Environmental Protection

Rikers Island Methane Assessment Report

March 2024

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List of Abbreviations

BWT	Bureau of Wastewater Treatment
DEP	New York City Department of Environmental Protection
FLIGHT	Facility Level Information on Greenhouse Gases Tool
RNG	renewable natural gas
LandGEM	Landfill Gas Emissions Model
scfm	standard cubic feet per minute
TM	Technical Memorandum
USEPA	United States Environmental Protection Agency
WRRF	Water Resource Recovery Facility

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1 Introduction

This report is intended to satisfy the requirement of New York City 2021 Local Law 31, for the New York City Department of Environmental Protection (DEP) to complete an assessment of:

…the presence of methane on Rikers Island, the potential for the installation of methane recovery systems, and the use of such systems by any such wastewater treatment facility. Such methane assessment should consider the return on investment of municipally built and operated methane recovery systems, the potential for public-private partnerships, and the potential for the use of methane for electricity generation.

This report presents the result of a desktop analysis of subsurface methane concentrations on Rikers Island resulting from historical landfilling practices. Based on estimates of the quantity and quality of subsurface methane and the cost intensiveness of capturing and utilizing the gas, the report concluded that methane recovery on Rikers Island is not practical.

2 Presence of Methane on Rikers Island

There is no available data on subsurface methane concentrations on Rikers Island. An estimate of methane generated from historical landfilling practices on Rikers Island was instead developed using information collected on waste disposal activities, previous reports on existing subsurface conditions, and research on other similar landfills. The following summarizes the available background information:

- Debris excavated for construction of the New York City subway was barged to the island from the late 1800's through the early 1900's.
- Beginning in the early 1920's, waste from New York City was disposed of on the island. The waste included ash from coal heating and waste incinerators and residential household waste.
- Waste disposal at Rikers Island stopped in the mid-1940's when the Fresh Kills landfill on Staten Island became the primary location for waste disposal in New York City.
- The island increased in size from approximately 90 acres in the late 1800's to approximately 413 acres (an estimated 323 acres of waste added).

There is Facility Level Information on Greenhouse Gases Tool (FLIGHT) methane emissions data reported for Rikers Island and maintained by the United States Environmental Protection Agency (USEPA). These data can be attributed to power production facilities currently in operation on Rikers Island such as the cogeneration facility. It is unlikely related to methane emissions resulting from the historical landfill activities.

Because there is no data available on methane concentrations in the subsurface of Rikers Island, assumptions were made to develop hypothetical concentrations based on available information and industry knowledge of landfill degradation. The USEPA Landfill Gas Emissions Model (LandGEM) was used to estimate potential methane emissions due to prior waste disposal activities on the island. To develop hypothetical methane concentrations, several fill scenarios were modeled.

The assumptions made to develop hypothetical subsurface methane concentrations on Rikers Island include:

- Percent organics = 75 percent
  - This is a conservative estimate given the age and likely material in the landfill (predominantly ash and subway debris). The organics content is likely much lower than this assumption but is presented as the assumed generation rate for this report to present a “best case scenario” generation rate.
- Volume of Fill = 18.2 million cubic yards
  - Assumed all 323 acres at a depth of 35 feet is available for methane generation based on previous geotechnical investigations on Rikers Island.
- Target model output year = 2050
  - 2050 is an approximate year that a new Wastewater Resource Recovery Facility (WRRF) could start operating on Rikers Island. In addition to this study, Local Law 31 also requires DEP to assess the feasibility of building a WRRF on Rikers Island that could incorporate a methane recovery system from the historical landfill.

Figure 1 shows the USEPA LandGEM results for the most conservative (“best case scenario”) methane generation case for Rikers Island. The model results estimate that the potential methane generation rate has significantly decreased on Rikers Island since a peak in the 1940s. In 2050, the projected rate could range from near zero to 40 standard cubic feet per minute (scfm).

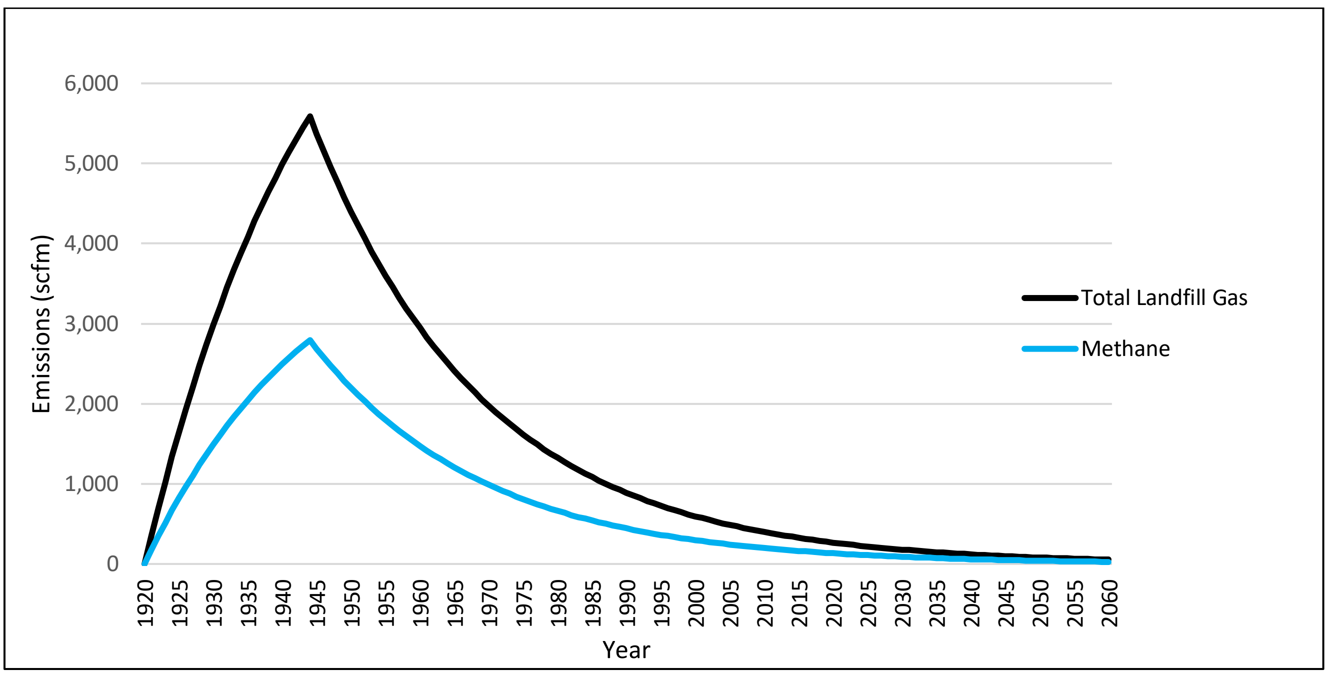

Figure 1. Estimated landfill gas and methane generation on Rikers Island

Using this methane generation estimate from LandGEM, a projection was then determined of the methane available for recovery. Assumptions on two variables that impact methane available for recovery were used:

- Recovery Efficiency = 90 percent
  - Methane recovery requires the use of a barrier to capture the gas. Because the landfill practices on Rikers Island predate modern landfill design, Rikers Island is not lined or capped like most closed landfills are required to be in the present day. For the estimate of gas available for recovery, the analysis assumed a geomembrane barrier cap could be installed, which provides the greatest recovery efficiency at 90 percent. It is critical to note that this is an extremely conservative estimate – it is impractical to install geomembrane barrier on the historical landfill areas of Rikers Island from both a technical and cost perspective.

- Groundwater Table Impact = 50 percent
  - Methane cannot be recovered from waste in groundwater, and the existing subsurface information suggests the groundwater level at Rikers Island is high. At Rikers Island, it is believed that much of the waste is submerged in groundwater with the only the top few feet of fill above the groundwater level. Therefore, the recoverable methane volume is estimated at 50 percent. This is also a conservative estimate given the actual groundwater level.

Given the LandGEM results and the above assumptions on recovery, 18 scfm is a feasible upper bound for the level of methane that could be recovered at Rikers Island. For the purpose of evaluating the potential scale of a methane recovery system, this report uses a baseline of 18 scfm as an upper bound of the methane recovery potential, which is the equivalent of 1.1 million British thermal units per hour and ~4,600 metric tons of carbon dioxide per year. Even this upper bound is a relatively insignificant volume of methane and assumes methane can be recovered from all 323 landfilled acres of the island. For context, other wastewater facilities that recover methane from landfills utilize at least 30-40 times this landfill gas volume.

3 Feasibility of Rikers Island Methane Recovery

The current approach for capturing landfill gas in the industry was analyzed. A recovery system for methane from an existing landfill would require:

- Collecting methane gas from the landfill waste, including a barrier layer over the gas collection system to reduce methane emissions through the ground surface and prevent air intrusion into the collection system (capping).
- Conveying the gas to one or more locations for methane management.
- A blower (or blowers) to induce gas flow by applying a vacuum.
- An energy recovery system and/or a methane combustion system for redundancy.

The historical landfill on Rikers Island is uncapped and to recover landfill gas would require capping most of the island. Even a small amount of air intrusion would reduce gas quality and increase the need for supplemental fuel for gas management. Covering the estimated 323 acres of landfill area with a barrier would be cost intensive and may restrict other future uses. Parts of the island that would already provide large continuous impermeable coverage (such as beneath structures of a WRRF) could be targeted but this smaller area would further reduce the 18 scfm that could be recovered. Gas quality also generally degrades with time. Installations of this type of system are unprecedented for a landfill the age of the one on Rikers Island.

Technologies for electricity or energy use of methane recovered from landfill include microturbines and renewable natural gas (RNG). Previous installations of these technologies require higher gas production rates than the historical landfill on Rikers Island is currently providing to be economically viable. Another method of utilizing methane is reducing the greenhouse gas emissions (GHG) from captured gas. Technologies such as flaring or vapor combustion could reduce the GHG impact of the gas but are challenging given the dilute nature of the potential methane associated with the existing landfill.

DEP has formed successful partnerships with National Grid and the New York City Department of Sanitation to leverage private capital and technical resources agencies for climate action and renewable energy projects. These projects require an influx of capital and generally involve profit sharing. Due to the dilute nature of the gas and lack of gas quantity (including diminishing nature of available methane), there is low revenue potential for the methane at Rikers Island and, therefore, opportunities for public-private partnerships are limited and non-viable.

4 Conclusions and Recommendations

After estimating the hypothetical methane release rate from the historical landfill on Rikers Island and reviewing available methane release capture technologies, the collection and use of methane on Rikers Island is not recommended. Using conservative estimates in the model, the quantity of gas from the existing landfill is very low, the anticipated quality of the gas is dilute, and the cost intensiveness of capturing and utilizing the low concentration of gas makes methane recovery impractical.