

QUANTIFICATION of Excess Construction Soils in Ontario

INTRODUCTION

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.

Many construction industry stakeholders have stated that the management and placement of excess soils and fill is not only a growing operational and logistics concern, it represents a growing additional cost.

The Province and other stakeholders are proposing regulatory policies and other measures for managing soil and fill movement, but it is not possible to determine the effectiveness or adequacy of such measures without additional information related to the quantities and costs associated with such materials.

When excavation from a roadbed or other infrastructure construction site occurs, the soil that had been compressed by decades (if not centuries) of load bearing, expands as it is no longer under pressure. Most native soils require considerable time and energy to re-compact to the condition in which it was originally situate. Consequently engineered materials, primarily stone and aggregate, which are more stable and easily compressed, are used to backfill many infrastructure construction project excavations. The soil that was excavated is no longer used and owners and contractors must find an alternate site for those excavated soils (herein referred to as "**Excess Construction Soils**").

With the exception of renovations and alterations, most types of construction project involve some degree of excavation and thereby generate excess materials. Given the costs as well as administrative and regulatory burdens¹ often associated with sourcing and transporting excess construction fill to a third party site, many owners and contractors will try to leave the material on the construction site, either as visual or acoustic berming, landscaping features or simply a slight increase in the elevation of parts of the property.

It is estimated that approximately 80% of soil and fill excavated from MTO construction sites is placed elsewhere within the MTO right of way or placed into interim storage. Most municipalities however do not have sufficiently wide rights of way or other regions in which to place excavated material from road and utility construction and will generally require construction contractors to find a permanent site for the placement of excavated materials.

¹ The management of Excess Construction Soil became more of a cost and an administrative burden due to recent regulatory amendments to Ontario Regulation 153/04 in 2009 and 2011 related to the assessment, sampling, testing and movement of soils, as the new regulations added more potential contaminants of concern and stricter procedures were introduced for sampling and analysis.



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With respect to residential construction, the ability of the developer to place excavated material on site depends on the size of the site and relative location. In the denser urban centres in the Golden Horseshoe almost all of the excavated material must be removed from the construction site, whereas there is more flexibility in new subdivision developments to contour the design of homes, boulevards and parks and avoid exporting excavated materials.

AVAILABLE RECORDS AND DATA FOR EXCESS CONSTRUCTION SOILS MOVEMENTS IN ONTARIO

On an annual basis, there are thousands of infrastructure construction projects across Ontario ranging in capital costs from under twenty thousand dollars to over one billion dollars in value. Apart from Statistics Canada, there is no central repository for the total number or value of construction projects across the Province.

Municipalities will publicize the value of their upcoming capital construction budgets but that information cannot be used to determine quantities or trends related to Excess Construction Soils. There are no province-wide reporting requirements for the testing of soil samples or the quantities of excess soils moved from construction sites with the exception of provincially-regulated landfills and waste disposal sites.

While there are studies in Canada and the U.S. which estimate quantities and types of waste generated by various industries, including construction and demolition debris, excavated soil is generally excluded from those quantities.

There is no comprehensive province-wide reporting regimen to track soil movements or the acceptance of soils at any private sites. While some municipalities have instituted fill import restrictions and/or site alteration bylaws, most municipalities simply address movements on an applicant by applicant basis and do not compile or publish any annual soil movement or placement information.

A review of data sources in other Canadian Provinces, the U.S. and elsewhere around the globe gave no indication that any jurisdiction has published estimates of excess construction soils generated other than soils from specific individual projects such as a very large hydro electric water reservoir north of Moscow.²

² See <http://www.themoscowtimes.com/business/article/digging-deep-to-power-moscow/467589.html>



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METHODOLOGY FOR THE STUDY

The only consistent and comprehensive source of province-wide data for construction activity is that provided by Statistics Canada, which is available for up to 138 separate types of construction activity.³

In order to prepare a rough estimate of Excess Construction Soils quantities across Ontario, a number of tender competition results were reviewed for different classes of construction, e.g. schools and universities, auto dealerships, gas distribution mains, new road construction, etc. For each of such categories, generally assumptions are made about the quantity of soil generated from the site based on parameters such as the number of floor levels, total square footage of the building. The estimated quantity of soil is then compared to the total capital cost of the project for several similar tendered projects to obtain a 'sector multiplier'. For instance the 'sector multiplier' for high rise residential condominium apartment buildings is 0.0003, so that one could obtain a crude estimate of the quantity of Excess Construction Soils from such a project by multiplying the winning tender value by the 'sector multiplier' of 0.0003. The 'sector multiplier' for manufacturing plants and factories is 0.0008 and the 'sector multiplier' for automobile dealerships is 0.0004. One of the reasons why the multiplier is higher for manufacturing plants and factories as compared to high rise residential is that manufacturing plants would be lower in total height and therefore there would be more excavation per square metre of useable space.

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 is a necessity. For instance excavation is normally required for watermains and sewers whether an existing pipe is being replaced or a new service is being installed for the first time. That is in contrast to many construction projects for government buildings which have a relatively high percentage of renovation/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.

³ 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>



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ESTIMATED VOLUMES

Based on the methodology outlined above, the quantity of excavated materials that needed to be taken off of the construction sites across Ontario for permanent placement at a third party site ranged from a low of just under 16 million cubic metres per year to a high of almost 25 million cubic metres per year during the period of 2008 through 2010. A table summarizing the respective volumes by construction sector and year is appended to this report.

ANALYSIS OF ESTIMATED QUANTITIES

To put this issue into perspective, the estimated annual volume of Excess Construction Soils in Ontario would cover an area one kilometre long by one kilometre wide and up to 25 metres in height. The construction of the Suez Canal created about 75 million cubic metres of soil over a period of about 10 years.⁴ Excess Construction Soils from Ontario would equal that volume in four years or less.

The estimated quantity of Excess Construction Soils generated is significantly less than the 80 million cubic metres of aggregates estimated to be produced across the Province.⁵ Aggregates are used in many construction projects which do not generate any Excess Construction Soils that must leave the site. For instance, oil and gas transmission lines are often constructed cross country and not necessarily within road allowances. When such pipelines are constructed, large quantities of sand and similar materials are added for pipe bedding, however the excavated soil is simply backfilled and not removed from the construction site. For the reconstruction or widening of roads, it is often the case where the grade of the new paved surface is higher than it was prior to construction, as the volume of aggregates added to the roadbed does not always equal the volume of excavated material.

The estimated quantity of Excess Construction Soils generated province-wide is about twice the approximately 9 million cubic metres of ready mix concrete produced in Ontario each year.⁶

The writer has some concerns about the completeness of the information sourced from Statistics Canada (“StatsCan”). For instance the results show no investment in student residences in either 2008 or 2010 but a value of more than \$100 million in 2009. According to StatsCan there was zero investment in Ontario daycares and libraries in 2010 and no tunneling construction projects in either 2008 or 2009. The StatsCan data appears to be silent on the significant investments that were made for the construction

⁴ As reported on the Wikipedia website

⁵ Information obtained from the Ontario Stone Sand and Gravel Association

⁶ Verbal information from the Ready Mix Concrete Association of Ontario



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and installation of wind turbines that are a common sight on dozens of properties in Huron and Bruce County as well as other parts of the Province.

The StatsCan data may not have captured all of the investments in roads and highways across the Province when it estimated about \$3 billion per year in road and highway construction projects. The 2010 Ontario Provincial budget announced that it was spending \$2.1 billion on provincial highways, which excludes investments in municipal roads and construction on the 407 highway⁷. The City of Toronto capital budget for roads in 2010 was \$180 million.

StatsCan data also indicates a zero dollar investment in gas mains and distribution in 2010, contrary to the hundreds of millions of dollars that were approved by the Ontario Energy Board for the capital budgets of Enbridge Gas and Union Gas⁸ who not only operate distribution systems across the Province but also operate underground gas storage and production facilities in Ontario. New and replacement natural gas transmission and distribution pipes would have generated between 800,000 and 4,000,000 cubic metres of Excess Construction Soils during each of the years.

Regardless of any anomalies in StatsCan data upon which the estimated Excess Construction Soil quantities are based, the handling, transport and placement of such soils adds a very significant sum to the cost of infrastructure construction in Ontario. A recent RCCAO report published on July 12, 2012⁹ estimated the costs of handling, transporting and disposing of approximately 1.5 million cubic metres of Excess Construction Soils that are expected over the next several years from the Eglinton Crosstown LRT construction project in Toronto. Based on the Eglinton Crosstown LRT cost estimates for handling materials from the project, the annual cost of managing all of the Excess Construction Soils in Ontario would be anywhere from \$700 million to more than \$1.7 billion per year.

⁷ While the eastern extension of Highway 407 had not yet started, there were a number of other construction projects from 2008 to 2010 that may have contributed Excess Construction Soils. In 2010 there was widening of lanes between Highway 404 and Markham Road and widening of bridges between Highway 403 and Highway 401. In 2009, 13.4 kilometres of new lanes were added to the 407 corridor between Markham Road and York/Durham Line and there was additional ramp and bridge widening work. There was also bridge widening work in 2008 from Markham Road to York/Durham Line.

⁸ Ontario Energy Documents indicate that in 2008, 2009 and 2010 Enbridge and Union Gas installed a total of 575 km, 202 km and 429 km of new distribution mains in the respective years. In addition to new lines of pipe, it is estimated that the two gas distributors replaced a combined total of 600 to 1,300 km of older pipe for each of those years.

⁹ Accessible via the internet at <http://www.rccao.com/news/files/RCCAO-JULY2012-REPORT.pdf>



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RECOMMENDATIONS AND CONCLUSIONS

A review of data sources in Canada, the U.S. and elsewhere around the globe indicate that no jurisdiction has published estimates of excess construction soils generated other than on specific projects. It is recommended that the Ontario government and other stakeholders undertake studies to better estimate not only the quantities of excess construction soils being generated, but estimates of the quality of those soils and the intended destinations for placement of that material.

With cost estimates of up to \$1.7 billion per year for the management of Excess Construction Soils, it is absolutely vital that key Ontario government ministries and agencies such as the Ministry of the Environment, Ministry of Transportation, the Ministry of Municipal Affairs and Housing and Infrastructure Ontario, to name just a few, work with industry stakeholders and NGO's to establish pragmatic definitions and regulations as well as simple and clear guidelines that fairly allocate responsibilities and liabilities while minimizing overall costs and administrative burdens.

Expectations are that the quantity of Excess Construction Soils will increase in the coming years with many large scale infrastructure projects under way, such as the Eglinton Crosstown LRT rapid transit project in Ontario which alone will generate 1.5 million cubic metres of soil, a variety of sewer and watermain projects in Toronto that will generate up to 8 million cubic metres of Excess Construction Soils between early 2012 and the end of the decade, a large number of hydrocarbon transmission pipeline projects for new and replacement large diameter pipe, completion of the subway extension north from Downsview to Highway 7, expansion of Highway 407 east from its current terminus, rapid transit projects slated for Waterloo Region and the National Capital Region.

Trucking and disposal costs on a per cubic metre basis are likely to continue to increase at a rate that is greater than the core consumer inflation rate as fewer sites remain open near urban regions (such as the GTHA) to accept Excess Construction Soils.

All Ontario stakeholders will have to dig much deeper to find practical and cost effective solutions to mitigate and manage Excess Construction Soils.





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Summary of

Excess Construction Soils Generated by Sectors

	2008		2009		2010	
	Excess Construction Soils (millions m ³) LOW Range Estimate	Excess Construction Soils (millions m ³) HIGH Range Estimate	Excess Construction Soils (millions m ³) LOW Range Estimate	Excess Construction Soils (millions m ³) HIGH Range Estimate	Excess Construction Soils (millions m ³) LOW Range Estimate	Excess Construction Soils (millions m ³) HIGH Range Estimate
INDUSTRIAL, COMMERCIAL & INSTITUTIONAL						
INDUSTRIAL	0.5	0.5	0.3	0.3	0.4	0.4
COMMERCIAL	2.7	3.2	2.0	2.4	1.9	2.4
INSTITUTIONAL	0.9	1.0	1.0	1.2	1.3	1.6
RESIDENTIAL	5.6	5.6	5.2	5.2	5.7	5.7
SEWER & WATERMAIN	2.9	2.9	3.5	3.5	6.7	6.7
ROADS	2.5	2.7	3.3	3.5	3.2	3.5
HEAVY ENGINEERING	0.01	0.02	0.02	0.02	0.1	0.1
PIPELINE	0.7	4.0	0.1	3.0	0.7	3.7
ELECTRIC POWER	<u>0.9</u>	<u>1.2</u>	<u>0.5</u>	<u>0.8</u>	<u>0.0</u>	<u>0.5</u>
Total Annual Volume Excess Construction Soils (millions m³)	<u>16.7</u>	<u>21.1</u>	<u>15.9</u>	<u>19.9</u>	<u>20.0</u>	<u>24.6</u>

