The Alberta Floods - an engineer's perspective

A guide for journalists prepared by the Science Media Centre of Canada

Welcome to another edition of our *Science and Engineering Snapshots* produced by the SMCC. A short synopsis of Alberta's infrastructure damage and some of the engineering solutions that may help is followed by contact information of experts ready to take your calls.

Alberta is facing billions of dollars in damages after some of the largest floods in the province's history swept through central and southern regions late last week. Current reports suggest the estimates range from $3-5 billion, a figure likely to increase in the coming days. Premier Alison Redford pledged $1-billion in support for flood relief, which includes initial repairs to damaged infrastructure in rural towns and cities.

In Calgary alone, over 3000 buildings need to be inspected before they will be fully functional. Engineers will play a critical role in restoring these buildings, along with the bridges, highways and plants that were affected by the floodwaters.

Once the Alberta government and its various municipalities have dealt with immediate emergencies, sources say there are plans to reach out to consulting, contract and temporary engineers eager to help rebuild primary infrastructure and restore essential services. For example, a water treatment plant located in Black Diamond, southwest of Calgary, was washed away in the flood leaving nothing more than a concrete slab. In response, engineers jury-rigged a solution using fire hoses connecting hydrants all the way from Turner Valley, the next town over. But such solutions are only temporary.

The Alberta Association of Professional Engineers and Geoscientists (APEGA) is working with those agencies and organizations seeking professional engineering assistance in the wake of the disaster.

Repairs to essential services is just one of the major engineering issue the province will face, says Nigel Shrive, a professor in the Civil Engineering Department at the University of Calgary. He says the problems facing engineers fall into two general categories: those that are visible and those that aren't.

Engineers conducting the first infrastructure surveys will look for obvious signs of destruction: cracked buildings, warped rail lines, buckled roads and bridges bent out of shape. The actual floodwaters are only partially to blame for these troubles. Shrive adds that debris carried by the flood - trees uprooted from the soil or houses dislodged from their foundations - acted like waterborne battering rams, smashing into the city's infrastructure, like a house that smashed into a partially submerged bridge in Calgary's Briar Hill neighbourhood. Had it hit the

wrong part of that bridge (say a girder that supports the entire structure) then it would - and may still - come toppling down.

Those damages hidden from view are another major cause of concern for engineers. Consider structures made out of wood, says Shrive, like the walled-in frames of many houses. The wood becomes sodden, loses its strength and will warp or rot, jeopardizing either the wall or the entire frame.

The situation is worse underground. Some of the soil Calgary is built on contains “swelling clay” - clay particles in the soil that can be near the surface or deep below, depending on the location. Shrive says the particles are made up of two layers that can be pried apart when water seeps in. Once separated, the layers may start to slip and slide. The ground acts much like a “sheet of ice” under these circumstances, says Shrive. And the houses, malls, bridges, stoplights and stadiums built on this ground can distort as the soil slips below.

Another significant concern is the potential for complete soil erosion or even sinkholes opening up after channels of underground floodwater shredded away the soil below. Engineers call this “scour,” a process that erodes the ground supporting the bases of bridges or the foundations of homes. Buildings tip, roads collapse and bridges sink wherever the scour is bad enough.

In response, Shrive says engineers will need to scour the city’s infrastructure, looking for obvious and unseen signs of flood damage. Initial surveys may require one to several hours of coordinated inspection before buildings can be deemed safe.

Most buildings in Canada must measure up to a structural design code that requires them to withstand one disaster, like a flood, every fifty years. In Calgary, a flood of this magnitude hasn’t occurred since the early 1930s. However, Shrive says many developers and engineers build safety features into their designs to withstand disasters even if they don’t strike as often as expected.

For those buildings that aren’t considered safe, engineers have several options for repairs. For example, foundations that have partially tipped or sunk because of soil erosion can be dug out and underpinned with new, more solid substrate or concrete. Wooden structures may be replaced by masonry, steel or concrete; materials that are durable and far more resistant to floods.

Here is a list of professional engineering experts who can answer your questions about infrastructure, environmental hazards, reconstruction and technology that may be useful to help the recovery efforts in the wake of these floods.

GENERAL OVERVIEW: Nigel Shrive, in the Department of Civil Engineering, University of Calgary, 403-239-9104, ngshrive@ucalgary.ca. Shrive gives a graphic overview of the impact the flood had on infrastructure such as homes, commercial buildings, roads and bridges.

ROADS AND BRIDGES: Tom Brown, professor of civil engineering at the University of Calgary, 403-210-9448, brownt@ucalgary.ca. While Brown is available to discuss the impact of the flood on roads and bridges, he also can provide an engineer's perspective on the effects of disasters - like earthquakes or ice storms - on structures.

SOIL: Alireza Bayat, assistant professor in the Department of Civil and Environmental Engineering at the University of Alberta, 780-492-5112, abayat@ualberta.ca. Bayat's research interests lie in monitoring programs used to assess how soil and pavement respond to different environmental stresses.

ENVIRONMENTAL HAZARDS: Quazi Hassan, assistant professor in environmental engineering at the University of Calgary, 403-210-9494, qhassan@ucalgary.ca. In the past, Dr. Hassan was involved in mapping the extent of floods and the damage caused to various infrastructure.

BUILDING REPAIR: Mamdouh El-Badry, professor of civil engineering at the University of Calgary, 403-220-5819, melbadry@ucalgary.ca. El-Badry specializes in the repair and rehabilitation of concrete structures, such as buildings, stadiums (like the Saddledome) and bridges. He also investigates and develops new technologies to assess damaged structures.

Saaed Mirza, professor of civil engineering at McGill University, 514-398-6862, saeed.mirza@mcgill.ca. Mirza is available to discuss rehabilitation of infrastructures in Calgary such as buildings, roads, bridges and sewers. Dr. Mizra is available to comment in French and English.

TECHNOLOGY: Andrew Hunter, assistant professor in geomatics engineering at the University of Calgary, 403-220-7377, ahunter@ucalgary.ca. Hunter uses technology to engage and inform communities on planning issues, such as how and where to build given the threat of floods.

Bill Teskey, professor of geomatics engineering at the University of Calgary, 403-220-7397, wteskey@ucalgary.ca. Teskey's expertise is precise engineering of large-scale structures like Calgary's Olympic Oval. He can comment on what will need to be done to inspect and repair Calgary's marquee buildings and stadiums.

FLOODS THEN AND NOW: Slobodan Simonovic, professor in civil engineering and member of the Institute for Catastrophic Loss Reduction, Western University, 519-661-4075 (work), simonovic@uwo.ca. Simonovic gives a general overview

of damage caused by floods in Canada and what research is being done to mitigate the threat.

OTHER CONTACTS:

Jennifer Sowa, Media Relations, Schulich Engineer Magazine, University of Calgary, 403-220-3724 (w), 403.993.8679 (cell), jsowa@ucalgary.ca

Richard Cairney, Communications Officer, Faculty of Engineering at the University of Alberta, 780-492-4514, rcairney@ualberta.ca

Philip Mulder, Director of Communications, The Association of Professional Engineers and Geoscientists of Alberta (APEGA); 780-499-3873, PMulder@apega.ca

Media Relations, Alberta Environment and Sustainable Development, 780-427-8636

The SMCC has spoken with experts on many aspects of the flooding including climate, engineering and hydrology. We will continue to update and broadcast our contacts to members in the days to come. If you'd like help reaching someone, give us a call at ***613-249-8209****.*

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