SIXTH FIVE-YEAR REVIEW REPORT FOR COLESVILLE MUNICIPAL LANDFILL SUPERFUND SITE BROOME COUNTY, TOWN OF COLESVILLE, NEW YORK

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, New York

Pat Evangelista Digitally signed by Pat Evangelista Date: 2025.03.10 15:35:25 -04'00'

March 10, 2025

Pat Evangelista, Director
Superfund and Emergency Management Division

Date

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LIST OF ABBREVIATIONS & ACRONYMS

AWQS	Ambient Water Quality Standards
CFR	Code of Federal Regulations
COC	Contaminant of Concern
DCA	Dichloroethane
DCE	Dichloroethene
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
FYR	Five-Year Review
ICs	Institutional Controls
IRZ	In-Situ Reactive Zone
MCLs	Maximum Contaminant Levels
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
OU	Operable Unit
PCE	Tetrachloroethene
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonate
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SMP	Site Management Plan
TCA	Trichloroethane
TCE	Trichloroethene
TOC	Total Organic Carbon
µg/L	micrograms per liter
UU/UE	Unlimited Use/Unrestricted Exposure
VI	Vapor Intrusion
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

This is the sixth FYR for the Colesville Municipal Landfill Superfund site. The triggering action for this statutory review is the completion date of the previous FYR, which was March 10, 2020. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act Section 121, consistent with the National Contingency Plan (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

The site is being addressed as a single operable unit (OU), which is the subject of this FYR.

This FYR was conducted by EPA remedial project manager George Jacob. Participants included Urszula Kinahan and Tara Bhat, EPA human health risk assessors; Rachel Griffiths, EPA hydrogeologist; Detbra Rosales, EPA ecological risk assessor; Michael Basile, EPA community involvement coordinator; and Payson Long of the New York State Department of Environmental Conservation (NYSDEC).

The Potentially Responsible Party for the site was notified of the initiation of the FYR. The FYR began on July 1, 2024.

Site Background

The site is located in the Town of Colesville, Broome County, New York. The 113-acre property on which the 35-acre landfill is situated is bounded by East Windsor Road to the south and by unnamed tributaries of the Susquehanna River to the west-northwest (North Stream) and to the east (South Stream) (see Appendix A, Figure 1). Both tributaries discharge to the Susquehanna River, which is located to the south of the landfill. The area surrounding the site includes undeveloped woodlands, as well as agricultural tracts and scattered residential parcels. Many of the residents of the Town of Colesville use private water supply wells. These wells utilize groundwater from both shallow and deep aquifers. Other homes utilize groundwater obtained from springs.

In 1983, samples collected by the Broome County Health Department from residential wells in the vicinity of the site indicated that the Colesville Landfill was contaminating the groundwater beneath and in the immediate vicinity of the site. The sample results prompted the Broome County Department of Public Works to install carbon filters on the affected residences.

Six residential parcels were originally located to the south and southeast of the landfill (see Appendix A, Figure 2). To prevent human exposure to site contaminants at these parcels, Broome County purchased four of the properties, removed the structures, and placed environmental easements on them. New double-cased bedrock wells were installed on the remaining two properties which the County was unable to acquire.

The landfill was owned and operated by the Town of Colesville between 1969 and 1971. Broome County purchased the landfill in 1971 and operated it until 1984, when it closed.

The landfill was primarily used for the disposal of municipal solid waste, although drummed industrial wastes from various sources were also disposed of between 1973 and 1975. Operational records indicate that these drummed wastes consisted of aqueous dye waste and organic solvent waste. Known waste constituents included benzene, cyclohexane, acetone, isopropyl alcohol, methanol, ethanol, n-hexane, toluene, xylene, dimethyl ether, zinc, aluminum, iron, tin sulfate, and chloride. In practice, drummed wastes were randomly co-disposed with the municipal solid wastes and disposed of in segregated areas. The drums were either buried intact or were punctured and crushed prior to burial.

Appendix B, attached, summarizes the documents utilized to prepare this FYR. Appendix C, attached, summarizes the site's topography and geology/hydrogeology. Additional details related to background, physical characteristics, geology/hydrogeology, land/resource use, and history related to the site can be found at www.epa.gov/superfund/colesville, EPA's webpage for the site.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Colesville Municipal Landfill Superfund Site		
EPA ID: NYD980768691		
Region: 2	**State:** NY	**City/County:** Town of Colesville/Broome County
SITE STATUS		
NPL Status: Final		
Multiple OUs? No	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: State		
Author name (Federal or State Project Manager): George Jacob		
Author affiliation: EPA		
Review period: 3/11/2020- 3/01/2025		
Date of site inspection: 11/21/2024		

Type of review: Statutory
Review number: 6
Triggering action date: 3/10/2020
Due date *(five years after triggering action date)*: 3/10/2025

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The site was listed on the Superfund National Priorities List in 1986.

In 1988, Wehran-New York (Wehran) completed a remedial investigation (RI)[1] at the site on behalf of the Broome County Department of Public Works and GAF Corporation,[2] the PRPs, pursuant to an Order on Consent (Index No. T010687) issued by NYSDEC. The RI found that the landfill was releasing low levels of volatile organic compounds (VOCs) into the groundwater. Five VOCs were identified as the major contaminants in the groundwater plume:1,1-Dichloroethane (1,1-DCA); 1,1,1-trichloroethane (1,1,1-TCA); trichloroethylene (TCE); cis-1,2-dichloroethene (cis-1,2-DCE); and benzene.

Possible human exposure pathways and media evaluated as part of the Baseline Human Health Risk Assessment (HHRA) included consumption of contaminated site groundwater and direct contact with contaminated soil and stream sediments near leachate seeps in the vicinity of the site. The results of the HHRA indicated that the carcinogenic risk (2.85×10^{-4}) and noncancer hazard (3.85) associated with exposure to potable well water at the site exceeded EPA's cancer risk range and non-cancer target threshold value of 10^{-6} to 10^{-4} and 1, respectively. Although the calculated risk of 7.41×10^{-6} associated with direct contact with leachate seep soils/sediments did not exceed EPA's risk range, the RI concluded that remediation of these seeps was warranted in order to minimize any future environmental impacts. No ecological risk assessment was performed as part of the 1988 RI.

Response Actions

In 1990, Wehran completed a feasibility study (FS).[3] Based upon the results of the RI/FS, in 1991, EPA signed a Record of Decision (ROD) for the site.

The following remedial action objectives (RAOs) were identified in the ROD:

[1] An RI determines the nature and extent of contamination at a site and evaluates the risk to public health and the environment.
[2] In 2001, while the groundwater remedy was under construction, GAF Corporation declared bankruptcy. Subsequently, NYSDEC and Broome County negotiated a new Order on Consent under which the remaining work was completed.
[3] An FS identifies and evaluates remedial alternatives to address the contamination at a site.

- Control the release of VOCs from the site to the glacial outwash aquifer that underlies the project area; properly close the landfill and eliminate leachate seeps and any associated leachate discharges to the North and South streams;
- Eliminate the potential for direct human or animal contact with any active leachate seeps;
- Continue the existing quarterly residential well monitoring program along with the temporary water supply and carbon filtration program for the affected residences until a new water supply is constructed; and
- Restore the groundwater underlying the site to levels consistent with state and federal Maximum Contaminant Levels (MCLs).

The major components of the selected remedy include the following:

- Installation of a multimedia cap on the landfill;
- Installation of a leachate collection system;
- Installation of groundwater extraction wells to contain the groundwater contamination;
- Collection of contaminated groundwater from beneath and downgradient of the landfill;
- Treatment of the extracted groundwater, using metals treatment and air stripping;
- Discharge of the treated water to surface water;
- Imposition of property deed restrictions, if necessary, to prevent the installation of drinking water wells at the site and to restrict activities which could affect the integrity of the cap; and
- Provision of new wells for affected residents in the vicinity of the site.

Status of Implementation

Pursuant to the above-referenced Order on Consent with NYSDEC, Wehran, on behalf of the PRPs, began the engineering design for the selected remedy in 1991. During the initial stages of the design, the PRPs' consultant performed extensive field work to collect additional data for the groundwater portion of the remedial design. By 1993, it was apparent that there were technical issues related to the groundwater extraction and treatment system that would not be easily or promptly resolved. It was, therefore, decided that the landfill cap design and the alternate water supply (double-cased deep wells) design should be completed separately from the groundwater extraction and treatment system design to allow the capping of the landfill and alternate water supply components of the remedy to proceed.

Landfill Cap

In 1994, Wehran completed the engineering design for the capping of the landfill and wetland restoration (creation of a new wetland to replace the three small wetland areas on the landfill surface). The capping of the landfill and wetland restoration, performed by Tug Hill Construction, Inc., was completed in 1995.

Alternate Water Supply

An alternate water supply well design (deep wells), which was prepared by Wehran, was approved by NYSDEC in 1995. Deep wells were only installed on two properties, as Broome County purchased the other affected properties.

Groundwater Remedy

Based upon design-related aquifer tests conducted at the site, it was determined that extracting contaminated groundwater at the landfill, as called for in the ROD, would not likely be an effective means of remediating the groundwater at the source in a reasonable time frame. Specifically, the aquifer tests determined that the aquifer near the landfill has a low permeability, which would severely limit the area of influence of the extraction wells and would allow the groundwater to be pumped at only a very low rate (0.25 to 0.5 gallon per minute). Such conditions would necessitate the installation of an inordinate number of extraction wells. This conclusion led to an evaluation of alternative groundwater technologies and the performance of an in-situ reactive zone (IRZ) pilot-scale study to evaluate the effectiveness of one of the more promising technologies, enhanced reductive dechlorination. This process involves injecting the contaminated groundwater with an easily degradable carbohydrate solution (*e.g.,* molasses), which provides excess organic carbon that promotes microbial activity in the aquifer, enhancing the breakdown of chlorinated VOCs. Based upon the results of the pilot study, which showed a significant decline in VOC concentrations, it was concluded that this technology, in combination with the installation of downgradient extraction wells (as called for in the ROD), offered the most technically feasible approach to restoring groundwater quality in a reasonable time frame. This change to the remedy was documented in a September 2000 Explanation of Significant Differences (ESD).

The groundwater management system, constructed by Clean Earth Technologies, Inc., became operational in 2002. It consists of 17 automated reagent injection wells, three groundwater recovery wells, and an on-site groundwater treatment system.

Additional Remedial Measures

In 2000, during an inspection of the site performed as part of the FYR process, EPA inspected a low-lying wet area and a spring on the south side of the landfill in the vicinity of spring location SP-5 (see Appendix A, Figure 3). Sample results indicated that these areas were contaminated with site-related contaminants that exceeded NYSDEC's Part 703 water quality standards (WQS) for Class C fresh water. When WQS were not available, the NYSDEC Division of Water Technical Operational Guidance Series (TOGS 1.1.1) standard and guidance values were used for comparative purpose. The source of the low-lying wet area was groundwater discharging upward through a vertical, three-foot diameter concrete structure that extends approximately 2.5 feet below the ground surface. The concrete structure appears to have been placed there to enhance the spring as a source of water. Until the contamination was detected, the opening of this structure was partially buried and obscured by dense vegetation. Since contaminated water from the spring and the low-lying wet area could potentially discharge to nearby streams, remedial measures to address these areas were undertaken in 2003 and 2004, respectively. The remedy for the low-lying wet area consisted of a sand filter and a granular activated carbon unit that were placed in the concrete

structure (a cover was placed over the top of the structure). The water then flows through a horizontal 4-inch diameter drainage pipe running through the side of the concrete structure. A riprap-lined outlet structure to prevent erosion was installed at the discharge point of the drainage pipe. This system is referred to as the "SP-5 Spring Water Remediation System."

Along the bank of the North Stream, which is as close as 100 to 200 feet to the northwest of the landfill in some areas, was a spring (SP-4) at the toe of a steep slope that could discharge directly to the stream. The SP-4 remedy consisted of a subsurface stone infiltration bed in the area of the spring which prevents the contaminated spring water from exfiltrating above the land surface. Large boulders were placed between the stream and the infiltration bed to protect the integrity of the infiltration bed during high water conditions. These actions, which were performed by Arcadis, were documented in a 2004 ESD. The SP-4 remedy resulted in a significant improvement from pre-remediation conditions, with only intermittent minor exfiltration of the spring water occurring in high water conditions, currently.

In an October 2016 ESD, EPA documented the need for an institutional control (IC)[4] to address the potential for vapor intrusion (VI) in the area. The IC requires VI sampling to determine whether this pathway is of concern if buildings are constructed in this area in the future or if the nearby vacant houses are occupied, is needed. To that end, letters were sent by EPA to the Broome County Department of Public Works and the Town of Coleville Office of Code Enforcement indicating that EPA and NYSDEC should be contacted prior to the approval of any building permits or Certificates of Occupancy for the residential properties in the vicinity of the site that do not have environmental easements and restrictive covenants. Periodic reminders will continue to be issued to these agencies. The initial notifications and the subsequent reminders constitute an IC. The IC will remain in place until VI is no longer a viable exposure pathway.

Institutional Controls Summary

Table 1, below, summarizes the status of the ICs.

Table 1: Summary of Planned and/or Implemented Institutional Controls

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater and Soil	Yes	Yes	Landfill properties	Protect the integrity of remedy or cause the contaminants to migrate without the express written approval of NYSDEC and EPA and prohibits the installation of drinking water wells	Declaration of Restrictive Covenants, Restrictions and Environmental Easement (DCR&EE); March 19, 2014

[4] ICs are nonengineered controls, such as property or groundwater use restrictions imposed by a property owner by recorded instrument or by a governmental body by law or regulatory activity for the purpose of reducing or eliminating the potential for human exposure to contamination and/or protect the integrity of a remedy.

				on the landfill property and the use of the underlying groundwater for potable or process water.	
Groundwater	Yes	Yes	Two residential properties	Restrict installation of groundwater wells	DCR&EE; February 13, 2015
Soil Vapor Intrusion	Yes	Yes	Four residential properties	Prevent the VI pathway, if buildings are constructed in future	May 7, 2015 letters to the Broome County Department of Public Works and the Town of Coleville Office of Code Enforcement (see above)

Systems Operations/Operation and Maintenance

To maintain the integrity and effectiveness of the cap, routine operation and maintenance (O&M) activities are necessary. The inspection/maintenance plan for the cap calls for regular inspection and evaluation of the cap, mowing the vegetation during the growing season, and fence maintenance. Repairs are to be made to the cap, as necessary, to control the effects of settling, subsidence, erosion or other events, and to prevent run-on from eroding or otherwise damaging the final cover. The inspection/maintenance plan has been modified to incorporate long-term groundwater monitoring, the molasses injections, the O&M of the groundwater extraction and treatment facility, and the maintenance of the SP-5 Spring Water Remediation System.

The site is inspected on an annual basis as follows:

- the site is inspected for debris, litter, waste and vandalism;
- the landfill cap is inspected for vegetation loss due to erosion or poor grass growth;
- annual ground inspections note stressed or undesirable species of vegetation on the landfill surface and side slopes;
- the landfill property is visually inspected for leachate outbreaks (precipitates on the ground surface, intermittent seeps, or soft spots);
- the landfill cap is inspected for cracks, settlement, erosion and deposition, ponding, and animal burrows;
- the gas venting pipes are inspected for damage;
- the site access gate and fence are inspected for operational locks and vandalism;
- the culverts, drainage ditches, and settlement gauges are inspected for sediment buildup or erosion; and
- the groundwater monitoring wells are inspected for operational locks, damage, and vandalism.

Groundwater monitoring is performed every fifth quarter at 14 monitoring well locations. The samples are analyzed for VOCs and metals, while a subset (typically, nine wells) are also analyzed for monitored natural attenuation parameters (*i.e.,* dissolved gases such as ethene, ethane, and methane), alternate electron acceptors, and total organic carbon (TOC).

Emerging contaminants sampling was performed in 2017; seven monitoring locations were analyzed for 1,4-dioxane and per- and poly-fluoroalkyl substances (PFAS).[5]

Spring water sampling and sediment and surface water sampling are performed on a semiannual sampling schedule. An annual O&M report that is submitted by the PRP includes a summary of the results of the sampling and findings of the inspections, along with a certification that remedy-related O&M is being performed.

The groundwater extraction and treatment system operated and molasses injections were performed every three months until 2012. From 2012 through 2019, the groundwater was monitored while the molasses injections and the groundwater extraction and treatment system were dormant to evaluate the behavior of site contaminants in natural conditions (In-Situ Reactive Zone Discontinuation Pilot Study). Based on contaminant of concern (COC) trends observed during the pilot study (*i.e.,* increasing levels of contaminants in several monitoring wells), it was decided that substrate injections (molasses) would resume in 2019 and continue on an "as needed" basis. Contaminant concentrations and geochemistry following the 2019 injections are to be monitored and used as a primary trigger to initiate future molasses injection events. The secondary trigger for a future injection is to be based on contaminant trends (*i.e.,* if concentrations are not decreasing or persist above MCLs). Molasses injections have occurred annually since 2019. The most recent molasses injection was performed in August 2023. The groundwater extraction and treatment system remains off, but is maintained should it be needed in the future.

Consistent with NYSDEC requirements associated with effecting a Declaration of Covenants and Restrictions and Environmental Easement, the County prepared a site management plan (SMP) in 2014. The SMP provides for the proper management of all post-construction remedy components, including monitoring.

Remedy Resilience Assessment

Damage along the streamside of the landfill occurred during flood events in the past. The placement of larger riprap stones following the last major storm event has been successful in preventing storm damage. Potential impacts to the Site area from severe weather have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of weather-related events in the region and near the Site. Please see Appendix D, attached, for the full remedy resilience assessment.

[5] PFAS are a group of man-made chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctanesulfonate (PFOS).

III. PROGRESS SINCE THE LAST REVIEW

The protectiveness determinations from the last FYR are summarized in Table 2, below.

Table 2: Protectiveness Determinations/Statements from the 2020 FYR

OU #	Protectiveness Determination	Protectiveness Statement
01	Short-term Protective	The OU1 remedy protects human health and the environment in the short-term because unacceptable exposure to contaminated media has been interrupted by the implemented remedial actions and has been completed and has addressed all human health and ecological risks and all ICs are in place, preventing unacceptable use of soil and groundwater. In order to be protective in the long-term, contaminant trends need to be evaluated to determine whether concentrations are decreasing and whether additional injections are necessary.
Sitewide	Short-term Protective	The sitewide remedy protects human health and the environment in the short-term because unacceptable exposure to contaminated media has been interrupted by the implemented remedial actions and has been completed and has addressed all human health and ecological risks and all ICs are in place, preventing unacceptable use of soil and groundwater. In order to be protective in the long-term, contaminant trends need to be evaluated to determine whether concentrations are decreasing and whether additional injections are necessary.

The previous FYR had one recommendation, which is summarized in Table 3, below.

Table 3: Status of Recommendations from the 2020 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
01	A number of wells that monitor the migration of the plume continue to show exceedances of AWQS. Some of the monitoring wells have increasing trends. As a result, molasses injections were restarted in September 2019. It is expected that the injections will encourage further contaminant degradation and reduce contaminant concentrations. Monitoring will confirm this and will be used to determine whether	Monitor trends to determine whether contaminant concentrations are decreasing and whether additional molasses injections are necessary.	Ongoing	Additional molasses injections have been conducted annually since September 2019.	Click here to enter a date

	additional molasses injections are necessary.				

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On August 7, 2024, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, and Puerto Rico, including the Colesville Municipal Landfill Superfund site. The announcement can be found at the following web address: https://www.epa.gov/superfund/R2-fiveyearreviews.

In addition to this notification, Mr. Basile posted a public notice on the EPA site profile page https://epa.gov/superfund/colesville-landfill and provided the notice to the town of Colesville by email on December 23, 2024, with a request that the notice be posted on the town's website. This notice indicated that a FYR would be conducted at the Colesville Municipal Landfill Superfund site to ensure that the cleanup at the site continues to be protective of people's health and the environment. Once the FYR is completed, the results of the review and the FYR report will be made available on the EPA site profile page and at the site information repositories. The information repositories are maintained at the Town of Colesville Town Hall, Harpursville, New York and the EPA Region 2 Superfund Records Center, 290 Broadway, 18th Floor, New York, New York. Efforts will be made to reach out to local public officials to inform them of the results.

Data Review

Groundwater

Groundwater samples are collected every fifth quarter. During the review period, groundwater sampling was conducted in September 2019, November 2020, March 2022, and June 2023. Several site-related VOCs exceeded the NYSDEC Class GA Ambient Water Quality Standards (AWQS). The reoccurring highest levels of VOCs include TCE, cis-1,2-DCE, 1,1-DCA, chloroethane, and chlorobenzene which all have an AWQS of 5 micrograms per liter (µg/L), vinyl chloride which has an AWQS of 2 µg/L, and benzene which has an AWQS of 1 µg/L. Sitewide, contaminant concentrations and the areal extent of contamination has greatly reduced since the implementation of the remedy in 2002 (see Appendix A, Figures 4 and 5).

Because the site covers a large area and there is a radial component to groundwater flow to the west, southwest, and south toward the discharge boundaries of the North Stream and the Susquehanna River, groundwater conditions are assessed according to locations of monitoring wells. Mid-plume monitoring wells are situated downgradient of the injection wells, recovery wells are situated downgradient of the mid-plume monitoring wells, plume boundary wells are located downgradient and south of the former recovery wells, off-site monitoring wells are serving as sentinel wells situated downgradient of the southern boundary of the landfill, and perimeter wells are situated along the outer edges of the landfill (see Figure 1).

Mid-Plume Monitoring Wells

Historically, the highest levels of VOCs have been detected in the mid-plume monitoring wells. For this reason, this area was designated for molasses injections. These monitoring wells include GMMW-2, GMMW-5, GMMW-6, PW-3, PW-4, and PW-5.

The parent compounds PCE and 1,1,1-TCA were below their respective AWQS of 5 µg/L during the review period. PCE degradation compounds (*i.e.,* TCE, cis-1,2-DCE, vinyl chloride) and 1,1,1-TCA degradation compounds (*i.e.,* 1,1-DCA, chloroethane) were present in all the monitoring wells except PW-5, which has been non-detect for all COCs since 2012. The maximum concentrations of PCE degradation compounds were observed in monitoring wells GMMW-2 (8.7 µg/L TCE in 2019) and GMMW-6 (77 µg/L cis-1,2-DCE and 12 µg/L vinyl chloride in 2020) above their respective AWQS. The maximum concentrations of 1,1,1-TCA degradation compounds were observed in monitoring well GMMW-6 (110 µg/L chloroethane in 2019, and 53 µg/L 1,1-DCA in 2020). Contaminant concentrations in mid-plume monitoring wells have exhibited decreasing trends since 2019, when the injections resumed.

Concentrations of ethene and ethane are present in most of the monitoring wells, indicating that complete reductive dechlorination is occurring in this portion of the site. Increasing TOC concentrations throughout the review period suggest that resuming molasses injections has positively impacted groundwater in the vicinity of the mid-plume monitoring wells. TOC concentrations in monitoring wells GMMW-2, GMMW-5, and GMMW-6 in 2023 are above 20 milligrams per liter, a level that is recommended to support enhanced reductive dechlorination on a long-term basis.

Chlorobenzene was present above its AWQS in monitoring wells GMMW-2, GMMW-5, and GMMW-6 during the review period. Concentrations were relatively stable, with a maximum concentration of 28 µg/L observed in monitoring well GMMW-6 in 2022.

Recovery Wells

The recovery wells were not pumping during the Discontinuation Pilot Study and remain inactive as the molasses injections have resumed. Recovery well GMPW-4 (located downgradient of mid-plume monitoring wells) is sampled as part of the long-term monitoring network. During the last review period, an increasing trend of contaminants in recovery well GMPW-4 suggested possible downgradient migration of COCs and was a contributing factor for resuming molasses injections. As of 2023, concentrations of 1,1-DCA, chlorobenzene, chloroethane, cis-1,2-DCE, and TCE exceed AWQS, though all concentrations have decreased since 2019 when injections restarted. Of these contaminants, TCE had the highest concentration observed during the review period with a maximum detection of 21 µg/L in 2019.

Plume Boundary Wells

The area downgradient of the recovery wells is monitored by monitoring wells W-16S, W-17S, and W-18. VOCs did not exceed AWQS at monitoring well W-17S during the review period.

Chlorobenzene and 1,1-DCA have exceeded AWQS in well W-16S during the review period with respective maximum concentrations of 24 µg/L and 11 µg/L in 2019. As of 2023, chlorobenzene concentrations have decreased to 20 µg/L and 1,1-DCA only marginally exceeds its AWQS at 6.5 µg/L. In monitoring well W-18, concentrations of 1,1-DCA, cis-1,2-DCE, and TCE marginally exceeded AWQS in 2019. As of 2023, only TCE still exceeds AWQS at a concentration of 5.7 µg/L. The decreasing trends observed in these wells during the review period support the efficacy of molasses injections.

Downgradient Wells

Monitoring well W-20S is situated downgradient of the south side of the landfill and serves as a sentinel well. It has shown no exceedances of site-related contaminants.

Landfill Perimeter Wells

Landfill perimeter wells are located along the outer edges of the landfill, including monitoring wells GMMW-7, PW-7, and W-7. Monitoring well W-7 is located along the south side of the landfill and side gradient of where the groundwater contaminant plumes have been identified in the mid-plume area. No exceedances of AWQS were observed in monitoring well W-7 during the review period. Monitoring well GMMW-7 is located along the southwest landfill boundary, upgradient of the injection wells. Maximum concentrations in monitoring well GMMW-7 during the review period include 110 µg/L of 1,1-DCA, 53 µg/L of chloroethane, 77 µg/L of cis-1,2-DCE, 23 µg/L of TCE, and 40 µg/L of vinyl chloride in 2019, and 15 µg/L of chlorobenzene in 2023. VOC concentrations decreased throughout the review period at monitoring well GMMW-7 with the exception of chlorobenzene which remained relatively stable. Monitoring well PW-7 is situated along the northwest boundary of the landfill, upgradient of the North Stream. Concentrations of VOCs at monitoring well PW-7 were highest in 2019, including 76 µg/L of 1,1-DCA, 21 µg/L of chlorobenzene, 36 µg/L of chloroethane, 56 µg/L of cis-1,2-DCE, 9.1 µg/L of TCE, and 16 µg/L of vinyl chloride. As of 2023, only 1,1-DCA and cis-1,2-DCE exceeded AWQS with respective concentrations of 16 µg/L and 7.7 µg/L.

Emerging Contaminants Sampling

Emerging contaminants sampling for PFAS and 1,4-dioxane was performed in 2017 at seven monitoring locations. In 2020, NYSDEC established drinking water MCLs for PFOA and PFOS of 10 ng/L, and for 1,4-dioxane of 1 µg/L. In 2023, NYSDEC released ambient water quality guidance values of 6.7 ng/L for PFOA, 2.7 ng/L for PFOS, and 0.35 µg/L for 1,4-dioxane. In April 2024, EPA finalized drinking water MCLs for PFOA and PFOS of 4 nanograms per liter (ng/L), and perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid, and hexafluoropropylene oxide dimer acid of 10 ng/L. No PFAS compounds exceeded their NYSDEC MCLs. PFOA concentrations exceeded the EPA MCL and NYSDEC guidance value at two sampling locations (monitoring wells GMMW-2 and GMMW-6) with a maximum concentration of 9.8 ng/L at monitoring well GMMW-6. PFOS concentrations exceeded the NYSDEC guidance value at one monitoring well, GMMW-02, at a concentration of 2.7 ng/L. Concentrations of 1,4-dioxane exceeded the NYSDEC guidance value of 0.35 µg/L in monitoring well GMMW-02 at 0.9 µg/L and monitoring well GMMW-06 at 1.9 µg/L. The NYSDEC MCL of 1 µg/L for 1,4-dioxane was

only exceeded in monitoring well GMMW-6 as described above. Emerging contaminants were not detected in downgradient deep bedrock residential wells. Based on the low levels identified in monitoring wells and lack of detections in the residential wells, further investigation is not anticipated at this time.

Surface Water and Sediment Monitoring

Surface water samples were collected at locations SW-2, SW-3, SW-4, and F-6 (see Figure 3). Surface water samples were collected as direct grab samples from the North Stream at areas collected with the spring samples, and at a location further downgradient of the springs (F-6) in accordance with the SMP. Surface water samples were collected and analyzed by ALS Laboratory for VOCs and metals and field analyzed for dissolved oxygen, specific conductance, pH, oxidation- reduction potential, temperature, and turbidity. During this review period VOC and metals concentrations in surface water were low or non-detect and in compliance with water quality standards (WQS) except for iron exceeding the NYSDEC Class C standard in 2021-2022, followed by aluminum and magnesium exceeding standards in 2022. However, concentrations of iron, aluminum, and magnesium in 2023 were below limit detection and consistent with background, upgradient samples SW-2 and historical data. Additionally, calcium concentrations showed a slight increase at SW-2, SW-3, and SW-4 in 2023 in comparison to other years. The exceedance observed in various contaminants could be due to the increase in turbidity levels during different sampling seasons. Overall, the data indicates that surface water quality is not being adversely impacted by the landfill.

Sediment samples were collected during the monitoring events where the SP-3 spring exfiltrates from the large riprap area onto the stream bank. Sediment samples collected at the SP-3 area during the review period were generally consistent with the background sediment sample for most metals except for a few metals. Nickel concentrations exceeded NYSDEC Freshwater sediment screening values in 2020. Followed by an exceedance in arsenic concentrations from 2020-2021. Lead, Iron and Silver concentrations also exceeded screening values in 2021. However, lead, silver, and nickel concentrations were below screening values in 2022-2023. Manganese concentrations exceeded screening values in 2022, but concentrations were below screening values in 2023. Iron concentrations slightly exceeded screening values in 2023. Overall concentrations observed in the sediment are within the range of previous sampling events, NOAA SQuiRT values and below class A standards.

Spring Water Monitoring

Spring water samples were collected at locations SP-2, SP-3, SP-4, and SP-5 throughout this review period. In general, concentrations of constituents were consistent with previous years. VOC concentrations between 2020-2023 were non detect or low in the spring water samples except for chlorobenzene, exceeding the NYSDEC WQS in 2020-2023 consistently at SP3. Trichloroethene exceeded the NYSDEC WQS in 2023 at SP-3 but there was no exceedance of WQS in other locations. Metals concentrations were generally below the WQS with the expectation of a couple of metals. Aluminum concentrations exceeded WQS in various locations between 2020-2023. Iron concentrations also exceeded WQS criteria between 2020-2023. Arsenic concentrations exceeded WQS at various locations from 2021-2023. Additionally, lead and zinc exceeded the criteria at

location SP-2 in 2022 but not in 2023. The observed exceedance of various constituents in the spring water samples may be due to an increase in turbidity level during the sampling period and will continue to be monitored.

At location SP-5, the Spring Water remediation system, the concentrations of VOCs remained stable and below or within the range of previous concentrations. Influent TVOC concentrations during the review period were low or within the range of previous concentrations, which are not believed to be impacting the environment.

Site Inspection

A FYR inspection of the site was conducted on November 21, 2024. In attendance were George Jacob, Detbra Rosales, Tara Bhat and Urszula Kinahan from USEPA, Payson Long from NYSDEC, Debra Smith, and Justin Scheidweiler from Broome County, and Jon A. Sundquist from Barton & Loguidice, Consultant to Broome County. The purpose of the inspection was to assess the protectiveness of the remedy.

No issues were observed during the inspection, impacting current and/or future protectiveness. The cap and vegetative cover are intact and in good condition; the fence around the cap within the site is intact and in good repair; the monitoring wells are functional; and there is no evidence of trespassing or vandalism.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

The remedy selected in the ROD, as modified by the ESDs, calls for the capping of the landfill, leachate collection, molasses injections near the landfill, downgradient contaminated groundwater collection and treatment, imposition of property deed restrictions, if necessary, to prevent the installation of drinking water wells at the site and to restrict activities which could affect the integrity of the cap, and an IC requiring VI sampling if, in the future, buildings are constructed on-site where elevated VOC groundwater contamination is present or if nearby vacated houses are reoccupied.

In 2012, the extraction wells were shut down and molasses injections were discontinued to conduct an In-Situ Reactive Zone Discontinuation Pilot Study. The study ended in 2014 and a report was submitted in 2015. Based upon its review of the results of the pilot study, EPA concluded that the natural attenuation capacity of the aquifer was not sufficient on its own to degrade the COCs and that resuming molasses injections would enhance the naturally-occurring biodegradation of site contaminants to help the site groundwater achieve Applicable or Relevant and Appropriate Requirements. The PRP resumed the molasses injections in September 2019 and injections have occurred annually since then, most recently in August 2023.

Sitewide, contaminant concentrations and the areal extent of contamination has greatly reduced since the implementation of the remedy in 2002; however, exceedances exist in the mid-plume,

recovery and plume boundary wells. During the Discontinuation Pilot Study, some wells exhibited increasing concentrations as the geochemical and biological effects of the previous molasses injections wore off. Since injections resumed in 2019, contaminant concentrations have decreased sitewide. It is expected that the injections will encourage further degradation in site wells and reduce contaminant concentrations. Monitoring will confirm this and be used to determine whether additional injections are necessary. ICs are in place and the sentinel well shows no detections.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

The exposure assumptions and toxicity data used to estimate potential risks and hazards to human health followed general risk assessment practices at the time the risk assessment was conducted. Although the risk assessment process has since been updated, and specific parameters and toxicity values may have changed, the risk assessment process that was used is consistent with current practice and the need to implement the remedial action remains valid.

As called for in the ROD, a multimedia cap was constructed over the landfill which has effectively eliminated the potential for direct contact exposures to landfill materials. In addition, a fence is present around the perimeter of the site to further restrict unauthorized access and help protect the integrity of the cap.

As for potential groundwater exposures, the nearest residences in the vicinity of the site have either been demolished, vacated, or are currently using a double-cased bedrock well. Analytical results collected in 2022 from the two residential bedrock wells in the vicinity of the site do not show any exceedances of VOCs above state and federal MCLs. In 2017, these wells were also sampled and analyzed for 1,4-dioxane and PFAS, including PFOA and PFOS, and results show no detections above current federal or state MCLs. Ongoing site-wide groundwater monitoring continues to ensure contamination emanating from the landfill is not impacting nearby potable wells. Furthermore, environmental easements preventing the installation and use of groundwater wells on nearby residential properties are in place, ensuring future use of groundwater is also an incomplete exposure pathway.

The RAOs identified in the decision documents and listed in the "Response Action" section of this document remain valid for the site.

The groundwater cleanup goals selected at the time of the ROD were the more stringent of state and federal MCLs. Although some of the NYSDEC groundwater quality standards have changed since the time of the decision document, most notably those for 1,2-DCA 1,1-DCE, and benzene, the ROD-established cleanup levels remain protective of human health.

The soil vapor intrusion (VI) into indoor air pathway was not evaluated in the original risk assessment, however based on recommendations from previous FYRs this evaluation was conducted in 2008. Based on the sampling results of the VI evaluation, the previous FYR concluded that if structures were to be built downgradient of the landfill, the VI pathway could be of concern. Consistent with previous FYRs, this determination remains valid for the current review period, however, because no buildings are currently occupied in the immediate area of the

elevated sample location, this pathway remains incomplete. An ESD, signed in 2016, documented EPA's determination that to ensure protectiveness of the selected remedy, an IC requiring a VI investigation in the event that buildings are constructed in the vicinity of the site or if currently vacant houses are reoccupied is needed. This IC ensures that the VI pathway remains incomplete in the current and future timeframes.

Even though no ecological risk assessment was performed at this site, the 1988 RI performed an ecological survey of the site. Using NYSDEC significant habitat maps of Colesville there were no habitats critical for the survival of any plant or animal species on or near the site. However, the site is located within range of several migratory species and may at times be used as a resting or stop over area. The potential impacts on these species are minimal. Additionally, the landfill cap eliminated any potential risk from surface soil contaminants to terrestrial receptors. Any potential ecological risks associated with the North Stream have been addressed by sediment excavations conducted by Broome County, as evidenced by the surface water results throughout this FYR period. VOC and metals concentrations found in surface water were low or non-detect and in compliance with water quality standards (WQS) and consistent with historical data. Even though VOCs and metals were present in surface water and spring water samples, concentrations of VOCs and metals are not impacting ecological receptors. Metals concentrations found in sediment samples collected during this FYR period were generally consistent with the background values. Despite having iron concentration's fluctuating throughout this FYR, the majority of metals were within the range of previous data, within the NOAA SQuiRT values and below NYSDEC Class A values. As such, continued monitoring will ensure that the remedy is functioning as intended in protecting the environment and wildlife.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No further information has come to light that would call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Table 4, below, presents the recommendations and follow-up actions for this FYR.

Table 4: Issues and Recommendations

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
1

OTHER FINDINGS

The 2016 ESD documented the need for an IC to address the potential for VI in the area. The IC requires VI sampling to determine whether this pathway is of concern if buildings are constructed

in this area in the future or if the nearby vacant houses are occupied. To that end, in 2015, letters were sent by EPA to the Broome County Department of Public Works and the Town of Colesville Office of Code Enforcement indicating that EPA and NYSDEC should be contacted prior to the approval of any building permits or Certificates of Occupancy for the residential properties in the vicinity of the site that do not have environmental easements and restrictive covenants. Periodic reminders are to continue to be issued to these agencies. Because there have not been any reminders since the initial notification, it is suggested that reminders be issued in 2025 and at least every five years going forward.

VII. PROTECTIVENESS STATEMENT

Table 5, below, presents the operable unit and sitewide protectiveness statements.

Table 5: Protectiveness Statements

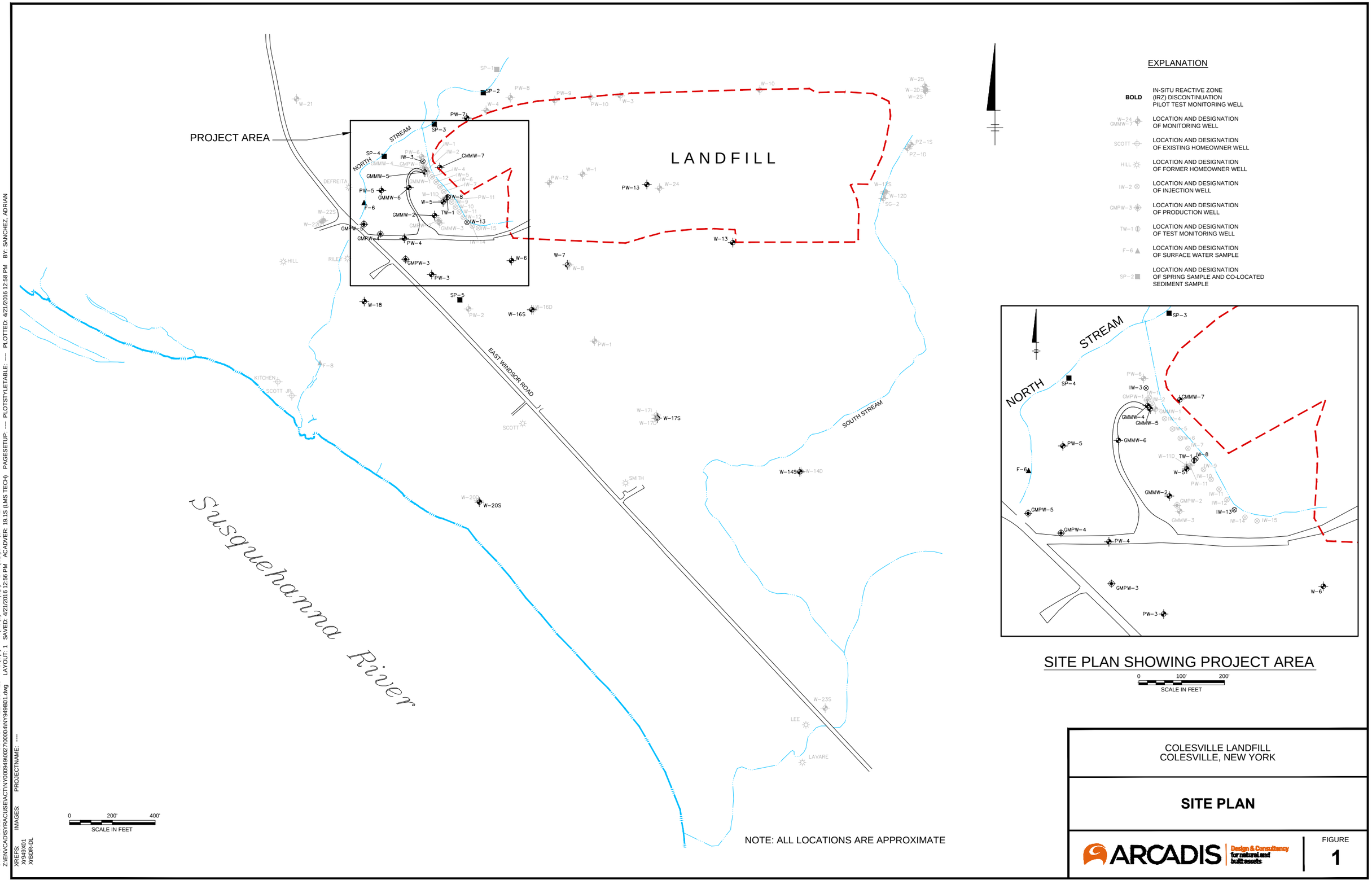
Protectiveness Statement(s)	
Operable Unit: OU1	*Protectiveness Determination:* Protective
Protectiveness Statement: The OU1 remedy is protective of human health and the environment.	
Sitewide Protectiveness Statement	
Protectiveness Determination: Protective	
Protectiveness Statement: The sitewide remedy is protective of human health and the environment.	

VIII. NEXT REVIEW

The next FYR report for the Colesville Municipal Landfill Superfund site is required five years from the completion date of this review.

APPENDIX A – FIGURES

Figure 1: Site Location Map



EXPLANATION

BOLD	IN-SITU REACTIVE ZONE (IRZ) DISCONTINUATION PILOT TEST MONITORING WELL
W-24 GMMW-7	LOCATION AND DESIGNATION OF MONITORING WELL
SCOTT	LOCATION AND DESIGNATION OF EXISTING HOMEOWNER WELL
HILL	LOCATION AND DESIGNATION OF FORMER HOMEOWNER WELL
IW-2	LOCATION AND DESIGNATION OF INJECTION WELL
GMPW-3	LOCATION AND DESIGNATION OF PRODUCTION WELL
TW-1	LOCATION AND DESIGNATION OF TEST MONITORING WELL
F-6	LOCATION AND DESIGNATION OF SURFACE WATER SAMPLE
SP-2	LOCATION AND DESIGNATION OF SPRING SAMPLE AND CO-LOCATED SEDIMENT SAMPLE

SITE PLAN SHOWING PROJECT AREA

0 100' 200'
SCALE IN FEET

NOTE: ALL LOCATIONS ARE APPROXIMATE

COLESVILLE LANDFILL
COLESVILLE, NEW YORK

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

Figure 2: Residential Parcels

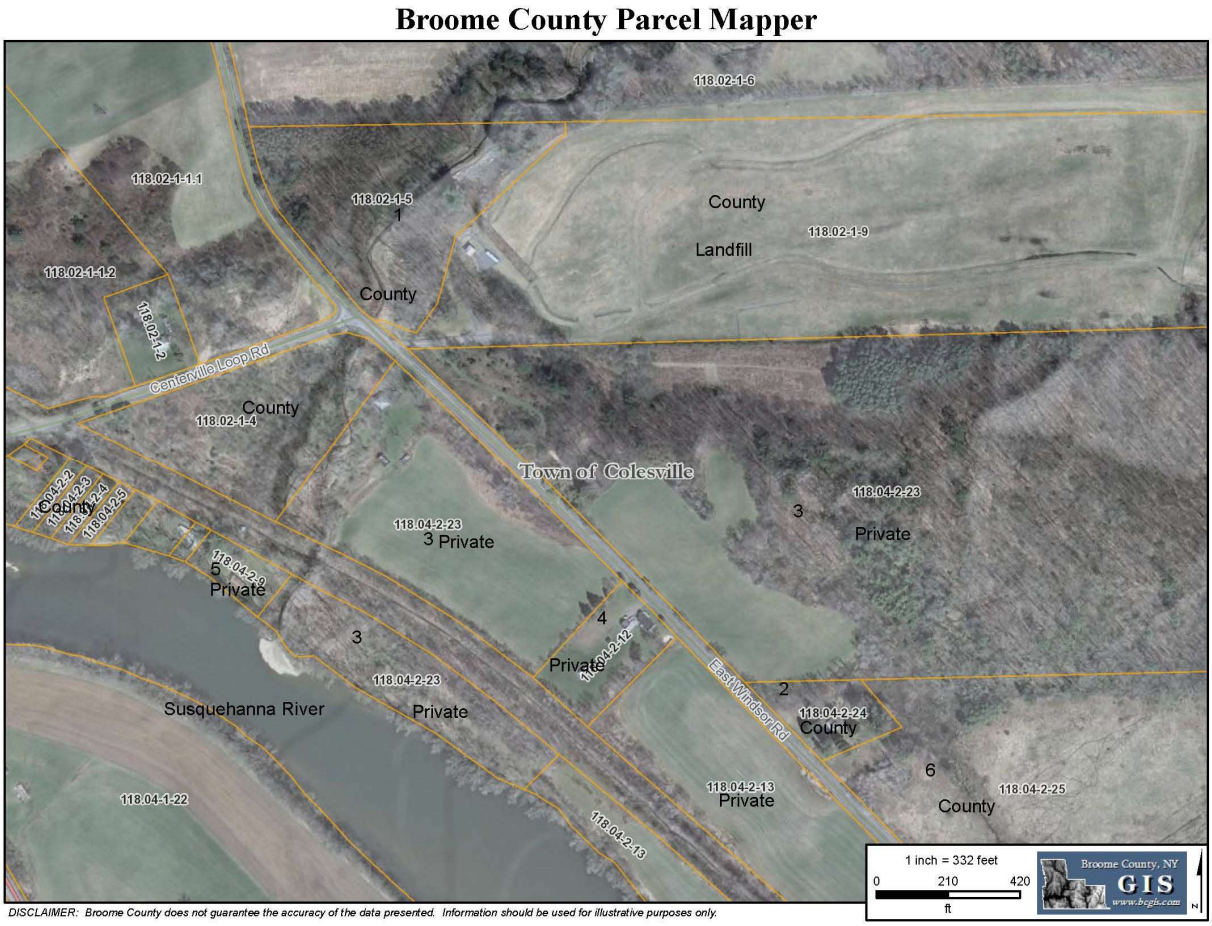
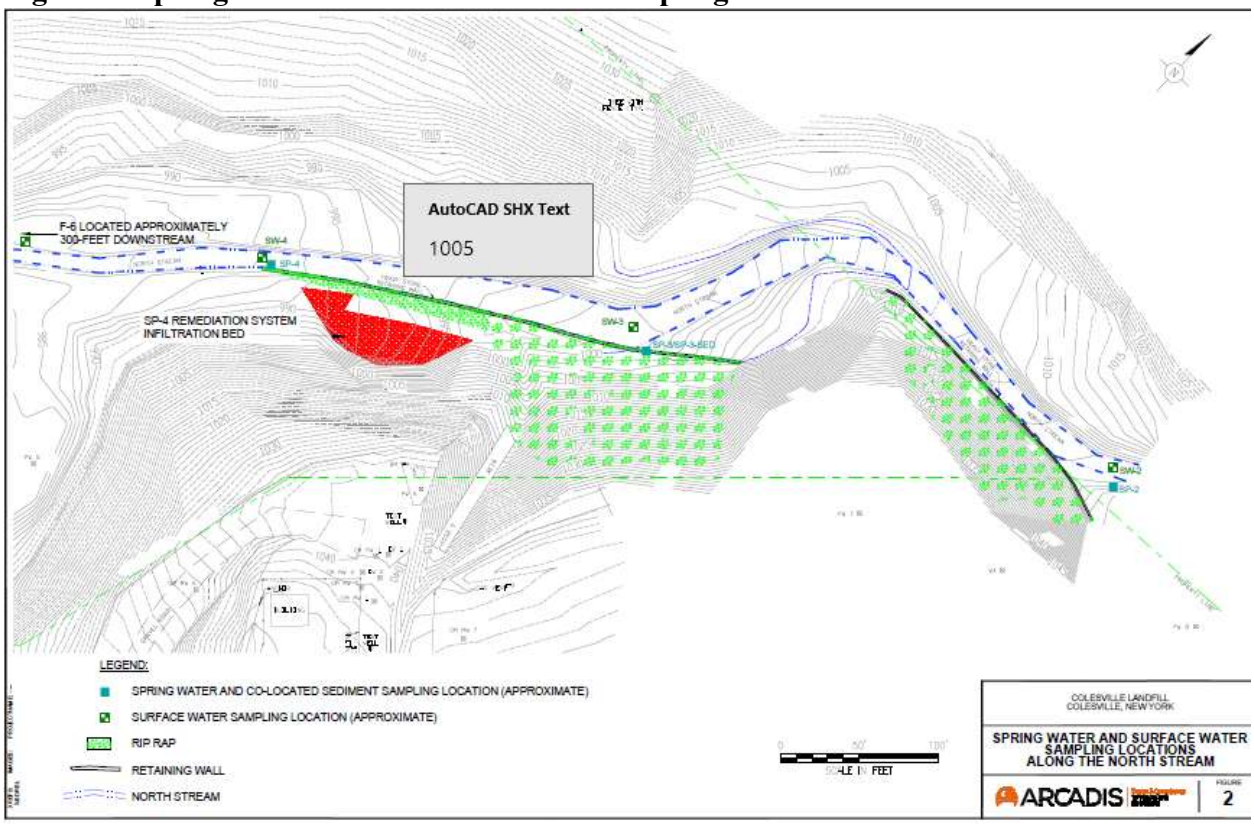


Figure 3: Spring Water and Surface Water Sampling Locations



APPENDIX B – REFERENCES

Documents, Data, and Information Reviewed in Completing Five--Year Review	
Remedial Investigation/Feasibility Study, Wehran Engineering	1990
Record of Decision, EPA	1991
Operation and Maintenance Monitoring Manual, Arcadis	1994
Groundwater Remediation System Engineering Report, Arcadis	2000
First Five-Year Review Report, EPA	2000
Explanation of Significant Differences, EPA	2000
LTM (Long Term Monitoring) Plan, Arcadis	2002
Spring Remedy, Arcadis	2003
Explanation of Significant Differences, EPA	2004
Preliminary Close-Out Report, EPA	2004
Interim Remedial Action Report, Arcadis	2004
Second Five-Year Review Report, EPA	2005
Annual Monitoring Reports, Arcadis	2009-2014
Third Five-Year Review Report, EPA	2010
Plume Delineation Report, Arcadis	2012
Declaration of Restrictive Covenants, Restrictions and Environmental Easement, EPA and NYSDEC	2014
Sediment Report, Arcadis	2014
Third Five-Year Review Report Addendum, EPA	2014
Fourth Five-Year Review Report, EPA	2015
In-Situ Reactive Zone Discontinuation Pilot Study Report	2015
Fifth Five-Year Review Report	2020
Annual Reports	2020-2024

APPENDIX C: SITE TOPOGRAPHY, GEOLOGY, AND HYDROGEOLOGY

Site Geology/Hydrogeology

The Colesville Landfill Superfund site is characterized as rural and includes large tracts of undeveloped woodlands, as well as agricultural tracts and scattered residential parcels. Of the 113 acres on which the site is situated, the landfill occupies approximately 35 acres. The property's topography ranges from approximately 1,400 feet above mean sea level in the east to about 970 feet above mean sea level in the west.

Surface water drainage at the site is via two tributaries of the Susquehanna River—the North Stream and the South Stream. The North Stream, located to the north and west of the landfill, flows southwesterly to the Susquehanna River. To the east and south of the landfill is the South Stream, which flows to the south-southwest into a low-lying wet area. Both tributaries join the Susquehanna River approximately 0.5 miles north of Doraville.

The Susquehanna River is classified as Class B surface water in the vicinity of the site. Class B waters are suitable for both primary1 and secondary contact recreation, as well as for fish propagation. The North Stream and South Stream are Class C and D waters, respectively. These waters are suitable for secondary contact recreation and fish propagation only.

Vegetation patterns at the site are a mixture of herbaceous field, weed, and grass species. Both open-field and forested habitats characterize the surrounding area. These habitats support a large variety of avian and mammalian species. No New York State Department of Environmental Conservation Significant Habitat Areas are found on-site, although the site is located within the range of several migratory endangered or threatened species. The predominant aquatic species found in the Susquehanna River include small mouth bass, rock bass, and white suckers.

Glacial outwash deposits at the site consist of a heterogeneous mixture of gravel, sand, clay and silt. The average hydraulic conductivity of these materials is approximately 0.3 feet per day. Water moving within the glacial outwash aquifer beneath the landfill is part of a shallow groundwater subsystem that discharges into nearby surface-water bodies. In this type of hydrogeologic setting, essentially all of the areal recharge to the glacial outwash aquifer moves horizontally because of the dense glaciolacustrine clay confining unit that underlies the glacial outwash aquifer. The direction of groundwater flow at the Colesville Landfill site is toward the west, southwest, and south discharging to the North Stream and Susquehanna River. Although groundwater is present in the till and glaciolacustrine clay, the low permeabilities of these units limit their potential for groundwater flow. A very small portion of the base flow to the Susquehanna River is derived from groundwater flow moving upward from the bedrock aquifer, through the glaciolacustrine clay into the overlying glacial outwash aquifer, where it ultimately seeps into the Susquehanna River.

The area surrounding the site includes large tracts of undeveloped woodlands, as well as agricultural tracts and scattered residential parcels.

Many of the residents of the Town of Colesville use private water supply wells. These wells utilize groundwater from both shallow and deep aquifers. Other homes utilize groundwater obtained from springs.

The nearest residential parcels to the landfill are located to the south and southeast along East Windsor Road. Measures have been taken at six properties that are impacted by site contamination to prevent human exposure to site contaminants. The measures included purchase by Broome County, implementation of environmental easements and installation of double-cased wells. The table below provides the status of the six properties (see Appendix A, Figure 2, for the locations of the properties).

Residential Property Status

Property	Property Distance from Landfill (ft.)	Occupancy Status	Environmental Easement?	Double-Cased Well?
Property 1	400	Demolished	Yes	N/A
Property 2	1,140	Vacant	Yes	No
Property 3	560	Vacant	Yes	No
Property 4	900	Occupied	No	Yes
Property 5	1,240	Vacant	No	Yes
Property 6	2,000	Demolished	Yes	N/A

APPENDIX D − REMEDY RESILIENCE ASSESSMENT

In accordance with Region 2 practice, three tools were utilized to assess the Colesville Landfill Superfund site. Screenshots from each of the tools used are included below.

The first tool, CMRA (see CMRA), examined five hazards (extreme heat, drought, wildfire, flooding, and costal inundation) for Broome County, the county in which the site is located. According to the CMRA tool, the National Risk Index Rating for extreme heat and wildfire are "Relatively Low" and "Very Low," respectively. No risk rating was provided for drought, although the projected number of dry days is expected to remain relatively stable over time (see Figures D-1 through D-3). The CMRA tool reported the risks for flooding as "Relatively High." Damage along the streamside of the landfill occurred during flood events in the past. The placement of larger riprap stones following the last storm event has been successful in preventing storm damage. Because the site is not near the coast, costal inundation is not applicable. See Figures D-4 and D-5.

The second tool is called the NOAA Sea Level Rise Viewer (SLRV) (see https://coast.noaa.gov/slr/). This tool assessed the potential for impacts to the site vicinity from sea level rise and coastal flooding. Figure D-6 from the SLRV shows that a 7-ft. increase in the current mean higher high water (MHHW) level would result in a high risk of impacts from sea level rise to the site vicinity.

The final tool is called the USGS U.S. Landslide Inventory (see https://www.usgs.gov/tools/us-landslide-inventory-and-susceptibility-map). As shown by Figure D-7, there have been no landslides recorded in the vicinity of the site.

Potential site impacts from severe weather have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of severe-weather effects in the region and near the site.

FIGURE D-1

Broome County, New York

Total Population
193,188

% Population with Income Below Poverty
17%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
31.26%

National Risk Index Rating
Relatively Low
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Temperature thresholds:							
Annual days with maximum temperature > 90°F	2 days 2 - 4	11 days 4 - 21	12 days 5 - 19	16 days 6 - 33	22 days 8 - 40	22 days 8 - 48	50 days 14 - 88
Annual days with maximum temperature > 95°F	0 days 0 - 0	2 days 0 - 9	2 days 0 - 7	4 days 1 - 16	7 days 1 - 17	7 days 1 - 23	24 days 2 - 56
Annual days with maximum temperature > 100°F	0 days 0 - 0	0 days 0 - 1	0 days 0 - 2	1 days 0 - 5	2 days 0 - 9	2 days 0 - 5	9 days 0 - 36
Annual days with maximum temperature > 105°F	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 1	0 days 0 - 4	0 days 0 - 3	3 days 0 - 21
Annual temperature:							
Annual single highest maximum temperature °F	92 °F 90 - 93	95 °F 93 - 99	96 °F 93 - 101	97 °F 93 - 103	99 °F 95 - 107	99 °F 94 - 106	104 °F 95 - 114
Annual highest maximum temperature averaged over a 5-day period °F	87 °F 86 - 87	90 °F 88 - 95	91 °F 88 - 94	92 °F 89 - 97	94 °F 89 - 99	94 °F 90 - 100	99 °F 91 - 110
Cooling degree days (CDD)	421 degree-days 379 - 450	697 degree-days 525 - 923	735 degree-days 556 - 967	844 degree-days 594 - 1,207	983 degree-days 683 - 1,369	1,001 degree-days 683 - 1,496	1,609 degree-days 935 - 2,340

N/A = Data Not Available for the selected area

FIGURE D-2

Broome County, New York

Total Population
193,188

% Population with Income Below Poverty
17%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
31.26%

National Risk Index Rating
No Rating
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Average annual total precipitation	40"	42"	42"	42"	43"	43"	45"
	39 - 42	40 - 46	38 - 46	39 - 46	40 - 46	40 - 48	41 - 49
Days per year with precipitation (wet days)	219 days	217 days	217 days	216 days	215 days	216 days	213 days
	214 - 224	205 - 227	199 - 225	204 - 226	198 - 223	201 - 225	190 - 234
Days per year with no precipitation (dry days)	146 days	148 days	148 days	149 days	150 days	150 days	152 days
	142 - 151	138 - 161	140 - 166	139 - 162	142 - 168	140 - 164	131 - 175
Maximum number of consecutive dry days	9 days	9 days	9 days	9 days	9 days	9 days	10 days
	8 - 10	8 - 11	8 - 12	8 - 11	8 - 13	8 - 11	8 - 12
Temperature thresholds:							
Annual days with maximum temperature > 90 °F	2 days	11 days	12 days	16 days	22 days	22 days	50 days
	2 - 4	4 - 21	5 - 19	6 - 33	8 - 40	8 - 48	14 - 88
Annual days with maximum temperature > 100 °F	0 days	0 days	0 days	1 days	2 days	2 days	9 days
	0 - 0	0 - 1	0 - 2	0 - 5	0 - 9	0 - 5	0 - 36

N/A = Data Not Available for the selected area

FIGURE D-3

Broome County, New York

Total Population
193,188

% Population with Income Below Poverty
17%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
31.26%

National Risk Index Rating
Very Low
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Days per year with no precipitation (dry days)	146 days 142 - 151	148 days 138 - 161	148 days 140 - 166	149 days 139 - 162	150 days 142 - 168	150 days 140 - 164	152 days 131 - 175
Maximum number of consecutive dry days	9 days 8 - 10	9 days 8 - 11	9 days 8 - 12	9 days 8 - 11	9 days 8 - 13	9 days 8 - 11	10 days 8 - 12
Days per year with precipitation (wet days)	219 days 214 - 224	217 days 205 - 227	217 days 199 - 225	216 days 204 - 226	215 days 198 - 223	216 days 201 - 225	213 days 190 - 234
Temperature thresholds:							
Annual days with maximum temperature > 90°F	2 days 2 - 4	11 days 4 - 21	12 days 5 - 19	16 days 6 - 33	22 days 8 - 40	22 days 8 - 48	50 days 14 - 88
Annual days with maximum temperature > 100°F	0 days 0 - 0	0 days 0 - 1	0 days 0 - 2	1 days 0 - 5	2 days 0 - 9	2 days 0 - 5	9 days 0 - 36

N/A = Data Not Available for the selected area

FIGURE D-4

Broome County, New York

Total Population
193,188

% Population with Income Below Poverty
17%

Building Codes Hazard Resistance
Resistant

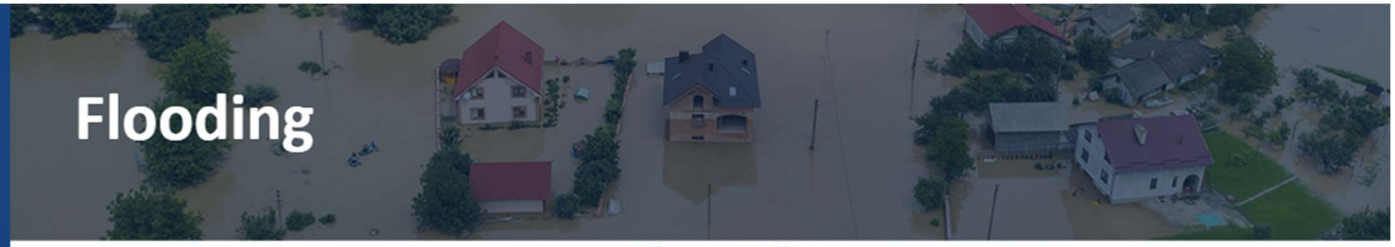
% Population Disadvantaged
31.26%

National Risk Index Rating
Relatively High
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit

Source: Census Bureau, CEO, Esri, FEMA, MRLC, NOAA, UCSD



Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Annual average total precipitation	40" 39 - 42	42" 40 - 46	42" 38 - 46	42" 39 - 46	43" 40 - 46	43" 40 - 48	45" 41 - 49
Days per year with precipitation (wet days)	219 days 214 - 224	217 days 205 - 227	217 days 199 - 225	216 days 204 - 226	215 days 198 - 223	216 days 201 - 225	213 days 190 - 234
Maximum period of consecutive wet days	14 days 12 - 15	14 days 13 - 16	14 days 13 - 16	14 days 13 - 16	14 days 13 - 16	14 days 13 - 16	14 days 12 - 20
Annual days with:							
Annual days with total precipitation > 1inch	3 days 2 - 4	4 days 3 - 5	4 days 3 - 5	4 days 3 - 5	4 days 3 - 6	4 days 3 - 6	5 days 3 - 7
Annual days with total precipitation > 2 inches	0 days 0 - 0	0 days 0 - 0	0 days 0 - 1	0 days 0 - 0	0 days 0 - 1	0 days 0 - 1	0 days 0 - 1
Annual days with total precipitation > 3 inches	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0
Annual days that exceed 99th percentile precipitation	5 days 4 - 6	6 days 5 - 7	6 days 5 - 7	6 days 5 - 7	7 days 6 - 8	7 days 6 - 8	8 days 7 - 9
Days with maximum temperature below 32 °F	50 days 47 - 54	37 days 18 - 47	37 days 25 - 47	32 days 12 - 43	28 days 15 - 38	27 days 8 - 38	14 days 3 - 26

N/A = Data Not Available for the selected area

FIGURE D-5

Broome County,
New York

Total Population
193,188

% Population with Income Below Poverty
17%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
31.26%

National Risk Index Rating
Not Applicable
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit

Coastal Inundation

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Sea level rise:							
Percent of selected county impacted by global sea level rise	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For more information on sea level changes, see the Interagency Sea Level Rise Scenario Tool

N/A = Data Not Available for the selected area

FIGURE D-6

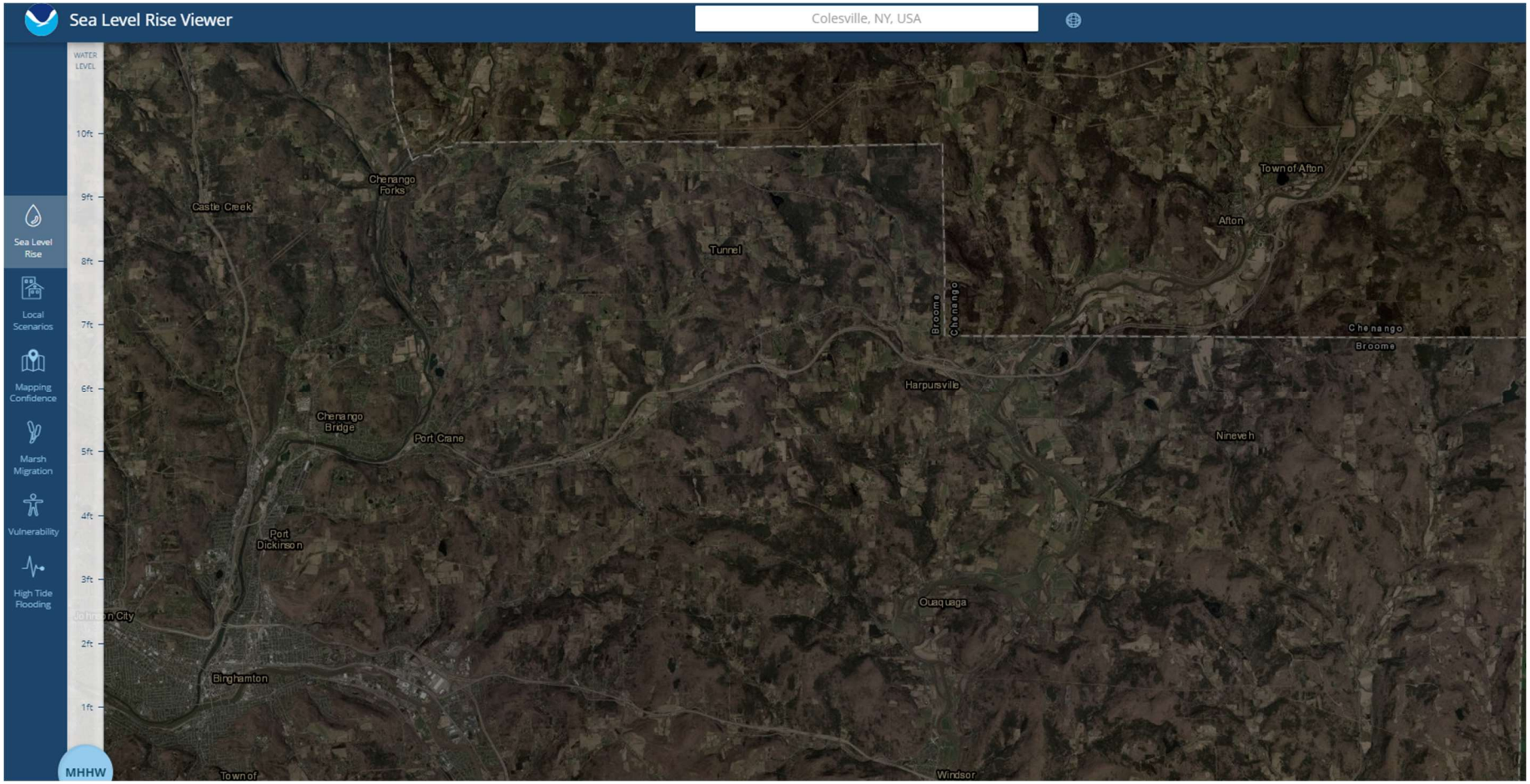
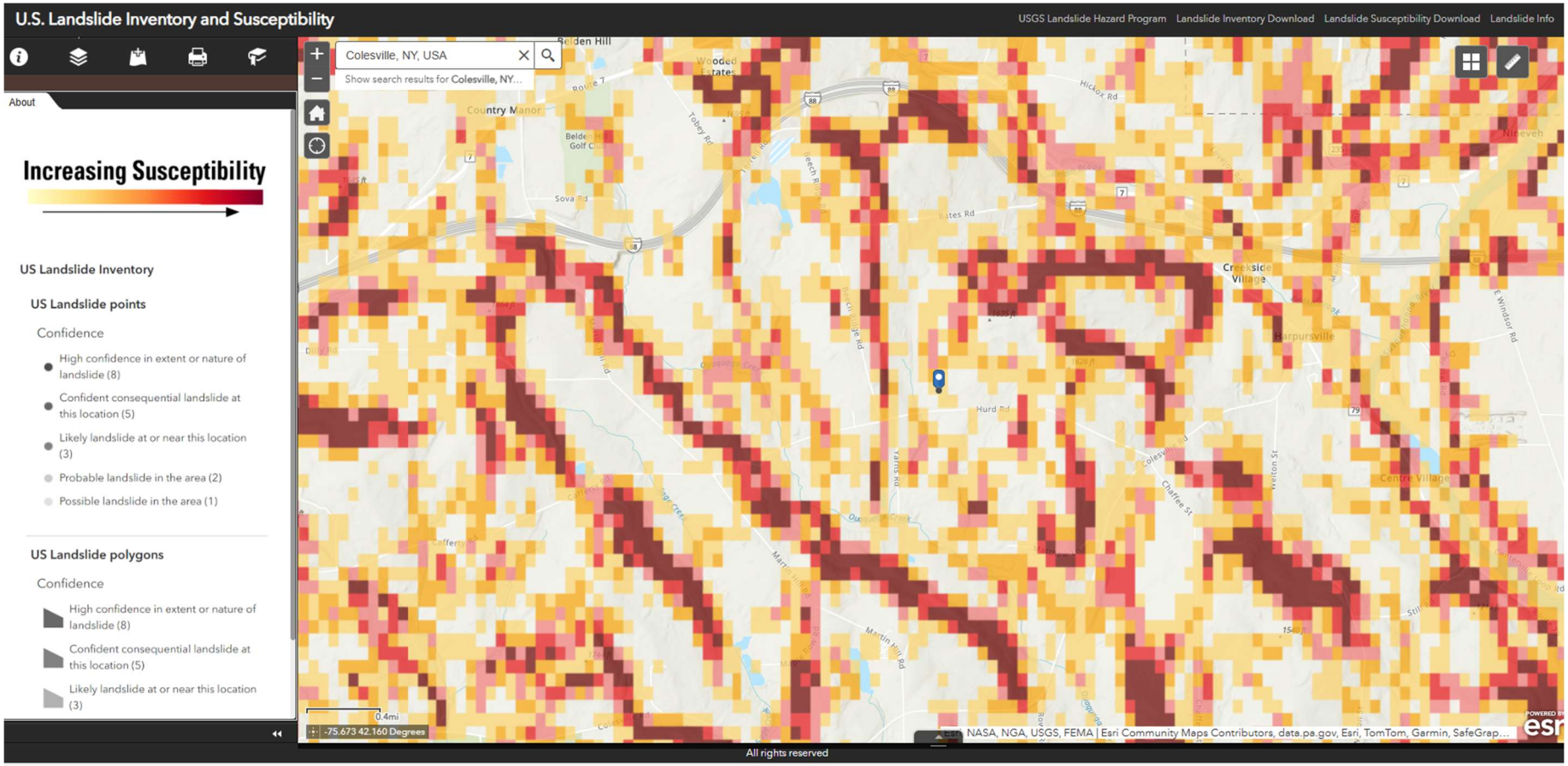

Sea Level Rise Viewer
Colesville, NY, USA
WATER LEVEL
10ft
9ft
8ft
7ft
6ft
5ft
4ft
3ft
2ft
1ft
MHHW
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
Chenango Forks
Castle Creek
Tunnel
Town of Afton
Afton
Broome
Chenango
Chenango
Broome
Harpursville
Chenango Bridge
Port Crane
Nineveh
Port Dickinson
Ouaquaga
Binghamton
Windsor

FIGURE D-7



*The site location is denoted by the blue tag.