Cold Climate Constructed Wetlands

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WHAT ARE "CONSTRUCTED WETLANDS?"

In wetland ecosystems, there are biological, chemical, and physical processes that naturally clean and filter water. Constructed wetlands are designed to mimic natural wetlands. They use wetland plants, soils, and microorganisms to clean water in a way that is often less expensive than more traditional water treatment systems. When properly designed, built, and operated, constructed wetlands provide high quality water treatment, while also adding beauty and habitat to your site.

GREAT, BUT DO THEY WORK IN COLD CLIMATES?

Constructed wetlands work in all kinds of climates. All wastewater treatment is biologically based, and biological reactions slow down at low temperatures. The challenges presented in locations that experience cold seasons (temperatures below 0° C) are addressed through specific design considerations intended to negate any issues with performance.

WHAT VEGETATION IS APPROPRIATE FOR COLD CLIMATE CONSTRUCTED WETLANDS?

Cold climate constructed wetlands use native wetland vegetation to help naturally treat wastewater. In the winter, when plants are dorment, their roots still provide surface area for benficial attacted growth bacteria that aid in the treatment process. Areas with greater emergent wetland vegetation, for example cattails and rushes, tend to accumulate more snow around the dormant plants, which provides helpful insulation.

WHAT HAPPENS IF WE EXPERIENCE EXTREME COLD CONDITIONS?

If snow cover is limited or if extreme cold conditions are expected, additional challenges may be encountered:

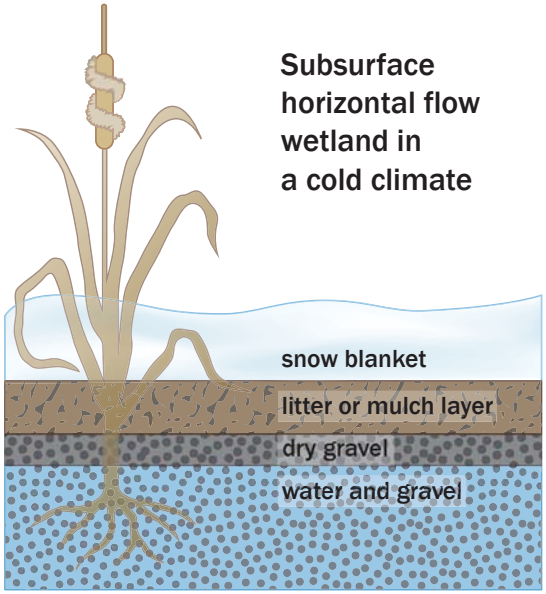
- Ice formation could cause hydraulic short-circuiting or failure.
- Nitrogen and BOD removal are temperature dependent processes; cold climate systems need to be larger and deeper to assure proper treatment.

Strategies to address these challenges may include increasing treatment area, insulating from heat loss, deepening installation for freeze protection, and/or recirculating the water to keep it from freezing.

The constructed wetlands at the Omega Center for Sustainable Living in summer and winter

HOW ARE CONSTRUCTED WETLANDS DESIGNED FOR COLD CLIMATES?

The temperature in a wetland is controlled by ground heat from the earth and loss of heat to the environment. Heat losses can be minimized during cold temperatures by insulation (e.g., vegetation litter, snow, mulch, dry gravel) to preventing ice formation and freezing. A combination of sources are available to provide insulation to a constructed wetland, including vegetation litter, snow, mulch, and dry gravel. The thickness of the mulch layer is calculated/modeled by determining the overall heat flow resistances of each material using the layer thickness and thermal conductivity. Site-specific climate data from late winter is used to calculate the heat flow resistance provided by annual snow fall and snow cover. February is typically the time of year when wetland water temperatures are still quite cold, but daytime solar radiation is increasing and melting snow cover, thus increasing the potential for ice to form on the wetland surface at night.



Subsurface horizontal flow wetland in a cold climate

adapted from Kadlec & Wallace, 2009

WHERE ARE COLD CLIMATE CONSTRUCTED WETLANDS BEING USED SUCCESSFULLY?

Biohabitats has included a climate zone map showing sites that use cold climate constructed wetlands as a major wastewater treatment component. We have also included project profiles and performance data from some of our cold climate treatment systems.

The constructed wetlands at Sidwell Friends Middle School in summer and winter

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ADDITIONAL RESOURCES

Mander, Ü. and Jenssen, P. (eds.) (2003) *Constructed Wetlands for Wastewater Treatment in Cold Climates.*

Wallace, S. (2009) Constructed wetlands – how cold can you go? *Canadian Water Treatment.* pgs 14-15.

Kadlec R. and Wallace S. (2009) *Treatment Wetlands, 2nd Edition.* Section 4.4 Cold Climates.

Restore the Earth & Inspire Ecological Stewardship

COLD CLIMATE CONSTRUCTED WETLAND PROJECTS
by climate zone

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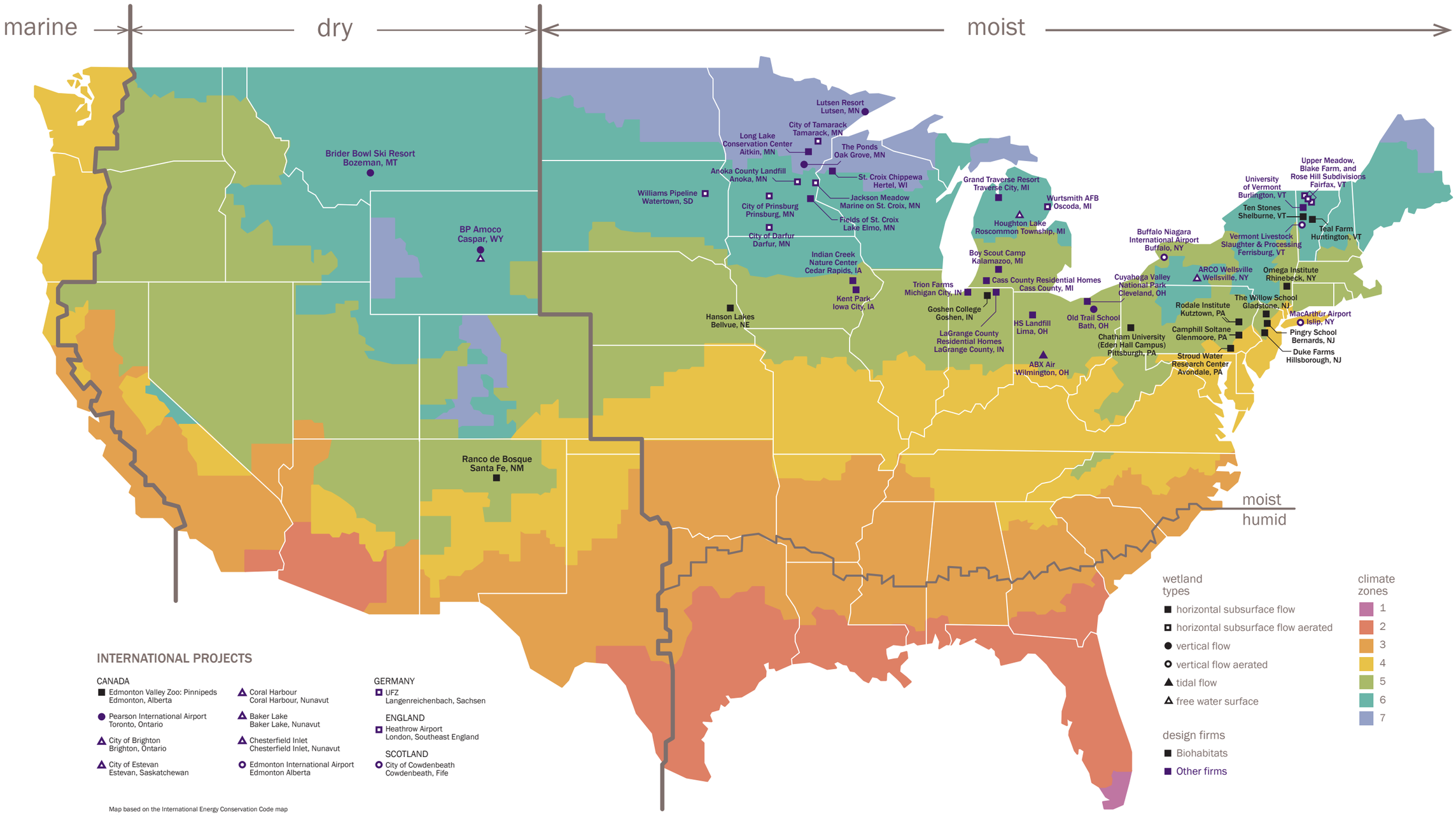

INTERNATIONAL PROJECTS

CANADA
- Edmonton Valley Zoo: Pinnipeds
  Edmonton, Alberta
- Pearson International Airport
  Toronto, Ontario
- City of Brighton
  Brighton, Ontario
- City of Estevan
  Estevan, Saskatchewan
- Coral Harbour
  Coral Harbour, Nunavut
- Baker Lake
  Baker Lake, Nunavut
- Chesterfield Inlet
  Chesterfield Inlet, Nunavut
- Edmonton International Airport
  Edmonton Alberta

GERMANY
- UFZ
  Langenreichenbach, Sachsen

ENGLAND
- Heathrow Airport
  London, Southeast England

SCOTLAND
- City of Cowdenbeath
  Cowdenbeath, Fife

wetland types
- horizontal subsurface flow
- horizontal subsurface flow aerated
- vertical flow
- vertical flow aerated
- tidal flow
- free water surface

design firms
- Biohabitats
- Other firms

climate zones
- 1
- 2
- 3
- 4
- 5
- 6
- 7

Map based on the International Energy Conservation Code map