Subsurface Utility Network Registration and The Publication of Real Rights: Towards Full 3D Cadastre

Jacynthe POULIOT and Philippe GIRARD, Canada

Key words: 3D cadastre, subsurface utility network registration, managing overlapping RRR (rights, responsibilities and restrictions)

SUMMARY

Placing utility networks underground is now a common practice in many countries. While technical challenges exist, administrative and legal issues also pose problems since the presence of underground networks creates restrictions and obligations for surface owners. Based on a case study in the province of Quebec, Canada, land registers are examined and jurisprudence reviewed, in order to create a clear portrait of current practices regarding the registration and publication of real rights attached to underground utility networks. Consequently, five challenges were identified and a discussion is proposed to help official land administration authorities and stakeholders take better decisions regarding creating a full 3D Cadastre or not.

RÉSUMÉ

Les réseaux d'utilité publique sont de plus en plus enterrés i.e. souterrains. S'il existe encore des défis techniques associés à ce genre de travaux, les aspects légaux et administratifs doivent également être examinés puisque la présence des réseaux souterrains amène certaines restrictions et obligations pour le propriétaire de la surface. En se basant sur le cas d'étude de la province du Québec, Canada (son registre foncier et la jurisprudence), cette présentation dresse d'abord un portrait des procédures actuelles entourant l'enregistrement et la publication des droits des réseaux souterraines. Puis cinq défis sont mis en lumière et une discussion est proposée afin d'aider les autorités officielles d'administration des terres et les intervenants à prendre de meilleures décisions quant à la possibilité d'implémenter ou non un système de type cadastre 3D.

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1. INTRODUCTION

Although expensive, burying utility networks is a global trend (Navigant Consulting, 2005). The reduction of visual intrusions and space savings associated with hiding utilities are widely considered to be aesthetic, efficient and ecologically friendly (Jeong et al., 2004). As a result, power and telecommunication networks are joining gas and water pipelines in an already dense underground. However, placing such infrastructure out of site has financial, technical and legal consequences. Regarding administrative and legal aspects, the vertical coexistence of real rights somewhat weakens the classic definition of property rights as extending from the 'centre of the earth to the zenith' since restrictions and obligations required for the use and maintenance of utility networks are often legally imposed on the surface owner. Consequently, ignoring the presence of such infrastructure may create problems (Girard and Pouliot, 2015). Damaging utility infrastructure can cause disruption of essential services and have a substantial impact on the environment, particularly regarding soil contamination. Additionally, the person causing breakage incurs health risks and legal proceedings.

Locating underground utility networks becomes a major challenge. One may argue that suppliers of such utility services should be required to provide XYZ coordinates of newly installed infrastructure. However, the reality is quite different, since very few information sources and official registers containing underground utility networks are available. Even on 2D plans, in many countries including Quebec, underground utilities are rarely shown on cadastre maps or recorded in land administration registers. This situation differs greatly from one country to another. For example, in Switzerland an official cadastre for subsurface pipes exists, in which the position of the infrastructure is partially available in 2D with optional height attribute. In Australia, the network infrastructure is represented on 2D plans. For more information, see the survey made by the FIG Joint Commission 3 and 7 Working Group on 3D Cadastres that proposed a world-wide inventory of the 2014 status of 3D cadastre (FIG, 2014).

Moreover, utility networks often share complex geometric dimensions not easily represented or integrated in current 2D cadastral frameworks. Consequently, in most countries, underground utilities are not shown on cadastral maps and no public, up-to-date cartography exists (van Oosterom et al., 2014). For instance, the Quebec jurisdiction has decided instead to register utility networks in a special land register to provide them the publication of rights despite an absence of cadastral registration. Nevertheless, their relationship with land parcels remains unclear in most

cases, thus possibly diminishing the benefits of the publication of real rights and consequently failing to protect the right or secure the ownership. In the context of a Canadian research grant, we hypothesized that having a full 3D cadastre that integrates aerial, surface and subsurface legal objects represents a valuable solution. However, supplementary investigation from the point of view of the registration process is required prior to considering such implementation (as suggested by many authors, more specifically Ho et al., 2013). In this paper, full 3D cadastre will refer to having rights established in bounded volumes, no matter if the real estate object is located in the subsurface, on the surface or in the air (Stoter 2004).

The paper is organized as follows. We first give a brief description of the Quebec land registration system and some examples of its incompatibility regarding the registration of utility networks. We then explain how the government of this Canadian province circumvented these problems but then created completely new challenges regarding the registration and the location of these networks. Finally, we enumerate a series of challenges to be addressed for implementing better practices regarding the registration of underground networks and the publication of real right associated to them.

2. QUEBEC LAND MANAGEMENT SYSTEM

2.1 Quebec Land Register

The land registration system is maintained by the *Government of Québec,* through an organism whose name is abbreviated as *Foncier Québec*. The land register is a deed registration system. Compared to the most common Torrens system, in which registration equals indefeasible property title, deed registration systems register only the instruments (the deeds) related to that land.

In the Quebec cadastre system, each parcel of land is associated with a file in an index of immovables, directly associated to the cadastral map, which indicates where the parcel is located, as well as its metes and bounds. The cadastral map, as shown in Figure 1, is a 2D map showing the limits and size of the lot (the parcel); each property has its own unique lot number and official measurements (length, perimeter and area). The registration of a right on a particular land parcel is achieved by indicating on its land file the nature and the number of the deed that created it. The cadastral map is the baseline of the publication system in this Canadian province.

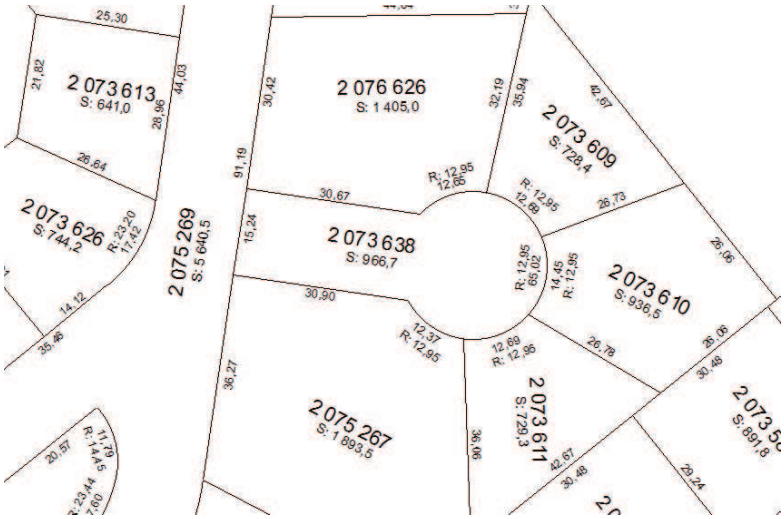

Figure 1. Example of a Quebec cadastral map

2.2 Utility network registration

Cadastral registration is mandatory to operationalize the publication of rights in the land register. While the Quebec cadastral 2D framework allows registration of utility networks, this is still largely limited, due to their complex geometric dimensions and their third dimensional component. In order to allow the publication of rights on these types of real property, the Quebec official authority has created a complementary land register, "the register of public service networks", which mimics the land register operations. Each network is thus registered on a file, recorded with a sequential number, the name of the network holder, the name of the regional administration, and various but non-mandatory textual data, including road names, address, description of the surrounding space, etc. However, this register is not supported by a cadastral plan. Figure 2 shows an example of the online interface for querying the register of public service networks (*available only in French*). Note that in this interface only the sequential number (shown as *numéro d'ordre* in the figure) can be queried, although this number is rarely known by users.

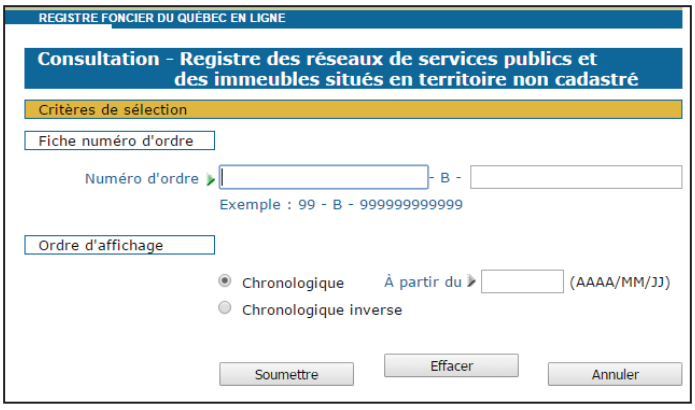

Figure 2. Example of the online search tool for the register of public service networks

3. CHALLENGES REGARDING UNDERGROUND UTILITY NETWORK REGISTRATION

What is the basic role of a registration system? The protection of rights. To reach this ultimate goal, a land register should enable anyone to locate 1) the land file in order to know the rights published on a parcel and 2) the immovable itself. The constitution of a complementary register with no cadastral map poses limitations, and thus creates challenges, related to both these basic roles. Based on case study analysis and jurisprudence review, we currently identify five challenges:

Challenge 1: Definition
The definition given in the Civil Code of Quebec of a network is very broad. A network can be "a railway network or a network of cable communications, water or gas distribution, power lines, oil or gas pipelines or sewage conduits". Path length or configuration does not matter. The only condition that must be met, in addition to what is dictated by the Civil Code, is right of superficies, i.e., that the infrastructure ownership must be different from that of the land. This elusive concept is reflected by the vast diversity of objects recorded in the register of utility networks. For example, a gas pipeline network several thousand kilometres long coexists with optical fibres extending a few metres. These objects remain the same within the meaning of the law.

Challenge 2: Intangibility
As explained above, operations related to the opening, handling and consultation of files in the register of public service networks is modelled on that of the land register. However, the fact that it is not supported by a cadastral plan makes these operations intangible in many aspects. In the land register, a file will be opened as soon as a new cadastral lot is delimited by a surveyor. These lots can then be subdivided, cancelled, replaced or unified. Still, there is always a tangible link with the physical reality of the immovable.

In the case of the register of public service networks, this link vanishes. A file will not be opened as soon as the network is built, but rather only when someone wishes to publish a mortgage, a sale, or any other real right on this network. For subsequent transactions, acts designate the network by its file number so that the right can be published. In that sense, this register strictly plays a role of publication of rights. However, network subdivisions and combinations can be performed anyway. As in cadastral operations, subdivision or combination of networks will result in the creation of new files. A single physical network can thus be registered through many files, each representing one of its sections.

Challenge 3: Querying
Querying the register of public service networks can be performed with either the file number (sequential number) or the name of the owner. However, the land file number is not disseminated. While the name of the owner can be queried, if the same owner holds rights on several networks, it becomes impossible to identify the correct land file without consulting all files of that owner. This

may represent several thousands of files for some telecommunications companies which often perform excessive file subdivisions of their fibre-optic networks. Finding a file referring to a given network, and as a corollary the rights published on it, is thus a complex operation because the file number (a sequential number) has no spatial reference.

Challenge 4: Designation
Quebec law imposes minimal obligations on utility networks in terms of their geographic localization and none in terms of geometric description. The Civil Code of Quebec merely requires the designation of the "territory" the network serves. Any additional details are left to the discretion of the utility network owner or the official authority (notary). Inevitably, a range of situations is generated. At worst, the network is simply designated by the fact that it covers the "Cadastre du Québec", which means basically any territory covered by the Quebec cadastral plan. At best, the network is designated by its ends, sometimes its length, and potentially, while most rarely, its path.

Challenge 5: Localization
The absence of a cadastral plan for utilities, combined with these flawed designation makes localization of underground networks hardly possible using the public data. Even if the designation in terms of endings, length and path is precise, it is still impossible to know which land parcels are affected by a given network. The location of utility networks is therefore almost impossible to determine since no related information exists in the registration process, and spatial relationships with surroundings are approximate and difficult for the authority to certify.

Without a comprehensive linkage between cadastre and, at least, the path of the network, identification of affected land parcels is nearly impossible. To circumvent this problem, notaries and surveyors are tempted to use accompanying easements to locate networks. Unfortunately, mapping the associated Rights, Restrictions and Responsibilities (RRR) as a surrogate is hazardous. The Law offers utility network owners implied easements, which are enforceable without registration. Also, when an easement is registered on a land file, its concordance with network location is not guaranteed by Law.

4. DISCUSSION AND CONCLUSION

The ability to addressing all these challenges would be required in order to argue in favour of full 3D cadastre. For instance, we believe that encouraging, or even imposing, standards for the geometric and semantic description of networks (subsurface and aerial) is a prerequisite (Pouliot et al., 2015). Is it necessary to reiterate that networks remain physical objects? The lack of minimal standards about length or path configuration creates a melting pot of hardly comparable objects. As a reminder, in the register of public service networks, lengthy gas networks that are impossible to locate are filed alongside excessively segmented optic networks impossible to identify.

The International Standards Organization has proposed many existing standards, such as Geographic Information (ISO-TC211) and the one on land administration (ISO-19152). But these proposals are often generic and application of them in a concrete registration system management with a 3D cartographic framework is still expected by the community of specialists. As discussed in Karki and Thomson (2014), fundamental examination should be done on this aspect, and collaboration among GIS specialists, lawyers/notaries and other specialists would be important to accomplish this. For example, a growing industry segment, subsurface utility engineering (SUA), focuses on the establishment of good practice guidelines to reduce uncertainty associated to construction projects (Jeong et al., 2004). As a first step in this direction, ASCE (American Society of Civil Engineering) has published a guideline for the collection and depiction of existing subsurface utility data (ASCE, 2002).

However, standards will have limited impacts without the imposition of strict land designation requirements. The only one that seems to be truly helpful is the list of parcels affected by the presence of a network. During our research in the register of public service networks, conducted during the summer of 2015, the opening deed providing a list of parcels affected by the presence of a network was an exception. From the perspective of publishing and protecting property rights, this approach appears particularly informative because it provides a direct link between this register, the land register and the cadastral map. This information is easy to decode, appears rich in land data and gives a sufficiently accurate geographical location. Considering the availability of a fully cadastral map and automated spatial analysis tools, obtaining such a list can nowadays be achieved in seconds even for large networks. Such designation standards would facilitate searches while promoting the publication and protection of property rights.

Nevertheless, such a list cannot be truly useful if no mention is made directly on the land file of the parcels concerned. We believe that network owners would benefit from having proper easements published in the land register. The implied easements provided by many jurisdictions throughout the world are hardly effective and put at risk the integrity of the networks. Do we need to emphasize the fact that the publication of rights significantly loses its advantages with lack of registration?

The mission of the Quebec Land Register does not include providing data that could be used to produce an integrated map representing the position and shape of underground networks and their relationship with surrounding land parcels. Lawyers and land surveyors need to be provided with data collecting and updating procedure and management tools. The creation of a full 3D cadastre may solve some of the problems previously discussed. However, while research and technology related to registration and data acquisition of three-dimensional objects are multiplying, this will not be completed tomorrow (Ho et al., 2013, Paulsson and Paasch, 2013). 2D cadastre maps with the projection of the footprint of the underground networks may also be a worthwhile solution. More significantly, we advocate the development of rigorous registration standards in terms of network designations to maintain the utility of the real rights publicity system and promote the better planning, development and management of underground spaces.

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BIOGRAPHICAL NOTES

Jacynthe Pouliot is a full professor at the Department of Geomatics Sciences (www.scg.ulaval.ca) at Université Laval, Quebec, Canada and currently the head of the Unit. She is an active researcher at the Center for Research in Geomatics (www.crg.ulaval.ca) and received a personal discovery grant from the Natural Sciences and Engineering Research Council of Canada. Her main interests are the development of GIS systems, the application of 3D modelling techniques, and the integration of spatial information and technologies. She has been a member of the Professional association of Quebec land surveyors since 1988. She is also involved in the supervising committee of the 3D Ethics Charter (www.3dok.org) and a member of the FIG working group on 3D Cadastres.

Philippe Girard acquired a PhD in biological sciences in 2008. After a few years at University of California – Berkeley and McGill University as a postdoctoral fellow, he started studies in geomatics sciences in 2013. During his studies (ending in spring 2016), he developed a special interest in land rights. As a land surveyor, he wants to develop surveying expertise in this area, ideally around environmental issues.

CONTACTS

Professor Jacynthe Pouliot and Dr. Philippe Girard
Université Laval
Department of Geomatics sciences
Louis-Jacques-Casault Building, office 1317
1055 avenue du Séminaire,
Quebec, Canada, G1V 0A6
Phone: (418) 656-2131, ext. 8125
Contact: Jacynthe.pouliot@scg.ulaval.ca