FACILITY MANAGERS, PART III

Monitoring and Maintaining Closed Landfills in NH

Why are you here?

- Build your resume & accumulate professional development hours.
- Required by law and NH Solid Waste Rules.

Why this Workshop?

Closed Landfills

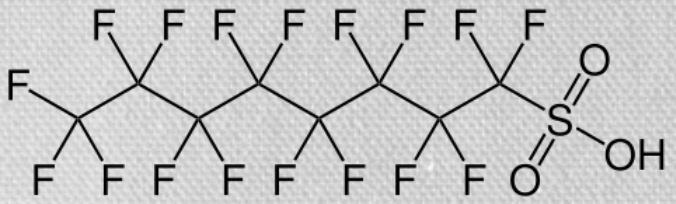
- Provide you with more information on the hazards of closed landfills
- Introduce the concepts of managing and maintaining closed landfills in NH
- Offer suggestions on how to discuss information with consultants and understand analytical data

Today's Agenda

- Old Landfill Basics
- Inspections & Reporting
  - Activity: Inspections
- Groundwater 101
  - Understanding and maintaining your monitoring permit
- The G.Y.S.T.
- Q&A

Why Does this Matter to You?

- You have a closed landfill
- It is permitted
- Why?
  - Landfills are forever. The waste still exists….remember this is waste from your parents, grandparents, AND businesses.
- Monitoring this landfill for
  continue to monitor and pr
  years.
- Why do we really care?
  - Anyone heard of PFAS? One
    contaminants!



Post-Closure Care of Solid Waste Landfills

"Old" Landfill Basics

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Solid Waste Management Bureau
New Hampshire Department of Environmental Services

Presentation Overview

- Brief History
- Landfill Design Basics
- Why Closed Landfills Still Matter

Brief History of "The Dump"

Pre-1970s

- Open Dumps
- Burn Dumps

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Brief History of "The Dump"

Federal legislation in 1960s-70s

- **Clean Air Act**
- **Solid Waste Act**

New Hampshire changes

- **1969-1972 NH Solid Waste Laws & Regulations**
- **1981 Solid Waste Management Act (currently RSA 149-M)**

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History: Closing "The Dump"

Late 1980s - State made it a priority to close unlined solid waste landfills
1994 - NH Legislature established the Grant Program

"In recognition of the potential for harm to both public health and the environment which can result from an unlined solid waste landfill that has not been properly closed… it is hereby declared to be the policy of this state to encourage municipalities to close all unlined solid waste landfills…"

~RSA 149-M:41

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History: Closed Landfills

1990s – Majority of unlined solid waste landfills closed

2013 – Last unlined municipal solid waste landfill closed

Today – Approximately 300 closed landfills in NH

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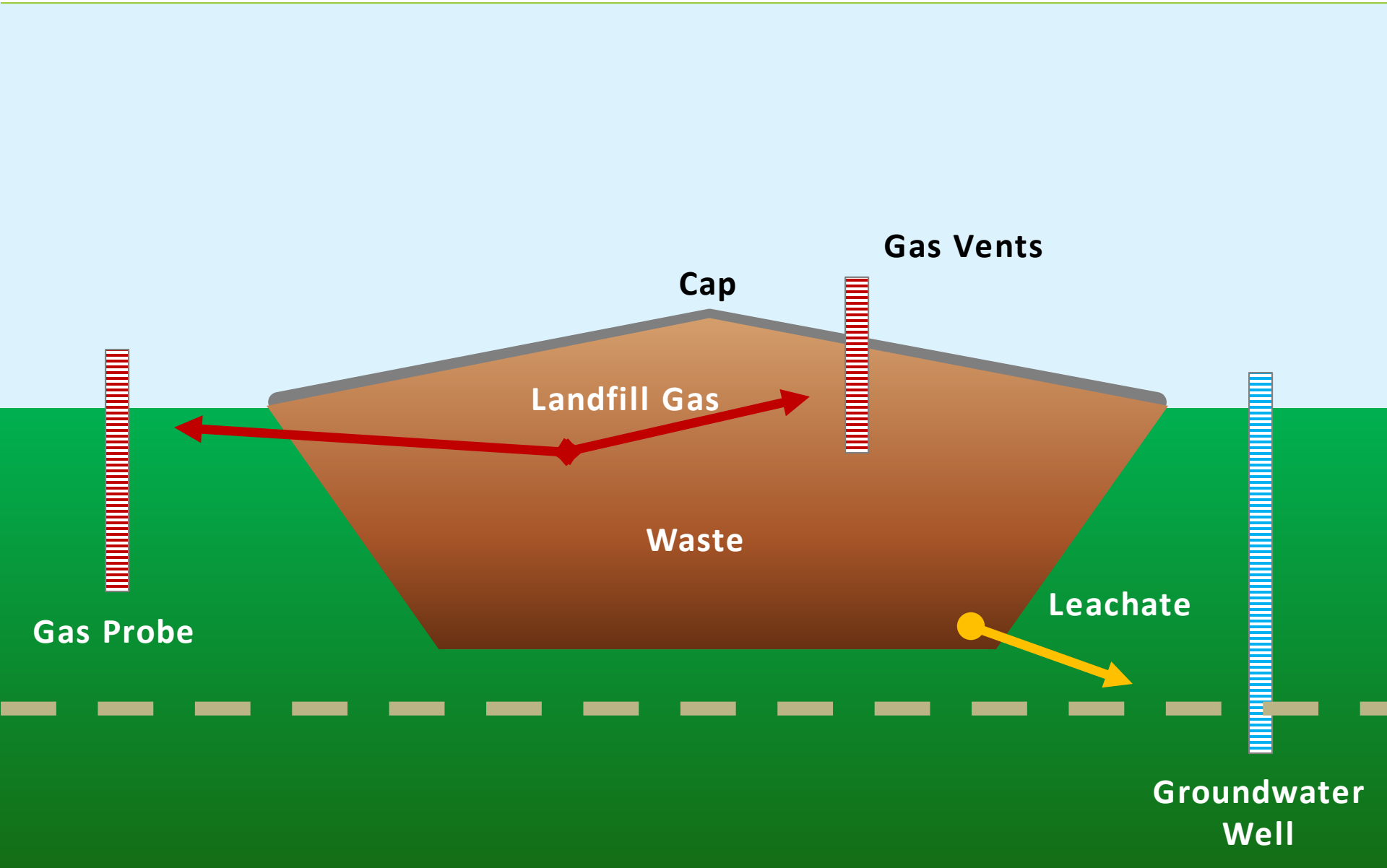
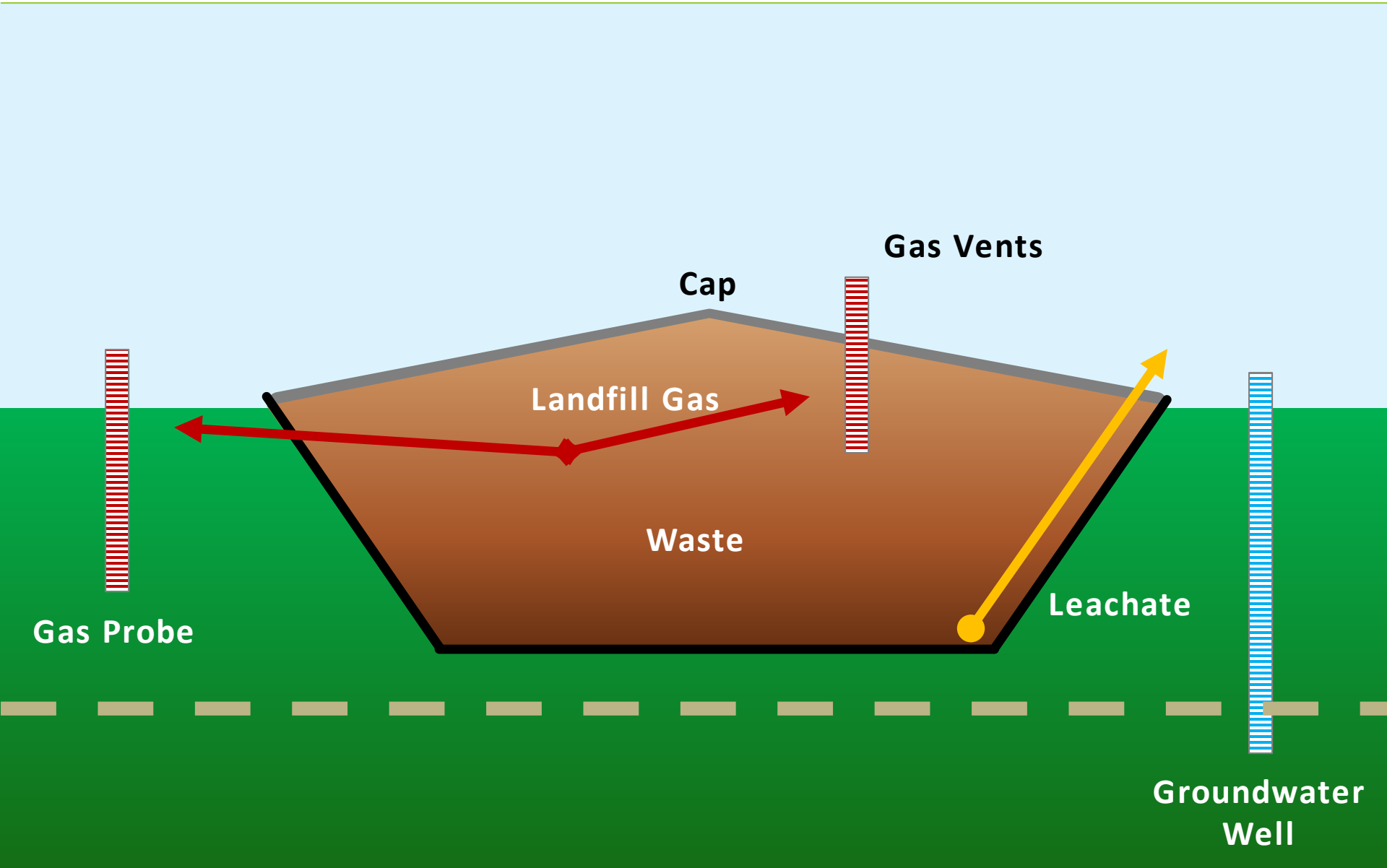
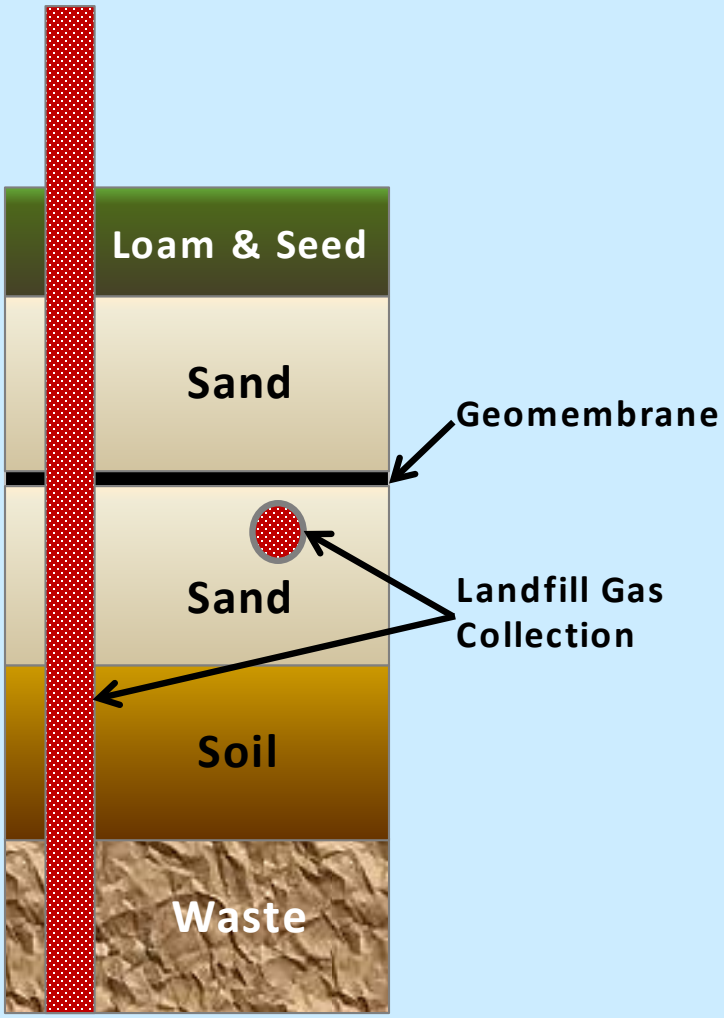
Basic Design: Unlined Landfill



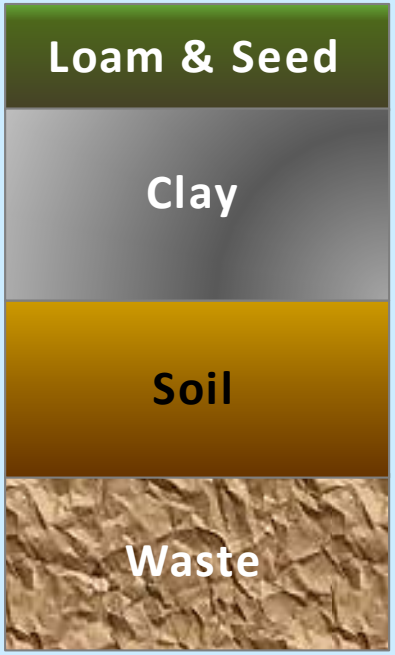
Basic Design: Lined Landfill



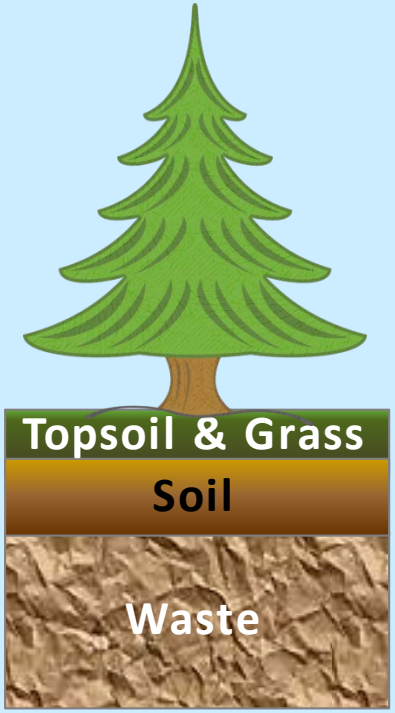
Landfill Cap → Cover



Geomembrane or "Plastic" Cap



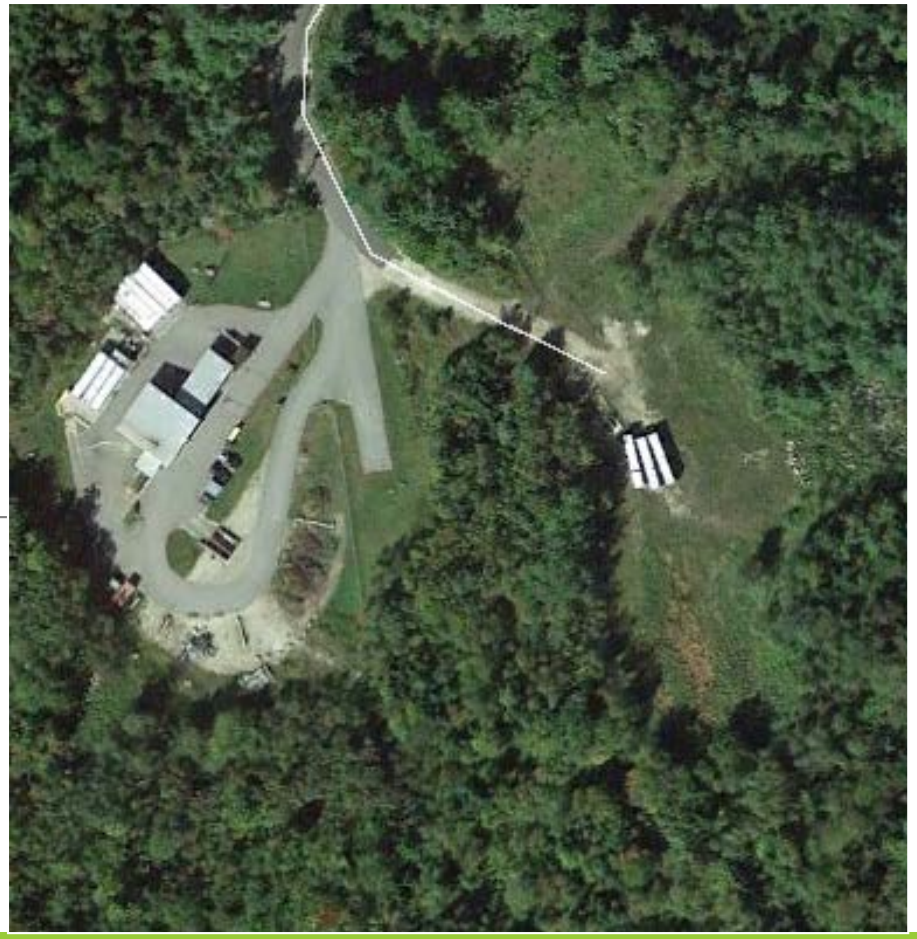
Soil Cap



Not A Cap / Maybe It's A Cover

"Brady Bill" Landfills

RSA 149-M:9(XIII)



"BRADY BILL" LANDFILLS

RSA 149-M:9(XIII)

(a) 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.

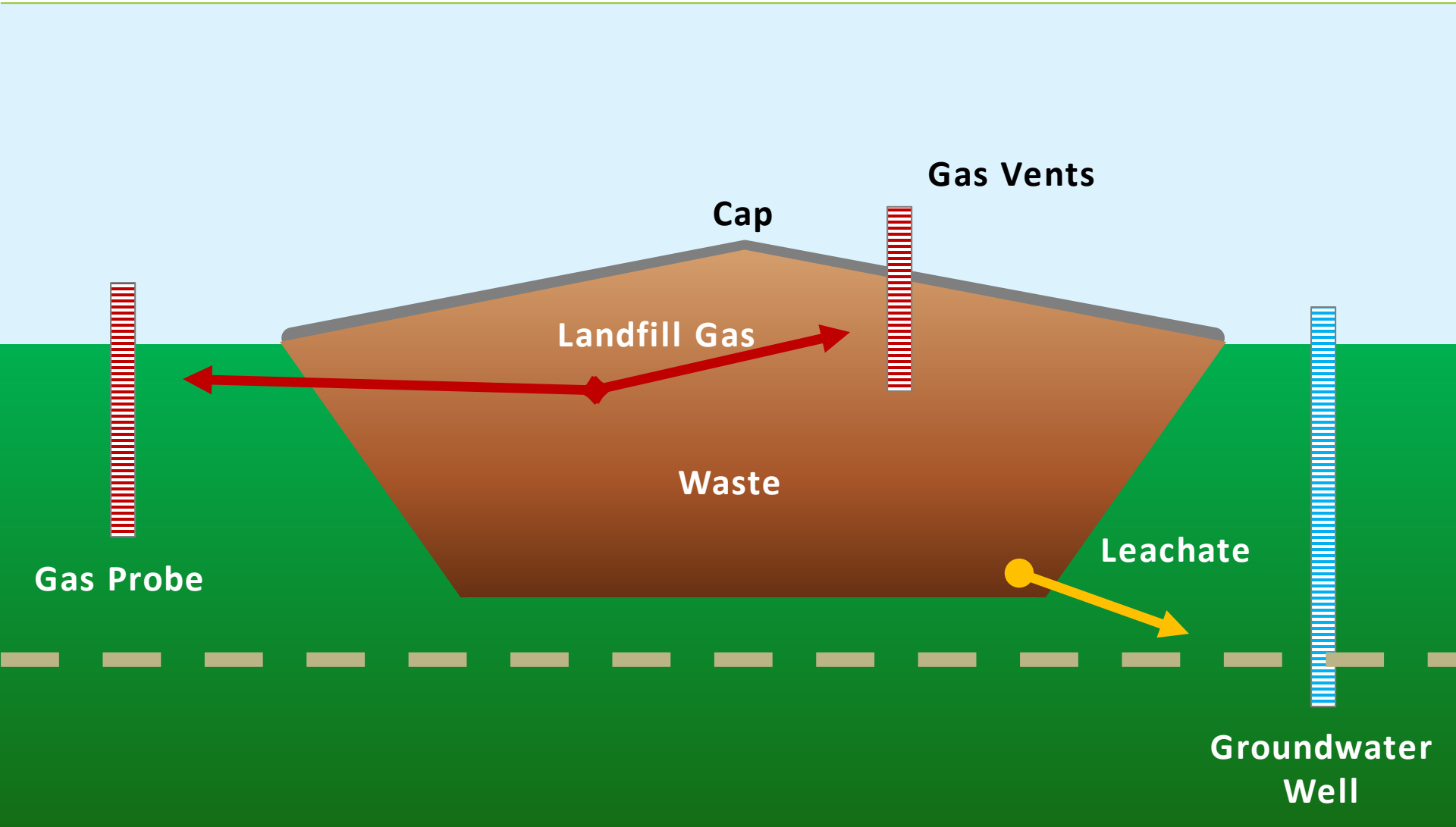
(2) Continues to show, through monitoring devices, that the inactive facility is having no adverse impact, as defined in rules adopted by the department, on the environment.

(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.

(b) A town which complies with the requirements of subparagraph (a) shall not lose grant funding for which the town is eligible under this chapter.

(c) This paragraph does not apply to those facilities governed under the terms of 40 CFR 258.

Basic Design: It's a Containment System!



Why Does My Closed Landfill Still Matter?

Poorly maintained containment systems can leak, leach, breach…

Negatively impacting water, soil, and air quality.

Why Does My Closed Landfill Still Matter?

Protect your investment

A little now saves big later

Reduce potential liability

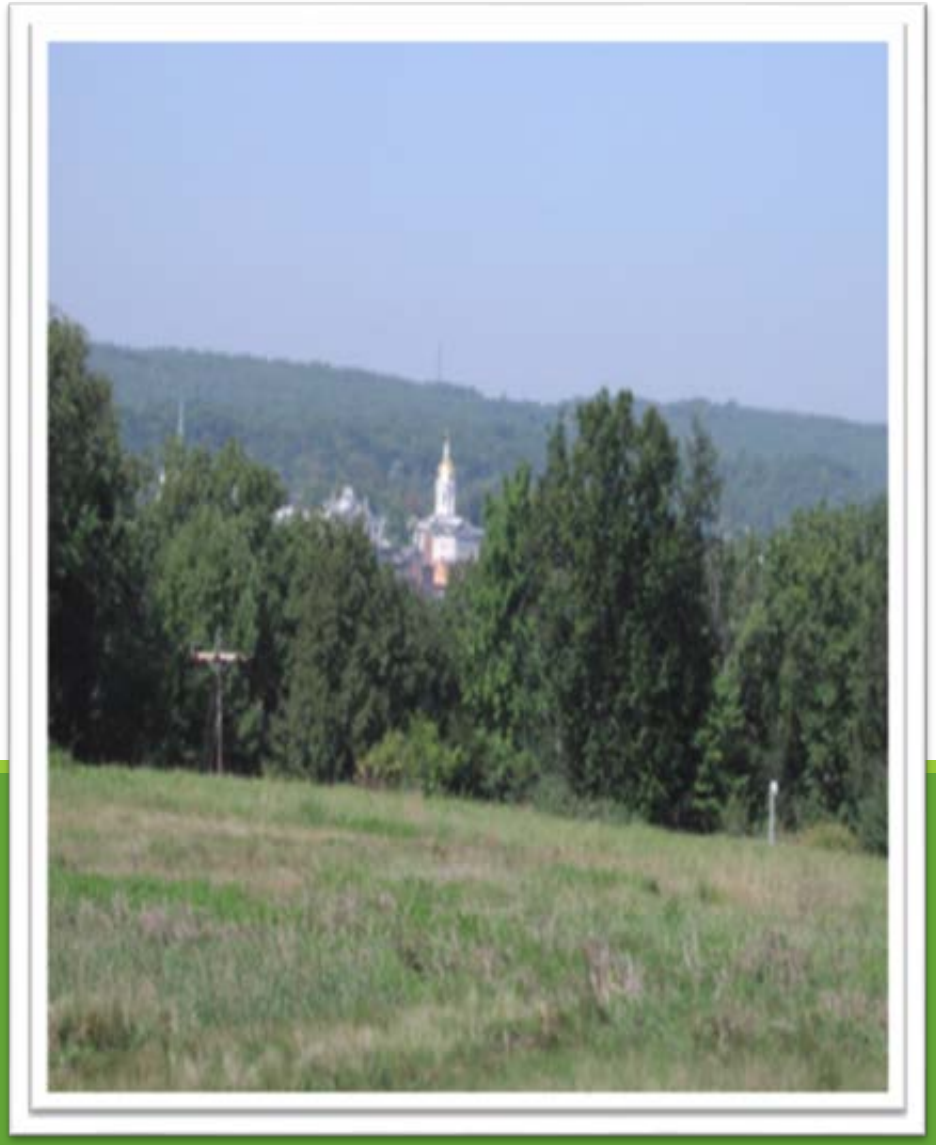
NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Why Does My Closed Landfill Still Matter?

- Landfills are a containment system for waste.
  - Unlined landfills rely on the cap.
- Waste is a mix of discarded or abandoned household, business, mining, agricultural, and industrial materials.
- Without periodic inspection, monitoring, and routine maintenance, we can not assume these containment systems (i.e., the cap) will continue to function adequately forever.

Presentation Review

- Brief History
- Landfill Design Basics
- Why Closed Landfills Still Matter



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Post-Closure Care of Solid Waste Landfills

Inspections & Reporting

Solid Waste Management Bureau
New Hampshire Department of Environmental Services

Presentation Overview

- Closure Plan
- Inspections
- Performance Standards
- Reporting

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Closure Plan

- Follow your closure plan
- Regularly inspect, monitor, and maintain your landfill
  - Inspect at least 2x per year
- Maintenance includes repair

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Elements of a Landfill Inspection

A. General Site Conditions

B. Stormwater System Conditions

C. Decomposition Gas Control Systems

D. Cap (Cover) Conditions

E. Leachate Collection and Leak Detection Systems

F. Other Site-Specific Features

Action Items for each area of inspection

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A. General Site Conditions

A. General Site Conditions

General site conditions include:

- **Access**
- **Signage**
- **Monitoring systems**
- **Other activities occurring**

A. General Site Conditions

Check the following:

- **Is access restricted?**
- **Are there weather resistant signs?**
- **Are access roads in good condition?**
- **Are other activities occurring at the facility?**
- **Are groundwater monitoring wells in good condition?**
- **Are surface water monitoring points in good condition?**

A. General Site Conditions

Not maintaining the site properly may lead to:

- **Trespassing**
- **Vandalism**
- **Inaccessible monitoring systems**
- **Contamination of monitoring systems**

Action Item

B. Stormwater Management Systems

B. Stormwater Management Systems

Stormwater management systems include:

- **Swales**
- **Berms**
- **Culverts**
- **Detention basins**

B. Stormwater Management Systems

Check the following:

- **If detention ponds maintained**
- **If culverts are free of obstructions**
- **If drainage swales are unobstructed**
- **If berms, benches are in good condition**
- **If there is evidence of erosion**
- **If channels are protected to prevent scour**
- **If swales have positive drainage**
- **If storm drains are in good condition**

B. Stormwater Management Systems

Not maintaining the stormwater management system properly may lead to:

- **Uncontrolled ponding/flooding**
- **Damage to cap**
- **Excess leachate generation**
- **Erosion/washouts**

C. Decomposition Gas Control Systems

C. Decomposition Gas: Basics

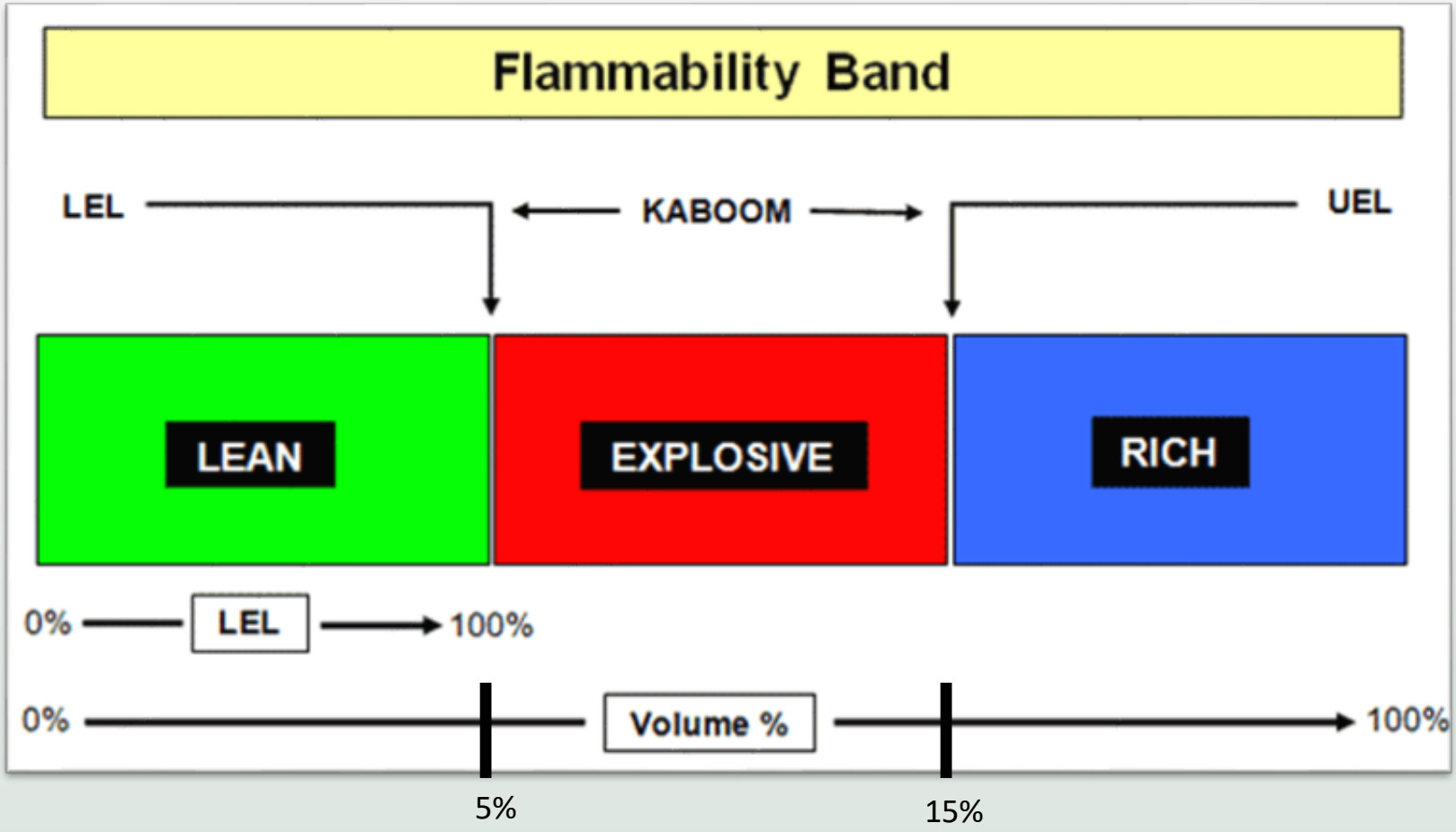
Decomposition Gas = Landfill Gas

Landfill gas is created as wastes break down, and is typically composed of methane, carbon dioxide and trace amounts of VOCs

Gases migrate along the path of least resistance, including laterally through soil

Gases must be <u>controlled</u> to prevent hazards to human health and safety, and the environment.

C. Decomposition Gas: Methane



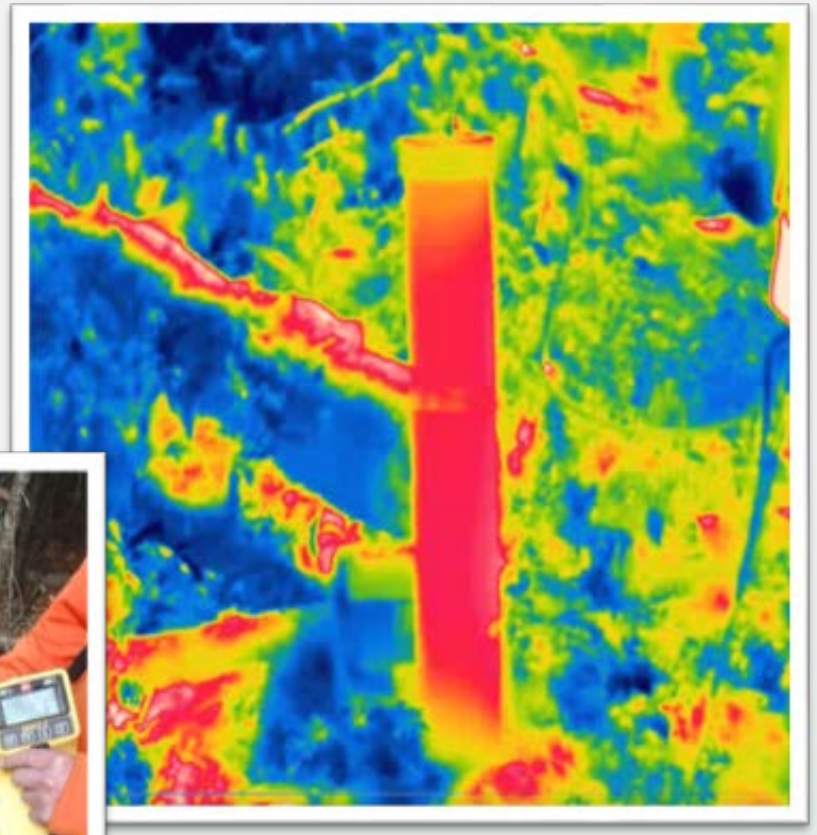
LEL = Lower Explosive Limit
UEL = Upper Explosive Limit

C. Decomposition Gas: Methane

Gas shall be controlled to not exceed:

>25% of the LEL for methane in structures on or off-site

>50% of the LEL for methane in the soil at the property line



C. Decomposition Gas: Methane

If there is an exceedance:

- **Notify NHDES immediately**
- **Implement contingency procedures to ensure protection of public health and safety**
- **Troubleshoot to determine the issue and re-establish control**

DATE	% LEL				
	WELL 1	WELL 2	WELL 3	WELL 4	WELL 5
2014	NP	NP	NP	NP	NP
1/16/2015	NT	NT	NT	NT	NT
12/18/2015	3	100	24	100	39

NP = Not provided to engineer
NT = Not tested

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C. Decomposition Gas Control Systems

Decomposition gas control systems include:

- **Active System = <u>Gas Extraction Wells</u>**
- **Passive System = <u>Gas Vents</u>**

Also includes your monitoring devices:

- **Gas probes**
- **Indoor air quality monitors**

C. Decomposition Gas Control Systems

Check the following:

- **If extraction wells or passive vents are in good condition**
- **If soil gas probes are in good condition**
- **If indoor air quality monitors are working**
- **If there are any landfill odors**
- **If there is evidence of stressed vegetation**

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C. Decomposition Gas Control Systems

Not maintaining the decomposition gas control system properly may lead to:

- **Build up of explosive gases in**
  - **The landfill**
  - **Site structures**
  - **Utilities**
  - **Homes**

Action Item

D. Cap (Cover) Systems

D. Cap (Cover) Conditions

Engineered Cap or Soil Cover is what protects the waste containment system

D. Cap (Cover) Conditions

Check the following:

- **Uniform settlement**
- **Slope promotes runoff**
- **Mowed regularly**
- **Evidence of erosion**
- **Vegetative layer in good condition**
- **Damage from unauthorized access**
- **Damage from burrowing animals**

D. Cap (Cover) Conditions

Not maintaining the cap properly may cause:

- **Difficulty in assessing the cap condition**
- **Difficulty mowing**
- **Damage to engineered cap by roots**
- **Exposed waste from toppled trees**
- **More expensive to repair cap**

Action Item

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E. Leachate Collection & Leak Detection Systems

E. Leachate Collection & Leak Detection Systems

System includes:

- **Leachate collection systems**
  - **Typically consist of a drainage layer, pumps, tanks, and sampling ports;**
  - **Are located above the liner; and**
  - **Take the leachate out of the waste containment system.**

- **Leak detection systems**
  - **Typically consist of a drainage layer, pumps, tanks, and sampling ports;**
  - **Are located below the liner; and**
  - **Are used to check for leaks of the waste containment system.**

E. Leachate Collection & Leak Detection Systems

For landfills with systems, check:

- **If the system is functioning properly**
- **If the on-site storage is intact and adequate**
- **Confirm that the leachate is removed (1 foot rule)**
- **Confirm that the leachate is disposed of regularly**

All landfills, check for:

- **Leachate breakouts and seeps**

E. Leachate Collection & Leak Detection Systems

Not maintaining these systems may lead to:

- **Leachate spills / breakouts**
- **Groundwater contamination**

Is it natural?

F. Other Site-Specific Features

F. Other Site-Specific Features

- For each area of inspection previously discussed, consider site-specific features

  Examples: Catch basin designations

  Particulars about a detention pond

- Any other site-specific features may need an additional section

  Examples: Retaining walls

  Geothermal systems

  Other monitoring systems (e.g., geotechnical)

  Post-closure uses

Action Items

Action Items

- **Inspections help you:**

  protect people

  by identifying action items

  required to maintain the closure system.

- **List your action items and a general timeframe for repair.**

- **In your next annual report, tell us what you did, how you did it, and send photos/documentation.**

- **Didn't get to it? Tell us when you will.**

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A Good Inspection Report Includes

A) General Site Conditions

B) Stormwater System Conditions

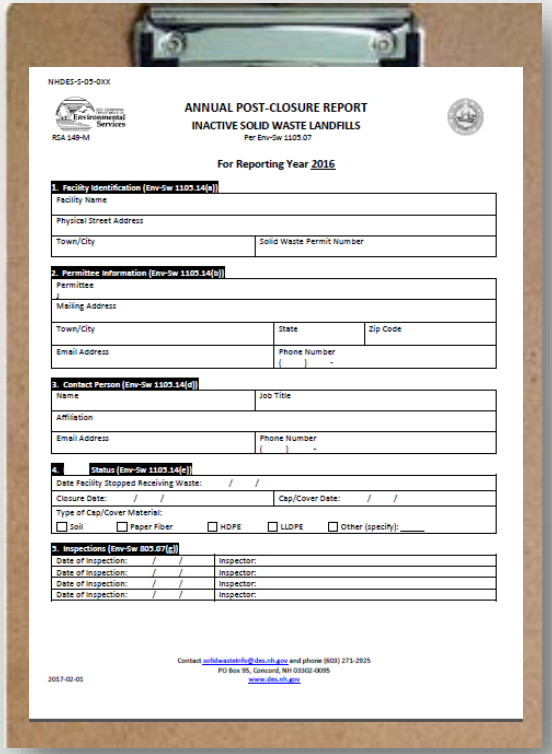
C) Decomposition Gas Control Systems

D) Cap Conditions

E) Leachate and Leak Detection Systems

F) Other Site-Specific Features

Action Items for each area of inspection



NHDES-S-05-0XX

RSA 149-M

ANNUAL POST-CLOSURE REPORT
INACTIVE SOLID WASTE LANDFILLS
Per Env-Sw 1105.07

For Reporting Year 2016

1. Facility Identification (Env-Sw 1105.14(b))
Facility Name
Physical Street Address
Town/City | Solid Waste Permit Number

2. Permittee Information (Env-Sw 1105.14(b))
Permittee
Mailing Address
Town/City | State | Zip Code
Email Address | Phone Number

3. Contact Person (Env-Sw 1105.14(d))
Name | Job Title
Affiliation
Email Address | Phone Number

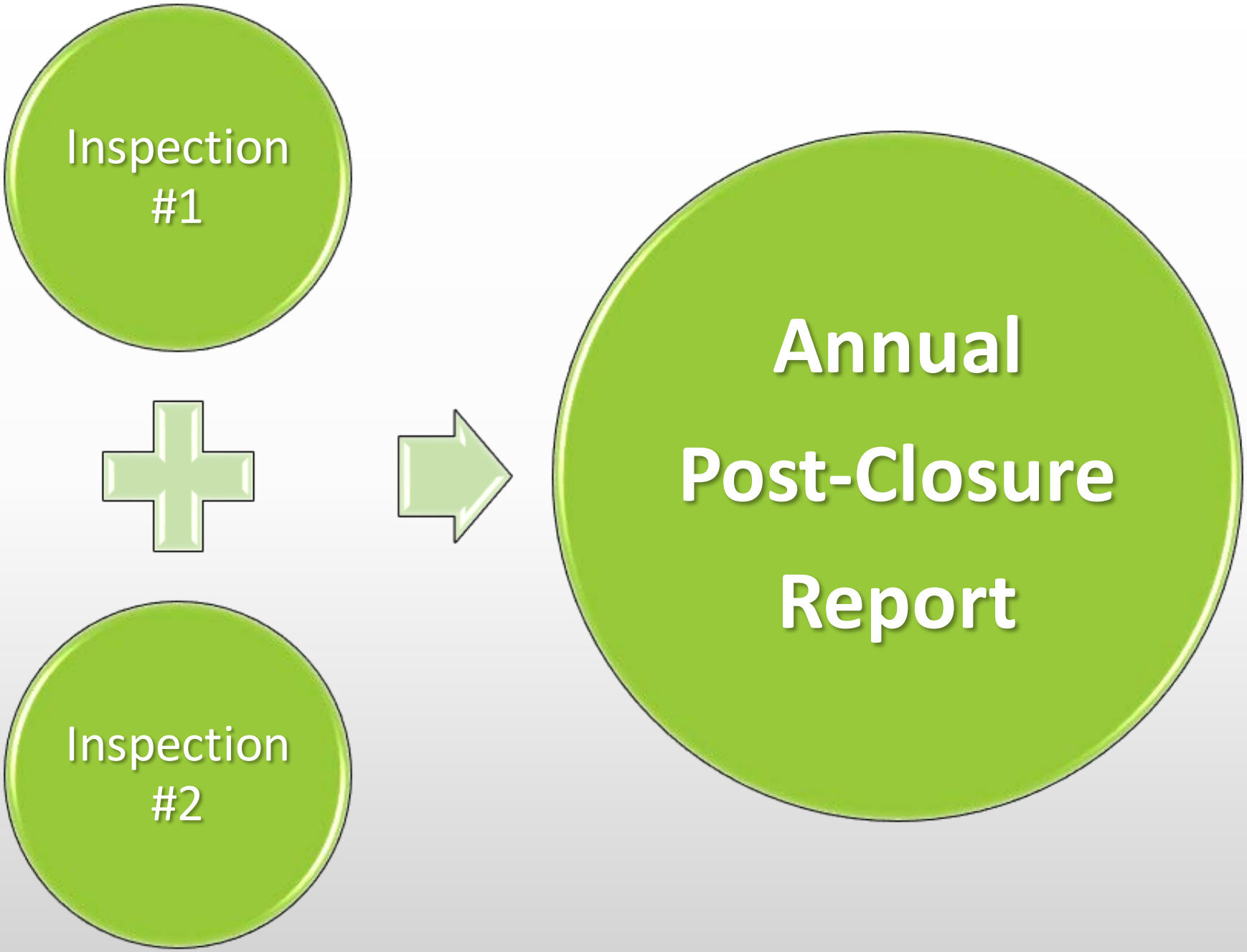
4. Status (Env-Sw 1105.14(e))
Date Facility Stopped Receiving Waste: / /
Closure Date: / / | Cap/Cover Date: / /
Type of Cap/Cover Material:
☐ Soil ☐ Paper Fiber ☐ HDPE ☐ LLDPE ☐ Other (specify): ____

5. Inspections (Env-Sw 805.07(a))
Date of Inspection: / / | Inspector:
Date of Inspection: / / | Inspector:
Date of Inspection: / / | Inspector:
Date of Inspection: / / | Inspector:

Contact solidwasteinfo@des.nh.gov and phone (603) 271-2925
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

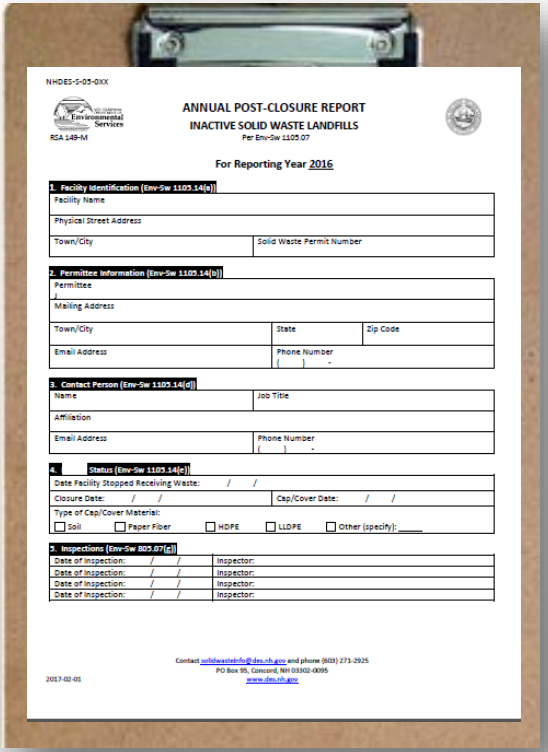
2017-02-01

NEW HAMPSHIRE DEPARTMENT OF Environmental Services


Inspection #1
Inspection #2
Annual Post-Closure Report

A Good Inspection Report Includes Annual Post-Closure

1. Facility Identification
2. Permittee Information
3. Contact Person
4. Summary of Inspection Findings
5. Action Item Summary
6. Summary & Assessment
7. Additional Information



NHDES-S-05-0XX

ANNUAL POST-CLOSURE REPORT
INACTIVE SOLID WASTE LANDFILLS
Per Env-Sw 1105.07
RSA 149-M

For Reporting Year 2016

1. Facility Identification (Env-Sw 1105.14(b))
Facility Name
Physical Street Address
Town/City | Solid Waste Permit Number

2. Permittee Information (Env-Sw 1105.14(b))
Permittee
Mailing Address
Town/City | State | Zip Code
Email Address | Phone Number

3. Contact Person (Env-Sw 1105.14(d))
Name | Job Title
Affiliation
Email Address | Phone Number

4. Status (Env-Sw 1105.14(e))
Date Facility Stopped Receiving Waste: / /
Closure Date: / / | Cap/Cover Date: / /
Type of Cap/Cover Material:
☐ Soil ☐ Paper Fiber ☐ HDPE ☐ LLDPE ☐ Other (specify): ____

5. Inspections (Env-Sw 803.07(a))
Date of Inspection: / / | Inspector:
Date of Inspection: / / | Inspector:
Date of Inspection: / / | Inspector:
Date of Inspection: / / | Inspector:

Contact solidwasteinfo@des.nh.gov and phone (603) 271-2925
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

2017-02-01

Due: March 31 for the previous calendar year

6. Summary and Assessment

Due: March 31 of ***Every Year***

6. Summary and Assessment

- **Summary of inspection, maintenance and monitoring, including:**
  - **All environmental monitoring performed**
  - **Relevant emergency, unexpected or unusual events**

- **Assessment of facility's status [Ref. Env-Sw 1105.14(f)]:**
  - **Evaluation of environmental monitoring data and information**
  - **Statement by a qualified professional engineer**
    - **ID if achieving performance expectations**
    - **Whether adjustments to post-closure care are recommended**

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Due: March 31

7. Additional Information

Other Activities

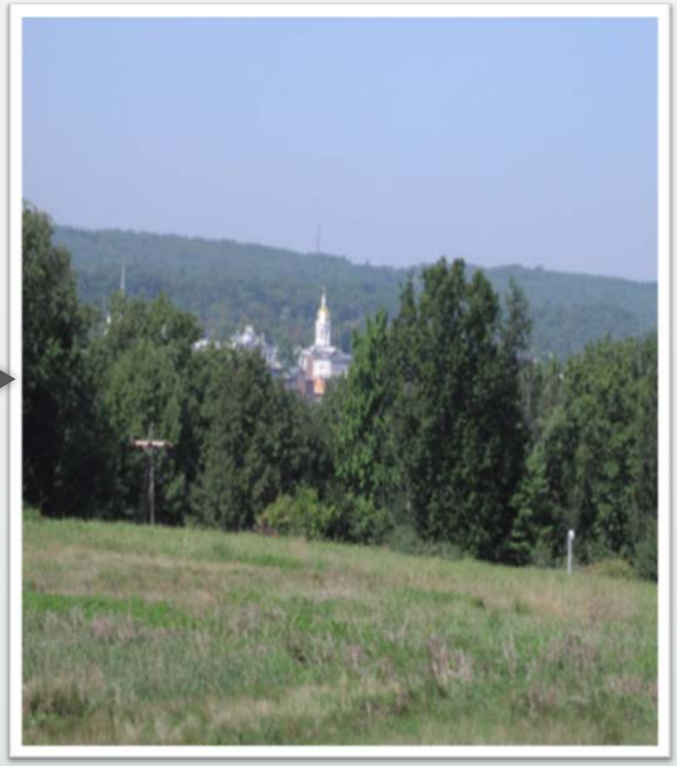
7. Additional Information

- Add anything not already addressed

- Good time to tell us if there are changes:
  - Contact person
  - Mailing address
  - Telephone number

- Other activities occurring on or <u>near</u> landfill:
  - that are not regulated by the solid waste rules, and/or
  - that are permit-exempt

Performance Standards



PERFORMANCE STANDARDS

Goal: To achieve 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.**

Env-Sw 807.04

"Performance Standards"

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Post-Closure Reporting

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Due: March 31

Why Reports Matter

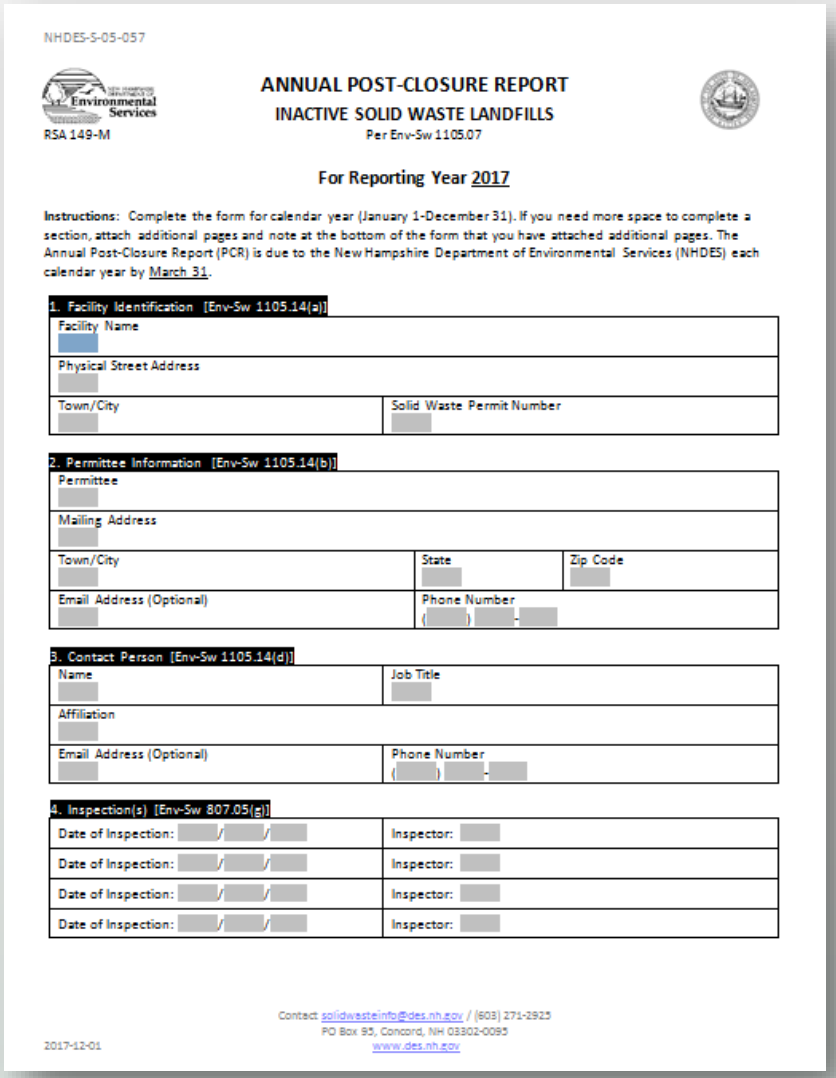
Compliance
- Law/Rules/Permit
- Refresher
- Action Plan

Information
- Data Collection
- Legislative Reporting
- Public Inquiries

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Due: March 31

ANNUAL POST-CLOSURE REPORT



NHDES-S-05-057

Environmental Services

RSA 149-M

ANNUAL POST-CLOSURE REPORT

INACTIVE SOLID WASTE LANDFILLS

Per Env-Sw 1105.07

For Reporting Year 2017

Instructions: Complete the form for calendar year (January 1-December 31). If you need more space to complete a section, attach additional pages and note at the bottom of the form that you have attached additional pages. The Annual Post-Closure Report (PCR) is due to the New Hampshire Department of Environmental Services (NHDES) each calendar year by March 31.

1. Facility Identification [Env-Sw 1105.14(a)]

Facility Name	
Physical Street Address	
Town/City	Solid Waste Permit Number

2. Permittee Information [Env-Sw 1105.14(b)]

Permittee		
Mailing Address		
Town/City	State	Zip Code
Email Address (Optional)	Phone Number ( ) -	

3. Contact Person [Env-Sw 1105.14(d)]

Name	Job Title
Affiliation	
Email Address (Optional)	Phone Number ( ) -

4. Inspection(s) [Env-Sw 807.05(g)]

Date of Inspection: / /	Inspector:
Date of Inspection: / /	Inspector:
Date of Inspection: / /	Inspector:
Date of Inspection: / /	Inspector:

Contact solidwasteinfo@des.nh.gov / (603) 271-2925
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov

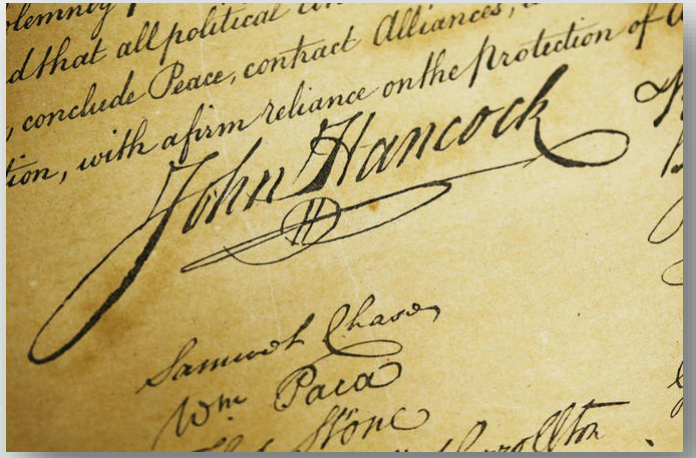
2017-12-01

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Due: March 31

SIGNATURE

- **The signature is an <u>affirmation</u> that:**
  - **The material and information submitted is correct and true to the best of your knowledge**
  - **That the person signing is duly authorized to sign for the permittee**



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Due: March 31

POST-CLOSURE REPORTS

Submitting Reports

- **Electronic:**

  Needs to be in **PDF**

  Submit through NHDES OneStop

  (https://www.des.nh.gov/onestop/)

  Site Code: 1 2 3 4 5 6 7 8 9

- **Paper:** Solid Waste Management Bureau

  NHDES

  PO Box 95

  Concord, NH 03302

Due: March 31

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

POST-CLOSURE CARE SUMMARY

- **Landfills are a waste containment system**
- **Follow your landfill's closure plan:**
  - **Inspect, Monitor, Maintain, and Repair your landfill**
- **Report your landfill's status to NHDES annually**
- **If you have questions, call us at (603) 271-2925**

Don't let a small problem become a BIG PROBLEM!!!

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Groundwater 101

Monitoring Landfills through Groundwater Management Permits

Jamie O'Rourke, P.G.
Solid Waste Management Bureau
New Hampshire Department of Environmental Services

NHDES

Presentation Objectives

- Why monitor old landfills?
- What is a Groundwater Management Permit (GMP)?
- What does a GMP do?
- Elements of a GMP
- GMP Reporting
- NHDES Responses
- A Landfill's Story…

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Definitions

Geology - study of the earth.

Hydrogeology - geology specific to water resources.

Groundwater - water which occurs below the land surface (*saturated zone*).

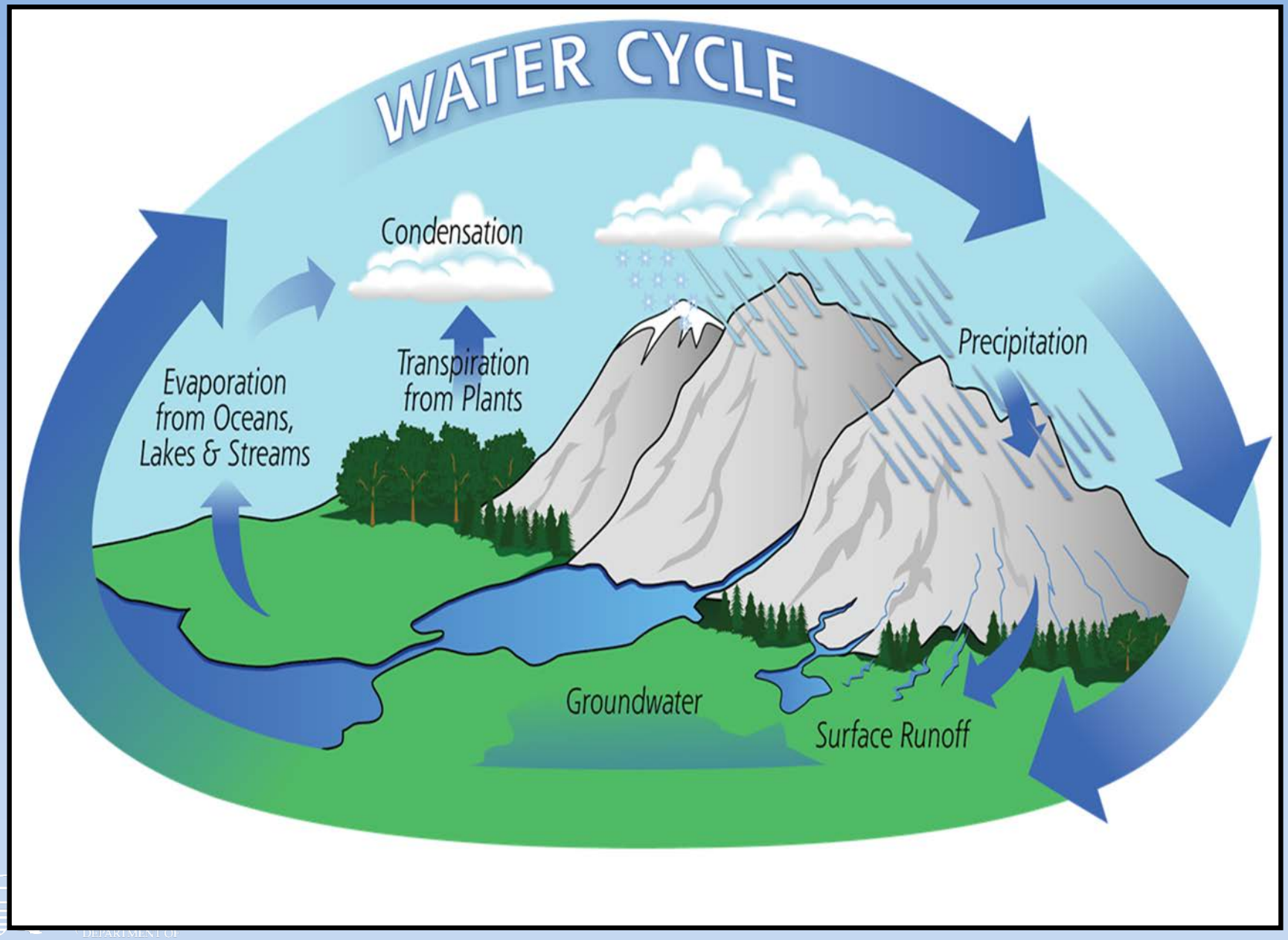
Vadose Zone - zone between the land surface and the groundwater surface or water table (*unsaturated zone*).

Aquifer - soil or bedrock that yields groundwater to wells in usable quantities.

GMP - Groundwater Management Permit

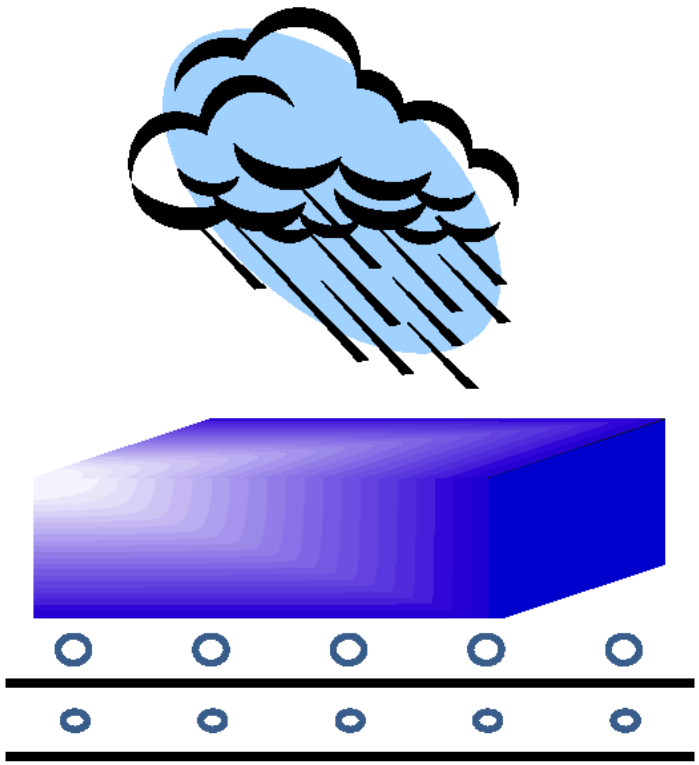
GMZ - Groundwater Management Zone – area of monitoring responsibility.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services



Basic Landfills

Lined



Unlined

Why Monitor Landfills?

- **Unlined Landfills' Waste:**
  - Is typically comprised of a wide range of discarded materials from residences and businesses.
  - Was not extensively characterized during the "closure" process due to cost (likely would not have resulted in changing the presumptive remedial solution or how the landfill was "closed").

Most unlined landfills were operated before hazardous waste rules and regs. were implemented

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Why Monitor Landfills?

- The presumptive remedial solution for unlined landfills was the construction and maintenance of an engineered cap to **"contain the source of contamination"** and thereby control future releases to groundwater and potential direct exposure to contaminants, without having to remove, treat, or destroy the contamination sources.

Groundwater Contaminants

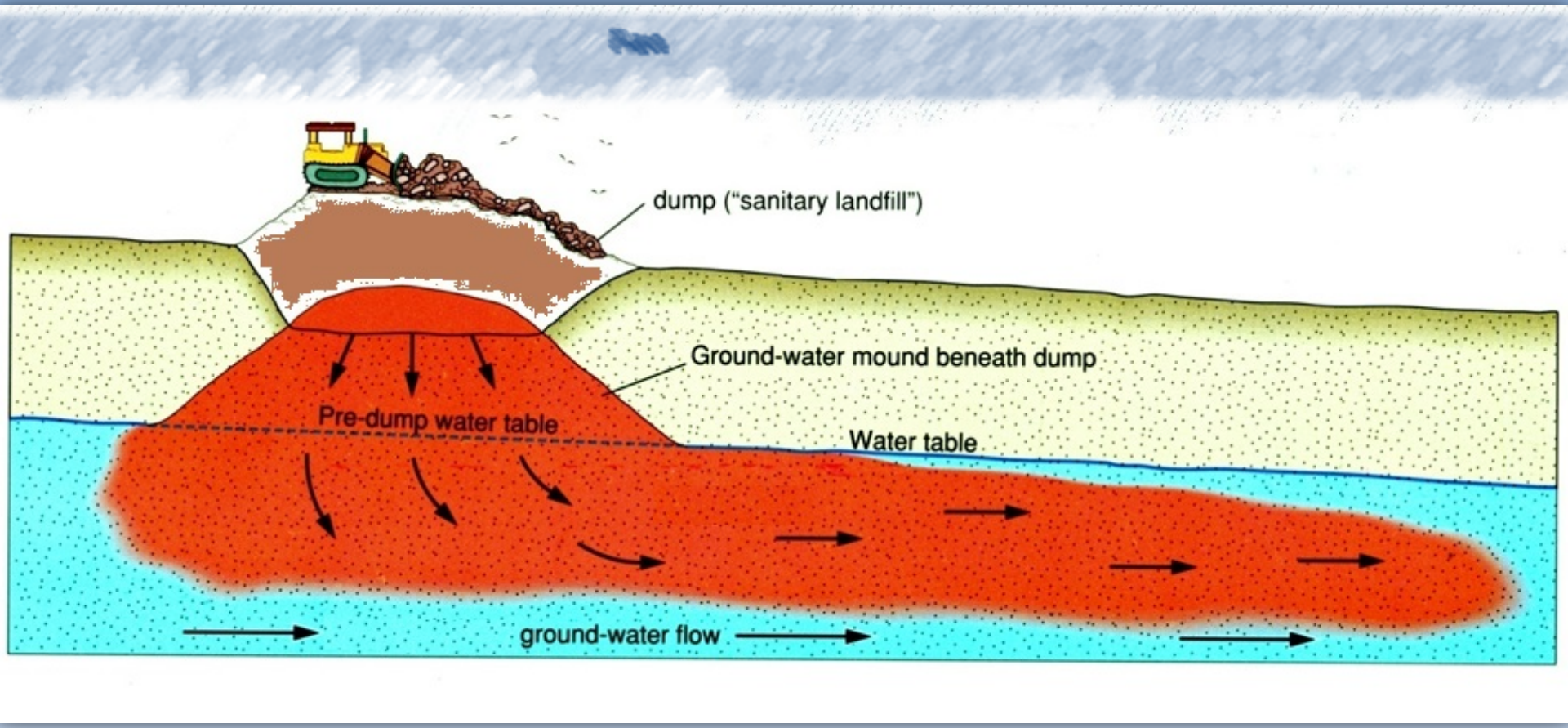
- Landfill indicators - chloride, nitrate, sulfate, etc.
- Metals - arsenic, iron, manganese, etc.
- Volatile organic compounds (VOCs) – petroleum products (benzene, toluene, naphthalene, etc.) and solvents (PCE, TCE) – about 65 compounds
- Emerging Contaminants - 1,4-dioxane, PFAS (Per- and polyfluoroalkyl substances), etc.

Drinking water standards established for most common groundwater contaminants

Concentration Units

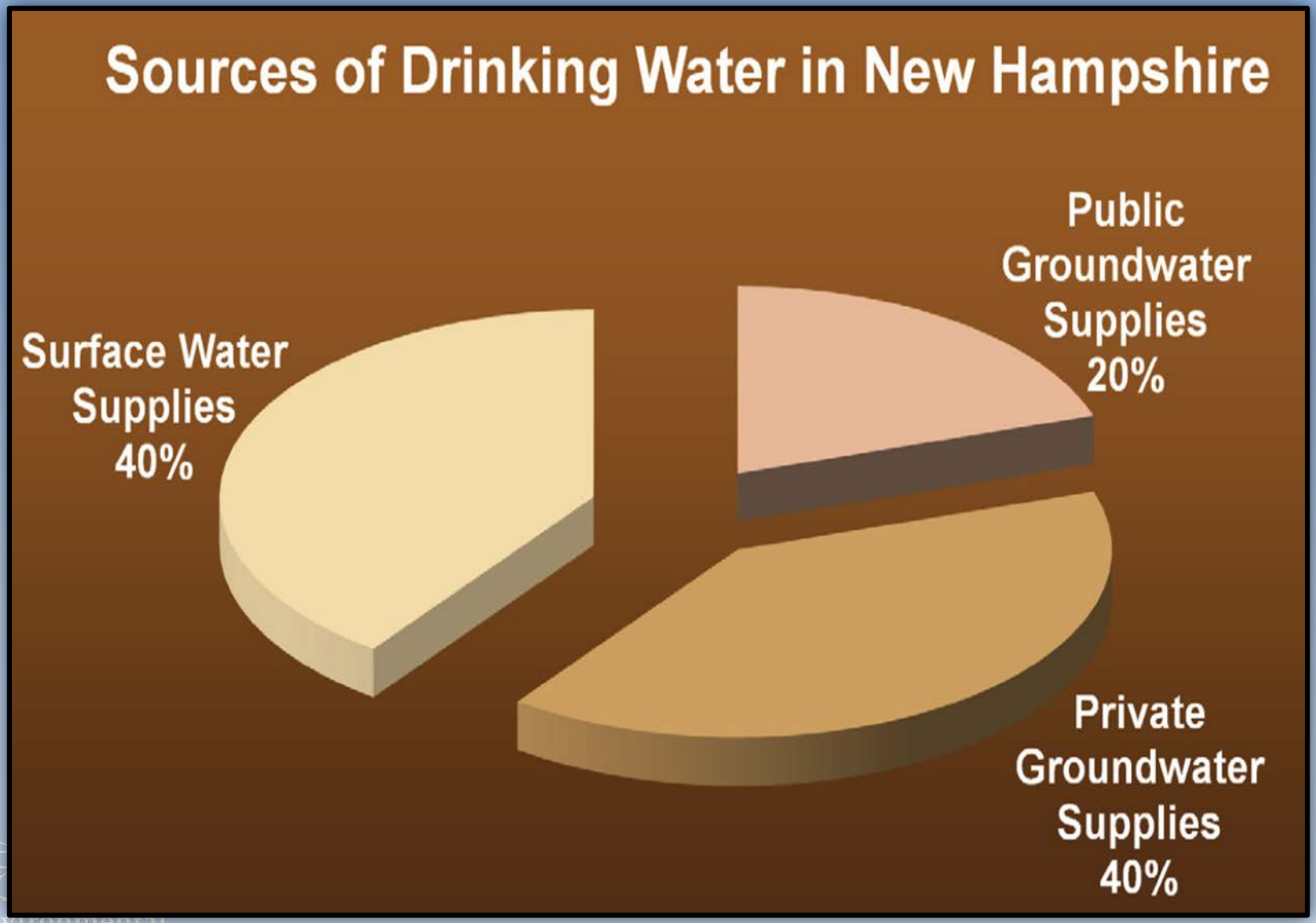
- Typical concentration units are:
  - parts per million (ppm),
  - parts per billion (ppb), or
  - parts per trillion (ppt).

Why Monitor Landfills?



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Why Monitor Groundwater?



How is Water Quality Monitored?

- Monitoring Wells
- Surface Water
- Seeps
- Water Supply Wells

How is Monitoring Addressed?

Groundwater Management Permit (GMP)

- Is a vehicle by which the state administers groundwater quality monitoring.
  - Env-Sw 807 - Landfill Closure and Capping Requirements
  - Env-Sw 807.05 - Post-Closure Inspections, Monitoring, Maintenance and Reporting Requirements
  - Env-Or 607 – GMP Monitoring Groundwater Quality Provisions

Goal is to protect groundwater quality

What is a GMP?

A **Groundwater Management Permit (GMP)** prescribes a program for periodic groundwater quality monitoring and reporting; provides for groundwater remediation either through active measures or natural attenuation; specifies performance standards for remedies, and describes procedures for performing site investigations and implementing remedial action plans.

Who has a GMP?

A responsible party shall apply for and obtain a GMP for any site where:

1. The discharge of a regulated contaminant at that site has caused and continues to cause the groundwater quality criteria of Env-Or 603.01 to be violated; or
2. An **unlined solid waste landfill**, regulated pursuant to RSA 149-M, is located.

A GMP

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

The

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

hereby issues

GROUNDWATER MANAGEMENT PERMIT NO. GWP-198804014-L-003

to the permittee

NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

to monitor the groundwater quality at the

FORMER SPARTAN CONSOLIDATED
(160 Rockingham Road)

in LONDONDERRY, N.H.

via the groundwater monitoring system comprised of

three monitoring wells

as depicted on the Site Plan entitled

Site Plan and Phreatic Surface Contour Map

dated July 19, 2017, prepared by Golder Associates Inc.

TO: NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION
7 HAZEN DRIVE
CONCORD, NH 03302-0483

Date of Issuance: December 29, 2017
Date of Expiration: December 28, 2022

Pursuant to authority in N.H. RSA 485-C:6-a, the New Hampshire Department of Environmental Services (NHDES), hereby grants this Permit to monitor past discharges to the groundwater at the above-described location for five years, subject to the following conditions:

(continued)

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

A GMP shall

1. Establish a Groundwater Management Zone (GMZ) and record in property records;
2. Require implementation of measures to restore groundwater quality within the GMZ to meet groundwater quality criteria of Env-Or 603.01;
3. Control the use of groundwater within the GMZ;
4. Require monitoring of the groundwater quality within the GMZ; and
5. Require an evaluation of the effectiveness of remedial measures.

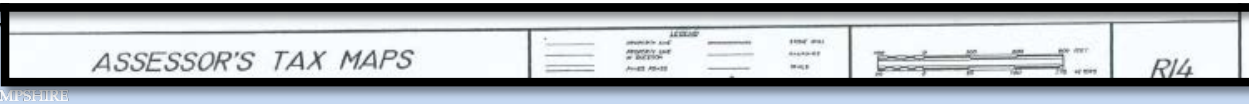
Major Elements of a GMP

7. The permittee shall maintain a water quality monitoring program and submit monitoring results to the Department's Waste Management Division no later than 45 days after sampling. Samples shall be taken from the on-site monitoring wells and surface water sampling points as shown and labeled on the referenced site plan, and listed on the following table in accordance with the schedule outlined herein:

Monitoring Locations	Sampling Frequency	Parameters
		elevation (wells only)

Summaries of water quality shall be submitted biennially (every other year) in the month of January, starting in 2014, to the Department's Waste Management Division, using a format acceptable to the Department. The Biennial Summary Report shall include the information listed in Env-Or 607.04 (a), as applicable, and shall be prepared and stamped by a professional engineer or professional geologist licensed in the State of New Hampshire.

- Co



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Duration of a GMP

- GMPs are 5 year permits

AND:

- Permittee continues to be fully responsible for the conditions of the GMP even after expiration until it is renewed.

How long do you need a GMP?

- Env-Or 607.07(d) specifies that groundwater monitoring shall continue under the provisions of a groundwater management permit until groundwater **contamination sources are eliminated**; and
- Env-Or 609.02(c) indicates that all sources of groundwater contamination must be eliminated before the agency issues a certificate of no further action.

GMP Reporting

- Data Transmittals

AND:

- Periodic Summary Reports
  - *"… summarize the effectiveness of the remedial measures and groundwater quality within the GMZ."*

GMP Reporting

- Data Transmittals should provide
  - Laboratory Report
  - Tabulated Data
  - Site Figure

All submittals to NHDES must include the required cover pages.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

GMP Reporting

- Periodic Summary Reports should provide
  - Brief Background / History / Site Conceptual Model
  - Discuss Sampling Protocols
    - How the samples were collected
    - Who took the samples
    - QA/QC procedures
    - Issues or limitations
  - Discussion, review, and assessment of analytical results and temporal trends
  - Conclusion & Recommendations

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

GMP Summary Reports

- Required NHDES Cover Pages

DES Waste Management Division
29 Hazen Drive; PO Box 95
Concord, NH 03302-0095

2016 ANNUAL SUMMARY REPORT
Former Spartan Transfer Station Site
160 Rockingham Road
Londonderry, New Hampshire

NHDES Site # 198804014
Project Type: LAND/UNLN
GMP # GWP-198804014-L-002

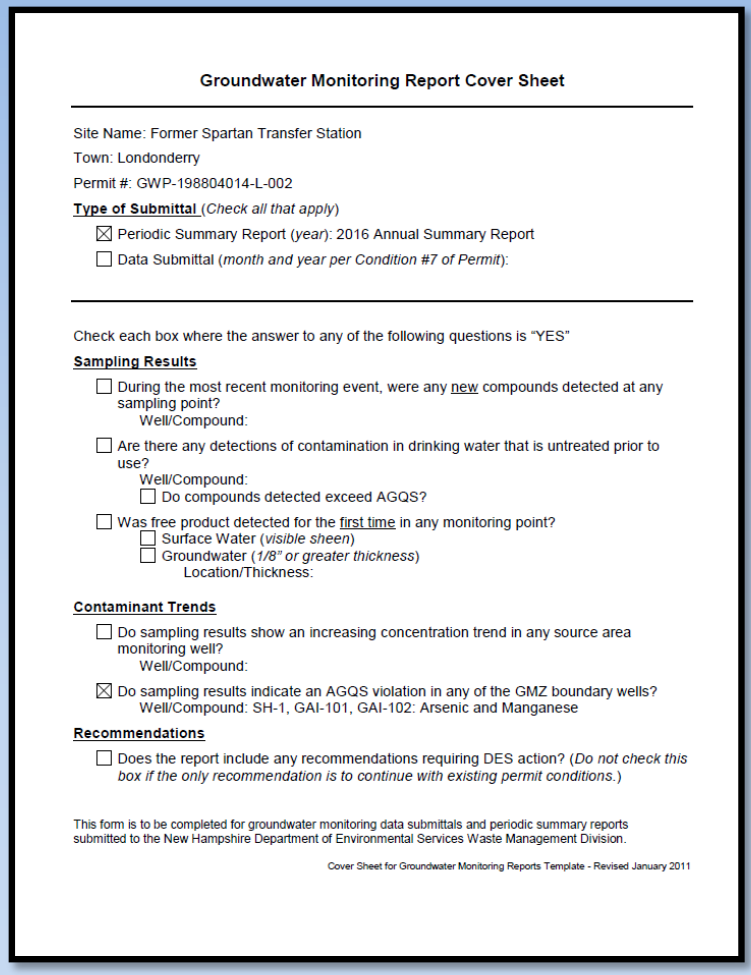
Prepared For:
NH Department of Transportation
P.O. Box 483, 7 Hazen Drive
Concord, NH 03302-0483
Dale O'Connell, P.G. (603) 271-3226

Prepared By:
Golder Associates Inc.
670 North Commercial Street, Suite 103
Manchester, NH 03101
Phone Number: (603) 688-0880
Contact Name: James Peace, PG
Contact Email: jim_peace@golder.com

STATE OF NEW HAMPSHIRE No. LICENSED PROFESSIONAL GEOLOGIST

Date of Report: July 26, 2016

Cover Sheet for Reports Template - Revised January 2011



Groundwater Monitoring Report Cover Sheet

Site Name: Former Spartan Transfer Station
Town: Londonderry
Permit #: GWP-198804014-L-002

Type of Submittal (*Check all that apply*)
- ☒ Periodic Summary Report (*year*): 2016 Annual Summary Report
- ☐ Data Submittal (*month and year per Condition #7 of Permit*):

Check each box where the answer to any of the following questions is "YES"

Sampling Results
- ☐ During the most recent monitoring event, were any new compounds detected at any sampling point?
  Well/Compound:
- ☐ Are there any detections of contamination in drinking water that is untreated prior to use?
  Well/Compound:
  - ☐ Do compounds detected exceed AGQS?
- ☐ Was free product detected for the first time in any monitoring point?
  - ☐ Surface Water (*visible sheen*)
  - ☐ Groundwater (*1/8" or greater thickness*)
    Location/Thickness:

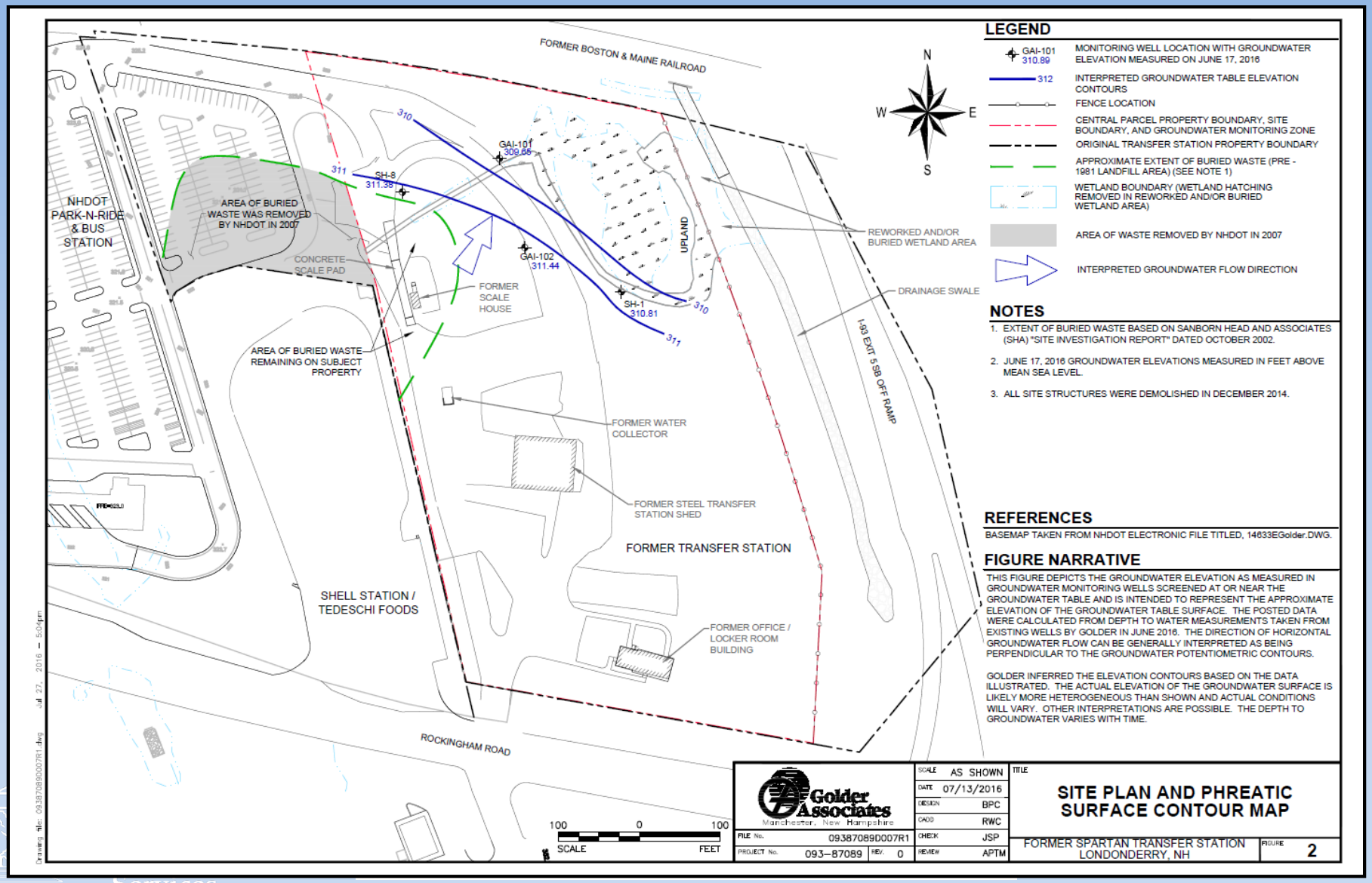
Contaminant Trends
- ☐ Do sampling results show an increasing concentration trend in any source area monitoring well?
  Well/Compound:
- ☒ Do sampling results indicate an AGQS violation in any of the GMZ boundary wells?
  Well/Compound: SH-1, GAI-101, GAI-102: Arsenic and Manganese

Recommendations
- ☐ Does the report include any recommendations requiring DES action? (*Do not check this box if the only recommendation is to continue with existing permit conditions.*)

This form is to be completed for groundwater monitoring data submittals and periodic summary reports submitted to the New Hampshire Department of Environmental Services Waste Management Division.

Cover Sheet for Groundwater Monitoring Reports Template - Revised January 2011

Report Attachments - Figures



Report Attachments - Data Tables

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July 2016 Page 1 of 1 Project No.: 093-87089.08

July 2016 Project No.: 093-87089.08

Table 1: Groundwater Elev
Former Spartan T
Londonderry, New
GMP No. GWP-19

Monitoring Location	GAI-102
Point of Reference Elev. (ft-	318.7
Ground Surface Elevation (	316.48
Northing	1062308.9
Easting	152688.2
Screened Interval (ft-bgs)	6 - 11
Depth of Well (ft-bgs)	11

Date	/ (ft)	GW Elev. (ft-msl)
2/5/2002 - 2/6/20		
4/17/2003		
10/22/2003		
6/1/2004		
10/13/2004		
6/1/2005		
10/11/2005		
6/25/2008		
6/25/2009		
8/24/2010		
6/29/2011		
8/24/2011		Well Damaged
6/21/2012		Well Damaged
6/12/2013	78	312.92
6/12/2014	76	311.94
6/12/2015	58	312.12
6/17/2016	26	311.44

Well Did Not Exist

Notes:
1) DTW = depth to water
2) GW Elev. = groundwater elev
3) ft = feet
4) ft-bgs = feet below ground sur
5) ft-msl = feet mean sea level
6) Ground surface elevations, re
7) Water level measurements pr
8) The top of the PVC well casin

P:\Projects\2009\093-87089 NHDOT-Londonderry PM\Reports\Ar

Table 2: Groundwater Analytical Results
Former Spartan Transfer Station Site
Londonderry, New Hampshire
GMP No. GWP-198804014-L-002

Parameters	Dissolved Metals					PAHs	Water Quality Indicators			
	Arsenic	Barium	Iron	Manganese	Selenium	Various	Chloride	Nitrate	Sulfate	TKN
Units	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l
AGQS	0.010	2.0	NS	0.84	0.05	various	NS	10	500	NS
SH-1										
2/5/2002	**0.035**	0.300	25	**18.1**	–	ND	NA	NA	NA	NA
4/17/2003	**0.078**	0.280	36	**16.9**	–	NA	NA	NA	NA	NA
10/22/2003	**0.032**	0.320	26	**17.4**	–	NA	NA	NA	NA	NA
6/1/2004	**0.022**	0.280	21	**16.6**	–	NA	559	ND	37.1	0.74
10/13/2004	ND	0.240	5.7	**13.4**	–	NA	542	ND	45.7	1.4
6/1/2005	**0.018**	0.300	16	**17.2**	–	NA	559	ND	38.9	1.3
6/1/2005	**0.020**	0.310	17	**17.2**	–	NA	566	ND	39.6	1.2
10/11/2005	**0.030**	0.380	23	**20.0**	–	NA	648	ND	37.5	1.9
6/25/2008	**0.024**	0.360	18.3	**13.8**	ND (0.015)	NA	491	ND (0.05)	30.2	1.0
6/25/2009	**0.041**	0.385	34.1	**14.4**	ND (0.015)	NA	447	ND (0.05)	16.5	1.9
8/24/2010	**0.032**	0.230	10.0	**6.7**	ND (0.001)	NA	330	ND (0.5)	32.0	1.1
6/29/2011	**0.065**	0.300	24.0	**9.1**	ND (0.001)	NA	310	ND (0.5)	18.0	1.7
6/21/2012	**0.032**	0.290	16.0	**7.6**	0.003	NA	300	ND (0.5)	27.0	1.3
6/12/2013	**0.043**	0.300	17.0	**9.0**	ND (0.001)	ND	230	ND (0.5)	20.0	1.7
6/12/2014	**0.043**	0.270	16.0	**8.6**	0.001	ND	360	ND (0.5)	33.0	1.4
6/12/2015	**0.054**	0.230	14.0	**4.7**	0.002	ND	210	ND (0.5)	27.0	1.5
6/17/2016	**0.055**	0.250	18.0	**6.6**	0.002	NA	220	ND (0.5)	22.0	1.7
SH-8										
2/5/2002	**0.016**	0.11	1.8	**3.1**	–	ND	NA	NA	NA	NA
4/17/2003	**0.019**	0.03	ND	**0.0088**	–	NA	NA	NA	NA	NA
4/17/2003	**0.022**	0.03	ND	**0.0097**	–	NA	NA	NA	NA	NA
10/22/2003	**0.020**	0.06	4.5	**1.2**	–	NA	NA	NA	NA	NA
10/22/2003	**0.018**	0.06	4.4	**1.2**	–	NA	NA	NA	NA	NA
6/1/2004	ND	0.049	ND	0.03	–	NA	63.3	7.3	112	0.35
10/13/2004	ND	0.053	0.22	**0.88**	–	NA	98	ND	18.2	1.7
10/13/2004	ND	0.055	0.22	**0.9**	–	NA	110	ND	24.4	1.8
6/1/2005	ND	0.045	ND	0.011	–	NA	32.4	4.3	99	0.41
10/11/2005	ND	0.057	ND	0.17	–	NA	36.4	6.3	99.5	1
10/11/2005	ND	0.055	ND	0.16	–	NA	35.6	6.4	101	0.82
6/25/2008	ND (0.01)	0.043	ND (0.05)	0.180	ND (0.015)	NA	88.5	ND (0.05)	7.2	0.51
6/25/2008	ND (0.01)	0.043	0.066	0.170	ND (0.015)	NA	90.1	ND (0.05)	7.3	0.43
6/25/2009	ND (0.01)	0.038	ND (0.05)	0.011	ND (0.015)	NA	11.0	2.54	35.6	0.54
8/24/2010	0.007	0.054	0.150	0.130	ND (0.001)	NA	150	ND (0.05)	40.0	ND (0.5)
6/29/2011	0.004	0.034	ND (0.05)	ND (0.005)	ND (0.001)	NA	4.0	1.0	30.0	ND (0.5)
6/21/2012	0.002	0.035	ND (0.05)	ND (0.005)	ND (0.001)	NA	5.0	1.7	27.0	ND (0.5)
6/12/2013	0.002	0.037	ND (0.05)	ND (0.005)	ND (0.001)	ND	4.0	1.4	27.0	ND (0.5)
6/12/2014	0.003	0.035	ND (0.05)	0.018	ND (0.001)	ND	15.0	ND (0.5)	7.0	ND (0.5)
6/12/2015	0.003	0.031	ND (0.05)	ND (0.005)	ND (0.001)	ND	4.0	1.9	19.0	ND (0.5)
6/17/2016	0.003	0.044	0.13	0.069	ND (0.001)	NA	31.0	ND (0.5)	12.0	0.6
GAI-101										
7/6/2011	**0.036**	0.085	30	**2.6**	ND (0.001)	NA	130	ND (0.5)	5.0	4.8
6/21/2012	**0.066**	0.060	19	**2.2**	0.001	NA	93	ND (0.5)	2.0	3.3
6/12/2013	0.007	0.028	3.5	0.68	ND (0.001)	ND	16	ND (0.5)	5.0	1.8
6/12/2014	**0.016**	0.098	30	**2.3**	ND (0.001)	ND	53	ND (0.5)	ND (1.0)	4.2
6/12/2015	**0.011**	0.029	6.8	0.68	ND (0.001)	ND	29	ND (0.5)	3.0	2.9
6/17/2016	**0.014**	0.028	10	**1.1**	ND (0.001)	NA	17	ND (0.5)	ND (1.0)	2.3
GAI-102										
7/6/2011	**0.026**	0.100	9.2	**13**	ND (0.001)	NA	390	ND (0.5)	35.0	1.3
6/21/2012	Well Damaged - No Sample Collected									
6/12/2013	**0.013**	0.099	5.3	**14**	0.002	ND	350	ND (0.5)	26.0	1.4
6/12/2014	**0.020**	0.098	7.3	**15**	0.003	ND	360	ND (0.5)	24.0	1.4
6/12/2015	**0.017**	0.100	5.1	**9.4**	0.003	ND	250	ND (0.5)	130.0	1.3
6/17/2016	**0.012**	0.110	5.7	**14**	0.004	NA	390	ND (0.5)	48.0	1.9

Prepared by: BPC
Checked by: JMR
Reviewed by: JSP

Notes:
1. Groundwater samples collected on and after August 24, 2010 were collected by Golder Associates Inc. and submitted to Eastern Analytical Inc of Concord, New Hampshire for analysis. Groundwater samples prior to that event were collected by SHA on the dates indicated and submitted to Test America (formerly Severn Trent Laboratories, Inc. [STL]) of Amherst, New York for selected analysis.
2. Groundwater samples collected for metals analysis were field-filtered using a 0.45-micron filter, and preserved with nitric acid after filtering.
3. Only analytes detected in one or more samples are listed
4. ND (0.01) = not detected above the laboratory reporting limit
5. NA = not analyzed for the parameter(s) identified
6. NS = no standard
7. AGQS = Ambient Groundwater Quality Standards in accordance with NHDES Env-Or 600
8. mg/l = milligrams per liter
9. TKN = total kjehldahl nitrogen
10. Bold indicates an exceedance of the AGQS

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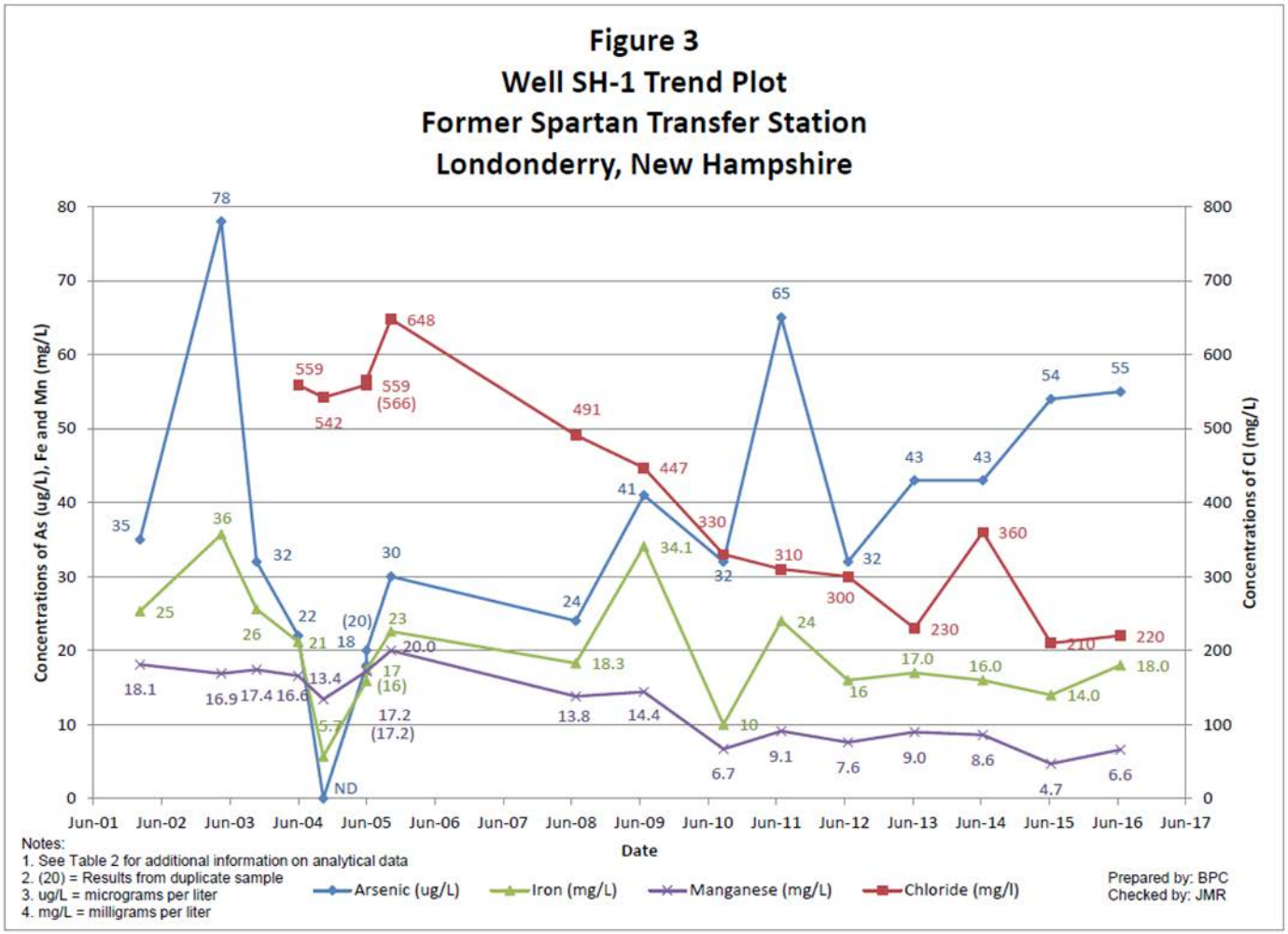
Golder Associates

Golder Associates

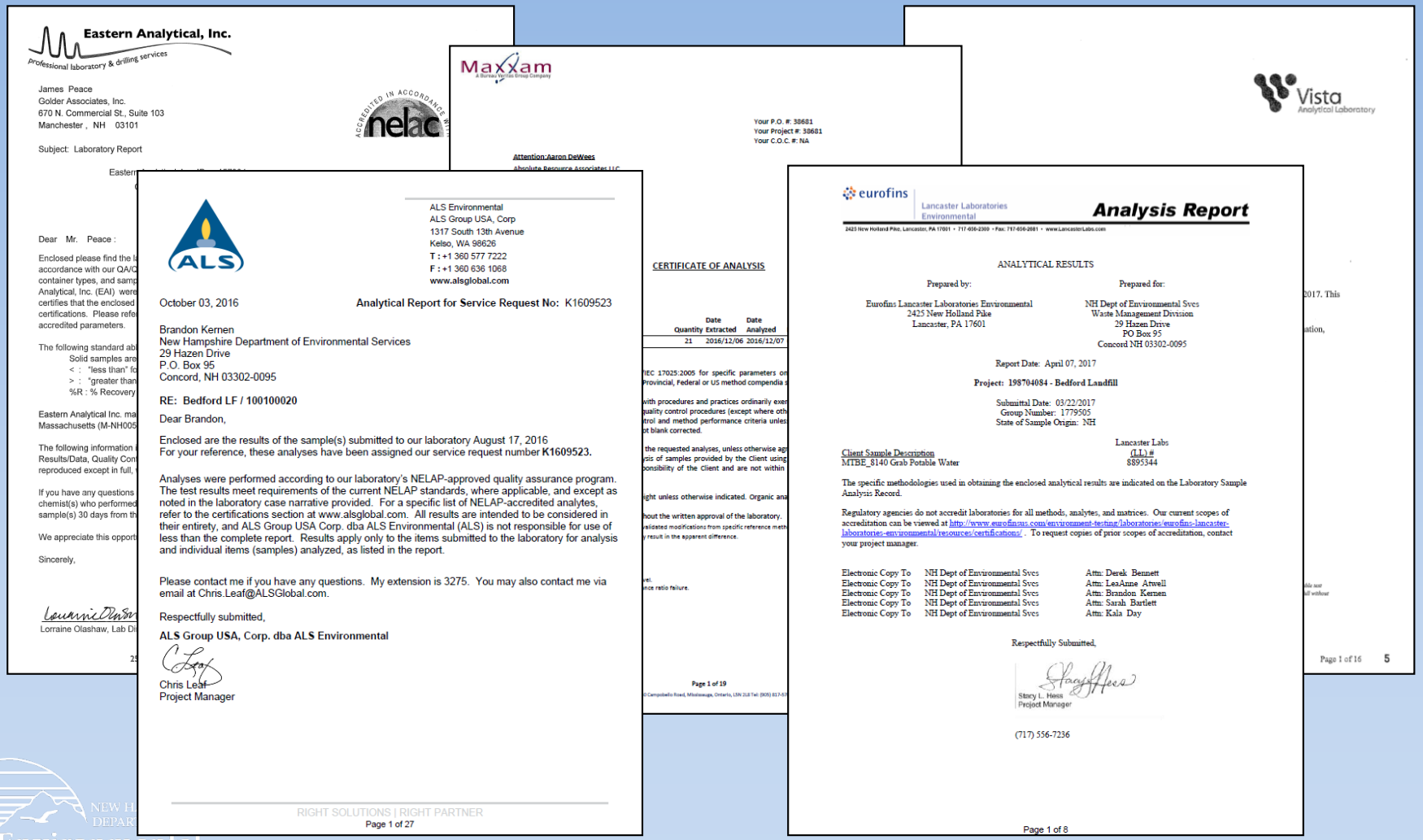
NEW HAMPSHIRE DEPARTMENT OF
Environmental Services

Report Attachments - Charts & Trends



Environmental Services

Report Attachments - Laboratory Reports



Eastern Analytical, Inc.
Professional laboratory & drilling services

James Peace
Golder Associates, Inc.
670 N. Commercial St., Suite 103
Manchester , NH 03101

Subject: Laboratory Report

Dear Mr. Peace :

Enclosed please find the l
accordance with our QA/C
container types, and samp
Analytical, Inc. (EAI) were
certifies that the enclosed
certifications. Please refe
accredited parameters.

The following standard ab
Solid samples are
< : "less than" fo
> : "greater than
%R : % Recovery

Eastern Analytical Inc. ma
Massachusetts (M-NH005

The following information
Results/Data, Quality Con
reproduced except in full,

If you have any questions
chemist(s) who performed
sample(s) 30 days from th

We appreciate this opport

Sincerely,

Lorraine Olashaw, Lab Di

Page 25

ACCREDITED IN ACCORDANCE WITH nelac

MaXXam
A Bureau Veritas Group Company

Your P.O. #: 38681
Your Project #: 38681
Your C.O.C. #: NA

Attention:Aaron DeWees

CERTIFICATE OF ANALYSIS

Quantity	Date Extracted	Date Analyzed
21	2016/12/06	2016/12/07

IEC 17025:2005 for specific parameters on
Provincial, Federal or US method compendia s

with procedures and practices ordinarily exer
quality control procedures (except where oth
trol and method performance criteria unles
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the requested analyses, unless otherwise agr
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Page 1 of 19

Vista
Analytical Laboratory

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Page 1 of 16 5

ALS

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
F : +1 360 636 1068
www.alsglobal.com

October 03, 2016

Analytical Report for Service Request No: K1609523

Brandon Kernen
New Hampshire Department of Environmental Services
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095

RE: Bedford LF / 100100020

Dear Brandon,

Enclosed are the results of the sample(s) submitted to our laboratory August 17, 2016
For your reference, these analyses have been assigned our service request number **K1609523.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3275. You may also contact me via email at Chris.Leaf@ALSGlobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Chris Leaf
Project Manager

RIGHT SOLUTIONS | RIGHT PARTNER

Page 1 of 27

eurofins | Lancaster Laboratories Environmental

Analysis Report

2425 New Holland Pike, Lancaster, PA 17601 • 717-656-2300 • Fax: 717-656-2681 • www.LancasterLabs.com

ANALYTICAL RESULTS

Prepared by:

Eurofins Lancaster Laboratories Environmental
2425 New Holland Pike
Lancaster, PA 17601

Prepared for:

NH Dept of Environmental Svcs
Waste Management Division
29 Hazen Drive
PO Box 95
Concord NH 03302-0095

Report Date: April 07, 2017

Project: 19870484 - Bedford Landfill

Submittal Date: 03/22/2017
Group Number: 1779505
State of Sample Origin: NH

Client Sample Description	Lancaster Labs (LL) #
MTBE_8140 Grab Potable Water	8895344

The specific methodologies used in obtaining the enclosed analytical results are indicated on the Laboratory Sample Analysis Record.

Regulatory agencies do not accredit laboratories for all methods, analytes, and matrices. Our current scopes of accreditation can be viewed at http://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/resources/certifications/ . To request copies of prior scopes of accreditation, contact your project manager.

Electronic Copy To	NH Dept of Environmental Svcs	Attn: Derek Bennett
Electronic Copy To	NH Dept of Environmental Svcs	Attn: LeaAnne Atwell
Electronic Copy To	NH Dept of Environmental Svcs	Attn: Brandon Kernen
Electronic Copy To	NH Dept of Environmental Svcs	Attn: Sarah Bartlett
Electronic Copy To	NH Dept of Environmental Svcs	Attn: Kala Day

Respectfully Submitted,

Stacy L. Hess
Project Manager

(717) 556-7236

Page 1 of 8

NEW H
DEPAR
Environmental
Services

Water Supply Sampling Results

Results should be sent by the consultant to:

- The water supply owner
- NHDES' Waste Management Division via NHDES OneStop Data Provider
  - As an a cc' on the original; and/or
  - Be attached to the regular submittal

A GMP may have specific requirements regarding reporting and submittal timelines.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Conclusions & Recommendations

"… summarize the effectiveness of the remedial measures and groundwater quality within the GMZ."

- **Conclusion**
  - What is the consultant's analysis of the data and interpretation of the data and any ongoing trends?
  - Is the conceptual model still valid?
  - Is the GMZ adequate?
- **Recommendations**
  - What are the next steps?
  - Continue monitoring per the GMP?
  - Is additional sampling or investigation needed?

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

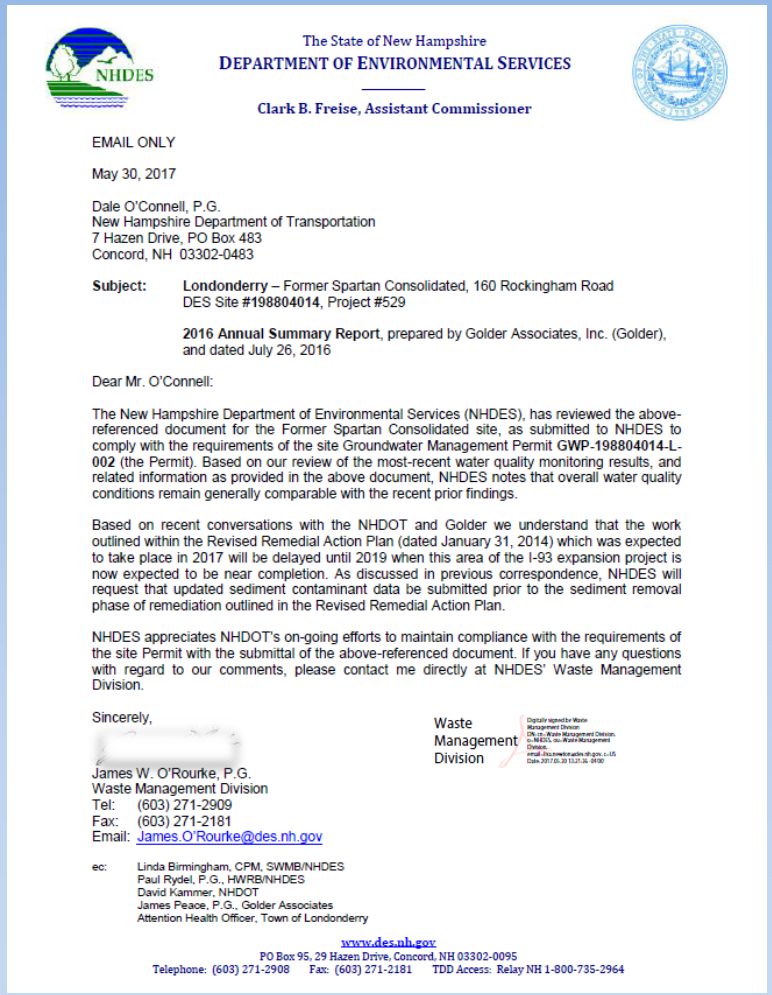
NHDES Responses

Letter, e-mail, or phone call to the permittee

Responses may:

- Request more information or data
- Request additional sampling or analysis
- Note deficiencies or errors to be addressed in future submittals

Not all submittals get a direct response



The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Clark B. Freise, Assistant Commissioner

EMAIL ONLY

May 30, 2017

Dale O'Connell, P.G.
New Hampshire Department of Transportation
7 Hazen Drive, PO Box 483
Concord, NH 03302-0483

Subject: **Londonderry** – Former Spartan Consolidated, 160 Rockingham Road
DES Site **#198804014**, Project #529

2016 Annual Summary Report, prepared by Golder Associates, Inc. (Golder), and dated July 26, 2016

Dear Mr. O'Connell:

The New Hampshire Department of Environmental Services (NHDES), has reviewed the above-referenced document for the Former Spartan Consolidated site, as submitted to NHDES to comply with the requirements of the site Groundwater Management Permit **GWP-198804014-L-002** (the Permit). Based on our review of the most-recent water quality monitoring results, and related information as provided in the above document, NHDES notes that overall water quality conditions remain generally comparable with the recent prior findings.

Based on recent conversations with the NHDOT and Golder we understand that the work outlined within the Revised Remedial Action Plan (dated January 31, 2014) which was expected to take place in 2017 will be delayed until 2019 when this area of the I-93 expansion project is now expected to be near completion. As discussed in previous correspondence, NHDES will request that updated sediment contaminant data be submitted prior to the sediment removal phase of remediation outlined in the Revised Remedial Action Plan.

NHDES appreciates NHDOT's on-going efforts to maintain compliance with the requirements of the site Permit with the submittal of the above-referenced document. If you have any questions with regard to our comments, please contact me directly at NHDES' Waste Management Division.

Sincerely,

Waste Management Division

James W. O'Rourke, P.G.
Waste Management Division
Tel: (603) 271-2909
Fax: (603) 271-2181
Email: James.O'Rourke@des.nh.gov

ec: Linda Birmingham, CPM, SWMB/NHDES
Paul Rydel, P.G., HWRB/NHDES
David Kammer, NHDOT
James Peace, P.G., Golder Associates
Attention Health Officer, Town of Londonderry

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PO Box 95, 29 Hazen Drive, Concord, NH 03302-0095
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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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- **Tools for moving forward**
- **The future of our closed landfills**

Contact Information

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