



Responsible Land Governance: Towards an Evidence Based Approach

ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY
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RIGOROUS IMPACT EVALUATION OF LAND SURVEYING COSTS: EMPIRICAL EVIDENCE FROM INDIGENOUS LANDS IN CANADA

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Abstract

This paper presents the empirical analysis of survey costs across a sample of 97 land surveys conducted on Indigenous lands (i.e. First Nation Reserves) in Canada. The data suggests the median cost to fully survey a parcel of land on-Reserve is approximately \$4,300/parcel. A multiple regression analysis showed significant relationships between the survey cost and: 1) the number of parcels - for every additional parcel included in the survey, the cost decreases by \$112/parcel; 2) Area – for every increase of 1 hectare, the cost increases by \$34/parcel; 3) water boundaries – if the survey includes a water boundary the cost increases by \$3090/parcel; 4) Company size – surveys performed by larger companies cost \$1900/parcel less, and medium sized companies \$1500/parcel less, when compared to small companies; 5) distance – as the distance travelled to the survey location increases by 1 km, the cost increases by \$2.40/parcel. Two other factors were not significant cost drivers – the extent of existing surveys in the community (i.e. parcel fabric), and the population of the community. The results of this research can potentially inform discussions both within Canada and internationally on the use of land surveys in developing or reforming land and resource tenure systems.

Key Words:

Land survey, Canada, Indigenous, costs

This paper does not necessarily reflect the views of Natural Resources Canada or the Government of Canada



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Context:

The cost of systemically registering land has been much discussed in the last decade (Land Equity International, 2015). Survey costs are one of the largest costs of registering property; comprising 30-60% of the total cost (Burns, Grant, Nettle, Britts, & Dalrymple, 2007). Costs vary as a function of ground survey, geodetic network and base mapping – with case studies in various countries documenting a survey cost from \$20(USD) to \$60/parcel (Byamugisha, Burns, Evtimov, & Zulsdorf, 2012). These findings have led to much discussion about the need to use fit-for-purpose systems (Enemark, Bell, Lemmen, & McLaren, 2014), and to empower lands managers (and others) within communities to survey/map parcels and then to allocate/register rights against those parcels (Kakraba-Ampeh, Yeboah, Owusu Asare, & Oppong-Konadu, 2014).

Examples abound: high costs of surveying and land registration created a barrier to implementation in the Philippines (Maurer & Iyer, 2008); in Latin America an established formal system reverted to informal (generally from inheritances) due to high costs of the formal structure at the fore-front (Barnes & Griffith-Charles, 2007); Burns noted that “experience in many countries suggests that survey accuracy is not a major concern” and that “no project in the developing world has been able to implement and sustain high-accuracy surveys over extensive areas of their jurisdiction” (Burns & Dalrymple, 2008, p. 10); FIG in their “Agenda 21” recommended to the survey profession that “standards for geodetic precision in boundary documentation...should not exceed those required to serve basic needs” and that “in several countries it has been demonstrated that overview maps (index maps), without detailed field surveying, are perfectly satisfactory...” (Onsrud, 2002) ; and the Commission on Legal Empowerment of the Poor summed up the situation noting that a “problematic practice” for land and real property was : “assuming that titling always has to be cadaster-based and rest upon expensive survey and mapping” (CLEP, 2008, p. 84). As Deininger stated:

...the cost of mapping increases exponentially with precision. A widespread confusion between tenure security and precision of measurement, together with lobbying by survey professionals, have often led countries to impose survey standards that exceeded the available implementation capacity and imposed costs that bore no reasonable relationship to land values. Consequently, in many projects with bilateral or multilateral support, costs of first-time registration were very high... (Deininger & Feder, 2009)



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Similar conversations are starting in Canada in regards to Indigenous lands such as First Nation Reserves. There are some 400,000 First Nation peoples living on some 3,100 Reserves; of which some 600 Reserves are the main centers for residential, commercial, educational and institutional purposes. Contracted land surveys through the Canada Lands Survey System provide the parcel fabric that underpins the formal property rights system on Indigenous Lands. These surveys (both present day and historically) are exceedingly accurate in their precision of measurement (Rogers, Ballantyne, & Heibein, 2016).

This paper explores the current cost of surveying parcels of land on such Reserves, by posing two research questions:

- 1) What is the median cost to survey a parcel on Indigenous lands?
- 2) What factors influence that cost?

A brief overview of parcel surveys on First Nation Reserves in Canada

Policy surrounding First Nations involve the better part of four centuries and have progressed through three distinct regimes: French, British, and Canadian. Historically, First Nation policies (including those for surveying and property rights) have centred on three concerns - to generalize: 1) driving the fur trade, 2) maintaining the European balance of power in North America; and 3) transforming First Nation societies into “self-reliant agriculturalists” (Surtees, 1966). Much has been written on the changing goals of Indigenous policies through these regimes, but it is the latter goal – transforming First Nation societies – which forms the basis of contemporary Indigenous policy which itself was predicated on three (sometimes contradictory) principles: protection, amelioration, and civilization. ‘Civilization’ was sometimes replaced by different terms such as: ‘advancement’, ‘assimilation’, or ‘integration’, but the underlying sentiment was the same (Tobias, 1976). These principles led to the creation of the formal Reserve system beginning in the 1820s. Simultaneously and in line with the goals of ‘civilization’ advocates began promoting the European ideals of formal private property rights on-reserve and the accompanying surveys as a fundamental test of Indigenous “civilization”.

Beginning in the 1820s the prevailing European philosophy was that “private ownership of property and possession would put an end to Indian warfare” due to the fact that “Indians have little property to lose”



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(Carter, 1990, p. 17). The call (at least among colonial officials) for privately held property to be formalized on Reserve continued into the 1840s, and culminated in the so called “Bagot Commission” which released its final report in 1844. The report “painted a depressing picture of...deplorable Indian conditions, and unresolved policy questions” and documented difficulties with “squatters on reserves” and “improper recording of land sales and leases” (Leslie, 1982, p. 39). To deal with these difficulties the commission recommended granting defined parcels to individual First Nation members, introducing a land registry system, and restricting the ability of land holders to transfer their land only to other First Nation members (Alcantara, 2003, p. 398). Political discussions on property rights also echoed the Bagot Commission’s findings. For instance, the Minister of the Interior in 1873 noted that “the great aim of the Government should be to give each Indian his individual property as soon as possible”¹ and this notion carried forward to the debates surrounding the first *Indian Act* of 1876: “as soon as they knew exactly what they possessed, they would look for enfranchisement”.² What is lost in both the Commission findings and the political debates of the time are that Indigenous communities in North America already had existing and very well defined concepts of property ownership interwoven into their societies, including ways to define property limits (Bobroff, 2001). Colonial officials had, at best, a very misguided view of these existing Indigenous concepts of property - as Alcantara puts it: “Indian notions of property ownership were not inferior to European ones, just different” (Alcantara, 2003).

Nevertheless, in 1876, the first *Indian Act* was passed and it formalized the colonial designs of property on-Reserve within its text. Sections 4-10 of the 1876 *Indian Act* introduced the idea of a “location ticket”, and authorized the Government of Canada to subdivide Reserve lands and to grant these plots of lands to individual band members. Location tickets were viewed as documentary evidence of lawful possession by an individual on Reserve. The government of the day regarded location tickets “as an essential feature of the civilization process...It was a means by which the Indian could demonstrate that he had adopted the European concept of property, which was an additional test of whether he had become civilized” (Tobias, 1976, p. 212). These ‘location tickets’ were also viewed as an intermediate step. If after a period of three years the location ticket holder could demonstrate effective development (e.g. farming) on the defined parcel, they would be given full fee-simple title to the property and the property would be removed from the Reserve land base. As some have noted, this process was a “double bonus” to the goals

¹ Government of Canada Sessional Papers 1873, 7, 42

² Parliament of Canada, House of Commons Debate, 1873, 3rd Parliament, 3rd Session, Vol. 2



of the Crown at the time because it “reduced the size of reserves by acquiring individual title and reduced government costs when removed from band and treaty pay lists” (Leslie, 1999, p. 49).

First Nation communities, however, were not enthralled with location tickets, which were tied to criticisms of the increased government interference into band affairs. Indeed, this led to First Nations thwarting the location ticket goals by:

...refusing to approve subdivision of their reserves. Without a system of allotted land, the issuance of a location ticket was impossible, and, of course, without such a ticket, Indian enfranchisement according to government regulations and procedures could not take place. (Leslie, 1999, p. 55).

There was no explicit policy on the subdivision and surveying of location tickets, but they were predominantly surveyed and marked on the ground (figure 1). In general, where subdivision surveys occurred, the adopted approach was to survey multiple lots at one time over the Reserve.³ In more isolated cases, the local Indian Agent subdivided the reserve without a survey. For instance, in 1884, on the Cowichan Reserve in British Columbia, the “agent divided the reserve...into individual holdings, and location tickets covering the same were issued by the Department to the different locatees” (Canada, 1884, p. 56). The unsurveyed subdivision approach is illustrated in figure 2.

Figure 1 - Sample of a subdivision survey for location tickets in 1900 (51928 CLSR)

Figure 2 – Sample of an unsurveyed subdivision for location tickets (TBC796 CLSR)

By the late 1880s, it was the belief of the Government of Canada that the property rights system set out under the *Indian Act* of surveying and allocating location tickets was having the wanted ‘civilization’ effect. For instance, the annual report of the Department of Indian Affairs in 1889 noted that surveyed location tickets for the Chippewa Bands near Lake Simcoe in Ontario were having:

... the desired effect of imparting a fresh impetus to their industry, and as a consequence they are rapidly becoming a wealthy Indian community. The desire to improve their holdings and ambition

³ Many unsurveyed location tickets were also subsequently surveyed or resurveyed when they were replaced by Certificates of Possession in the 1950s.



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to emulate one another in the production of good crops, erection of comfortable dwellings and commodious outbuildings is the natural result of the sense of proprietary rights which the possession of a title to their holdings engenders. (Canada, 1889)

The survey and issuance of location tickets continued substantially unchanged until the 1940s. At which time, an outcry of public support led directly to the call to reform existing Canadian Indigenous policies. A Special Joint Committee of the Senate and House of Commons was formed to address the issues. Over three years (1946-48) the Committee held 125 meetings, heard 122 witnesses, and received 411 reports from Indigenous groups and other interested parties (Mackay, 1952). The Committee held hearings on a variety of issues, with property rights and surveying among them. At a 1946 hearing of the Committee one Government official reported that “lack of funds and qualified staff had impaired a key component of Indian policy – the survey and subdivision of Reserve lands and the allocation of individual location tickets”, adding further that the survey and issuance of location tickets were only operational on 38 Reserves across the country (Canada, 1946).

In 1951, a large scale amendment to the *Indian Act* was passed. The amendments included the replacement of location tickets with a new interest called a ‘Certificate of Possession’ (CP), and new leasing provisions. Certificates of Possession took over from location tickets as the predominant documentary evidence of lawful possession of land on-Reserve pursuant to the *Indian Act*.⁴ In terms of the actual right being granted very little changed in the transition from location tickets to CPs in 1951. The substantial change was to the approval structure. All future CPs required the approval of the First Nation (via the Band Council) before being issued (Alcantara, 2003). Interestingly, just as in 1876, very little consideration was given to existing Indigenous customs and traditions around property, despite the local knowledge by Government officials of the efficacy of these customs in property matters. As F.J.C. Ball, an Indian Agent in Vancouver, noted: “[First Nations] have certain ways of doing things which

⁴ Other less prominent forms of property rights were issued under the *Indian Act*, they include:

- NETI (No Evidence of Title Issued)/Cardex holding – lawful possession of the parcel is recognized, but for various reasons (generally administrative) a CP was not issued; 27,072 were issued.
- Notice of Entitlements - documentary evidence is present, but no surveyed parcel exists; 9808 were issued.
- OKA Letter – A notice sent to a member of the Mohawks of Kanasatake of their rights being recorded; 2,237 were issued.
- Certificates of Occupation - a temporary right, generally issued to Reserves on the Prairies, which could be converted to a CP if certain conditions were met; 928 were issued.

Data for the above was received via personal correspondence with Indian Land Registry officials at the Department of Indigenous and Northern Affairs in December of 2016.



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appear haphazard to us, especially in dealing among themselves regarding property, land, etc. but it is surprising how well their unbelievable methods work, where strictly legal methods cause confusion, resentment and unrest” (Ball, 1946).

The subdivision and survey of Reserves into parcels was a point of contention in the House of Commons when the 1951 amendments were being considered. Some representatives supported surveys and subdivisions “because they felt it was only through these surveys that an individual owner could definitely establish his claims to land on a reserve”, while other representatives opposed the idea because it was so closely linked to allotment of the land as CPs.⁵ Despite the lack of consensus, surveys for subdivisions were enshrined in the 1951 *Indian Act*. Section 19 of the Act allowed the Crown to “authorize surveys of reserves” and “divide the whole or any portion of a reserve into lots or other subdivisions”. The requirement for these surveys were codified further in 1955 when the Department of Mines and Technical Surveys (which housed the Surveyor General of Canada) and the Department of Citizenship and Immigration (which was then responsible for Indigenous Affairs) signed an agreement on the “Rules respecting surveys, plans and description of lands” to be applied to on-Reserve property transactions. This was formalization, for the most part of what had been the standard practice for surveys dating back to location tickets and the original 1876 *Indian Act*. All CPs and leases over 10 years issued under the auspices of the *Indian Act* were required to be based on a survey plan under the *Canada Lands Surveys Act*⁶ and such surveys required a full field survey and physical monumentation placed at every deflection point or at intervals not exceeding 1 km (figure 3).⁷

Figure 3 - Sample of a full field survey and monumentation for CPs or long term leaseholds (77262 CLSR)]

The subdivision and survey of Indian Reserves has continued essentially unchanged to present day. New Interdepartmental Agreements between Natural Resources Canada and Indigenous and Northern Affairs (the modern day Departmental equivalents) were signed in 1991, 2003, and 2015, but remained

⁵ House of Commons, 21st Parliament, 4th Session, Vol.2. p. 1365. Ottawa: Canada.

⁶ For a transcript of the 1955 Interdepartmental Agreement see - <http://clss.nrcan.gc.ca/standards-normes/b1-1-v1-eng.php#b1-1-1>

⁷ The Manual of Instruction for the Survey of Canada Lands spells out the technical survey requirements. See - <http://clss.nrcan.gc.ca/surveystandards-normesdarpage/toc-canlan-terrecan-1-3-v1-eng.php>



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unchanged in terms of the survey requirements (full field survey and monumentation) as their predecessors.

From 1876-1951, approximately 7000 location tickets were issued (of which only a handful are still active today); and most of these were converted to CPs. Things increased dramatically post-1951. The Department of the Indigenous Affairs estimates approximately 140,000 CPs were issued on 288 Reserves (Flanagan, Alcantara, & Le Dressay, 2010). The exponential increase in CPs over the location tickets is credited to the 1951 *Indian Act* reforms and encouragement by federal officials to use the system (Brinkhurst & Kessler, 2013). The increased use of CPs also resulted in a substantial increase in surveys. From 1951-Present (CP system), 35,000 surveys (approximately 530 surveys/year) were performed on Reserve. By comparison, from 1876-1950 (location ticket system) only approximately 2,300 surveys (approx. 31 surveys/year) were performed.⁸

Surveys on-Reserve have always been the standard for most long term interests granted pursuant to the *Indian Act*, and mandatory since 1955. There is little doubt that the surveys performed for these interests are rigorous and accurate (Rogers, Ballantyne, & Heibein, 2016).⁹ This rigour and accuracy, however, has a substantial hypothesized trade-off – cost. While the rigour and accuracy of the current survey system may function appropriately for some Indigenous communities, the broader question is whether it is universally appropriate for all First Nation Reserves in Canada. The answer to this question is unknown - the survey system was not developed in consultation with Indigenous groups in Canada, so the degree to which it is acceptable has never been gauged. One obvious example is the many First Nation Reserves which utilize “traditional” or “customary allotments”. These holdings are sometimes defined via survey in a very formal way, while in other cases they are based on “occupation, community recognition, or inheritance” (Flanagan & Alcantara, 2003). The best empirical data on this subject suggests that approximately 55% of all interests on Reserve are held via customary allotments or in some other fashion not under *Indian Act* (Ballantyne, MacDonald, & Ballantyne, 2017). Likewise, data shows approximately 70% of interests on Reserve are surveyed, 30% are unsurveyed (Ballantyne & Rogers, 2012). If we assume all formal *Indian Act* interests are surveyed (because it is mandatory to do so), this

⁸ Numbers of surveys were calculated by searching the Canada Lands Survey Records constrained to ‘Parcel Surveys’ and filtered for Indian Reserve results. The numbers were not normalized for the number of parcels created per survey.

⁹ As a further example, all parcels surveyed on Reserve require geo-referencing to an accuracy of 0.10 m or better, and a relative accuracy in the cm.



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means only a small percentage of customary allotments or other community property systems use the current survey system. It is difficult to assess the reasons for this. It could be that the lack of surveys represents dissatisfaction with the current survey system and thus an unwillingness to utilize it, or alternatively it may represent that the customary system is viewed by the community as suitable in itself without the need for formal surveys.

In either case cost likely plays a significant deciding factor. Costs of surveys for individual parcels on Reserve are generally borne by the individual band member.¹⁰ This is a cause for concern because Indigenous communities have, on average “higher unemployment rates and lower individual incomes” and more than twice as many Indigenous Canadians live in poverty compared to non-Indigenous Canadians (INAC, 2009). Additionally, property values on-Reserve hold significantly less value than the market value off-Reserve (Bish, 2001). With these factors as context, the cost of a survey may be disproportionately high to the value of the property on Reserve. It is hoped the empirical data and research presented here on the costs of performing surveys will help inform the discussion on the efficacy, affordability and ultimately the acceptability of the current survey system on-Reserve in Canada.

¹⁰ Some bands allocate funds to subsidize survey costs. The Beasoleil First Nation, for instance, sets criteria for members to apply for funding from the Band for surveys of individual land holdings. See – Policy on funding requests to survey individual land holdings. Beasoleil First Nation. May 18, 2011



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Methodology:

A sample of 97 land surveys completed from 2010-2015 were selected. These surveys were performed by 54 different land surveyors across 10 Provinces. All 97 surveys were projects contracted by the Government of Canada to private sector land surveyors. The data is from publicly disclosed contract values from Natural Resources Canada.¹¹ The cost of the survey was broken down to a per parcel amount (e.g. if a survey of 3 parcels cost \$9,000, then the unit parcel cost is \$3,000).

In order to answer the research question on what factors that influence cost, data on seven other variables was also collected, as follows:

- 1) Area - The size of the survey was a proxy to gauge the complexity of the survey work being undertaken. For instance, a large area may involve many GNSS (e.g. GPS) setups or extensive traversing. Areas were calculated by summing all parcels areas (ha) within each survey and reducing to a mean parcel size (divided by the number of parcels in the survey) for direct comparison with the average parcel cost.
- 2) Distance - Most professional land surveyors in Canada are located in urban areas, whereas 1/3 of Indigenous communities in Canada are near urban areas (Sharpe & Lapointe, 2011). This distance between surveyor and Reserve might impact logistical costs (travel and accommodations). Distance was calculated by measuring the quickest driving route from the surveyor's location to the job site (km).
- 3) Number of parcels - Surveys can vary from single parcels to large subdivisions. It is expected that as the number of parcels in a survey increase, the unit cost per parcel will decrease (owing to economies of scale).

¹¹ The Government of Canada discloses all contracts over \$10K as per its Treasury Board policy of 2003. Disclosure of contracts by Natural Resources Canada are available online at: <http://www2.nrcan-rncan.gc.ca/dc-dpm/index.cfm?lang=eng>. Parcel surveys contracted by Natural Resources Canada on-Reserve are generally for band welfare purposes (school sites, nursing stations, RCMP stations, churches, etc...), economic development parcels (designations and leases) and occasionally for CPs.



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- 4) Extent of existing surveys (parcel fabric - PFI) – There is much difference as to whether land surveys are part of the land management philosophies of the 600 communities. Some survey parcels for all houses, community buildings, roads, and other developments; others eschew surveys in favour of informality. The hypothesis was that more land surveys in a community meant lower survey costs (more survey evidence to tie to = less work for the surveyor). Parcel fabric was calculated using the Parcel Fabric Index (PFI) methodology.¹²
- 5) Water boundaries – The existence of watercourses in the Reserve was thought to affect the cost of a survey, because researching and locating a water boundary is a complex task.¹³
- 6) Company size – The size of the company contracted to perform the survey work was collected because profit margins were speculated to vary across firms (i.e. overhead costs, salaries, ...). Sole proprietorships and small partnerships were classified as small, private corporations were classified as medium, and public corporations were classified as large.
- 7) The population of the community – Indigenous communities differ in location, size, capacity and complexity. They range from vacant tracts of wilderness to communities with the infrastructure and development potential of large towns. The population of a community (from Statistics Canada census of 2011) was considered a reasonable measure to quantify these differences.

Figure 4 – Excerpt from a parcel survey on Indigenous lands; Lots 203 & 204 established

Descriptive statistics were computed to determine the median cost to survey. Several multiple regression analyses were performed, with the dependent variable as the cost per parcel as against the seven independent variables. The company size variable (non-numeric) was coded as 1-medium size firm, and 2-large firm. The coefficients for that variable are in relation to small firms. All regressions were done across the sample of 97 except for parcel fabric (where data was only available across 82 surveys).

¹² The methodology for determining PFI was defined in - Ballantyne and Rogers. *Ascertaining First Nations Communities for Optimum Fabric Renewal: Parcels and Enablers*. Paper prepared for presentation at the *Annual World Bank Conference on Land and Poverty*. 2012

¹³ Ballantyne. *Water boundaries on Canada Lands: That fuzzy shadowland*. NRCAN. 2015



Results:

The median cost was ~\$4,300; however, surveys do vary substantially, as suggested by the standard deviation of ~\$4,200. The variation is also illustrated by the range of costs, area, number of parcels surveyed, and the distance the surveyor travelled (see table 1).

Table 1 – Descriptive statistics of the survey cost per parcel on Indigenous Lands

The advantage of employing a multiple regression analysis is in *ceteris paribus* interpretation of the estimated coefficients. The disadvantage is that this method assumes a causal relationship. The regression coefficients can be interpreted as the effect of a specific independent variable on the dependent variable, when holding the effect of all other independent variables constant.

Four of the seven independent variables - area, number of parcels, water boundaries and company size - were statistically significant at the 95% confidence interval. A fifth variable - distance - was statistically significant at the 93% confidence interval (see table 2). Parcel fabric and First Nation population were statistically insignificant. Taken as a whole, the variable explains some 41% of the variation in survey costs.

Table 2 - Multiple regression analysis and coefficients

The coefficient values suggest that:

- As the number of parcels increase by 1, the cost of the survey decreases by \$112/parcel
- As the area increases by 1 ha, the cost of the survey decreases by \$34/parcel
- Including a water boundary in the survey increases the cost by \$3090/parcel¹⁴
- Large firms are \$1900/parcel cheaper than small firms, and medium size firms are \$1500/parcel cheaper than small firms.¹⁵
- As the distance travelled increases by 1 km, the cost of the survey increases by \$2.40/parcel

¹⁴ The sample of 97 had 14 surveys with water boundaries, and 83 without. The median cost of a parcel survey with a water boundary was ~\$6,500/parcel, whereas the median without a water boundary was ~\$4,200

¹⁵ No statistically significant relationship was found between large and medium firms



Discussion

Many of the statistically significant findings support intuitive assertions about costs. Increasing the number of parcels included in a survey creates an economy of scale, which regardless of logistical costs will drive prices down in most situations. For instance, the Saskatchewan Land Surveyors Association suggest fees of \$2,225 per day for a two man field survey crew, and \$145/hour for drafting and calculation work (SLSA, 2016). If you can split these costs over multiple parcels in one project, the job may take longer driving cost up, but the unit cost (per parcel) will likely be lower. Similarly, increasing the area of the parcel surveyed, in most instances, increases the cost because it is more ground to cover, more monuments to place in the ground, and more instrument setups.

The impact of distance, likewise, matches the preliminary intuitive conclusions on costs (albeit at the 93% confidence interval). As the distance the surveyor has to travel to a job site increases the cost of the survey increases as well (presumably from increased travel and accommodation costs). Interestingly, the amount by which distance increases costs is not overly substantial (\$2.40/km) in relation to the overall median costs and the impact of the other variables. One possible explanation for this is that surveys, on average, on more remote Reserves are less complex. More remote Reserves, in general, have lower populations and hence less development. Due to this, surveys in more remote areas may require fewer instrument setups; fewer monuments placed in the ground; and involve fewer ties to infrastructure and other interests on the ground. This is supported by research into parcel fabric, which shows a correlation between remoteness and the degree to which a community has existing surveys to tie to – the more remote you get, the fewer surveys (Ballantyne & Rogers, 2012). Remoteness may affect logistical costs (transport, accommodation, etc...) but this is potentially offset by a trade off in complexity (see figures 5 and 6). Overall, this appears to lead to a muted effect of distance on costs.

Figure 5 - A remote, less complex survey on the Waterhen Indian Reserve (97890 CLSR) – \$4,200/parcel

Figure 6 - A less remote, and more complex survey on the Kootenay Indian Reserve (97718 CLSR) - \$3,700/parcel

A less intuitive finding is the degree to which the inclusion of a water boundary can drive up survey costs (a cost increase on average of \$3,000/parcel). This is not to say the use of water boundaries in itself is the culprit. Indeed, water boundaries have a lot of utility, not the least of which is to the land holder. Land holders benefit by having an obvious (and understandable) physical limit to their property via the water



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itself or the banks of the watercourse. Additionally, we have a propensity to live near water, so it is unlikely water boundaries are going anywhere (Kummu, deMoel, Ward, & Varis, 2011). A different avenue to explore might be how water boundaries are defined in surveys. As Ballantyne notes: “there is little merit in seeking high precision in re-establishing water boundaries” (Ballantyne B. , 2016, p. viii). Water boundaries, presently, are surveyed in two predominant methods: 1) a ground survey with physical measurements to the water boundary; or 2) the digitization of the water boundary from aerial imagery with sporadic ground observations (ground truthing). Whatever method is used, the current requirements for water boundaries on-Reserve are that they be surveyed in such a way that it results in the boundary being plotted on a plan to at least an accuracy of 0.5mm relative to other features shown on the survey plan (Surveyor General Branch, 2014). Given the likely significant cost impact of surveying water boundaries using the present methods, and the published research indicating the futility of defining water boundaries to such a high precision, a discussion about the efficacy of the current requirements is probably worthwhile.

The final variable - firm size - also shows interesting results. Larger and medium sized firms outperformed smaller firms by a wide margin. For the most part, the small firms in the sample were unincorporated sole proprietorships or partnerships, and the medium and larger firms were incorporated (either private or public corporations). The difference in cost between unincorporated (i.e. smaller firms) and incorporated firms (medium to large firms) is supported by wider research on the productivity gap that exists in Canada between incorporated and unincorporated businesses. For instance, Baldwin and Rispoli used data from Statistics Canada from 1987-2005 to show that “the level of nominal GDP per hour worked is significantly lower for unincorporated enterprises (\$23.20 in 2005) than it is for corporations (\$43.40 in 2005)... GDP per hour worked in the unincorporated sector was just 53% of GDP per hour worked in the corporate sector.” (Baldwin & Rispoli, 2010, p. 6). The gap shrinks when we are talking about the service sector – which would include land surveying. In that sector, unincorporated businesses are 70% as productive as corporations (J., Leung, & Rispoli, 2011). The gap in productivity via incorporations is likely a function of many factors which are difficult to uncouple and single out. Two brief examples can be given for survey costs: 1) incorporation of survey companies allows for a “different form of risk sharing” and allows “for the potential specialization of functions between managers and capital providers” (Baldwin & Rispoli, 2010, p. 25); and 2) larger survey companies tend to be incorporated and this leaves them “better suited to take advantage of productivity gains resulting from



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economies of scale”, they also like achieve a “firm size that is normally associated with higher productivity levels” (Baldwin & Rispoli, 2010, p. 25).

Conclusions:

The data suggests a median cost to survey a parcel on Indigenous lands (i.e. Reserves) in Canada is approximately \$4,300/parcel, albeit with a high degree of variation.¹⁶ The analysis of the coefficients suggests that the most expensive parcel surveys under the current survey system for Indigenous Lands will:

- Be of larger parcels (cover a large area);
- Be a one-off survey (of a single or small number of parcels);
- Be in a remote area (i.e. distant from the survey workforce);
- Be performed by a small company; and
- Have a water boundary.

Conversely, the least expensive surveys will:

- Be small in size (i.e. small lots)
- Cover multiple parcels in a single survey
- Be close to urban areas (i.e. near the survey workforce)
- Be performed by medium to large firms
- Have no water boundaries

Such a rigorous evaluation of surveys costs (a significant part of land management) is invaluable, in three respects. First, it can inform the broader debate across the developing world about the need to pursue equitable strategies when assisting local communities with land management.

Second, it provides baseline data within Canada to allow the next questions to be posed:

- Are the current costs reasonable?
- How do such costs compare to similar contexts in Canada in non-Indigenous communities?
- Should some of the variables that significantly influence cost be addressed?

¹⁶ Of course, a weakness of this analysis of survey costs is that it relies solely on survey contracts issued by the Government of Canada. For an alternative analysis, see: Cost analysis for legal surveys on Canada Lands. Presented at ACLS AGM - Ottawa. March 3, 2017



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- To what extent should a community's property values and per-household income influence survey costs?
- Given the historical legacy of the current survey system, should reforms, in consultation with Indigenous communities, now be undertaken?

Third, the evaluation findings inform land tenure reform, "land interventions" and institutional capacity building across all Indigenous communities in Canada. That is, can the findings be used as a lever to widen the conversations about fit-for-purpose and other-like initiatives? Can they influence surveying partnerships and mentoring among First Nations, private-sector land surveyors and the federal government? Can they promote formal accredited training in applied land management (e.g. with courses in mapping/GIS, data capture/surveying, planning, and boundary principles) so as to build capacity within First Nations?



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Tables:

	Area per parcel	Distance	No. Of Parcels	Parcel fabric index	Cost per Parcel
Median	1.05 ha	134 km	2 parcels	0.47	\$4,297
Std Deviation	56 ha	214 km	10 parcels	0.30	\$4,223
Minimum	0.001 ha	0 km	1 parcel	0.02	\$508
Maximum	407 ha	1056 km	59 parcels	0.98	\$23,460
Sample size	97	97	97	82 ¹⁷	97

Table 1 - Descriptive statistics of the survey cost per parcel on Indigenous Lands

Number of obs	=	97
F(7, 89)	=	9.37
Prob > F	=	0.0000
R-squared	=	0.4125
Root MSE	=	3361.4

Cost per parcel	Robust					
	Coef	Std. Err.	t	P> t	95% conf interval	
Distance	2.40451	1.307123	1.84	0.069	-0.1927167	5.001736
No. of parcels	-112.4682	28.24783	-3.98	0.000	-168.596	-56.34036
Water boundary	3090.11	1562.191	1.98	0.051	-13.92636	6194.155
Area	34.34089	7.013573	4.90	0.000	20.40507	48.27671
Population	0.1176552	0.1499585	0.78	0.435	-0.1803092	0.4156195
Company size						
1	-1525.74	711.4056	-2.14	0.035	-2939.288	-112.1925
2	-1904.384	641.6354	-2.97	0.004	-3179.3	-629.468
_cons	5331.336	650.6105	8.19	0.000	4038.587	6624.085

Table 2 - Multiple regression analysis and coefficients

¹⁷ Parcel Fabric Index scores were available for 82 of the 97 Reserves in the sample. A separate coefficient analysis using the sample of 82 showed PFI to be statistically insignificant to the cost per parcel at the 95% confidence interval



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Figures:

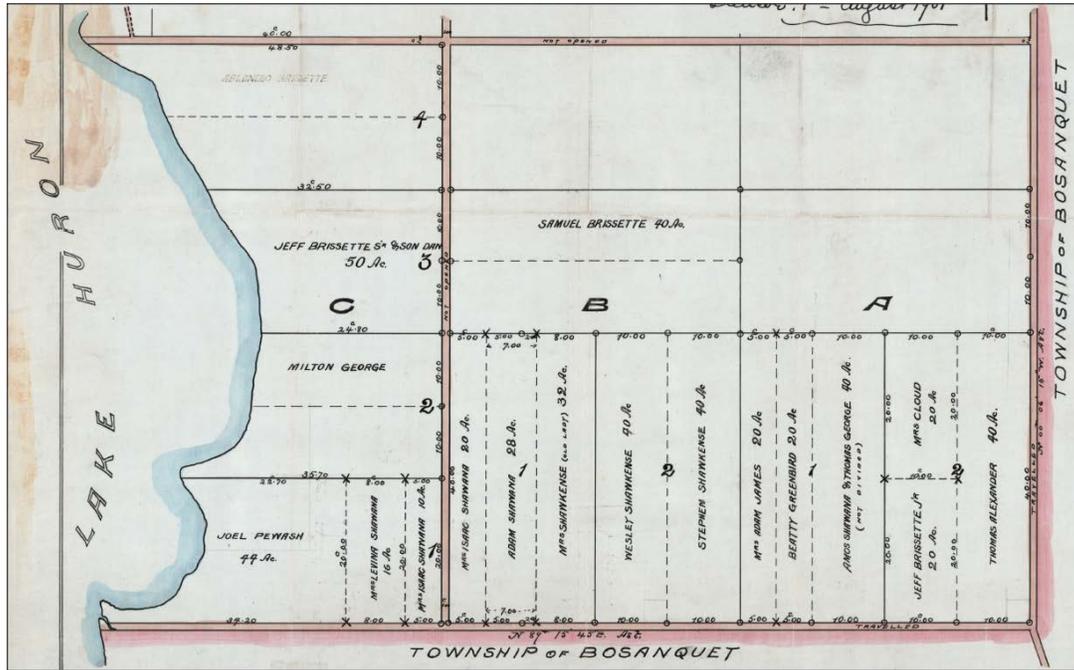


Figure 1 - Sample of a subdivision survey for location tickets in 1900 (51928 CLSR)

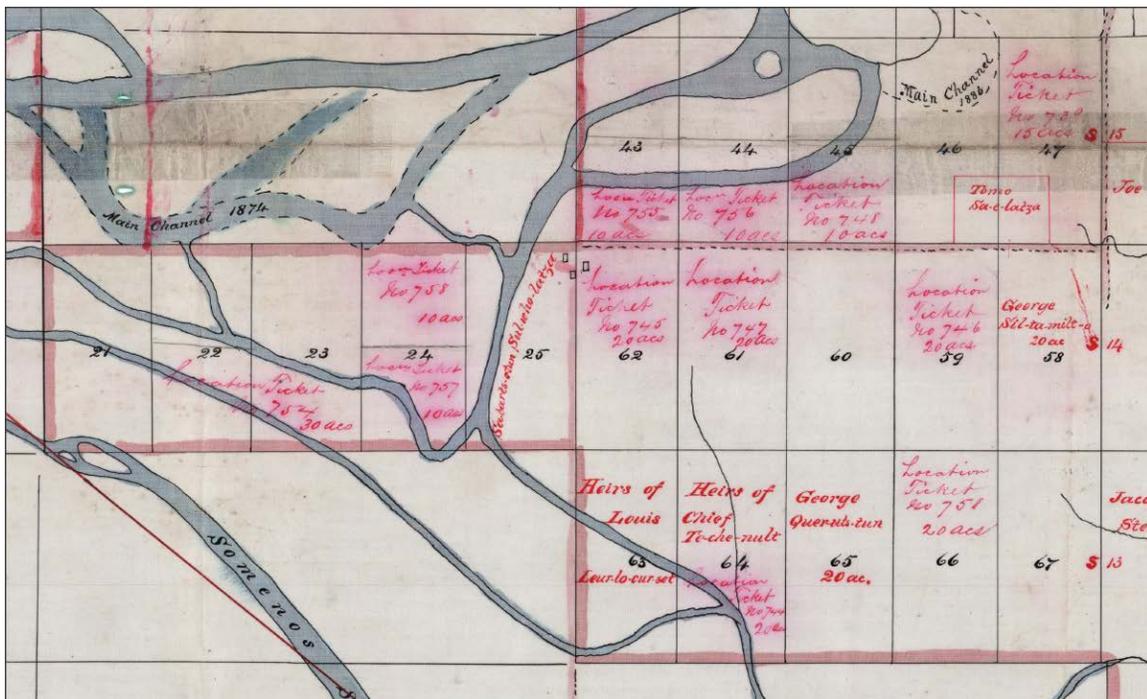


Figure 2 - Sample of an unsurveyed subdivision for location tickets (TBC796 CLSR)



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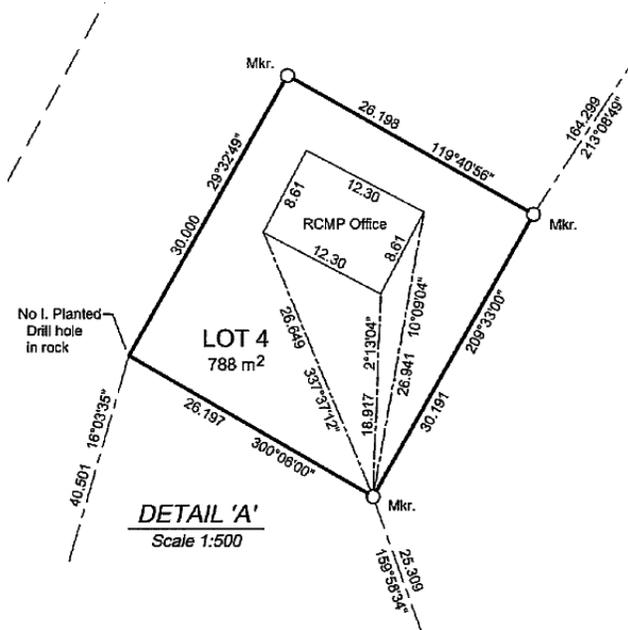


Figure 5 - A remote, less complex survey on the Waterhen Indian Reserve (97890 CLSR) – \$4,200/parcel

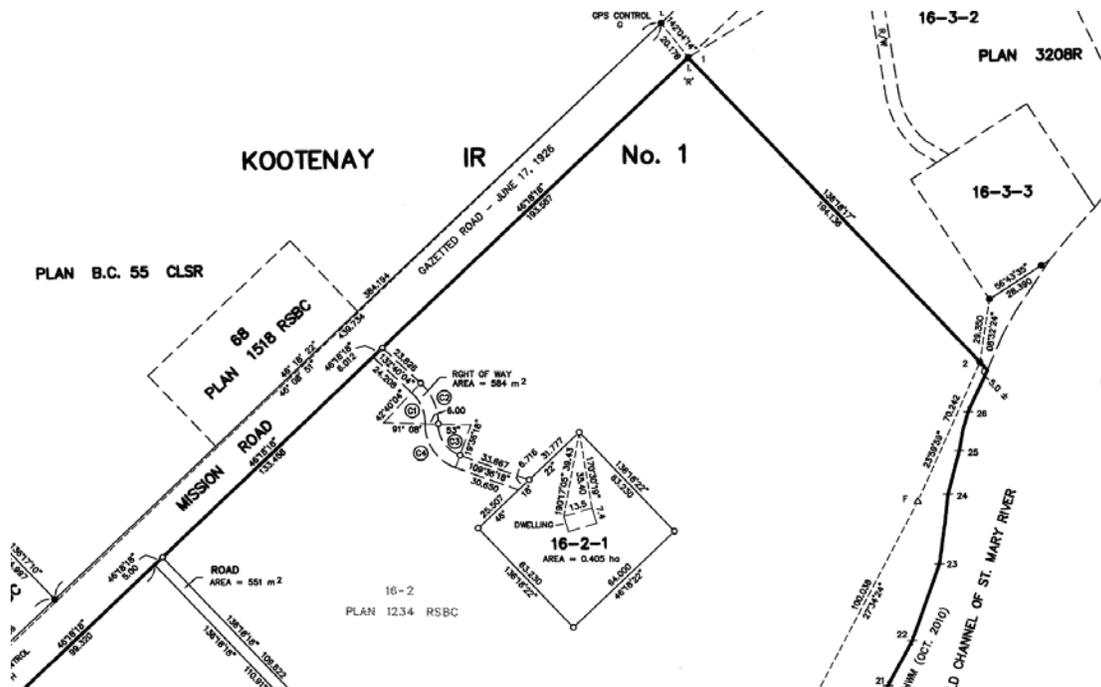


Figure 6 - A less remote, and more complex survey on the Kootenay Indian Reserve (97718 CLSR) - \$3,700/parcel