-copy reference maps into electronic form.

2.2.2.2   Summary of Data Integration Issues

The following is a summary of the data issues impacting the OGC and the issuance of oil and gas related tenures:

- Reliance on hard-copy reference maps for recording and confirming the status of all oil & gas related applications and tenures.
- Client and agents required to do status prior to submission, but may not be using most appropriate government sources.
- Submissions not checked against sources other than those held by OGC. Creates potential for tenure conflict if other types of tenures exist.
- Uncertainty in knowledge of road location, status and use (common to all agencies).

2.2.3   Ministry of Forests

Table 6 – Ministry of Forests Summary Table

Agency Role	Issuance and management of licences and authorizations to harvest Crown timber and build road under the Forest Act
Major Activities	• Prior to issuing new licences or authorizations, determine nature of existing resource tenures or encumbrances on Crown land • Accurately identify and note the area to be harvested under an authorization (e.g. cutting permit, road permit, licence to cut)
Primary Data Sources	• INCOSADA - Integrated Corporate Spatial and Attribute Database – An initiative to bring all key ministry datasets, including forest tenure attributes and mapping, into a single province-wide database based on consistent standards for integration and access • District staff also use FTAS, FAMAP, licensee data and hard-copy maps • TRIM • GATOR for accessing Crown land tenure information

2.2.3.1   Forest Related Tenures

The Ministry of Forests (a.k.a. Forest Service), including BC Timber Sales (BCTS) operates in an environment that is fundamentally different from the oil and gas and mineral business areas. Forest tenures tend to cover large areas of land and continue for long periods of time. Most licences issued to major companies are replaceable and can roll over repeatedly. As well, the Forest Practices Code (replaced now with the Forest and Range Practices Act) requires forest companies to identify planned road and logging activities several years in advance. This allows the Forest Service to take a longer-term approach to reviewing tenure and status issues.

Forest Service personnel acknowledge that their own databases (e.g. INCOSADA) are not kept up to date by regional or district staff. As well, boundary information may not be up to date due to historical boundary errors and changes in the height of land designation for Forest Service boundaries.

Staff noted the importance of distinguishing between private and Crown land ownership and LRMP zoning and related strategies in decisions to issue tenures and harvest authorities.

In Kamloops, Forest Service attendees did not identify underlying issues with INCOSADA and other Forest Service data. Underlying issues identified in Ft. St. John related to a combination of transposition inaccuracies (e.g. photocopying hard copy maps and then digitizing them) and not updating to take into account the "correction" due to the shift from NAD 27 to NAD 83. In Ft. St. John, Forest Service representatives stated that district management takes a risk-based approach to working with underlying errors in boundaries. Since most forest tenure areas are fairly stable, Forest Service managers generally know the nature and location of other tenures in the commercial forest areas.

This allows them to "risk manage" and issue cutting permits and road permits, knowing that their data bases are not up to date.

In Ft. St. John, Forest Service personnel pointed out that "correction" of tenure boundaries (particularly cutting permit and road permit locations) could trigger a significant "cascading" effect of workload. Adjustments to the boundaries of one cutting permit could trigger shifts in the location of neighbouring blocks. Staff are concerned about funding the cost of correcting this information prior to the implementation of ILRR, recognizing that the Forest Service cannot keep up with its current workload (before taking on the "correction" workload).

2.2.3.2   Summary of Data Integration Issues

- INCOSADA not kept up to date by all districts resulting in missing, incomplete or inaccurate information.
- Local knowledge and 'risk management culture' drives program delivery decisions at the district level, at the expense of keeping central databases (i.e. INCOSADA) accurate and up to date.
- Correction of forest tenure boundary information would trigger 'cascading' workload effect in relation to neighbouring tenure boundaries.

2.2.4   **Ministry of Energy and Mines**

Table 7 - Ministry of Energy and Mines Summary Table

Agency Role	Issuance of exploration and development licences for leases and permits for mining purposes.
Major Activities	Determine nature and status of existing mining claims and other legal tenures
Primary Data Sources	Printed and digital maps are generated from MiDA. MiDA records are housed in an Oracle RDB database containing the record data on all Free Miner Licenses, and mineral, placer, and coal tenure information, administrative reserves, and tenure holder attribute data. It also contains limited information on areas that have an effect on the above data (alienation). Digital maps are updated when the information is plotted into MiDA by Titles Technicians located in Victoria. Attribute records are updated by the Gold Commissioner.

2.2.4.1   **Mineral Tenures**

During the workshop in Kamloops, participants discussed data requirements relating to statusing, tenuring and licensing of mineral and exploration activities. Energy sector aspects of these functions are discussed in the section of this report relating to the Oil and Gas Commission.

Based on the Kamloops session, Energy and Mines tends to rely on applicants to identify existing tenures and document land status when applying for claims or leases. MEM does not vet the data submitted by applicants, other than to check it against their own hard copy maps (generated through MiDA) which tend to focus on identifying existing claims, leases, licences, and reserves and not other tenure rights, encumbrances or constraints. MEM relies on referrals to other agencies to identify these other tenures as well as other conflicts. Due to workload, these agencies often do not complete the referral before the claim is granted. MEM takes the view that the applicant bears the risk of ensuring that he or she has the applicable rights prior to investing in exploration activities.

Representatives from other Ministries, such as Water Land and Air Protection, raised the point that due to downsizing, they were moving away from processing application specific referrals and that now applicants are expected to demonstrate compliance with LRMP zoning and constraints. Furthermore, it was implied that the issuing agency, such as MEM, would ultimately be accountable for ensuring compliance with LRMP's and that other Ministries and agencies such as MEM should not rely on referrals.

A similar approach is also used for claim staking and for mine development applications although mines with production in excess of 25,000 tonnes per year are subject to an environmental impact assessment. Attendees felt that such assessments would identify tenure and encumbrance issues as well as environmental risks.

2.2.4.2   Summary of Data Integration Issues

- Extensive reliance on hard-copy maps (held by Gold Commissioner) to record claim information. While these maps may contain up to date claim information, they may not provide a complete picture of other tenure rights, encumbrances or constraints.

- Hard copy maps will continue to be used in addition to electronic versions in MiDA. Since there is a delay of at least 20 days from the time a claim is staked and title obtained to when it is entered in MiDA, a hard copy map is the only source of spatial extent and location during that interim period.

2.2.5   Ministry of Water, Land and Air Protection

Table 8 - Ministry of Water, Land and Air Protection Summary Table

Agency Role	•	Responsible for issuance and administration of trapping and guide outfitting tenures under the Wildlife Act
	•	Responsible for administration of parks, including access and any commercial activities, and administration of other protected areas such as ecological reserves
Major Activities	•	Environmental protection of air, water and land quality
	•	Environmental stewardship of biodiversity, including wildlife, fish and protected areas
	•	Park and wildlife recreation management, including hunting, angling, park recreation and wildlife viewing
Primary Data Sources	•	Protected Areas Registry
	•	Contaminated Sites Database
	•	Guide Outfitter Territories & Traplines
	•	Various LRMP datasets

2.2.5.1   Trapping and Guide Outfitting Areas

The Ministry of Water, Land and Air Protection (WLAP) is responsible for the issuance and administration of tenures, licences and permits relating to trapping and guide outfitting. Both tenures convey rights over a specific land area.

For the most part, trapping and guide outfitting tenures were issued decades ago when there were few, if any competing land uses. Tenure boundaries were plotted on small-scale maps covering large areas and a scale of 1:250,000 or smaller. This data was not intended for and hence is not suitable for use in land statusing because of the poor definition of the boundaries when combined with data captured and 1:20,000 or larger.

WLAP does not have the resources to keep information on these tenures up-to-date and relies on other agencies (LWBC, Forest Service, etc.) to identify and record changes. Thus, although they have custodial responsibility, they have, due to funding shortages, delegated the data management to other agencies by default. However, with funding shortages also facing other agencies, it is unlikely that this information is being kept up to date.

2.2.5.2   Identification and Protection of Parks and Protected Areas

WLAP is also responsible for the administration and protection of parks.

In Kamloops, workshop attendees cited three major issues regarding the accuracy of parks status and location data:

- Parks data is housed in two different databases: Tantalis, held by Registries Department and the Protected Areas Registry held by the Parks and Protected Areas Branch of WLAP. These two databases can sometimes provide conflicting or different information regarding the location of parks and the designation of

areas as parks, however, a process is currently underway to resolve some of the Parks and Tantalis discrepancies;

- Government re-surveyed and updated the location of heights of land to aid in defining forest district and other administrative boundaries. Park boundaries are often delineated by a portion of a district or some other administrative boundary. Since the park data bases have not been updated systematically for changes in the height of land definition, the park boundary will appear to vary from the district boundary when they are presented on maps; and

- The definition of a "park" for statusing and mapping purposes can vary. Certain ecological reserves and protected areas are sometimes treated as and shown as "parks". As well, staff noted that government must define how ecological reserves and protected areas should be designated in registries and for statusing purposes. This creates the risk that an agency may issue authorizations involving development to a tenure holder that unknowingly takes place within a park.

Participants in Kamloops noted that encumbrances and other constraints on tenure issuance are established through land use plans. Some participants raised concerns that in conducting status checks, government staff may not be aware of encumbrances that may arise from land use plans. They cited the need to include land use plan information to the ILRR. This raises an important issue relating to the overall scope and purpose of the ILRR and its relationship to the LRDW.

2.2.5.3   Summary of Data Integration Issues

- Lack of metadata concerning initial capture and maintenance of trap-lines and guide-outfitter boundaries risks inappropriate use of the data for purposes that were never originally intended (such as operational land and resource allocation decisions).

- Uncertainty regarding official source for information concerning parks and protected areas and the ongoing maintenance of these boundaries based on relationships to heights of land and other administrative boundaries results in inconsistent definition of the boundaries across the various sources over time.

- Uncertainty regarding access to official sources of encumbrances and constraints established via land use planning processes (such as wildlife habitat areas established via LRMP process) and whether or not these should be included in the ILRR.

3. IMPEDIMENTS TO ILRR DATA INTEGRATION

The section analyzes impediments to the integration of land and resource data in BC. This analysis is based on the regional workshops undertaken in this specific assignment, as well as all the preceding data assessment work conducted over the last 12 months.

Open dialogue about these impediments among the many ILRR stakeholder groups may help to drive the way forward in addressing some of the issues preventing integration of data. However, some of the impediments, especially relating to organizational culture, are quite ingrained and will be very difficult to change.

The impediments are grouped in three major categories:

- Organizational and Cultural
- Standards
- Technology

Each major category is further broken down into a number of sub-topics. Specific illustrative examples are identified, where appropriate. These may have emerged through the regional workshops, or during any of the former data assessment work. Where possible, suggestions or recommendations are made which may help to reduce or eliminate the impediment. Often there is insufficient information to quantify the extent of the issues arising from a particular impediment

3.1 Organization and Culture

There are numerous barriers to the integration of land and resource data stemming from organization and culture. These are identified and discussed as follows, but not in any particular order or priority.

3.1.1 Lack of confidence in electronic data sources

Many of the rights-granting agencies that participated in the workshops still rely on hard-copy sources to greater or lesser degrees. While regions are using more and more electronic sources and tools for accessing those sources, there is still widespread reliance on hard-copy, including maps and documents, for operational record keeping. For example, OGC (oil and gas tenures) and Government Agents (mineral tenures) regard hard-copy maps as their most reliable and complete records, and their business processes include the updating of these maps when new applications come in the door. Regardless of efforts to update electronic sources (centrally or regionally) with current application, tenure and other business specific information, the hard-copy source persists as an important tool in operational decision-making.

Reasons cited for use of hard-copy included, lack of appropriate access tools and training, lack of confidence in the accuracy, completeness and timeliness of electronic sources, service delivery pressures and in some cases such as Government Agents there is a legal and regulatory requirement to maintain hard-copy maps. One agency has adopted a very cynical view of electronic sources based on numerous previously unsuccessful (in their eyes) attempts to provision electronic sources and integrate them efficiently into their business processes. For these reasons it will be difficult to move agencies away from their reliance in hard-copy sources and a lot of effort will be required to prepare electronic data sets and to train and support staff in the use of electronic data sets and tools.

Of the many issues associated with continued updating of hard-copy sources, two stand out which impact the integration of data. Firstly, hard-copy data is inherently incompatible with electronic data, so integration of hard-copy with electronic is impossible without an extensive and expensive data conversion process. Efforts to quantify the time and effort to convert hard-copy into electronic form were performed for this assignment.

The second issue relates to the currency of data. In the case of OGC, the reference maps used as the base for plotting new oil and gas applications and tenures is quite out of date and even uses an older geo-referencing standard than the current provincial standard (i.e. NAD 27 vs. NAD 83). The net effect of this is that two incompatible and inconsistent sources are maintained. One source is a regionally maintained, but out-of-date hard-copy reference map containing up-to-date business specific application and tenure information and the other a more up-to-date electronic base (e.g. Tantalis that may not contain complete and up-to-date business specific application and tenure information. This typically occurs because of a backlog or lag in the update process. The hard-copy source is used extensively by the rights-granting agency to support operational decision-making, while the incomplete electronic source is used by other agencies in confirming land status.

This situation is not unique to OGC. Similar processes have also been observed for the handling of water licenses and mineral tenures in some regions. In the past, when a new set of reference base maps was prepared, a hard-copy was sent to the regions and considerable effort expended in transcribing all the business specific information from the old base to the new base. However, workforce adjustment and increasing workloads have significantly curbed these activities, with the result that no single source, hard-copy or electronic, contains complete and current view to support the operational decision-making demands for the rights-granting agencies.

This issue could be one of the most difficult to solve for the ILRR Project, particularly for the proposed North-East deployment. Provisioning complete and reliable electronic sources and backing them up with the tools and training required to move staff away from dependence on hard-copy sources will require significant change management efforts.

3.1.2   **Multiple sources for same data**

Multiple sources for the same data contribute significantly to problems with data integration. Not only is it inefficient from a data collection and maintenance perspective, but the risk of inconsistently defined data across the various sources increases significantly as does the uncertainty of identifying the official source. These types of problems are clearly illustrated in the sample map sheets that were prepared for the workshops where there are various boundaries that are inconsistently and ambiguously defined. Much of the conflicting or inconsistent line work is the result of data from different sources collected at different points in time using different collection techniques, standards and tools.

It is acknowledged that some agencies depend on data defined by other agencies to support their business needs. In many cases this is accomplished by acquiring a copy of a subset of a dependent dataset and using it as a reference for agency specific information (e.g. Park or Ecological Reserves for forest cut blocks). The copied data may be transformed, reformatted and manipulated to suit the particular technology standards of the acquiring agency, incorporated into the acquiring agency's dataset and published accordingly. If the relationship back to the source is not retained, then there is little hope of keeping the copied data synchronized with the original (which may not be the official source since the copy may not have been acquired from the official source). A complicated web of dependencies has now emerged and in some cases it has become quite unclear as to who has the official responsibility for the maintenance, access and distribution dependent datasets. For example, confusion was evident during the workshops as to where the official source for Parks and Protected Area boundary data resided. Some identified the Protected Areas Registry held by WLAP, while others thought that Tantalis, held by Registries Department was the official source.

This is issue is primarily one of data custodianship issues and should be addressed by the Data Custodian Council.

3.1.3   **"Project" orientation**

In some cases land resource data is collected to serve the needs of a particular project. LRMPs and treaty negotiations are good examples of this. Considerable effort is expended to capture, acquire, massage and analyse the data to meet the project objectives. An issue here is that information acquired, used and created within the scope of the project may have considerable value outside the scope of the project, but this may not have been recognized during the planning of the project, or worse, recognized but disregarded in favour of the pressures to complete the project on time and on budget.

While it is recognized that each project will have its own unique requirements for data, the potential use of the project information outside and beyond the immediate scope and timeframe of the project could be considered and data standards established and used accordingly. This may require an adjustment in thinking by project team members to be aware that information created inside the project may have value outside the project and

serve a broader set of business needs and purposes. For example, resource management zones resulting from an LRMP process that have potential to limit certain activities on land and the disposition of certain kinds of interests should be viewed as 'corporately accessible' information. The standards for defining such zones should be consistent, regardless of the originating project, and the information accessible from an officially recognized location, such as the ILRR or the LRDW. Is should not be required for a user to navigate a maize of project specific information in order to access this information.

3.1.4   Management culture

Maintenance of electronic data sources is significantly affected by management culture in the regions. For various reasons, some agencies have adapted 'risk management' approaches to offset the uncertainty arising from incomplete, inaccurate or conflicting information. Ministry of Forests is a good example of this where local decision-making autonomy (vested in the District Manager) combined with local expert knowledge are used to 'risk manage' the business when the information that would otherwise be used to support the decision is inadequate.

While this may be an appropriate way to manage business, it does not help to improve the quality and completeness of electronic records. Furthermore, over time as land and resources are developed, the land and resource issues become more contentious, and the pool of local expertise diminishes, the risk of a resource conflict increases substantially.

Changing the management culture to recognize the important role that quality electronic records can play in reducing decision-making risk will likely be very difficult.

3.1.5   Organizational change

All the rights-granting agencies have been significantly impacted by organizational change and downsizing brought about by funding and staff reductions. These changes have blurred the traditional lines of responsibility for the collection, management, distribution and access of data, and may have resulted in reduction or elimination of data entry checking procedures and other data maintenance functions.

A further aspect of organizational change is heightened tension between regions and headquarters regarding responsibilities for data collection and maintenance. Headquarters appear to view regional staff as being somewhat undisciplined in data management activities, while regions view headquarters as unconnected with the real world, and providing systems that don't meet their business needs or are inadequately supported.

Unfortunately, these tensions create an environment where data quality ultimately suffers. Given the current service delivery pressures, regional staff are not motivated to take the time to enter data into a system and to check it if they feel the system does not work for them. Over time they will develop their own systems or workarounds that work for them, and any opportunities for integration be completely lost.

3.2   Standards

Various categories of standards enable or limit the potential for integration of disparate sources of data. The following were identified or inferred from the regional workshops and the earlier data assessment work.

3.2.1   Geo-referencing

Consistent geo-referencing standards are fundamental to the integration of spatial data. While such standards have been in place for BC government spatial data sets for a number of years, there may still be some legacy data that does not confirm to these standards, including many of the hard-copy reference maps still used by regional staff that are based on the older NAD 27 standard.

The conversion of agency specific information from these reference maps into electronic form, such as oil and gas information will also require conversion to the current NAD 83 standard to enable spatial integration of data.

3.2.2   Metadata

A common problem with many of the data sources identified for the ILLR and discussed in this report is the lack of metadata enabling a user to determine the fitness for use for a desired purpose. This was an issue cited by the workshop participants repeatedly through this assignment, and has been a recurring theme in the management of data across the resource ministries for a number of years.

An excellent example that emerged during the workshops would be publication of metadata regarding the capture of guide-outfitter territories from small-scale maps in a rather crude fashion. By knowing this information, a user could determine if the data was suitable for the intended application, since the original capture of the information was almost certainly meant for different purpose.

While it is acknowledged that MSRM is making progress in this area, responsibilities for the collection, maintenance, access and type of metadata should be clearly established and adhered to for every data source to be included in the ILRR.

Given that it will take many years to improve the quality of data in the ILRR, publication of completeness and accuracy information as metadata will at least give users the opportunity to decide whether the data fit to use or not.

3.2.3   Data Modeling

One of the biggest impediments to the integration of data is inconsistency in data models across data sources. This has been a big enough problem in trying to integrate simple textual data with items like names and addresses, but is much worse when trying integrated spatial data consisting of points, lines polygons, grid cells and attributes.

Typical data modeling problems include:

- **Definitional problems.** These are problems in the underlying definition of data entities and attributes where the same item may have different meanings in different sources. For example, the term parcel could mean a legal parcel in one system, and an assessment parcel in another system and both are legitimately different despite sharing the same name.
- **Structural problems.** These are problems in the underlying structure of data and the relationships between data elements. For example a parcel legal description may be modeled as a text string in one database, and a series of more granular fields in another database, or, an administrative boundary may be modeled as a polygon in one system and a connected series of lines in another system. In either, example, integrating both pieces of information.

3.2.4   Technology

Technology standards are a big factor in the current state of land and resource and the potential of integration of data collected and managed by different technology platforms. Discussion of impediments relating specifically to technology standards is identified below.

3.3   Technology

The following are impediments to the integration of data arising from the use of different technology platforms by different agencies over a number of years.

3.3.1   Evolving & Maturing Technology

Technology tools and platforms have matured and evolved of the years, particularly for spatial technologies. Today there are much more powerful and flexible ways organize (i.e. model) and store spatial information than existed during the years when much of the information that comprises the ILLR data sources were being initially compiled.

The limitations that existed in prior versions of tools affect the degree to which the data created using these tools can be integrated. An extreme example of this would be any data created using Intergraph tools in IGDS format and the issues associated with translating, transforming and integrating that data with more recent data stored in, say, ESRI's ArcSDE. Even the ESRI tools have gone through a number of iterations of fundamental change in the way the data is internally stored and managed. This often creates problems in the forward migration of data from the old to the new way of storing things when systems are upgraded or replaced. In spite of claims of forward compatibility, these processes can be extremely time consuming and expensive.

There is still likely a large amount of legacy spatial data held in government data sources that were compiled using older versions of tools with less flexible data structures and it

may be necessary to convert and transform some or all this data into structures supported by the current technology standards in order to achieve integration.

3.3.2   Different Technology Standards

This has traditionally been one of the biggest impediments to the integration of data, particularly spatial data. Different tools have always had fundamentally different ways of storing and maintaining data. Recent efforts to standardize on a single vendor platform have brought about some success for those agencies that have standardized on a particular tool, but the debate continues regarding whether to standardize on a toolset, whether to standardize the protocols to exchange data between different systems, or some combination of both.

While ESRI tools have become the de-facto standard tools in the BC government, other tools are used, such as MicroStation from Bentley Systems Inc. and Autodesk MapGuide from Autodesk Inc. This diversity will continue to present problems for accessing and integrating data.

4.   RECOMMENDATIONS

The following recommendations arise from the data integration workshops.

These recommendations reflect the goal of creating a complete and contiguous parcel fabric to support users of the Integrated Land and Resource Register (ILRR).

1. **Develop agency specific plans to address data deficiencies and data quality issues in existing information targeted for inclusion in the ILRR.**

    Data deficiency is most apparent in the north-east region in relation to the energy and forestry sectors. Oil and Gas Commission staff rely on a combination of hard-copy reference maps and data submitted by the energy industry to process applications. Electronic information regarding the location and nature of existing energy industry roads and pipelines and other tenures such as trapping and guide outfitting is out of date and inaccurate.

    Due to the inaccuracy of electronic information regarding energy sector roads, the forest industry and the Ministry of Forests carry out separate steps to identify the location and nature of these roads. As well, the Ministry of Forests faces a substantial backlog in electronically updating the location of cutblocks and roads.

    Staff from these ministries who participated in the workshops recommended that government take the following steps prior to designing and implementing the ILRR:

    •   Determine the nature of information required on each type of tenure;

    •   Assess the current status of the required information in terms of government electronic data bases;

    •   Identify the other sources of information used to obtain this information;

    •   Determine the specific improvements necessary to collect the required data and to place it in an electronic form that will be acceptable for the ILRR project;

    •   Estimate the cost and time required to make these improvements in the data; and,

    •   Propose data upgrade priorities and critical path.

2. **Confirm the scope of legal interests, rights, designations and encumbrances to be included in the ILRR and review land use planning and designation data needs and status prior to designing ILRR**

    Participants raised a number of issues and questions relating to the identification of land use zones on provincial databases. Since these issues extended beyond legal tenuring and status matters, they were considered to be outside the scope of this engagement. Based on comments from participants, it is evident that front line personnel in these ministries have a number of concerns about the ability of government databases to accurately capture and identify land use zones and related constraints and conditions. Most

ministries due to funding reductions, such as WLAP, are phasing out the provision of referral responses to other agencies. Ministries involved in issuing tenures and authorizations and the licensees will require access to and accurate designation and description of land use constraints and conditions to support their decision-making.

Prior to commencing design of the ILRR, government must determine the nature of land use planning information that needs to be captured on provincial databases, the current status of these databases, and the extent to which this information will be linked to or accessible through the ILRR.

3. Assist agencies in the transition from the use of hard-copy reference maps to digital base maps

Discussions with workshop participants and their follow up comments indicate that front line staff in the ministries believe that the electronic data essential for accurate statusing and land and tenure registration is well below an acceptable level. If current electronic data sources were made accessible through the ILRR, these agencies and their clients would place virtually no reliance on the ILRR as an authoritative source or record of interest and encumbrances for land and resources. They would, instead, use a range of electronic and hard-copy forms of data much as they do now, plus their own local knowledge, in making land use and tenuring decisions.

4. Establish custodial responsibilities for ILRR data sources

Custodial responsibilities need to be clearly defined and communicated concerning the collection, maintenance, access and distribution of ILRR data sources. These responsibilities must include definition of official data source for use in the ILRR.

5. Establish metadata standards and management processes for ILRR sources

Custodial responsibilities should also extend to establishing metadata standards and practices for ILRR source data. Such metadata needs to be published and made accessible to agency users to enable to determine the official or best available sources and to assess the fitness of data for use.

6. Develop integrated ILRR data model

Key to the eventual integration of ILRR data will be an integrated or harmonized data model wherein all ILRR data elements, attributes and relationships are clearly defined. This model should be major deliverable of the ILRR requirements and architecture phase.

SIGN-OFF

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