

An Independent Study
Commissioned by



RESIDENTIAL AND
CIVIL
CONSTRUCTION
ALLIANCE OF
ONTARIO

Constructing Ontario's Future



2017 UPDATE: QUANTIFICATION of Excess Construction Soils in Ontario

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RCCAO

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The Residential and Civil Construction Alliance of Ontario (RCCAO) is composed of management and labour groups that represent a wide spectrum of the Ontario construction industry.

The RCCAO's goal is to work in cooperation with governments and related stakeholders to offer realistic solutions to a variety of challenges facing the construction industry and which also have wider societal benefits.

RCCAO has independently commissioned 42 reports on planning, procuring, financing and building infrastructure, and we have submitted position papers to politicians and staff to help influence government decisions.

For more information on the RCCAO or to view copies of other studies and submissions, please visit **rccao.com**

RCCAO members include:

- Carpenters' Union
- Greater Toronto Sewer and Watermain Contractors Association
- Heavy Construction Association of Toronto
- International Union of Operating Engineers, Local 793
- International Union of Painters and Allied Trades, District Council 46
- Joint Residential Construction Association
- LiUNA Local 183
- Ontario Formwork Association
- Toronto and Area Road Builders Association

2017 UPDATE: QUANTIFICATION of Excess Construction Soils in Ontario

An independent research study prepared for the Residential
and Civil Construction Alliance of Ontario (RCCAO)



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1.0 EXECUTIVE SUMMARY



The Residential and Civil Construction Alliance of Ontario (RCCAO) has been working collaboratively with the Ministry of the Environment and Climate Change (MOECC, or “the Ministry”) for several years to develop supportive policies and implement best management practices (BMPs) for excess construction soils. In December 2016, MOECC released its “Excess Soil Management Policy Framework” after a nearly one-year formal consultation process.

After having reviewed best practices in other jurisdictions, RCCAO began promoting a model employed in the U.K. to beneficially reuse excess soils through soil matching and other methods. Based on codes of practice adopted by CL:AIRE,¹ it was clear that reusing excess soils at compatible sites significantly reduced the possibility that these soils would be sent to landfill or otherwise improperly disposed of. Case studies conducted by CL:AIRE demonstrated the effectiveness of its materials management plan, which included soils tracking systems and a website registry.

In Ontario, as with other jurisdictions, there is a lack of data on the quantity of excess clean soil that is generated from infrastructure and development projects. The first such province-wide study was commissioned by RCCAO in large part because of a request by the Ministry in 2012. The “Quantification of Excess Construction Soils in Ontario” study provided estimates for different construction sectors for three years: 2008, 2009 and 2010, with low and high ranges. For the final year of study, 2010, a cumulative total of between 20.0 and 24.6 million cubic metres (m³) of excess construction fill was generated by all major construction activities in Ontario.

While the intent for this study was to replicate the methodology used five years ago, unfortunately, data sets formerly provided by Statistics Canada are no longer available. Other data sources were thus accessed to fill in the gaps to arrive at reliable estimates.

For 2015, it is estimated that a minimum of 25.8 million m³ of excess construction fill was generated in Ontario. To put this volume into perspective, this amount of soil would fill the Rogers Centre (the stadium in Toronto formerly known as the SkyDome) to the top of the roof 16 times.²

This total is broken down as follows:

- Municipal and Other Infrastructure: 10.7 million m³
- New Residential: 8.6 million m³
- ICI, excluding Roads and Utilities: 6.5 million m³

COMPARING 2015 WITH 2010

A conservative methodology has been used to derive this total, but even so, 25.8 million m³ is higher than the high end of the range for the 2008 to 2010 period, with the peak being 24.6 million m³ for 2010. The distribution, however, has shifted considerably as residential construction represented only 5.7 million m³ of excess fill five years ago. On the other hand, municipal and other has decreased from 14.5 million m³, while the ICI (industrial, commercial, institutional) category has risen from 4.4 million m³.

The shift in sources of excess construction soil means that a greater portion of excess construction fill is being generated by private developers and a smaller portion is being generated by municipal and provincial government bodies. Despite this shift, challenges remain for data capture and the adoption of voluntary best practices without a proper governance structure in place.

2.0 BACKGROUND

As stated in the 2012 report, “Ontario’s provincial and municipal governments have recognized the importance of continuing investments in infrastructure, namely roads, transit, sewer and water works, as well as other fundamental infrastructure such as schools and hospitals.” The excavation associated with building such infrastructure generates excess fill of various quality. Prior to 2012, there was no analysis for Ontario or anywhere else in Canada regarding annual estimates of excess construction fill.

Despite the recommendation in the 2012 report “that the Ontario government and other stakeholders undertake studies to better estimate both the quantities of excess construction soils being generated, and the quality of those soils and the intended destinations for placement of that material,” this objective has not been advanced in any meaningful way.

By 2011, the Ontario government was proposing regulatory policies, guidelines and other measures to manage soil and fill movement. It was recognized by Queen’s Park and other stakeholders that to develop effective instruments for managing excess construction fill, it would be useful to have data on the quantities of excess soil being generated, as well as other metrics related to any proposed new requirements. As a result of a request by the Ministry in 2012, RCCAO commissioned and published an analysis and estimates of excess construction fill generated across Ontario. Low and high estimates were generated for three specific years:

- **2008:** 16.7 - 21.1 million m³
- **2009:** 15.9 - 19.9 million m³
- **2010:** 20.0 - 24.6 million m³

While reuse of clean excess soils might have taken place for certain projects such as highway corridors, anecdotal evidence pointed to a dig-and-dump approach for most excavated material.

In January 2014, the Ontario government published a guideline document, “Management of Excess Soil – A Guide for Best Management Practices.”³ The BMP Guide encouraged all stakeholders to look for opportunities to minimize the amount of soil to be excavated during construction projects, to reuse excavated soil on site wherever possible, or off site at a similar civil construction project. The Guide provided no information on estimated volumes or costs associated with excess soils.

The purpose of this report is to provide updated information on RCCAO’s 2012 report as there have been no published estimates up to the time that this report was published. In fact, the 16 to 24 million m³ range continues to be used in many reports.⁴

3.0 AVAILABLE SOURCES FOR MORE RECENT DATA



RCCAO's 2012 estimates were based primarily on Statistics Canada data for the calendar years 2008 through to 2010 and the application of sector specific estimates for each class of construction listed by Statistics Canada. At that time, data was published for 138 separate types of construction activity;⁵ for the years 2011 and 2012, many of those categories did not have sufficient reliable data for Statistics Canada to publish any value. The specific database was discontinued for all years commencing after December 31, 2012 and more recent data only shows 21 separate types of construction activity, with the most recent data being for 2014 on an "intentions" basis. For years beyond 2014, data is provided for only three classes of non-residential construction: industrial, commercial and institutional (ICI).

Detailed information, however, is available for residential construction across Ontario, through the housing starts reported monthly by the Ontario Home Builders' Association for four different types of housing:⁶ single-detached, semi-detached, row housing and apartments/condominiums.

In terms of estimating some of the more significant sources of excavated materials, such as road construction, capital budget information remains available for the Ministry of Transportation's highway construction programs as well as road construction projects for various upper-tier and lower-tier municipalities. This allows one to generate an estimate of the number of kilometres of new roadway that are being constructed or reconstructed and by using typical designs one can get an estimate of soil volumes that would need to be excavated.

With respect to subsurface utilities and sewers, it was necessary to view a number of municipal capital budgets for the construction and/or replacement of water mains and sewers. Once again, the object is to get an estimate as to how many kilometres of buried pipe are being installed. Combining length of pipes with estimated trench widths and estimated depths at which pipes are buried can be used to generate volumes of excavated fill. Annual reports for natural gas distributors that outline approvals obtained from the Ontario Energy Board for construction – as well as other information about capital investments for their distribution systems – provided a basis for estimating the value of province-wide construction for the utilities sector. The plans and budgets are then translated into estimated kilometres of buried pipe, which in turn generates an estimate of excavated fill for that sector.

In the U.K., an independent, not-for-profit organization, Contaminated Land: Applications in Real Environments (CL:AIRE), promotes regeneration of both clean and contaminated soils and has an operational soil registry and matching service. However, that organization does not appear to have attempted to publish any estimates of annual volumes of excess soils generated in specific regions or across the U.K. RCCAO has established a separate organization, SOiL⁷ to provide a soil-matching service for Ontario which is based on CL:AIRE's service. Unfortunately, it has not yet acquired sufficient data from which to estimate excess construction fill generated by all construction sectors in Ontario. Uptake on soil matching and use of SOiL service has been hampered by uncertainty within the municipal sector regarding use of MOECC's BMP Guide. To date, municipal outreach has been limited and no training support has been provided by the provincial government.

A review of data sources in other Canadian provinces, the U.S. and elsewhere around the globe found only one jurisdiction had published an English-language estimate of total excess construction soils other than soils from specific individual projects.⁸

That exception was Japan: due to the massive impact of the 2011 tsunami, various English language reports were generated by Japanese sources, including a 2013 technical paper "Recycling Materials in Geotechnical Applications."⁹ This report states that 140 million m³ of excess construction fill was generated across Japan in 2008. There are parallels between Japan's estimated value and RCCAO's estimate for 2008 for Ontario of between 16.7 and 21.1 million m³: Japan's population that year was approximately 10 times that of Ontario's at nearly 13 million, although Japan's housing stock is much smaller on a per-capita basis.¹⁰

4.0 METHODOLOGY FOR THE STUDY

RCCAO's prior excess construction fill quantification study of 2012 relied heavily on Statistics Canada data for various types of construction projects such as municipal sewers, gas pipelines, shopping centres, schools and warehouses. In examining the capital value of various types of construction projects one needs to consider what proportion of projects are in the nature of renovations or alterations which would not generate any excavation activity, as opposed to new construction where excavation takes place.

Excavation is typically required for water mains and sewers, whether an existing pipe is being replaced or a new service is being installed for the first time. This contrasts with many construction projects for government buildings in which there is a relatively high percentage of renovation or alteration work. Estimates were made for the various classes of construction projects as to percentage of projects that would or would not generate excavation activity and hence excess construction soils.

To calculate excess construction fill quantities for various types of projects, this study relied on the results of tender competition results used for the 2012 study which gave a correlation between capital cost and the length of roads, pipes or square footages of commercial buildings, etc. These values were adjusted based on changes to the construction price indices published by Statistics Canada for the period 2009 to 2016.¹¹

For each category, general assumptions were made about the quantity of soil generated from the site based on parameters such as the number of floors and total square footage of each building to be constructed. The estimated quantity of soil was then compared to the total capital cost of the project and the exercise was repeated for several similar tendered construction projects to obtain a "sector multiplier."¹² For example, the sector multiplier for water mains and sewer pipes was 0.003, so that one could obtain a crude estimate of the quantity of excess construction fill for such an activity by multiplying the water and sewer capital construction budget by the sector multiplier of 0.003.

A province-wide breakdown for gas main construction during 2015 was not available, but there was information for "utility construction" which included electrical power distribution and cable TV. Since these types of projects generate a low quantity of excess fill (many networks have overhead cables and directional drilling), an overall estimate of 0.0008 was used for utilities other than water and sewer.

For the 2015 housing starts data, an assumption was made that the average single-family detached house was 3,300 square feet. Based on a standard footprint, estimated excavation soil quantities were derived. Similar calculations were made for semi-detached, row housing and condominiums using smaller building footprints.

For roads, sewer and water main projects, capital budgets were identified for selected municipalities, and based on the relative populations of those municipalities as compared to the population of the entire province of Ontario, municipal budgets were extrapolated to generate province-wide figures.

5.0 ESTIMATED VOLUMES



Based on the methodology outlined above, the quantity of excavated materials that needed to be taken off construction sites across Ontario for permanent placement at a third-party site was estimated to be 25.8 million m³ in 2015, as shown in Table A on page 15.

By way of comparison, the estimated quantity of excess construction fill generated is significantly less than the 75 million m³ of aggregates estimated to be produced across Ontario in 2015.¹³ As in the previous study, the annual level of aggregate production significantly exceeds the total volume of excess construction soils. Aggregates are used in many construction projects which do not generate any fill that must leave the site. For instance, oil and gas transmission lines are often constructed cross country and not necessarily within road allowances. Sand and other aggregates are often used as a supportive base and padding for the pipe. Displaced soil, however, is usually distributed on the same right of way and not taken off site. Aggregates are also one of the primary components of concrete cement and asphalt cement, both of which do not generally displace in situ soils or fill. A large portion of concrete structures, such as buildings, are above ground and therefore would not displace equivalent volumes of soil.

While estimates can be made about the quantity of soil generated each calendar year across Ontario, there is no mechanism in place to provide qualitative information about what percentage of excess fill would be characterized as Table 1, 2 or 3 under Ontario's "Soil Ground Water and Sediment Standards for Use under Part XV.1 of the *Environmental Protection Act*."¹⁴ The placement and movement of soils meeting Table 1 criteria would trigger minimal adverse environmental impacts as compared to the placement of Table 3 soils on sites that might impact the quality of surface or ground water. Even soils from agricultural lands may pose a risk if such soils contain excess quantities of pesticides and other harmful substances. Although soils excavated from road allowances may have high levels of dissolved road salts, MOECC is looking at risk-based alternatives to encourage the reuse of this type of impacted soil.

6.0 DATA GAPS



A variety of recent reviews and reports – including an Excess Soil Management Research report commissioned by the MOECC and prepared by Conestoga-Rovers & Associates in 2015 – refer to recent increases in the generation of surplus soils and the measures taken by local municipalities to regulate and/or restrict the importation of fill onto sites within their municipal boundaries, but there has been no attempt to quantify the issue or measure the effectiveness of any particular by-law or other control instrument.

Stakeholders have noted that there is still a need to define the attributes of “clean” soil and what alternatives are available for the management of soil that is not clean other than disposal at a licensed landfill. Indeed, some stakeholders are asking for documentation of where all excavated soils are transported and to keep a record of such movement, but MOECC has not yet established the necessary regulatory framework.

Many observers would agree that one cannot be confident that they have solved a problem unless there are measurement tools in place. In the context of excess construction fill there are two enormous data gaps, an estimate of the annual quantity of excess construction fill generated province-wide, and a qualitative breakdown of that volume. If it were determined that 95% of all excess construction fill in Ontario meets Table 1 criteria,¹⁵ the regulatory framework might be very different than a scenario in which 50% of all excess construction fill fails Table 3 criteria¹⁶ and only 10% meets Table 1.

Generally speaking, whenever new regulatory frameworks are established, it increases the costs of compliance and increases the incentives to circumvent such regulatory controls.

The Province of Ontario and all stakeholders require consistent and reliable information on the quantity and quality of excess construction soil being generated annually in order to craft effective instruments to manage such materials in an environmentally sound and fiscally responsible manner.

7.0 CONCLUSIONS

The continuing reduction of construction-related information from Statistics Canada has reduced the reliability of some of the data used in this report to estimate excess construction fill. Statistics Canada decisions dating back to 2010 to consolidate data from 138 fields of activity to a dozen or less have removed one of the few consistent sources of data upon which to estimate excess construction soil volumes.

Conservative estimates were used in generating the sector multipliers so that the estimated quantity of excess construction fill of 25.8 million m³ is likely understated. Due to the Statistics Canada data sets being discontinued, however, it was determined that providing low and high ranges was not going to be feasible.

A review of data sources in Canada, the U.S. and elsewhere around the globe indicates that Japan is the only jurisdiction that has published estimates of excess construction soils generated (other than on specific projects).

To repeat the recommendation made in RCCAO's 2012 Quantification report, it is incumbent on the Ontario government in conjunction with other stakeholders to undertake studies to better estimate the quantity of excess constructions soils being generated in different sectors as well as the quality of these soils.¹⁷ In discussions with MOECC, RCCAO has suggested that the creation of Soils Ontario – modelled after CL:AIRE in the U.K. – would be able to be the repository for this type of information.

New technological solutions are being developed, such as mobile phone and tablet apps to link contractors with haulers that would track volumes emanating from source sites and taken to receiving sites across Ontario. As part of the province's initiatives to address climate change, support an innovation economy and deliver infrastructure in more effective ways, implementation of the Excess Soil Management Framework is a critical objective.

Expectations are that the quantity of excess construction soils will continue to be high in the coming years. The federal government's 2017 budget projects that \$186 billion will be invested in infrastructure on housing, infrastructure and transit. Ontario's long-term infrastructure plan calls for \$160 billion to be invested over 12 years (beginning in 2014-2015). At the local level, sewer and water main projects and a continuing high demand for new housing to address the needs of a growing provincial population will result in the generation of excess soils. Trucking and disposal costs on a per-cubic metre basis are likely to increase at a rate that is greater than the core consumer inflation rates as fewer sites remain open around the GTA to accept excess construction soils and clean fill material.

Establishment of soil-matching services in Ontario, as proposed by RCCAO's SOiiL program or other plans similar in scope to the CL:AIRE approach, will not only direct excess construction fill to suitable placement sites, but also will provide regulators and stakeholders with better data for developing excess construction soil strategies and actions.

TABLE A: SOURCE OF EXCESS CONSTRUCTION FILL

SOURCE OF EXCESS CONSTRUCTION FILL	2015	ESTIMATED QUANTITY (millions of m ³)
New Residential Construction		
Single-Detached Homes	6.0	
Semi-Detached	0.4	
Row and Townhomes	1.7	
Apartments/Condominiums	0.5	
Net New Residential Construction		8.6
Municipal and Other Infrastructure		
Provincial Highway Construction	0.6	
Municipal Roads, Sidewalks, etc.	2.1	
Water Distribution and Sewers	3.4	
Other Utilities (gas, electric, transmission, etc.)	3.6	
Special Projects (transit tunnels, etc.)	1.0	
Net Municipal and Other Infrastructure		10.7
ICI Excluding Roads and Utilities		
Industrial	1.3	
Commercial	3.2	
Institutional	2.0	
Net ICI Excluding Roads and Utilities		6.5
NET EXCESS CONSTRUCTION FILL		25.8

ENDNOTES

- 1 Contaminated Land: Applications in Real Environments (CL:AIRE) is an independent not-for-profit organization established in the United Kingdom in 1999 to stimulate the regeneration of contaminated land through soil matching services and best excess soil management practices. <http://www.claire.co.uk>
- 2 According to the Rogers Centre website at http://www.rogerscentre.com/fun/community_funfacts.jsp, the volume inside the Toronto stadium with a closed roof is estimated to be 1.6 million m³. Therefore, the excess construction soil generated in 2015 across Ontario would fill 16 Rogers Centres (i.e., 1.6 m³ x 16 = 25.6 million m³).
- 3 A copy of the BMP Guide can be viewed and downloaded at <https://www.ontario.ca/page/management-excess-soil-guide-best-management-practices>. A review and commentary on the practices in the guideline is beyond the scope of this report.
- 4 A report prepared by Conestoga-Rovers & Associates for MOECC on “Excess Soil Management Research” (Oct. 2015) cited RCCAO’s research in its first footnote. (Note: CRA changed its name to GHD on July 1, 2015, but continued to use the CRA name on the document).
- 5 Statistics Canada has published a table of construction investments based on Provinces and construction sectors at <http://www5.statcan.gc.ca/cansim/pick-choisir?lang=eng&p2=33&id=0290040#customizeTab>
- 6 http://ohba.ca/housing_starts
- 7 Supporting Ontario Infrastructure Investments and Lands – <http://www.soil.com>
- 8 These would include large hydroelectric water reservoirs or tunnelling projects in countries such as Panama and Ukraine.
- 9 <http://www.claisse.info/2013%20papers/data/e057.pdf>
- 10 See page 7 of the 2012 Quantification Report at <http://www.rccao.com/news/files/QUANTIFICATIONofExcessConstructionSoilsinOntarioOct92012CLEAN.pdf>
- 11 See Statistics Canada table 327-0043 accessible at <http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3270043>
- 12 A “sector multiplier” converts the dollar value of a capital project, such as construction of new sewers, into cubic metres. The sector multiplier of sewer construction is 0.003, meaning that a sewer construction project with a value of \$100,000 would be expected to generate roughly 300 m³ of excavated construction fill.
- 13 Information obtained from the Ontario Stone Sand and Gravel Association of Ontario
- 14 Available for download at <https://www.ontario.ca/document/soil-ground-water-and-sediment-standards-use-under-part-xv1-environmental-protection-act>
- 15 Ibid
- 16 Ibid
- 17 In November 2016, the Ontario Society of Professional Engineers, in conjunction with the Greater Toronto Sewer and Watermain Contractors’ Association and RCCAO, released “Excess Soil Management: Ontario is Wasting a Precious Resource,” which calculated the benefits of adopting a BMP approach based on 24 case studies. See <http://bit.ly/ExcessSoilManagement>



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