

Closed Landfills: Hazards & Best Management Practices

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What is NEWMOA?

- The Northeast Waste Management Officials' Association
- Formed by the New England Governors back in the 1980s
 - NJ & NY joined
 - Formally recognized by US EPA in 1986
- Non-partisan, non-profit association of the Solid Waste, Hazardous Waste, Waste Site Cleanup, and Pollution Prevention & Toxics programs in CT, ME, MA, NH, NJ, NY, RI, VT
- www.newmoa.org

Overview of NEWMOA's Closed Landfill Project

- Rural northern New Hampshire & Vermont
- Focused mostly on pre-regulation landfills – stopped taking waste before official closure (& post-closure) requirements
 - NH law in 1981
 - VT in 1987
- Funded: USDA Solid Waste Management Grant
 - This material is based on work supported under a grant by the Rural Utilities Services, United States Department of Agriculture. Any opinions, findings, and conclusions or recommendations expressed in this material are solely the responsibility of the authors and do not necessarily represent the official view of the Rural Utilities Services.

Why NEWMOA Focus on Closed Landfills?

NHDES visited 16 closed landfills in 2016 & noted:

- Methane gas exceeding 50% LEL at the property line
- Woody vegetation growing in drainage swales
- Ponding of water in drainage swales and on the cap
- Trees/brush growing on the cap
- Erosion
- Distressed vegetation
- Landfill cap not mowed
- Animals burrowing into the cap
- Damaged fences
- Unauthorized access/trespassing

Why Care About Closed Landfills?

- Liability!
 - Contamination of water resources
 - Generation of methane gas
 - Physical hazards
- Landfill owners – including municipalities – **are responsible for all costs** to clean up environmental contamination



Municipal officials need to be aware of the location & condition of ALL landfills

- Most towns have more than one old landfill:
 - One that closed more recently – often where the transfer station is
 - One (or more) that is even older
 - Several NH & VT towns have 3 or more old landfills
 - Landfills – especially that closed pre-1980s - might be on private property





Contamination of Water Resources

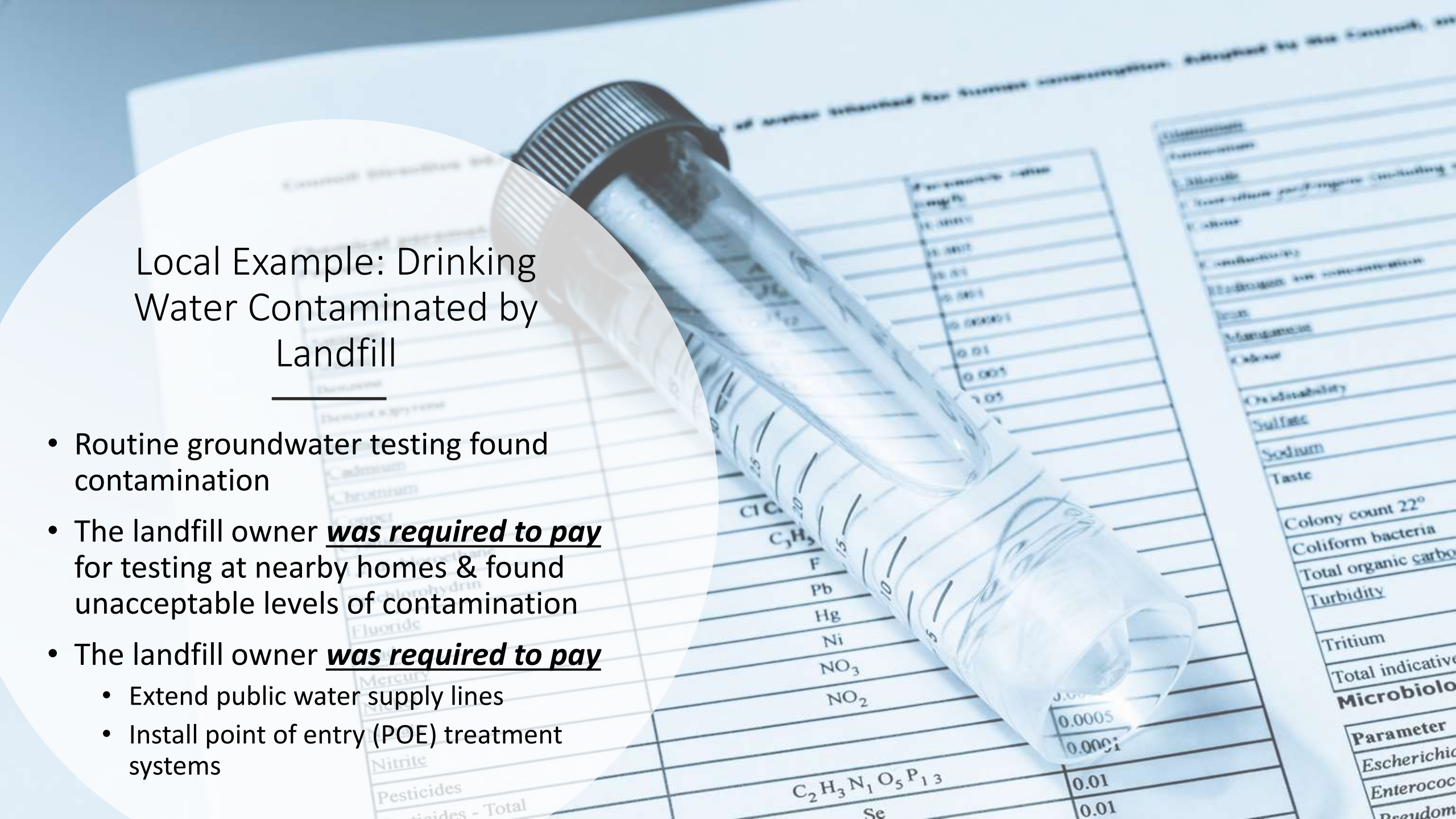
Water Contamination Can Affect Community Health

- Rain & snow enter the landfill becoming leachate
- The bottoms of old landfills were not lined
- Leachate pollutes surface & groundwaters
- **Effective risk reduction:** Properly maintain cover soil & vegetation systems to reduce water movement through waste



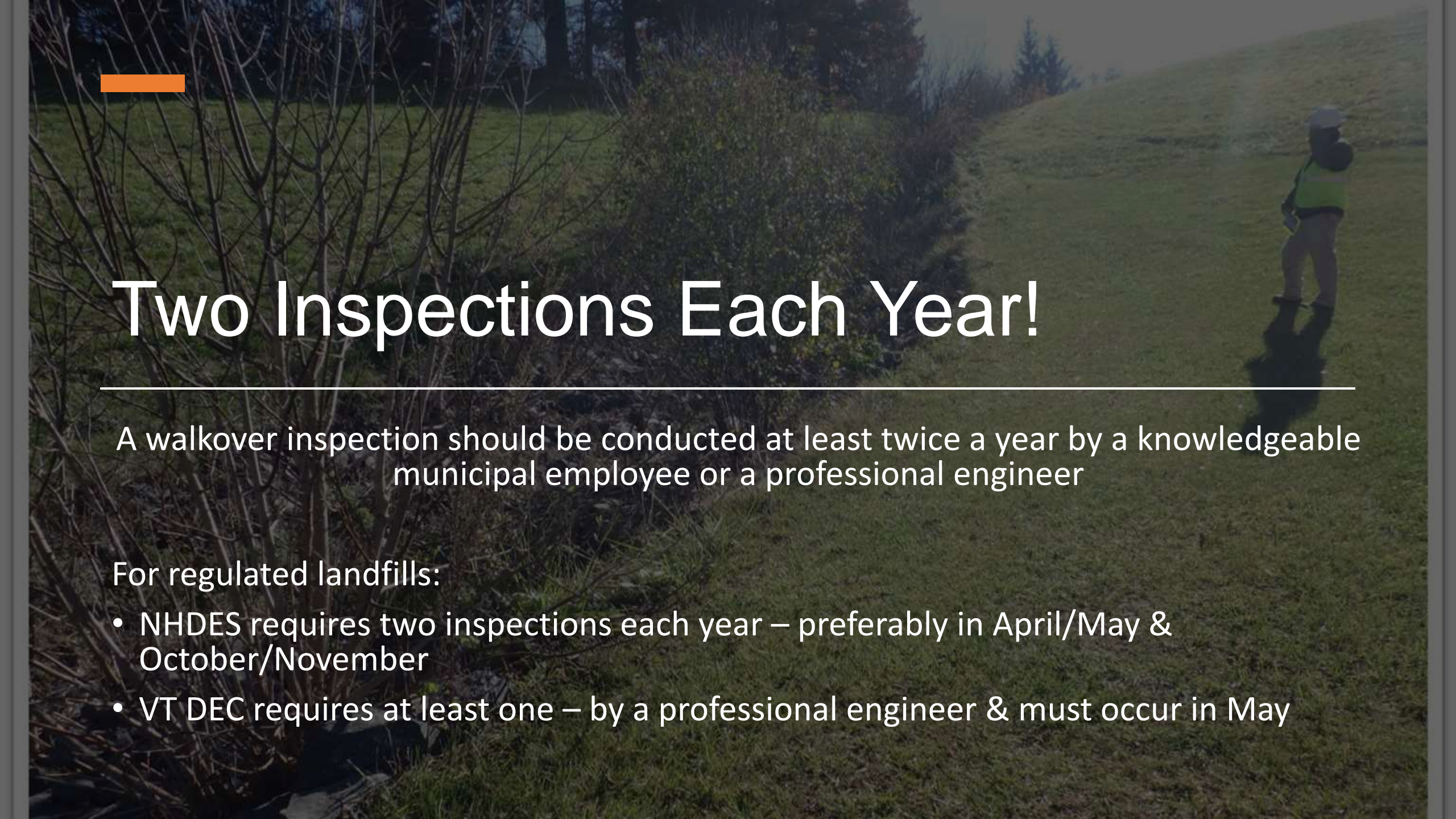
Local Example: Drinking Water Contaminated by Landfill

- Routine groundwater testing found contamination
- The landfill owner **was required to pay** for testing at nearby homes & found unacceptable levels of contamination
- The landfill owner **was required to pay**
 - Extend public water supply lines
 - Install point of entry (POE) treatment systems



Landfill Owners Should Make Sure That:

- No waste is exposed
- Good depth of soil covers all waste
- Cover soil is kept intact
- Healthy grass covers waste areas
- No trees or woody vegetation is growing in waste areas, including side slopes
- Cover soil reduces water infiltration and promotes run-off
- Run-off is managed by diverting it off & away from the landfill without causing erosion



Two Inspections Each Year!

A walkover inspection should be conducted at least twice a year by a knowledgeable municipal employee or a professional engineer

For regulated landfills:

- NHDES requires two inspections each year – preferably in April/May & October/November
- VT DEC requires at least one – by a professional engineer & must occur in May

Annual Mowing to Prevent Tree Growth

- Shallow landfill cover soil cannot support trees as they mature
- Blown over trees damage cover soils & expose waste
- **Effective risk reduction:** Mow closed landfills at least once annually or as needed to control woody growth
 - Plan to mow in late September to avoid killing nesting species and insects





Maintain Good Grass Cover

Prevents soil erosion by
water or wind

Animal burrows provide
a direct pathway into the
waste





Local Example: Erosion Exposes Waste

- A municipal landfill was capped with thin soils
- Annual mowing was not conducted & large trees grew
- Following a rainstorm event, the slope gave way and deposited waste across a road & into a river

Waste Settlement & Drainage

- Waste settles over time, causing depressions that allow for ponding water
- **Effective risk reduction:** Fill depressions with soil, regrade to promote runoff, & restore grass coverage



Leachate Breakouts

- Leachate breakouts or “seeps” come out of a landfill side slope or at the base (or toe) of the landfill
- **A leachate seep creates a potential hazard & must be addressed immediately – contact your state and/or your engineer!**
- **Effective risk reduction:** maintain healthy grass coverage & ensure a good depth of cover soil that is graded to reduce infiltration





Generation of Methane Gas

Methane Gas Formation & Risks

- As organic wastes in a landfill age, they decompose & generate methane & other gases
- **Gas production can continue for decades after a landfill closes**
- Landfill gas can ***travel underground 1,000 feet or more*** from the landfill
- Methane gas, at certain concentrations, can explode or otherwise fuel a fire
 - *One visual sign of methane gas is stressed or dead vegetation*



Local Example: Landfill Gas Impacts Utility Work

- Utility workers measured gas levels before entering their roadside excavation
- Explosive levels were found & they had to wait an hour for the gas to dissipate
- Source was a nearby old landfill
 - It had been closed for more than 20 years
- The property owner was required to install a landfill gas interceptor system & **must keep paying** to conduct gas monitoring



Structures Near Landfills

- Permanent structures should not be built on top of landfilled waste or near an old landfill
- **Effective Risk Reduction:** Measure gas levels in the soil at the property boundary & in any on-property buildings at least once a year
 - If the measured level increases, measure more frequently to make sure you are aware if a dangerous situation develops



Local Example: Landfill Gas Explosion

- A town maintenance garage located adjacent to a closed municipal landfill
- A particularly cold & snowless winter froze the ground deeper than normal, likely causing the landfill gas to migrate
- A welder's spark fell into a floor drain & set off an explosion
 - Fortunately, it did not injure anyone or cause significant damage





Encroachment of Development

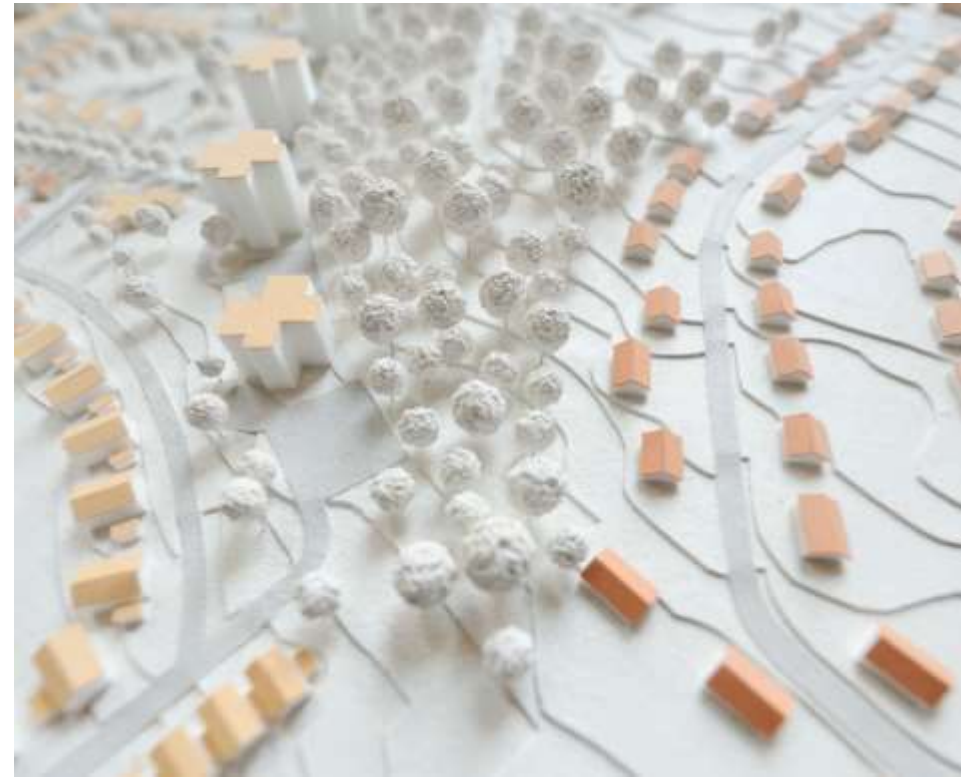
- **Liability!**

- If a groundwater well will be the water supply, the groundwater might already be contaminated, or ***the new pumping might cause contamination to spread & move into the well***
- Methane gas might migrate into structures



Effective Risk Reduction:

- Include a notice on the deed for the property that is recorded at the Registry of Deeds
- Increase awareness of the location of old landfills
 - Particularly among local officials that oversee real estate development
- Adjust zoning & planning ordinances & codes to limit development near old landfills





Physical Hazards

Source & Reduction of Physical Hazards

- Closed landfills are tempting locations for unauthorized uses
 - All-terrain vehicles (ATV) & illegal waste dumping
- Trespassing increases liability!
 - Disturbs the landfill cover (increases leachate)
 - Potential damage to infrastructure (e.g. wells, gas vents)
 - Creates injury hazards
- **Effective risk reduction:** Restrict access with gates & barriers, post signs identifying old landfill, remove illegal waste & **take preventative measures**



An Opportunity for Closed Landfills!

- Closed landfills are typically large open areas & should be evaluated for solar energy generation potential
- For a solar project to be economically feasible, there typically needs to be a three-phase power line available near the site
 - If three-phase power is located nearby, contact a solar developer to help identify next steps





Requirements for Regulated Landfills in NH & VT

Post-Closure Care Requirements in NH



If a landfill ceased operations after July 9, 1981, it should have a:

- Solid Waste Permit
- Closure Plan:
 - Includes post-closure inspection, monitoring & maintenance requirements that are specific to your site
- Groundwater Permit (most landfills)

Post-Closure Care Requirements in NH

ALL landfills that ceased operations after July 9, 1981 – even if they are “Brady Bill” landfills

- ***Inspect, monitor, and repair*** any damage
- Conduct two inspections per year, ***and file those reports*** with NHDES
- File their “**Annual Post-Closure Report**” ***by March 31st*** of each year

The Post-closure Care period extends until you can ***demonstrate to NHDES*** achievement of the “performance standards” in the NH Solid Waste Rules:

- Stop generating leachate,
- Stop generating decomposition gases like methane,
- Achieve maximum settlement,
- Remove harmful impacts to air and water, and
- Remove threat to human health and the environment.

“BRADY BILL” LANDFILLS

RSA 149-M:9(XIII)

ALLOWED SOME LANDFILLS TO CLOSE WITHOUT INSTALLING A COSTLY MULTI-LAYER CAP DESIGN (OFTEN THICK SOIL & GRADING INSTEAD)



No permit issued by the department to a town with a population of 5,000 persons or fewer shall require the town to clean up an inactive, municipally-owned, unlined landfill (inactive facility)

if the town:

- (1) ***Monitors*** the inactive facility in accordance with requirements established in RSA 485-C and RSA 149-M and rules adopted by the department.
- (2) ***Continues to show***, through monitoring devices, that the inactive facility is having no adverse impact, as defined in rules adopted by the department, on the environment.
- (3) ***Has obtained approval of a closure plan*** from the department by January 30 of the calendar year in which the facility is scheduled to close by the department.

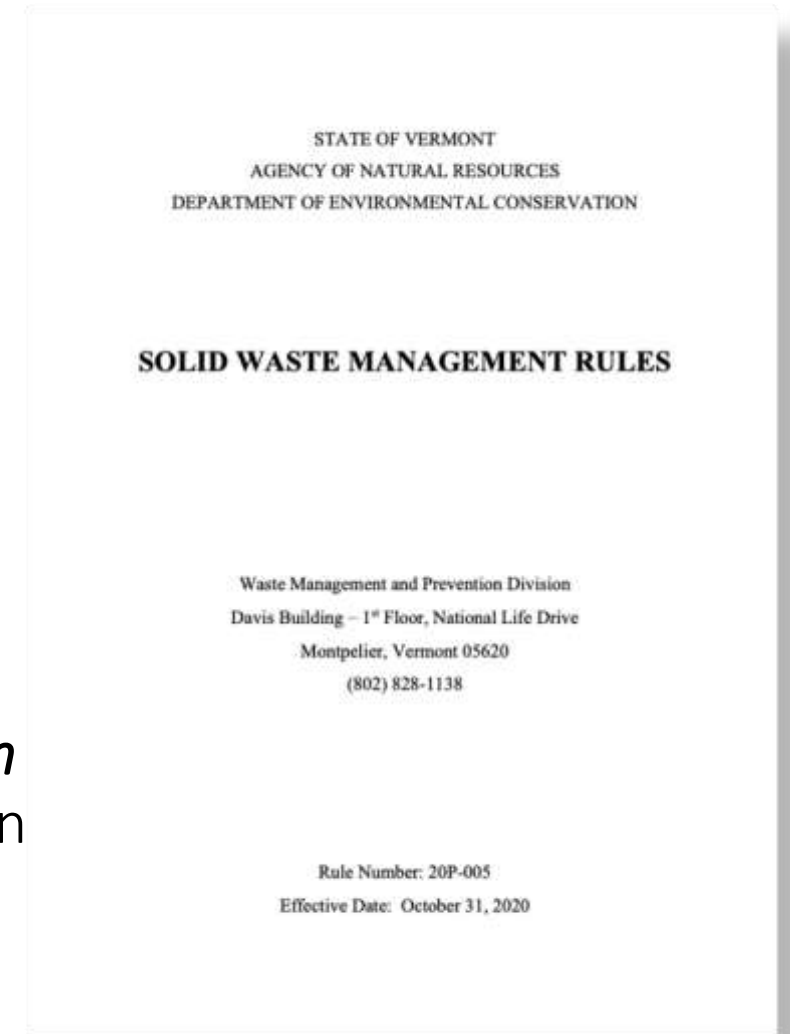
Post-Closure Care Requirements in VT



- If closed after 1987, should be under a permit or court-issued order (Assurance of Discontinuance or Closure Order) & have a post-closure plan
- Plan incorporates the BMPs into a written document:
 - Regular monitoring & maintenance: property access controls, landfill cover system, erosion control, drainage systems, groundwater monitoring wells, leachate collection system (if applicable) & gas control (if applicable)
 - Periodic groundwater sampling & analysis
 - Identification of sensitive receptors (e.g. surface water or residential wells)
 - Explosive gas monitoring & management
 - **Cost estimate for implementing the plan!**

2020 Solid Waste Management Rules

- VT DEC requires:
 - a registered engineer or approved qualified professional **conducts an annual inspection** of the landfill property *in the month of May* & the report is submitted to DEC within 30 days!
 - Vegetative cover mowed at least once a year
 - Make timely repairs to the landfill cover
 - Water quality testing reports, if required, submitted to DEC within 60 days





Assistance Resources Developed by the Project



Signature

Date

Best Management Practices & Requirements Guides (8 pages)

NH: www.newmoa.org/wp-content/uploads/2023/03/NH_Closed_Landfill_BMPs.pdf
VT: www.newmoa.org/wp-content/uploads/2023/03/VT_Closed_Landfill_BMPs.pdf
Writable: https://www.newmoa.org/wp-content/uploads/2023/08/closed_landfill_bmps.pdf



Closed landfills are a long-term liability for municipalities because they can create environmental and other problems that negatively impact residents, visitors, and others. Landfill owners, including municipalities, are responsible for the costs to cleanup environmental contamination. Therefore, **it is important that municipal officials are aware of the location and condition of all the closed landfills in their community.** Many New Hampshire towns have *more than one* closed landfill – one that long-time residents remember using (often near the location of the current transfer station) and one or more that was used before that one opened. Municipal officials need to know about and maintain all of them.

This Closed Landfill Best Management Practices (BMP) Guide is designed to help municipal officials understand the actions they should take to reduce the potential environmental contamination from closed landfills and to protect the health and safety of their community. Note that landfills that ceased operations *after July 9, 1981*, have additional requirements that are outlined on page 7 of this document.

Closed landfills can cause:

- Contamination of water resources
- Generation of methane gas
- Physical hazards

NHDES IS HERE TO HELP!

The New Hampshire Department of Environmental Services (NHDES) can answer questions and provide advice and limited technical guidance to municipalities. NHDES is most interested in providing cooperative assistance to address problems as soon as they arise. Contact NHDES' Solid Waste Management Bureau: (603) 271-2925 or solidwasteinfo@des.nh.gov. Additional information is available from NHDES: <https://www.des.nh.gov/waste/solid-waste>.

TWO INSPECTIONS EACH YEAR

A walkover inspection should be conducted at least twice a year by a knowledgeable municipal employee or a professional engineer. Inspections should be conducted in the spring following snowmelt and after/during the annual mowing event in the fall. Inspectors should look for:

- **Soil cover:** tree growth, animal burrows, erosion, and exposed waste
- **Grass cover:** bare spots and dead grass/vegetation (could indicate a methane gas problem)
- **Cover grading:** settlement or areas where water can pond; and sloughing of side slopes
- **Stormwater management:** obstructions in ditches, culverts and other features, erosion, or excessive sediment accumulation
- **Access restrictions:** evidence of ATVs, dirt bikes, or other unauthorized access

A separate Closed Landfill Inspection Checklist is available at: https://www.newmoa.org/nh_inspection_checklist/.

Inspection Checklists (4 pages)

NH: https://www.newmoa.org/wp-content/uploads/2023/03/NH_Inspection_Checklist.pdf

VT: https://www.newmoa.org/wp-content/uploads/2022/05/VT_Inspection_Checklist.pdf

Writable: https://www.newmoa.org/wp-content/uploads/2023/08/inspection_checklist.pdf

CHECKLIST

Name: _____
 Organization and Position: _____

 Landfill Name: _____
 Town Where Landfill is Located: _____
 Landfill Street Location: _____
 Date of Inspection: _____

Circle the most applicable response for each question

VEGETATION				
	1	2	3	Notes/Action Items
Are trees or bushes growing on the landfill, including the side slopes?	None	Areas of brushy growth	Trees/bushes cover large areas	
Can you walk all the way around the landfill at the bottom of the side slope?	Yes	Some obstructed areas	Not at all	
Is grass growing over the entire landfill, including the side slopes?	Yes	Several small bare or mossy spots	Many large bare spots	
Are there animal burrows on the landfill, including the side slopes?	None	Several small	Many large or connected	

DRAINAGE				
	1	2	3	Notes/Action Items
Is the landfill graded so there are no depressions where water can pond? (if it hasn't recently rained, look for mossy growth or muddy looking bare spots)	Yes - no depressions	Several small depressions	Many large depressions	
Is there any evidence of erosion on the side slopes?	None	Several small concentrated channels a few inches deep	Many large channels with bare soil	
Are all drainage features that are located off the landfill (such as drainage swales/ditches, culverts, detention ponds) free of obstruction (including tree & shrub growth) & no evidence of sediment build up?	Yes - no obstructions & no sediment OR Not applicable - there are no off landfill drainage features	Some obstructions OR some sediment	Obstructions & sediment	

LANDFILL LEACHATE				
	1	2	3	Notes/Action Items
When walking around the landfill, is there any soil that is stained orange or an area where liquid is seeping from the slope?	No	A small dry area	Large wet area	
Is the leachate collection system functioning properly?	Yes OR Not applicable - no collection system		Visible Cracks or overflow	

LANDFILL GAS				
	1	2	3	Notes/Action Items
Are there any buildings located on the landfill itself?	No		Yes	
Are there any building or other structures located around the base of the landfill?	None	More than 100 feet away	Within 100 feet	
Are all gas vents in good condition?	Yes OR Not applicable - no gas vents	1 has cracks or missing screen	More than 1 is broken	
Is the gas management system functioning properly?	Yes OR Not applicable - no management system	Small area of stressed vegetation	Large area of dead vegetation	

PROPERTY ACCESS				
	1	2	3	Notes/Action Items
Is access to the property restricted?	Yes - gate locked & no way around	Somewhat restricted - some boulders or tree logs	No barrier to entry	
Are there "no entry" signs warning the public that there is a landfill?	Yes		No	
Is there evidence of unauthorized access (such as ATV trails or illegal dumping)?	No		Yes	

GROUNDWATER MONITORING WELLS				
	1	2	3	Notes/Action Items
Are all groundwater monitoring wells at the landfill accessible & easy to find & covered & locked?	Yes - all in good condition & locked OR Not applicable - no groundwater monitoring wells	Hard to find - covered but not locked	Cannot find any of them	
Notes/Action Items				

The results of each inspection should be shared with one or more senior municipal officials, such as the Selectboard Chair, the Town Manager, the Director of Public Works, and/or the Town Clerk.

- Any answers other than “1” require follow-up to address deficiencies.
- **Any answers of “3” require immediate attention** – contact the state for advice and assistance. Also consult the “Closed Landfills: Guide to Best Management Practices & Requirements” for more information
(available at: https://www.newmoa.org/closed_landfill_bmps/)
- Any answers of “2” indicate an issue that needs ongoing monitoring and/or attention before the situation worsens.

Yearly Tasks for Municipalities

- Delegate responsibility for maintaining the landfill(s)
- At least ONCE a year
 - Mow to prevent tree growth
 - Measure level of methane gas in soil (& inside nearby structures, if any)
- At least TWICE a year
 - Walkover inspection
 - Review results of each inspection **& address deficiencies!**
- For regulated landfills:
 - Follow requirements for groundwater monitoring & reporting
 - Submit required post-closure report(s)

Municipal Reminder Checklist (2 pages)

NH: https://www.newmoa.org/wp-content/uploads/2023/03/NH_Municipal_Checklist.pdf

VT: https://www.newmoa.org/wp-content/uploads/2023/03/VT_Municipal_Checklist.pdf

Writable: https://www.newmoa.org/wp-content/uploads/2023/08/municipal_checklist.pdf

CHECKLIST

Name: _____ Today's Date: _____

Position in Town: _____

Landfill Name: _____

Landfill Street Address: _____

Date began accepting waste: _____ Date ceased operation: _____

1: Is there a town position that includes responsibility for maintaining the landfill? YES NO

Position: _____

Name of person currently employed in that position: _____

2: Has the landfill been mowed at least once in the past year? YES NO

Date of mowing: _____

3: If applicable, has the level of methane gas in the soil been measured (in % Lower Explosive Limit (LEL)), at the property boundary on all sides of the landfill at least once in the past year? YES NO

What was the highest level in % LEL: _____ Date of measurement: _____

4: If there are structures located at the same property as the landfill, has the level of methane gas been measured inside each structure at least once in the past year? YES NO

What was the highest level in % LEL: _____ Date of measurement: _____

5: Have walkover inspections been conducted at least twice a year by a knowledgeable municipal employee and/or a professional engineer? YES NO

Date of SPRING inspection: _____ Date of FALL inspection: _____

6: Have you reviewed the results of each inspection? YES NO

7: Have all deficiencies noted in the inspections been properly addressed? YES NO

8: If the landfill ceased operation after July 9, 1981 – has the "Annual Post-Closure Report" been submitted to NHDES? YES NO

9: Does the landfill have a groundwater management permit? YES NO

What is the frequency of monitoring? _____ Was it completed when required? YES NO

What is the frequency of reporting to NHDES? _____ Was it sent when required? YES NO

10: Has a notice been added to the deed for the property noting that it contains a landfill? YES NO

You should be able to answer "YES" to EVERY question. If not, please implement the changes required so that "yes" is the answer to everything.

Lessons Learned

- Mowing:
 - mowing the top is easy – but the side slopes not so much
 - All the landfills visited had woody growth (or big trees!) on the side slopes
- Many regulated old closed landfills are not submitting the reports that they should!
 - Some doing the groundwater monitoring/reporting but not inspection & other reports
- Difficulty evaluating landfills on private property
- Encroachment of development is real – either recent or in the past
- Luckily (?) many old unregulated landfills did a lot of burning so current generation of leachate and gas not a huge problem

Questions?

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Call: (617) 367-8558, ext 303

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Project Webpage:

<https://www.newmoa.org/projects/closed-landfill-project/>

