TECHNICAL REVIEW

OF THE MAY 2021 LEACHATE REINTRODUCTION TO SANITARY SEWER PLAN

IN CONNECTION WITH THE

BFI WASTE SYSTEMS OF NEW JERSEY, INC. LANDFILL

A.K.A. FORMER MONROE TOWNSHIP LANDFILL SUPERFUND SITE

(NJDEP PI NO. G000004439; EPA ID NJD980505671)

Spotswood-Gravel Hill Road
Block 148, Lot 37
Township of Monroe
Middlesex County, New Jersey

Prepared for:

Township of Monroe

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EXECUTIVE SUMMARY

On behalf of the Township of Monroe ("Township"), CME Associates ("CME") has prepared a technical review of the report entitled "Leachate Reintroduction to Sanitary Sewer Plan," prepared by Republic Services, a.k.a. BFI Waste Systems of New Jersey, Inc. ("BFI"), dated May 13, 2021 ("May 2021 BFI Leachate Reintroduction Plan"). The BFI Landfill ("Landfill") is an approximately 86-acre closed landfill and designated as Block 148, Lot 37 in the Township of Monroe, Middlesex County, New Jersey. The Landfill was operated for 23 years, between 1955 and 1978, before its closure.

BFI is the current operator of the Former Monroe Township Landfill Superfund Site, and is responsible for the post-closure care of the Landfill, including the ongoing operation, monitoring, and maintenance activities in accordance with the 1993 Post-Closure Monitoring and Maintenance Plan and 1993 Record of Decision (ROD) issued jointly by the NJDEP and USEPA. The site was delisted from the National Priorities List (NPL) in February 1994.

The Township retained CME to provide Independent Landfill Expert Services to represent the interests of the Township and its residents in light of ongoing public health concerns related to leachate being discharged from the Landfill into the public sanitary sewer. Leachate from the Landfill which has historically discharged into the public sanitary sewer lines at Lani Street but ceased in September 2020 due to multiple odor complaints from residents of the surrounding area. BFI would like to reintroduce Landfill leachate into the sanitary sewer in accordance with the May 2021 Leachate Reintroduction Plan. Accordingly, this Technical Review of the Leachate Reintroduction Plan has been prepared by Behram Turan, P.E., LSRP, Director of Environmental Services at CME Associates, as an Independent Landfill Expert. The résumé of Mr. Turan is included in **Appendix 1**.

Based on his review of the Leachate Reintroduction Plan along with the limited documents made available to CME to date, it is Mr. Turan's expert opinion with a reasonable degree of scientific certainty that the May 2021 BFI Leachate Reintroduction to Sanitary Sewer Plan failed to demonstrate the potential cause of odors emanating from the landfill leachate discharging into the public sanitary sewer since at least August 2020, and provide technical justifications that the leachate reintroduction to the public sewer system would be safe and protective of human health and the environment. The proposed Leachate Reintroduction Plan significantly lacks the evaluation of multiphase flow and its potential effect on derated sewer line flow capacity due to the presence of untreated leachate within the conveyance system generating gases due to volatilization and denitrification processes. Particularly, the presence of gases can cause temporary blockages within the areas where pipe inverts encounter successive high and low

elevation conditions. In addition, the proposed Leachate Reintroduction Plan fails to recognize that all of the lateral connections on the existing gravity sewer system represent a preferential pathway directly into the homes of residents.

The Proposed Leachate Reintroduction Plan does not provide a safe means for leachate disposal as alleged by BFI, and it should be rejected. If the leachate is not pre-treated before discharging to the sanitary sewer, a dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

1.0 INTRODUCTION

CME Associates ("CME") has prepared this Technical Review on behalf of the Township of Monroe ("Township") to provide technical justification for the rejection of the May 2021 Leachate Reintroduction to Sanitary Sewer Plan ("May 2021 Leachate Reintroduction Plan") prepared by Republic Services, a.k.a. BFI Waste Systems of New Jersey, Inc. ("BFI"), and their private consultants. BFI is the current operator of the BFI Landfill, formerly the Former Monroe Township Landfill Superfund Site ("Landfill"), and is responsible for the post-closure care of the Landfill, including the ongoing operation, monitoring, and maintenance activities in accordance with the 1993 Post-Closure Monitoring and Maintenance Plan and 1993 Record of Decision (ROD) issued jointly by the New Jersey Department of Environmental Protection (NJDEP) and U.S. Environmental Protection Agency (USEPA) prior to the site's delisting from the National Priorities List (NPL). Thus, BFI is responsible for proper landfill leachate management, including the containment, storage, and disposal of leachate generated at the closed Landfill.

The Township retained CME to provide Independent Landfill Expert Services to represent the interests of the Township and its residents in light of ongoing public health concerns related to the Landfill. In particular, the residents whom inhabit the neighborhoods surrounding the landfill have been experiencing ongoing "strong chemical odors" akin to "sewage, rotten eggs, turpentine, and acetone" at both the interiors and exteriors of their residences since at least August 2020. There is significant evidence that one (1) pathway of the recurring odors may be related to leachate from the Landfill which has historically discharged into the public sanitary sewer lines at Lani Street. Following the receipt of multiple complaints from residents between August and September 2020, the NJDEP ordered BFI to discontinue the discharge of landfill leachate to the sanitary sewer pending further investigation and utilize a truck and haul operation to remove leachate from the Landfill on a daily basis. BFI subsequently performed a series of additional investigations and assessments and implemented certain corrective actions for the Landfill's leachate collection and conveyance system, concluding in the May 2021 Leachate Reintroduction Plan that it was safe for the leachate to be reintroduced into the sanitary sewer with a reduced flow rate and supplemental monitoring/ regulating equipment.

Mr. Behram Turan, P.E., LSRP of CME Associates was appointed the Independent Landfill Expert due to his extensive experience in Solid Waste Management and Landfill Engineering in the State of New Jersey, including but not limited to, over 30 years of experience in landfill design, landfill closure and post-closure design and construction oversight, operating landfill operations and maintenance, regulatory compliance, expert testimony and litigation support services, site remediation, brownfields redevelopment, wetlands mitigation, surface water hydrology, hydrogeology, groundwater flow and contaminant mass transport, and water resources planning.

He is also currently the Solid Waste Engineer for three (3) operating landfills in New Jersey, the Middlesex County Landfill, Cumberland County Landfill, and Gloucester County Landfill. Mr. Turan's full credentials are summarized in his résumé provided in **Appendix 1**.

Based on his review of the Reintroduction Plan and evaluation of technical data provided in the limited documents made available to CME to date, Mr. Turan has prepared this Technical Review in which he summarizes background information, recent events, and the closure systems at the Landfill, before discussing the Leachate Reintroduction Plan and offering his professional opinion and rebuttal of several claims made by BFI and their consultants. The report is arranged into the following sections:

- **Section 1**. Introduction
- **Section 2.** Background
- **Section 3.** Summary of Landfill Closure Systems
- **Section 4.** Recent Complaints and Events
- **Section 5.** Leachate Quantity and Quality Characteristics
- **Section 6.** May 13, 2020 BFI Leachate Reintroduction to Sanitary Sewer Plan
- **Section 7.** Technical Review of the May 2021 BFI Leachate Reintroduction Plan
- **Section 8.** Conclusions and Recommendations
- **Section 9.** References

It should be noted that it is the professional opinion of the Independent Expert that several potential exposure pathways may exist in connection with the Landfill and that addressing the Township's odor and pollution concerns will likely require a holistic approach involving a comprehensive review of the Landfill's closure systems, implementation of a testing protocol, and further analysis of previously and newly collected data. Accordingly, this report precedes a comprehensive Technical Review report which will include an evaluation of the effectiveness and protectiveness of the source control measures in place at the Landfill, as well as recommendations for site improvements.

2.0 BACKGROUND

2.1 Site Location and Description

The BFI Landfill is an approximately 86-acre closed landfill and designated as Block 148, Lot 37 in the Township of Monroe, Middlesex County, New Jersey. The Landfill is bounded by Lani Street and Lori Street to the north-northeast; Carnegie Street to the north-northwest; Spotswood-Gravel Hill Road and Red Oak Court to the west; Mulberry Court, Birch Court, and Sycamore Court to the south; and Guinevere Road and Tall Oaks Drive to the east. Although at the time of the ROD the Landfill was only bordered on two (2) sides by residential housing, with wooded areas adjacent to the other sides, it is now completely surrounded by low to mid-density residential development. The greater surrounding area is characterized primarily of single-family residential development with sporadic commercial and institutional establishments and some vacant wooded land. A review of historic aerial photography indicates landfilling began at the site circa 1955. Prior to 1955, the site was comprised of vacant woodlands since at least 1930.

2.2 Topography

Elevation at the site ranges from approximately 70 ft amsl along northern site boundary to approximately 130 ft amsl at the crown in the eastern portion of the Landfill. The Landfill is situated on a regional high point. Surface drainage at the site runs primarily to the north and south away from the crown of the Landfill[1].

2.3 Geology/Hydrogeology

The predominant geologic and hydrogeologic units underlying and surrounding the Site are the Merchantville and Magothy Formations. Quaternary sediments overlying the Merchantville and Magothy Formations represent the surficial geology of the Site.

The Merchantville Formation directly underlies the majority of the Landfill, with groundwater flowing to the east or southeast. The Merchantville Formation dips towards the southeast and is not present below the northern portions of the Site. The Merchantville Formation ranges up to 50-feet thick and is thickest toward the southeast, below the Landfill and the surrounding Quaternary deposits. The ROD stated that, due to the low vertical migration rate, the vertical migration of leachate constituents through the Merchantville Formation to the Magothy

[1] USEPA, 2000

Formation is negligible. The compacted clay cut-off wall and leachate collection system have been installed in this portion of the Landfill to control lateral movement of leachate[2].

The Magothy Formation lies directly below the Merchantville, except in the northeast corner where the Merchantville formation is absent. Groundwater flow in the Magothy is generally toward the east. The Magothy Formation consists of sands and silty sands inter-bedded with lignite seams, with traces of pyrite and iron oxide, and lies directly below Quaternary deposits to the north and the Merchantville Formation to the southeast. The Magothy Formation is under unconfined conditions in the vicinity of the Landfill, and becomes confined to the southeast, beneath the Merchantville Formation. Small discontinuous intercalations of silty clays determine locally perched conditions. The perched zones range in thickness from 2-feet to 7-feet, and have been identified predominantly in the northern portions of the Site[3]. A perched groundwater zone is found 20 feet above the Magothy in the northeast corner where the Merchantville is absent[4]. Hydraulic conductivity values in the Magothy Formation are highly variable, with values in the 10^{-2} cm/sec to 10^{-5} cm/sec range[5].

Quaternary sediments consist of clean sands, which grade to silty sand with depth are present in the southern and eastern areas of the Site, where it separates the portion of the Landfill covered with a soil cap from the underlying Magothy Formation[6].

2.4 Site History

The Landfill was operated for 23 years, between 1955 and 1978, before its closure. Based on NJDEP documentation, only municipal and household waste was placed in the Landfill; however, the USEPA's NPL Site Narrative for the site indicates that hydrochloric acid is known to have been disposed of at the site[7]. The Township operated the Landfill from the mid-1950s until 1968 when it was leased to Princeton Disposal Service. Browning-Ferris Industries of South Jersey (BFI) acquired Princeton Disposal Service in 1972 and BFI operated the Landfill until 1978 when the NJDEP ordered site operations to cease due to a leachate spill in the northeast corner of the property adjacent to Lani Street. The seepage forced the abandonment of a nearby housing construction project. In 1979, the State of New Jersey ordered the Landfill to undergo closure and

[2] Taylor Geoservices, 2021
[3] Excerpt from Rizzo, 1991 as reproduced in Golder Associates 22nd Annual Report, dated March 2015 included in Appendix A, Taylor Geoservices, 2021
[4] USEPA, 2014
[5] Excerpt from Rizzo, 1991 as reproduced in Golder Associates 22nd Annual Report, dated March 2015 included in Appendix A, Taylor Geoservices, 2021
[6] Taylor Geoservices, 2021
[7] USEPA, 1983

required installation of a leachate collection system in response to the 1978 leachate seep. Following cessation of operations, an Administrative Consent Order (ACO) was signed by BFI and NJDEP on October 19, 1979. The ACO established methods and schedules for designing and implementing a landfill closure plan. In 1980, the following interim measures were constructed in the northeastern extent of the Landfill:

- installation of a 900-foot compacted clay cut-off wall, and
- installation of a leachate collection system.

The Landfill was placed on EPA's NPL in September 1983. NJDEP was designated the lead agency and EPA was designated the support agency. The Landfill source control measures required under the closure plan were completed in 1984. The selected remedies for the closure of the Landfill included:

- installation of a 7,000-foot long compacted clay leachate cut-off wall of varying depths circumscribing the portion of the Site covered by the protective soil cap,
- construction of intercepting sewers to temporarily convey leachate discharge into the sewer for treatment at the public wastewater treatment facility under a NJPDES permit;
- installation of an underground leachate collection drain;
- construction of intercepting sewers to convey leachate to the Middlesex County Utilities Authority (MCUA),
- construction of a clay cap covering the northern portion of the Landfill, and
- construction of a soil cap covering the remainder of the Landfill.

BFI and the NJDEP entered into a second ACO effective December 29, 1986 which required BFI to perform a remedial investigation and feasibility study (RI/FS) to determine the effectiveness of the remedial measures already in place, and determine if any additional measures were required to address site contamination. Additional remedial measures completed between 1987 and 1991 included:

- upgrades to the soil erosion and sediment control systems by replacing a former channel with rip-rap lined channels and upgrading the sedimentation basin,
- installation of a 7-ft fence chain-link surrounding the perimeter of the Landfill,
- closure of the previous leachate storage lagoon (1991),
- construction of a double-walled underground leachate storage tank,
- installation of an emergency power generator for the leachate collection system, and
- installation of thirteen (13) landfill gas vents located at each of the leachate collection system manholes, MH-1 through MH-13, for LFG ventilation under an NJDEP Air Pollution Control Permit.

BFI completed a Remedial Investigation (RI) and Baseline Risk Assessment (BRA) for the Site between 1987 and 1992. During the RI/FS, a site-specific risk assessment looked at several potentially exposed populations including; off-site residents, site trespassers, site workers, and future recreational site users. Each of these populations was evaluated for potential exposure to contaminated groundwater, soil, sediments and air. The risk assessment determined that the remedial measures already in place were effective, and none of the exposure pathways posed an unacceptable risk. The RI/FS also evaluated ecological risks. Based on the on and off-site chemical data, information on the source of contaminants, and remedial measures taken pursuant to the ACO, it was concluded that it was unlikely that there would be adverse impacts on the flora and fauna of the area, on the wetlands communities as a whole, or on potential threatened and endangered species in the vicinity of the site. The RI/FS was completed in 1992 and formed the basis for the selection of a remedy for the site, as discussed further below[8].

After reviewing the RI and BRA results, the NJDEP, as the lead agency, issued the ROD on April 23, 1993. The ROD called for No Further Action with Maintenance and Monitoring requirements based upon the requirements of the NJDEP Natural Remediation Compliance Program described in N.J.A.C. 7:26D. The major components of the remedy include[9]:

- Maintenance of existing source control remedial measures (leachate collection and management system, emergency power supply, clay cut-off wall, protective cover systems, surface water drainage systems, passive LFG venting system, and security fence);
- Groundwater monitoring system, consisting of off-site sentinel and site perimeter monitoring wells;
- On-going monitoring of LFG, leachate, and surface water; and
- Upgrading of the passive LFG vent system.

As partial fulfillment of the ROD, the passive LFG ventilation system was upgraded through the installation of eleven (11) passive LFG vents, GV-1 through GV-11, through the clay cap along the northern portion of the Site, in July 1993[10]. The passive gas vents were converted to LFG extraction wells (EWs) in 1995, as part of an active LFG extraction system, which also included two (2) additional wells and a candlestick flare. The active LFG extraction system was expanded in 1999 with the addition of sixteen (16) EWs, EW-14 through EW-29, and associated header and lateral pipes, and a condensate line along the eastern and southeastern boundaries of

[8] USEPA, 2019
[9] Golder Associates 1993
[10] Golder Associates, 1993

the Site. In 2001, three (3) new EWs, EW-15A through EW-17A, were installed in the vicinity of gas monitoring probe (GMP) GMP-8R[11].

The Site was removed from the NPL in February 1994. Since that time, the USEPA has conducted five (5) Five-Year Review Reports to evaluate the implementation and performance of the remedy whether it remains protective of human health and the environment. The last 5th Five-Year Review Report was conducted in 2019. A Chronology of Site Events has been summarized in **Table 1**.

Table 1. Chronology of Site Events

(*Table 3 from 2019 EPA 5th Five-Year Review*)

Table 3: Chronology of Site Events	
Event	**Date(s)**
Landfill run by Monroe Township	Mid -1950s to 1968
Landfill leased and operated by Princeton Disposal	1968 to 1972
BFISJ operates Landfill after taking over Princeton Disposal	1972 to 1978
Landfill ordered closed by NJDEP after leak of Leachate	1978
Administrative Consent Order (ACO) signed by BFISJ and NJDEP	1979
Site listed on the National Priorities List (NPL)	September 1983
Work under 1979 ACO completed	1984
Second ACO signed by BFISJ and NJDEP	December 1986
Work under 1986 ACO Completed	1991
Record of Decision – No further action with maintenance & monitoring	April 23, 1993
Site deleted from the NPL	Feb. 3, 1994
First Five-Year Review completed	January 2000
Second Five-Year Review completed	April 2005
Third Five-Year Review completed	January 2009
Forth Five-Year Review completed	October 2014
Site inspection for Fifth Five-Year Review	June 12, 2019

[11] Taylor Geoservices, 2021

3.0 SUMMARY OF LANDFILL CLOSURE SYSTEMS

The engineering controls which are currently in place at the site, including the leachate collection and management system, landfill cover systems, surface water, sediment and erosion control, groundwater monitoring system, landfill gas vent system, site security fencing, and emergency power supply, and are maintained in accordance with the September 1993 Post-Closure Monitoring and Maintenance Plan prepared by Golder Associates (see **Appendix 2**).

3.1 Source Controls

3.1.1 Leachate Management System

Part of the approved closure remedy for the Landfill included the installation of the leachate collection and management system. The purpose of the leachate collection and management system is to collect and remove leachate from the Landfill. The leachate collection system consists of an approximately 7,000-ft long compacted low-permeability clay cutoff wall and passive leachate collection drain. The main components of the system are as follows:

3.1.1.1 Low Permeability Clay Cutoff Wall

The low permeability clay enhanced soil wall was installed along the outside the of the leachate line trench and was keyed into the underlying Merchantville Formation clay[12]. The clay cutoff wall could not be installed on the northern portion of the Landfill due to the absence of an underlying clay layer to key the wall into. On this portion of the Landfill, a low permeability clay cap was installed (maximum permeability of 10^{-7} centimeters per second) to minimize infiltration of precipitation[13].

3.1.1.2 Landfill Leachate Collection Drain

The landfill leachate collection system operates by both a gravity-fed system and pump station operations. Perforated piping is installed along the interior perimeter of the cutoff (slurry) wall that surrounds the Landfill. As discussed below, this perforated piping collects and deposits leachate in one (1) of three (3) pump stations, and ultimately all leachate passes through the front pump station, also known as the AB Sump[14].

[12] Excerpt from Rizzo, 1991 as reproduced in Golder Associates 22nd Annual Report, dated March 2015 included in Appendix A, Taylor Geoservices, 2021
[13] USEPA, 2019
[14] BFI, 2021

3.1.1.3 Landfill Leachate Collection System (PS-A)

The perforated collection piping from manholes (MH-) 4, 5, 6, and 7 directs leachate into Pump Station A (PS A). Inside PS A, two (2) pumps operate on a lead-lag system, guided by float level sensors, which discharge into a force main that exits into MH-3. MH-3 then gravity feeds into MH-2, then MH-1, and finally into the AB Sump. Perforated piping ends at MH-1, with solid piping to AB Sump[15].

3.1.1.4 Landfill Leachate Collection System (PS-B)

Leachate in perforated piping from MH-7, 8, 9, 10, 11, and 12 is directed into Pump Station B (PS B). Inside PS B, two (2) pumps operate on a lead-lag system, guided by float level sensors, which discharge into a force main into MH-12A. MH-12A then gravity feeds into MH-13, where the perforated piping ends. From MH-13, in solid piping, leachate gravity feeds into the AB Sump[16].

3.1.1.5 Landfill Leachate Collection System (AB Sump)

Leachate enters the AB Sump via gravity from Manholes MH-1, 2, 3, 12, 12A, and 13. Once leachate is collected in AB Sump, two (2) pumps operate on a lead-lag system, guided by float level sensors, to discharge leachate into the Underground Storage Tank (UST). From the UST, leachate is typically discharged through piping that directs liquids through the flow meter and then out to the sewer. A single pump operates in the UST with its operations guided by a float level sensor. A backup pump for the UST is maintained on site in the event of repairs or malfunction to the primary pump[17].

3.1.1.6 Landfill Leachate Discharge System (UST)

The 20,000-gallon underground storage tank (UST) is also fitted with an overflow line that feeds back to the AB Sump in the event that the UST receives to much liquid. There is also a manual valve that allows the liquid to bypass the UST, however this line is only used in emergency situations[18].

3.1.1.7 Intercepting Sewers

The leachate is conveyed in the Monroe Township sanitary sewer line to the MCUA

[15] Excerpt from BFI, 2021
[16] Excerpt from BFI, 2021
[17] Excerpt from BFI, 2021
[18] Excerpt from BFI, 2021

treatment works under a MCUA Non-Domestic Wastewater Discharge permit (permit #13036 dated August 28, 2020)[19].

Hydraulic Gradient Monitoring Wells and Piezometer SetsMonitoring well and piezometer sets were installed along transects at several locations along the leachate line to monitor hydraulic gradient in the vicinity of the leachate drain line and cut off wall. The monitoring sets in each transect generally consist of three (3) to five (5) individual piezometers or wells installed along a transect that is perpendicular to and crosses the leachate line/cutoff wall. In general, a set consists of one (1) piezometer installed directly into the gravel trench of the leachate drain line, one (1) piezometer installed directly at the cut off wall, and one (1) piezometer/well installed 5-10 feet outside of the cut off wall. In some cases, an additional piezometer or well is installed further downgradient from the outside of the cull off wall or further inside the Landfill from the leachate line/cut off wall and within the waste mass.

The purpose of hydraulic gradient monitoring is to determine local hydraulic gradients at these three (3) locations (transects) across the leachate collection line/ clay cut-off wall. The three (3) transects were defined in the ROD and the monitoring points along each are as follows:

<u>Transect 1</u>

VW-2ER	(at leachate line, in gravel on waste side)
VW-3A	(at cut off wall, in soil at the cut off wall)
VW-4A and VW-5AR	(outside cutoff wall in soil)

<u>Transect 2</u>

VW-10A	(at leachate line, in gravel on waste side))
VW-9C	(at cut off wall, in soil at the cut off wall)
VW-6R	(inside Landfill within waste mass)
VW-8B	(outside cutoff wall in soil)

<u>Transect 3</u>

VW-14E	(at leachate line, in gravel on waste side)
VW-15B	(at cutoff wall, in soil at the cut off wall)
VW-16B, VB-16C and VW-17AR	(outside cutoff wall)

As part of post-closure monitoring, a semi-annual hydraulic gradient evaluation of the monitoring well and piezometer sets is conducted along the three (3) transects located

[19] Taylor Geoservices, 2021

along the southern perimeter in the vicinity of the leachate drain line and cut off wall. The observed gradients along these transects are determined by comparing groundwater levels from monitoring points located at the leachate collection line/clay cut-off wall (VW- 2ER, VW-10A and VW-14E) to adjacent monitoring points, which are located inside and outside of the leachate collection line/clay cut-off wall. The leachate collection system should induce an inward or flat (approximately <1ft/ft) gradient toward the leachate collection line near the cutoff wall and leachate line. Flow directions on the outside of and more distant (<30 feet) from cutoff wall, however, can vary based on influence from natural groundwater levels outside of the Landfill[20].

3.1.2 Multi-layer clay cap and soil cover systems

The purpose of the engineered capping systems is to prevent exposure to buried wastes, minimize stormwater infiltration, promote surface water runoff, and prevent erosion of waste. The protective cover system is comprised of two (2) types of caps: a single layer cap consisting of 24 inches of vegetative soil; and a multilayer cap consisting (from bottom to top) of 12 inches of compacted clay with maximum permeability of 10^{-7} cm/sec, a 6-inch sand drainage layer, and 6 inches of vegetative soil. The 24-inch vegetative soil cap covers much of the southern and eastern portions of the Landfill. The multilayer cap covers the remainder of the Landfill[21].

3.2 Monitoring Systems

3.2.1 Groundwater Monitoring System

The purpose of the groundwater monitoring wells and piezometers is to detect potential migration of contaminants from the Site and to monitor groundwater elevations. In accordance with the requirements of the ROD, the groundwater monitoring wells will include a sentinel groundwater monitoring well system and a Site perimeter groundwater monitoring well system. In addition, a system of piezometers will be used to monitor groundwater levels in the vicinity of the clay cut-off wall in the southern area of the Site.

3.2.1.1 Sentinel Monitoring Wells

The general purpose of the sentinel groundwater monitoring system is to provide an early warning system for the potential migration of contaminants from source areas of the Landfill. The periodic ground water samples collected from these wells provide data

[20] Taylor Geoservices, 2021
[21] Golder, 1993

that confirms that the leachate control measures are functioning correctly and remain protective of human health and the environment.

Three (3) of the four (4) sentinel monitoring wells are located along the northern boundary of the Landfill. Well B-48 is positioned offsite to the north-center of the Landfill and is in the Magothy Formation. Wells B-1RSS and B-46 are both located onsite at the northeast corner of the Landfill and in the Merchantville and Magothy formations respectively. The fourth well (B52R) is positioned offsite to the south of the center of the Landfill and in the Merchantville formation[22].

According to the ROD, monitoring wells and piezometer sets in the Merchantville Formation along the Site's southern boundary are part of the sentinel monitoring system[23].

3.2.1.2 Perimeter Monitoring Wells

The perimeter monitoring wells are located both on site and off site and the objective of these wells is to continually evaluate the performance of the remedial system and to track groundwater quality adjacent to the Landfill.

Five (5) of the eight (8) perimeter wells are set in the Merchantville Formation: B-51SS (offsite to the west, background groundwater quality), B-53R (offsite to the east), B-46SS (onsite in the northeast), B-21R (on site in the northwest), and B-7R (offsite to the east). The remaining three (3) wells are set in the Magothy Formation: B-41R (offsite to the south), B-43R (offsite to the southeast), and B-44R (offsite to the southeast)[24].

3.2.2 Landfill Gas Vent Systems

The purpose of the passive gas venting system is to control potential migration of landfill gas. The existing gas venting system consists of 13 landfill gas vents located at each of the manholes along the leachate collection system. The system has been upgraded with the installation of 11 additional passive landfill gas vents on the northern portion of the Landfill in accordance with the ROD.

[22] Taylor Geoservices, 2021
[23] Golder, 1993
[24] Taylor Geoservices, 2021

4.0 RECENT COMPLAINTS AND EVENTS

Between August and September 2020, a series of odor complaints by residents of neighboring housing developments were reported to the Township and BFI. The NJDEP subsequently ordered BFI to discontinue the discharge of landfill leachate to the sanitary sewer pending further investigation and utilize a truck and haul operation to remove leachate from the site on a daily basis. On September 23, 2020, BFI temporarily discontinued the discharge of landfill leachate to the sanitary sewer and began hauling leachate off-site on September 26, 2020. Since then, there have been ongoing communications between the Township and BFI, NJDEP, EPA, and the respective parties' consultants to evaluate and remediate ongoing concerns pertaining to the storage and management of landfill leachate generated at the site including storage capacity issues, several recent leachate spills, increased truck traffic due to off-site leachate hauling operations, and continuous odors generated from the leachate reportedly permeating surrounding neighborhoods. These concerns have raised additional questions by the Township and public regarding the proper closure of the Landfill and effectiveness of post-closure maintenance and monitoring.

4.1 Odor Complaints

Township residents started reporting odor complaints between August 4 and August 13, 2020. On September 16 and 17, 2020, residents observed additional odors and reported them to the Township's office. Although multiple odor complaints were received during this period indicating a potentially worsened odor issue, odor has reportedly been an issue in the surrounding neighborhoods for many years according to many residents and Township officials. Since this time, many more complaints have been received by Township residents following the cessation of leachate disposal into the public sanitary sewer, indicating that other potential causes and/or pathways may exist and should be investigated.

4.2 Leachate Spill Incidents

When BFI ceased discharging leachate from the Landfill Site into the Township's sewer collection system, they instituted a temporary procedure to store leachate in a series of storage tanks adjacent to the Landfill entrance off Lani Street. The stored leachate is then pumped into tanker trucks and hauled to off-site facilities. Since the time the truck and haul operation were implemented in September 2020, BFI is responsible for at least six (6) leachate spills into residential streets and storm sewers[25], including but not limited to, the following incidents identified in our review of available documentation:

[25] Dalina, 2021

- **NJDEP Incident No. 20-11-21-1256-49:** On Saturday, November 21, 2020 at approximately 6:35 am, the Township was notified by a neighborhood resident of a spill situation at the Landfill site. The resident observed a substance coming from the above ground tanks, making its way down the gravel driveway into the road. The estimated volume of waste discharged was initially reported as 4 gallons and has been revised to 200-800 gallons.

- **NJDEP Incident No. 20-12-24-1035-18:** Between December 24 and December 28, 2020 three (3) more spill incidents occurred at the Landfill Site:
    - 12/24/2020: Surcharge of liquids at Manhole 10 (MH-10)
    - 12/25/2020: Surcharge of above-ground storage tank due to high flows during rain event
    - 12/28/2020: Second surcharge of MH-10

- **March 13, 2021:** The Township received an update from a resident at 1:00 pm that a red storage tank was overflowing with leachate onto Lani Street (near Lori Street).

5.0 LEACHATE QUANTITY AND QUALITY CHARACTERISTICS

In the May 2021 Leachate Reintroduction Plan, BFI claims that the leachate quantity and quality characteristics have not changed. There is evidence that in both cases, these claims do not reflect the recent data and are inaccurate.

Leachate Quantity

Specifically, the Reintroduction Plan states "In the first eight (8) months of 2020, the Landfill discharged 7.9 million gallons of leachate to the sewer. This is a little less (3% less) than the average amount of leachate discharged from the Landfill in the January through August period since 2013—in other words, leachate is being produced in 2020 at about the same rate as the last seven (7) years"[26]. In addition, the 27th Annual Post-Closure Environmental Monitoring Report states, "These volumes are generally consistent with the recent past, dating back to 2016"[27].

Comparison of the Leachate Discharge Volume data for the period between October 1, 2019 – September 30, 2020 provided in **Table 2**, as reproduced from the 27th Annual Post-Closure Monitoring Report, with the data in **Table 3** which lists the leachate hauling volumes for the 6-month period between December 30, 2020 – June 30, 2021 shows a significant increase in the volume of leachate being produced at the Landfill. For the **one-year period** between October 1, 2019 – September 30, 2020, it is reported that **9,592,267** gallons of leachate were discharged. In the **six-month period** between December 30, 2020 – June 30, 2021, data obtained from the BFI Hauling Summary spreadsheet indicates **10,547,300** gallons were hauled off site. Thus, this is a significant change in leachate quantities from prior years reporting.

[26] BFI, 2021
[27] Taylor Geoservices, 2021

Table 2. Monthly Leachate Discharge Volumes
October 1, 2019 – September 30, 2020
(from 27th Annual Post-Closure Monitoring Report, Taylor Geoservices, 2021)

Reporting Month	Volume Discharged
October (2019)	399,661
November (2019)	289,112
December (2019)	609,261
January (2020)	828,188
February (2020)	514,382
March (2020)	1,271,864
April (2020)	292,615
May (2020)	1,429,187
June (2020)	1,754,702
July (2020)	1,331,454
August (2020)	490,600
September (2020)*	381,241
Annual Total	**9,592,267**

*Leachate discharge to sewer ceased September 23, 2020

Table 3. Monthly Leachate Hauling Volumes
December 30, 2020 – June 30, 2021

BFI Hauling Summary (December 20, 2020 through June 30, 2021)	
Reporting Month	Volume Hauled
December 30 – 31 (2020)	128,500
January (2021)	1,751,800
February (2021)	1,306,000
March (2021)	2,187,000
April (2021)	2,150,000
May (2021)	1,470,000
June (2021)	1,554,000
6-Month Total	**10,547,300**

Starting in 2020, the Landfill's maximum allowable daily discharge into the public sewer system was 70,000 gallons (as stipulated in the MCUA wastewater discharge permit). If the daily leachate generation is approaching or exceeds the daily discharge limit, the automatic pumping controls will slow down and then stop the pumps. The automatic valving controls will switch the discharge direction to have flows directed into onsite storage. After the appropriate valves have

been opened or closed, flow will resume to fill the onsite tanks. At the start of a new day the lines will begin discharging to the sewer system again.

BFI prepared an area to store five (5) 21,000-gallon storage vessels (frac tanks), all within secondary containment to protect surface water in the event of leak or spill. These vessels will provide approximately 105,000 gallons of additional storage capacity[28].

Leachate Quality

BFI claimed in the May 2021 Reintroduction Plan that the chemical characteristics of the leachate have remained about the same over the last three (3) years[29].

The leachate collection system and discharge to the Publicly Owned Treatment Works (POTW) is to be monitored in accordance with the MCUA Non-Domestic Wastewater Discharge permit. As reported in the 27th Annual Post-Closure Environmental Monitoring Report, the required sampling and analyses were conducted in accordance with the MCUA Permit. Leachate is sampled semi-annually for Total Toxic Organics (TTO), biological oxygen demand (BOD), chemical oxygen demand (COD), Total suspended solids (TSS), petroleum hydrocarbons, and total organic carbon (TOC). Specified inorganic parameters are sampled quarterly, pH is tested on a monthly basis, and flow rate is measured continuously[30].

Monthly Self-Monitoring Reports (SMRs) are prepared and submitted to the MCUA by BFI. These SMRs include the analytical results along with the monthly leachate flow volumes. As reported in the May 2020 SMR, the loading value for TTO at Discharge Point-1 was calculated to be 0.714 kg/day based on the May 21, 2020 TTO sample and the May 1 through May 31, 2020 flow rates. The Non-Domestic Wastewater Discharge Permit (#13036, dated August 5, 2015) then in effect for the discharge indicated that the maximum mass loading limit for the sum of detected TTO parameters was 0.484 kg/day. On August 11, 2020, the MCUA issued a Notice of Violation (NOV) to BFI for this exceedance. BFI subsequently submitted a written response to the NOV via a letter dated August 20, 2020 which suggested additional follow-up sampling[31].

Via correspondence dated August 28, 2020, MCUA updated/revised the Wastewater Discharge Permit, and the daily maximum loading for TTO increased from 0.484 kg/day to 0.564 kg/day. The updated/revised MCUA permit #13036 went into effect on September 1, 2020. The

[28] BFI, 2021
[29] BFI, 2021
[30] Taylor Geoservices, 2021
[31] Taylor Geoservices, 2021

TTO loading result for September 2020 was 0.416 kg/day and is based on a detection total of 10.47 mg/l and an average flow for the month of 0.0105 MGD. This TTO loading amount was less than updated permit limit of 0.564 kg/day[32].

Stantec Leachate Gas Sampling Event October 19, 2020

Stantec conducted a leachate gas sampling program and collected a total of four (4) samples of vapor from the UST.

UST Vapor Sampling

A total of 26 individual VOCs from the standard analyte list and 23 TICs were identified in one (1) or more samples collected from the UST. Detected concentrations were lower in samples collected during stagnant conditions as compared to turbulent conditions. This suggests that turbulence was associated with increased volatilization of VOCs in leachate to the vapor phase in the UST. In general, concentrations in both the morning and afternoon turbulent samples were similar.

Six (6) VOCs were detected at concentrations that exceed AIHA odor thresholds: 1,2,4-Trimethylbenzene, 1,3,5- Trimethylbenzene, Ethylbenzene, m&p Xylenes, o Xylene, and Toluene. The odor thresholds for these six (6) compounds are approximately 100 to 1,000 times lower than their associated occupational TLV concentrations. For example, toluene had the highest sample results of all compounds detected in vapor samples. The highest concentration of toluene, 189.3 parts per billion (ppb) was reported in the turbulent morning sample. This concentration was higher than the AIHA odor threshold for toluene of 21 ppb, but less than one percent (1%) of the occupational TLV of 20,000 ppb (100 times lower). All compounds in the morning stagnant sample were less than their associated odor thresholds. The six (6) compounds that were detected at concentrations exceeding their odor thresholds (listed above) are commonly associated with petroleum products. Carbonyl Sulfide and Sulfur Dioxide, reported as a single concentration, were the only reduced sulfur compounds detected in the vapor samples. The detected concentrations were similar, regardless of operating condition (stagnant v turbulent) or time of day and were below AIHA odor thresholds[33].

UST Leachate Sampling

A total of twenty-three (23) individual compounds were detected in the leachate samples. Fifteen (15) of the twenty-three (23) compounds were also detected in the vapor samples,

[32] Taylor Geoservices, 2021
[33] Stantec, 2020

suggesting a high degree of concordance between compounds detected in leachate and vapor. The compounds in vapor that exceeded AIHA odor thresholds (1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Ethylbenzene, m&p Xylenes, o Xylene, and Toluene) were all present in leachate.

VOCs were detected in both leachate and vapor inside the UST. There was a high degree of concordance between the compounds detected in leachate and vapor inside the UST. The petroleum signature associated with the group of compounds detected above their AIHA odor thresholds could be consistent with the residents' complaints of "turpentine" or "acetone" odors[34].

January 19, and 20, 2021 Jacobs Odor Study:

Task 2 work was focused on obtaining the necessary data to allow identification of odor strength, odor causing compounds and potential hazardous compounds. Jacobs prepared a Sampling Plan which MTUD staff and Jacobs staff executed on December 2, 2020. Liquid samples were collected from the key locations:

- landfill leachate from the leachate collection buffer tank on the Landfill site, and
- sewage from the sewage collection system downstream of the leachate discharge point near the impacted homes on Michelle and Lori Street.

The results show that:

1. The odor character of the leachate is significantly more intense and less pleasant when compared to the odor character of the sewage. The odorous chemical compounds detected in the leachate explain the general odor description ('*chemical', 'gasoline', 'solvent', 'diesel'*) of the leachate at the time of the sampling.
2. The odor emission rate will be significantly higher from the leachate when compared to the sewage, especially when the leachate pumping rate is around 80 gpm and the daily average sewage flowrate in the Michelle Street sewer is estimated to be about 7.5 gpm. is expected that sewage turbulence will increase during periods of higher residential water use (diurnal peaks) as compared with the average sewage flowrate of 7.5 gpm; this may also increase the odor emission rate of the liquids. Therefore, caution is recommended when considering the future leachate pumping rates into the sanitary sewer system.

[34] Stantec, 2020

3. Multiple hazardous compounds have been identified in the leachate. Based on the samples taken on December 2, 2020, it is expected that the exposure compound concentrations in the residential neighborhood and homes along the sewer alignment that conveys leachate are most likely not exceeding the exposure limits as recommended by the National Institute for Occupational Safety and Health (NIOSH). Although the chemical compound concentrations appear to be below the NIOSH Recommended Emission Limits (REL), the compounds are toxic substances and should not be in people's homes. It also needs to be noted that the leachate sample taken on December 2 was relatively dilute when compared to what is typical for leachate; therefore, if the leachate were to become more concentrated with contaminants, it is expected that concentrations in air would be higher than noted in this memorandum and may exceed their REL.
4. The liquid quality of the leachate seems typical for sanitary landfill leachate; however, appears to be relatively dilute as compared with typical leachate (i.e. BOD and COD concentrations). Based on the parameters measured of both the sewage and the leachate it is not expected that the sewer water chemistry is making the leachate smell significantly worse when mixed in the sanitary sewer flow. However, there is a potential for the pH of the leachate to become slightly higher when blended with the sanitary flow, potentially promoting the emissions of ammonia from the leachate, while the pH of the sewage will become slightly lower, potentially promoting the emissions of odorous hydrogen sulfide and methyl mercaptan from the sewage.

Increased OERs can be expected at elevated temperature of the liquid (summer), but in this situation, especially when there is increased sewer flow turbulence, which is very likely to correlate with higher leachate pumping rates and durations. The level of turbulence can be expected to be the main driver for the actual odor emission rate (OER) as the volatilization rate of the odor causing compounds is an exponential correlation with the level of turbulence. A higher liquid flow rate (or pump rate in case of the leachate) will increase the turbulence in the sanitary sewer flow and thus the volatilization of odorous chemicals from the leachate, increasing the actual odor emission rate. The Total Odor Emission Capacity (the specific OEC multiplied by the liquid flow rate) from the leachate flow is already one (1) order of magnitude (1 order of magnitude = 10 times) higher when compared to the sewage flow (175,600 OU/hour versus 14,000 OU/hour as shown in Table 1). Combined with the increased turbulence of the higher leachate flow (80 gpm versus 7.5 gpm for the daily average sewage flow) it can be expected that the actual odor emission rate (OER) from the leachate will be significantly more than one (1) order magnitude higher as compared to the sewage OER[35].

[35] Jacobs, 2021 Technical Memorandums

6.0 SUMMARY OF MAY 13, 2021 BFI LEACHATE REINTRODUCTION TO SANITARY SEWER PLAN

On May 13, 2021, BFI submitted to NJDEP a Report entitled "Leachate Reintroduction to Sanitary Sewer Plan", prepared by its consultant, SCS Engineers ("May 2021 BFI Leachate Reintroduction Plan"). BFI claims that the report incorporates "…efforts taken by BFI and its consultants to assess the potential source of odors related to leachate discharge through the sanitary sewer and accompanying efforts to provide a safe means for reintroduction of leachate."

The May 2021 BFI Leachate Reintroduction Plan appears to be a compilation of various Appendices, responding to the Township and its consultant, EPA, and NJDEP comments, and various Attachments, outlining the elements of the leachate management and reintroduction to the sanitary sewer as follows:

List of Appendices:

APPENDIX A- Response to Jacobs Engineering Comments

APPENDIX B- Response to EPA Comments

APPENDIX C- Response to EPA Comments

APPENDIX D- Response to MTUD Comments

APPENDIX E - Response to NJDEP Comments

List of Attachments:

Attachment A- Sewer Evaluation

Attachment B- Background Flow Evaluation and Clean Water Injection Testing

Attachment C- Background Flow Evaluation and Clean Water Testing

Attachment D- Leachate Reintroduction Plan

Attachment E- Discussion of Data

Attachment F- Data Graphs

Attachment G- Data Challenges

Attachment H- Site Layout

Attachment J- Tank Containment and Road Improvements

The May 2021 BFI Leachate Reintroduction Plan lists certain investigations and response actions through January 4, 2021, following the odor complaints received in August and September, leading to discontinuing the discharge of landfill leachate to the sanitary sewer on September 23, 2020, as follows:

- 9/23/2020 Evaluated pump operations and discharge into sewer system; last day the Landfill discharged into public sewer system.
- 9/26/2020 Landfill commenced use of tanker trucks to haul liquids to wastewater treatment plant.
- 10/8-9/2020 Cleaned AB Sump, Discharge lines from UST to sewer, and other on-site sewers feeding the AB Sump.
- 10/13/2020 MTUD inspected select sewer lines along Lani and Lori Streets and all of Michelle Street.
- 10/19/2020 Stantec, retained by BFI, collected Air and Liquid Samples at the leachate storage underground storage tank (UST).
- 10/22/2020 Made improvements to the storm water channel located outside the fence
- 10/30/2020 Installed the first of two (2) 21,000-gallon tanks to provide additional capacity and flexibility in matching liquid generation and discharge to sewer.
- 11/3/2020 A variable frequency drive (VFD) was installed in the UST pump control panel.
- 11/4/2020 UST was cleaned.
- 11/5/2020 Additional liquid sampling occurred on-site.
- 11/10/2020 Conducted first smoke test at resident's home.
- 11/10/2020 Additional air and liquid sampling was completed at the UST and other key structures on the site.
  Installed the second of two (2) temporary 21,000-gallon tanks to provide additional capacity and flexibility in matching liquid generation and discharge to sewer.
- 12/2/2020 Additional liquid sampling was completed at the UST
- 12/11/2020 Installed hard piping from UST to two (2) above-ground tanks for protection against freezing
- 12/24/2020 Surcharge of liquids at Manhole 10 (MH-10), upstream of Pump Station B (PS B). Emergency response team (First Call Environmental) mobilized to deploy oil booms and absorbent material along fence perimeter and along ditch outside of property. MTUD (Jet/Vacuum Truck and Crew) assisted with removing liquid from PS B.
- 12/25/2020 Surcharge of above-ground storage tank due to high flows during rain event. Cleanup on 12/26 included deployment of absorbent material. Emergency response team on site to assist with cleanup and to check MH-10 absorbent material.
- 12/28/2020 Second surcharge of MH-10. MTUD again assisted with removing liquid from PS B via vacuum truck. Emergency response team on site to assist with cleanup and deploy additional adsorbent materials around MH-10
- 12/29/2020 Delivery of eleven (11) temporary storage tanks to assist with removing liquids out of PS B and MH-10. Start of 24-hour observations and pumping at PS B and MH-10 to on-site storage tanks

- 12/30-31/2020 Third and fourth temporary tanks delivered to front of site to supplement two (2) existing tanks. Start of second hauler company with transportation and treatment at Baltimore, Maryland treatment facility. Second hauler focused on removing liquids from tanks near PS B.
- 1/4/2021 Smaller tanks were swapped for larger tanks near PS B. Daily trucking quantities increased

A brief summary regarding the Landfill's leachate infrastructure and the public sewer infrastructure where the leachate previously discharged is provided below, which is excerpted from the May 2021 BFI Leachate Reintroduction Plan.

Landfill Leachate Infrastructure:

The Landfill collects leachate through underground perforated piping and discharges it into the AB Sump. Leachate is pumped out of the AB Sump into the UST. From the UST, a level-controlled pump periodically pumps the leachate out of the tank and into a pipeline that flows through the flow meter. After passing through the flow meter the leachate discharges into the Township's sanitary sewer system in MH-1 at Lani Street (see **Appendix 3**).

Township's Sanitary Sewer Infrastructure:

Leachate travels in an 8-inch pipe that gravity drains east along Lani Street. Several homes along Lani Street and Guinevere Road discharge into this sewer line. Ultimately, this line flows to a manhole (MH-4) located at the intersection of Lani Street and Michelle Street. This manhole also collects liquids from homes along Launcelot Lane. From MH-4 an 8-inch gravity sewer flows north under Michelle Street through additional manholes (MH-5 and MH-6). Homes on either side of Michelle discharge into this sewer line. Ultimately, this 8-inch pipe discharges into a manhole (MH-7) located at Lori Street and Michelle Street (see **Appendix 3**).

Sewer Size Evaluation:

The evaluation disregards sewer air dynamics to determine the theoretical limiting size of the sewer, which is solely based on liquid flow mechanics. The capacity of half-full sewer pipes in the system range from a low of 207 gallons per minute (gpm) to a high of 625 gpm. The section with the lowest flow capacity may limit the flow through the sewer system unless another reach of the sewer is determined to be the limiting factor due to air restrictions within the sewer. It appears that the sewer reaches between MH-3 and MH-4 on Lani or MH-6 and MH-7 on Michelle Street have the most limited ability to transmit sanitary sewer flows.

The sewer pipe between MH-6 and MH-7 on Michelle Street is one of the most limiting sections. Thirty-six (36) homes contribute to this section and thus peak diurnal residential loading is expected to be 36 X 0.5 gpm = 18 gpm. In other words, even if this section of sewer pipe contained 18 gpm (4.6% of the total daily flow from 36 houses), it still would have about 200 gpm of available capacity. Similarly, MH-3 and MH-4 has the same result with about 200 gpm of available capacity. This is more than double and, in some cases, quadruple the rate at which the Landfill currently intends to inject leachate.

For this investigation, it was assumed that the sanitary sewer system for each home is capable of preventing sewer gas infiltration into the home from the sewer system from pressurizations up to 2 in-w.c. at each trap; 75% of that assumed minimum capacity was used as a design threshold.

The May 2021 BFI Leachate Reintroduction Plan claims that it is also possible that elevated flows for extended duration within the sewer system made localized air pressure points within the sewer system that then pushed sewer gases into residences.

The May 2021 BFI Leachate Reintroduction Plan presented the studies and evaluations of the Background Flow Evaluation and Clean Water Injection Testing in **Attachments B** and **C**.

Background Flow Evaluation and Clean Water Injection Testing:

Background monitoring plan was prepared to monitor the sanitary sewer system using flow meters, pressure transducers and photo-ionization detectors to document sewer flows, sewer gas pressures, and the presence of volatile gases escaping the sewer on a typical day.

Three (3) temporary flow meters were installed and monitored along the sewer path that leachate normally flowed. No leachate flow was present since the discharge to the public sewer line was discontinued on September 23, 2021. A total of three (3) temporary flow meters were installed along the sewer route (two (2) in MH-4, and one (1) in MH-7). These meters provided information on the community usage during background conditions and generated a background diurnal curve for flow through MH-7.

A total of seven (7) pressure transducers were temporarily placed in each manhole along the route from MH-1 to MH-7. Pressure readings within each manhole documented the pressures in the sewer system.

Photo Ionization Detectors (PIDs) were utilized to periodically inspect around the manhole lids to test for evidence of pressurized sewer gases and VOCs escaping the sanitary sewer system during the initial background phase, and clean water phase.

The intent of injecting clean water into the sanitary sewer system was to find the points at which the sanitary sewer is stressed, causing excessive sewer air pressurization/depressurization. Clean water test was conducted at various flow rates of 45 gpm, 60 gmp, 75 gmp, and 90 gmp for the duration of 60 minutes.

The observed pressure and flow data for the initial monitoring period from 2/5/2021 through 2/10/2021 were graphed when no leachate was entering the system from the Landfill. The data indicated that the sanitary sewer system appeared to be operating normally for the monitoring period, without any significant pressure events observed. Monitoring data of the sewer system identified typical diurnal flow patterns associated with residential systems, and an average flow of 8 gallons per minute through MH-7. The monitoring also documented peak flows of 29 gpm, maximum depth of approximately 1.75 inches. These flow observations appear to be well within the design parameters of the system.

The May 2021 BFI Leachate Reintroduction Plan presented the Leachate Reintroduction Plan in **Attachment D**.

Leachate Reintroduction Plan:

This Plan included monitoring both during baseline sewer conditions and during periods when clean water was discharged to the sewer to simulate leachate discharges in addition to baseline conditions.

Clean Water Injection Testing, also referred to as "Sewer Pressure Study", was conducted once on February 17 and three (3) times on March 2, 2021, by discharging significant amounts of clean water over a 60-minute period into the sewer to simulate releases of leachate from the Landfill. Testing Plan included injecting clean water into the sewer from the Landfill to simulate leachate flow at increasing rates of 45, 60, 75 and 90 gpm injected for one-hour periods.

Pressures were monitored in the sewer both before and after clean water discharges to evaluate if measured pressures in the sewer exceeded the pressure identified as "safe" in the Testing Plan (1.5 inches of water column pressure, or in. w.c). Clean water was discharged at 45, 60, 75 and 90 gallons per minute (gpm), and the tests were performed in

the morning and over the noon hour. During the three (3) clean water discharge events on March 2 of 60, 75, and 90 gpm, the recorded pressure at MH-5 varied between as much as +0.33 in. w.c. and as little as -0.33 in. w.c. These are far below the criterion of 1.5 in. w.c. established in the Testing Plan. Adding up to 90 gpm of clean water to the sewer system did not increase pressure in the sewer above the safe pressure limit.

Diurnal Flow Patterns were evaluated based on the flow monitoring between February 5 and March 2, 2021, inclusive, in order to understand the normal variations in flow in the system under baseline conditions. In general, flows observed in MH-7 were generally similar to the flow observed during the baseline study.

Air monitoring from the manhole covers for VOCs were conducted during background monitoring and clean water testing using a photoionization detector (PID). No VOCs were detected above natural background concentrations. It is reported that there have been some challenges related to the flow records, pressure records, and diurnal curves.

Summary and Findings of the Leachate Reintroduction Plan alleges that "Based on the investigation summarized above and, in the Attachments, the sewer system has ample capacity to support current residential usage and sufficient capacity to convey Landfill leachate discharge rates of up to 90 gpm without creating significant pressurization events in the sewer system."

In addition, the Leachate Reintroduction Plan concludes the next steps as "BFI proposes to commence initial leachate reintroduction to the sewer at 9 AM on March 15, 2021. This will provide interested parties time to review pressure and flow data and for BFI to calibrate the VFD and pump. Initial leachate reintroduction into the sewer system will be limited to 45 gpm with discharge events occurring as required. Sometime in the following week, BFI will propose a day to perform confirmatory testing to verify that leachate reintroduction into the sewer can be safely performed at 60, 75, and 90 gpm."

7.0 TECHNICAL REVIEW OF THE MAY 2021 BFI LEACHATE REINTRODUCTION PLAN

Based on the review of available documents, it is Mr. Turan's expert opinion with a reasonable degree of scientific certainty that the May 2021 BFI Leachate Reintroduction to Sanitary Sewer Plan failed to demonstrate the potential cause of odors emanating from landfill leachate discharge into the public sanitary sewer since at least August 2020, and provide technical justifications that the leachate reintroduction to the public sewer system would be safe and protective of human health and the environment. We offer the following rebuttal to multiple claims made by BFI and its consultants.

1. **Page 3 of the Memorandum, prepared by SCS Engineers, dated January 6, 2021, revised February 8, 2021, which is a part of the May 2021 BFI Leachate Reintroduction to Sanitary Sewer Plan indicates:**

   "Leachate quantity and quality characteristics have not changed."

   Comparison of the Leachate Discharge Volume data for the period between October 1, 2019 – September 30, 2020 provided in **Table 2**, as reproduced from the 27th Annual Post-Closure Monitoring Report, with the data in **Table 3** which lists the leachate hauling volumes for the 6-month period between December 30, 2020 – June 30, 2021 shows a significant increase in the volume of leachate being produced at the Landfill. For the **one-year period** between October 1, 2019 – September 30, 2020, it is reported that **9,592,267** gallons of leachate were discharged. In the **six-month period** between December 30, 2020 – June 30, 2021, data obtained from the BFI Hauling Summary spreadsheet indicates **10,547,300** gallons were hauled off site. Thus, this is a significant change in leachate quantities from prior years reporting.

   Monthly Self-Monitoring Reports (SMRs) are prepared and submitted to the MCUA by BFI. As reported in the May 2020 SMR, the loading value for Total Toxic Organics (TTO) at Discharge Point-1 was calculated to be **0.714 kg/day** based on the May 21, 2020 TTO sample and the May 1 through May 31, 2020 flow rates. The Non-Domestic Wastewater Discharge Permit (#13036, dated August 5, 2015) then in effect for the discharge indicated that the maximum mass loading limit for the sum of detected TTO parameters was **0.484 kg/day**. On August 11, 2020, the MCUA issued a Notice of Violation (NOV) to BFI for this exceedance. BFI subsequently submitted a written response to the NOV via a letter dated August 20, 2020 which suggested additional follow-up sampling (Taylor Geoservices, 2021). Via correspondence dated August 28, 2020, MCUA updated/revised the Wastewater Discharge Permit, and the daily maximum loading for TTO increased from 0.484 kg/day to **0.564 kg/day**. The updated/revised MCUA permit #13036 went into effect on September 1, 2020. Thus, the calculated TTO of **0.714 kg/day**,

which resulted a NOV is a recent change reflective of leachate quality being discharged from the Landfill that contains higher toxic substances.

The BFI's allegation "leachate quantity and quality characteristics have not changed" is flawed. Therefore, the proposed Leachate Reintroduction Plan is not the safe means for leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

2. January 19, and 20, 2021 Jacobs Odor Study

On December 2, 2020, Jacobs conducted a study and collected liquid samples from landfill leachate at the leachate collection buffer tank on the Landfill site, and sewage from the sewage collection system downstream of the leachate discharge point near the impacted homes on Michelle and Lori Street. The results show that:

- The odor character of the leachate is significantly more intense and less pleasant when compared to the odor character of the sewage. The odorous chemical compounds detected in the leachate explain the general odor description ('*chemical', 'gasoline', 'solvent', 'diesel'*) of the leachate at the time of the sampling.
- The odor emission rate will be significantly higher from the leachate when compared to the sewage, especially when the leachate pumping rate is around 80 gpm and the daily average sewage flowrate in the Michelle Street sewer is estimated to be about 7.5 gpm is expected that sewage turbulence will increase during periods of higher residential water use (diurnal peaks) as compared with the average sewage flowrate of 7.5 gpm; this may also increase the odor emission rate of the liquids. Therefore, caution is recommended when considering the future leachate pumping rates into the sanitary sewer system.
- Multiple hazardous compounds have been identified in the leachate. Based on the samples taken on December 2, 2020, it is expected that the exposure compound concentrations in the residential neighborhood and homes along the sewer alignment that conveys leachate are most likely not exceeding the exposure limits as recommended by the National Institute for Occupational Safety and Health (NIOSH). Although the chemical compound concentrations appear to be below the NIOSH Recommended Emission Limits (REL), the compounds are toxic

substances and should not be in people's homes. It also needs to be noted that the leachate sample taken on December 2 was relatively dilute when compared to what is typical for leachate; therefore, if the leachate were to become more concentrated with contaminants, it is expected that concentrations in air would be higher than noted in this memorandum and may exceed their REL.

- The liquid quality of the leachate seems typical for sanitary landfill leachate; however, appears to be relatively dilute as compared with typical leachate (i.e. BOD and COD concentrations). Based on the parameters measured of both the sewage and the leachate it is not expected that the sewer water chemistry is making the leachate smell significantly worse when mixed in the sanitary sewer flow. However, there is a potential for the pH of the leachate to become slightly higher when blended with the sanitary flow, potentially promoting the emissions of ammonia from the leachate, while the pH of the sewage will become slightly lower, potentially promoting the emissions of odorous hydrogen sulfide and methyl mercaptan from the sewage.
- Increased odor emission rates (OERs) can be expected at elevated temperature of the liquid (summer), but in this situation, especially when there is increased sewer flow turbulence, which is very likely to correlate with higher leachate pumping rates and durations. The level of turbulence can be expected to be the main driver for the actual OER as the volatilization rate of the odor causing compounds is an exponential correlation with the level of turbulence. A higher liquid flow rate (or pump rate in case of the leachate) will increase the turbulence in the sanitary sewer flow and thus the volatilization of odors from the leachate, increasing the actual odor emission rate. The Total Odor Emission Capacity (the specific OEC multiplied by the liquid flow rate) from the leachate flow is already one (1) order of magnitude (1 order of magnitude = 10 times) higher when compared to the sewage flow (175,600 OU/hour versus 14,000 OU/hour). Combined with the increased turbulence of the higher leachate flow (80 gpm versus 7.5 gpm for the daily average sewage flow) it can be expected that the actual odor emission rate (OER) from the leachate will be significantly more than one (1) order magnitude higher as compared to the sewage OER.

The May 2021 BFI Leachate Reintroduction to Sanitary Sewer Plan failed to address the adverse effects of mixing the landfill leachate with domestic sewer as indicated in the conclusions of the Jacobs study.

Therefore, the proposed Leachate Reintroduction Plan is not the safe means for

leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

3. November 6, 2020 Stantec Technical Memorandum- Leachate Gas Sampling Event

Four (4) grab vapor and leachate samples were collected from the UST. The results show that:

- A total of twenty-six (26) individual VOCs from the standard analyte list and twenty-three (23) TICs were identified in one (1) or more vapor samples collected from the UST. Detected concentrations were lower in samples collected during stagnant conditions as compared to turbulent conditions. This suggests that turbulence was associated with increased volatilization of VOCs in leachate to the vapor phase in the UST.
- A total of twenty-three (23) individual compounds were detected in the leachate samples. Fifteen (15) of the twenty-three (23) compounds were also detected in the vapor samples, suggesting a high degree of concordance between compounds detected in leachate and vapor. The compounds in vapor that exceeded AIHA odor thresholds (1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, Ethylbenzene, m&p Xylenes, o Xylene, and Toluene) were all present in leachate.
- The petroleum signature associated with the group of compounds detected above their AIHA odor thresholds could be consistent with the residents' complaints of "turpentine" or "acetone" odors.

The May 2021 BFI Leachate Reintroduction to Sanitary Sewer Plan failed to address the adverse effects of mixing the landfill leachate with domestic sewer as indicated in the conclusions of the Stantec study.

Therefore, the proposed Leachate Reintroduction Plan is not the safe means for leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

4. Recommendations from Review of 12/2/2020 SCS Engineers Memo (Appendix A)

"Clearly identify the cause(s) of the odor complaints that were encountered in August and September 2020. Relate the leachate pumping activities to the odor complaints. Include any other information that may be relevant, including; weather, etc."

BFI's response to the question above recognizes the fact that "As was verified by Jacobs Engineering, (de)pressurization of the sanitary sewer is believed to be the cause of odor detections and subsequent complaints. Sustained flow at a rate of approximately 87 gallons per minutes was indicated as the likely cause of (de)pressurization." However, Leachate Reintroduction Plan presented in **Attachment D** alleges that "Adding up to 90 gpm of clean water to the sewer system did not increase pressure in the sewer above the safe pressure limit." The Clean water injection testing performed at 45, 60, 75 and 90 gpm in absence of considerations for any vapor pressure from VOCs did not prove anything new other than indicating that the existing sewer pipe system has the hydraulic capacity and conveyance of the liquid. BFI indicates in Sewer Size Evaluation section of its Report that "The evaluation disregards sewer air dynamics to determine the theoretical limiting size of the sewer, which is solely based on liquid flow mechanics. The capacity of half-full sewer pipes in the system range from a low of 207 gallons per minute (gpm) to a high of 625 gpm." The Leachate Reintroduction Plan fails to correlate the leachate flow rates to "the likely cause of (de)pressurization in the sewer lines."

Therefore, the proposed Leachate Reintroduction Plan is not a safe means for leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate to directly to the Middlesex County Treatment Facility.

"Provide a solid basis for a proposed plan to reintroduce leachate flow into the municipal sewer system that eliminates the possibility of residents being exposed in their homes and neighborhood to odors generated from discharge of the landfill leachate to the sewer system."

BFI falsely claims that "Leachate discharge through a sanitary sewer is a common practice in landfill management and is a much safer process than other methods such as hauling leachate in tanker trucks. Assessment of the sewer system itself and potential impacts from leachate discharge and development of a plan for controlled leachate reintroduction is essential for management of the landfill leachate."

The Solid Waste Regulations as indicated in N.J.A.C. 7:26-2A.7(e) provides safe means and methods of managing the landfill leachate as follows:

(e) A leachate treatment and disposal system shall be designed and constructed in accordance with the following:

1. All leachate treatment and disposal systems shall be required to obtain a NJPDES permit in accordance with the NJPDES regulations, N.J.A.C. 7:14A;

2. The leachate treatment and disposal system shall be designed in accordance with one of the following options:

i. Complete treatment on-site with direct discharge to surface or groundwater;

ii. Pretreatment on-site, if required, with discharge to an off-site treatment works for final treatment; or

iii. Storage on-site with discharge to an off-site treatment works for complete treatment.

Therefore, the proposed Leachate Reintroduction Plan is not the safe means for leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

5. Response to EPA Comments (Appendix C)

"Prolonged pumping of leachate at a rate of 80 to 85 gallons per minute (gpm) raised the pressure in the sewer pipes and forced sewer gasses into the homes near the Landfill. The Leachate Reintroduction Plan technical memorandum concluded that the sewer can accommodate a leachate flow rate of 90 gpm, without a significant rise in pressure.

The memorandum provides no explanation of why an 85 gpm leachate flow produced enough pressure in the sewer system to cause odors in homes odors and why a 90 gpm clean water flow rate produced no pressure reading in the sewer above the established testing limit. Such an explanation is needed to understand the underlying causes of the odor event, and to evaluate and develop adequate monitoring systems and controls to prevent odors entering homes in the future."

BFI fails to adequately address the concerns raised by EPA as the Leachate

Reintroduction Plan did not offer any means of correlating the clean water flow rates to the likely cause of (de)pressurization in the sewer lines. The Clean water injection testing performed at 45, 60, 75 and 90 gpm was conducted in absence of consideration for any vapor pressure from VOCs volatilization emanating from highly toxic Landfill leachate, if and when reintroduced into the public sewer system.

BFI falsely claims that "BFI has performed extensive testing to identify leachate flow rates that negatively impact the sewer; however, each test shows that the sewer system is working as designed and is not stressed, even at the maximum discharge rates that BFI is proposing." Again, BFI test study only proved that the public sewer system has the hydraulic capacity to convey clean water up to 90 gpm. The testing was done in absence of landfill leachate, and ignored the vapor pressure from VOCs volatilization of highly toxic landfill leachate, contrary to BFI's claim "testing to identify leachate flow rates."

BFI falsely claims that "Test results show that if a home has a functional P-trap and their plumbing system is not otherwise damaged, then sewer gases should not enter the home."

BFI's May 2021 Landfill Reintroduction Plan failed to demonstrate the potential cause of odors emanating from landfill leachate discharge into the public sanitary sewer, and did not consider the effects of the dynamics of volatilization of highly toxic landfill leachate mixing with less potent domestic sewage as stated in the January 20, 2021 Jacobs Memorandum, "The Total Odor Emission Capacity (the specific OEC multiplied by the liquid flow rate) from the leachate flow is already one (1) order of magnitude (1 order of magnitude = 10 times) higher when compared to the sewage flow (175,600 OU/hour versus 14,000 OU/hour). Combined with the increased turbulence of the higher leachate flow (80 gpm versus 7.5 gpm for the daily average sewage flow) it can be expected that the actual odor emission rate (OER) from the leachate will be significantly more than one (1) order magnitude higher as compared to the sewage OER."

BFI's May 2021 Landfill Reintroduction Plan ignores the presence of vapor pressure from VOCs emanating from highly toxic landfill leachate in public sewer system, which was one of the main sources of odor complaints. BFI's claim "…if a home has a functional P-trap and their plumbing system is not otherwise damaged, then sewer gases should not enter the home." is misleading the public that functional P-trap would have protected the residents from recent odor intrusions. All homes that are located within the sewer service area in Monroe Township do have the P-trap to prevent sewer gas from entering the homes. However, odor complaints were received from residents located within

the close proximity to the Landfill, where highly toxic landfill leachate was discharged into the public sewer system, not from residents located elsewhere in the Township.

BFI's May 2021 Landfill Reintroduction Plan does not consider adequate monitoring systems for real time monitoring of VOCs emanating from highly toxic landfill leachate in order to prevent odors entering homes in the future. BFI proposes to manually monitor VOC levels using hand-held PID instrument in and around sewer line manhole lids periodically, which would not prevent any future odor intrusion incident as it would not enable the operator to proactively adjust feed rate before exceeding the flow and pressure limits, specifically after hours.

Therefore, the proposed Leachate Reintroduction Plan is not the safe means for leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

6. Leachate Reintroduction Plan (Attachment D)

Summary and Findings of the May 2021 BFI Leachate Reintroduction Plan alleges that "Based on the investigation summarized above and, in the Attachments, the sewer system has ample capacity to support current residential usage and sufficient capacity to convey landfill leachate discharge rates of up to 90 gpm without creating significant pressurization events in the sewer system." In addition, the May 2021 BFI Leachate Reintroduction Plan concludes the next steps as "BFI proposes to commence initial leachate reintroduction to the sewer at 9 AM on March 15, 2021. This will provide interested parties time to review pressure and flow data and for BFI to calibrate the VFD and pump. Initial leachate reintroduction into the sewer system will be limited to 45 gpm with discharge events occurring as required. Sometime in the following week, BFI will propose a day to perform confirmatory testing to verify that leachate reintroduction into the sewer can be safely performed at 60, 75, and 90 gpm."

As indicated in Item 5 above, the Clean water injection testing performed at 45, 60, 75 and 90 gpm was conducted in absence of consideration for any vapor pressure from VOCs volatilization emanating from highly toxic landfill leachate, if and when reintroduced into the public sewer system. The testing was done in absence of landfill leachate, and ignored the vapor pressure from VOCs volatilization of highly toxic landfill leachate.

It appears that the initial leachate introduction rate of 45 gpm into the public sewer system is selected arbitrarily without any scientific basis. BFI did not offer any credible means of providing a real time monitoring for the vapor pressure from VOCs volatilization of highly toxic landfill leachate as the flow rates would be increased to 60, 75, and up to 90 gpm. Again, the Leachate Reintroduction Plan fails to correlate the leachate flow rates to the likely cause of (de)pressurization in the sewer lines.

The May 2021 BFI Leachate Reintroduction Plan indicates that "the temporary flow meters may have under-reported flows in the sewer during the clean water tests, based on a comparison of those flow results and the known clean water flow rates as measured on March 2 by the permanent and recently calibrated flow meter at the Landfill (60, 75, and 90 gpm). These known flow rates should have been added to background (13 to 20 gpm) and the total flow reflected in the flow rates reported by the meters. But as shown in the Attachment F graphs, total flows reported were less than expected flows. We know what flows of clean water were introduced to the sewer even if the temporary flow meters did not correctly report them." There appears to be unaccounted flow within the sanitary sewer system, which may be attributed to Inflow/Infiltration (I/I), a typical concern that gravity sanitary sewer lines have.

The gravity sanitary sewer system for each home is designed to prevent sewer gas infiltration into the home from the sewer system with pressurizations at least 2 in-w.c. at each P-trap. The May 2021 BFI Leachate Reintroduction Plan failed to demonstrate that pressurization events in excess of a typical residential sewer P-trap tolerances could occur due to the VOCs volatilization of highly toxic landfill leachate. A dedicated force main should be constructed for the safe disposal of leachate as the current gravity sanitary system was not designed to convey highly toxic landfill leachate/industrial waste.

The proposed Leachate Reintroduction Plan fails to recognize that well over 100 of the lateral connections on the existing gravity sewer system represent a preferential pathway directly into the homes of residents.

Therefore, the proposed Leachate Reintroduction Plan is not a safe means for leachate disposal as alleged by BFI, and it should be rejected. A dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel directly to the Avenue K sewerage pumping station, which will convey the leachate to directly to the Middlesex County Treatment Facility.

8.0 CONCLUSIONS AND RECOMMENDATONS

Based on his review of the Leachate Reintroduction Plan along with the limited documents made available to CME to date, it is Mr. Turan's expert opinion with a reasonable degree of scientific certainty that the May 2021 BFI Leachate Reintroduction to Sanitary Sewer Plan failed to demonstrate the potential cause of odors emanating from the landfill leachate discharging into the public sanitary sewer since at least August 2020, and provide technical justifications that the leachate reintroduction to the public sewer system would be safe and protective of human health and the environment. The proposed Leachate Reintroduction Plan significantly lacks the evaluation of multiphase flow and its potential effect on derated sewer line flow capacity due to the presence of untreated leachate within the conveyance system generating gases due to volatilization and denitrification processes. Particularly, the presence of gases can cause temporary blockages within the areas where pipe inverts encounter successive high and low elevation conditions. The Proposed Leachate Reintroduction Plan does not provide a safe means for leachate disposal as alleged by BFI, and it should be rejected. If the leachate is not pre-treated before discharging to the sanitary sewer, a dedicated force main should be constructed for the safe disposal of leachate from the Landfill and travel to the Avenue K sewerage pumping station, which will convey the leachate directly to the Middlesex County Treatment Facility.

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APPENDIX 1

Independent Expert's Resume

BEHRAM TURAN, P.E., LSRP

DIRECTOR OF ENVIRONMENTAL ENGINEERING SERVICES

TITLE: Principal

DEGREE:

Rutgers University, New Brunswick, NJ
Princeton University, Princeton, NJ
Advanced Graduate Level Course Work and Research in Groundwater Flow and Mass Transport, 1986-1991

Colorado State University, Fort Collins, Colorado
M.S., Hydrology & Water Resources Management, 1984

Istanbul Technical University, Istanbul, Turkey
B.S., Civil Engineering, 1980

CERTIFICATIONS:

Professional Engineer, NJ, 1995 / #24GE03921000
Professional Engineer, Delaware, 1994 / #9606
Licensed Site Remediation Professional (LSRP) in NJ, 2009 / # 591482
Certified Subsurface Evaluator in NJ, 2003 / #203210

PROFESSIONAL TRAINING

Chlorinated Solvent Site Investigation & Implementation of In-Situ Remediation (2021)

Vapor Intrusion Investigation & Mitigation Innovation Series (2021)

Remediation of Heavy Metals Using In-Situ Approaches (2021)

Geotechnical Engineering and Linear Construction During Site Remediation (2021)

RAOs – Is there Ever Finality (2021)

Using UVOST, TarGOST, and DyeLIF to Characterize NAPL (2020)

Conceptual Site Models (2020)

PCB Remediation – What Every LSRP Needs to Know (2018, 2020)

Vapor Mitigation Design and Installation (2020)

Variances – Diverging from a Rule while Successfully Achieving Rule Objectives (2020)

What SRRA 2.0 Means to LSRPs (2020)

Rapid Design & Analysis of Ground Water Remediation Systems (2018)

Groundwater in Fractured Bedrock (2018)

Remediation Methods for 1,4 Dioxane (2018)

In-Situ Chemical Oxidation Developments (2018)

LSRPA Regulatory Roundtable (2018, 2020, & 2021)

LSRP Ethics (2017, 2020)

NJDEP Case Study Training for LSRPs (2013)

NJDEP's Regulatory Training in Underground Storage Tanks (2002, 2006, 2009, 2012, 2015, 2018)

40-hour OSHA Hazardous Waste Site Operations Health and Safety Certification (1992)

8-hour HAZWOPPER refresher (yearly since 1992)

8-hour HAZWOPPER Supervisor/Management (2006)

Extensive knowledge of surface water control models, and groundwater flow and mass transport models, including RMA2, TR55, HEC1, HEC2, MODFLOW, MT3D, SESOIL, MOC (Konikov's model) and PTC (Princeton Transport Code).

MEMBERSHIP AND AFFILIATIONS:

American Society of Civil Engineers
Solid Waste Association of North America

GENERAL QUALIFICATIONS

Mr. Turan is the Principal and Director of the Environmental Engineering Division of CME Associates. Mr. Turan has over 30 years of experience in the fields of environmental engineering, including site remediation, brownfields redevelopment, management of dredged materials and beneficial reuse, solid and hazardous waste management, hydrogeology, groundwater flow and contaminant mass transport, and water resources planning. Mr. Turan is a Professional Engineer in the state of New Jersey, a Licensed Site Remediation Professional (LSRP), and a Certified Subsurface Evaluator. Mr. Turan has issued over fifty (50) Response Action Outcomes (RAOs) since the initiation of the LSRP

Program. Mr. Turan has directed landfill engineering services including landfill design, and closure and post-closure activities. Mr. Turan has been solid waste engineer in charge of providing landfill engineering services including landfill cell design, Title V air permitting services, landfill final cap and closure designs, ground water and leachate monitoring, landfill gas sampling, and is the solid waste engineer for three (3) operating landfills in New Jersey.

SUMMARY OF EXPERIENCE:

Solid and Hazardous Waste Management

- Solid Waste Engineer in charge of providing GCIA with services for the operation and permitting of the GCSWC including: i) annual topographic survey; ii) annual engineering report; iii) annual inspection; iv) landfill gas flare emissions testing/reporting; v) surface and perimeter landfill gas monitoring; vi) statistical analyses for the Groundwater Detection Monitoring Program; vii) statistical analyses for the NJPDES permit for storm water basin recharge; viii) permit renewal and compliance assistance for the Title V Air Pollution Control Operating Permit; ix) design, contract administration, construction oversight, and inspection services for the construction of Cells 13, 14, and 15; x) preparation of the design for the Lateral Landfill Expansion of approximately 71 acres, and obtain approval for the Amendment to the Gloucester County District Solid Waste Management Plan for the Phase IX Development Lateral Expansion; xi) leachate treatment pilot study; xii) design of two pump stations for the GCUA regional sewage/leachate forcemain; xiii) prepared updates to the Landfill Closure/ Post-Closure Financial Plan; and xix) on-call services including litigation support and other services required by the Authority.
- Solid Waste Engineer in charge of providing defined and on-call professional services for the Cumberland County Landfill, as well as providing defined and on-call professional services in connection with the operation and permitting of the Cumberland County Solid Waste Complex, including: i) Annual Topographic Survey Report, ii) Annual Engineering Report, iii) Annual Inspection Report, iv) Statistical analyses associated with Groundwater Detection Monitoring Program, v) Statistical analyses associated with NJPDES permit for storm water basin recharge, vi) Design of stormwater management system including additional detention basins, vii) Design of a new infiltration basin as a part of enhanced site-wide Stormwater Management Plan, viii) Preparation of the Renewal of Solid Waste Facility Permit and Minor Modification, ix) Preparation of updates to the Landfill Closure/ Post Closure Financial Plan, x) Performance evaluation of the existing leachate treatment system and designing/overseeing the expansion plan for increased leachate treatment capacity, xi) Re-certifications of constructed landfill cells, and xii) Provisions of other on-call landfill services as necessary.
- Solid Waste Engineer for the Middlesex County Utilities Authority in connection with the operation and permitting of the Middlesex County Landfill, including NJPDES compliance services, annual inspection and report for the stormwater system and update of the Stormwater Pollution Prevention Plan (SWPP), and updates to the Middlesex County Landfill's Closure/Post-Closure Financial Plan Update. Mr. Turan recently designed and oversaw the installation of an odor control and mitigation system and interim cap at the landfill.
- In charge of providing defined and on-call services for the Monmouth County Reclamation Center Landfills, including i) Semiannual ground water protection program compliance reports for MCRC; ii) Semiannual ground water contour map for both the upper Kirkwood and Vincentown Aquifers; iii) Annual Compliance Statement, Semiannual Deviation Reports, Annual Emission Statement, Annual Greenhouse Gas Report for the MCRC Title V Operating Permit; iv) Quarterly letter report and monitoring location map for the results of perimeter gas testing at Howell Landfill; v) Semiannual letter report for the results of laboratory

gas testing from three gas vents at Howell Landfill; vi) Annual topographic report for the approximate 266-acre area of the Phase I, II and III landfills as required by N.J.A.C. 7:26-2A.8 for submission to the NJDEP; vii) Closure permit, NJPDES permit and Title V permit compliance and monitoring services; viii) Prepared updates to the Landfill Closure/ Post Closure Financial Plan including the new Lateral Landfill Expansion, and ix) On-call services include activities related to the landfill operations.

- In charge of providing Geotechnical Engineering Services Burlington County Resource Recovery Complex to assist the County with the permitting and design of the proposed Landfill No. 3 lateral expansion which is approximately 50 acres. Mr. Turan oversaw the geotechnical investigations in accordance with the NJDEP Solid Waste Regulations (NJAC 7:26-2A(6)) and the NJDEP DGW Permitting Program for Sanitary Landfills. A Geotechnical Design Analysis Report to support the Engineering Design and permitting for the proposed lateral expansion was prepared.
- In charge of providing Bergen County with professional engineering services related to the former Overpeck Landfill Areas I, II, III, and IIV in Bergen County, New Jersey, including annual waste water services, exhaust air sampling, annual pump station operation and management, alarm system calibration, quarterly groundwater monitoring, closure and post-closure operation and maintenance, quarterly NJDEP reporting, and quarterly landfill gas monitoring.
- In charge of the implementation of the landfill closure and redevelopment activities for the former City of Bayonne Landfill Site in Bayonne, New Jersey, including Fill Acceptance Protocol and Review Engineer for final cover system, design of containment system including slurry wall and leachate collection and conveyance system, operations of the leachate control system and leachate pre-treatment system, implementation of final cover system including Processed Dredged Materials, design of underslab gas ventilation system for the Club House, design of landfill gas control system and enclosed flare, and regulatory compliance for NJDEP permit requirements.
- In charge of landfill closure and redevelopment of a portion of the ILR Landfill for a proposed 550,000 SF warehouse/office building in Edison, New Jersey, including preparation of Landfill Closure and Post-Closure Care Plan, preparation of Major Landfill Disruption Permit application, preparation of landfill capping system, and preparation of landfill gas collection and conveyance system.
- In charge of landfill closure and post-closure activities for the City of Linden Sanitary Landfill in Linden, New Jersey, including design of the active landfill gas extraction and control system and enclosed flare, Quality Assurance services for the landfill closure activities including final capping system, stormwater management system, preparation of Landfill Closure and Post-Closure Plans with environmental improvements which included a slurry wall and leachate collection system. The project also included the attainment of all applicable local and state permits. Directed construction oversight for the environmental improvements of the City of Linden Landfill.
- In charge of designing a landfill gas collection system for a 330,000 square-foot warehouse building located at a former inactive dump site in Carlstadt, New Jersey. The activities included the design of an active gas extraction and underslab gas ventilation system.
- Provided services for the closure and redevelopment of a 165-acre former Elizabeth Landfill site for a major commercial facility (Jersey Gardens Mall) in Elizabeth, New Jersey. The project involved remedial investigations, feasibility studies, groundwater and surface water modeling, and design of a leachate collection system and stormwater management system as well as attainment of all related federal, state and local permits pertinent to the disruption and closure activities.

- Prepared landfill closure plans for the redevelopment of an inactive dump site for an educational institution in Passaic County, New Jersey. The project involved the design of leachate collection and conveyance system, stormwater management system, landfill gas collection and passive ventilation system, and landfill cover system.

Beneficial Reuse of Fill Materials

- Principal in charge and designated Review Engineer for imported beneficial reuse material used as part of the implementation of the Closure Plan and Redevelopment of the Overpeck Park Landfill Areas IV into a passive recreation park including Processed Dredged Materials (PDM) for capping the site and the import of clean tested soil for covering the PDM and supporting the proposed landscaping.
- Prepared Fill Acceptance Protocols and Beneficial Use Determination applications for a number of projects and successfully obtained NJDEP's approval for beneficial reuse materials including Processed Dredged Materials.
- Principal in charge and designated Review Engineer for over 2 million cubic yards of imported beneficial reuse materials used for the final cover system of the Bayonne Golf Course Redevelopment Project including the Former PSE&G site and the City of Bayonne Landfill in Bayonne, New Jersey.
- Principal in charge and designated Review Engineer for over 5 million cubic yards of imported beneficial reuse materials for shaping/grading and cover systems including Processed Dredged Materials at the Meadowlands Redevelopment Project in Lyndhurst, New Jersey.
- Principal in charge of preparation of Fill Acceptance Protocol for approximately 150,000 cubic yards of imported fill materials and Processed Dredged Materials for redevelopment of a portion of the former ILR Landfill in Edison, New Jersey.
- Providing review engineering services to the Sayreville Economic and Redevelopment Agency (SERA) regarding the acceptance of the imported fill materials (approximately 1 million cubic yards) through the process of redeveloping over 400 acres of waterfront land into a prosperous mixed-use development consisting of residential, retail, office space, hotels, entertainment and recreation in Sayreville, New Jersey.

Regulatory Compliance and Permitting

- Principal in charge of providing engineering services related to the permit renewal and compliance assistance for the Title V Air Pollution Control Operating Permit at the Gloucester County Landfill Facility.
- Principal in charge of providing engineering services for the Monmouth County Reclamation Center Landfills, including NJPDES permit and Title V permit compliance and monitoring services.
- Principal in charge of preparing design and a Pre-construction Subchapter 8 Permit Application and an Air Pollution Control Operating Permit (Title V) Application for an active gas collection system consisting of 54 gas extraction wells and an enclosed flare at the City of Linden Sanitary Landfill located in Linden, NJ.
- Principal in charge of preparing a Subchapter 8 pre-construction permit application for gas collection system consisting of 26 wells and an enclosed flare for landfill closure and redevelopment of the former City of Bayonne Landfill and PSE&G Sites to Bayonne Golf Club in Bayonne, New Jersey
- Principal in charge of preparing a Pre-construction Subchapter 8 permit application including negotiations for permit conditions with NJDEP and USEPA for landfill gas collection system consisting of 160 wells, an enclosed flare and a sub-slab ventilation system for landfill closure and redevelopment of the former Industrial Land Reclaiming Landfill to Middlesex Logistics Center Warehouse in Edison, New Jersey
- Principal in charge of preparing a Pre-construction

Subchapter 8 permit application for a passive landfill gas venting system, and a Pre-construction Subchapter 8 air permit application for the former Plainsboro Landfill in Plainsboro, New Jersey.

- Principal in charge of procuring the environmental permits for the NJTA Interchange 12 Final Improvements project including NJDEP Freshwater Wetlands General Permit Nos. 12 and 14, an Individual Freshwater Wetlands Permit/ Waterfront Development, Water Quality Certification, Transition Area Waiver and Coastal Consistency and Individual Section 10 and 404 Permit from the U.S. Army Corps of Engineers, and preparation of wetlands mitigation proposal, and engineering design of compensatory wetlands mitigation for approximately 10-acre area including the procurement of NJDEP and ACOE permit approvals.
- Principal in charge of procuring NJDEP permits for the redevelopment of a portion of ILR Landfill in Edison, NJ, including, Waterfront Development Permit, Landfill Closure and Post-Closure Plan, Major Landfill Disruption Permit, and Closure and Post-Closure Financial Plan, and Remedial Action Workplan approval.
- Principal in charge of procuring NJDEP permits for the redevelopment of a Former Hess Oil and Gasoline Bulk Storage Facility in Newark, New Jersey, including Waterfront Development Permit, Applicable Use Determination for the Dredged Processing Facility, Nationwide ACOE permit, and Air Permit for the operation of the facility.

LSRP Program Experience

- Principal and LSRP in charge performing remedial investigation and remedial action at the Former South River Metals Redevelopment Site, Aberdeen, New Jersey, and identifying an integrated planning and management strategy for remediation and ultimately redevelopment of the site. The project involved conducting a Site Investigation, Remedial Investigation, and Remedial Action for the site in accordance with NJAC 7:26E. A Remedial Action Report for Soils was submitted to NJDEP, Remedial Action Permits for soil were issued by NJDEP for each of the residential lots, restricted Use Response Action Outcomes (RAOs) for all soil AOCs were issued, and a Remedial Action Report including a classification exception area (CEA) for the groundwater and surface water contamination at the site was submitted. A Remedial Action Permit for Groundwater is pending with the NJDEP and a RAO for groundwater will be issued upon completion of the groundwater RAP.
- Principal in charge and LSRP of record for remedial investigation, remedial action workplan, and remedial action for soil and groundwater contamination associated with the former heating oil UST discharge at the Former Middlesex County Administration Building.
- Principal in charge and LSRP of record for the preparation of remedial investigation and remedial action workplan for groundwater related to the release of a former gasoline UST at the Middlesex County Improvement Authority Tamarack Golf Course in accordance with Technical Requirements for Site Remediation.
- Principal in charge and LSRP of record for the remedial investigation and remedial action conducted for areas of concern associated with former and existing USTs on the site, as well as with former auto repair operations. The site was redeveloped as a Fire House by the Borough of South River.
- Principal in charge of and LSRP of record for remedial investigation, remedial action workplan, and remedial actions for soil and groundwater contamination at the Former Wolfson Parking Deck.
- Principal in charge and LSRP of record for remedial investigation and remedial action related to the groundwater contamination emanating from former USTs for the Roosevelt Care Center in accordance with the Technical Requirements for Site Remediation.

- Principal in charge and LSRP of record for the remedial investigation, remedial action workplan, and ecological evaluation of sensitive receptors concerning heavy metals contamination of Lenape Park in Union County in accordance with Technical Requirements for Site Remediation.
- Principal and LSRP in charge of site remediation related to the closure of a regulated 1,000-gallon leaded gasoline underground storage tank and associated remediation at the Old Homestead Facility in Frankford Township in Sussex County. Based on the findings of the post-remedial soil and groundwater sampling included in the Remedial Action Report, Mr. Turan issued an unrestricted Response Action Outcome (RAO) for the former 1,000-gallon UST.
- Principal and LSRP in charge of remedial activities related to Princeton Meadows Golf Course in Plainsboro, Middlesex County, New Jersey. Remedial activities are related to the soil and groundwater contamination associated with the former five (5) USTs removed from the maintenance building area at the golf course. The required corrective actions include implementation of an interim remedial action to address remaining free product and offsite contamination.
- Principal and LSRP in charge providing LSRP services related to Multiyear LSRP services for five Road Maintenance Garage (RMG) locations within the County of Sussex. Soil and groundwater at the site are contaminated at levels above the applicable remediation standards. Remedial activities were provided under the supervision of Mr. Turan, in accordance with the Technical Requirements for Site Remediation (NJAC 7:26E), and the Administrative Requirements for the Remediation of Contaminated Sites N.J.A.C. 7:26C-6.2(c).
- Principal and LSRP in charge of a site investigation at an ISRA facility in an industrial complex in Hillsborough Township. Mr. Turan prepared all necessary documents to bring the site in compliance and issued a Response Action Outcome (RAO) for the site.
- Principal and LSRP in charge of remediation of Penska Farm located in Marlboro Township. Mr. Turan oversaw the remedial investigation and remedial action of the site and brought the site from the initial preliminary assessment report through to an RAO.
- Principal and LSRP in charge of remediation of a mixed-use lot in Jersey City. Mr. Turan oversaw remedial activities and issued a site-wide RAO for the site.
- Principal and LSRP overseeing the complete remediation from Preliminary Assessment through Remedial Action for a child-care center in the City of Clifton. Mr. Turan conducted remedial activities and issued an unrestricted use RAO for a child-care center.
- Principal and LSRP in charge of bringing a vacant site into compliance for the Woodbridge Redevelopment Agency along Lincoln Highway in Woodbridge for open space. Mr. Turan oversaw the site from the site investigation through remedial action and restoration of the site. Upon completion, an RAO was issued for this site.
- Principal and LSRP in charge of a 100.34-acre open space site in Monroe Township for Middlesex County. Mr. Turan prepared a Remedial Action Work Plan to address areas of concern at the site. After execution of the workplan, Mr. Turan issued an unrestricted use AOC-based RAO for the site.
- Principal and LSRP in charge of conducting remediation at the Department of Public Works Facility in Old Bridge Township. Three existing USTs were identified as Areas of Concern.
- Principal and LSRP in charge of conducting all remedial activities for a 187.8 acre property formerly used for agricultural purposes in South Brunswick Township. Mr. Turan brought the site from a Preliminary Assessment through remedial activities to the issuance of an RAO.
- Principal and LSRP in charge of preparing a Remedial Investigation and Remedial Action

Report for a preschool and park in North Brunswick Township. Mr. Turan as the LSRP brought the sites into compliance and issued two (2) Unrestricted RAOs for the sites.

Expert Testimony and Litigation Support

- Prepared expert report and provided technical support for litigation concerning the landfill slope failure and fugitive gas emissions from the toe drain related to the design and construction of the Final Cover of Cells 1A and 1B at the Gloucester County Solid Waste Complex.
- Prepared expert report for a litigation concerning the conduct of an environmental firm in the performance of Phase I and limited Phase II environmental site assessments for a commercial property transaction.
- Prepared expert report and provided technical support for Passaic Valley Sewerage Commissioners ("PVSC") regarding Spectraserv Pollution Control Facility's non-compliance with the NJDEP permit requirements for the stabilized sewage sludge materials at disposal facility in North Jersey.
- Prepared expert report and provided litigation support for the New Jersey Turnpike Authority Interchange # 12 Final Improvements project regarding cost recovery action against one of the property owners. Expert Report included evaluation of the existing site contamination and the required site remediation with respect to the identified soil and groundwater contamination. In addition, the Expert Report included rebuttals of certain opinions with respect to site remediation requirements and associated costs.
- Prepared an expert report and testimony for a litigation concerning the migration pathways of benzene contamination in soil and groundwater, and potential impact of mercury soil contamination on groundwater resulted from former operations of the chemical plant in Clifton, New Jersey.
- Prepared an expert report for litigation to provide expert opinion and technical support regarding the source(s) of the soil and groundwater contamination emanated from a former gas station operation in New Jersey in an effort to recover costs associated with the performance of soil and groundwater investigations as well as soil remediation at the property.
- Prepared an expert report and rebuttal for PRP litigation to identify relative contributions of responsible parties for the cleanup and remediation costs of approximately $40 million for a superfund site located immediately upgradient to the site by performing a regional groundwater flow and contaminant mass transport modeling in Fair Field, New Jersey.

APPENDIX 2

Site Plan

N
W
E
S
E 2,072,500
E 2,073,000
E 2,073,500
E 2,074,000
N 558,000
N 557,500
N 557,000
N 556,500
E 2,073,500
E 2,074,000
E 2,074,500
E 2,075,000
E 2,075,500
B-49
B-50
B-48
B-21R
B-18R
B-51-SS
B-39
B-13R-SS
B-13R-PVC
B-47
B-1R-SS
B-1R-PVC
B-54
B-46P
B-46-PVC
B-46-SS
B-45R
B-7R
B-44
B-53R
B-52R
B-41R
B-43R
A-B SUMP
GMP-15
GMP-14
GMP-16
GMP-17
GMP-18
GMP-19
GMP-20
GMP-1
GMP-2
GMP-3
GMP-4
GMP-5
GMP-6
GMP-7
GMP-8R
GMP-9
GMP-10
GMP-11R
GMP-12
GMP-13
LORI STREET
LANI STREET
GEW-9
GEW-10
MH1
MH2
MH3
MH4
MH5
MH6
MH7
MH8
MH9
MH10
MH11
MH12
MH13
AUXILIARY POWER STATION
UNDERGROUND LEACHATE STORAGE TANK (20,000 GAL)
2-24" DIA. CMP CULVERTS
2-21" DIA. CMP CULVERTS
15" DIA. CMP CULVERT
FLARE
SPOTSWOOD GRAVEL HILL ROAD
EXISTING SEDIMENTATION BASIN
PUMP STATION A
PUMP STATION B
EW-1
EW-2
EW-3
EW-4
EW-5
EW-6
EW-7
EW-8
EW-11
EW-12
EW-13
EW-14
EW-15
EW-15A
EW-16
EW-16A
EW-17
EW-17A
EW-18
EW-19
EW-20
EW-21
EW-22
EW-23
EW-24
EW-25
EW-26
EW-27
EW-28
EW-29
P-1A
P-1B
P-1C
P-2A
P-2B
P-2C
P-3A
P-3B
P-3C
P-3D
P-4A
P-4B
P-4CA
P-4D
P-5A
P-5B
P-5C
VW-1B
VW-2ER
VW-3A
VW-4A
VW-5AR
VW-6R
VW-7B
VW-8B
VW-9C
VW-10A
VW-11
VW-13
VW-14E
VW-15B
VW-16B
VW-16C
VW-17AR
Transect 1
Transect 2
Transect 3
60
70
80
90
100
110
120
130
140

KEY

- Piezometer
- Merchantville Formation Monitoring Well
- Monitoring Well Perched within Magothy Formation
- Magothy Formation Monitoring Well
- Existing Installation (not monitored)
- Gas Monitoring Probe
- Landfill Gas Extraction Well
- Manhole
- Leachate Collection System & Compacted Clay Cutoff Wall
- 7 Foot Chain Link Fence
- Landfill Property Boundary
- Drainage Channel
- 4" Diameter Forcemain
- Hydraulic Gradient Monitoring Transect Line
- Protective Soil Cap
- Protective Clay Cap

NOTES

1. Locations of features and monitoring points are approximate
2. Base map provided by Paul C. Rizzo Assoc. Inc. 12/91, from the Supplemental Environmental Investigation Report, Monroe Township Landfill, Monroe, New Jersey
3. Green color indicates sentinel well, blue color indicates perimeter monitoring well
4. Sampling of sentinel wells B-48, B-1RSS, B-46P and B-52R occurs semi-annually for VOCs and metals
5. Sampling of perimeter monitoring wells B-21R, B-41R, B-43R, B-7R, B-44, B-46SS, VB-51SS and B-53R are sampled annually for VOCs and metals
6. VW-1B was removed from monitoring system in 2013

Prepared for:

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Figure 2

Checked by: AJS

Drawn by: MI

3/19/2021

BFI WASTE SYSTEMS OF NEW JERSEY, INC.
MONROE TOWNSHIP LANDFILL

Site Plan

Monroe Township, Middlesex County
New Jersey

0
300 ft US

APPENDIX 3

Limits of Sewer Investigations

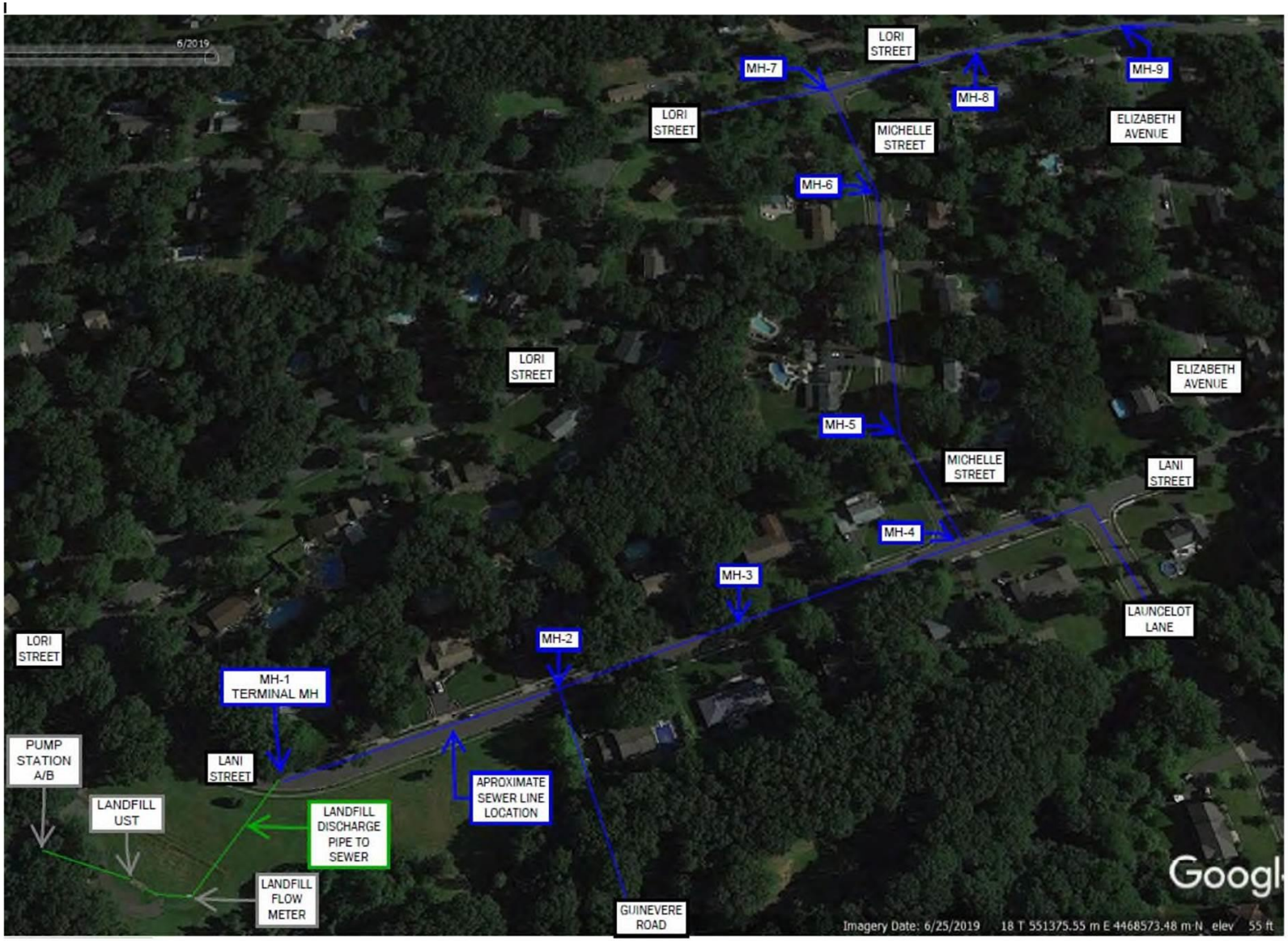

Figure 1. Limits of Sewer Investigation (Image taken from Google Earth)