Climate Change Vulnerability Assessment and Green Resiliency Corrective Action Report

Cross-County Sanitary / Kessman Landfill

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Prepared For:

New York State Department of Environmental Conservation

Prepared By:

TRC Engineers, Inc.
10 Maxwell Drive, Suite 200
Clifton Park, New York 12065

Prepared by:

Daniel Warren

Reviewed by:

Yulia Kalmykova, PhD/Howard Nichols

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
AR5	Fifth Intergovernmental Panel on Climate Change Assessment Report
BMP	Best management practice
CCVA	Climate Change Vulnerability Assessment
ClimAID	Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State (2011 and 2014 Reports)
CMIP5	Coupled Model Intercomparison Project, Phase 5, by World Climate Research Programme
CORDEX	Coordinated Regional Climate Downscaling Experiment
EPA	United Stated Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ft	feet
GHG	Greenhouse gas
HAPs	Hazardous air pollutants
in	inch
IPCC	Intergovernmental Panel on Climate Change
IRM	Interim Remedial Measure
mph	miles per hour
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen oxides
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
PCB	Polychlorinated biphenyls
PM10	Particulate matter less than 10 microns in size
RCP	Representative Concentration Pathway
ROD	Record of Decision
RSO	Remedial system optimization
SEFA	Spreadsheet for Environmental Footprint Analysis
SMP	Site Management Plan
SO_x	Sulfur oxides

1.0 Introduction

TRC Engineers, Inc. (TRC) has prepared this Climate Change Vulnerability Assessment and Green Resiliency Corrective Action Report (CCVA Report) for the New York State Department of Environmental Conservation (NYSDEC) to assess climate change vulnerabilities for the Cross-County Sanitary / Kessman Landfill ("Kessman Landfill", or "Site"). This CCVA Report provides an assessment of the potential for climate change to impact the remedy in place at the Site (i.e., engineering controls) and provides recommendations, or corrective actions, to address potential vulnerabilities arising from climate change.

Section 2.0 of the report provides a brief background overview of the Site, including the physical setting and history concerning contamination and remedial actions. Section 3.0 begins the climate change assessment and documents the methodologies and sources used to develop the potential ranges for climate projections. Sections 4.0 and 5.0 provide information regarding general climate change trends, and regional projections developed by the State of New York, respectively. Section 6.0 presents Site-specific projections using proprietary GIS-based software. Section 7.0 presents a summary of vulnerabilities that may affect the Site.

The vulnerabilities identified were then assessed with respect to the remedy components in place at the Site to determine if and how climate change might compromise the protectiveness of the remedy. Corrective actions, if needed, are then proposed in Section 8.0, for each vulnerability identified in the assessment. The corrective actions include a combination of material measures, such as the removal of contaminated sediments from the wetlands portion of the Site, to focused monitoring to ensure that Site conditions do not change in ways that limit the effectiveness of the remedy, such as by causing increased methane generation due to changes in leachate levels and warmer weather, and side-slope erosion due to increased precipitation and runoff.

In Section 9.0, the corrective actions are evaluated with respect to sustainability metrics to assess the environmental footprint of each, as appropriate. Remedial measures that are required to address contamination beyond the extents of the engineering controls are not included in the environmental footprint assessment.

Section 10.0 provides a final summary of the CCVA findings, and outlines monitoring and inspections and other best management practices (BMPs) to be included in the Site Management Plan (SMP).

2.0 Site Background

The Site is in the NYSDEC Inactive Hazardous Waste Disposal Site Program (New York State Superfund Program), and is located at 286 Cornwall Hill Road, Patterson, Putnam County, New York. The Site location and layout, including relevant Site features, are shown on Figures 1 and 2, respectively. The Site covers an area of approximately 10 acres, including 7.2 acres of closed landfill and 2.8 acres of contiguous, low-lying wetland swamp.

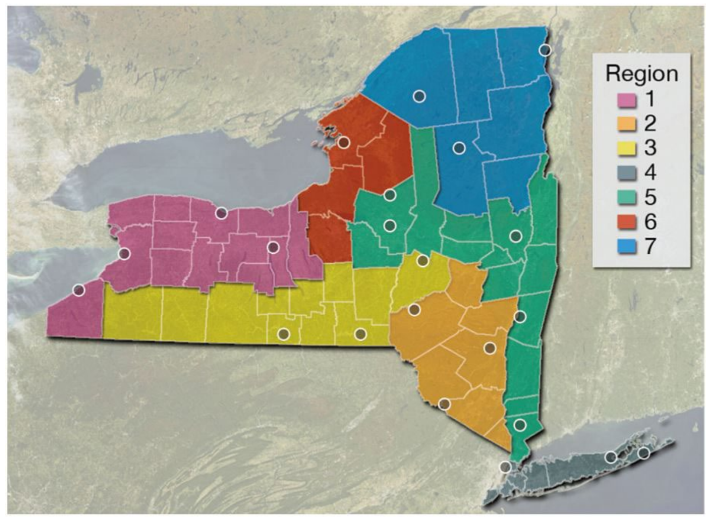
The Site operated as a municipal landfill from approximately 1963 to 1972, and as a private landfill from 1972 to 1974. Industrial and hazardous wastes were allegedly disposed of at the Site between 1972 and 1974. Numerous investigations have been conducted at the Site beginning in the early 1980s and extending to the present day. An Interim Remedial Measure (IRM) was conducted between 1993 and 1994 which involved removal and off-Site disposal of approximately 272 buried drums and approximately 100 cubic yards of impacted soil. A Remedial Investigation and subsequent Feasibility Study were both completed in 1994, in addition to the Record of Decision (ROD), which was issued in November of 1994. Remedial Actions were completed between 1995 and 1996, and included excavation of impacted sediment from the adjacent wetland area and placement within the landfill footprint, and installation of engineering controls including: a low permeability cap, a leachate collection system, and landfill gas venting system.

Residual polychlorinated biphenyl (PCB) contamination was subsequently discovered in the wetland area in the early 2000s, and investigations into the possible sources and extent of contamination began shortly thereafter. The investigations continued through 2018, and the collective findings are described in detail in the RSO Report for the Site, prepared in December 2020. Removal of the contaminated sediment is planned for the summer of 2022.

3.0 CCVA Methodology

The New York State Energy Research and Development Authority (NYSERDA) has developed the technical report: "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State" (2011 ClimAID Report) to provide information on potential vulnerabilities from climate change and to help develop adaptation strategies for the effects of climate change. An update to the report, issued in 2014, provided updated climate projections based on new climate models and additional data. The reports provide both quantitative and qualitative projections for several key factors. Quantitative projections are provided for temperature, precipitation, sea level rise (for coastal and Hudson Valley regions) and extreme events, while qualitative projections are provided for heat indices, frozen precipitation, lightning, intense precipitation of short duration and storms (hurricanes, nor'easters, tornados).

The ClimAID assessment divided New York State into seven regions; with historical climate trends and future projections analyzed for each region. The Site is located in Region 5 - East Hudson and Mohawk River Valleys. Projections for the qualitative and quantitative factors described above were developed for each region, and the Region 5 projections are used in this CCVA report.



This CCVA Report included a survey of relevant sources regarding the Site's vulnerability to natural hazards and climate impacts, and a location risk assessment using proprietary GIS-enabled software, referred to hereinafter as the Risk Assessment Toolbox. The Toolbox models future natural hazards and climate impacts based on the Coupled Model Intercomparison Project, Phase 5, by World Climate Research Programme (CMIP5) reports and data from past events. The reviewed literature included reports and online resources from the New York State Energy Research and Development Authority (NYSERDA), Federal Emergency Management Agency (FEMA), and National Oceanic and Atmospheric Administration (NOAA).

The Risk Assessment Toolbox is based on the Intergovernmental Panel on Climate Change (IPCC) framework and the Representative Concentration Pathway (RCP) scenarios for atmospheric greenhouse gas concentrations from the Fifth IPCC Assessment Report (AR5), published in 2014. It should be noted that the Physical Science Basis Report from the Sixth IPCC Assessment Report was released in August 2021 and the GIS-enabled software used in the location risk assessment has not been updated to reflect the data presented therein. The climate change scenarios presented in AR5 are:

- RCP 2.6: Moderate scenario leading to a warming at the end of the 21^{st} century of probably less than 2° Celsius (C) relative to the pre-industrial period (1850–1900).

- RCP 4.5: Intermediate scenario leading to a warming at the end of the 21st century of more than 2°C relative to the pre-industrial period (1850–1900).
- RCP 8.5: Most severe scenario leading to a warming at the end of the 21st century of probably more than 4°C relative to the pre-industrial period (1850–1900).

This report assumes projected global warming of approximately 5.4°F (3°C) by 2100, in line with the current scientific consensus, which assumes enactment of planned climate policies (i.e., RCP 4.5) [1].

[1] Hausfather, Z. and Peters, G. (2020). Emissions – the 'business as usual' story is misleading. Nature 577, 618-620.

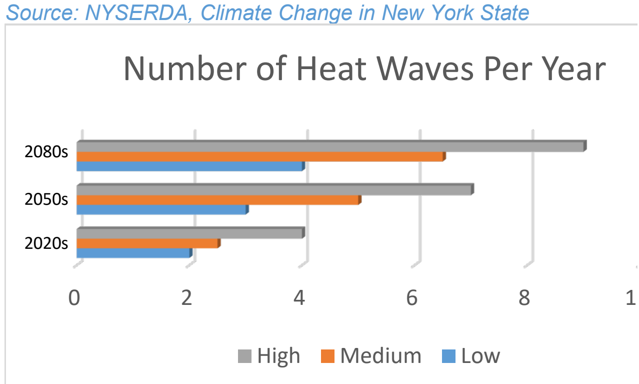
4.0 Region 5 Vulnerability to Natural Hazards

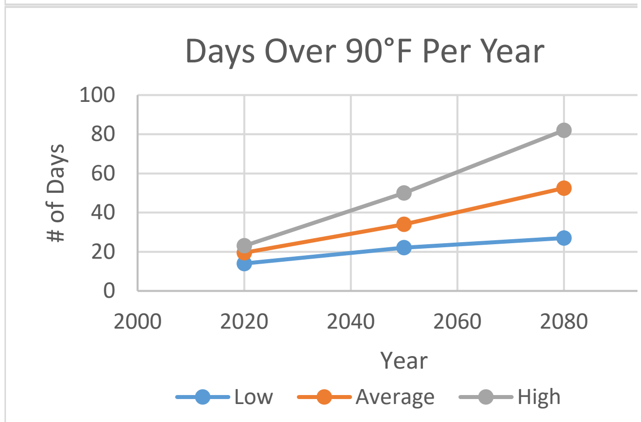
A summary of the natural hazards threatening Region 5 are discussed below. Natural hazards un-related to climate change, including earthquakes, volcanos and tsunami are considered in the Rish Assessment Tool Box, and are presented in the vunerability assessment projections. According to NYSERDA, average temperatures are increasing across New York State, including Region 5, leading to extreme weather events such as heat waves and heavy rainfall. These extreme events are predicted to continue and accelerate within the State as higher temperatures are extremely likely for New York State in the future.

Extremes of hot weather are defined as:

- **Extreme Hot Days:** Individual days with temperatures at or above 90 °F.
- **Heat Waves:** Three consecutive days with maximum temperatures above 90 °F.

Source: NYSERDA, Climate Change in New York State





Region 5 is vulnerable to the effects of extreme temperature, such as extreme hot days and and heat waves, and extreme precipitation, which can lead to flooding[2]. The projected number of heatwaves and days with temperatures over 90°F in the future are shown on the right. The high range estimates project a significant increase in heat waves, with up to 9 heat waves projected per year.

Low-lying areas are particularly vulnerable to the effects of flooding. Flooding is most intense in Region 5 in the late summer and fall, as large river systems overflow with rainfall runoff deposited by tropical storms. The number of extreme rainfall events is projected to increase, further increasing the chances for river flooding, leading to a greater potential for erosion.

Region 5 is expected to see a decrease in the number of cold weather days leading to warmer winters. Earlier snow melt may dissrupt breeding habits of amphibians that rely on wetland areas or vernal pools for their lifecycles. The endangered bog turtle is known or suspected of using the wetlands area near the Site, and may be impacted by these weather changes.

[2] Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information NYSERDA Report, https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/ClimAID/2014-ClimAID-Report.pdf/

In addition, coastal storms, such as tropical cyclones and nor'easters, can cause wind damage and intense precipitation throughout the entire State. The effects of Hurricane Irene and Tropical Storm Lee in 2011 demonstrated that Region 5 is vulnerable to inland flood risks associated with major storm rainfall. Figure A1 in Appendix A shows the tracks of major historic storms relative to the location of the Site. Three storms have passed within the immediate vicinity of the Site, including Hurricane Irene (by then a tropical storm), a 1893 unnamed category 1 storm and a 1924 extra tropical cyclone. These records show that coastal storms are likely to impact the area around the Site.

5.0 Review of Climate Projections for Region 5

Weather data associated with Region 5 is collected from the Saratoga Springs weather station, located approximately 130 miles from the Site. The 2014 ClimAID Report provided updated climate information for New York City following Hurricane Sandy, data from the new climate models developed for the IPCC AR5 report, additionally collected data, and improved understanding of climate change science. According to the 2014 ClimAID Report, average annual temperatures and precipitation are projected to increase over the next 80 years for Region 5 (Table 1). Also extreme events, such as the number of days over 90 °F, will rise in the next 60 years from the current average of ten per year to a mid-range estimate of 35 to 70 per year. Intense downpours, defined as days with a rainfall of over one inch, will increase from an average of 10 days per year to a mid-range estimate of 11 to 13 days per year (Table 2).The 2014 ClimAID Report concluded that higher temperatures and increased heat waves have the potential to increase fatigue of materials in the water, energy, transportation, and telecommunications sector in Region 5. Projected higher average annual precipitation and frequency of heavy precipitation events could also potentially increase the risks of flash floods, impacting roadways, and create travel delays.

The projected increases in average air temperature, percipitation and the number of extreame weather events predicted by the 2014 ClimAID Report are provided in the tables below.

Table 1. Mean Annual Medium to High Temperature and Precipitation Projections for Region 5

Indicator	2020s	2050s	2080s	2100
Air Temperature, ^{0}F Baseline: 47.6 °F (1971 – 2000)	+ 2.3° to +3.7°	+ 4.5° to +7.1°	+ 5.6° to +11.4°	+6.1° to +13.6°
Annual Precipitation, inches Baseline: 38.6 inches (1971 – 2000)	+0.8 in to +3.9 in	+1.5 in to +5.8 in	+1.9 in to +6.6 in	+1.9 in to +10.0 in

Table 2. Probability of Extreme Events in Region 5

Date Range	2020s			2050s			2080s		
Extreme Weather Event	Low	Medium	High	Low	Medium	High	Low	Medium	High
Days over 90°F (10 days)	14	17 to 22	23	22	27 to 41	50	27	35 to 70	82
# of Heat Waves (1 heat wave)	2	2 to 3	4	3	4 to 6	7	4	5 to 8	9
Duration of Heat Waves (4 days)	4	5 to 5	5	5	5 to 6	6	5	5 to 7	9
Days below 32°F (155 days)	123	127 to 136	139	98	104 to 119	125	77	84 to 109	120
Days over 1" Rainfall (10 days)	10	10 to 11	12	10	11 to 12	13	10	11 to 13	14
Days over 2" Rainfall (1 day)	1	1 to 2	2	1	1 to 2	2	1	1 to 2	2

Notes:

1. Current number of extreme events show in parentheses
2. Low estimate represents 10^{th} percentile likelihood
3. Medium estimate represents 25^{th} to 75^{th} percentile likelihood
4. High estimate represents 90^{th} percentile likelihood

5.1 Extreme Events

According to the 2011 ClimAID Report, more frequent extreme events are among the likely climate impacts for Region 5. These extreme events include extremes of heat, intense rainfalls, and coastal flooding caused by tropical storms and nor'easters. Due to the Site's inland location, it is not vulnerable to the effects of coastal flooding. However, it is vulnerable to the effects of other extreme events. The frequency and duration of heat waves is expected to increase and the number of annual cold days is expected to decrease in Region 5.

Although the increase in the total annual precipitation for Region 5 between 2020 and 2080 is expected to be between 5 and 17%, a larger increase is expected in the frequency, intensity and duration of extreme precipitation events. Extreme precipitation events, defined as a rainfall event with 1, 2, or 4 inches per day, can overwhelm stormwater systems and result in increased pluvial flooding and erosion events.

5.2 Flooding

According to the 2014 ClimAID Report, the relative flood vulnerability of any location in Region 5 is likely to remain the same, even with increased precipitation; however, the frequency of flooding is expected to increase, due to an increase in the frequency and intensity of storms. This agrees with the projections from the Risk Assessment Toolbox, which predicts that eastern portions of the Site remain at a high risk for River Flood under three different RCP Scenarios. These Site-specific projections are discussed in detail in Section 6.0.

NOAA's National Hurricane Center online tool indicates that the Site is not located in an area vulnerable to storm surge flooding from a Category 4 or lesser huricane (Figure A5). Storm surge data were not available for Category 5 hurricanes; however, the distance of the Site from the coast or Hudson River (which may experience storm surges) is sufficient to prevent storm surge related flooding.

6.0 Site Specific Risk Assessment

The findings of the Risk Assessment Toolbox analysis for the Site are discussed in this section. The Risk Assessment Toolbox was used to screen the Site location for several potential natural hazards which could impact the Site and reduce the effectiveness of the existing engineering controls. The assessment includes natural hazards that are not impacted by climate change but should still be considered in a vulnerability assessment. The hazard zone rating scores presented in this section represent relative risk or severity levels for each expected hazard. A lower zone score represents a lower overall risk for each hazard and high scores represents a higher risk or the potential for stronger events to impact the Site. Similarly, color bars are used to provide a visual indication of hazard risk, where darker colored bars, in general, indicated higher risk. A legend of the hazard ratings and color coding (relating to Tables 3 and 7) is provided at the end of this section.

Earthquakes and Volcanoes hazards were identified as low risk for the Site and they are not discussed further. Additionally, because the Site is not located in a coastal environment the risks of tsunami are not considered in this assessment.

According to the risk assessment results in Table 3 below, the Site is in Zone 1 for tropical cyclones (i.e. hurricanes or tropical storms) and extratropical storms (i.e. nor'easters). The tropical cyclone Zone 1 rating predicts storms with wind speeds equivalent to Category 3 hurricanes, while the extratropical storm Zone 1 rating predicts storms with maximum winds of 74 mph to impact the Site. Other significant risks include tornado, flash flood, hail, and lightning. A portion of the Site is also at risk of a 100-year river flood, as described above.

Table 3. Hazard Scores for Kessman Landfill

Hazard Scores

	low — high	hazard rating
Earthquake		Zone 0: MM V and below
Volcanoes		No hazard
Tsunami		No hazard
Tropical Cyclone		Zone 1: 142 - 184 km/h
Extratropical Storm		Zone 1: 81 - 120 km/h
Hail		Zone 3
Tornado		Zone 3
Lightning		Zone 3: 4 - 10
River Flood		Zone 100 year return period
Flash Flood		Zone 3
Storm Surge		No hazard
Wildfire		Zone 2

Based on the results presented in Table 3, the tropical cyclone and river flood hazards will be unchanged under RCP4.5 and RCP8.5 scenarios. It should be noted that maximum 5-day precipitation is expected to increase by 16% in the RCP8.5 year 2100 scenario, compared to the current level (refer to Section 6.1), increasing the chances for pluvial flooding. Yet, from analysis of the maps, it appears that the floodplain extent is unchanged for all the analyzed scenarios (see Figures A3 and A4).

6.1 Temperature, Precipitation and Climate Indices

Table 4 below shows current values and predicted changes for the Annual Maximum Temperature for the Site from the Risk Assessment Toolbox. The results show an increase in the range of 6.3 - 14.6° Fahrenheit (F) from the current level of 94.1° F for different RCP scenarios. These ranges are in line with the 2011 ClimAID Report. The current annual maximum temperature is based on data from 1986-2005. The mean increase in maximum temperatures was derived using available CORDEX models. The projected temperature increases, along with the increases in the expected number of heat waves, suggest that heat stress represents a potential risk to the Site.

Table 4. Climate Change Risks – Temperature

Annual Maximum Temperature			
Current (°F)	94.1		
RCP 2.6	2030	2050	2010
Mean Change (°F)	6.3	6.7	5.9
Projected (°F)	100.4	100.8	100
RCP 4.5	2030	2050	2010
Mean Change (°F)	6.8	8.3	9.4
Projected (°F)	100.9	102.4	103.5
RCP 8.5	2030	2050	2010
Mean Change (°F)	7.2	9.7	14.6
Projected (°F)	101.3	103.8	108.7

Table 5 below shows current values and predicted changes for the Maximum 5-Day Precipitation for the Site from the Risk Assessment Toolbox. Significant increases of precipitation are expected in the RCP4.5 (the current trajectory of the emissions) and RCP8.5 scenarios. The current maximum 5-day precipitation amount is based on data from 1986-2005. The relative increase in the maximum 5-day precipitation amount was derived using available CORDEX models. These ranges are in line with the ClimAID Reports and suggest that precipitation and extreme precipitation events represent a risk to the Site.

Table 5. Climate Change Risks – Precipitation

Maximum 5-Day Precipitation			
Current	3.78	inches	
RCP 2.6	2030	2050	2010
Relative Change (in)	0.3%	-1.4%	0.8%
Projected (in)	3.79	3.73	3.81
RCP 4.5	2030	2050	2010
Relative Change (in)	3.2%	1.2%	8.3%
Projected (in)	3.9	3.83	4.09
RCP 8.5	2030	2050	2010
Relative Change (in)	4.2%	6.4%	16.0%
Projected (in)	3.94	4.02	4.38

Climate indices, which include Heat Stress, Fire Weather Stress, Precipitation Stress and Drought Stress are shown in Table 6, below. The Fire Weather Stress and Drought Stress are low in all the scenarios. Precipitation Stress Index is relatively high, which correlates with results of the risk analysis with the areas in a risk zone for flash flood. The Heat Stress Index is currently moderate but will increase in RCP8.5 by the end of the century.

Table 6. Climate Indices

	Fire Weather Stress Index	Drought Stress Index	Heat Stress Index	Precipitation Stress Index
Current	0.0 - 2.0 low	NA	4.1 - 6.0 mod.	6.1 - 8.0
RCP 2.6, 2030	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 2.6, 2050	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 2.6, 2100	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 4.5, 2030	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 4.5, 2050	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 4.5, 2100	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 8.5, 2030	2.1 - 4.0	0.0 - 2.0 low	4.1 - 6.0 mod.	6.1 - 8.0
RCP 8.5, 2050	2.1 - 4.0	2.1 - 4.0	4.1 - 6.0 mod.	6.1 - 8.0
RCP 8.5, 2100	2.1 - 4.0	2.1 - 4.0	6.1 - 8.0	6.1 - 8.0

Legend of Hazard Ratings

(dark blue)	0.0 - 2.0 low
(cyan)	2.1 - 4.0
(green)	4.1 - 6.0 mod.
(orange)	6.1 - 8.0
(red)	8.1 - 10.0 high

6.2 Flooding and Storms

The Site is situated near three tributaries to the East Branch of the Croton River. Muddy Brook borders the Site to the south and two of its tributaries lie to the west and north of the Site. A marsh area identified as the Great Swamp Park is located east of the Site and fed by Muddy Brook and its northern tributary. The elevation of the Site ranges from approximately 450 feet above mean sea level (amsl) to 427 feet amsl, and there is an approximately six-and-a-half-foot drop in elevation between the western side of the landfill and the eastern side of the landfill, which is generally level with the marsh area to the east. A small ridge lies to the west of the Site along Cornwall Hill Road, with a maximum elevation of approximately 472 feet above mean sea level. The ridge serves as a natural flood control from the western tributary of Muddy Brook. There are no topographical features to the south, east, or north that serve as natural flood controls for the Site. Surface profiles of the Site and surrounding area are provided in Appendix A, as Figures A6 and A7.

FEMA flood maps are available for the Site. According to the FEMA Map #36079C0151E[3] the northeast edge of the landfill is contiguous with the Special Flood Hazard Area Zone AE (i.e. Great Swamp Park), which is defined as a special flood hazard area subject to inundation with 1% annual chance flood. This Special Flood Hazard Area has a base flood elevation of 432 feet and encroaches on the eastern portion of the Site (Figure A2). A topographic map of the Site, provided as Figure 3, shows the approximate location of the 432-foot elevation line along the eastern toe of the landfill slope. According to the FEMA flood maps the Site is bordered to the north and south by a Flood Hazard Area with a 2% annual chance flood, and these areas border monitoring wells 3A and 3B, 5A and 5B and 20A and 20B. The Site is also located approximately 700 feet northwest of a Regulatory Floodway (regulatory floodplain) associated with Muddy Brook.

Table 7 presents the Tropical Cyclone and River Flood Hazards in RCP4.5 and RCP8.5. As indicated in the table, the Site is in zone 1 relative to tropical cyclones, and zone 3 relative to river flood hazards. These ratings appear unchanged in the RCP4.5 and RCP8.5 scenarios, concluding that the Site lies in an area of minimal additional flood hazard.

Based on the foregoing, the eastern border of the Site and the adjacent PCB-impacted sediment targeted for remediation are most prone to flood risk. This result is consistent with the Risk Assessment Toolbox, which shows current river flood risk impact limited to the very north-eastern edge of the Site (Figures A3 and A4).

[3] FEMA Flood Map #36079C0151E, effective date March 4, 2013

Table 7. Tropical Cyclone and River Flood Hazards in RCP4.5 and RCP8.5

Tropical Cyclone

	low ... high	hazard rating
Current		Zone 1: 142 - 184 km/h
RCP 4.5, 2030		Zone 1: 142 - 184 km/h
RCP 4.5, 2050		Zone 1: 142 - 184 km/h
RCP 4.5, 2100		Zone 1: 142 - 184 km/h
RCP 8.5, 2030		Zone 1: 142 - 184 km/h
RCP 8.5, 2050		Zone 1: 142 - 184 km/h
RCP 8.5, 2100		Zone 1: 142 - 184 km/h

River Flood

	low ... high	hazard rating
Current		Zone 100 year return period
RCP 4.5, 2030		Zone 100 year return period
RCP 4.5, 2050		Zone 100 year return period
RCP 4.5, 2100		Zone 100 year return period
RCP 8.5, 2030		Zone 100 year return period
RCP 8.5, 2050		Zone 100 year return period
RCP 8.5, 2100		Zone 100 year return period

Hazard Score Legend (Tables 3 and 7)

Wildfire
No hazard
Zone 1: low
Zone 2
Zone 3
Zone 4: high
The effects of wind, arson and fire-prevention measures are not considered.

Earthquake
Zone 0: MM V and below
Zone 1: MM VI
Zone 2: MM VII
Zone 3: MM VIII
Zone 4: MM IX and above
Probable maximum intensity (MM: modified Mercalli scale) with an exceedance probability of 10% in 50 years (equivalent to a „return period" of 475 years) for medium subsoil conditions.

Volcanoes
No hazard
Unclassified
Zone 1: minor hazard
Zone 2: moderate hazard
Zone 3: high hazard
Secondary effects that can occur as a result of the large-scale distribution of volcanic particles (e.g. climate impacts, supraregional ash deposits) are not considered

Tsunami
No hazard
Zone 0 minimal flood risk
Zone 1000 year return period
Zone 500 year return period
Zone 100 year return period
Zones based on 100m SRTM (Version 4.1) elevation model, taking into account height above sea level and distance from coasts.

Tropical Cyclone
Zone 0: 76 - 141 km/h
Zone 1: 142 - 184 km/h
Zone 2: 185 - 212 km/h
Zone 3: 213 - 251 km/h
Zone 4: 252 - 299 km/h
Zone 5: ≥ 300 km/h
Probable maximum intensity with an exceedance probability of 10% in 10 years (equivalent to 'return period' of 100 years).

Extratropical Storm
No hazard
Zone 0: ≤ 80 km/h
Zone 1: 81 - 120 km/h
Zone 2: 121 - 160 km/h
Zone 3: 161 - 200 km/h
Zone 4: > 200 km/h
Probable maximum intensity with an average exeedance probability of 10% in ten years (equivalent to a „return period" of 100 years).

Hail
Zone 1: low
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6: high
Frequency and intensity of hailstorms.

Tornado
Zone 1: low
Zone 2
Zone 3
Zone 4: high
Frequency and intensity of tornados.

Lightning
Zone 1: 0,2 - 1
Zone 2: 1 - 4
Zone 3: 4 - 10
Zone 4: 10 - 20
Zone 5: 20 - 40
Zone 6: 40 - 80
Global frequency of lightning strokes per km² and year.

Defended River Flood
Zone 0 minimal flood risk
Zone 500 year return period
Zone 100 year return period
Areas threatened by extreme floods. Defended: Includes flood protection.

Flash Flood
Zone 1: low
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6: high
Frequency and intensity of flash floods.

Defended Storm Surge
No hazard
Zone 1000 year return period
Zone 500 year return period
Zone 100 year return period
Detailed calculation for coasts. Zones based on 30m ALOS Digital Elevation Model (DEM), taking into account wind speed and bathymetry. Does consider dykes / defense dataset.

7.0 CCVA Findings and Limitations

The CCVA has identified several natural risks for the Site, which are predicted to increase in frequency and/or intensity in the future due to the effects of climate change. These risks have been identified by examining climate change projections for New York State Climate Region 5, the overall findings of the IPCC, and the Risk Assessment Toolbox analysis. The findings can be used as a basis for estimating possible damages from natural and climate risks, and are further discussed in the following report sections. Where necessary, corrective actions are subsequently recommended to enhance the protectiveness of the Site remedy despite climate changes.

In summary, the significant climate and natural hazards risks which are material to the Site include the following:

1. Precipitation Stress;
2. River Flooding;
3. Heat Stress; and
4. Tornados.

This study considered risk assessment of only the Kessman Landfill Site, and the findings of this report should not be used for any other location in Climate Region 5. TRC has made every effort to ensure the accuracy of the analysis in this report using available information and tools at the time of the report preparation. However, it should be noted that climate projections are prone to uncertainties and are being updated continuously. Overall, the conclusions and results described in this report should be treated as the indications of possible outcomes, and not predictions.

8.0 Potential Corrective Actions

Potential impacts to Site operations and engineering controls related to each of the significant climate and natural hazards identified for the Site are discussed below. An analysis of how the potential climate and natural hazards would interact with the Site will be followed by recommendations, if necessary, to mitigate the potential climate change impacts. The precipitation stress and river flooding are considered together because they have similar impacts to Site conditions.

The recommended corrective actions should be considered in preparation of the SMP for long-term management of the Site.

8.1 Precipitation Stress and River Flooding

As described above, an increased risk of heavy rain is likely due to climate change. The overall annual precipitation (38.6 in.) is expected to increase by a range of 5% to 17% (1.9 in. to 6.6 in.) between 2020 and 2080 and the number of extreme precipitation events is expected to increase as well. These extreme events, where rainfall amounts range from 1 to 4 inches per event, can lead to more frequent flooding. Portions of the Site, primarily the northeastern wetland area, are located within the flood plain with surface elevations below the base flood elevation of 432 feet. The base flood elevation is partway up the side slope of the landfill.

Potential hazards related to precipitation and river flooding include:

1. Potential erosion of soil in the wetland area.
2. Potential erosion of soil within the landfill area and along the landfill side slopes, which may damage the cap.
3. Potential for stormwater to enter the landfill through leachate drains or damage to the cap. Note, the leachate collection system construction details were not documented in an as-built drawing set.

To address these hazards, TRC recommends the following corrective actions:

1. Ensure the side slopes of the landfill have adequate vegetation to prevent erosion from stormwater run-off.
2. Ensure the toe of the landfill is protected with coarse aggregate along the bottom 10 feet, in accordance with the 2021 Remedial Construction Contract Drawings, to mitigate future slope erosion due to flooding and extreme precipitation events.
3. Ensure that future monitoring wells installed along the toe of the landfill (including MW-R20A and MW-R20B, to be installed in 2022) are located at an elevation that will preclude flooding and potential cross-contamination between groundwater and surface water (top of casing elevation must be above 433 ft AMSL).

4. Include monitoring of the leachate collection system (hydraulic and chemical monitoring) in the long-term inspection and monitoring program for the Site. The free flow of water into and out of the landfill should be prevented to the extent possible.
5. Conduct periodic inspections of the landfill cap, especially after significant storms or rainfall events. The inspections should include assessments of the health of the vegetative cover, signs of erosion or scour and the integrity of the gravel layer at the toe of the landfill slope.
6. Conduct repairs as needed to prevent damage to the cap or exposure of the landfilled waste to the environment.

8.2 Heat Stress

An increase in the maximum annual temperature is expected based on the CCVA. The annual maximum temperature for the Site is expected to increase by a range of 6.3°F to 14.6°F from the current maximum of 94.1°F. The increase in high temperatures may stress vegetation or lead to changes in the geochemical conditions within the landfill.

Potential hazards related to heat stress include:

1 Elevated temperatures may be damaging to vegetation that covers the landfill cap, side slopes, and wetlands areas. The resulting loss of vegetation may lead to decreases in erosion resistance and potential slope stability issues along the landfill side slopes, especially if high temperatures are followed by strong storm events.

2 Elevated temperatures may also increase the ambient temperature in the landfill, potentially leading to increased methane production. The methanogenic bacteria that convert carbon from the landfilled waste into methane in the landfill will benefit from increases in leachate temperatures, potentially increasing methane production rates.

To address these hazards, TRC recommends the following corrective actions:

1. Conduct regular inspections, mowing, and maintenance of the vegetation on the landfill cap, side slopes, and adjacent wetlands areas. Additional watering may be needed if vegetation appears stressed. Areas where the soil surface is exposed should be appropriately re-seeded and cultivated to ensure a full vegetative cover across the landfill.
2. Conduct landfill gas venting system inspections on a regular basis. Confirm that the venting system is unclogged and operating as designed. Additional inspection events should be conducted in the summer when temperatures are higher.
3. Conduct methane monitoring concurrent with landfill gas venting system inspections. Confirm that elevated methane concentrations are not present in the system, with an emphasis to the west in the direction of the adjacent residences and structures. Methane production levels may increase if the leachate collection system outfalls are closed, preventing stormwater from entering the landfill. Leachate elevations are

expected to decrease if the outfalls are closed, leaving more unsaturated waste materials available for conversion to methane.

4. If methane is observed during the landfill gas venting system inspections, an assessment should be made to determine if the methane can be recovered and used as a fuel source. Given the age and limited waste volume in the landfill, it is likely that methane production will be low and that any methane present in the landfill will be too dilute to be used as an effective fuel source.
5. If methane is found at the landfill at sufficient concentrations to present an explosion hazard, but below concentrations that would be usable for a fuel source, the landfill gas vents can be retrofitted to enhance venting. Additional measures, such as active landfill gas extraction, can be considered if monitoring shows that methane concentrations around the landfill perimeter are elevated.

8.3 Tornados

An increase in frequency of tornados at the Site is possible. There are currently no above ground facilities, no support structures, and no permanent utility connections at the Site that could be damaged in the event of a tornado. However, temporary facilities (i.e., office and equipment storage trailers) which may be required for future Site work, would need to be evaluated against the recommendations below.

Potential hazards related to tornados include:

1. Potential damage to vegetation and trees.
2. Potential damage to the Site cap is possible if a severe tornado struck the Site.
3. Potential damage to temporary facilities and utility connections.

To address these hazards, TRC recommends the following corrective actions:

1. Limit the storage of loose equipment and material on-Site to prevent objects from being moved or damaged due to wind.
2. Conduct routine Site visits to inspect and maintain vegetation, including trees, in healthy condition.
3. Maintain trees and tall shrubs in healthy condition to minimize damage from severe storms.
4. Conduct Site inspections after any strong storms with potential tornados pass near the Site. Any damage to the cap should be promptly repaired.
5. Ensure that temporary structures that will remain unattended are properly anchored to resist anticipated wind loads. The anchor should meet or exceed local building code requirements and should be sufficient to resist an EF-2 tornado (111 to 135 miles per hour wind speed). The anchoring system may take engineering design, as installing

an anchor through the landfill cap should be avoided, and the landfilled waste may not prove suitable for anchoring.

8.4 Green Remediation Practices

A series of green remediation practices, with potential applicability to this Site, have been developed, and are included in Appendix C. These practices are intended to be evaluated (and potentially applied) during future Site activities, including implementation of the upcoming RSO, as well as during performance of routine inspections, monitoring events, and subsequent corrective measures, if any. These practices include material selection, procedures and processes, and equipment selection, and are intended to be consistent with NYSDEC policies in CP-49 (Climate Change and DEC Action), DER-31 (Green Remediation), CP-75 (DEC Sustainability) and Section 1.14 of DER-10 (Technical Guidance for Site Investigation and Remediation). Several of the practices are based on United States Environmental Protection Agency (USEPA) guidance for best management practices, including Best Management Practices for Excavation and Surface Restoration (EPA 542-F08-012). The green remediation practices that are relevant to the RSO implementation have been included in the RSO contract documents and will be incorporated into the RSO remedial activities.

9.0 Sustainability Assessment of Corrective Actions

An assessment of the environmental footprint of the proposed corrective actions is provided in this section. The footprint, or lifecycle, assessment was conducted using the United States Environmental Protection Agency (EPA) software Spreadsheet for Environmental Footprint Analysis (SEFA). The SEFA software uses three spreadsheet files to estimate the environmental footprint of the project in the following categories:

- Personnel transport
- Material use
- On-Site equipment uses
- On-Site electricity use
- Waste transportation and disposal
- Water use
- Renewable energy use
- Laboratory analysis
- Miscellaneous energy and air emissions

SEFA provides graphical and tabulated outputs for the lifecycle assessment. These outputs include estimates of total energy use, greenhouse gas (GHG) emissions, nitrogen oxide (NO_x) and sulfur oxide (SO_x) emissions, particulate matter less than 10 microns in size (PM_{10}), and hazardous air pollutant (HAP) emissions. The results of the lifecycle assessment are presented in Appendix B.

The footprint assessment includes the proposed routine monitoring events including leachate, groundwater, surface water, sediment, landfill gas, and cap inspections. The footprint also includes an assessment of the routine landscaping work to be conducted at the Site, as well as an assumed small cap repair event that would be conducted periodically. Transportation, equipment use, and laboratory analyses (for groundwater, sediment, surface water, and leachate quality) have been included in the assessment. A summary of the results of each component of the footprint assessment is provided below.

<u>Routine Inspections</u>

Proposed routine landfill inspections would be conducted on a quarterly basis. Three of the inspection events will be completed by one staff, and will include inspections of leachate levels, landfill gas readings at each gas vent, and visual observation of the cap and vegetation quality as well as the remediated wetland area. The fourth site inspection would include collecting groundwater samples from the 8 on-Site monitoring wells, as well as sediment, surface water, and leachate sample collection. It is assumed that the fourth inspection and sampling event would require 2 staff to compete the work in one day.

The SEFA evaluation considered 1 year of Site monitoring in the assessment. The annual environmental footprint is provided in the Footprint Summary in Appendix B. Graphs illustrating the distribution of the footprint, including emissions generated on-Site as wells as those generated off-Site, such as electricity generation for the laboratory analyses, are also provided in Appendix B. These quarterly site inspections are expected to generate a minimum amount of waste, approximately 0.1 tons (200 lbs), and will not require significant water or energy use. The total air emissions for NO_x, SO_x, PM_{10} and HAPs is expected to be approximately 21.5 lbs per year. GHG emissions, mainly derived from travel to and from the Site, is expected to be approximately 0.4 tons (800 lbs).

Landscaping

Proposed routine landscaping events needed to keep the Site in good order were also considered in this assessment. The annual routine tasks would include up to 6 normal maintenance events, consisting of mowing and periodic watering as needed, one spring cleanup event to apply fresh grass seed as needed, and up to 4 snow removal events to clear the site access point and gates. The footprint assessment assumes that the landscaping crews will be local, traveling approximately 10 miles to arrive at the site. The majority of waste generated during the landscaping would be recycled on site, by spreading grass clippings and shredding leaf waste, minimizing the need for off-site waste management.

The SEFA evaluation considered 1 year of Site landscaping in the assessment. The annual environmental footprint is provided in the Footprint Summary in Appendix B. Graphs illustrating the distribution of the footprint, including emissions generated on-Site as wells as those generated off-Site are also provided in Appendix B. The landscaping events are expected to generate a minimum amount of waste requiring off-Site disposal, approximately 0.1 tons (200 lbs), with the majority of the landscape waste (~ 1 ton) being recycled on site. The use of up to 5,000 gallons of water annually has been considered in the assessment. The total air emissions for NO_x, SO_x, PM_{10} and HAPs is expected to be approximately 18.3 lbs per year. GHG emissions, mainly derived from on-Site equipment use and travel to and from the Site, is expected to be approximately 1.2 tons (2,400 lbs).

Site Repairs

The footprint assessment has considered the need for periodic repairs to the landfill cap, as a result of erosion. The frequency of these repairs has been assumed to be once per 10 years; however, the actual frequency cannot be accurately predicted. The repair activity includes the repair of a 20-foot by 20-foot section of the cap soil or gravel cover, including importing and placement of up to 26 tons of clean fill soil. The assessment assumes that the landfill cap membrane would not require repairs or replacement. The assessment assumes the repaired area would be hydroseeded and would require watering and maintenance beyond the routine landscaping activities.

The SEFA evaluation for the site repairs considered one event. The single event environmental footprint is provided in the Footprint Summary in Appendix B. Graphs illustrating the distribution of the footprint, including emissions generated on-Site as wells as those generated off-Site are also provided in Appendix B. The site repairs are expected to generate up to approximately 1 ton of waste for off-site disposal, and require the use of up to 10,000 gallons of water (including 4 follow-up site inspections and watering events). The total air emissions for NO_x, SO_x, PM_{10} and

HAPs is expected to be approximately 21 lbs per event. GHG emissions, mainly derived from on-Site equipment use are expected to be approximately 1.4 tons (2,800 lbs) per event.

A schedule showing the total emissions and water consumption for the site over a 30 year lifespan in provided in Appendix B, and is accompanied with a graph showing the emissions for GHG, NO_x, SO_x, PM_{10}, HAPs and water use. The emissions are also evaluated using the EPA equivalency calculator, and the results of the comparison are also provided in Appendix B. The total air emissions for NOx, SOx, PM10 and HAPs over the assumed 30 year period are estimated to be approximately 0.63 tons. The total GHG emissions over the assumed 30 year period are estimated to be approximately 53 tons, roughly equivalent to driving 120,800 miles or satisfying energy use of 5.8 average homes for one year.

The footprint of the remedy, corrective measures, Site inspections and periodic repair events could be reduced by the generation of renewable energy on-Site, either through the installation of solar photovoltaic panels, small windmill(s) or potentially using methane to generate electricity. Additionally, enhancements to the vegetation and ecosystem beyond the maintenance of existing conditions could be implemented to enhance the value of the wetlands for species diversity. While these steps will not enhance the protectiveness of the remedy, they can be used to off-set part or all of the environmental footprint of the remedy and suggested corrective actions.

10.0 Summary

The CCVA has identified several natural risks for the Site, which are predicted to increase in frequency and/or intensity in the future due to the effects of climate change. The engineering controls at the Site are expected to be adequate to withstand the anticipated increase in temperature and the increased potential for storm events that may result in flooding at the Site, and no changes to the cap or surrounding area are proposed. TRC does recommend including routine inspections in the SMP, as well as inspections to be conducted after significant rainfall events, storms or potential flooding conditions. The ability of the Site engineering controls to withstand repetitive storm events will be diminished if the cap, slopes and wetlands areas are not maintained in proper conditions, as these Site features are critical in preventing contact with the underlying waste material and contamination.

The corrective actions presented in Section 8.0, and assessed for their respective environmental footprints in Section 9.0, were developed to confirm that the Site remains in good condition and is more likely to withstand flooding, increased precipitation, higher temperatures and the potential for more significant storms in the future. The recommendations include routine Site inspections, routine landscaping and maintenance, and periodic repairs to the Site cap. Site inspections are proposed on an annual basis and following significant storms, and would include an assessment of the following:

- Cap condition and health of vegetated cover;
- Leachate elevations and quality;
- Landfill gas concentrations and distribution; and,
- Confirmation that equipment and structures, if any, are properly anchored.

Corrective actions should be conducted if damage to the cap or vegetated cover are observed during a routine or post-storm inspection. The assessment of the leachate collection and gas venting systems may also require corrective measures, including cleaning of gas vents or active measures to control the spread of landfill gas and/or leachate from the Site.

The corrective actions described in Section 8.0 of this CCVA, and summarized in Table 8 below, should be included in the SMP and should be incorporated into the routine maintenance and monitoring of the Site.

Table 8. Summary of Potential Hazards and Corrective Actions

Potential Hazard	Potential Corrective Action
Potential Precipitation and Flooding Hazards	• Ensure the side slopes of the landfill are adequately vegetated. • Ensure the toe of the landfill is protected with coarse aggregate. • Ensure that future monitoring wells are installed above the flood level of approximately 433 ft AMSL. • Include monitoring of the leachate collection system. • Conduct periodic inspections of the landfill cap. • Conduct repairs as needed to prevent damage to the cap or exposure of the landfilled waste to the environment.
Potential Heat Stress Hazards	• Conduct regular inspections, mowing, and maintenance of the vegetation on the landfill cap, side slopes, and adjacent wetlands areas. • Conduct landfill gas venting system inspections on a regular basis. • Conduct methane monitoring concurrent with landfill gas venting system inspections. • Assess the methane levels to determine if methane recovery can be performed, and if gas vent enhancements or retrofits are needed.
Potential Tornado Hazards	• Limit the storage of loose equipment and material. • Conduct routine Site visits to inspect vegetation and trees. • Maintain trees and tall shrubs in healthy condition. • Conduct Site inspections after any strong storms with potential tornados. • Ensure temporary structures are properly anchored to resist wind loads.

11.0 References

Federal Emergency Management Agency (FEMA). Flood Map #36079C0151E, effective date March 4, 2013.

Intergovernmental Panel on Climate Change AR5. 2014. The Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change. https://www.ipcc.ch/assessment-report/ar5/.

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National Oceanic and Atmospheric Administration. National Storm Surge Hazard Maps. https://www.arcgis.com/apps/MapSeries/index.html?appid=d9ed7904dbec441a9c4dd7b277935fad.

New York State Energy Research and Development Authority. 2014. Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information Report. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Environmental/ClimAID/2014-ClimAID-Report.pdf/.

NOAA NCEI, Tropical cyclone tracks, https://oceanservice.noaa.gov/news/historical-hurricanes/

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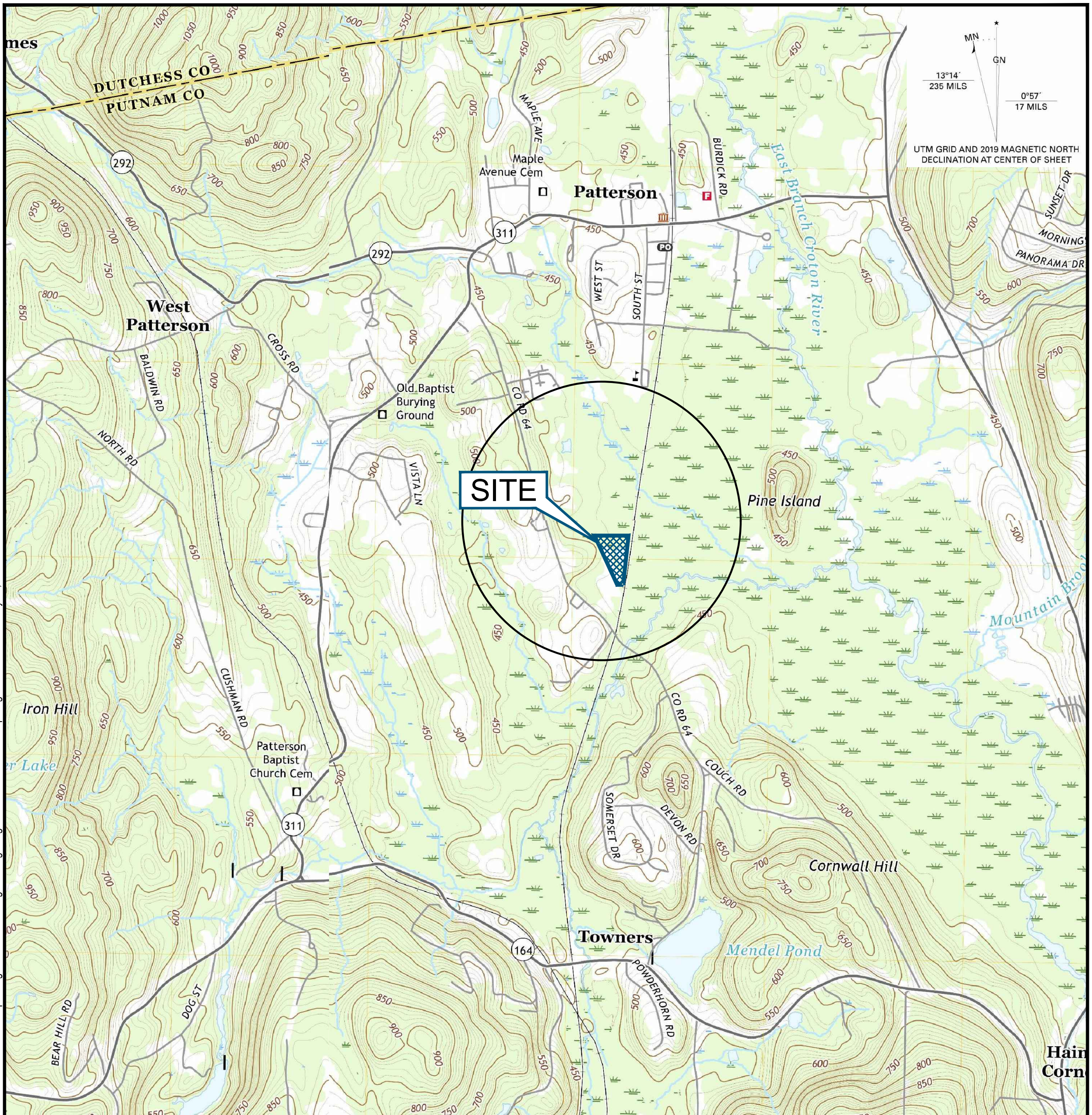
Figures



SCALE: 1:2400

KILOMETERS: 1 | 0.5 | 0 | 1 | 2

METERS: 1000 | 500 | 0 | 1000 | 2000

MILES: 1 | 0.5 | 0 | 1

FEET: 1000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000

QUADRANGLE LOCATION

MAP INCLUDES INFORMATION FROM THE FOLLOWING MAP SHEET(S):
TP, BREWSTER, NY, CT, 7.5-MINUTE DATED 2019,
NE, PAWLING, NY, CT, 7.5-MINUTE DATED 2019,
NW, POUGHQUAG, NY, 7.5-MINUTE DATED 2019,
W, LAKE CARMEL, NY, 7.5-MINUTE DATED 2019.

MAP OBTAINED THROUGH USE OF TOPOVIEW WITH THE INTERFACE CREATED BY THE NATIONAL GEOLOGIC MAP DATABASE PROJECT (NGMDB), IN SUPPORT OF THE TOPOGRAPHIC MAPPING PROGRAM, MANAGED BY THE USGS NATIONAL GEOSPATIAL PROGRAM (NGP).

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1090 Union Road, Suite 280
West Seneca, NY 14224
Phone: 716.221.0774
www.TRCcompanies.com

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SITE NO. 340011 - CROSS-COUNTY SANITARY/KESSMAN LANDFILL
286 CORNWALL HILL ROAD
PATTERSON, NEW YORK 12563

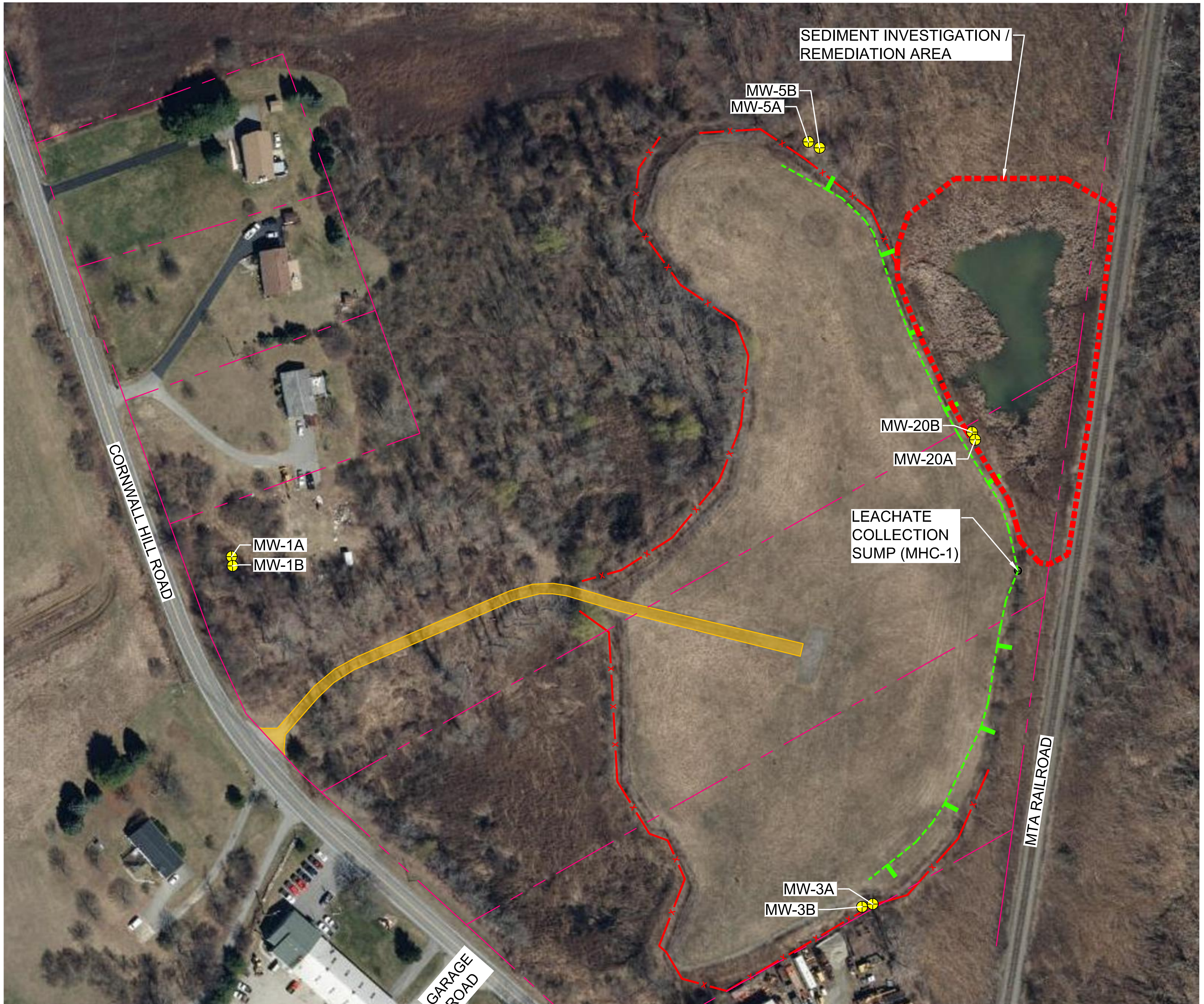
TITLE:

SITE LOCATION MAP

DRAWN BY:	H. DELGADO
CHECKED BY:	J. YAEGER
APPROVED BY:	K. SULLIVAN
DATE:	JUNE 2020
PROJ. NO.:	387570.0000.0000
FILE:	Figure 1 - Site Location Map.dwg

FIGURE 1

8.5x11 --- ATTACHED XREFS: --- ATTACHED IMAGES: NY_Brewster_20190930_TM; NY_Lake_Carmel_20190930_TM; NY_Pawling_20190926_TM; NY_Poughquag_20190927_TM;
DRAWING NAME: B:\NYSDEC\D009812\Work Assignments\D009812-07 Kessman Landfill\RSO Report\Figures\TRC Working Drawings\ Figure 1 - Site Location Map.dwg --- PLOT DATE: May 20, 2020 - 1:51AM --- LAYOUT: 8.5x11P



0 120' 240'

SCALE: 1" = 120'

N

LEGEND (SYMBOLS NOT TO SCALE):

- ACCESS ROAD
- FENCE LINE
- PROPERTY BOUNDARY
- SEDIMENT INVESTIGATION / REMEDIATION AREA
- MW-XX MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
- LEACHATE MANHOLE LOCATION
- LEACHATE COLLECTION PIPE (WITH APPROXIMATE LOCATION OF OUTLETS SHOWN. NOT FIELD VERIFIED.)

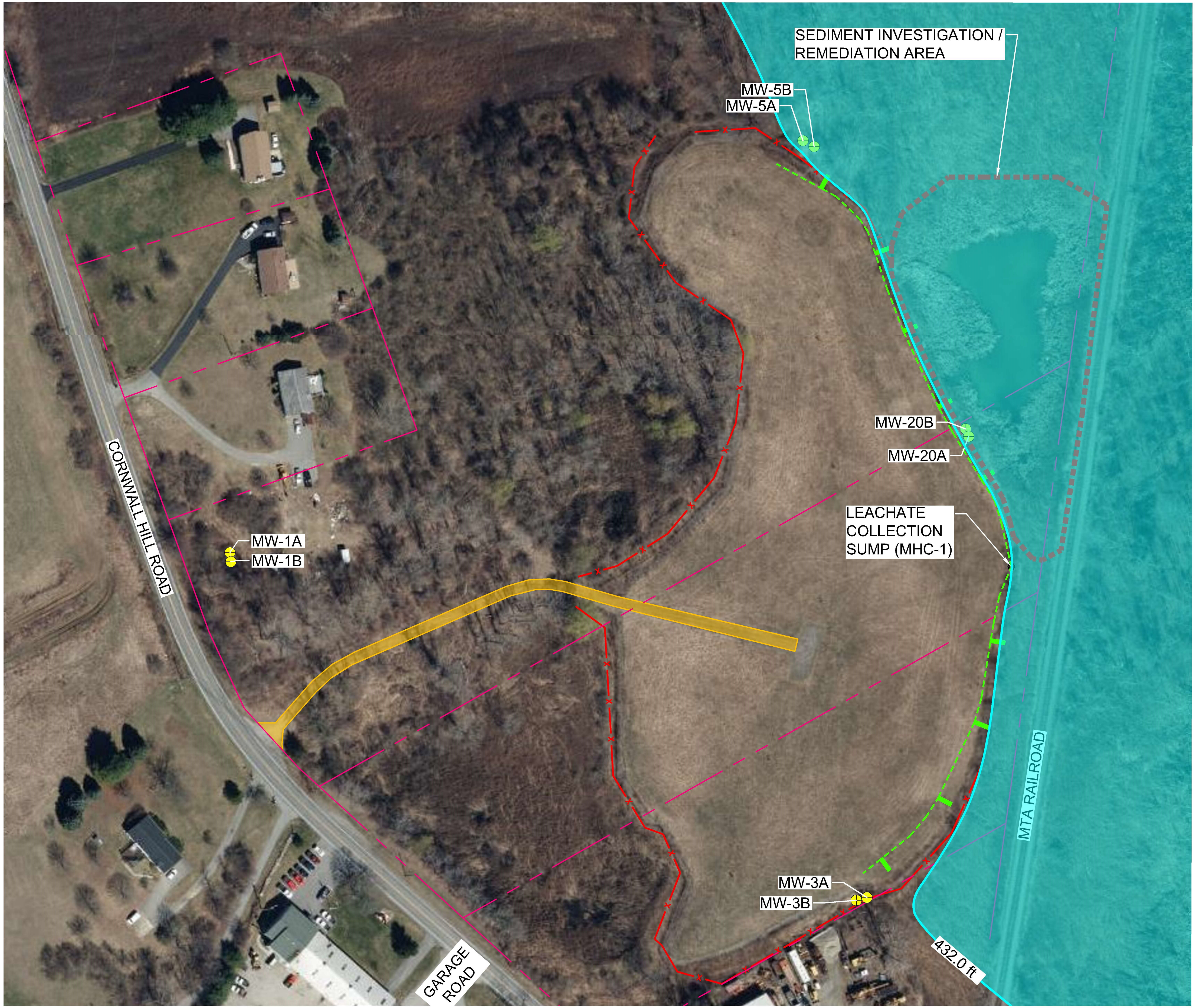
NOTES:

1. BASEMAP IMAGERY SOURCED FROM ESRI DATABASE DATED NOVEMBER 5, 2019.
2. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.

SHEET SIZE: 11" BY 17"

PROJECT: NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION SITE NO. 340011 - CROSS-COUNTY SANITARY/KESSMAN LANDFILL 286 CORNWALL HILL ROAD PATTERSON, NEW YORK 12563	
TITLE: SITE LAYOUT	
DRAWN BY: H. DELGADO	PROJ NO.: 387570.0000.0000
CHECKED BY: J. YAEGER	FIGURE 2
APPROVED BY: K. SULLIVAN	
DATE: JUNE 2020	
TRC	1090 Union Road, Suite 280 West Seneca, NY 14224 Phone: 716.221.0774 www.TRCcompanies.com
FILE NO.:	Figure 2 - Site Layout.dwg

DRAWING NAME: \\cliftonpark-vfp\cliftonpark\ECR\Projects\NYSDEC\D009812\Work Assignments\D009812-07 Kessman Landfill\RSO Report\Figures\TRC Working Drawings\ Figure 2 - Site Layout.dwg --- PLOT DATE: June 22, 2020 - 7:52PM --- LAYOUT: 11X17L



0 120' 240'

SCALE: 1" = 120'

LEGEND (SYMBOLS NOT TO SCALE):

- ACCESS ROAD
- FENCE LINE
- PROPERTY BOUNDARY
- SEDIMENT INVESTIGATION / REMEDIATION AREA
- MW-XX MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
- MH LEACHATE MANHOLE LOCATION
- LEACHATE COLLECTION PIPE (WITH APPROXIMATE LOCATION OF OUTLETS SHOWN. NOT FIELD VERIFIED.)
- AT OR BELOW BASE FLOOD ELEVATION OF 432.0 FT ABOVE MEAN SEA LEVEL

N

NOTES:

1. BASEMAP IMAGERY SOURCED FROM ESRI DATABASE DATED NOVEMBER 5, 2019.
2. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.

SHEET SIZE: 11" BY 17"

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SITE NO. 340011 - CROSS-COUNTY SANITARY/KESSMAN LANDFILL
286 CORNWALL HILL ROAD
PATTERSON, NEW YORK 12563

TITLE:

BASE FLOOD MAP

DRAWN BY:	B. SCHLAFF	PROJ NO.:	387570.0000.0000
CHECKED BY:	H. NICHOLS	FIGURE 3	
APPROVED BY:	H. NICHOLS		
DATE:	JANUARY 2022		

TRC
1090 Union Road, Suite 280
West Seneca, NY 14224
Phone: 716.221.0774
www.TRCcompanies.com

FILE NO.: Figure 3-Base Flood Map.dwg

Appendix A: Climate Risk and Impact Maps

Figure A1. Historical Storm Tracks in the Study Area. Source: Tropical cyclone tracks, NOAA NCEI, https://oceanservice.noaa.gov/news/historical-hurricanes/

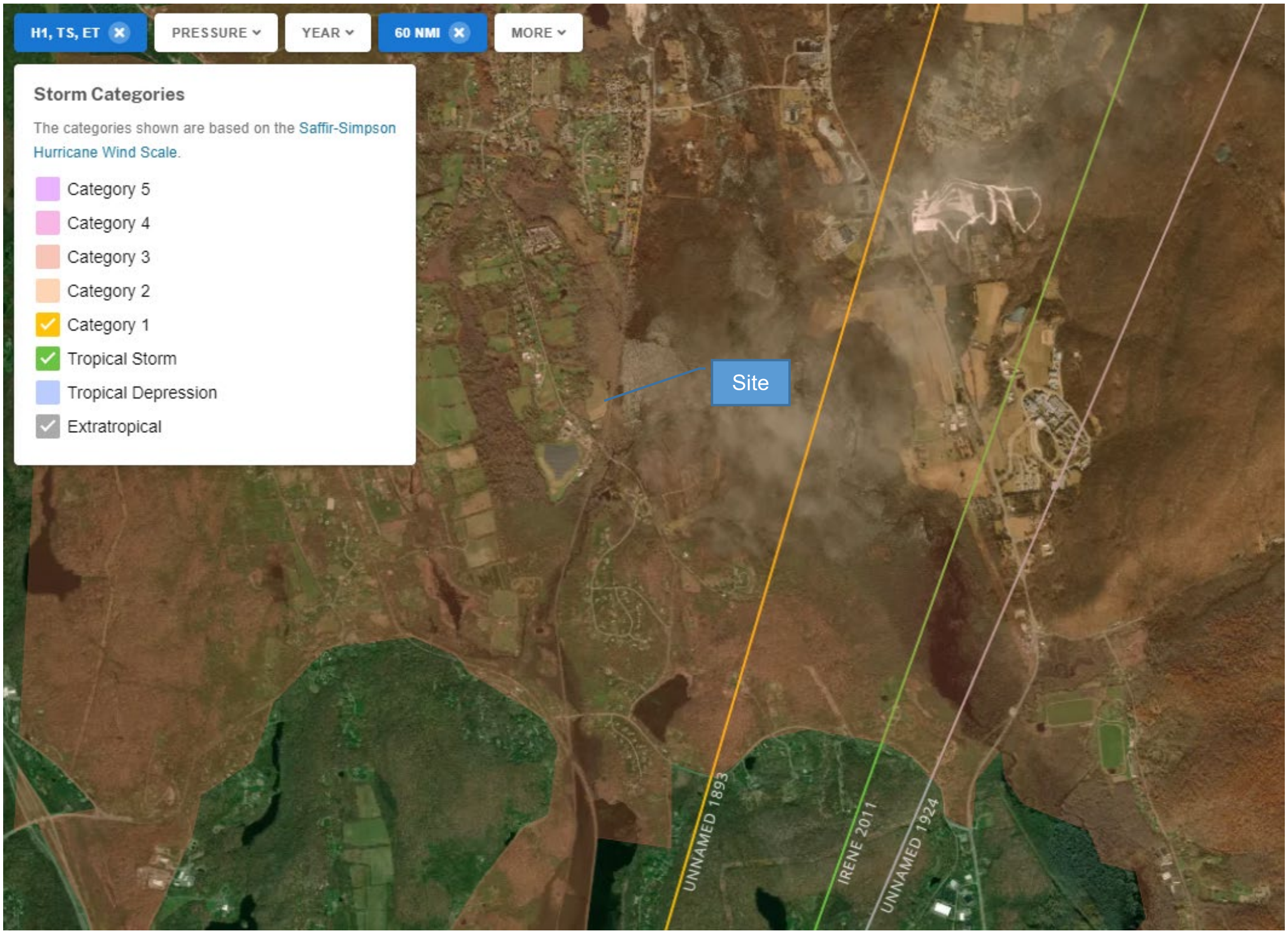


Figure A2. FEMA Map #36079C0151E

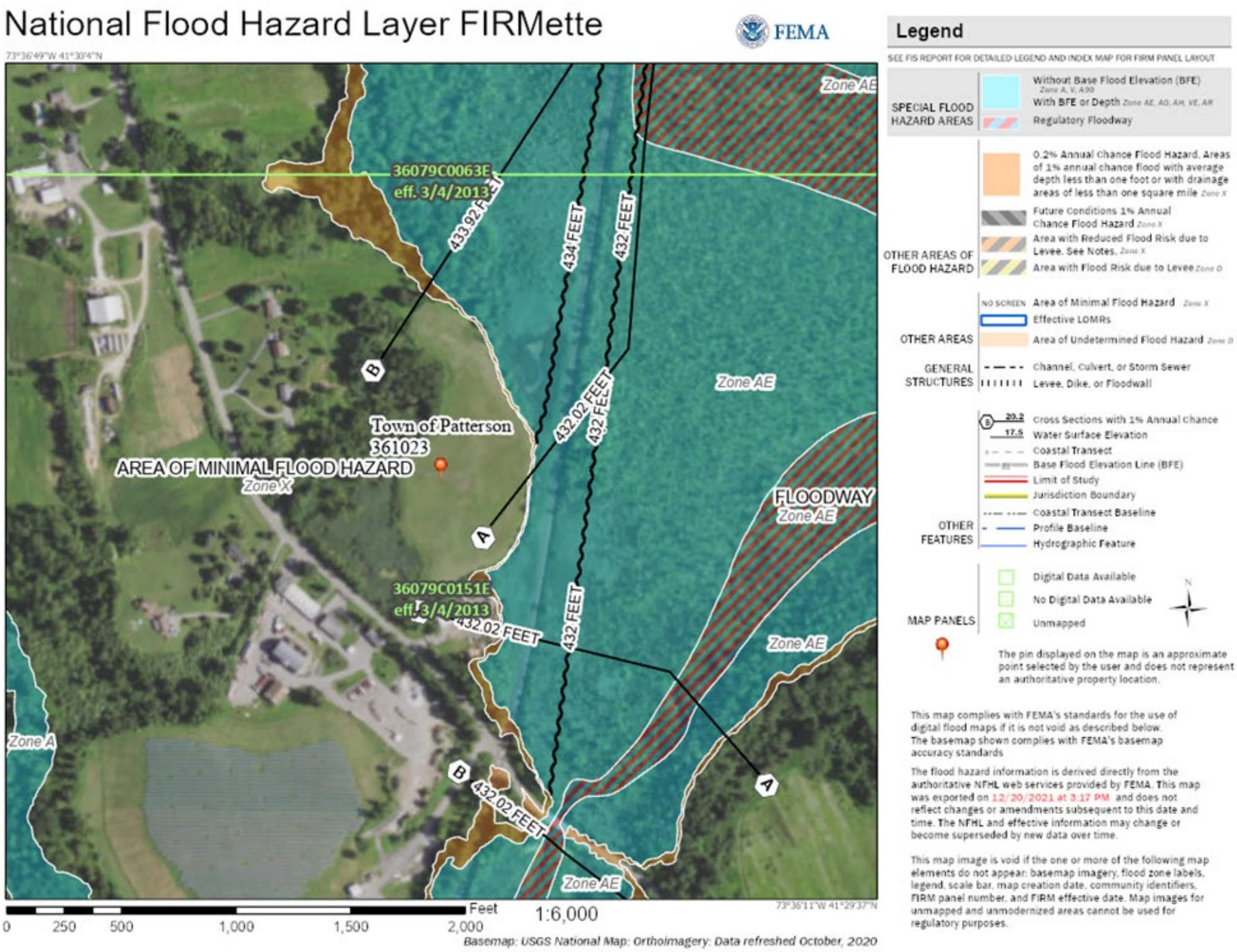


Figure A3. River Flood Risk at Present

Figure A4. River Flood Risk in RCP8.5 Scenario

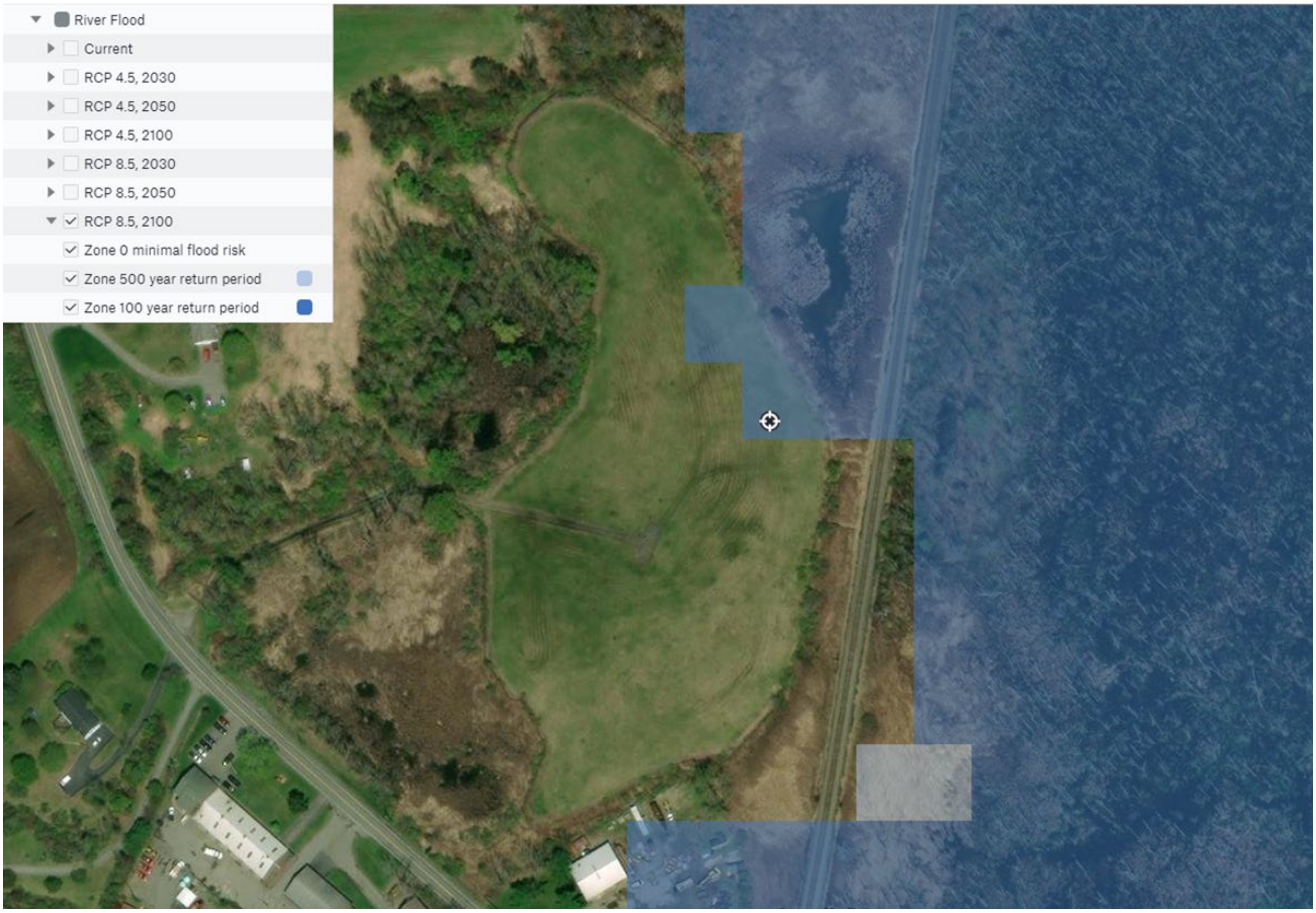


Figure A5: NOAA Storm Surge Flooding Risk, Category 4 Hurricane

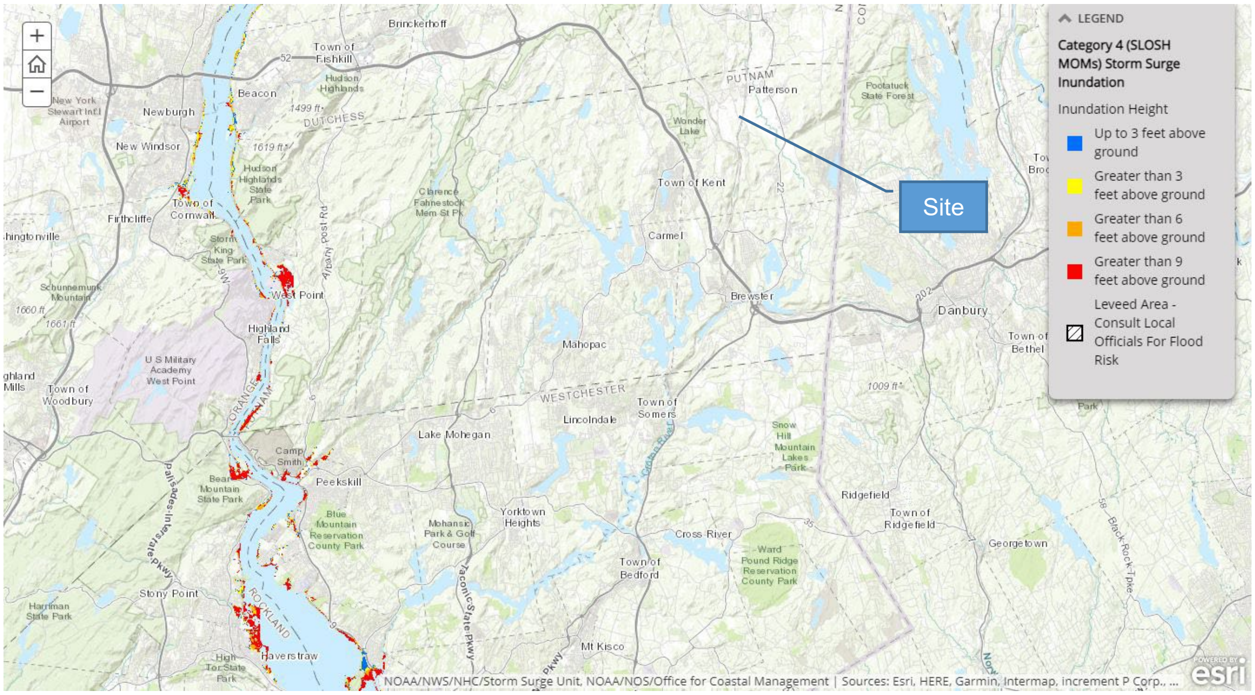
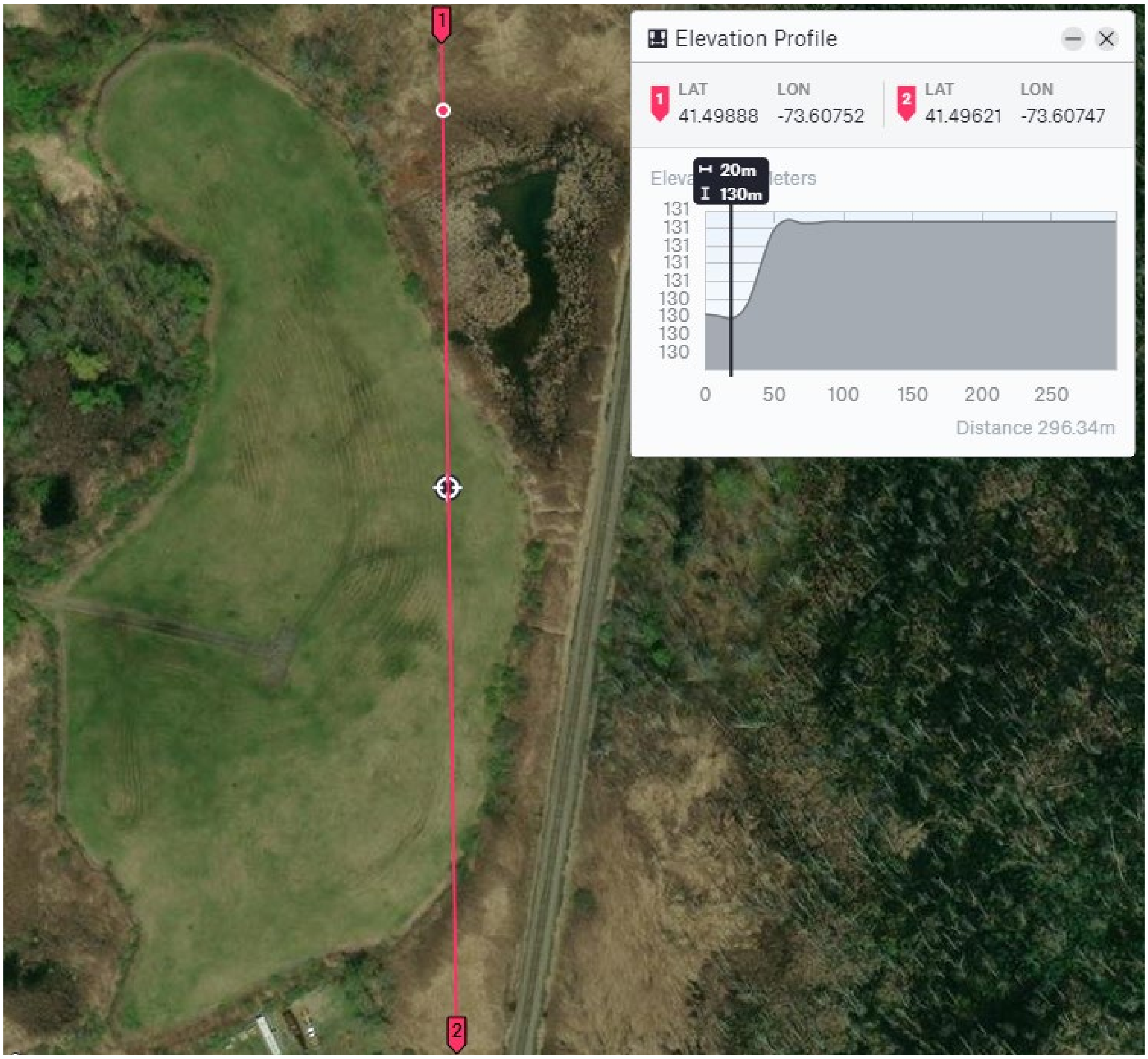


Figure A6. Elevation Profile

Figure A7. Elevation Profile



Appendix B: SEFA Output Files

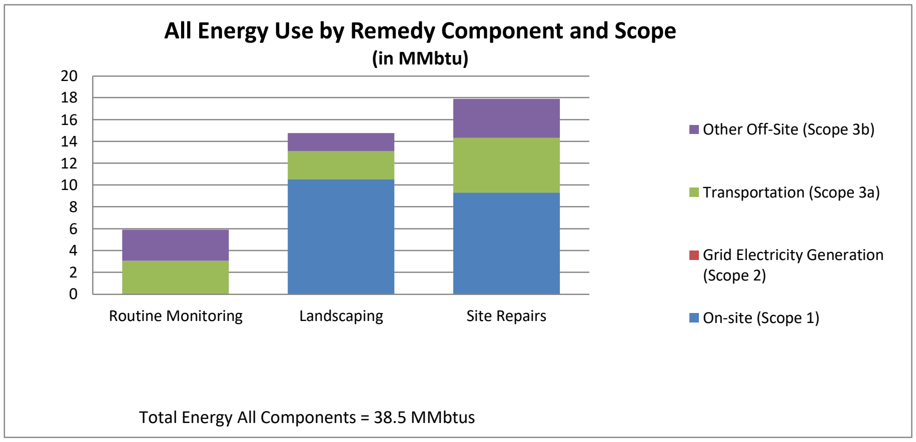
Environmental Footprint Summary

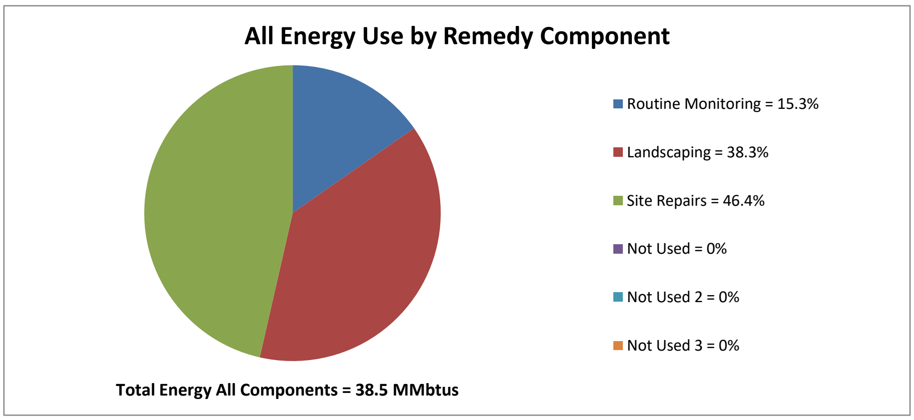
Core Element	Metric		Unit of Measure	Footprint						
				Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
Materials & Waste	M&W-1	Refined materials used on-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-2	% of refined materials from recycled or reused material	%							
	M&W-3	Unrefined materials used on-site	Tons	0.000	0.000	26.500	0.000	0.000	0.000	26.5
	M&W-4	% of unrefined materials from recycled or reused material	%			0.0%				0.0%
	M&W-5	On-site hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-6	On-site non-hazardous waste disposed of off-site	Tons	0.1	0.1	1.0	0.0	0.0	0.0	1.2
	M&W-7	Recycled or reused waste	Tons	0.0	1.0	0.0	0.0	0.0	0.0	1.0
	M&W-8	% of total potential waste recycled or reused	%	0.0%	90.9%	0.0%				45.5%
Water (used on-site)	W-1	Public water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-2	Groundwater use	MG	0.0	0.005	0.01	0.0	0.0	0.0	0.0
	W-3	Surface water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-4	Reclaimed water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-5	Storm water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-6	User-defined water resource #1	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-7	User-defined water resource #2	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-8	Wastewater generated	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	5.9	14.8	17.9	0.0	0.0	0.0	38.5
	E-2	Energy voluntarily derived from renewable resources								
	E-2A	On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-2B	Voluntary purchase of renewable electricity	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-3	Voluntary purchase of RECs	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-4	On-site grid electricity use	MWh	0.000	0.000	0.000	0.000	0.000	0.000	0.0
Air	A-1	On-site NOx, SOx, and PM emissions	Pounds	0.0	13.5	12.0	0.0	0.0	0.0	25.5
	A-2	On-site HAP emissions	Pounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	A-3	Total NOx, SOx, and PM emissions	Pounds	20.1	18.2	20.8	0.0	0.0	0.0	59.1
	A-3A	Total NOx emissions	Pounds	6.4	16.6	17.8	0.0	0.0	0.0	40.8
	A-3B	Total SOx emissions	Pounds	11.8	1.1	2.0	0.0	0.0	0.0	14.9
	A-3C	Total PM emissions	Pounds	1.9	0.5	1.0	0.0	0.0	0.0	3.5
	A-4	Total HAP emissions	Pounds	1.4	0.1	0.2	0.0	0.0	0.0	1.7
	A-5	Total greenhouse gas emissions	Tons CO2e*	0.4	1.2	1.4	0.0	0.0	0.0	3.0
Land & Ecosystems		Wetlands areas are present on-site and adjacent to the landfill. These areas will be maintained as part of the landscaping scope of work. Wetlands are habitat for the endangered bog turtle species.								

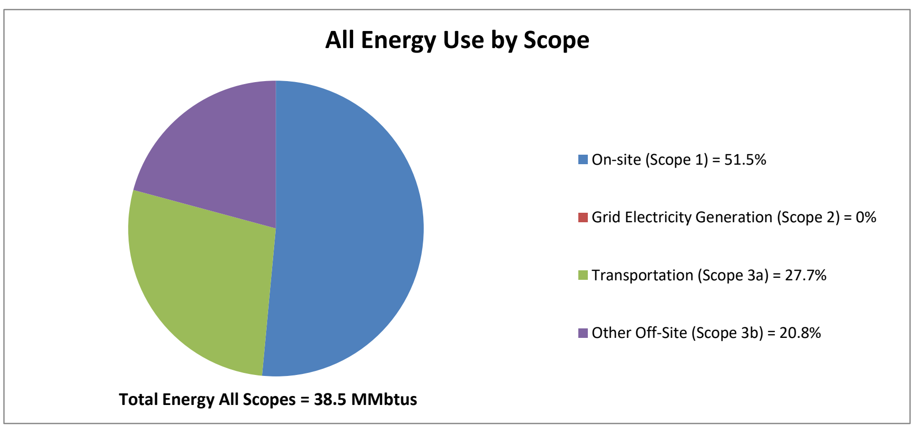
** Total greenhouse gases emissions (in CO2e) include consideration of CO2, CH4, and N2O (Nitrous oxide) emissions.*
"MMBtu" = millions of Btus
"MG" = millions of gallons
"CO2e" = carbon dioxide equivalents of global warming potential
"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)
"Tons" = short tons (2,000 pounds)

The above metrics are consistent with EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012

Notes: Routine Monitoring and Landscaping tasks reflect **annual** footprints. Site Repair task reflects an infrequent cap repair event assumed to have a 10 year frequency. Repair is for a 20' x 20' section of cap, no membrane damage.
Assessment assumes no renewable energy generation from the site using solar or landfill gas.







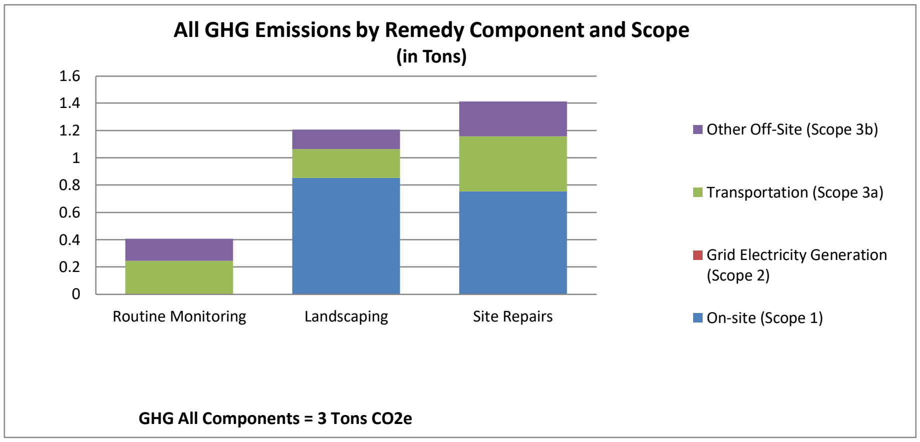
Total Energy MMbtus	Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
On-site (Scope 1)	0.0	10.5	9.3	0.0	0.0	0.0	19.8
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	3.1	2.6	5.0	0.0	0.0	0.0	10.7
Other Off-Site (Scope 3b)	2.8	1.6	3.6	0.0	0.0	0.0	8.0
Total	5.9	14.8	17.9	0.0	0.0	0.0	38.5

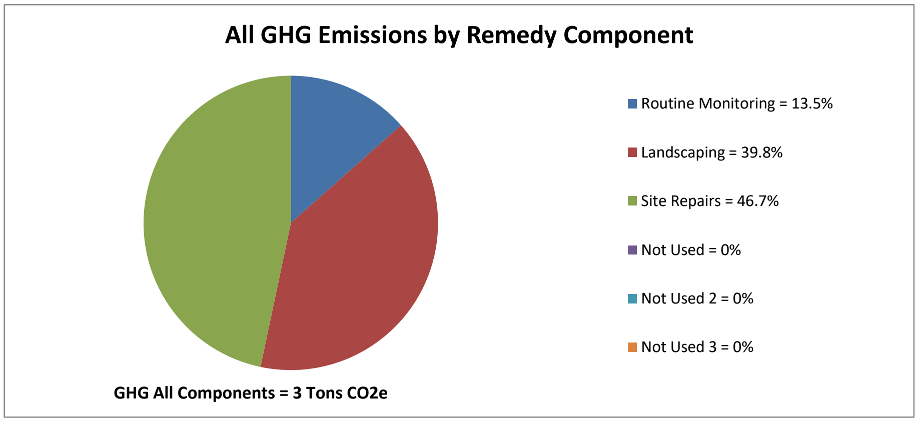
Routine Monitoring = 15.3%
Landscaping = 38.3%
Site Repairs = 46.4%
Not Used = 0%
Not Used 2 = 0%
Not Used 3 = 0%

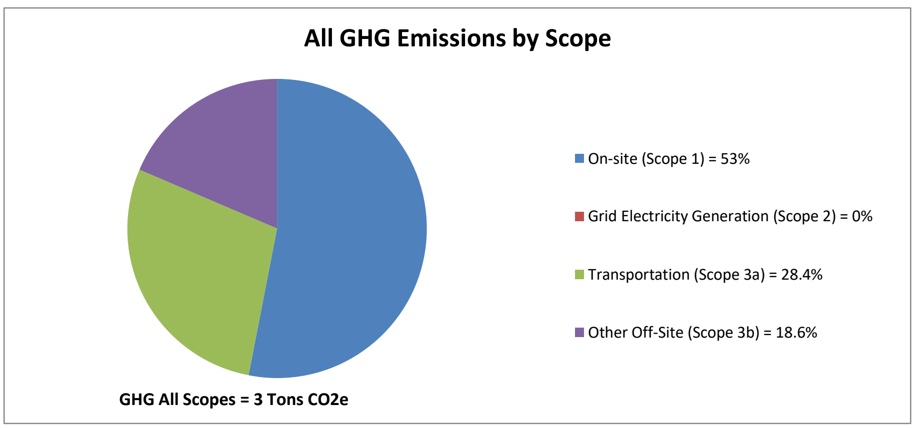
On-site (Scope 1) = 51.5%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 27.7%
Other Off-Site (Scope 3b) = 20.8%

Total Energy All Components = 38.5 MMbtus
Total Energy All Scopes = 38.5 MMbtus

__Note__: Routine Monitoring and Landscaping Values are annual, Site Repairs are per event







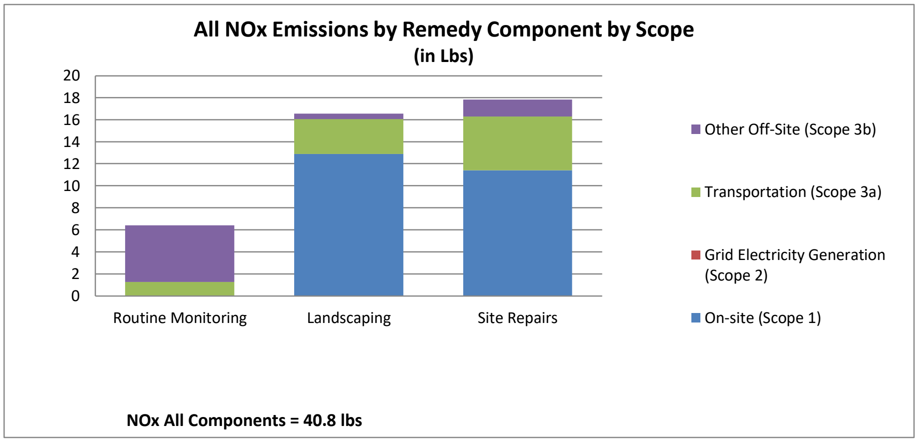
GHG Tons CO2e	Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
On-site (Scope 1)	0.0	0.9	0.8	0.0	0.0	0.0	1.6
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.2	0.2	0.4	0.0	0.0	0.0	0.9
Other Off-Site (Scope 3b)	0.2	0.1	0.3	0.0	0.0	0.0	0.6
Total	0.4	1.2	1.4	0.0	0.0	0.0	3.0

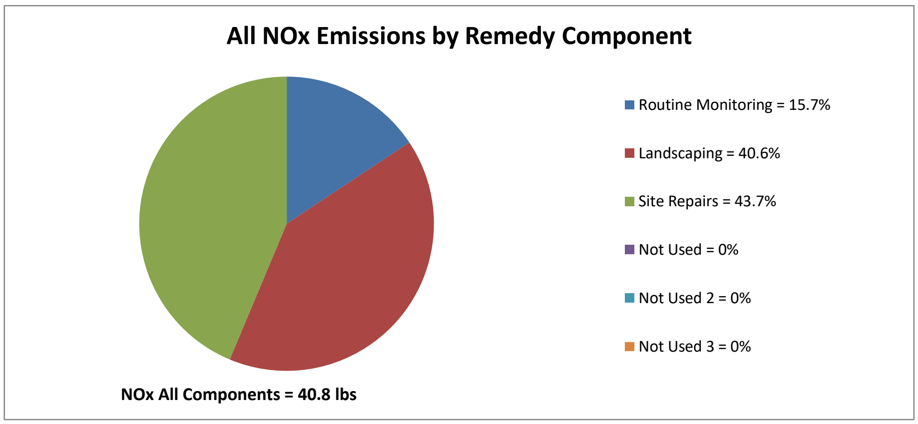
Routine Monitoring = 13.5%
Landscaping = 39.8%
Site Repairs = 46.7%
Not Used = 0%
Not Used 2 = 0%
Not Used 3 = 0%

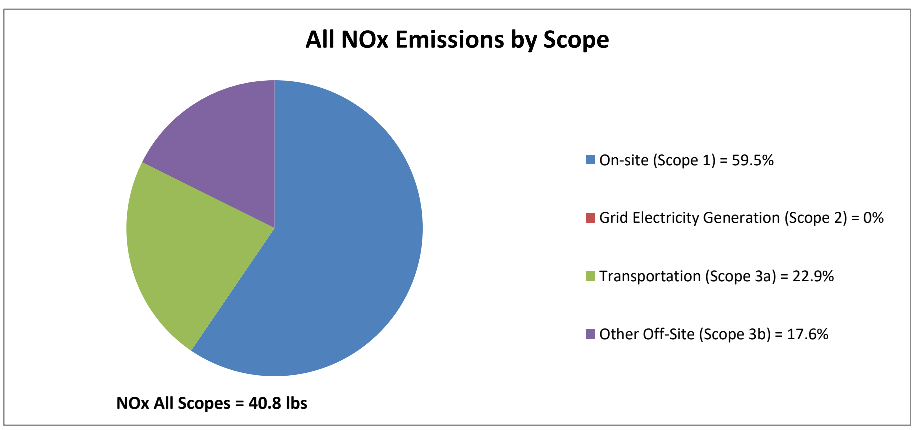
On-site (Scope 1) = 53%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 28.4%
Other Off-Site (Scope 3b) = 18.6%

GHG All Components = 3 Tons CO2e
GHG All Scopes = 3 Tons CO2e

Note: Routine Monitoring and Landscaping Values are annual, Site Repairs are per event







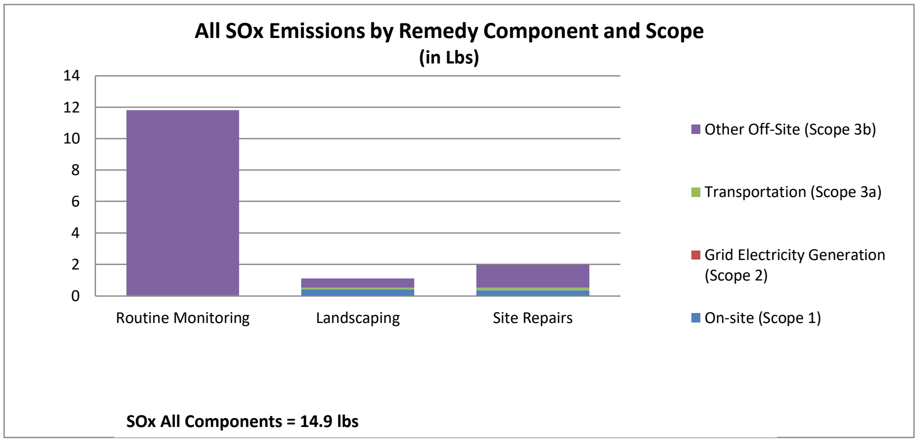
NOx lbs	Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
On-site (Scope 1)	0.0	12.9	11.4	0.0	0.0	0.0	24.3
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	1.3	3.2	4.9	0.0	0.0	0.0	9.3
Other Off-Site (Scope 3b)	5.1	0.5	1.5	0.0	0.0	0.0	7.2
Total	6.4	16.6	17.8	0.0	0.0	0.0	40.8

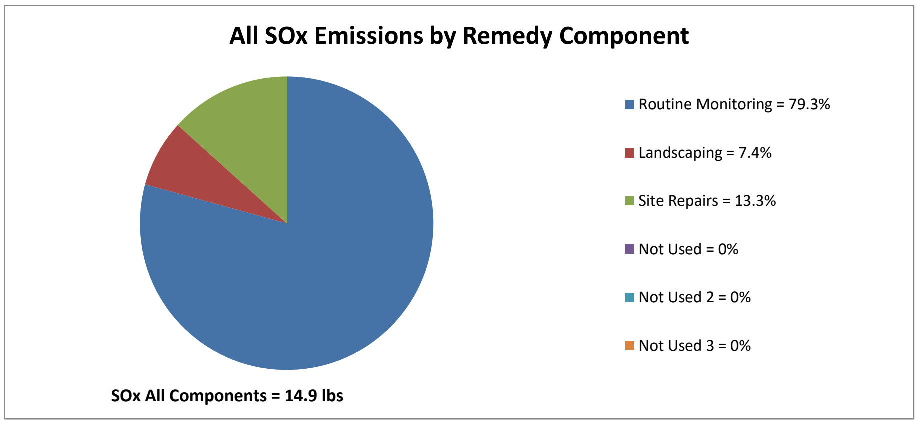
Routine Monitoring = 15.7%
Landscaping = 40.6%
Site Repairs = 43.7%
Not Used = 0%
Not Used 2 = 0%
Not Used 3 = 0%

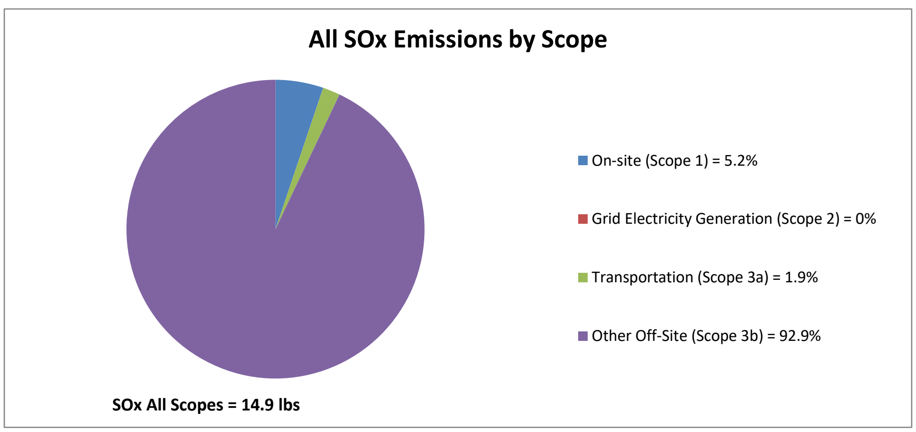
On-site (Scope 1) = 59.5%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 22.9%
Other Off-Site (Scope 3b) = 17.6%

NOx All Components = 40.8 lbs
NOx All Scopes = 40.8 lbs

Note: Routine Monitoring and Landscaping Values are annual, Site Repairs are per event







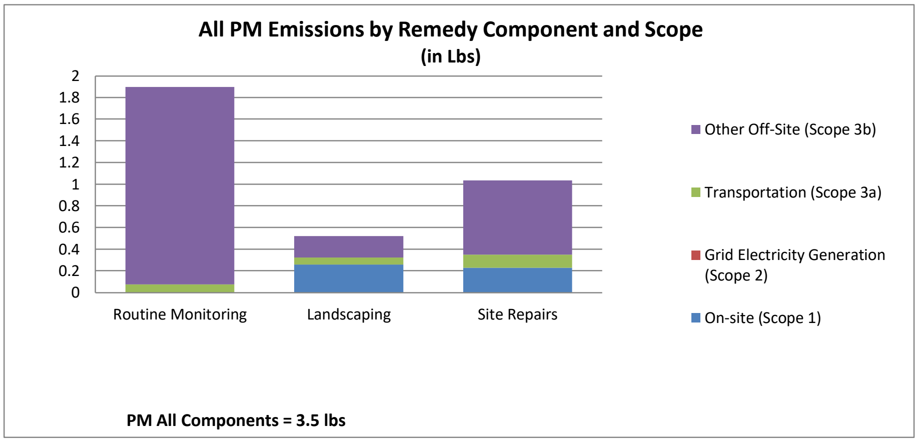
SOx lbs	Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
On-site (Scope 1)	0.0	0.4	0.4	0.0	0.0	0.0	0.8
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.0	0.1	0.1	0.0	0.0	0.0	0.3
Other Off-Site (Scope 3b)	11.8	0.6	1.5	0.0	0.0	0.0	13.8
Total	11.8	1.1	2.0	0.0	0.0	0.0	14.9

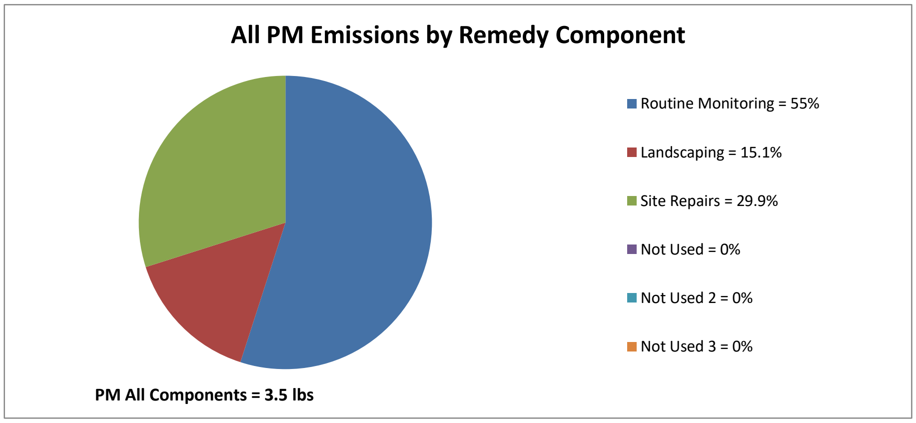
Routine Monitoring = 79.3%
Landscaping = 7.4%
Site Repairs = 13.3%
Not Used = 0%
Not Used 2 = 0%
Not Used 3 = 0%

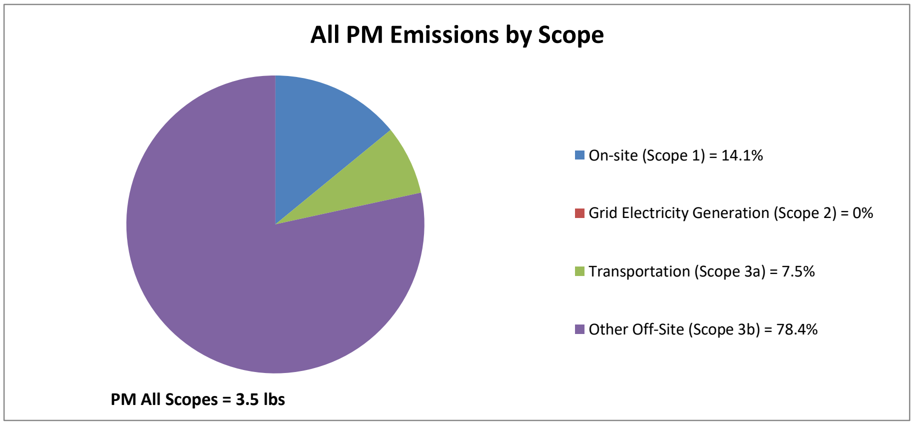
On-site (Scope 1) = 5.2%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.9%
Other Off-Site (Scope 3b) = 92.9%

SOx All Components = 14.9 lbs
SOx All Scopes = 14.9 lbs

Note: Routine Monitoring and Landscaping Values are annual, Site Repairs are per event







PM
lbs

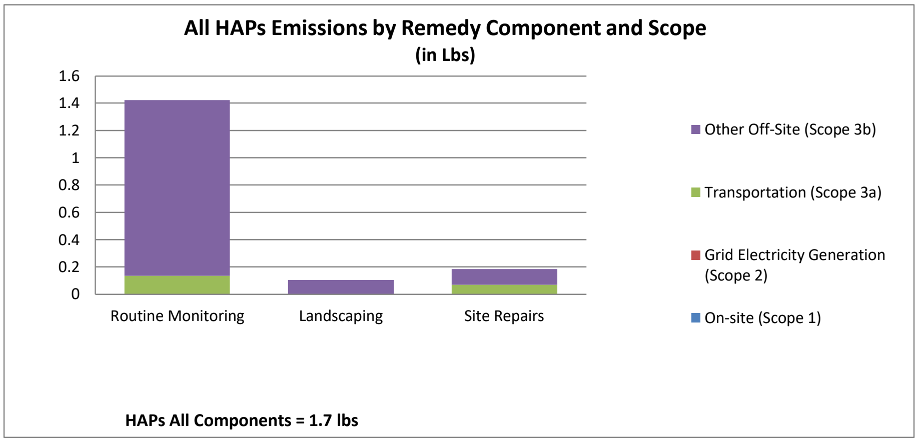
	Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
On-site (Scope 1)	0.0	0.3	0.2	0.0	0.0	0.0	0.5
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.1	0.1	0.1	0.0	0.0	0.0	0.3
Other Off-Site (Scope 3b)	1.8	0.2	0.7	0.0	0.0	0.0	2.7
Total	1.9	0.5	1.0	0.0	0.0	0.0	3.5

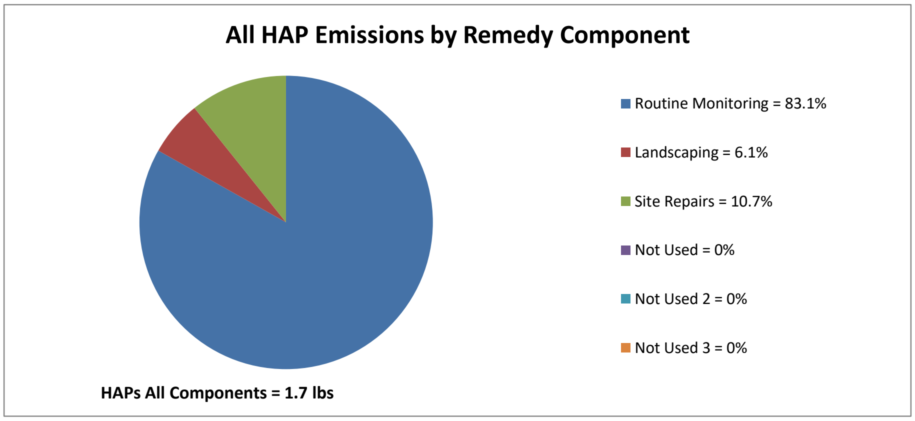
Routine Monitoring = 55%
Landscaping = 15.1%
Site Repairs = 29.9%
Not Used = 0%
Not Used 2 = 0%
Not Used 3 = 0%

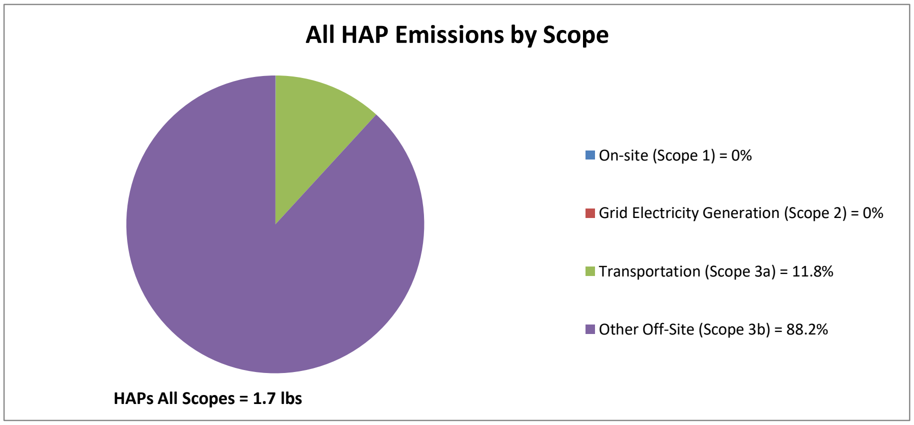
On-site (Scope 1) = 14.1%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 7.5%
Other Off-Site (Scope 3b) = 78.4%

PM All Components = 3.5 lbs
PM All Scopes = 3.5 lbs

Note: Routine Monitoring and Landscaping Values are annual, Site Repairs are per event







HAPs lbs	Routine Monitoring	Landscaping	Site Repairs	Not Used	Not Used 2	Not Used 3	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.1	0.0	0.1	0.0	0.0	0.0	0.2
Other Off-Site (Scope 3b)	1.3	0.1	0.1	0.0	0.0	0.0	1.5
Total	1.4	0.1	0.2	0.0	0.0	0.0	1.7

Routine Monitoring = 83.1%
Landscaping = 6.1%
Site Repairs = 10.7%
Not Used = 0%
Not Used 2 = 0%
Not Used 3 = 0%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 11.8%
Other Off-Site (Scope 3b) = 88.2%

HAPs All Components = 1.7 lbs
HAPs All Scopes = 1.7 lbs

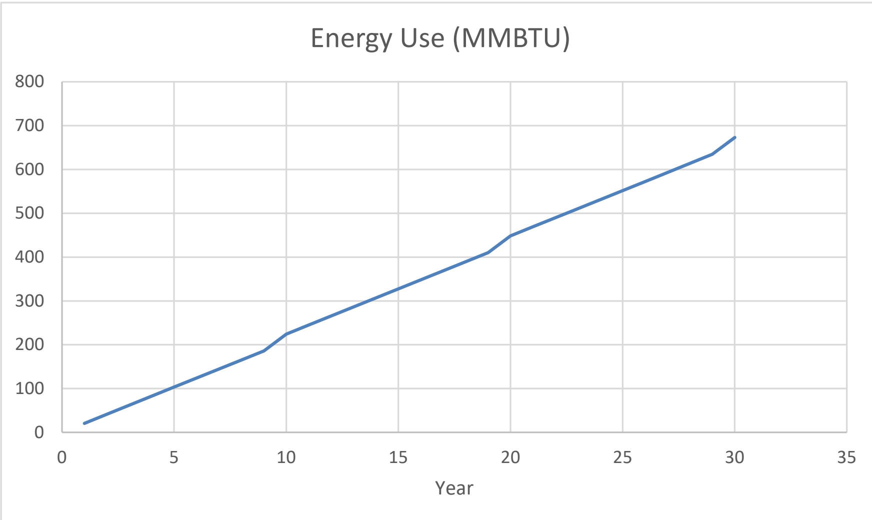
Note: Routine Monitoring and Landscaping Values are annual, Site Repairs are per event

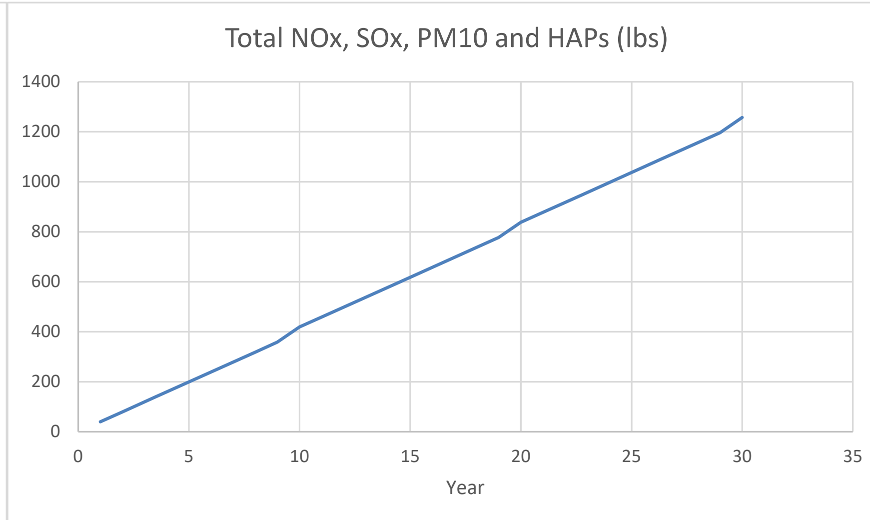
Environmental Footprint Assessment
Projected Emissions and Water Usage Schedule
Kessman Landfill CCVA

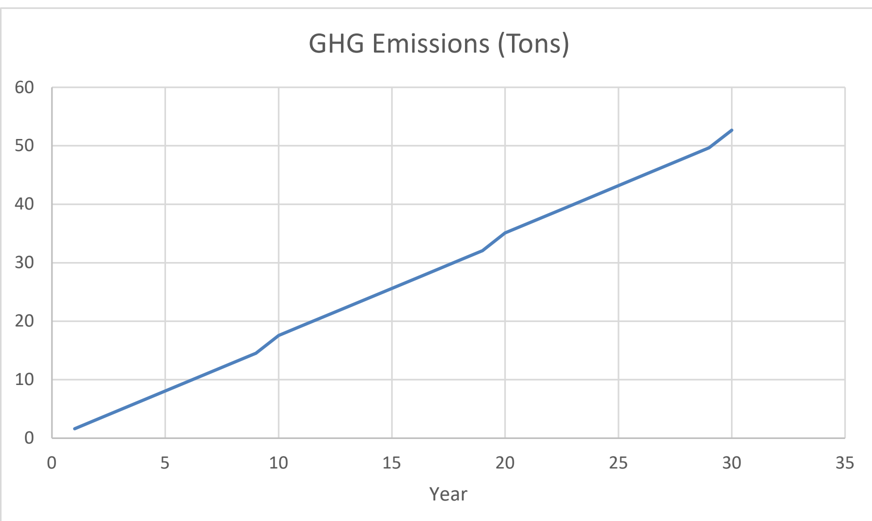
Year	Energy Use (MMBTU)		GHG Emissions (Tons)		Total NO_x SOx and PM10 (lbs)		HAPs (lbs)		Water (1,000 gal)	
	Annual	Total	Annual	Total	Annual	Total	Annual	Total	Annual	Total
1	21	21	2	2	38	38	2	2	5	5
2	21	41	2	3	38	77	2	3	5	10
3	21	62	2	5	38	115	2	5	5	15
4	21	83	2	6	38	153	2	6	5	20
5	21	103	2	8	38	191	2	8	5	25
6	21	124	2	10	38	230	2	9	5	30
7	21	144	2	11	38	268	2	11	5	35
8	21	165	2	13	38	306	2	12	5	40
9	21	186	2	15	38	345	2	14	5	45
10*	39	224	3	18	59	404	2	15	15	60
11	21	245	2	19	38	442	2	17	5	65
12	21	266	2	21	38	480	2	19	5	70
13	21	286	2	22	38	518	2	20	5	75
14	21	307	2	24	38	557	2	22	5	80
15	21	328	2	26	38	595	2	23	5	85
16	21	348	2	27	38	633	2	25	5	90
17	21	369	2	29	38	672	2	26	5	95
18	21	389	2	30	38	710	2	28	5	100
19	21	410	2	32	38	748	2	29	5	105
20*	39	449	3	35	59	807	2	31	15	120
21	21	469	2	37	38	846	2	32	5	125
22	21	490	2	38	38	884	2	34	5	130
23	21	511	2	40	38	922	2	35	5	135
24	21	531	2	42	38	960	2	37	5	140
25	21	552	2	43	38	999	2	39	5	145
26	21	572	2	45	38	1037	2	40	5	150
27	21	593	2	46	38	1075	2	42	5	155
28	21	614	2	48	38	1113	2	43	5	160
29	21	634	2	50	38	1152	2	45	5	165
30*	39	673	3	53	59	1211	2	46	15	180

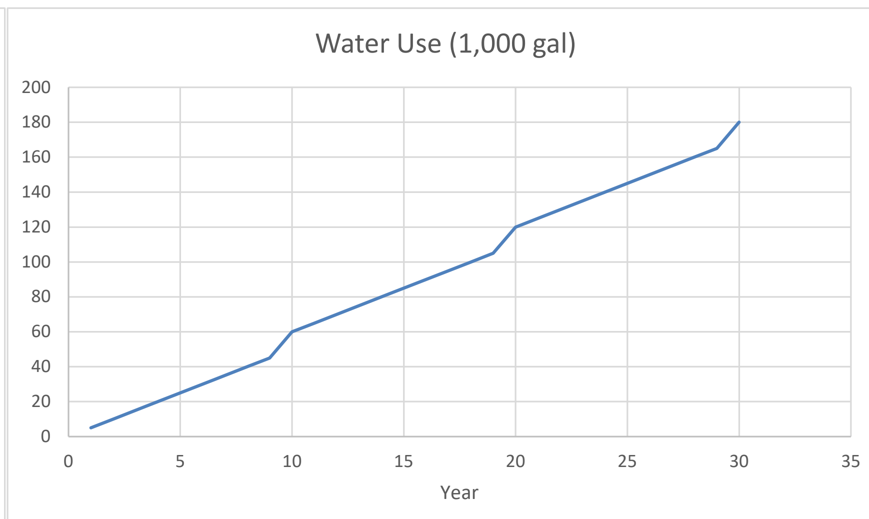
Notes:
Annual values include monitoring, landscaping and periodic repair events
* - Denotes year with projected cap repair event

Environmental Footprint Assessment
Projected Emissions and Water Usage Graphs
Kessman Landfill CCVA









Environmental Footprint Assessment
EPA Emissions Equivalency
Kessman Landfill CCVA

Greenhouse gas emissions from

- **10.5** Passenger vehicles driven for one year

-or-

- **120,837** Miles driven by an average passenger vehicle

CO_2 emissions from

- **5,410** gallons of gasoline consumed

-or-

- **4,723** gallons of diesel consumed

-or-

- **53,143** Pounds of coal burned

-or-

- **0.636** tanker trucks' worth of gasoline

-or-

- **5.8** homes' energy use for one year

-or-

- **8.7** homes' electricity use for one year

-or-

- **0.265** railcars' worth of coal burned

-or-

- **111** barrels of oil consumed

-or-

- **1,966** propane cylinders used for home barbeques

-or-

- **0** coal-fired power plants in one year

-or-

- **5,848,674** number of smartphones charged

Greenhouse gas emissions avoided by

- **16.4** Tons of waste recycled instead of landfilled

-or-

- **2.3** Garbage trucks of waste recycled instead of landfilled

-or-

- **2,046** trash bags of waste recycled instead of landfilled

-or-

- **0.01** Wind turbines running for a year

-or-

- **1,822** Incandescent lamps switched to LEDs

Carbon sequestered by

- **795** tree seedlings grown for 10 years

-or-

- **58.9** acres of U.S. forests in one year

-or-

- **0.329** acres of U.S. forests preserved from conversion to cropland in one year

So https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Appendix C: Green Remediation Recommendations

Green Remediation Recommendations

The following green remediation measures are proposed for the RSO implementation, periodic cap repair work (conducted on an as-needed basis) and routine inspection events. These measures adhere to the NYSDEC policies in CP-49 (Climate Change and DEC Action), DER-31 (Green Remediation), CP-75 (DEC Sustainability) and Section 1.14 of DER-10 (Technical Guidance for Site Investigation and Remediation). Certain recommendations are from United States Environmental Protection Agency (USEPA) guidance for best management practices, including Best Management Practices for Excavation and Surface Restoration (EPA 542-F08-012). The recommendations are separated into several categories including materials requirements, general Site requirements, equipment requirements, and Site restoration and revegetation requirements.

MATERIALS RECOMMENDATIONS

The RSO implementation should consider and incorporate the use of the following materials to the extent practicable:

- Use Compact Fluorescent Lights (CFL) or LED.
- Reuse PVC Pipe.
- Use environmentally friendly electronics (e.g., ENERGY STAR).
- Use of items composed of recovered materials such as recycled asphalt, concrete, and rubble; recycled wood including mulch products; recycled metals including steel, copper, and brass; and items/products composed of recycled cardboard.
- Use of items constructed using renewable resources such as biomass energy (such as ethanol), hydropower, geothermal power, wind energy, and solar energy.
- Use bio-based cleaning products.
- Use bio-based dust controls and dust suppressants: Products formulated to reduce or eliminate the spread of dust associated with gravel roads, dirt parking lots, open excavations, stockpiled materials or similar sources of dust. Provide minimum 85% biobased content.
- Use geotextile fabrics/tarps made of recycled material.
- Use hydraulic fluids that are biodegradable for operating hydraulic equipment such as excavators, bulldozers, and drill rigs.
- Use phosphate-free detergents instead of organic solvents or acids to decontaminate equipment not used directly for sample collection.
- Substitute temporary silt fences with biodegradable erosion controls such as tubular devices filled with organic materials.
- Products must be certified environmentally clean before delivery to the project Site. Engineer’s approval should be required for all products.

PROCEDURAL/PROCESS RECOMMENDATIONS

The RSO implementation should consider and incorporate the following general Site procedures and best management practices to the extent practicable:

- Set up an on-Site recycling program for CONTRACTOR-generated wastes.
- Provide all required documentation in electronic format, eliminating the need for printing, inks, paper, and mail/delivery impacts.
- Sequence work to minimize double-handling (e.g., direct loading of waste, direct placement of backfill, etc.) of materials.
- Provide locally made materials that are composed of recovered materials to the maximum amount practicable.
- Provide materials that generate the least amount of pollution during mining, manufacturing, transport, installation, use and disposal.
- Maintain office trailer heating and cooling systems at efficient set points. Utilize renewable energy for trailer power and lighting when possible.
- Avoid materials that contain ozone-depleting chemicals (e.g., CFCs or HCFCs) and that emit potentially harmful volatile organic compounds (VOCs).
- Employ construction practices that minimize the generation of excessive dust and combustion by-products.
- Minimize use of scarce, irreplaceable and endangered resources.
- Reduce impact to land and ecosystems, to the extent practicable.
- Reuse treated wastewater for non-potable uses on-Site including sanitary facilities, dust control, decontamination, and other uses. Contain and reuse water on site, to the extent practicable, as approved by the NYSDEC.
- Ensure temporary facilities (i.e., field offices and sanitary facilities, etc.) and permanent structures (i.e., treatment plants, offices, etc.) are thoroughly and properly insulated.
- Design structures to take full advantage of passive solar heating and cooling.
- Incorporate green requirements into cleanup and supporting service procurements.
- Choose service providers with local offices, to minimize the distance of worker commutes and machinery transport.
- Choose equipment and product vendors with nearby production or distribution centers, to minimize delivery-related fuel use.

EQUIPMENT RECOMMENDATIONS

The following requirements for on-Site equipment should be implemented during the RSO work to ensure the work follows best management practices (BMPs):

- Minimize equipment engine idling.
- Utilize properly sized equipment and minimize the number of mobilizations needed to deliver and remove heavy equipment. Utilize an automated coupling system for equipment, rather than a manual pin-on system for changing excavator attachments, to reduce machine operating time.
- Use machine models capable of performing assorted tasks, whenever feasible, to avoid field deployment of multiple types of machines. For instance, a single excavator can be equipped with a bucket for digging, a breaker for demolition or a grapple for land clearing.
- Incorporate electronic intelligence systems to improve productivity within and among field machines. “Smart” systems enable work managers to remotely monitor field operations via machine-to-machine communications and identify changes to be made by machinery operators accordingly.
- Use machines with variable-speed control technology, which automatically reduces engine speed during low workload requirements, or with pump torque control, which allows a machine operator to change a machine’s hydraulic pump torque.
- Use machines with repowered or newer engines that are more fuel efficient.
- Implement an engine idle reduction plan to avoid fuel consumption when machinery is not actively engaged. Options include manual shutdown after a specified time such as five minutes, engagement of automatic shutdown devices, or use of auxiliary power units to heat or cool machinery cabs.
- Minimize emissions during Site work (i.e., replace or retrofit older engines or use newer efficient models or use low-sulfur fuel).
- Deploy direct-push technology (DPT) instead of rotary drilling rigs whenever feasible for additional subsurface sampling or for monitoring well installation. DPT can reduce drilling duration by as much as 50-60% while minimizing generation of drill cuttings or the need to dispose of drilling fluids.
- Employ transportation methods, such as rail, which have demonstrated low emissions.
- Choose trucking methods and fleets that use vehicles equipped with fuel efficiency options such as tractor trailer skirts and air tabs, as well as clean diesel technology.
- Practice engine maintenance in accordance with manufacturers’ standards and properly train operators to run equipment efficiently.

- Perform all required equipment inspections to reduce the potential for breakdowns, hydraulic fluid spills, and other negative impacts due to lack of inspections.
- Use 2007 or newer diesel trucks or retrofitted diesel trucks with equivalent emissions reductions that get better fuel mileage, reduce air toxics and use low sulfur fuel or alternative fuel.
- Identify on-Site or nearby sources of backfill and topsoil, to avoid long-distance transport of clean soil.
- Use solar power packs to recharge batteries in small electronic devices such as small hand tools, cell phones, laptop computers and sensors.
- Deploy mobile power systems to operate construction equipment or tools such as electricity generators, chainsaws, wood chippers, refrigeration units, or temporary lighting fixtures. Use maneuverable photovoltaic (PV) panels or small wind turbines that can be easily transported via carts, pick-up trucks or trailers.
- Install a ground-mounted PV array, wind turbine or mechanical windmill to power equipment needed for long-term Site monitoring or maintenance. Properly scale and configure such equipment to provide power to other remediation equipment if possible.
- Use high efficiency variable speed pumps for groundwater extraction and treatment plant operations.
- Optimize the dewatering treatment system using properly sized equipment to minimize excess energy usage.

RESTORATION AND REVEGETATION RECOMMENDATIONS

The Site must be restored upon completion of the RSO work. The restoration should include the re-planting of vegetation to stabilize the cap and provide the required habitats and ecosystem in the wetland areas. The wetlands plantings include a diverse mixture of trees and grass that will require inspection and maintenance until they are established.

The following requirements for restoration and revegetation should be implemented during the RSO work to ensure the work follows best management practices (BMPs):

- Revegetate backfilled areas as quickly as possible through use of a diverse mix of grasses, shrubs, forbs and trees supporting many habitat types.
- Replant the wetlands areas using the wetlands seed mixture and the tree plantings species and quantities specified on Drawing C-110 in the RSO design package.
- Include plant species that promote colonization of bees and other pollinators.
- Seed or install native rather than non-native species, which typically increases the rate of plant survival and minimizes the need for irrigation and soil or plant fertilization.

- Choose grass species requiring little or no mowing.
- Substitute chemical fertilizers, herbicides or pesticides with non-synthetic inputs, integrated pest management methods, and soil solarizing techniques during vegetation planting, transplanting or ongoing maintenance.
- Retrieve native, noninvasive plants for later replanting.

SITE INSPECTION RECOMMENDATIONS

The leachate collection system, landfill gas venting system, landfill cap and the restored wetlands will require periodic inspections and upkeep to ensure they remain effective in protecting human health and the environment.

The following requirements for restoration and revegetation should be implemented as part of the RSO work to ensure the work follows best management practices (BMPs):

- Use of energy efficient or electric vehicles for personnel transport to the Site.
- Use local vendors to provide equipment and materials needed for Site inspection and maintenance.
- Use local businesses to conduct routine landscaping activities and minimize landscaping visits to the extent practicable while maintaining safe conditions at the Site.
- Compost or spread grass clippings and leaf debris on-Site to be used as fertilizer for subsequent growth, reducing off-Site waste disposal and the importation of chemical fertilizers.
- If leachate and landfill gas monitoring show the need for frequent Site inspections, consider the installation of a solar powered telemetry system to provide on-demand information from in-situ data loggers. Data loggers could be employed to measure leachate elevation within the landfill and methane concentrations in the LFG vent stacks or in-situ monitoring points.
- Consider the use of passive diffusion bags for routine groundwater sampling events. This will reduce the amount of purge water generated, the amount of time spent on-Site and the need for groundwater purging equipment.