Edmonton's airport upgrades its deicing fluid treatment system

By Mark O. Liner

Airports and airlines are required to protect nearby streams and water bodies from wintertime deicing activity. Such is the case with Edmonton International Airport (EIA) and Whitemud Creek, which runs along its western side.

In 2000, the airport constructed a subsurface flow wetland to provide treatment of glycol, and other deicing chemicals, found in the stormwater during spring melt. Addressing a need to accommodate increasing air traffic and associated deicing operations, EIA initiated an upgrade of the wetland system to increase treatment capacity and operational flexibility.

Through reconfiguration of the hydraulics and the addition of aeration, the full-scale system has the capacity to provide up to 4,000 m^3/d of treatment at a loading of 711 kg-BOD/day.

Associated Engineering led the design team with support from Naturally Wallace Consulting. Stuart Olson Dominion is responsible for construction management of the project. Subcontractor Nelson Environmental is responsible for the majority of construction and equipment.

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The project is currently under construction, and will be commissioned this November.

Background

Aircraft are typically deiced with glycol-based solutions, such as propylene glycol (PG). As over 758 litres of PG can be used for deicing a plane, BOD requirements for treatment become very high. Each airport has different circumstances that lead to varying strategies for aircraft deicing fluid (ADF) management. Those with centralized deicing pads are able to capture and funnel the majority of deicing fluid as a concentrate, which makes it easier to dispose of it or recycle. With at-gate deicing, airports usually capture and hold glycol-rich stormwater in larger storage basins, and

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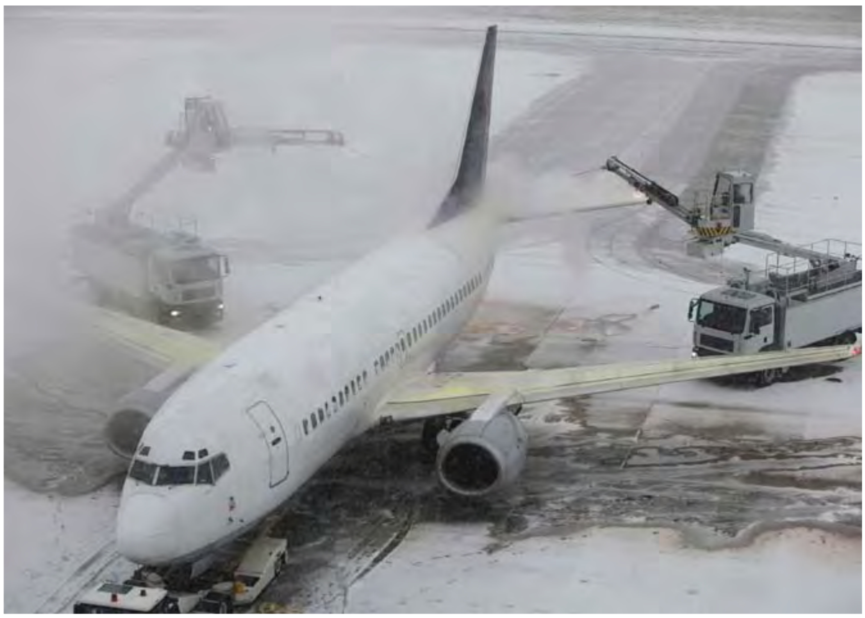


The upgrade of EIA's glycol treatment system included a Forced Bed Aeration system.

treat or discharge it as time permits.

EIA uses a combination of approaches that include sewage plant discharge of high strength concentrate, and storage and on-site treatment of low strength stormwater.

Previous design

At EIA, ADF-contaminated snow is collected and stored to manage the release of glycol from the airfield. Glycol and other plane and pavement deicing compounds are channeled to the 91,000 m^3 Gun Club Pond, located northwest of the airport. BOD concentrations in the pond can be as high as 600 mg/L during spring melt, so the water requires treatment prior to discharge to Whitemud Creek.

The existing wetland treatment system consists of 12 square gravel-filled beds arranged in six trains of two cells each. Each bed is 43 m x 43 m, with a gravel depth of 0.6 m. Water from the Gun Club Pond is delivered, via a submersible pump, with measured flows of between eight and 28 litres per second. Flow rate is governed by the hydraulic head difference between the pond and the wetland beds.

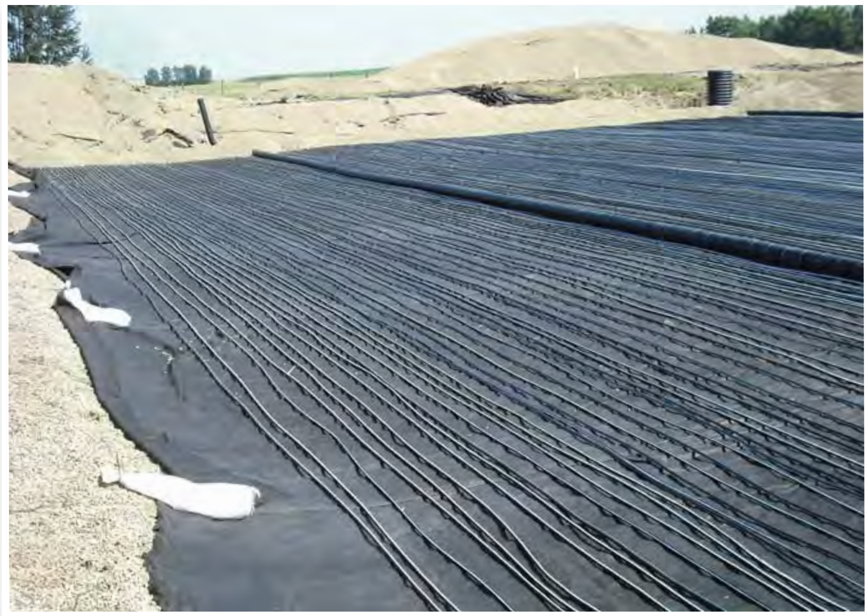
System upgrade design

The system upgrade is designed to provide over 711 kg-BOD/d of treatment, and to allow increased flow rates as the concentration of the BOD drops during spring melt. It includes reconfiguration of two existing treatment trains initially and a third train in the future. The first cell of each of the upgraded trains has been modified to a vertical flow configuration, and incorporates patented Forced Bed Aeration™.

The second cell in the train has been reconfigured as a surface flow wetland for polishing of the effluent. Aggregate from the second cell was relocated to the first cell, to increase the aggregate and water depth to 1 metre. The depth of aggregate in the second cell is 0.3 m, with a total water depth of 0.6 m.

With the addition of aeration and nutrients, the upgraded system can provide up to 10 times more treatment in half the footprint of the existing wetland system. Aeration and nutrient systems are designed so that levels can be adjusted based on influent concentrations. Converting to vertical flow removes the hydraulic constraints previously experienced with the old horizontal flow wetlands. An upgraded lift station also provides substantially more flexibility, when meeting the aberrant flows of spring melt. Finally, incorporation of a recycle system, within each of the first cells, permits expedited start-up in the spring.

Adding aeration to enhance treatment



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The aeration system uses specially manufactured tubing that is installed beneath the gravel layer. Two positive displacement blowers, each sized to deliver 1,500 SCFM, supply air.

Tubing is placed to provide a low level of uniform aeration across the bed floor. Aeration holes, or emitters, are spaced such that there are 36 emitters for each

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square metre. This provides efficient aeration of the gravel bed, and results in robust growth of aerobic bacteria, that are responsible for the degradation of pollutants in the stormwater.

Similar aeration systems have been employed for the glycol treatment systems at London Heathrow and Buffalo Niagara International Airport. In each case, providing uniform aeration is central to increasing the capacity of treatment, and meeting the highly variable oxygen demands associated with deicing activity.

Theory of operation

After each winter, the concentration of BOD will be measured in the Gun Club Pond to determine the amount of total organic mass that needs to be treated. A calculation of supplemental nutrients will be undertaken to determine the amount of nutrients that are required to achieve healthy bacterial growth. A nutrient solution will be fed to the pond and mixed.

After this, an initial batch of glycol-contaminated stormwater will be introduced to the drained beds to begin the initial "acclimatization" phase. Blowers and recirculation pumps will be started and the contents of the bed will be aerated and re-circulated, until there is evidence of bacterial activity and BOD levels drop to acceptable discharge levels.

At this point, the first bed is acclimated and the influent pumps will be turned on to provide automated discharge into the beds. Treated stormwater from the first bed will flow by gravity to the second bed, where it will be polished further and ultimately discharged to Whitemud Creek.

As the Gun Club Pond is lowered, periodic sampling will determine the level of BOD in the system, and the influent pumping rate will be increased relative to the decrease in BOD concentrations. This will maintain a constant mass load to the beds, within the capabilities of the treatment system.

Once the Gun Club Pond is empty, discharge into the treatment system will stop. However, aeration of the beds will continue. With no more influent or effluent, aerobic bacteria generated during the treatment period will be starved and undergo *in situ* aerobic digestion. Aeration and recirculation of the beds will continue for two weeks and then be shut off to promote evaporation and plant uptake of nutrients. Prior to the onset of winter, the beds will be drained to minimize ice formation.

Conclusion

The upgrade of the EIA glycol treatment system demonstrates how Forced Bed Aeration can be used to improve an existing wetland system. Reconfiguration of the existing cells and the addition of aeration greatly increase the capacity and operational flexibility of the system. Innovative engineering allowed EIA to expand capacity, by using existing infrastructure. In doing so, the airport can continue to meet its environmental protection obligations.

Mark O. Liner is with Naturally Wallace Consulting. E-mail: mark.liner@naturallywallace.com