What I hope to dig into

* Prevalence of wastewater problem
* Aging infrastructure
* Why this is a problem – what are its effects? What are its causes?
* Accessibility of water leaks for surveying, mapping,

Focusing on Canadian data where possible – problem should fit within scope of Canadian Engineering Grand Challenges

Intentionally avoided articles Colin has already grabbed

Various keywords used in search: water, wastewater, hydro, infrastructure, aging, Canada, pipes, leak, city, survey, map, detect, break

Quotes highlighted lightly to help distinguish from thoughts/derived meanings

My (Ryan’s) favourite sources have a bullet point highlighted in yellow identifying why it’s a favourite

Links below ranked by relevance/directness

1: Leaking water infrastructure in Canada

2: Leaking water infrastructure

3: Need for water supply

3) <https://www.reuters.com/article/idUSL5N1GS4H9>

* “With the world’s population expected to grow by one third to more than 9 billion by 2050, the world will need 55 percent more water and 70 percent more energy, the United Nations says.”
  + Cannot afford to waste any water
* “Population growth will also lead to a 70 percent increase in demand for food, putting more pressure on water through farming, which is already the biggest consumer of water.”
* Increasing water demands as population continues to grow - good argument for developing a system to prevent waste of good water
* Articles iterating similar points:
  + <https://www.reuters.com/article/idUSKCN0PQ12N20150716>

2) <https://www.reuters.com/article/idUSKBN23O06T>

* Zimbabwe city Bulawayo has crumbling infrastructure
  + “More than 30% of the water running through the city’s pipes leaks out before it reaches consumers, city council spokeswoman Nesisa Mpofu told ...”
  + Not Canada, still indicates that the problem exists somewhere
  + Cities have water reserves. Extraneous water loss:
    - digs into those reserves
    - Puts strain on the *production* of water to put into reserve
* Changing climate impacts how much water may be claimed by local human populations and when

3) <https://search-proquest-com.proxy.lib.uwaterloo.ca/docview/2475199557/F5090510AA7E4A93PQ/3?accountid=14906>

* “As an example, a nexus modelling study for the city of New York found that many energy-saving strategies increased water use and vice versa”
  + An interesting consideration should our project address water-saving strategies
* Article directly discusses UN SDGs

2) <https://search-proquest-com.proxy.lib.uwaterloo.ca/docview/2479037142/C22392991F404DE3PQ/1?accountid=14906>

* “Industrial Growth Partners has acquired infrastructure services provider Hydromax USA LLC. The Omaha, Neb.-based company delivers tech-enabled field services to utilities as well as water and wastewater systems, including surveys, mapping and leak detection. IGP acquired its stake from Warren Equity Partners, which remains a minority investor.”
  + Tech addressing surveys, mapping, leak detection
  + Others have invested in the problem

2) <https://global-factiva-com.proxy.lib.uwaterloo.ca/ga/default.aspx>

* Water leak occurred
* City couldn’t handle the repair appropriately
* Also raises concern of leaks being safety hazards

2) <https://global-factiva-com.proxy.lib.uwaterloo.ca/ga/default.aspx>

* Got bad enough that the consequences were “no water or low supply” - surely there was partial failure before then? This is only speculation though, since there was no measurement or surveying occurring before then.

2) <https://global-factiva-com.proxy.lib.uwaterloo.ca/ga/default.aspx>

* Public image suffers if local authorities can’t address leaks quickly enough

1) <https://www.thestar.com/news/canada/2020/11/11/left-behind-in-neskantaga-and-exiled-in-thunder-bay-a-nation-still-waits-for-clean-water-at-home.html>

* First Nations community suffers from not having access to water for a long time
* Boil advisory
* “‘It’s really a bunch of different things that are happening in the community with pumps, water leaks, sewage station, housing problems,’ Mr. Wesley said about the issues that have plagued the water system and delayed the lifting of the boil water advisory another two years. The project team suspect that slow leaks in the water distribution system forced the community to start shutting the water off at night – which Mr. Wesley says could be a contributing factor to the leaks. He says there are eight different locations that will likely require digging to identify and repair the leaks.
  + Known about the issue for 2 years, leaks still not identified and repaired
* Canadian example of a water leak and identification issues, real people are affected

1) <https://www.thestar.com/news/canada/2020/10/01/french-hoping-to-get-to-the-bottom-of-water-line-breaks.html>

* Canadian example of several water leaks occurring in the same town

2) <https://www.thestar.com/news/world/us/2020/01/14/faulty-valve-blamed-for-north-dakota-oil-wastewater-spill.html>

* Wastewater spill introduces contaminants in North Dakota to pastureland
* Fortunately, no water sources harmed – not always the case though!
* Faulty valve
* This is an instantaneous spill as opposed to continued leak – less relevant

1) <https://www.tvo.org/article/an-epidemic-of-leaky-pipes-why-these-thunder-bay-residents-may-fight-city-hall>

* Canadian (Thunder Bay) example of water leaks, real people are affected
* Some mention of systemic problem only being identified once the misplaced water was noticed

2) <https://www.sciencedaily.com/releases/2015/06/150607214248.htm>

* Very real consequence of leaky pipes
* All in the title: “Leaky pipes can allow contaminants into our drinking water”
* Engineers prove health consequences may arise due to leaky pipes

\*) <https://global-factiva-com.proxy.lib.uwaterloo.ca/ga/default.aspx>

* Analysis of water & wastewater leak detection market
  + Growth expected
  + Mentions viability of various products (drones vs satellite vs CCTV)
  + Leak management/detection as a service will outpace leak detection products
    - Argument against our product being viable in the long-term market; the need statement should likely refrain from claiming that the market needs it

\*) <https://www-scopus-com.proxy.lib.uwaterloo.ca/record/display.uri?eid=2-s2.0-85098755451&origin=resultslist&sort=plf-f&src=s&st1=&st2=&sid=b5a4a0a4b92416d89c25fa0dfd2ddadc&sot=b&sdt=b&sl=26&s=TITLE-ABS-KEY+%28water+leak%29&relpos=2&citeCnt=0&searchTerm=>

* Similar problem: “Leakages from water pipelines cause economic losses and environmental hazards. … leak detection and localization, especially in real-time, minimize the damage.”
* Microelectromechanical systems (MEMS) solution – this is similar to our project constraints, but more advanced?