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SCOPE CHANGES AND TUNNELLING EQUIPMENT REQUIRED FOR SOUTHEAST COLLECTOR TRUNK SEWER PROJECT

The Transportation and Works Committee recommends the adoption of the recommendations contained in the following report, May 30, 2008, from the Commissioner of Environmental Services:

1. RECOMMENDATIONS

It is recommended that:

1. Regional Council authorize expanding the existing purchase order for the consulting services of Earth Tech, Hatch Mott MacDonald and their sub-consultants Thurber, Inspec-Sol, CRA, Gartner Lee to undertake the design, contract administration, construction inspection and monitoring services required for the Southeast Collector Trunk Sewer (SEC) project. Accordingly, the existing purchase order number B8634 to Earth Tech (Canada) Inc. be increased from \$22,308,297 to \$61,083,570 which represents an increase of \$38,775,273 exclusive of GST.
2. The Chair and Regional Clerk be authorized to execute the contract, subject to the approval of Legal Services as to form and content.
3. Regional Staff be authorized to negotiate with the local tunnel supplier, Lovat Inc., for the advanced procurement of Earth Pressure Balance Tunnel machines in order to meet the scheduled completion date of 2012. This is in accordance with the Purchase By-law No. A-0353-2004-089, Section 10 Sole Source Purchases. A sole source purchase may be made for the procurement of goods, services or construction without issuing a call for bids where the compatibility of a purchase with existing equipment, facilities or service is the paramount consideration.

2. PURPOSE

The purpose of this report is to secure authorization to retain Earth Tech and Hatch Mott MacDonald for the complete engineering and environmental services related to the design, contract administration, construction inspection environmental enhancements and environmental monitoring in accordance with Council Report No. 7 of the Transportation and Works Committee September 27, 2007. Additionally the report provides the status of negotiations with City of Edmonton to carry out a portion of the tunnelling services and seeks Council authorization to negotiate with Lovat Inc. for the advance procurement of the necessary tunnel boring machines for this project.

The requested fee for the engineering services has been developed as a result of a detailed negotiation process with Earth Tech and Hatch Mott MacDonald and requires Council authorization as per the Purchasing By-law.

Council authorization to negotiate with Lovat Inc. is required as the estimated cost of the tunnel machines exceeds the authorization under the Purchasing By-law for sole source purchases.

3. BACKGROUND

Update on recent Southeast Collector (SEC) negotiations

The September 5, 2007 report to Transportation and Works Committee from the General Manager of Water and Wastewater concluded with a commitment for Regional staff to report back on the results of the negotiations undertaken with the City of Edmonton, Earth Tech Canada Inc., and Hatch Mott MacDonald Ltd. In this report, staff will provide updates as well as provide Council with information on the construction procurement strategy for completion of the new Southeast Collector Trunk Sewer by 2012.

The Region is proceeding with a three pronged approach to complete the sewer by 2012. The IEA, detailed design and the procurement phases are being undertaken concurrently with the design proceeding on the basis of tendering four sections of the tunnelling work for construction. A prequalification process is planned for these contracts. This is a process where contractors are solicited to submit qualifications to show that they meet the required levels of expertise and experience. It is important that these qualification criteria are set at an appropriate level to achieve the required expertise while ensuring there is sufficient pool of eligible contractors.

The Region is also planning a contractor's workshop with the intention to invite contractors to an information session and site tour over a one day period. The intent is to provide an overview of the project, general description of contract divisions, geotechnical conditions, schedule and procurement issues. A tour of the project will also be arranged with a handout information package.

A procurement strategy for the SEC is now in place

The project team has developed a procurement strategy for the SEC. This identifies the need to expedite several activities on this project to meet the tight timelines for the in-service date of December 2012. The procurement strategy was developed based on critical path schedules to complete the project by December 2012.

A critical component of the procurement strategy is the need for early purchase of the tunnelling machines, prior to securing the regulatory approvals.

The project will need up to four tunnel boring machines and their manufacture would take approximately 12 months. Procuring these machines ahead of the construction contracts will allow the Region to initiate tunnelling soon after the regulatory approvals are secured.

TBM manufacturers are Lovat (Canada), Herrenknecht (Germany), Robbins-Mitsubishi (USA-Japan), Wirth-NFM (Germany-France), Kawasaki (Japan), Akkerman-Hitachi Zosen (USA-Japan).

Lovat, Herrenknecht and Kawasaki have the most in-house experience of earth pressure balance TBM's. In the two USA-Japan partnerships, the Japanese partner provides all the EPB experience. For Wirth-NFM the EPB experience is from NFM who have produced a relatively small number of large diameter machines. Japanese manufacturers have had very limited sales in North America, totally limited to Obayashi, a Japanese contractor operating in North America. Wirth-NFM have sold no machines in North America. Akkerman has produced only two machines from its partnership with Hitachi Zosen. This would suggest that the main contenders would be Lovat and Herrenknecht. These two companies compete frequently through out the world.

For this project, Lovat offers the advantage over Herrenknecht based on their local knowledge, local support during construction, easy monitoring of the manufacturing process and the offer of an open book comparison with previous supply contracts.

LOVAT has a strong history with both The Regional Municipality of York and the City of Edmonton

Lovat, located in Toronto, is one of a relatively small number (about four worldwide) of TBM manufacturers and is world renowned. Lovat is as qualified as two or three other industry leading manufacturers for the production of these machines. Lovat has been the sole supplier of tunnelling machines to the City of Edmonton since 1975.

York Region is currently using two Lovat TBMs on the YDSS Interceptor project and two Lovat TBMs on the Bathurst Langstaff sewer project. In addition, all TBMs used on the YDSS projects in the past have been supplied by Lovat. The project teams have benefited greatly from having the expertise and services of an internationally recognized TBM manufacturer locally available, within 38 kilometres of the project locations.

Procuring the machines from Lovat has significant advantages in terms of their ability to provide support services during construction, their desire to make sure the project, located in their "backyard", is a success, and their history of supplying TBMs to work in local ground conditions. Lovat supplies machines throughout the world and its machines are presently setting production records in the UK and elsewhere. According to the

Procurement Strategy and the critical path project schedule, manufacturing of the TBMs could start as early as January 2009, subject to the issuance of a purchase order from York Region in the Fall 2008.

The total cost associated with the procurement of the TBMs is currently estimated to be in the order of \$20,000,000. The final cost would be determined by the number and type of machines and the features included within the machines and the overall package of services included within the procurement contract.

Previous Council authorization obtained to Negotiate with Earth Tech and Hatch Mott MacDonald

Regional Council, at its meeting of January 20, 2005, approved the services of Earth Tech (Canada) Inc. as prime consultant in the amount of \$14,638,400 to complete the IEA phase of the new Southeast Collector trunk sewer along with the detailed design, contract administration and contract inspection services. Of this amount, \$7,315,440 was allocated for detailed design, contract administration and contract inspection of the project. At the time, the fee for detailed design and contract administration was based on an estimated construction cost that ranged from \$80 million to \$103 million. This was based on little known and assumed conceptual information at the time, with respect to length, complexity of the route and the type of construction method. At the time it was assumed significant portions of the South East Collector could be constructed in shallow trenches using the open-cut method.

The three year long IEA process, through extensive consultation, determined a preferred route in June of 2007. The preferred route was determined to be Preferred Sewer Route 13, 15 kilometres in length and up to 40 m deep in sections, requiring tunnelling with little open cut construction, (*see Attachment 1*). The current construction cost estimate for the SEC is \$425 Million, more than four times the 2005 estimate that was the basis for the engineering fees approved by Regional Council in January 2005. The higher construction cost estimate reflects a higher level of project definition at the end of the IEA, increased level of construction complexity and includes the cost of four tunnel boring machines, disposal of excavated material from liners, 14 construction shafts, connection and diversion chambers, metering chambers, odour control and corrosion control facilities.

Given the complexities noted above, York Region staff recognized the need to strengthen the team with additional tunnelling expertise. Accordingly, staff held several meetings with the Mississauga firm, Hatch Mott MacDonald (HMM) to increase their role in the project. HMM are experts in the field of tunnelling, working on major tunnelling projects throughout North America including the Niagara Tunnel project for Ontario Power Generation, as well as the 19th Avenue YDSS Interceptor tunnelling project in York Region.

On September 27, 2007, Regional Council authorized staff to re-negotiate with Earth Tech and HMM for the design, contract administration, construction inspection and environmental monitoring services for the redefined Southeast Collector Project. Regional staff was also authorized to increase the existing purchase order (PO) number B8634 to Earth Tech (Canada) Inc. to \$22,308,297 to provide the additional services required for the increased scope of engineering services, associated with additional work on the IEA component of the project. Based on Council authorization to re-negotiate the required design, contract administration, construction inspection and environmental monitoring services, staff worked with the team to negotiate the re-defined scope and costs. The increased cost of engineering services for the redefined SEC project as defined through this comprehensive and rigorous process is \$38,775,273.

Negotiations with the City of Edmonton

In September, 2007 staff were authorized to negotiate an appropriate scope of work for the City of Edmonton to undertake all or part of the tunnelling work of the SEC.

Since that time, staff have held several meetings and workshops with Edmonton to discuss several aspects including project planning, technical review and legal considerations to develop the principles of the agreement as outlined below.

November 2007: Meetings in Edmonton to develop principles of the agreement, contractual documents, insurance, bonding and business principles to facilitate the future business and contractual relationship, and visits to on-going tunneling construction projects.

December 2007: Two workshops were conducted in Markham, Ontario. Each workshop was for duration of two days. The first workshop was to work on the project planning for development of a preliminary project plan and detailed schedule. The second workshop was to review technical considerations such as constructability on the preliminary and conceptual engineering information.

The Edmonton's tunneling division is seeking authorization from their Council to carryout this work. Staff will continue to negotiate the terms of the agreement with Edmonton and will report back to Council for approval in the fall of this year.

Until Edmonton's participation is confirmed, the project team will continue parallel approaches to keep open the competitive tendering option.

4. ANALYSIS AND OPTIONS

4.1 LOCAL TUNNEL SUPPLIER FOR EARLY PROCUREMENT OF TBMS

Southeast Collector project schedule would benefit measurably by procuring from internationally renowned tunnelling machine supplier located in the GTA

Lovat has been producing TBMs since 1972 and ranks within the top three soft ground TBM manufacturers in the world and has supplied eleven TBMs to the City of Edmonton for use on their sewer system. Lovat has a long history of supplying machines to contractors for use in tunnels in York Region, from projects on the original YDSS to all of the more recent YDSS projects.

Lovat specialises in the manufacture of earth pressure balance tunnel boring machines of the type required for the Southeast Collector. The proximity of the Lovat manufacturing facility to the project allows an unrivalled ability to provide support to their machines. This was recently demonstrated on the 19th Avenue project where, on arrival of the TBM at a shaft, the contractor discovered that the cutting head had suffered extreme wear. Lovat was able to organise the cutterhead removal and delivery to their plant where it was completely rebuilt. This happened during the holiday season. Lovat organized repairs at their facilities and completed the job with a total turnaround time of ten days, which helped to mitigate impacts to the project schedule.

Similarly, local availability of Lovat's technical staff and maintenance personnel offers fast response to machine performance issues and a close attention to machine monitoring and maintenance. Lovat locally sources most of their supplies and therefore has a short delivery time for these items.

4.2 REGION SUCCESSFULLY NEGOTIATES DETAILED SCOPE AND FEES WITH EARTH TECH AND HATCH MOTT MACDONALD

Since Council authorization in September 2007, Regional staff, Earth Tech and HMM began to negotiate the scope of work for the design, contract administration and environmental monitoring services.

A clear definition of the scope of services required to complete the design, contract administration and site inspection for the preferred route for the Southeast Collector has been established including development of over 1000 detailed task sheets. This has enabled proper definition of scope, accurate estimation of fees, and an appropriate allocation of risk with respect to scope and fees associated with the detailed tasks. Allocation of risks for time, scope and fees associated with the individual tasks was done through a mix of lump sum and time and materials pricing. Time and materials pricing was used for items where the scope was difficult to quantify at this time.

For these items the consultant would bill the Region using pre-established unit rates within pre-approved allowances carried for these items. As an example, contract administration and site inspection services will be paid for on a time and materials basis, using pre-approved hourly rates given the time sensitive nature of these services.

During negotiations the fee proposal from Earth Tech and HMM was reduced from \$57.3 million to \$46.2 million. This was accomplished through the optimization of scope and services, discounting, elimination of duplication and reduction of fee amounts and allowances.

The detailed definition of tasks and activities and their corresponding fee structures will facilitate efficient administration of the fees and reduce “extras” during the project.

4.3 ADDITIONAL SCOPE OF WORK

Additional scope of services represents a significant increase over the scope anticipated in 2005. Increases relate to the change in construction method, the requirement to procure equipment and materials, and additional staffing for construction administration and environmental monitoring. The following highlights the key changes in scope compared to original assumptions for this project.

- Complexity associated with the design of 15 km of sewer up to 40 m in depth, including tunnel, access shafts, drop shafts, diversion and metering chambers. This represents approximately \$4.5M or 11% of the total increase requested.
- Increased and advanced the timing of geological investigations and monitoring including construction of 300 test wells, to develop a profile of the sewer within optimum dense soil conditions (Newmarket Till), which reduces project risk and minimizes the need to dewater. This represents approximately \$1.23M or 3% of the total increase requested.
- Increased scope of environmental and ecological monitoring, mitigation and enhancement services primarily associated with underground construction activity in Rouge River Valley and Bob Hunter Park, First Nations concerns and other stakeholders potentially affected by the project. This represents \$6.5M or 18% of the total increase requested.
- Extensive vibration monitoring program at construction shafts and along hydro corridor. This represents approximately \$0.35M or 1% of the total increase requested.
- Complexities associated with provision of an odour control facility to mitigate odour complaints. This represents approximately \$1.20M or 3% of the total increase requested.
- Additional requirement to identify and improve haul roads due to increased traffic and improve them prior to construction to accommodate for heavy construction traffic. This represents approximately \$1.8M or 5% of the total increase requested.

- Design and construction of 13 shafts for lowering and removing tunnel boring machines. This represents approximately \$1.36M or 3% of the total increase requested.
- Preparation of traffic plans and intersection improvements as a result of shaft construction. This represents approximately \$0.57M or 1% of the total increase requested.
- Preparation of drawings for utility crossings, relocation and notification processes. This represents approximately \$0.15M or 0.4% of the total increase requested.
- Increased contract administration services resulting in increased resident engineering (tunnelling) and inspection fees during construction. This represents approximately \$13.27M or 34% of the total increase requested.
- Increased number of tenders from two to eleven (including four tunnel contracts, three utility contracts, two pre-purchase contracts for TBMs, segments, in award contracts). This represents approximately \$2.6M or 7% of the total increase requested.
- Property acquisition for permanent and temporary easements within York and Durham Regions. This represents approximately \$0.32M or 1% of the total increase requested.
- Advanced procurement of tunnel boring machines, segmental liners for 15 kilometre tunnel. This represents approximately \$0.42M or 1% of the total increase requested.
- Utilization of dedicated staff for project planning and control. This represents approximately \$2.5M or 7% of the total increase requested.
- Extensive requirements for federal (DFO, EC), provincial (MOE, MNR, MTO), utilities (Railways, Hydro) and local municipal approvals from Markham and Pickering. This represents approximately \$1.9M or 5% of the total increase requested.
- Approach of a negotiated contract with the City of Edmonton for tunnel construction. This represents approximately \$0.3M or 1% of the total increase requested.

Project delivers on Councils' Commitment to the Environment

In accordance with Council's commitment to the environment, specifically the Sustainability Strategy, Greening Strategy, Natural and Cultural Heritage papers, the Southeast Collector Project has developed as well, the Terms of Reference for this project, project enhancements that will benefit the environment, community and local infrastructure. Environmental enhancements will include improvements to the natural environment, surface and groundwater systems. Recreational enhancements will include improvements to existing or new additions to community facilities and cultural heritage through trail systems, pathways, linkages to existing recreational facilities, etc. Local infrastructure enhancements will include improvements to existing or new infrastructure features not currently in existing community budgets. The team is continuing to consult with the community groups, city, town parks and First Nations communities and will report back to Council in the fall of 2008 on the status of these enhancements.

5. FINANCIAL IMPLICATIONS

Breakdown of the fee increase

The existing Purchase Order to Earth Tech (Canada) Inc. to \$22,308,297 will be modified to include the role of Hatch Mott MacDonald, Thurber, Inspec-Sol, CRA, Gartner Lee and other miscellaneous sub-consultants and accordingly is increased by \$38,775,273 to a total cost of \$61,083,570 excluding GST.

Fees provided in this section include all disbursements and all escalation to hourly rates to account for inflation to the end of the project in 2015. This is based on detailed design services from 2008 to 2009, construction administration services from 2010 to 2012 and post-construction environmental services from 2013 to 2015.

Table 1
Cost Breakdown of Engineering Services for Individual Environmental Assessment, Detailed Design, Contract Administration and Site Inspection

Scope	Description	Previous Cost (existing PO)	New Cost
IEA	Environmental Assessment	\$14,992,857	\$14,800,000
Detailed Design	Design, Approvals, Tendering	3,525,455	21,856,000
	Procurement		
	Property acquisition		484,206
	Design		14,844,264
	Approvals		2,013,503
	Tender Documents		1,352,955
	Pro-active mitigation		1,001,932
	Tendering		724,277
	Project Management		1,434,863
Contract Administration	Site resident administration and inspection staff	3,240,474	17,504,571
	Manufacturing (TBM and Tunnel lining)		241,733
	Tunnel Contracts (36 mths)		13,266,620
	Haul Roads and Municipal infrastructure		1,123,018
	Post construction services		636,710
	Project Management		2,236,490

Environmental Monitoring	Measuring groundwater levels and stream flows	549,511	6,922,999
	During Design		1,108,899
	During Construction		4,146,264
	Post construction		1,667,836
TOTAL		\$22,308,297	\$61,083,570

Engineering fees consistent with projects of similar magnitude and complexity

The total engineering fees including the fee increase and exclusive of environmental monitoring represent approximately 11 % of the overall construction cost, currently estimated at \$425 M and which is consistent with industry standards for engineering fees of similar magnitude and complexity. Fees associated with the Environmental Monitoring are over and above what is typically required on construction projects and are accordingly not considered in the 11 % calculation.

Sufficient funds have been included in the 10-Year Capital Budget as the capital funding source for the design, contract administration, inspection and construction cost. This project is being funded by Development Charges and user rates and is included in the Development Charges by-law.

6. LOCAL MUNICIPAL IMPACT

Sections of the existing SEC Trunk Sewer are currently operating close to maximum capacity. Without additional capacity the section of the existing SEC trunk sewer between 9th Line and Townline Road in the Town of Markham and a further section of the system within the City of Pickering, between Townline Road and Liverpool Road is at risk of surcharging as early as 2013-2015. Therefore, addressing the capacity constraints of the existing system is vital to prevent sewage from overflowing into watercourses or backing up in to basements, during peak flow conditions.

The new SEC Trunk sewer will be required to address the additional sanitary sewer flows projected from future growth as allowed for in York Region's Official Plan. As envisioned in the Province of Ontario's Growth Plan for Greater Horseshoe (2006) there will be the requirement to service a residential population of 1.5 million people and an employment population of 800,000 people by the year 2031. To do this, a new SEC sewer has to be constructed to carry the projected flows for the design year 2036. Currently, additional significant projects are underway on the YDSS including; the Bathurst/Langstaff Trunk sewer, YDSS Interceptor and King City Sanitary Servicing

which will divert increased flow to SEC. Duffin Creek Water Pollution Control Plant is being expanded to treat the increase flows.

7. CONCLUSION

Population and the resulting flow projections indicate that the Southeast Collector trunk sewer construction is required to be completed by the end of 2012. To ensure timely project delivery in accordance with the current critical path schedule, staff recommend negotiating with Lovat for the advance procurement of the tunnel boring machines. Staff will report back in the fall 2008 on the results of the negotiations undertaken with Lovat for council approval and to update Regional Council on the overall construction procurement strategy for completion of the Southeast Collector sewer by 2012.

Given the increased complexity of the project and the detailed definition of the design, procurement and construction phases of the project and pursuant to a Council report in the fall of 2007. Revised total engineering fees were negotiated with the consultant team headed by Earth Tech and Hatch Mott MacDonald for completion of the redefined project.

Approval is required for a total engineering fee of \$61,083,570 exclusive of GST. This will ensure continuity and adherence to the critical path schedule for the SEC project. This represents an increase of \$38,775,273 to the previously approved fee.

For more information on this report, please contact Bala Araniyasundaran, extension 5131, Director Capital Delivery of the Water and Wastewater Branch in the Environmental Services Department.

The Senior Management Group has reviewed this report.

(The attachment referred to in this clause was included in the agenda for the June 11, 2008 Committee meeting.)