

Questionnaire 3D-Cadastres: status November 2010

Canada, Quebec



IMPORTANT PRELIMINARY NOTES:

This questionnaire was fulfilled by Jacynthe Pouliot, professor at Laval University-Geomatics Department and Louis-André Desbiens, Direction de l'enregistrement cadastral at Foncier Quebec, a sector of the Ministry of Natural Resources and Wildlife responsible for the cadastre and land rights registration covering both private territory and public land.

In Québec, the State has taken responsibility for the protection of land rights, but it fulfils its responsibility differently according to whether the rights involve public or private land, depending on the legal rules that apply. Private land comes under the civil law, which regulates relations between individuals, where public land comes under the administrative law, which regulates relations between individuals and the state. Public land are registered in the Register of the Domain of the State while rights related to the private territory are published in the Land Register.

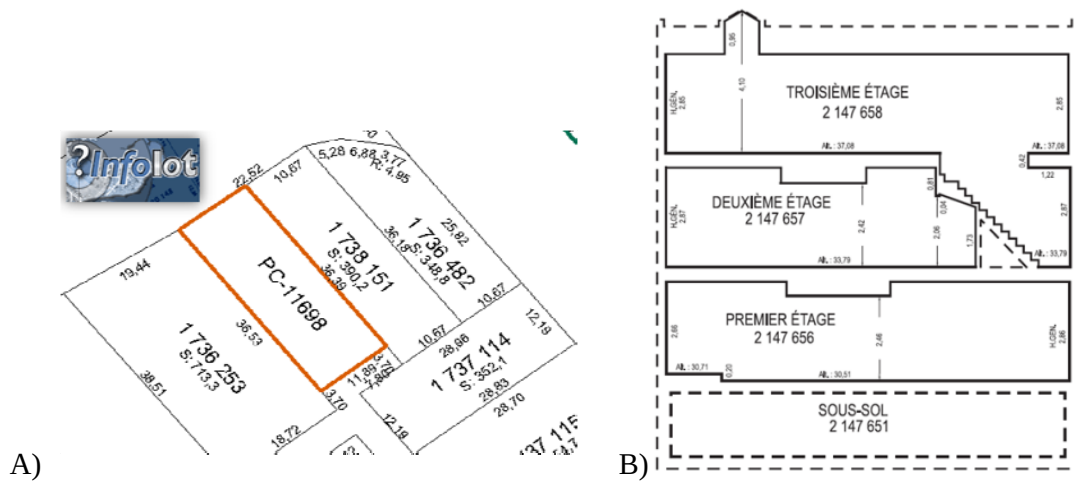
The rules governing the *Land Register* are set out in the *Civil Code of Québec* (C.C.Q.) and are applied uniformly throughout Québec¹. The Code establishes a system for the publication of rights that is based on the cadastral plan systematically updated. The cadastral plan is the material support for the land book, just as the land book is the legal support for the publication of rights². Each immovable property is designated by a number and represented graphically on the plan, with its dimensions, area and boundaries, and located in relation to surrounding properties.

The cadastre plan is a 2D graphical description of the limits and the size of the lot where each property has its own ID (unique lot number). In the case of superimposed properties, called “cadastre vertical”, the cadastral plan shows a polygon with a specific number (PC-XX) but without any official measures. The PC number refers to one or more complementary plans (PC). These PC plans are prepared by land surveyors (private firms). The private firms usually stored the original PC as a CAD file but this file is not available for others users. The users of the PC have access to paper format or a 2D pdf file (an image of the draws) resulting from a scanning process. On the PC we can find vertical profiles of each vertical lot and horizontal plans. The following pictures show an example of the cadastral plan with a PC polygon and an example of a vertical profile available on a PC. You can get another example of the content of a PC file at

<http://cadastre.mrnf.gouv.qc.ca/documents/produits-services/pdf/plancomplementaire.pdf>.

¹ In Québec, the land registration and cadastral systems are established by the state for the entire province. However, various organizational mechanisms ensure that municipalities systematically receive cadastral data and data on property transactions, allowing them to establish and update their land taxation systems.

² *Commentaires du ministre de la Justice – Le Code civil du Québec*, Volume II, p. 1910.



- A- An example from Infolot (<http://infolot.mrnf.gouv.qc.ca/ddci/index.asp>) of the cadastral plan that refers to a complementary plan (PC)
- B- A vertical profile of the superimposed properties extracted from the PC plan

It is thus important to understand that the current Quebec cadastral system does not offer volumetric representation of 3D parcels. Instead, it proposes vertical profiles from which the third dimension can be derived. This is why, some questions hereafter are not applicable to the Quebec context.

Finally, we have to specify that the following answers of the questionnaire represent the point of view of land surveyors who are involved in the process of producing/managing cadastral plans. We are not necessary fully aware about the application of the concept “3D parcels” and RRR related to public properties or natural resources, such as mines or subterranean infrastructure, although we tried to fulfilled questions related to theses topics.

To answer the questionnaire and for some questions, we assumed that 3D parcels = 3D lots = 2 1/2D representation of the lot, even if this hypothesis is not fully adequate.

Some of our references are:

- MRNF 2003. Instructions pour la présentation des documents cadastraux relatifs à la mise à jour du cadastre du Québec. Version 2.0, Février 2003, document rédigé par le ministère des Ressources naturelles du Québec (MRNF), Direction de l’enregistrement cadastral, Gouvernement du Québec.
- MRNF 2009. Instructions pour la réalisation d’un mandat de rénovation cadastral. Version 6.0, Mars 2009, Document rédigé par le ministère des Ressources naturelles et de la Faune du Québec (MRNF), Direction générale de l’arpentage et du cadastre, Gouvernement du Québec. Available at this link <http://cadastre.mrnf.gouv.qc.ca/documents/produits-services/pdf/instruction-V6-0.pdf>.
- Pouliot, Roy, Fouquet-Asselin, Desgroseilliers, 2010. A First experiment for the construction of a volumetric representation. Presented at the 3DGeoinfo conference, Berlin, De. Nov. 3-4. 2010.

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This questionnaire is an activity of the FIG working group 3D-Cadastrres 2010-2014. The purpose of the survey is to make a world-wide inventory of the status of 3D-Cadastrres at this moment (fall 2010) and the plans/expectations for the near future (2014). By sharing this information, it should be possible to improve cooperation, learn from each other and support future developments. For more information on the FIG working group on 3D-Cadastrres see the website of this working group www.gdmc.nl/3DCadastrres. Now a few notes and suggestions, which should be helpful when completing the questionnaire:

- In this questionnaire the concept of 3D-Cadastrres with 3D parcels is intended in the broadest possible sense. However, what exactly is (or could be) a 3D parcel is dependent on the legal and organizational context in the specific country (state, province). 3D parcels include land and water spaces, both above and below surface.
- A more formal definition: A 3D parcel is defined as the spatial unit against which (one or more) unique and homogeneous³ rights (e.g. ownership right or land use right), responsibilities or restrictions are associated to the whole entity, as included in a Land Administration system.
- As the definition above is quite abstract, it is tried in the questions below to be more specific and real world situations are used. Also two example sets of partial/preliminary answers are included from Australia, Queensland and The Netherlands, to support the questions and to be of help when formulation the answers for your jurisdiction.
- A 3D parcel is a 'legal object' describing a part of the space. Often there is a relationship with a real world/physical object, which can also be described in 3D. Please be aware of the difference between these two types of objects and that the focus in the context of 3D-Cadastrres is on 3D parcels (spaces of legal objects).
- If a certain question is not relevant or if you have no clue what to respond, do not spend any time on this (and leave the field blank).

³ Homogenous means that the same combination of rights equally apply within the whole 3D spatial unit. Unique means that this is the largest spatial unit for which this is true. Making the unit any larger would result in the combination of rights not being homogenous. Making the unit smaller would result in at least 2 neighbour 3D parcels with the same combinations of rights.

1. General/applicable 3D real-world situations

This part of the questionnaire refers to the applicable 3D real-world situations to be registered by 3D parcels. It also addressed the types of 3D geometries, which are considered to be valid 3D representations for these parcels.

	Canada (Quebec) 2010	Canada (Quebec) 2014
1.1. Are all 3D parcels constrained to be within one surface (2D) parcel?	Yes it is constrained to surface parcel but not necessarily one parcel. The volumetric dimension is not supported by our cadastral system. The 3 rd dimension of a 3D parcel is represented on 2D plans (available via PC plans) that do not contain volumetric representation but vertical profiles. In the context of condominium, one land parcel is usually enough (but not always) to indicate the PC number, but this is not a restriction. This is especially true in the case of properties having large spatial extent such as subways where several land parcels are used to refer at the PC plans.	
1.2. Are ambulatory ⁴ boundaries permitted?	Theoretically they are, but we did not yet face this kind of situation in the vertical dimension, only for horizontal representation.	
1.3. Is it allowed to have 3D parcels not related to physical constructs or objects?" (e.g. airspace, subsurface volumes)	Yes. Usually the 3D parcels do refer to constructions (buildings, subway, tunnel), but it is not a restriction since we can	

⁴ An ambulatory boundary is a boundary of a land parcel which follows the movements of a natural feature such as a river. Its position determined at points of time (when a survey is carried out), but between such "fixes", the definition of the property is the position of the real world natural feature.

	apply it to mining properties for example.	
1.4. Are disconnected parts of a single 3D parcel allowed?	No.	
1.5. Limitation – e.g. must the 3D parcel be described by a boundary definition?	Not sure to understand the meaning of limitations? In terms of representation, there are no specific restrictions.	
1.6. Are curved surfaces to bound the 3D parcels allowed?	Yes, no specific restrictions about this technical aspect.	
1.7. Must the curved surfaces (if allowed) be cylindrical sections, or any other constraint?	No restrictions.	
1.8. Any other constraints – e.g. all surfaces must be horizontal or vertical?	No.	
1.9. Is there generic legislation (law and/or regulations) for 3D descriptions of parcels? If so please, mention law and article(s).	There is no legislation for the <u>description</u> of parcels but guidelines exist for the production of cadastral plan (horizontal plans and vertical profiles). (see MRNF 2003) There are legislations (Loi sur le cadastre and the Civil code) that refer to cadastre and regulation issues. Civil code of Quebec : rules 3026 to 3045.	
1.10. Is the legal text available in original language?	Yes, French and English	
1.11. Is the legal text (relevant part) available in English translation?	Yes.	
1.12. Do you have example descriptions of typical 3D parcels; either ‘prototype’ or ‘operational’?	See MRNF 2003 and a prototype presented in the article Pouliot et al., 2010	
1.13. Is there a formal model for the 3D parcels (UML style); e.g. based on ISO TC211 series?	No.	
1.14. Are natural resources (groundwater, mining rights) considered as 3D parcels?	Mining rights are currently published in the Register of real right of State resource development, a section	

	of the Land Register which the law declares to be property separate from the land on which it is exercisable. This kind of object is not necessary represented in the cadastral plan, but could be if the owner request this action. For now, we find no such example in the cadastral plan.	
1.15. Are polluted areas considered as 3D parcels (as legal restrictions are associated to these spaces: above and below surface)?	N/A since the cadastre system does not include this kind of information	
1.16. Are spatial plans considered as 3D parcels (as rights or restrictions are related to them)? Sometimes also called spatial development plans, zoning plans or physical plans (land use, urban, regional, environmental,...)	N/A since the cadastre system does not include this kind of information	
1.17. Any other geometric issues?		

2. Infrastructure/utility networks

This refers to the situation where an infrastructure network is considered to be defined within the cadastre. For example in some jurisdictions, an underground network might be privately constructed for the purpose of leasing space in it for other organisations to run cabling. In this case, a network, or part of that network may be considered to be a real estate object.

	Canada (Quebec) 2010	Canada (Quebec) 2014
2.1. Do you register network parcels? (e.g. subterranean conduit networks)	A railway network or a network of cable communications, water or gas distribution, power lines, oil or gas pipelines or sewage conduits are currently immatriculated in the Register of real right of State resource development which the law declares to be property separate from the land on which it is exercisable. Theses kinds of objects are not necessary represented in the cadastral plan, but could be if the owner requests this action. We currently find few of them in the cadastral plan.	
2.2. If so, can the network structure be traced in the database(s)?	Not the network traces itself but an approximate view of its shape via the number of land surfaces intersecting the network (i.e. all PC-Polygons intersected).	
2.3. Does the jurisdiction have private networks? If so please, mention law and article(s).	Yes.	
2.4. If so, are they registered as 3D property parcels?	The network are registered but not represented (see 2.1). They are approximately described in text document.	
2.5. Is the legal text available in original language? If so, give	Yes.	

references to relevant document(s).		
2.6. Is the legal text (relevant part) available in English translation?	Must be.	
2.7. Do you have example descriptions of typical 3D parcels for networks; either 'prototype' or 'operational'?	We can find some.	
2.8. If the network (legal) objects break at the surface parcel, how do you deal with intersecting networks or vertically parallel networks?	N/A	
2.9. Any other geometric issues?		

3. Construction/building units

This refers to 3D properties that are related to constructions and apartment (condominium) buildings. The individual units are often defined by the actual walls and structure of a building, rather than by metes and bounds. E.g. “unit 5 on level 6 of ... building”.

	Canada (Quebec) 2010	Canada (Quebec) 2014
3.1. Do you register 3D construction/building units?	Yes.	
3.2. If so, what are the most important types? E.g. apartment units, or also other buildings or even more general constructions (infra related; such as bridge, tunnel or even other, such as windmills,...)	Most apartment units.	
3.3. Does the jurisdiction have construction/building units? If so please, mention law and article(s).	Yes. See for examples (the list is not exhaustive) C.c.Q : rules 996, 1007, 1009, 1010, 1011, undivided co-ownership (1012, - 1037), Divided co-ownership (1038-1109), 1787-1794, Cadastral plan (3033, 3041, 3061, 3066)	
3.4. Is the legal text available in original language?	Yes, French and English	
3.5. Is the legal text (relevant part) available in English translation?	Yes.	
3.6. Do you have example descriptions of typical 3D parcels; either ‘prototype’ or ‘operational’?	See MRNF 2003 and Pouliot et al., 2010	
3.7. What would be typical 3D boundaries in an apartment complex: middle of the wall and floor/ceiling, or walls, floors/ceiling as neutral/shared 3D space?	The external boundary of the walls, the floors and the ceiling.	
3.8. Is common property inside the building registered? If so, how?	The common property that includes the land, the walls, the stairs, etc, is registered under a unique lot number. They are represented in the complementary plans (PC). Common parts are indicated in the deed and in the Declaration of co-ownership.	

3.9. Who owns the common property inside the building?	All co-owners and manage by a “syndicate of co-owners”.	
3.10. Who owns the land on which the apartment is built?	Idem The land parcel is part of the common property.	
3.11. Any other geometric issues?		

4. X/Y Coordinates

	Canada (Quebec) 2010	Canada (Quebec) 2014
4.1. Do the plans of survey guarantee X/Y coordinates? (and are they relative or in an absolute spatial reference system?)	No. They are stored in an absolute spatial reference system (MTM) but it is its relative position that make it official (see C.c.Q. 3026).	
4.2. Are the cadastral database coordinates authoritative?	No. They have no official value but they could serve for cadastral operation.	
4.3. If not, what is the authoritative source of X/Y coordinates?	None.	
4.4. Do you have parcels defined by the walls of a building (with no recorded geometry)?	Yes, in the case of internal common parts such as walls they act as a boundary instead of X/Y coordinates.	
4.5. What is the spatial reference system for X/Y Coordinates?	MTM, NAD83, GRS80.	
4.6. Any other X/Y coordinate issues?		

5. Z Coordinates/height representation

	Canada (Quebec) 2010	Canada (Quebec) 2014
5.1. Are the Z coordinates of 3D parcels relative to local ground?	On the PC plans and on the vertical profile we do not find any Z coordinates but an orthometric altitude (geoid) and H (height) relative to the altitude.	
5.2. Are Z coordinates reduced to a standard datum (absolute)? If so, what is the spatial reference system for the Z coordinate?	datum CGVD-Canadian Geodetic Vertical Datum 1928.	
5.3. In principle possible to store both relative and absolute Z coordinate?	Only relative.	
5.4. Is the earth surface (height) explicitly stored (in the DCDB or other accessible register)?	No.	
5.5. What is the source of elevation for the 2D surface parcel?	Datum CGVD28.	
5.6. Any other Z coordinate issues?		

6. Temporal Issues

	Canada (Quebec) 2010	Canada (Quebec) 2014
6.1. Are temporal limits part of the definition of a parcel (2D or 3D)?	No.	
6.2. Are moving parcels allowed?	No.	
6.3. Are there any limitations on the range of temporal limits? (e.g. only on 3D apartments).	Maybe on Emphyteutic Lessee.	
6.4. Are there any attempt to integrate 3D space and temporal representations, into a single 4D space/time representation?	No.	
6.5. In the case of tidal boundaries, what happens to the 3D ambulatory parcel if the 2D land parcel changes extent due to the movement of High Water Mark?	N/A	
6.6. Any other temporal issues?	Emphyteutic Lessee.	

7. Rights, Restrictions and Responsibilities

	Canada (Quebec) 2010	Canada (Quebec) 2014
7.1. Range of RRR on 3D parcels.	No specific rules although those related to co-ownerships (see C.c.Q. 3041. The immatriculation of the private and common portions of a vertical divided co-ownership may not take place before the foundation and main walls of the building in which they are situated allow measurement of their boundaries).	
7.2. Are there any limitations on the range of rights? (e.g. subterranean parcels must be owned by Govt).	No.	
7.3. Any other RRR issues?		
7.4. Are there RRRs that are only allowed in 3D (and not valid for 2D)	No.	
7.5. Is there specific legislation (laws, regulations) defining 3D RRR types? If so, provide details, e.g. references to documents/articles.	No.	
7.6. Can 3D sub-surface/above-surface parcel be owned by someone other than the person owning the land parcel?	Yes, it is what we call right of superficies.	
7.7. What applications do you foresee for 3D cadastre?	- PC validation - For the representation of complex situation of superimposed properties - To have a complete overview of the geometry of the property and thus improve other systems like taxation, water supply and sewer systems - To be able to apply 3D spatial analysis	

8. DCDB (The Cadastral Database)

	Canada (Quebec) 2010	Canada (Quebec) 2014
8.1. Does the DCDB contain representation of 3D parcels (in any form)?	Not directly, as explained before.	
8.2. If so, how are they represented (in the DCDB)?	As 2D polygons and specific identifying (PC-Number).	
8.3. If so, how are they presented on cadastral “maps” (including screen presentations)?	Idem.	
8.4. Are there possibilities to store geometry of 3D parcels in the DCDB?	No.	
8.5. Is it possible to manage a 3D topological structure in the DCDB?	No.	
8.6. Are constraints/rules defined for valid 3D objects (closed volume, no overlap, no gap in 3D)? What about rules for a mix of 2D and 3D representations?	The control is done manually and refers at having no overlapping between vertical and horizontal geometry.	
8.7. How can internal and external user query and visualize the 3D content supporting rotating, slicing, transparency, perspective (3D web/view service, 3D pdf documents,...)?	The 3 rd dimension is currently available via paper plan or 2D PDF image file. And it only shows vertical profiles.	
8.8. What Spatial DBMS software do you use? Any 3D capabilities included and used?	Oracle (for the descriptive component), the geometry is stored on an Arc/Info system.	
8.9. Do you have any validation rules for 3D representation in the database?	No.	
8.10. What (GIS/CAD) software is used for updating, editing, analysis, and visualization of the cadastral data? Any 3D capabilities included and used?	The 2D geometric primitives are currently stored in an Arc/info file. The 2D cadastral plans are distributed in DXF format. The PCs are available as image (2D PDF file).	
8.11. What web software is used for remote data access/distribution and visualization? Any 3D capabilities included and used?	Land Register on line (http://www.registrefoncier.gouv.qc.ca) and Infolot Web interface (http://infolot.mrnf.gouv.qc.ca/)	

	No 3D capabilities. We can download CGM and CPC lite images.	
8.12. Is your DCDB organised as Multi-Layers or Object Oriented or some other data model?	MultiLayers.	
8.13. How do you query 3D objects in your DCDB?	The only way to query 3D objects is by the PC polygons number. But we only get a 2D polygon and some information about the lots attached to it. We can also get the PC file but no direct access to 3D objects.	
8.14. Is it possible to query neighbourhood parcels to a 3D object, vertically as well as horizontally?	No.	
8.15. Any other DCDB issues?		

9. Plans of Survey (including field sketches)

	Canada (Quebec) 2010	Canada (Quebec) 2014
9.1. Do the survey plans carry 3D parcel representations?	First the survey plans are not available to users. Second they do not contain 3D representations but only vertical profiles of the properties.	
9.2. If so, how are they represented?	See 9.1	
9.3. Is there specific legislation (regulations) describing the requirements for Plans of Survey in 3D? If so, please give link to the relevant documents.	There is instructions (see instructions de l'arpenteur général du Québec, MRNF) for the preparation of the survey plans. The only information which refers to the 3 rd dimension is about the obligation to be linked to the datum CGVD28.	
9.4. Is sketch level allowed (low geometric quality, but in principle enough to indicate the 3D object)?	No.	
9.5. Is it possible to define a 3D parcel by referring to other 3D real world objects/ topography (and not specifying coordinates)?	No.	
9.6. In what format are the 3D parcels submitted for registration; attached to legal document in a single pdf (which has good 3D capabilities) or in an extension of (city)GML for 3D parcels, or....?	As 2D drawings see 9.1	
9.7. Are the 3D parcels somehow checked for spatial validity; e.g. volume is closed, does not overlap with neighbour volume (and also no unwanted 3D gaps)?	Land surveyors are doing some visual and manual control.	
9.8. Do you have examples of (prototype or production) 3D survey plans available?	As mentioned, the survey plans only contain vertical profiles. See MRNF 2003 and Pouliot et al., 2010.	
9.9. Are any reference objects visible on the survey plan (e.g. real buildings, roads, that is 3D	No, even though we can find an approximate	

topography)?	representation of the spatial extent of the real building (for condominium)	
9.10. What form of 3D data acquisition is used (CAD, terrestrial surveying, sketches, stereo/oblique images, laser scanning,...)?	No specific instructions from this point of view but land surveyors usually work with terrestrial surveying.	
9.11. What software do you use for creating and processing survey plans? Any 3D capabilities included and used?	The surveyors mainly use Autocad, Microstation or CivilCAD.	
9.12. Can 3D parcels be subdivided, consolidated or nullified?	Yes.	
9.13. Is there any existing technical circular or directive to assist Surveyors in 3D data collection in the field?	No.	
9.14. Any other survey plan issues?		

10. Other Issues

Please include any other issues that may be of interest in an international context. For example, in some foreign jurisdictions 3D parcels can only be separated by horizontal planes.

10.1. Country (State, Province)	Québec, Canada
10.2. Your name, function/position and your organization	This questionnaire was fulfilled by Jacynthe Pouliot, professor at Laval University-Geomatics Department and Louis-André Desbiens, Direction de l'enregistrement cadastral, from the Ministry of Natural Resources and Wildlife-Foncier Québec (MRNF). MRNF-Foncier Quebec is responsible of the design and the management of the cadastral system.
10.3. Contact details: address email, telephone	Jacynthe.pouliot@scg.ulaval.ca and Louis-Andre.Desbiens@mrnf.gouv.qc.ca
10.4. Other issues	