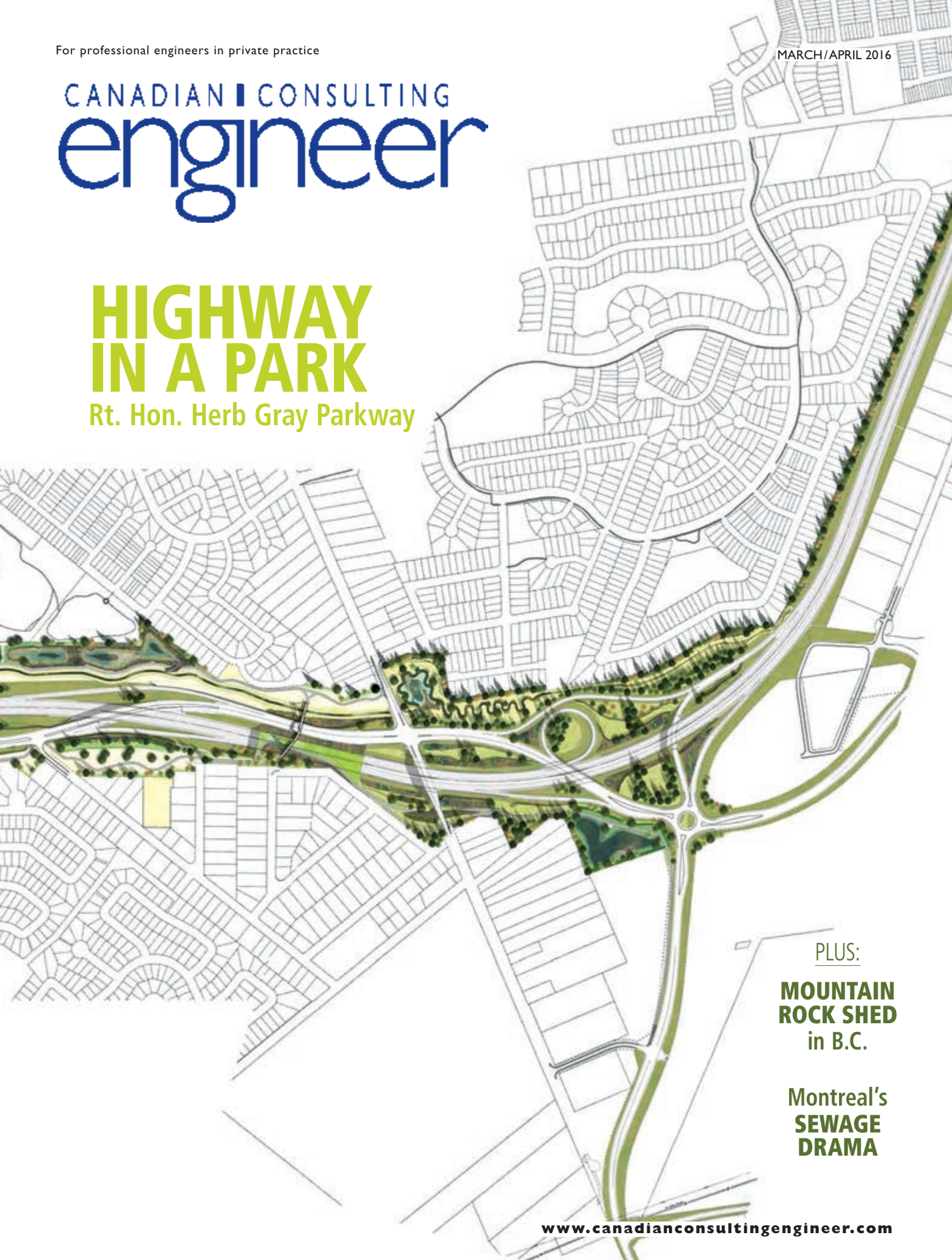
For professional engineers in private practice

MARCH/APRIL 2016

CANADIAN CONSULTING engineer

HIGHWAY IN A PARK

Rt. Hon. Herb Gray Parkway



PLUS:

MOUNTAIN ROCK SHED in B.C.

Montreal's SEWAGE DRAMA

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Cover: Partial map of Rt. Hon. Herb Gray Parkway, near Windsor, Ontario. Image by Hatch Mott MacDonald. See story p. 14

Montreal's Sewage Drama. See story p. 21

March/April 2016
Volume 57, No. 2

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Green buildings, geothermal, seawater cooling in St. John's, energy storage.

on topic

When the public has had enough

Worldwide 5.5 million people die every year from air pollution. So said researchers at an international science conference held in Vancouver in February. Over half of these deaths occur in the two countries with the fastest growing economies, India and China. That's no surprise. We've all see the photos of people with masks on their faces struggling through smog-ridden streets. Just a half-century ago manufacturing cities like London and Birmingham in the U.K. were frequently drenched in yellow smog so thick and putrid that you literally could not see a hand in front of your face. With great industrialization, with material affluence, comes great environmental cost.

A less harmful, but still offensive, invasion of the air we breathe is caused by the odours that drift across parts of cities from wastewater treatment plants. Even new plants don't always manage to control their odours, despite the best promises made about new technologies.

In western Canada, few specific limits on odour emissions from sewage plants have been established (see article by Kim Fries, P.Eng. of CH2M, p. 25). There are costs involved in adding odour control technologies to plants, so governments are weighing economics into their decisions over how stringent they will make their rules.

Wherever there is large scale engineering activity the public is likely to be disturbed. Industrial plants and sewage treatment are just part of the picture. Construction projects are notorious for raising the hackles of neighbouring communities. People complain about drills pounding all hours of the night, dust covering their gardens, lack of access through their streets.

Short term intrusions are one thing. We all benefit from the products of these activities, and if we live in a big city, noise and disruption is part of the equation. But it's hard not to sympathize with people who can seldom go out of their doors without breathing in the unpleasant odour of sewage. A nearly constant bad odour is such a pervasive intrusion.

In a recent article in a McCarthy Tetrault newsletter "Beware of the Residential Invasion," Sebastian Thomas argues that with cities increasingly deciding to develop communities on their brownfield sites, the nuisances caused by industrial operations: "mostly noises, odours and traffic" are being overlooked. "For an industrial owner, this may rapidly become a nightmare, both from a public relations and from a regulatory compliance standpoint."

Controls on greenhouse gas emissions are coming fast with the large provinces imposing carbon taxes and penalties. Environmental controls on nuisance odours and other noxious emissions from industry and sewage treatment plants are also becoming more rigorous. Engineers are on the front lines. They must find the right technologies and equipment to fulfil the requirements and so enable people to breathe clean air and live healthy lives.

Bronwen Parsons

FOR PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE

CANADIAN CONSULTING engineer

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Giant Mine, Northwest Territories.

AWARDS

Alberta consulting engineers celebrate wide range of skills

Consulting Engineers of Alberta handed out its Showcase Awards at the Edmonton Northlands Expo Centre on February 4.

The association gave out 14 awards of excellence to a diverse range of projects. In both the environmental and the natural resources, mining and industry categories awards of excellence went to AECOM Canada for the Giant Mine Roaster Decontamination and Deconstruction project. The closed mine near Yellowknife, NWT has multiple problems, including the risk of collapse and presence of hazardous materials and contamination. AECOM worked with Golder in assessing, designing and supervising the project for the federal government.

The Bowness Sanitary Offload Trunk project in Calgary, also by AECOM, won an award of excellence for sustainable design.

A project in Saint Lucia earned Golder an award of excellence in the international category. The John Compton Dam De-silting and Rehabilitation project is a plan to restore the island's water supply. About 50% of the main surface reservoir had become filled with sediment. Golder also won for the Dominion Diamond Jay Project at the former Ekati Mine in the Northwest Territories.

DIALOG

Donadeo Innovation Centre for Engineering, University of Alberta.

Stantec won an award for the South Red Deer Regional Wastewater System in the water resources and energy category. Located in a highly populated corridor and crossing environmentally sensitive areas, the project will serve six communities. Stantec won two awards in the community development and outreach category, one for Snye Point Urban Park in Fort McMurray, and another for a "Garden for Growth" created for Lethbridge Family Services.

For buildings, awards of excellence went to Smith and Andersen for the PCL North American Headquarters, Building 1 in Edmonton; to DIALOG for the 85,000-sq.ft. Donadeo Innovation Centre for Engineering built on a sliver of land at the University of Alberta; and to ISL Engineering & Land Services for the

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ENVIRONMENT

Federal government announces $75 million for studies and pilots

At the Globe conference in Vancouver on March 2, Prime Minister Justin Trudeau announced two initiatives to "give Canadian cities and towns the tools they need in order to reduce [greenhouse gas] emissions and adapt to a changing climate." One grant is $75 million to the Federation of Canadian Municipalities for studies, plans and pilot projects. There will also be funding for case studies, workshops, conferences and webinars. Another $50 million is to improve building and infrastructure codes. Trudeau said: "Going forward, new growth will be clean growth. The future is happening now, and Canada needs to be a part of it."

WATER

Water used as a political weapon

Protestors in New Delhi, India, cut off the water supply to millions of citizens for three days at the end of February. The Jats, a farming group who are upset that they are excluded from quotas for university and government jobs, took control of the Munak canal in the state of Haryana. The canal channels water into New Delhi from rivers to the north and supplies about 60% of the city of 16 million. Seven water treatment plants had to be shuttered during the riots.

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Bowness Park Redevelopment.

In transportation, Buckland & Taylor/COWI won for the rehabilitation and widening of the Athabasca River Bridge on Highway 40 near Hinton, Alberta. The project brought the 99-year old bridge up to modern standards within a year and cost 25% of what it would have cost to replace the bridge.

In the "small firm, big impact" category, and in the studies, software and special services category, SMA Consulting won for its STATES, Simulation Tool for Automated Tunneling Estimation and Scheduling.

Dick Walters, P.Eng., and Don Chambers, P.Eng., founders of BW Brooker Engineering in Edmonton, won CEA's Lieutenant Governor's Award for Distinguished Achievement. Visit www.cea.ca/events-a-seminars/showcase-awards

BUILDINGS

Brock Commons 12-storey timber structure under way

The tallest timber tower in the world is under construction at the University of British Columbia in Vancouver. The 18-storey Brock Commons Student Residence will be 53 metres tall when completed in 2017.

In comparison, the Wood Innovations and Design Centre in Prince George, B.C. that opened to much acclaim in 2014 is six storeys and 29 metres high.

Brock Commons Student Residence, University of B.C.

The $51-million Brock Commons is a hybrid structure consisting of mass timber timber construction on a concrete podium and concrete stair cores. Glulam columns with steel connectors support 5-ply cross laminated timber (CLT) panels on a 2.85 m x 4.0 m grid that act as a diaphragm.

The facade is a prefabricated system of steel stud frames, high-pressure laminate panels containing 70% wood-based fibres, and pre-installed windows.

Acton Ostry are architects, with Architekten Hermann Kaufmann of Austria as tall wood advisors. Consulting engineers are Fast + Epp (structural), Stantec (mechanical-electrical-sustainability), and GHL (fire and code). Others include: RDH (building science), Kamps (civil), Geopacific (geotechnical), RWDI (acoustics), Cadmakers (virtual design modeling), and EnerSys Analytics (energy modelling). Urban One Builders are managing the construction.

COMPANIES

SNC-Lavalin "pleased" with 2015 results

On March 3, SNC-Lavalin Group of Montreal announced its financial results for last year. Among them, total engineering and construction (E&C) revenues for 2015 increased by 28%, to $9.4 billion, compared to 2014. The company attributed this result to increases in its oil and gas business, revenues generated by its Kentz division, and to the power segment.

The increases were partially offset by a decrease in the infrastructure and construction sectors, and in op-

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CHAIR'S MESSAGE

We must lead as an industry to make QBS a reality

Recently, we have experienced two seemingly divergent conversations: a series of meetings across Canada sponsored by the Canadian Construction Association (CCA) discussing the quality of construction documents and the strategic initiative by ACEC to encourage the use of qualifications-based selection (QBS) for procuring consulting engineering services. Ultimately, these conversations will converge with the realization that procurement methods based primarily on cost are not in the best interest of owners, contractors or financiers. Selecting the most qualified team does not guarantee success, but it does increase the likelihood of success.

To make QBS a reality, we need to demonstrate leadership as an industry. While there are many facets to the quality issue, the focus seems to be quality of construction documents, as opposed to the quality of engineering. So in a world of the Alternative Project Delivery Method, we need to openly negotiate quality "definitions" with the users, whether they are contractors or owners. For a risk averse project, quality may mean minimizing exposure to risk, whereas another project may be seeking innovation. For these projects, quality will have a different definition. To address this, QBS will allow engineering firms to think in terms of "Quality-Based Delivery" and focus on the needs of the entire project delivery chain as well as provide successful outcomes as required by our clients. This in turn will help our member firms to be more successful.

ACEC will advocate fair procurement methods that allow firms to engage industry in a way that promotes both quality and innovation. However, it will all be for naught if firms continue to practice "discount engineering," reinforcing the cost based selection method. QBS is ultimately a team-based approach, and ACEC is engaging with CCA to build an environment that recognizes qualifications, past achievements and innovation in our sector. We believe that in that environment, our firms will be truly successful.

PERRY MITCHELMORE, P.ENG.
CHAIR, ACEC BOARD OF DIRECTORS

MESSAGE DU PRÉSIDENT DU CONSEIL

Notre industrie doit faire preuve de leadership sur la SBC

Ces derniers temps, nous avons assisté à deux conversations dont les sujets de discussion semblent divergents, soit une série de rencontres partout au Canada organisées par l'Association canadienne de la construction (ACC) pour discuter de la qualité des documents de construction, et l'initiative stratégique de l'AFIC visant à encourager l'utilisation de la sélection basée sur les compétences (SBC) pour retenir les services de firmes de génie-conseil. Ultimement, ces discussions convergeront du moment où il sera reconnu que les méthodes d'approvisionnement fondées principalement sur le coût ne sont pas dans le meilleur intérêt des propriétaires, des entrepreneurs et des financiers. Choisir l'équipe la mieux qualifiée ne garantit pas nécessairement le succès, mais cela augmente certainement les chances de succès.

Pour que la SBC devienne réalité, nous devons faire preuve de leadership en tant qu'industrie. Bien qu'il y ait plusieurs facettes à la question de qualité, il semble qu'on mette l'accent davantage sur la qualité des documents de construction que sur la qualité de l'ingénierie. Dans un contexte de modes d'exécution de projets alternatifs, nous devons parler ouvertement des « définitions » de la qualité avec les propriétaires et les entrepreneurs. Pour certains projets la qualité signifie qu'il faut minimiser l'exposition au risque. Pour d'autres, la qualité peut signifier l'innovation. Dans un cas comme dans l'autre, la qualité a une définition différente. Pour y remédier, la SBC permettra aux firmes d'ingénierie de penser en termes de « prestation de services basés sur la qualité » et de se concentrer sur les besoins de toute la chaîne de réalisation de projet pour obtenir les résultats requis par nos clients. C'est alors que la SBC aidera aussi nos firmes membres à mieux réussir.

L'AFIC militera également en faveur de modes d'approvisionnement équitables qui permettront à nos firmes membres d'engager l'industrie d'une manière qui saura promouvoir la qualité et l'innovation. Mais ces efforts n'apporteront pas grand chose si des firmes continuent de se concurrencer sur les prix et de renforcer la sélection basée sur le prix. La SBC est une approche d'équipe, et l'AFIC travaille activement avec l'ACC pour créer un environnement qui reconnaît les qualifications, les réalisations et l'innovation dans notre secteur. Nous considérons que c'est dans un tel environnement que nos firmes réussiront.

PERRY MITCHELMORE, P.ENG.
PRÉSIDENT DU CONSEIL D'ADMINISTRATION DE L'AFIC

New federal government offers opportunities, challenges for consulting engineers

October's federal election brought a tremendous amount of change to Canadian politics. There was a change in government, with Justin Trudeau's Liberals returning to power — with a majority government — after a decade in opposition. Additionally, the new government has committed to being more activist than in the past, willing to spend and invest in programs and policies.

On the heels of our successful #VoteInfrastructure campaign during the federal election last fall, ACEC plans to capitalize on the great work being done at the grassroots level to educate new parliamentarians about the importance of our industry and infrastructure investment.

Along with our new campaign, #InvestInfrastructure / www.InvestInfrastructure.ca, ACEC will be embarking on an exciting strategy in 2016 that will reflect the style and platform of the new government and that will engage ACEC members and leverage their expertise.

ACEC has had meetings with the office of Infrastructure and Communities Minister Amarjeet Sohi to discuss how ACEC and other stakeholder partners can help the government successfully deliver on its ambitious infrastructure commitments. ACEC looks forward to working with Prime Minister Trudeau and his team, including Natural Resources Minister James Carr and Finance Minister Bill Morneau, among others.

In addition to infrastructure investment, other areas of public policy which provide the greatest opportunity for ACEC advocacy on behalf of its member firms will likely be:

- a strengthened environmental policy
- support for major energy and resource projects
- northern development
- flexibility for foreign workers, and
- a pragmatic approach to international trade

In January, ACEC made a formal submission to the Standing Committee on Finance as part of the government's pre-budget consultations. ACEC also encouraged its members to get involved and have their voice heard on the importance of infrastructure investment. ACEC is hopeful that the government will present a long-term, predictable and strategic plan for infrastructure investment. To ensure this, our members need to be seen, collectively, as a valued stakeholder and a trusted voice with government.

Over the coming months, ACEC will be seeking meeting opportunities with members of the government's standing committees — maintaining our customary nonpartisan approach — including appropriate committee chairs, members, parliamentary secretaries and critics of appropriate portfolios.

In addition, ACEC has recently relaunched its Parliamentary Partners program, offering ACEC members an opportunity to engage in grassroots advocacy, on behalf of the industry, at the local level in ridings across the country.

ACEC's keystone advocacy event will take place this fall with our annual Parliament Hill Day in late October in Ottawa. More details will follow on both Parliamentary Partners and Parliament Hill Day as we progress through the year.

For more information, please visit www.acec.ca (see "Advocacy").

Save the date: ACEC National Leadership Conference

A showcase for Canada's consulting engineering firms

Ottawa, October 23-25

Be part of an exciting series of events for leaders in Canada's consulting engineering sector, October 23-25. Join us for ACEC's national conference, in conjunction with the Canadian Consulting Engineering Awards Gala and ACEC's Parliament Hill Day.

Advancing and celebrating consulting engineering in Canada

Focusing on top priorities and key business issues for consulting engineering firms, this conference will feature experts and important stakeholders from both the private and public sectors. You will also have the opportunity for high-level meetings with Members of Parliament and other national decision makers as part of ACEC's advocacy on behalf of consulting engineering firms. Participants are also invited to celebrate excellence in our industry at the Canadian Consulting Engineering Awards Gala.

Stay tuned for more details!

Municipal infrastructure at critical juncture: 2016 Canadian Infrastructure Report Card

One third of Canada's municipal infrastructure is at risk of rapid deterioration. This was a key finding of *Informing the Future: The 2016 Canadian Infrastructure Report Card* which assessed the state of municipal roads and bridges, public transit, buildings, sport and recreation facilities, stormwater, wastewater and potable water infrastructure. The results indicate that much of Canada's municipal infrastructure is at a critical juncture.

ACEC is a member of the Report Card Advisory Board.

For more information, please see http://www.canadainfrastructure.ca/en/.

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A brief overview of construction financing

By Jillian Murray, Director, Corporate Finance, Grant Thornton LLP

As a consulting engineer in the construction field, your clients rely on you for services that range from pre-feasibility and investment studies to the creation of final construction designs. While you may not play a direct role in helping builders acquire financing, you can provide information that influences the end decision. Lenders require background information to convince them that a specific project is a wise investment — and well-presented engineering documentation can provide an excellent form of evidence. That's why it helps to understand the construction financing process.

Construction financing 101: the lenders

In Canada, there are many lenders willing to meet the needs of construction projects, including:

- Chartered banks
- Canada Mortgage and Housing Corporation
- Business Development Bank of Canada
- Life insurance companies
- Specialized real estate lenders (non-banks)
- Local, regional and other private lenders

Your client's ideal lender will depend on their type of project and their preferred lending scenario.

First things first

In the initial discussion and proposal stage, your client will provide potential lenders with information to gauge their interest. To do this effectively, they must provide enough details to let the lender appropriately assess whether the project meets its lending criteria.

This may include: architectural renderings, construction cost estimates, financial projections, background information on the project team and shareholders, and potential sources of equity to fund the project. At this point, the cost estimates play a large role in understanding the lending value of the construction loan — so the more information you can provide, the better.

If the lender is willing to proceed, it will typically issue a non-binding discussion paper (or term sheet) that will outline the general lending terms and conditions.

What they need, when they need it

After the term sheet is accepted, the lender will begin its due diligence. This will involve going over many aspects of the project, including:

- its cash flow projections
- the reputation and financial qualities of the borrower
- the quality, experience and reputation of the project developer, engineers and general contractors
- overall market conditions (e.g. vacancy rates, interest rates, lease-up timeframe)
- project attributes (e.g. costs, engineering design, environmental reports, permits) and
- project value relative to loan value

Clearly, information provided by the engineering consultant contributes greatly to a well-presented financing proposal. The more comprehensive information you provide — detailing your experience, projected costs and project design — the better positioned your client will be in their search for financing.

Cash in hand

With the due diligence phase complete, your client will likely receive project financing in two separate loans: construction and take-out.

The construction loan is generally drawn in tranches, where the amounts are tied to the level of completion of the project. This loan will fund acceptable soft costs — such as your engineering fees — as well as hard costs for the project. By providing in-depth invoices for your services — and carefully verifying other invoices if you're the designated third-party engineer — you can help your client fulfill their loan obligations.

It may also be your role to highlight potential details that run the risk of being overlooked — such as, for example, that sales taxes are not often funded by the lender, which means your clients will be required to bear the cash impact until available rebates can be submitted.

Once all the soft and hard costs are funded — and the construction is complete, the building is occupied and all of the conditions are met and verified — the construction financing will be replaced by permanent take-out financing.

Big picture thinking

Few builders expect their engineers to be experts in the field of construction finance. That said, having a working understanding of the overall process will not only greatly help your client, but let you prove yourself to be an invaluable member of their team.

continued from page 8


Neil Bruce

erations and maintenance. There was also a decrease in mining and metallurgy.

Neil Bruce, president and chief executive officer, said: "Despite the turbulent markets and persisting softer economic environment, we are entering 2016 with a strong balance sheet, a stable and diversified backlog and a continued focus on improving performance that has yielded cost reductions from our "STEP Change" program."

Stantec results benefit from infrastructure and buildings

In February Edmonton-based Stantec reported an increase in gross revenue of 13.7% in 2015 compared to 2014. However, net income had decreased 4.9% over the same period

Bob Gomes, president and chief executive officer, said the company had benefited from growth in infrastructure and buildings, which helped to offset a "retraction" in energy and resources. The oil and gas sector accounted for 15% of the company's gross revenues in 2015, compared to 25% in 2014.

Stantec made six acquisitions during 2015, including some engineering assets of the Dessau Group in Quebec.

CONSTRUCTION

Non-residential construction starts down

Statistics Canada had no big surprises when it published its figures for building permits for the year 2015.

The value of all building permits issued by municipalities in 2015 was unchanged from 2014, at $85 billion. While residential construction permits rose 4.4%, the growth was offset by a 6.3% decline in the non-residential component. Six provinces posted non-residential declines, with Quebec the largest decline.

STRUCTURES

Engineers win at B.C. Wood Design Awards

Two B.C. engineers — a structural engineer and a fire protection engineer — won special recognition at the 2016 Wood Design Awards. The awards were presented by Wood WORKS! BC at the Vancouver Convention Centre West on February 29.

The Wood Champion Award was presented to Andrew Harmsworth of GHL Consultants. A specialist in fire engineering, Harmsworth was recognized for his leadership in tall wood construction, and for his contribution to the establishment of wood-friendly building code changes.


University of B.C. Student Union building.

Thomas Leung of Thomas Leung Structural Engineering was the Engineer Award recipient. He is known as a leader in mid-rise construction in B.C. and was honoured for his designs in six-storey light-frame wood.

For building awards, there were 103 nominations in 13 categories. The entries included submissions from England, Germany, Japan, China, South Korea and Taiwan for the new International Wood Design category. This award went to Gerald Epp of StructureCraft Builders for the Tsingtao Pearl Visitor Centre in Qingdao, China.

Among the other winners, C.C. Yao of Read Jones Christoffersen won a Jury's Choice award for the University of B.C. Student Union Building in Vancouver.

PROFESSION

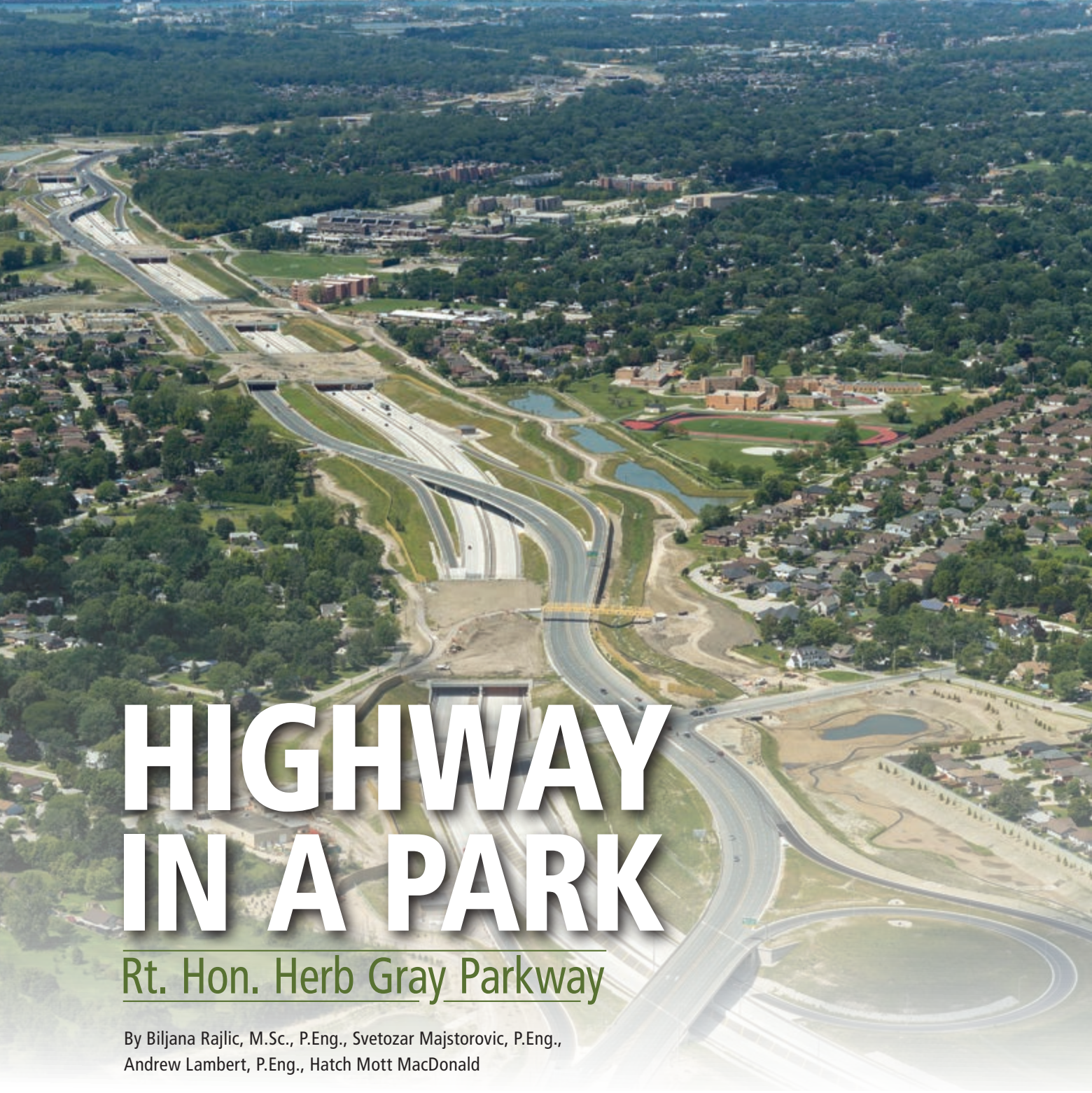
CNRL tank collapse under investigation

The Association of Professional Engineers and Geoscientists of Alberta (APEGA) has reopened its inquiries into a fatal accident that occurred at the CNRL Horizon oil sands site in April 2007.

The tank was one of 11 being constructed by SSEC Canada, a Chinese company, at the site, 70 kilometres north of Fort McMurray. It was a circular steel high-cone roof tank, 56 metres in diameter and 20 metres high. A team of temporary workers from China were inside when it started to collapse inwards, killing two of them.

APEGA only recently received the Alberta Occupational Health and Safety Incident report on the incident. The report indicates that a professional engineer was not involved in the structure's erection design as was required.

Anderson Associates consulting engineers prepared the report. It describes many shortcomings in the tank's erection design. For example, the tank roof support structure: "was not designed for the static and dynamic loads imposed by the 33 to 45 km/h wind that occurred on the day of the incident, let alone for the maximum expected wind speed of 83 km/h as determined by the Alberta Building Code, or 190 km/h recommended by the American Petroleum Institute. "



HIGHWAY IN A PARK

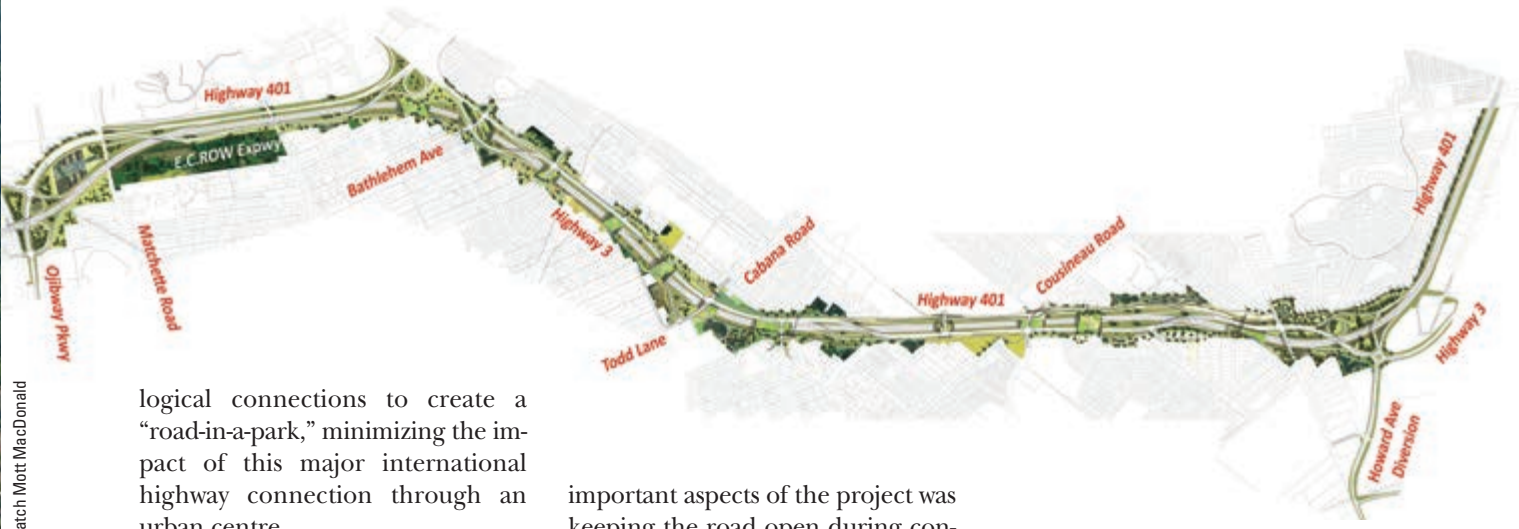
Rt. Hon. Herb Gray Parkway

By Biljana Rajlic, M.Sc., P.Eng., Svetozar Majstorovic, P.Eng., Andrew Lambert, P.Eng., Hatch Mott MacDonald

The Rt. Hon. Herb Gray Parkway is the access road component of the new end-to-end transportation system identified by the Detroit River International Crossing (DRIC) study through Windsor and Essex County in southwest Ontario. The new parkway, constructed between 2011 and 2015, is 11 kilometres long. It consists of a below-grade international highway connection (Highway 401), an at-grade local service road network (Highway 3), and includes approximately 20 kilometres of multi-use trails and 300 acres of green space.

Completed in 2014, the parkway also includes three interchanges, 14 bridge structures, 11 cut-and-cover tunnels, 12 signalized intersections and a multi-lane roundabout. It extends Highway 401, the main east-west artery from Toronto, to a future international customs inspection plaza and new river crossing to Detroit, Michigan. The Windsor-Detroit corridor is Canada's busiest land border crossing and carries approximately one third of the trade between Canada and the U.S.

The parkway's green space was designed to include extensive eco-



All images courtesy Hatch Mott MacDonald

logical connections to create a "road-in-a-park," minimizing the impact of this major international highway connection through an urban centre.

To achieve the objective of reconnecting communities on either side of the previous at-grade roadway, the Highway 401 portion of the parkway was built about 8 metres below-grade. This section of the road travels alongside deep earth berms and retaining walls, through 11 tunnels, and under six bridges. The landscaped tunnel tops, or land bridges, maintain links between communities on each side of the parkway, providing road and trail crossings, and continuous ecological habitat.

The parkway was a $1.4-billion design-build-finance-maintain project. It was undertaken by the Windsor Essex Mobility Group, who subcontracted the design and construction portion to Parkway Infrastructure Constructors, a joint venture of Dragados, Acciona and Fluor. The multi-disciplinary design consultant team consisted of 350 people from Hatch Mott MacDonald, Amec Foster Wheeler, Dillon Consulting and Lea Consulting.

As this is Canada's busiest land border crossing, with up to 11,000 transport trucks per day accessing the existing bridge, one of the most important aspects of the project was keeping the road open during construction, with limited exceptions between 1 a.m. and 5 a.m. To achieve this, the team devised comprehensive plans for managing and diverting traffic and coordinating construction staging. Approximately 26-lane kilometres of road diversions were constructed north and south of the construction corridor to keep traffic moving.

Retaining walls and difficult soil conditions

The project team found innovative ways to minimize the use of materials and shorten the construction times. One innovation related to soil improvements for the foundations and backfill for the retaining walls along the buried sections of the roadway. Proprietary reinforced soil system (RSS) retaining walls were used instead of cast-in-place reinforced concrete. The RSS interlinked concrete panels were secured by straps laid through compacted granular backfill or lightweight concrete, and founded on reinforced granular mats. These multiple layers of granular mats separated by geotextile material were used to better distribute wall backfill pressures onto the weak native soils. Lightweight cellular concrete was used as backfill for the RSS wall systems to meet global stability and wall foundation bearing pressure requirements. This is the first application of lightweight cellular concrete in RSS walls in Ontario.

Since RSS walls are prefabricated elements that are lighter and more flexible than traditional concrete walls, they required less substantial foundations, reducing the construction time. Also, RSS walls are produced in a controlled environment and therefore have better aesthetics. A stability issue of weak soil below the approximately 10-m high fill embankments on the highway's west end was resolved by importing silty clay fill from the east end and using it as fill material, along with the use of staged soil preloading and vertical wick drains. This strategy expedited settlement of the soils and improved the undrained shear strength of the weak and compressible clays.

Design of parkway tunnels

The tunnels were unique structures

A new parkway built in the Windsor-Detroit trade corridor of southwest Ontario has long stretches sunk below grade.

and presented challenges during design and construction. They comprise a large portion of the parkway, covering over two kilometres, while supporting the existing municipal road system and utility corridors above. However, the majority (93%) of the tunnels are covered with up to 850 mm of soil and vegetation that help to support a Carolinian Prairie landscape throughout the parkway. For example, Tunnel T5, the largest, carries over 14,000 square metres of landscaped area and recreational trails above both Highway 3 and Highway 401, a location which includes 10 lanes of traffic and two ramp connections.

Foundations. All tunnels on the project were built using cut-and-cover construction. This work involved a 5-7 metre deep cut into lacustrine clay material. Since this clay is of a comparatively low strength as foundation material for structures, the design team recommended the use of deep steel pile foundations. All steel piles were driven to bedrock roughly 15-25 metres below the roadway level, resulting in several kilometres of steel piles being used for the abutment and pier foundations at each tunnel. At the abutments the engineers were forced to consider alternative lightweight backfill to eliminate geotechnical stability and settlement concerns.

NU girders. The large number of precast concrete girders required on this project provided a good opportunity for the design-build team to introduce an alternative girder shape called the Nebraska University, or "NU" girder. When compared to the Canadian Precast Prestressed Concrete Institute (CPCI) girder traditionally used in Ontario, the NU shape is structurally more efficient, requiring significantly fewer girders, and reducing fabrication and construction time. These girders have a wide top flange providing a better worker platform and shorter deck slab spans. The wide bottom flange has increased strands and flexural capacity, requiring fewer girders compared to conventional "I" beams. As a result, 485 fewer girders were needed, saving bearings, precast panels and time.

This was the first use of NU girders in Ontario. Prior to this project the CPCI "I" type precast concrete girder was used exclusively by the Ontario Ministry of Transportation (MTO) on all new bridge structures with precast "I" girders.

Introducing the NU girder type resulted in the parkway design team having to develop new standard drawings. Working closely with the constructor, MTO and the precast girder manufacturer's representatives, the team produced a final girder design that met the project requirements as well as the tight construction schedule. The NU girder has now become one of the standard types used by MTO for bridge structures across the province.

Fire protection. One requirement was that the precast girders used for the tunnels must have a much higher standard of fire protection, at a level normally only applied to long bored tunnels. The design-build team, in collaboration with international fire experts, developed an in-house state-of-the-art fire design criteria based on complex heat transfer analysis. The final solution required a modified NU girder shape with an increase in concrete cover

End of NU girders after being installed on top of a new tunnel abutment. Fewer NU girders are required compared to conventional "I" beams.

RSS retaining walls line buried sections of the highway; this was the first application of lightweight cellular concrete in RSS walls in Ontario.

of up to 50 mm at some locations, and the addition of polypropylene fibres into the concrete mix to prevent explosive spalling. Assumptions used in the fire design criteria were verified by laboratory fire tests undertaken by the National Research Council in Ottawa.

Restoring the ecosystem

The tunnel tops and surrounding greenspace landscaping establish both ecological and community connections, one of the goals of the project. Approximately 20 kilometres of multi-use pathways run on both sides of the corridor, with frequent cross connections. The trails include extensive wayfinding and interpretative signage, laybys, urban rest areas and trailheads.

The parkway design minimizes its impact on the rare Carolinian Prairie ecosystem to the south, which is a natural heritage area with several designated zones. Protective steps taken included relocating and providing unique habitats for species at risk, and creating new wetland and fish compensation areas.

Protection work was not limited to the design and future use of the greenspace areas. Species at risk permits awarded for construction included the requirement for extensive measures to protect two snake species found in the area. This meant training for all 7,000 people accessing the site during construction, a snake "hotline" that linked directly to a herpetologist who was responsible for removing snakes found in the construction zone, and over 13 kilometres of protective fencing that prevented animals and snakes from entering the construction zone. The fencing was specially designed with a geotextile fabric that prevented Eastern Foxsnakes (a climbing snake) from going over the fencing.

There are seven pedestrian bridges linking the trail network, and their aesthetic design afforded an opportunity to introduce a First Nations theme, using colours and teachings of the clans of the local Anishinaabe First Nations, as interpreted by members of Walpole Island First Nation.

In many areas, noise walls were used to mitigate the impact of highway sound. They have patterning that mimics a grassland, while several RSS walls feature a leaf pattern reminiscent of the Oak Savannah found in these ecological areas.

Roundabout benefits

The parkway includes a multi-lane roundabout at the east end of the project where Highway 3, Highway 401 and a local interchange all converge. The roundabout provides a free-flow of traffic previously unavailable at the traditional signalized intersection. The benefits of a roundabout are that they reduce traffic speed and improve safety. They also require traffic to make fewer stops than with a signalized intersection, thereby reducing congestion. There are other, long-term benefits, including eliminating the maintenance and electricity costs associated with traffic signals, and reduced noise and air pollution from idling vehicles.

Innovations and coordination

Throughout design and construction of the project, obstacles were overcome by innovative engineering. On the environmental side, the design team was able to receive clearance for over 80% of the site in less than one year. CCE

Owner:	Ontario Ministry of Transportation
Concessionaire:	Windsor Essex Mobility Group
Client:	Parkway Infrastructure Constructors (design-build joint venture)
Design consultants:	Hatch Mott MacDonald (lead), Dillon Consulting, Amec Foster Wheeler, and Lea Consulting

LANDSLIDE PROTECTION IN B.C.

After a landslide fell on a CN rail line in the steep mountains of B.C., Klohn Crippen Berger was asked to analyze the risks of potential further rock falls and design new protective structures for the track.

By Klohn Crippen Berger

On November 25, 2012 a 53,000 m^3 rock landslide occurred along the Canadian National Railway track between Lytton and Boston Bar, in the Coastal Mountains of B.C.

The debris covered 70 metres of the track and was up to 10 metres deep. It caused a four-day service disruption on the line, which is a single track mainline used by both CP and CN for all their westbound traffic from Kamloops to Vancouver. The service disruption on this line caused significant business losses to both railways.

The rock also destroyed a 21-m long protective structure known as a "rock shed" over the track.

After the debris was cleared away, there was still a risk of rock falling from the disturbed rock slope. CN therefore retained Klohn Crippen Berger (KCB) to characterize and assess the hazards and then recommend passive measures to protect the tracks. To complicate matters, the new protective structures had to be constructed while train service continued on the line.

KCB designed and constructed two remediation structures. First a "mesh attenuation curtain" (MAC) was installed to act as a barrier in the short term. It was to protect the construction works at the site from rock falls.

Second, KCB designed a long "composite barrier wall/rock shed structure" to permanently protect the track. The structure consists of a retaining wall anchored into the mountainside and a concrete roof structure. The roof structure is supported on steel frames and micropiles anchored into the bedrock. The project was completed in spring 2014.

Mesh attenuation curtain

Particularly hazardous conditions were experienced by the surveying and engineering team as they were scaling the steep rock face to do the initial site investigations during the summer of 2013. A gully had formed from wind erosion in the dry overburden above the head scarp of the landslide, generating constant ravelling and loose material falling from above.

Due to these unsafe working conditions, the

All images courtesy KCB

Top: completed rock shed structure, with mesh steel curtain (just visible) above it. Above: construction under way; the wall and roof are independent structures and are tied back to the rock slope.

initial plan to install a dynamic rockfall barrier (one that moves and dissipates energy when hit) to protect the site during construction of the wall-shed structure had to be abandoned as it required work on the slope. An alternative was required that would not only protect the work site at track level, but also was something that itself could be installed safely. The solution was a mesh attenuation curtain (MAC) draped across the active slope.

The curtain consists of a Geobrugg TECCO high tensile steel mesh, connected with hooks to a 25-mm support cable. Based on our measurements of rock block sizes on the site and dynamic rock fall analyses, we estimated a design impact load on the system of 250 kN.

The support cable is suspended approximately 200 metres across the site and attached by a system of anchors into the rock. The anchor system is arranged to allow the load to be evenly distributed to each anchor. Pulleys are installed at locations where the support cable changes direction.

Barrier wall and rock shed

The composite barrier wall/rock shed structure consists of a barrier wall with backfill to absorb the impact of falling rock's normal and drag forces, and a sloped rock shed to guide the debris flow over the track and down to the talus slope below.

The modular components of both the wall and shed are tied back to the rock slope with rock anchors. The wall and shed components are designed to act independently as structures. In this way, the load strains on the barrier wall are not transferred to the rock shed.

The design uses modular components in order to minimize disruption to the railway traffic during construction. Modular precast components were used for the retaining wall, rock shed concrete roof panels and rock shed footings. The rock shed concrete roof panels were fastened to prefabricated steel frames.

On the down-slope side of the rock shed the concrete footings, supporting the steel frames, are supported by reinforced grouted micro-piles which extend down through the

Above: installing the steel curtain.

talus and are founded in heavily fractured bedrock.

Modelling a rockslide

KCB's investigations showed that the greatest threat to the railway track was a potential retrogressive failure of the remaining rock mass, i.e. failure would initiate as a rockslide along a stepped failure surface and turn into a rock avalanche.

In order to ascertain the design parameters for the protection structures, KCB used innovative rock slope characterization techniques, including terrestrial LiDAR.

The rockslide modeling was performed using finite element modeling. A discrete fracture network was incorporated in the finite element analysis in order to model the breaking of intact rock bridges between the stepped geometry of the failure surface, and to provide estimations of potential future rockslide volumes.

These volumes were incorporated in DAN-W software to create dynamic run-out simulations of a rock avalanche and thereby derive the impact loads for the design of the new protection structure. The model was calibrated by finding best-fit frictional rheology (i.e. pre-rockslide geometry and strength characteristics) for back-analysis of the 2012 rockslide. A modified version of the pseudo-three-dimensional run-out analysis software DAN-W was used, allowing output of normal and shear stresses at the base of a sliding frictional mass. This was the first use of DAN-W for such a purpose. **CCE**

Client:	Canadian National Railways
Prime consultant:	Klohn Crippen Berger (Tim Keegan, Ph.D., P.Eng., Matthieu Sturzenegger, Ph.D., P.Geo., Ann Wen, P.Eng., David Willms, P.Eng., Garry Stevenson, P.Eng., P.Geo., Keith Mitchell, P.Eng, Bruce Hamersley, P.Eng.)
Modelling support:	Dr. Doug Stead, Simon Fraser University; Dr. Oldrich Hunger, University of British Columbia
Surveying:	ROCA Surveys
Construction:	Emil Anderson

Montreal's SEWAGE DRAMA

Last fall Montreal had little choice but to release a large quantity of raw sewage into the St. Lawrence River — unleashing a storm of public protest that was largely unfounded.

Montreal Mayor Denis Coderre on the first day sewage was released.

John Mahoney / Montreal Gazette

By Nathalie Ross, Ph.D.

At the end of September last year, the City of Montreal announced a plan to release untreated wastewater directly into the St. Lawrence River to allow repair work and the installation of equipment in a sewage interceptor. The announcement led to much hype in the media and controversy among politicians and citizens. The lessons learned from all this were not so much about the risks of the operation to water quality or its impact on wildlife, but about how socially unacceptable such an operation can be.

Why was the release needed?

Montreal's 30-kilometre long southeast wastewater interceptor, collecting water from LaSalle, Lachine, Verdun, and Notre-Dame-de-Grâce, had to be closed for seven days for city workers to remove hangers. The workers were also building a new snow chute underneath the Bonaventure Expressway near Pointe St-Charles, as well as conducting maintenance and inspection work. The sewer has a diameter ranging from approximately 3.0 to 5.5 metres and is buried as deep as 45 metres underground.

The water usually flows through the sewer at a rate of 12,000 litres a second and this had to be redirected into the river — a volume that was estimated at 8 billion litres for the duration of this operation. The discharge was planned to occur in the fall to minimize environmental risks, i.e. outside the fish spawning period, while nautical activities are reduced and water temperature is low.

Allowed under federal and provincial regulations

Regulatory wise, municipalities from Quebec (ROMAE, Article 8), Canada (CCME), and from the U.S. (Clean Water Act, USEPA) are allowed to release untreated wastewater at a sewage plant or at an overflow location.

In the province of Quebec, such releases — permitted during snow melt, for repair and maintenance work, or following water infiltration due to spring thaws — were identified over 45,000 times in 2013 alone, according to the MAMROT (Ministère des Affaires municipals et Occupation du Territoire)[i]. In Montreal, the last release of untreated wastewater in the St. Lawrence River was six years ago. Releases of untreated waste water into a body of water have also been reported for cities such as Halifax, Winnipeg, Vancouver, and Toronto.

"Currently in Quebec, the regulation is unclear," says expert Sarah Dorner, Ph.D., an associate professor at École Polytechnique de Montréal, referring to the duplication of federal and provincial regulations. "Once the Fisheries Act Proposed Regulatory Initiatives[ii] are finalized, responsibilities will be clearer," she adds.

Political and citizen controversy

The groups and individuals who opposed the Montreal sewage discharge argued they had difficulty conceiving that no other measures could be implemented to prevent the direct release in the river. The City of Montreal, mainly through its

TABLE 1: KEY DATES IN THE WASTEWATER RELEASE

September 2014	Documents obtained by the Canadian Press showed that Environment Canada knew about this planned waste water release into the St. Lawrence River, as early as September 2014.
September 29, 2015	The City of Montreal announced to the media a plan to release untreated waste water into the St. Lawrence River, to be initially conducted in the week of October 18.
October 3, 2015	More than 25,000 people signed a petition demanding the City of Montreal stop its plan.
October 8, 2015	Five experts from École Polytechnique de Montréal presented a position paperi supporting that the release was unavoidable, necessary, and legal.
October 14, 2015	Federal Infrastructure Minister Denis Lebel invoked Article 37 of the Fisheries Act to tell the city not to dump the sewage pending an independent scientific study on how the discharge would affect wildlife and drinking water. City of Montreal confirmed they would comply with the federal order.
October 16, 2015	Montreal Mayor Denis Coderre wrote a letter to Federal Environment Minister Leona Aglukkaq protesting that the suspension was "inappropriate and abusive."
October 18, 2015	Aglukkaq appointed three engineering experts, supported by and supplementing the scientific expertise of Environment Canada, to review Montreal's plan.
November 6, 2015	The federal agency reported that the expert panel concluded the risks associated with waiting were worse than the city's plan to release untreated waste water in the river.
November 10, 2015	The new federal Minister of the Environment and Climate Change, Catherine McKenna, lifted the order, with conditions.
November 11-13, 2015	Day 1 to Day 3 of the activities on the Montreal's Southeast interceptor.
November 15, 2015	Three days ahead of schedule, Montreal mayor announced that the release of waste water in the river was stopped and the work was completed.
February 3, 2016	City of Montreal made a post-mortem presentation on the operations.[iii]

mayor, Denis Coderre, maintained from day one that the city had done its homework, there was no other option, and the risk would be worse if the work was postponed as an unplanned overflow may have a detrimental impact on the river. All of this happened during a federal election campaign and a change in government, which are likely to have impacted how the drama played out. See Table 1 above.

Post-mortem on the release

"The post-mortem of this operation is important. Hopefully the public mobilization won't be forgotten before another release is planned," says expert Viviane Yargeau, ing., Ph.D., associate professor at McGill University.

As indicated in the table, the sewage release from the southeast interceptor into the St. Lawrence eventually took place in November. On February 3 this year, the results were presented by the City of Montreal[iii]. The work on the interceptor was completed in 69 hours instead of seven days, and the volume of waste water released into the St. Lawrence River was lower than anticipated: 4.9 billion instead of 8 billion litres.

"I salute the professionalism of our services," said Mayor Coderre, emphasizing that city workers were on site around the clock.

As predicted by the experts, the monitoring results showed that the environmental effects were local and short term (see Table 2). Water quality in the river was back to normal after 10 days. The impact was limited to a 250-metre corridor up to 10 kilometres downstream.

The most important benefit of the upgrades to the interceptor was a significant recuperation of wastewater discharge capacity; the water level in the interceptor was around 25 cm lower than before the operations. In addition, the inspection work allowed the engineers to identify where to make future interventions.

In light of what occurred last fall, the City of Montreal has made recommendations[iii] for future infra-

continued on page 24

continued from page 22

structure interventions. They will acknowledge and include the importance of social acceptability in their communication plans for similar operations.

The issue was not technical, the issue was not professionalism, but a cultural change that must be made," concluded Mayor Coderre. CCE

i http://www.polymtl.ca/carrefour/doc/documents/Position_Poly.pdf.
ii https://www.ec.gc.ca/default.asp?lang=En&n=DF9C1A4C&offset=5&toc=show#X-201409181036497.
iii http://webtv.coop/channel/video/Assemblee-du-comite-executif-de-la-Ville-de-Montreal-3-fevrier-2016-Presentation/1bb610275ed4ff7f2d90445c02332e1f/14.

TABLE 2:
WASTE WATER RELEASE SURVEILLANCE RESULTS — CITY OF MONTREAL

Quality of River Water

» Physico-chemistry (e.g., suspended matter) and bacteriological variables (e.g., E. coli counts) were back to normal ranges after 4 to 10 days.
» The impact was limited to a 250-m wide corridor and up to 10 km downstream from Montreal Island.
» No genotoxicity was detected.
» No drinking water intake sites were affected.

Quality of Water Discharged

» Using an ecotoxicological test conducted on rainbow trouts as a model, it was concluded that no mortality would be measured on trouts located a few metres from a discharge point, even after four days of exposure.

Quality of the Sediments and Plants

» Before, during, and after the release, metal concentrations in sediments were below CCME requirements.
» No toxicity was measured on plants.

Shoreline Clean-up

» Few waste residues were identified notably at two discharge points: St-Pierre and McGill.
» Less than 3 m^3 of waste was collected.
» No citizen complaints were received.

Industrial Discharge Follow Up

» No anomaly was observed in most of the cases. In the few cases where the standard was exceeded, a conformity plan of action was put in place.
» No emergency intervention was required.

Nathalie Ross, Ph.D. is a science writer living in Montreal, Quebec.

By Kim Fries, P.Eng., CH2M

Controlling Odours from Wastewater Treatment Plants

Communities are often worried about odours emanating from wastewater treatment plants in their backyards, but standards for establishing reasonable odour levels are only just being developed in western Canada.

When a western Canadian city conducted a public survey about a potential site for a wastewater treatment plant, more than 65 per cent of the respondents in residential areas nearby were most concerned about possible odours from the facility. Odour concerns can dwarf potential social and environmental considerations when communities are anxious about a wastewater treatment plant being built in their backyard. Nonetheless, regulatory agencies responsible for the approval and regulation of these plants have struggled to establish minimum performance levels that the facilities must meet to be considered "good neighbours."

Odour regulation in western Canada

Of the four western provinces, only Manitoba has generally applied standards for limiting odour emissions. An odour nuisance is considered to have occurred, "if the odour, smell or aroma is the subject of at least five written complaints received by the Director [of Conservation and Water Stewardship] within a 90-day period, from five different persons not living in the same household."

In Alberta, the Director of Environment and Parks has power to issue an environmental protection order for a substance or thing causing an offensive odour under the Environmental Protection and Enhancement Act. But the regulations do not define an "offensive odour," nor do Alberta's Ambient Air Quality Objectives and Guidelines specify or define offensive odours. However, an objective for hydrogen sulphide has been stated.

Similarly, British Columbia has legislation to prescribe nuisances, but no specific odour limits have been established.

Saskatchewan has recently developed odour control criteria and is working toward establishing regulations that set reasonable odour limits at wastewater treatment plant

Pine Creek Wastewater Treatment Plant Odour Control

When the first stage of Calgary's Pine Creek Wastewater Treatment Plant was completed in 2009, the nearest residence was more than 1 km away. However, as the adjacent lands were developed and neighbours were inevitable, odour containment and treatment systems were incorporated in the plant design to lower odour emissions to less than 3 OU/m^3.

About 7,500 m^3/h of odourous air from the influent pump station and the headworks is collected and treated in a packaged biofilter. A similar system was installed to handle about 1,200 m^3/h odorous air from the secondary sludge thickening facility.

CH2M

For the most severe odours associated with the primary clarifiers, raw sewage and primary effluent channels, and the primary sludge fermenters, a two stage system was employed. The first stage consists of a packed bed wet scrubber, and the second stage is comprised of a large biofilter. Since plant start-up, the three components of the treatment system have effectively managed the odour from the Pine Creek plant and no complaints have been received related to its operation.

boundaries, while being economically achievable (see end of article).

Also, a recent Request for Proposal for a new wastewater treatment plant in Regina stipulated control on odour — requiring the design to achieve odour levels less than 5 D/T (dilutions to threshold) at the property line, based on an hourly average and a compliance level of 99.5 per cent. Non-compliance was based on complaint criteria, similar to those noted for Manitoba. Although these standards are relatively comprehensive, they were self-imposed by Regina to address potential public concerns.

Engineering measurement of odours

The standard regulatory definition of odours in jurisdictions such as in California focuses on the detrimental effect that a nuisance odour can have on human activities. The engineering measurement of odour is generally based on the number of dilutions to which an air sample must be subjected before the odour is undetectable by at least half of a group of unbiased observers — a measurement expressed as D/T or odour units per unit volume (OU/m^3).

Odours from wastewater treatment facilities are generally caused by hydrogen sulphide, other reduced sulphur compounds, or volatile organics. Odour levels of the air can be measured at a location by taking a sample and shipping it to an accredited laboratory, or by using devices that measure surrogate compounds. However, due to the difficulty of collecting field measurements, capturing odour levels surrounding a specific location is best performed by air dispersion modeling.

The role of air dispersion modeling

Various computer-based models can be used for modeling odour emissions in the vicinity of a source. AERMOD and CalPUFF are two models most commonly adopted and accepted by regulatory agencies. Input to these models includes odour emission rates from various processes estimated on the basis of site specific sampling, literature sources (for example, McKinley, *Odor Threshold Emission Factors for Common WWTP Processes,* WEF/AWMA Odors and Air Emission Conference, 2008), topographical informa-

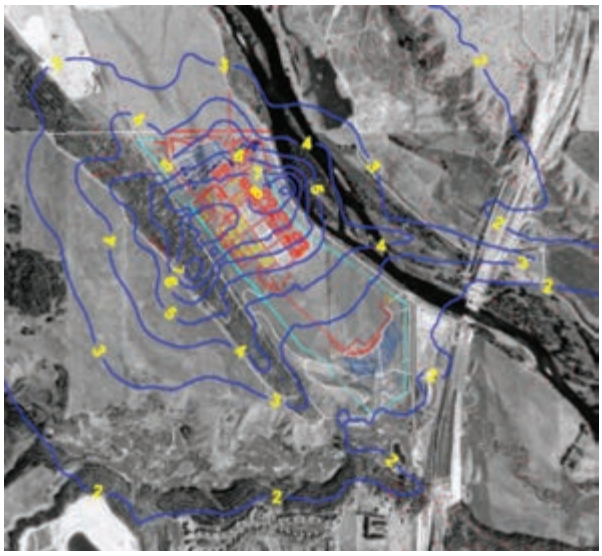


Figure 1. Estimated odour isopleths surrounding the Pine Creek WWTP in Calgary after odour control implementation (Pouliot and Fries, *Development of Odour Control Strategy for the Pine Creek Wastewater Treatment Plant*, 2004)

tion from the site and surrounding area, and local meteorological information. The models can be used to determine the incidence of odour levels for one hour time increments through a period (typically a year) at a series of locations (nodes) on the property and in the vicinity of the emitter. This data is generally plotted as a series of isopleths (lines of equal odour) based on the probability of that level of odour occurring.

For instance, predicted odour levels based on one hour intervals and 99.99 percentile values (worst case hour in any year) for Calgary's Pine Creek Wastewater Treatment Plant are shown in Figure 1. The illustrated data represents a case where a substantial level of odour mitigation was incorporated in the plant design (see page 25).

Establishing acceptable odour levels

While odour concentrations are important, the averaging period and compliance level are also critical characteristics in air dispersion modeling results. Regulatory agencies are most concerned about the definition of the combination of these three parameters to provide adequate protection against nuisance odours at the plant boundary,

and at the nearest receptor if there is a buffer zone. Because the public has differing sensitivities to odours, both to their concentration and frequency, deriving adequate protection is a difficult task.

Generally, the engineering community accepts complaints are improbable if odour concentrations are less than 5 OU/m^3, based on one hour averaging periods and at least 98.5 percentile compliance (United Utilities UK, *Odour Control and Removal Asset Standard,* 2015). However, some references suggest that because of the offensive nature of wastewater treatment plants, the odour levels should be as low as 1 OU/m^3 to eliminate the possibility of complaints (*Scottish Environmental Protection Agency, Odour Guidance*, 2010). These recommended limits are based on the assumption of relatively sensitive neighbours in close proximity to the plant.

Capital and operating costs for odour control and mitigation increase exponentially as standards become more stringent. At the relatively new Brightwater wastewater treatment plant in Seattle, due to the vociferous input from nearby residents, the plant was designed to achieve odour levels below 1 OU/m^3 at the plant boundary. The majority of the plant's treatment processes are contained, and contaminated air is exhausted through two or three stage treatment systems, depending on the contamination levels of the source. The total horsepower of the fans used for the contaminated air conveyance system exceeds the horsepower of the plant's aeration system, which is generally the largest energy consumer at a wastewater treatment plant.

Therefore, any regulations promulgated to address potential odour issues must strike a balance between perceived acceptable neighbourhood odour impacts and the costs associated with the consequent level of control at the plant.

Future directions in western Canada odour regulations

As mentioned above, Saskatchewan recently developed odour control criteria and is working toward establishing regulations that set reasonable odour limits at wastewater treatment plant boundaries, while being economically achievable.

Recently, it was suggested by a provincial task force (I Maqsood, *Saskatchewan's Air Modelling and Odour Guidelines*, 2014), that the guideline for urban residential areas should be 1 OU/m^3, based on a one hour averaging time and 99.5 per cent level of compliance. For urban commercial zones, or mixed commercial/residential zones, 2 OU/m^3 was suggested, and for industrial or restricted business zones and rural zones with mixed utilization, 4 OU/m^3 was advanced as the guideline.

These stringent guidelines would be difficult for many existing wastewater treatment plants to achieve without additional odour containment and treatment processes. Before these criteria evolve into hard and fast standards in Saskatchewan and the rest of western Canada, it is expected that their economic feasibility will be tested along with the resultant benefits to the community. CCE

Kim Fries, P.Eng., is a principal engineer and Canadian lead for wastewater infrastructure at CH2M. He is based in Calgary.

INTERNATIONALLY EDUCATED ENGINEERS

By Marjorie Friesen

Before the middle of the next decade, according to Statistics Canada research, almost all labour force growth will come from immigration. The Canadian-born workforce is in decline as the population ages and many workers are retiring. Many employers are already experiencing a shortage of skilled people, including engineers.

Consulting engineering companies that hire internationally educated professionals stand to benefit in various ways, besides filling a gap in their staffing needs. These employees can increase the firm's competitiveness in the global market by contributing their skills, knowledge and professional experience. They open the business to international ideas and opportunities.

They may help the firm develop new markets. They may speak several languages and have knowledge of cultures that can help the firm develop new local and global markets. They can help to make the firm more effective. They provide fresh perspectives, and new and more effective ways of doing business. Their creative and critical thinking can help boost innovation.

They may also be able to link the firm to other prospective employees and connect its business to important national or international organizations.

Firms that understand the benefits of internationally educated engineers and who hire them may nevertheless experience issues. Most of these issues are related to language and culture.

> Engineers who come to Canada from overseas have a great deal to offer consulting engineering companies, but firms have to be prepared to provide soft skills training and support.

Importance of soft skills

Employees from other cultures often have strong technical skills. However, they also often lack strong soft skills such as good speaking, listening and other English language communication skills. Sometimes they are unable to write or speak effectively to inform, persuade, clarify or make a request.

They may not be able to contribute effectively during meetings, develop a North American presentation style, or carry on small talk at networking and other events.

A lack of strong communication and other soft skills, including teamwork, negotiation, leadership and empathy, can lead to conflicts with co-workers, colleagues and clients.

In addition, employees who are misunderstood by those with whom they interact may feel frustrated. Managers may become frustrated, too, because of co-workers' and clients' complaints that their expectations have not been met. For instance, the manager may have to spend time editing a report that has missing information or unintelligible language.

In Canada, a great deal of emphasis is placed on soft skills and this increases with an engineer's level of responsibility. Communication skills include not

just language skills, but also non-verbal and body language. This is where many internationally educated engineers may have problems.

Non-verbal and body language account for up to 90 per cent of the spoken message. They include eye movements, facial expressions, gestures, posture, tone of voice, pitch, volume and intonation (the rising and falling of the voice). Individuals may fail to maintain eye contact, may not have a warm, friendly tone of voice, or may use other body and non-verbal language that is inappropriate in certain situations.

Help is at hand

In order to help their internationally trained engineers adapt to the business and professional environment in Canada, firms have a number of options

• ***Occupation Specific Language Training (OSLT) programs.*** In Ontario, for example, 15 colleges offer one or more OSLT programs in five different sectors: business, health sciences, human services, education, skilled trades, and technology, which includes engineering. The OSLT technology programs are offered at three colleges in the Greater Toronto Area (Seneca (Markham), Humber (Brampton) and Sheridan (Mississauga and Oakville), as well as in London, Barrie and Ottawa. The courses are free and last 180 hours. Applicants must be permanent residents or convention refugees, have training or experience in one of the five sectors and have upper- intermediate to advanced levels of English proficiency.

• ***University Language Training programs.*** Ryerson University in Toronto offers a workplace communication course that includes four 39-hour courses. The University of Toronto offers 10-week English language courses, including Canadian Workplace Culture & Communication.

In Western Canada, the University of British Columbia has an English communications course and the Universities of Alberta and Calgary offer conversation and writing courses. Through the English Language part-time program at the University of Saskatchewan, internationally-trained engineers can take intermediate and advanced level language skills courses.The University of Winnipeg has free part-time 12-week English for Engineering Professionals, as well as Business and IT Professionals courses. Applicants must have advanced levels of English.

• ***Language Trainer/Tutor.*** A business English trainer can be hired to come in to the firm's office and spend an hour or more with a group of employees on a weekly or bi-weekly basis. If just one employee needs to improve her workplace communication skills, the firm might hire a private tutor to provide training on site during the day or after hours.

Another benefit of a tutor/trainer is that they can customize the "course" according to the employees' needs.

• ***LINC Home Study.*** The firm can have the employee register in a government-funded Language Instruction for Newcomers to Canada (LINC) Home Study program. The Centre for Education & Training (CET) will evaluate their level of English proficiency and assign an instructor — when one is available — to the student. This is an online self-study program, free to all language learners provided they are not Canadian citizens. It is offered in Ontario and a few other provinces. It does take time to complete each level, as the instructor spends only 30 minutes each week with the student.

Costs and other issues

The best solution for the employer depends on:

» how much money the firm is willing to spend on language/communications skills training;
» the amount of non-billable hours they are prepared to set aside for the individual's training;
» the number of people who need training; and
» the individuals themselves (their level of proficiency and motivation).

Employees who are misunderstood by those with whom they interact may feel frustrated. Managers may become frustrated, too.

The OSLT programs, while free, do not include the cost of textbooks, which can be quite high. Ryerson's Workplace Communication in Canada program, which has an in-class and an on-line curriculum, costs $2,386. Part-time spoken and writing courses at the University of Saskatchewan cost $325.

And, will the employer pay for the employee's transportation to and from the college or university? English language trainers themselves may expect to be compensated for travel, although many can use Skype or videoconferencing.

If an employee's proficiency in English does not meet a program's requirements he will not be eligible. Once admitted, he will be expected to keep up with the curriculum and assignments and attend classes regularly.

Internationally educated professionals have much to contribute to Canadian engineering. Training in communication and soft skills will help them to achieve true success for themselves and their employing companies. **CCE**

Marjorie Friesen, MBA, is a TESL-certified English instructor based in Toronto. She is also the principal of Improve Your Workplace English, www.ImproveYourWorkplaceEnglish.com.

By Tamara Farber and
Bryan Buttigieg, Miller Thomson LLP

Damages for Contaminant Migration

Environmental contamination on adjacent lands in Ontario has resulted in a Court of Appeal decision that could have important repercussions.

A recent decision of the Ontario Court of Appeal — *Midwest Properties Ltd. v. Thordarson*, 2015 ONCA 819 — could impact the way environmental cases are argued. Environmental consultants asked to provide expert evidence should be aware of the evidence called in the case, and how it was considered by the Court.

As with many contaminated land cases, a dispute arose between two landowners. The "source property" was owned by Thorco, and the adjacent land was owned by Midwest. Midwest, the plaintiff, conducted intrusive subsurface testing, which revealed that contamination was present in excess of provincial standards on both Thorco's and Midwest's land, and that the contamination had migrated from Thorco's land. Midwest sued Thorco (and its principal, Mr. Thordarson) under typical heads of tort liability, and statutory liability under s. 99 of the Ontario *Environmental Protection Act* (EPA). So far, the story is pretty typical of contaminated land cases.

The long history of the regulator with the property, however, and Thorco's knowledge and disregard for prudent chemical storage, were atypical. Thorco had not only been ordered years ago by the Ministry of Environment (as it then was) to remediate Thorco's land, but had been convicted for failing to comply with Ministry orders to do so. From 1988 to 2011 Thorco was in a state of almost constant breach of Ministry permits and compliance orders.

Relying on the statutory compensation scheme in the EPA, the trial court awarded damages equal to the cost to remediate — the entire cost.

Expert evidence was called by Midwest as to the estimated cost to remediate Midwest's land. It is notable that Thorco did not call conflicting evidence on the remedial costs, but instead relied upon its expert to suggest that estimates were hard to predict and unreliable because there was insufficient data.

Thorco argued that the award of damages should not exceed the property value and cautioned the court that if damages were awarded while Thorco was still under compulsion to remediate its and Midwest's land, Midwest might be awarded the costs but it may never have to actually spend the money on remediation. If that were to happen, Thorco would effectively have to pay twice. The Court of Appeal rejected that argument, and held that the statute was concerned with the environment and putting the property back to its prior state, before the contamination. The fact that there was an existing Ministry order requiring the defendant to remediate the neighbour's land, did not preclude an award of damages.

Expert evidence was also called on:

- the impact that the contamination would have on financing and property value. This evidence was not given by bankers or appraisers, but by professional engineers who had estimated the remedial costs. The evidence was essentially commentary from consultants that the contamination would have an effect on financing.
- the fact that contamination on the Midwest property presented a health risk. This evidence was not given by medical, risk assessor or toxicological professionals, but by the same environmental consultants. It was based upon the findings of subsurface exceedances of groundwater samplings, but no indoor air sampling. No risk assessment evidence is referenced in the trial decision.

The court held that in contaminated land cases involving migration to a neighbouring property, the measure of damages could be remediation costs — even if those costs exceeded the property value.

Damages were awarded to Midwest even in the absence of hard data establishing the property condition at the time of purchase.

Thorco as well as the principal, Thordarson, were held to be jointly and severally liable for remediation costs of $1.3 million, and an additional $50,000 in punitive damages. It was a complete reversal of the trial judge's decision.

Consultants should know:

» The court held that the measure of damages in contaminated land cases involving migration to a neighbour-

ing property could be remediation costs even if those costs exceeded the property value. Many residential sites or smaller sites, especially in rural areas, can easily have restoration costs that exceed the property value.

» Damages were awarded before the remediation was undertaken and without any guarantee that the plaintiff would use the money to remediate its land. As with any award of damages, the award in this case came with no strings attached. As is known from other court decisions in Ontario, the Ministry of Environment and Climate Change is under absolutely no legal obligation to pursue the plaintiff to undertake the remediation. It can continue to insist that the defendant undertake all the work under the order.

» The appeal decision does not address the practical question of how the plaintiff — Midwest — would remediate their own site if Thorco continued not to remediate the source. Would Midwest be entitled to sue again in the event of re-contamination? If Midwest erected a barrier wall to effectively divert the contamination elsewhere, would it open itself up to liability to any downstream owner newly affected by the diverted contamination?

This decision is likely to have repercussions. Plaintiffs may well now favour pursuing civil damages under s. 99 of the EPA as opposed to claims in negligence or nuisance. Seeking remediation costs will likely also increase the potential damages awarded to many plaintiffs, especially ones who own smaller properties.

Consulting engineers should be wary, though, of professing expertise in areas where they might not have the ability to provide opinion evidence. The court leaned to favouring the plaintiff in this case, no doubt influenced by the behaviour of the defendant property owner. **CCE**

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products

CONCRETE

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GRUNDFOS

Grundfos PACO VSMS and KP Pumps Deliver High Flow and Reliable Operation to Vancouver's Greenest Office Tower

Occupying an entire block in the heart of downtown in Vancouver, B.C. is the city's first LEED Platinum certified office tower: Telus Garden. The 24-storey office tower, along with the 53-storey residential tower is an expansion of the pre-existing Telus data centre.

This complex utilizes a District Energy System (DES) to capture and transfer heat from the data centre to the two towers. A large cooling plant located in the office tower will distribute cooling amongst the buildings using the DES. This efficient design is set to have an 80% energy efficiency rating, and save 1000 tonnes of CO_2 emissions annually.

Due to the complexity of the systems to be installed in the office building, it was critical that the right product for the application be selected. Required was a solution that would deliver high flow (650 gpm to 2500 gpm) while performing reliably in a constrained space, be virtually maintenance free, and easy to install.

This criteria was significant as to why Grundfos would be the right fit for the project. Grundfos was involved in the project at the earliest stage. Grundfos sales engineers played a major role in the design process, working with consulting engineer Integral Group, and contractor Lisi Mechanical. Grundfos recommended the installation of PACO Vertical Space Miser Split Coupled (VSMS), and KP Double Suction Split Case pumps.

This combination of PACO pumps was chosen for the following reasons:

- PACO VSMS and KP have a double volute design that offers a superior reliability advantage over single volute. Double volute balances radial loads, reducing shaft deflection, which provides quiet operation and minimizes vibration, resulting in increased efficiency and reduced maintenance costs.
- PACO VSMS is a vertical mount top suction/top discharge pump that is made to fit in tight spaces. Installation is easy. Same size suction and discharge connections simplify piping.
- Top pull out design of PACO VSMS allows ease of maintenance and service without disturbing the volute, motor or piping.
- PACO KP is also a space saver, and is available in vertical or horizontal mount.
- PACO KP's double suction design provides higher operating efficiency than a standard base mounted pump. Double suction minimizes axial load, which extends the life of the wear rings, shaft seals and bearings.
- PACO KP's independent bearing housing allows access to the pump components without removing the top half of the casing for easy serviceability.

The PACO VSMS and KP pumps proved to be the right equipment for the job. "There is a lot of flow for what we need to do, and what I like about the particular KP pump is that the shop drawings were detailed to the very finest point. I was able to pre-manufacture offsite all my fittings and parts and bring them to site for a quick install," said Corey Bailey of Lisi Mechanical. "A company is only as good as its people. If you don't have the right kind of people you can't do a good job. That's why we align ourselves with Grundfos, because they have the right kind of staff and engineering department to help us put together this type of project."

The Telus Garden office building has been operational since Fall 2015.

Grundfos is the world's largest manufacturer of pumps and pumping systems. Grundfos' Canadian headquarters is located in Oakville, ON. 1-800-644-9599. To view a video of this installation please visit: www.grundfos.ca/about us/news centre/news

Specifier's Literature Review

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products

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Grundfos	34	PACO VSMS and KP Pumps Deliver High Flow and Reliable Operation to Vancouver's Greenest Office Tower	1-800-644-9599	www.grundfos.ca

Staying Small

Dick Walters and Don Chambers started their own structural engineering company in Edmonton during the depths of the 1980s oil crisis. The company thrived, but they consciously decided to keep it to a modest size.

Dick Walters, P.Eng. and Don Chambers, P.Eng. jointly won this year's Consulting Engineers of Alberta Lieutenant Governor's Award for Distinguished Achievement. They are the founders of Walters Chambers & Associates of Edmonton. Chambers has retired, but Walters still works at the company as a director along with his son Richard Walters. who is president. CCE talked to Dick Walters in early March.

Q. Why did you decide to start your own company?

Out of necessity. It was 1984, which was certainly a bad time for the economy in western Canada with the National Energy Policy coming in. Don and I were working for the same company and we had downsized to a point where the owner said he didn't want to downsize any further. Don and I had been doing most of the business development on the structural side, but every time we tried to get some work there was no work to get.

So we thought that if we weren't going to get paid working for somebody else, we might as well not get paid working for ourselves. And we could build something that we believed in and do it our way.

I had been with that previous company for 19 years, and Don had been with them for 14. So we had a good deal of experience and a few client contacts that stood us in good stead. I had previously spent about five years managing the first phase of the LRT underground in downtown Edmonton. It included building two stations, some tunnels, doing a whole lot of other things. As soon as I finished that project I did the Shaw Convention Centre, which ended up with one of the largest permanently tied back retaining walls in North America.

Dick Walters receiving the Lieutenant Governor's Award from Consulting Engineers of Alberta in February.

Q. But things were still pretty tough for you in those early days?

Yes the National Energy Policy affected the whole industry. It was so bad that I would have engineering students who graduated coming to me asking, "Can I come and work for nothing. I just want to get the experience."

Q. Why did you decide to keep your firm relatively small?

In our previous employment one of the things Don and I found was that we had drifted away from doing engineering, and we were really doing promotion and management, and so on.

We thought that we would like to do some hands-on engineering, to be closer to the clients, and closer to the client needs. So we intentionally said we don't want to get really, really big.

Based on our experience, there is a happy medium. You can be a fairly small company and be very efficient. Then there's a transition period where you go from, say, 35 people, to 70 people, which is when you need big systems. But you can't afford big systems, so you have to get bigger than that.

In our own minds we never wanted to go there. We wanted to keep things closer to ourselves and to be more hands on for our clients.

So that was our philosophy. We grew and we shrank, and we shrank and we grew, as the economy went up and down.

But in truth, from the original four people we never really looked back. We ultimately grew during one of the peaks in the mid-1990s to about 25 people. We have 11 people now.

Q. Did staying small mean that you didn't make the fortune that you might have?

Let's say I sleep better at night. I really feel that we made the right decision. CCE