Module: Historic Landfills and Perpetual Care

Introduction

The Region provides the oversight of environmental monitoring programs at its Regionally owned landfill sites. To prevent negative environmental impacts and ensure the environmental integrity of the sites, perpetual (or long-term) care programs have been established for each of the seven landfills the Region is responsible for. This module teaches students about historic landfills, what happens to waste in these sites, and the need for long term environmental management to ensure the health of the environment and the community.

Learning Objectives

1. Describe historic landfills and how waste was managed in the past
2. Identify where Regionally owned landfills are located
3. Identify and describe the potential environmental impacts from historical landfills
4. Describe the Region's role in landfill monitoring, mitigation, and rehabilitation
5. Make a connection between the waste we create and the potential long-term effects of the waste
6. Identify and explain how waste management in the Region has evolved over time

What are historic landfills?

Historic landfills are sites that once received waste for disposal and are now closed. These older landfills often predated modern environmental regulations when they were developed. This means that depending on the age of the site, they had few to no pollution prevention measures in place which are used by modern sites to reduce environmental impacts. Landfill sites that were established or operated more recently often have additional environmental controls than those operated in the past.

Historic landfills were usually located a short distance from populated areas to allow people to conveniently dispose of their garbage, in some cases before curbside programs were developed. At this time, it was common for waste to be sent to landfill and buried without further separation or diversion. These sites were often in rural areas outside of towns and cities in areas that, at the time, were considered to have little economic or ecological value such as in or near wetlands, streams, abandoned gravel/sand pits and rural areas away from developed communities, or even within water bodies.

These locations would later prove to be an environmental concern as water contamination can result from close proximity to surface waters such as wetlands and streams, and groundwater as the underlying soils from sand and gravels provides a porous subsurface pathway for leachate (the liquid within the landfill) migration.

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It is important to note that while there are numerous closed landfills throughout Durham, the Regional Municipality of Durham (Region) is only responsible for the long-term management of seven of the landfill sites within the Region's boundaries which were owned and operated by the local municipalities when the Region was created. For the purposes of this lesson, only landfills managed by the Region have been included in this module.

Where are Durham Region's historic landfill sites located?

While the Region no longer relies on landfill sites as its primary way to dispose of waste, we are responsible for the long-term management of seven closed landfill sites within the Region's boundaries which include:

1. Blackstock Landfill (landfill area ~2 hectares)
2. Brock Landfill (landfill area ~8 hectares)
3. Darlington Landfill (landfill area ~7.2 hectares)
4. Oshawa Landfill (landfill ~32 hectares)
5. Scott Landfill (landfill area ~2.2 hectares)
6. Scugog Landfill (landfill area ~7.2 hectares)
7. Whitby Landfill (landfill area ~9.7 hectares)

What happens to waste after landfilling?

Waste does not disappear once it is placed in a landfill. Landfill sites need to be managed to prevent any adverse environmental impacts.

Natural Attenuation

Historic landfills including those in the Region are often natural attenuation sites. Natural attenuation means that the site relies on a variety of natural processes (physical, chemical, or biological) to reduce the potential negative impacts from the buried waste. This could include reducing the mass, toxicity, mobility, volume, or concentration of contaminants that could impact the soil, surface water or groundwater. Some examples of natural attenuation are provided below.

1. **Biodegradation** occurs when microbes (really small organisms) eat contaminates and change them into small amounts of water and gas through the digestion process.
2. **Chemical reactions** with natural substances underground can convert some contaminates into less harmful forms.
3. **Dilution** decreases the concentration of contaminates as they move through and mix with clean groundwater.
4. **Evaporation** can cause some contaminates to change from liquids to gases within the soil and be diluted in the atmosphere or destroyed by sunlight.
5. **Sorption** causes contaminates to stick to the soil. While this does not destroy the contaminates, it does not allow them to move deeper into the soil or move off site.

For natural attenuation to be effective, a large buffer area is required to allow the natural processes to occur. As more land is utilized to build houses, road networks and stores, it is important to keep a

buffer area surrounding historic landfills, or to restrict certain activities in the area. When it comes to landfill management, two of the most problematic environmental impacts associated with landfills is landfill gas and water contamination from leachate. In the past, it was common to rely on natural attenuation to manage these concerns.

What is landfill leachate?

Landfill leachate is the liquid within the landfill. Leachate is generated when water passes through the waste, primarily through precipitation such as rainfall and snow. As the water percolates through the waste, it draws out (or leaches) chemicals or components from the waste and becomes contaminated. The liquid is termed 'leachate' when it flows back out of the waste. Leachate is also created when water is released from the natural decomposition of organic materials within the landfill and when liquids and chemicals that have been discarded as waste mobilize.

Leachate can contaminate groundwater, surface water and soil which can affect local drinking water or end up in rivers, wetlands and lakes and affect the health of local ecosystems.

What is landfill gas?

Landfill gases are produced as bacteria break down the organic materials that are part of the waste that has be disposed of in historic landfills. The quality and quantity of the gas depends on the type of waste in the landfill and the length of time since closure. The most landfill gas is produced when a landfill is first closed. Over time as organic material breaks down, less landfill gas is created.

Landfill gas is primarily made up of methane and carbon dioxide which are both greenhouse gases (GHG) and contribute to climate change by trapping heat in the atmosphere. Methane is a potent GHG which is 28 to 36 times more effective than carbon dioxide at trapping heat in the atmosphere. While these gases normally vent through the landfill cover at the surface, at a historic landfill site they may also move laterally away from the landfill in the subsurface above the water table. While buffer zones, streams and other natural areas often provide adequate protection, it is important to monitor these gases where there are neighboring properties or public access to the lands as methane can pose a safety risk as it is explosive above a concentration of 5% by volume.

Environmental Monitoring, Mitigation and Rehabilitation

To prevent negative environmental impacts, perpetual (or long-term) care programs have been established for each of the Region's seven landfills to ensure the environmental integrity of these sites. A team within the Region's Waste Management Division works with the Province, Regional Council and other stakeholders (a person or group with an interest or concern related the landfill) to monitor any potential impacts from each site to ensure the infrastructure is in good repair to continue to meet environmental standards and regulations.

Annual monitoring includes activities such as:

1. Surface and groundwater monitoring
   The water monitoring program is completed to assess the quality of the groundwater and surface water at and near the landfill site. Monitoring establishes if there are any off-site landfill leachate impacts to water resources and to determine whether remedial actions are required in consideration of monitoring findings. In addition, the monitoring program assesses

the adequacy of the existing monitoring program and determine if additional monitoring wells are required or need to be removed, repaired, or replaced.

2. Gas monitoring
   The landfill gas monitoring program is completed to assess the concentrations of landfill gas at the landfill site property boundary and evaluate the potential for the migration of landfill gas from the site at unacceptable concentrations. The landfill gas monitoring program assesses the performance of the gas collections systems and buffer zone at the landfill site and determine whether remedial actions are required in consideration of monitoring findings. In addition, the monitoring program assesses the adequacy of the existing monitoring program and determine if additional monitoring wells are required or need to be removed, repaired or replaced.

3. Soil erosion control and site grading
   Decomposition and settlement of waste material over time within the landfill is a natural process. While landfill cover (a barrier between the waste and the ground surface) are put in place to prevent water from entering the landfill, there may be pockets where waste materials settle out more than anticipated. Unanticipated settlement can result in loss of landfill cover, additional water migration, and can have an impact on engineered collection and drainage systems on site. In addition, landfills located adjacent to creeks or slopes can experience creek erosion, surface water runoff, and groundwater seepage that can result in slope failures. As a result, landfill staff must conduct regular inspections to ensure the integrity of the site.

4. Seep monitoring and repairs
   A landfill seep is the result of leachate flowing or leaking slowly through the landfill and reaching the earth's surface. It is important to manage landfills seeps because they can cause soil erosion on the slope, unpleasant odours, and can be aesthetically displeasing. Leachate can also travel beyond the landfill boundaries onto adjacent properties.

5. Vegetation, re-naturalization, and landscaping
   Vegetation and landscaping are monitored and maintained to help promote diversity of plant species, provide habitat for wildlife, and decrease the spread of invasive or nuisance vegetation.

6. Annual reports
   Annual reports are required by the sites permit to be prepared and submitted to the Ministry of Environment, Conservation and Parks for review. These reports summarize the results of the monitoring programs and establish trends to determine the environmental integrity of the landfill.

Innovation

The Region is committed to ensuring the safety of the community and the environment. In addition to regular monitoring, the Region continues to look for innovative ways to mitigate the effects of our closed landfill sites. An example of an innovative approach includes landfill mining. Check out the Landfill Mining module for more information!

Where does the Region's garbage go today?

The Region no longer relies on landfill as their primary disposal option. Today, waste is first diverted through the Region's various waste management programs including, but not limited to:

- Blue Box recycling
- Green Bin and Leaf and Yard Waste Collection for organic materials
- Special Curbside Collection for items such as electronics, batteries, bulky items and metals
- Waste Management Facilities to manage materials such as household hazardous waste, construction and demolition materials and tires
- Reuse events which encourage residents to drop-off reusable items for donation to local non-profit organizations

Garbage remaining after diversion efforts is sent to the Durham York Energy Centre (DYEC) located in Courtice in the Municipality of Clarington. At the DYEC garbage is incinerated to generate electricity from the heat released; and to recover additional metals for recycling.

Conclusion

To prevent negative environmental impacts, perpetual (or long-term) care programs have been established for each of the Region's seven historic landfills to ensure the environmental integrity of these sites and to ensure the health of the environment and the community. Waste does not just disappear once it leaves your house. Waste needs to be managed responsibly for decades to protect the environment and human health. How we choose to manage waste today impacts the future.

Curriculum Connections

The Ontario Curriculum, Grade 9 and 10: Canadian and World Studies, 2018 (revised)

- Issues in Canadian Geography, Grade 9, Academic (CGC1D)
- Issues in Canadian Geography, Grade 9, Applied (CGC1P)
- Civics and Citizenship, Grade 10, Open (CHV2O)

The Ontario Curriculum, Grades 11 and 12: Canadian and World Studies, 2015 (revised)

- Regional Geography, Grade 11, University/College Preparation (CGD3M)
- World Geography: Urban Patterns and Population Issues, Grade 12, University/College Preparation (CGU4M)
- Environmental Resource Management, Grade 12, University/College Preparation (CGR4M)
- World Issues: A Geographic Analysis, Grade 12, College Preparation (CGW4C)
- Living in a Sustainable World, Grade 12, Workplace Preparation (CGR4E)

The Ontario Curriculum, Grade 9 and 10: Science, 2008 (revised)

- Science, Grade 9, Academic (SNC1D)
- Science, Grade 9, Applied (SNC1P)
- Science, Grade 10, Applied (SNC2P)
- Science, Grade 10, Academic (SNC2D)

The Ontario Curriculum, Grade 11 and 12: Science, 2008 (revised)

- Environmental Science, Grade 11, University/College Preparation (SVN3M)

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