SECOND FIVE-YEAR REVIEW REPORT FOR GLOBAL SANITARY LANDFILL SUPERFUND SITE OLD BRIDGE TOWNSHIP, MIDDLESEX COUNTY, NEW JERSEY

Prepared by

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of Concern
EMP	Ecological Monitoring Plan
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FYR	Five-Year Review
GWQS	Groundwater Quality Standards
ICs	Institutional Controls
ITRC	Interstate Technology & Regulatory Council
LWZ	Lower water-bearing zone (Old Bridge Sand aquifer)
MCL	Maximum Contaminant Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Units
PCE	Tetrachloroethene
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
sVOC	semi-Volatile Organic Compound
TBC	To be considered
TIC	Tentatively Identified Compound
TOC	Total Organic Carbon
UU/UE	Unlimited use and unrestricted exposure
UWZ	Upper water-bearing zone
VOC	Volatile Organic Compound
VISL	Vapor Intrusion Screening Levels

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order 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.

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

This is the second FYR for the Global Sanitary Landfill Superfund Site. The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two operable units (OUs), both of which will be addressed in this FYR. Operable Unit 1 (OU1) addresses slope stabilization; landfill capping; gas, storm water and leachate management; perimeter security fence; and implementation of a monitoring program. Operable Unit 2 (OU2) addresses contaminant migration from the landfill into groundwater, surface water, sediment, soil, and wetlands.

The Global Sanitary Landfill Superfund Site FYR was led by Stephanie M. Wilson of EPA Region 2. Participants included Jeff Josephson (NJ Projects / State Coordination Section Chief), Abbey States (Human Health Risk Assessor), Michael Clemetson (Ecological Risk Assessor), and John Mason and Sharissa Singh (Hydrogeologists). The review began on 7/15/2019.

Site Background

The site is approximately 60 acres in size. The northeastern property line is also the municipal boundary between Old Bridge Township and the Borough of Sayreville. The site is bordered by wetlands to the northeast, southeast, and southwest and is in the drainage basin of Cheesequake Creek. Cheesequake Creek is located approximately 900 feet southeast. Residential areas of Old Bridge Township and the Borough of Sayreville are north and west-northwest of the site, respectively, and include several apartment complexes, as well as single-family homes, located off of Westminster Boulevard and Ernston Road (see Appendix B, Figure 1).

The site hydrogeology consists of a saturated, organic-rich meadow mat called the upper water-bearing zone (UWZ), a clayey silt semi-confining Amboy Stoneware Clay layer, and the Old Bridge Sand aquifer referred to as the lower water-bearing zone (LWZ). In general, water quality in the UWZ is nonpotable naturally due to the influence of the saline Cheesequake Creek and is classified as III-B by the New Jersey Department of Environmental Protection (NJDEP). However, UWZ monitoring wells located at the northwestern/upgradient perimeter of the landfill (i.e., downgradient well MW-6S and upgradient well MW-7S) do not meet Class IIIB classification criteria due to the absence of naturally occurring saline water constituents in this area. Therefore, water quality at those wells and the area in the vicinity of those wells are subject to Class IIA criteria. Beneath the main landfill mound and a portion of the northwest extension area, the UWZ is separated by a confining layer from the Old Bridge

Sand aquifer, which is the LWZ under the site. The LWZ is designated in New Jersey as a Class IIA potable water source. The thickness of the UWZ varies from 0 to approximately 25 feet, while the LWZ is reported to extend to approximately 150 feet below mean sea level. The general direction of the groundwater flow for both the UWZ and LWZ is to the south-southeast.

The NJDEP ordered Global Landfill Reclaiming Corporation to cease operations in 1984 after a landfill side-slope failure destroyed several acres of adjacent wetlands. In 1989, the site was placed on the EPA National Priorities List because of the presence of contaminated leachate and the discovery of buried drums containing hazardous waste in a portion of the landfill (40 Code of Federal Regulations, Part 300, Volume 54, Number 61, March 31, 1989). This is a state-lead enforcement site cleanup conducted by the Potentially Responsible Parties (PRPs); NJDEP is the lead agency and EPA is the support agency.

SECOND FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Global Sanitary Landfill		
EPA ID: NJDO63160667		
Region: 2	**State:** NJ	**City/County:** Old Bridge / Middlesex
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: State ***[If "Other Federal Agency", enter Agency name]*:**		
Author name (Federal or State Project Manager): Stephanie M. Wilson		
Author affiliation: U.S. EPA Region 2		
Review period: 7/20/2015 – 7/20/2020		
Date of site inspection: 9/4/2019		
Type of review: Statutory		
Review number: 2		
Triggering action date: 7/20/2015		
Due date *(five years after triggering action date)*: 7/20/2020		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Between 1991 and 1996, NJDEP conducted a remedial investigation/feasibility study (RI/FS) to evaluate the nature and extent of the contamination at the site. The RI/FS revealed that shallow groundwater at the site was contaminated with organic compounds, pesticides, and metals and the deeper groundwater was contaminated with inorganic and organic contaminants. In accordance with CERCLA guidance on municipal landfills, (Conducting Remedial Investigations/Feasibility Studies For CERCLA Municipal Landfill Sites, February 1991, OSWER Directive 9355.3-11), where established standards for one or more contaminants in a given medium are clearly exceeded, the basis for taking remedial action is warranted. The inorganic contaminants cadmium, chromium and lead, and volatile organic contaminants chlorobenzene, benzene, and vinyl chloride were all detected in excess of drinking water criteria, EPA's Maximum Contaminant Levels (MCLs). In addition, the presence of buried drums containing hazardous substances was identified. An ecological study of the wetland areas showed that the sediments near a landfill seep were adversely affecting certain native aquatic organisms. This impact was attributed to ammonia discharging from the landfill. Since no potential human exposure pathways have been identified for groundwater, a risk assessment of groundwater was not completed at the time the Record of Decisions (RODs) were issued. However, a risk assessment based on the findings of the RI/FS indicated that while soils, surface water, leachate, and airborne contaminants did not pose a threat to human health, the contaminated sediments in the immediate area of the landfill seep likely posed a threat to the environment.

Response Actions

The following is a summary of pre-ROD and ROD activities. As mentioned previously, the State of New Jersey issued a court order in April 1984 in response to the side-slope failure and Global's noncompliance with landfill operating procedures. The order required that a remedial plan for the slope failure be developed along with a closure plan. The PRPs performed a slope stability study which showed that the side slopes adjacent to the wetlands generally did not meet acceptable safety levels. An exploratory excavation in the 6.5-acre extension area in March 1988 uncovered drums of hazardous waste. After EPA added the site to the NPL in March 1989, NJDEP then conducted a Feasibility Study for closure of the landfill. A ROD for OU1 was signed by EPA, with the concurrence of NJDEP, in September 1991 and included slope stabilization and capping the landfill, in addition to leachate and gas management systems. Further negotiations with the owners, operators and the PRP Group resulted in the entry of consent decrees in 1992 and 1993. In accordance with these decrees, the PRP Group funded and constructed the OU1 remedy. The OU2 ROD was issued in September 1997 after NJDEP's contractors completed a Remedial Investigation/Feasibility Study for groundwater, surface water, sediment, and soil.

Remedial Action Objectives (RAOs):

The remedial action objective (RAO) for OU1 is to contain contaminants at the site and limit exposure to levels protective of human health and the environment.

For OU2, the RAOs are:

- Protect the potable Old Bridge Sand aquifer from contamination present in the

UWZ;
- Protect the wetlands from contamination present in the UWZ; and
- Prevent adverse ecological impacts from contaminated wetland sediments.

Remedy Components selected in the Record Of Decisions (RODs):

For OU1, the above objectives were addressed in part by the remedial actions selected in the OU1 ROD, which included a landfill cap and installation of a leachate collection and treatment system.

The major components of the OU2 remedy selected in the OU2 ROD include the following:

- Quarterly testing of new and existing on-site wells to monitor the extent of natural attenuation of contaminants in the groundwater;
- Annual reviews to evaluate the effectiveness of the selected ground-water remedy;
- Placement of a Classification Exception Area (CEA) which would also act as a Well Restriction Area for both the UWZ and the LWZ in areas where contaminants were detected;
- Localized removal of contaminated wetland sediments from the southeastern portion of the site;
- Placement of these sediments on top of the landfill before it is capped;
- Annual ecological monitoring for five years after operable units one and two are implemented; and
- Five-year reviews of the site pursuant to CERCLA and to determine whether any further action is needed to protect groundwater quality.

***Remedy components that have been modified in an Explanation of Significant Differences*:**

On August 15, 2006, EPA issued an Explanation of Significant Differences (ESD) that modified the materials and thickness of materials used for the landfill cover to provide for a lighter, more stable, but equally protective, landfill cap than the one selected in the OU1 ROD.

Cleanup levels:

Final cleanup levels for the LWZ are the NJDEP Ground Water Quality Standards (GWQS). The following table summarizes those standards for the current contaminants of concern:

NJDEP GWQS (2019), µg/L	
1,4-dioxane	0.4
benzene	1
chlorobenzene	50
tetrachloroethene	1
1,2-dichloroethane	2
ammonia	3

Status of Implementation

OU1 Landfill Cap:

In 1993, the State of New Jersey and approximately 29 PRPs signed a Consent Decree that required the companies to implement the OU1 remedy. Work was initiated in February 1994 with the submittal of a remedial action work plan and was completed in 2012. The following actions were subsequently taken:

- Installation of geotechnical monitoring instruments to determine how placing fill on the landfill might affect settlement and slope stability;
- Placement of grading fill on the top of the main landfill to crown the landfill and provide a base to support the cap;
- Placement of preload fill that was left for approximately one year to allow for settling and maintain a 3% drainage grade;
- Construction of a landfill gas management trench and venting system;
- Placement of fill material over approximately 95% of the landfill surface to grade the top of the landfill and contour the site so that rainwater would more readily run off the cap;
- Construction of leachate pump stations, conveyance piping, leachate collection tanks, and an equipment building to enable leachate disposal to a certified off-site treatment facility;
- Installation of 27 deep gas wells and 27 shallow gas vents just below the grading fill to manage the landfill gas that will be trapped beneath the geomembrane cover and in conformance with NJDEP air quality discharge requirements;
- Installation of 15 additional gas vents; and
- Installation of the cap cover (top down): topsoil, soil cover layer, geocomposite drainage layer, geomembrane, geosynthetic clay liner or a geotextile, and a soil grading layer.

OU2 - Groundwater Monitoring, Wetland Sediments, Wetlands Mitigation:

In 2008, the PRP Group modified the CD to incorporate the ESD changes and include OU2 provisions. A groundwater monitoring plan (GMP) was developed pursuant to the OU2 ROD and approved as a part of the 100% Remedial Design report. The primary objectives of the monitoring plan are to track groundwater quality in the UWZ along the perimeter of the landfill following placement of the cap; and, to monitor ground water quality and the natural attenuation of constituents in the LWZ. The GMP includes semi-annual monitoring of eight UWZ monitoring wells and eight LWZ monitoring wells. The effectiveness of the CEA in protecting human health and the environment will be evaluated by the PRP Group and evaluation of the monitoring results will be provided to NJDEP and EPA for approval every two years after completion of the remedy construction.

For wetland contaminated sediment removal, the OU2 ROD required that sediments be excavated to the limits and depths necessary to replace visibly stained and distressed vegetation with new soil and wetland vegetation. In 2011, the PRPs excavated 17,000 square feet of soil to an average depth of approximately 22 inches below ground surface, subsequently backfilled the area with imported clean topsoil, and installed native wetland vegetation. The excavated material was spread in the upland portion of the northwest extension area of the landfill and then the geosynthetic landfill cap was built above the excavated material.

From 2010 to 2011, the PRP worked on improvements to the selected wetlands mitigation area of the

site located 1.5 miles from the landfill. This work included removal and off-site disposal of debris and impacted surficial soil and revegetation.

Final Inspection and Construction Completion:

On August 20, 2012, EPA, NJDEP, and the PRP Group representatives conducted the pre-final inspection at the site. The inspection included both the landfill and the wetland mitigation areas. On August 31, 2012, NJDEP issued to the PRP Group a letter documenting the visit and acknowledging completion of construction of the landfill cap and all its components as well as the successful growth of vegetation at the wetland mitigation area, thereby determining that the remedies have been constructed in accordance with the plans and specifications for the OU1 and OU2 RODs.

IC Summary Table

Implemented institutional controls at the Site are summarized in Table 1 below.

Table 1: Summary of Planned and/or Implemented ICs

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	Yes	Yes	OU2	Protect against groundwater use for site related contaminants	CEA 2002
Soil and groundwater	Yes	No	Landfill property	To prevent damage to the cap's impermeable layer and to prevent direct exposure to landfill contaminants.	Deed notices and access agreements

Systems Operations/Operation & Maintenance

An Operation and Maintenance Plan (O&M Plan) for the site was developed to provide inspection, maintenance, and reporting activities in connection with the following activities:

- Site security to include fences, building and access roads;
- Cover system and vegetation;
- Storm water management system;
- Leachate collection system and leachate disposal;
- Landfill gas monitoring, sampling and testing;
- Geotechnical instruments;
- Ecological monitoring; and
- Groundwater monitoring.

Currently the landfill cap is inspected monthly. Mowing occurs once a year. Around 2013-2014, the southern drainage downchute was causing degradation to vegetation near the top of the chute. The vegetation was restored and concrete was sprayed on top of the chute to prevent further degradation. Leachate is no longer being collected and hauled since the PRPs demonstrated that the contamination in the leachate was below federal and state standards.

Groundwater sampling is conducted semiannually across a network of eight monitoring wells within the UWZ and eight monitoring wells within the LWZ. In early 2019, the upper casing of well MW-15S was replaced after sustaining damage resulting from localized frost heave.

As a part of the biennial CEA recertification, a well inventory was conducted within the CEA and areas surrounding the landfill footprint. The current CEA for the LWZ extends approximately 4,000 feet southeast along the plume axis from the source area (see Appendix B, Figure 2). The closest municipal supply well is located approximately one mile north of the site, while two additional wells exist approximately two miles to the east. There are no known residential wells located within one mile downgradient of the landfill. A replenishing well for Hooks Creek Lake (located approximately one mile southeast of the Site) is screened in the Farrington Sand aquifer which is separated from the overlying Old Bridge Sand aquifer by as much as 130 feet of clay geologic units. The OU-2 ROD found that there is no significant current risk to public water supply from impacted groundwater migrating from the Site in either the LWZ or the UWZ. No additional information refuting these findings has been obtained since the CEAs were established in 2014.

The wetlands mitigation area remains relatively free of *Phragmites*, though *Phragmites* is present along edges of the area. No ongoing maintenance is occurring in this area, which is currently owned by the state as part of Cheesequake State Park.

Potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site. This assessment was based in part on the minor amount of damage sustained at the site due to Super Storm Sandy in October 2012.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 1: Protectiveness Determinations/Statements from the 2015 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The remedy at OU1 is protective of human health and the environment.
2	Short-term Protective	The remedy at OU2 currently protects human health and the environment because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, the trends from additional rounds of data will need to be evaluated to ensure that the groundwater

		contamination in the LWZ is responding as expected to the completion of the cap.
Sitewide	Short-term Protective	The remedy at the site is protective of human health and the environment in the short-term because all human and ecological exposure routes have been addressed. However, in order for the remedy to be protective in the long-term, trends developed from additional rounds of groundwater sampling data will need to be evaluated to ensure that the groundwater contamination is responding to natural attenuation as expected with the completion of the landfill cap construction.

Table 2: Status of Recommendations from the 2015 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
2	Since the OU 1 remedy was only completed in 2012 not enough post landfill cap construction groundwater monitoring data has been completed to establish contaminated groundwater trends.	Continue groundwater monitoring	Ongoing	Groundwater monitoring continues twice a year	6/1/2020

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On October 1, 2019, 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, Puerto Rico and the Virgin Islands, including the Global Landfill site. The announcement can be found at the following web address: https://www.epa.gov/aboutepa/fiscal-year-2020-five-year-reviews. In addition to this notification, a public notice was made available on Old Bridge Township's municipal website and EPA's website on 11/26/2019, stating that a 5YR is being conducted and encouraging the public to submit any questions to the U.S. EPA. The results of the review and the report will be made available both on EPA's website at: https://www.epa.gov/superfund/global-sanitary-landfill and at the Site information repositories located at:

EPA Region 2 Public Reading Room
290 Broadway, 18th Floor
New York, NY 10007-1866
Phone: (212) 637-4308 (Call to make an appointment)

Clerk's Office
1 Old Bridge Plaza
Old Bridge Township, NJ 08857
Phone: (732) 721-5600

The NJDEP's Bureau of Community Relations keeps the local public informed about progress at the site.

Data Review

As stated previously, the remedial action objective (RAO) for OU1 is to contain contaminants at the site and limit exposure to levels protective of human health and the environment.

For OU2, the RAOs are:

- Protect the potable Old Bridge Sand aquifer from contamination present in the UWZ;
- Protect the wetlands from contamination present in the UWZ; and
- Prevent adverse ecological impacts from contaminated wetland sediments

Groundwater Monitoring:

Groundwater monitoring is essential for assessing potential contaminant migration, limiting exposure, and determining if the potable Old Sand aquifer (the LWZ) is being protected from contamination present in the UWZ.

Groundwater at the site is monitored on a semi-annual basis. The monitoring network consists of sixteen wells located along the perimeter of the landfill, eight wells screened in the UWZ and eight wells screened in the LWZ (see Appendix B, Figure 2). Groundwater movement at the site is to the south-southeast, although radial groundwater flow was documented on site prior to remedy completion. UWZ well MW-7S and LWZ well MW- 7D, located along the northwest perimeter of the landfill, and LWZ MW-13S, located approximately 750 ft to the north-northwest, serve to monitor upgradient groundwater conditions. Wells MW-8 (S&D) are located on the northeast side of the landfill, wells MW-3 (SR & A), MW-14 (S & D), and MW-4 (S & A) are on the southeastern border, wells MW-5 (S & AR) and MW-15 (S & D) are on the southwest border, and well MW- 6S is located in the western corner of the landfill. Groundwater samples from both the UWZ and LWZ are analyzed for VOCs (including 1,4-dioxane), SVOCs, and target analyte list compounds (TALs). Samples from the UWZ are also analyzed for PCBs and ammonia.

Data were analyzed from 2014 – 2018. Plots of the data are available in Appendix B and tables are available at the following web address: https://semspub.epa.gov/work/02/550212.pdf. Mann-Kendall analyses were run in order to demonstrate if there are increasing, decreasing, or stable concentration trends within the data. The data does not indicate there is a strong seasonal influence on contaminant concentrations.

Upper Water-bearing Zone (UWZ) –

With the exception of MW-6S and MW-7S, UWZ wells are naturally saline and regulated as non-potable Class III-B aquifers. UWZ wells reported concentrations of 1,4-dioxane, benzene, chlorobenzene, methylene chloride, tert-butyl alcohol, tetrachloroethene, and total detected VOC Tentatively Identified Compounds (TICs) above NJDEP GWQS). 1,4-dioxane was present above GWQS (0.4 µg/L) in all UWZ wells except upgradient well MW-7S. The highest reported value was 860 µg/L in MW-8S in March 2014 (See Appendix B, Plot 1). Statistical analyses indicate that concentrations of 1,4-dioxane is stable or significantly decreasing (MW-3SR, MW-6S, MW-

8S) in all UWZ wells. Benzene was detected above GWQS (1 µg/L) in MW-14S, MW-15S, MW-5S, and MW-8S (See Appendix B, Plot 2). The highest reported concentration was 100 µg/L in MW-8S in March 2014. Chlorobenzene was detected above GWQS (50 µg/L) in MW-14S, MW-15S, MW-5S, and MW- 8S (See Appendix B, Plot 3). The highest reported concentration was 4,700 µg/L in MW-15S in September 2018.

Levels of SVOCs above GWQS were recorded in the UWZ wells MW-4S, MW-5S, upgradient MW-7S, MW-8S, and MW-15S. 2,6-dinitrotoluene, 2-methylnaphthalene, bis(2-ethylhexyl) phthalate, hexachlorobenzene, naphthalene, N-nitrosodiphenylamine, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and total detected SVOC TICs were detected above GWQS, although most of the wells did not report levels above the GWQS consistently. The exception is MW-15S, which consistently reported N-nitrosodiphenylamine above GWQS (10 µg/L); the highest reported value within this well was 19 µg/L in 2014. The most recent MW-15S sampling event (September 2018) reported N-nitrosodiphenylamine concentrations of 15 µg/L. In March 2015, upgradient well MW-7S recorded 0.031 µg/L of hexachlorobenzene (GWQS = 0.02 µg/L), although no other detections occurred during the review period. MW-14S, MW-15S, and MW-8S reported values of total detected SVOC TICs above GWQS within every year of the current five year review period (See Appendix B, Plot 4).

UWZ wells reported metals concentrations above GWQS for aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium. The maximum observed arsenic, chromium, and lead concentrations were 33.8 µg/L (MW-3SR – 09/2017), 117 µg/L (MW-8S – 03/2017), and 19.9 µg/L (MW-5S – 03/2014), respectively.

All of the UWZ wells except for upgradient well MW-7S reported levels of ammonia that were above GWQS (3 µg/L) (see Appendix B, Plot 5). The highest reported level was 2,260 µg/L in MW-8S in 2016. Statistical testing does not indicate that ammonia concentrations are significantly decreasing in any of the UWZ wells.

Lower Water-bearing Zone (LWZ) –

During the current five year review period, well MW-8D recorded the highest concentrations of both 1,4-dioxane (GWQS: 0.4 µg/L) and benzene (GWQS: 1 µg/L) within the LWZ. In September 2014, concentrations for these contaminants were 95 µg/L and 2.2 µg/L, respectively. Statistical analyses indicate that concentrations of both contaminants are decreasing within this well. During the most recent sampling event (September 2018), MW-8D recorded 1,4-dioxane concentrations of 36 µg/L, and non-detectable concentrations of benzene. Elsewhere within the LWZ monitoring network, concentrations of 1,4-dioxane exceeded GWQS in all wells except MW-15D and upgradient well MW-13S during the review period (See Appendix B, Plot 6). These exceedances include upgradient LWZ well MW-7D, which reported one exceedance of 0.43 µg/L (09/2017). Other LWZ wells which recorded benzene above GWQS were MW-14D, MW-3A, and MW-5AR (See Appendix B, Plot 7). Benzene concentrations within these wells are stable, and benzene was not detected in any LWZ wells upgradient of the landfill.

In LWZ wells, chlorobenzene was detected above GWQS (50 µg/L) only in MW-5AR (See Appendix B, Plot 8). The highest concentration was 250 µg/L, recorded in 2014 and 2017. Statistical testing does not indicate that chlorobenzene concentrations are significantly increasing or decreasing within this well. MW-14D and MW-8D did not record any chlorobenzene

exceedances within this five year review period (maximum detected concentrations of 18 µg/L and 45 µg/L, respectively), and statistical testing indicates significant decreases within these wells during this time. Chlorobenzene was not detected in any LWZ wells upgradient of the landfill.

Tetrachloroethene (PCE) was found to be in exceedance of GWQS (1 µg/L) in the LWZ within wells MW-7D, MW-14D, MW-15D, and MW-5AR (See Appendix B, Plot 9). Concentrations are stable within all wells reporting exceedances. The highest reported value was 13 µg/L in September 2017 within wells MW-14D and MW-7D. In both cases, this event recorded a one-time concentration spike. In MW-14D, this measurement represented the only PCE exceedance of the five year review period, and within MW-7D the rest of the concentrations were less than 3.0 µg/L.

LWZ wells also reported exceedances of the VOC 1,2-dichloroethane and the inorganics aluminum, arsenic, beryllium, chromium, iron, lead, manganese, nickel, and sodium, consistent with the previous five-year review. With a maximum concentration of 7.5 µg/L in September 2014, arsenic concentrations were found to be in exceedance of GWQS within MW-14D every year of the five-year review period. Across the monitoring well network, maximum concentrations of beryllium and lead were 3.6 µg/L (MW-5AR, 03/2015) and 8.3 µg/L (MW-5AR, 03/2016 and 03/2016), respectively. With a maximum concentration of 199 µg/L (03/2015), upgradient LWZ well MW-7D was the only well which reported chromium concentrations in exceedance of GWQS during the current five-year review period.

Landfill Gas Emissions

Landfill gas emissions, specifically for flow, VOCs, methane, and CO_2, are measured quarterly. All of the values were below the NJDEP permit limits for 2014-2018.

Ecological Monitoring

Ecological Monitoring consisted of a network of five primary sampling locations, referred to as ECO-1 through ECO-5, established adjacent to and within 100 feet of the landfill, on its eastern side near tributaries of the Cheesequake Creek. Location ECO-5 coincides with the sediment remediation area. Two reference locations, ECO-RF1 and ECO-RF2, located approximately a half mile east-northeast of the landfill, were also established in a marsh in Cheesequake State Park to evaluate conditions unrelated to the landfill. Based on the success of the wetland vegetation and benthic organism survivability, a reduction of the monitoring program was approved in 2017. Therefore, in 2017 and 2018 ecological monitoring was only conducted at location ECO-5 (and associated reference samples).

The Ecological Monitoring Program (EMP) entails conducting a Visual Habitat Assessment of the wetlands surrounding the landfill at the designated sample locations and in the area of sediment restoration. The assessment involves a qualitative monitoring of the vigor of the wetland plant community and provides a means of identifying exposure to contamination.

The EMP also involves collecting sediment samples at the designated sample locations, which are analyzed for chemical constituents Target Compound List compounds (TALs), cyanide, ammonia, and total organic carbon (TOC), macro-invertebrates, and sediment grain-size. Samples collected from ECO-5 were also subject to bioassay testing. The analyses were necessary to determine whether concentrations of contaminants of concern (COCs) are bioavailable at levels that are toxic to aquatic invertebrates; the analyses are also used to evaluate the effectiveness of the remedy.

Results of Visual Habitat Assessment - In general, no indicators of landfill-related impacts were observed at the sample locations during the assessments from 2015 through 2018, neither were any significant changes in habitat observed in comparison to assessments completed in previous years.

Results of Sediment Analysis - Low levels of VOCs were detected at ECO-5 and reference sample locations in 2018 similar to previous events. Low concentrations of acetone, 2-butanone, and methylene chloride are not interpreted to be associated with the site and may be due to laboratory artifacts.

Ammonia was detected at all sample locations during the 2018 monitoring event including the reference samples. The concentrations ranged from 6.2 milligrams per kilogram (mg/kg) in ECO-5 to 52 mg/kg in ECO-RF2. Results are similar to those from the 2017, 2016, and 2015 sampling events. Since the ammonia concentrations were also reported for reference locations ECORF1 and ECO-RF2, this may indicate that there is the potential for other sources of ammonia in the marsh that are not related to the landfill.

Inorganics were detected in all sediment samples. As found in previous sampling events concentrations of inorganics in reference samples were similar to those reported in samples collected near the landfill. Additionally, the reference samples contained the highest detected concentrations of several of the metals analyzed.

TOC was detected at ECO-5 with a concentration of 0.6% which was a decrease from previous events (1.3% in 2017 1.5% in 2016 and 2015). The TOC concentrations for ECO-RF1 and ECO-RF2 (3.1% and 14%, respectively) were within the range of concentrations observed at previous sampling events. It is believed that TOC in samples is, largely, derived from decomposing plant material in marsh sediment.
Results of Benthic Macroinvertebrate Analysis - Based on the 2018 monitoring event, the number of unique taxa (8) observed at each location (a measure of diversity) increased compared to 2017 (2) and previous years. Benthic organisms identified (67) in the 2018 monitoring event increased by greater than 100% from the 2017 monitoring event (5). Overall 40% of the benthic organisms in the 2018 samples were Capitella capitata (a polychaete worm).

Results of Bioassay Tests - Toxicity testing was carried out on sediment samples collected in ECO-5 using the marine amphipod crustacean Leptocheirus plumulosus. Based on the 2018 monitoring event, the organism survival for the 10 day L. plumulosus test was 96%, which is similar to previous monitoring events (2017-95%, 2016-93%, 2015-93%). Thus, the tests indicate that exposure to sediment from ECO-5 did not negatively impact the representative benthic organism.

Site Inspection

The inspection of the Site was conducted on 9/4/2019. In attendance were EPA RPM Stephanie M. Wilson, EPA Section Chief Jeff Josephson, EPA Hydrogeologist John Mason, EPA Ecological Risk Assessor Michael Clemetson, NJDEP Project Manager Lynn Vogel, Golder Senior Consultant and Project Manager Christopher D. Hemingway, Golder Project Environmental Scientist Fran Malinky, PRP (Nokia) Representative John Galasso, and NJDEP Case Managers Asia Dandy and Randy Lupin. The purpose of the inspection was to assess the protectiveness of the remedy.

The inspection involved driving the perimeter of the site and inspecting key elements, including MW-8 and MW-15, drainage systems, the sediment remediation area, air vents, and the status of the cap. The group also visited the mitigated wetland area.

The only issue identified was that vandals had gained access to the site by cutting a section of fence and entering the property on all-terrain vehicles. The fence has been repaired and Jersey barriers will be installed to deter further vandalism. Though there was evidence of tire marks in the gravel on top the landfill, no damage to the cap was found.

V. TECHNICAL ASSESSMENT

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

The remedy included the excavation of contaminated sediment from an adjacent wetland area and disposal underneath the landfill cap, as well as a wetland restoration and periodic monitoring. Based upon the review of the 2017 and 2018 Annual Groundwater and Ecological Monitoring Report, it appears that there were some low level VOC detections in the sediment. However, some of the VOCs were considered to be laboratory contaminants and others were found in reference areas. Ammonia was found in all of the sediment sampling locations including the reference areas. Metals were also detected in the sediment with the greater concentrations being in the reference areas. Therefore, it is difficult to determine if these contaminant concentrations are site related. The benthic macroinvertebrate results indicate that the benthic communities have increased since 2017. The 2018 sediment toxicity testing shows similar survival percentage (96%) at location ECO-5 compared to previous years (2017-95% and 2016-93%). Consequently, the remedy is functioning as intended. ECO-5 will no longer be sampled yearly because performance goals have been met. The PRP Group is currently planning to sample ECO-5 once before the next five-year review and this task is expected to be included in a new O&M plan.

For OU2, one of the RAOs is to protect the potable Old Bridge Sand aquifer (LWZ) from contamination present in the UWZ. The data indicates that there is contamination which is not present in upgradient wells, but which exists elsewhere within both the UWZ and LWZ onsite. This suggests that contamination has moved from the UWZ into the LWZ. In particular, high 1,4-dioxane concentrations in the LWZ (range of 0.27 - 95 µg/L) and the UWZ (range of 0.73 – 860 µg/L) wells suggest that contamination has reached the LWZ, and that the UWZ is or has been a contaminant source. Other VOCs, specifically benzene, chlorobenzene, and 1,2-dichloroethane, were also found in LWZ wells above GWQS, but were not found in background wells. 1,4-dioxane and other site contaminants in LWZ wells are significantly decreasing or stable. The exception was one well (MW-14D) that showed significantly increasing trends in 1,2-dichloroethane, but the levels were all below GWQS.

Concentrations of contaminants in the UWZ remained elevated above GWQS, however these wells generally do not indicate increasing contaminant concentrations, and the aquifer is mostly classified as a non-potable Class III-B aquifer. Contamination has been detected within LWZ monitoring wells during this five-year review period, however the data indicate that concentrations of contaminants are generally stable or decreasing and this trend is expected to continue. The OU1 remedy has reduced the leaching of contaminants from the landfill material. No potential human exposure pathways have been identified, and a regularly-updated CEA remains in place in order to limit exposure potential. Since the completion of the OU1 remedy, no new contaminated groundwater discharge points have been identified within the wetlands. Moving forward, groundwater monitoring will continue to track any potential contaminant migration, or changes in

the contaminant flux to the LWZ. For these reasons, despite contamination in the LWZ, the remedy appears to be functioning as intended.

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

Land use considerations used in the baseline human health risk assessment are still valid. The exposure assumptions and toxicity values that were used to estimate the potential risks and hazards to human health followed the general risk assessment practice at the time the risk assessments were performed for each OU. Although the risk assessment process has been updated and specific parameters and toxicity values may have changed, the risk assessment process that was used is still consistent with current practice and the need to implement a remedial action remains valid.

As part of the OU1 remedy, source controls have been implemented to reduce human exposure to the landfill gas and leachate. The completed landfill cap prevents direct exposure to contaminated material and inhalation of fugitive dust. A security fence restricts access to the site, and the remaining contamination present on-site is inaccessible due to the landfill cap. Access to contaminated groundwater remains limited by a CEA. Therefore, exposure to site-related groundwater, soil, and sediment contamination during the monitored natural attenuation process is not anticipated.

One potential exposure pathway that was not evaluated at the time of remedy selection is vapor intrusion. A development of single-family homes was constructed several years after the RODs were issued 200 feet north of the landfill; however, the development is located upgradient of the UWZ plume. Concentrations of VOCs during the FYR period did not exceed EPA's upper-bound Vapor Intrusion Screening Levels (VISL) (set at a cancer risk of 10^{-4} and Hazard Quotient of 1), however maximum concentrations of 1,2-dichloroethane, 1,4-dichlorobenzene, benzene, chloroform, and vinyl chloride fell within the acceptable risk range of 10^{-6} to 10^{-4}. Since the site does not contain any buildings above the groundwater plume at this time and future development on the cap is prohibited, the vapor intrusion pathway is incomplete.

The remedial action objectives used at the time of remedy selection are still valid. The objectives of the ongoing groundwater monitoring are to track groundwater quality in the UWZ and the perimeter of the landfill and to monitor the natural attenuation of contaminants in the LWZ. Several contaminants remain in excess of state and federal MCLs both in the source area UWZ and LWZ, including 1,2-dichloroethane, 1,4-dioxane, benzene, chlorobenzene, tetrachloroethene, arsenic, chromium, and lead. There is no current or future exposure via the direct pathway (ingestion as a potable water source) since there are no wells in the contaminated area and a CEA prevents future well installation. The aquifer's primary NJDEP IIIB classification also precludes the future use of the UWZ as a potable water source. Therefore, the remedy is protective even though groundwater exceeds drinking water standards. Groundwater monitoring will ensure that concentrations continue to decrease, and contamination is not migrating.

Although the ecological risk assessment screening and toxicity values used to support the ROD may not necessarily reflect the current values, the excavation and capping eliminate any potential risk from surface soil contaminants to terrestrial receptors. Based on the information regarding the sediment sampling data (as discussed above), the landfill may not be the source of the ammonia. Therefore, the exposure assumptions and RAOs are still valid.

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

There is no other information that calls into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1 and OU2

OTHER FINDINGS

Since there are observed impacts to the LWZ from the UWZ, monitoring to confirm the conditions in LWZ are improving will continue.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: 01	*Protectiveness Determination:* Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy at OU1 is protective of human health and the environment.		
Protectiveness Statement(s)		
Operable Unit: 02	*Protectiveness Determination:* Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy at OU2 is protective of human health and the environment.		
Sitewide Protectiveness Statement		
Protectiveness Determination: Protective		*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedies for the Global Sanitary Landfill Superfund Site are protective of human health and the environment.		

VIII. NEXT REVIEW

The next FYR report for the Global Sanitary Landfill Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Second Five Year Review for Global Landfill,
OU1 ROD, EPA, September 1991.

OU2 ROD, EPA, September 1997.

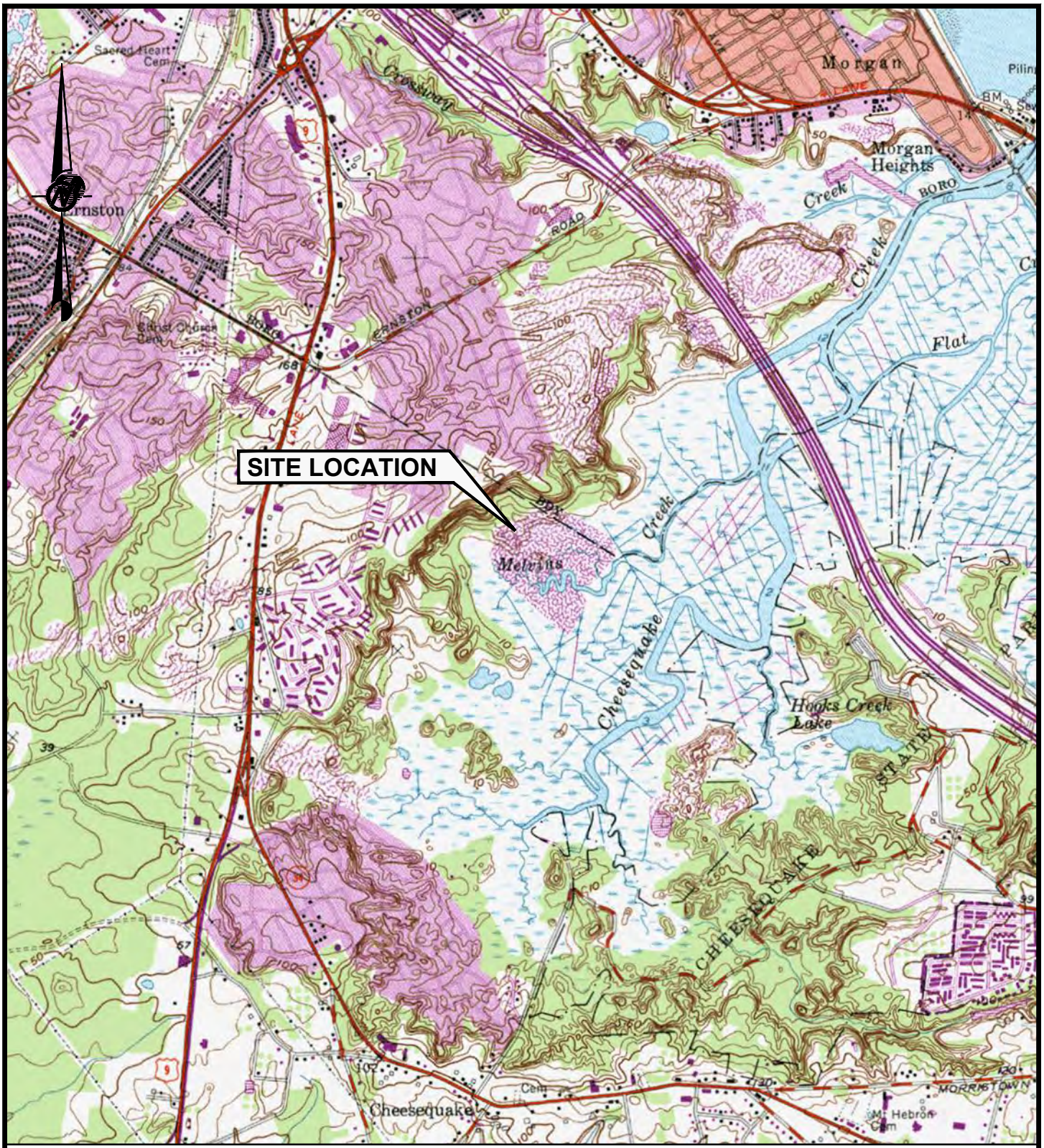
ESD for OU1 ROD, EPA, August 2006.

Remedial Action Report, PRP/Golder, September 2013

Annual Groundwater and Ecological Monitoring Report, PRP/Golder, 2014-2018
Global Landfill CEAS Groundwater Fate and Transport Description, PRP/Golder, December 20181

ITRC (Interstate Technology & Regulatory Council). 2013. Groundwater Statistics and Monitoring Compliance, Statistical Tools for the Project Life Cycle. GSMC-1. Washington, D.C.: Interstate Technology & Regulatory Council, Groundwater Statistics and Monitoring Compliance Team. http://www.itrcweb.org/gsmc-1/.

APPENDIX B – MAPS AND PLOTS



REFERENCE

1.) MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF SOUTH AMBOY, NEW JERSEY, DATED 1981.

2000 0 2000

SCALE FEET

NJ Authorization #24GA28029100

GOLDER

SCALE	AS SHOWN
DATE	04/02/19
DESIGN	FGM
CADD	RG
CHECK	FGM
REVIEW	CDH

FILE No.	9436183ZQ21		
PROJECT No.	943-6183	REV.	0

TITLE

SITE LOCATION MAP

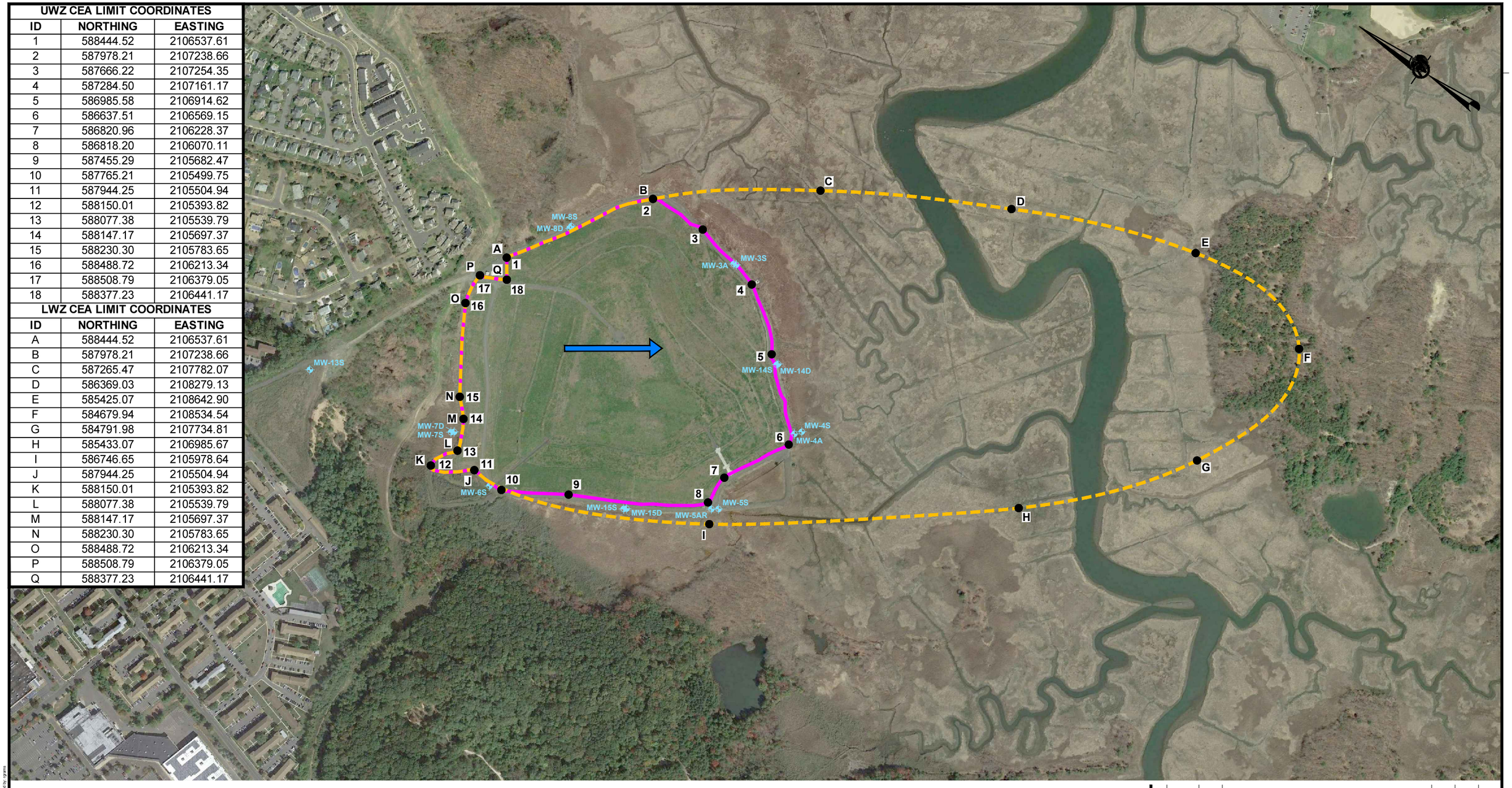
GLOBAL LANDFILL

FIGURE 1

Drawing file: 9436183ZQ21.dwg Apr 02, 2019 - 1:38pm

UWZ CEA LIMIT COORDINATES		
ID	NORTHING	EASTING
1	588444.52	2106537.61
2	587978.21	2107238.66
3	587666.22	2107254.35
4	587284.50	2107161.17
5	586985.58	2106914.62
6	586637.51	2106569.15
7	586820.96	2106228.37
8	586818.20	2106070.11
9	587455.29	2105682.47
10	587765.21	2105499.75
11	587944.25	2105504.94
12	588150.01	2105393.82
13	588077.38	2105539.79
14	588147.17	2105697.37
15	588230.30	2105783.65
16	588488.72	2106213.34
17	588508.79	2106379.05
18	588377.23	2106441.17

LWZ CEA LIMIT COORDINATES		
ID	NORTHING	EASTING
A	588444.52	2106537.61
B	587978.21	2107238.66
C	587265.47	2107782.07
D	586369.03	2108279.13
E	585425.07	2108642.90
F	584679.94	2108534.54
G	584791.98	2107734.81
H	585433.07	2106985.67
I	586746.65	2105978.64
J	587944.25	2105504.94
K	588150.01	2105393.82
L	588077.38	2105539.79
M	588147.17	2105697.37
N	588230.30	2105783.65
O	588488.72	2106213.34
P	588508.79	2106379.05
Q	588377.23	2106441.17



LEGEND

- APPROXIMATE LIMIT OF UWZ CEA BOUNDARY
- APPROXIMATE LIMIT OF LWZ CEA BOUNDARY
- MW-6S — GROUNDWATER MONITORING WELL NETWORK
- GENERALIZED DIRECTION OF GROUNDWATER FLOW

NOTE

1.) COORDINATES SHOWN REFERENCE THE NEW JERSEY STATE PLANE NAD 27 COORDINATE SYSTEM.

REFERENCES

1.) AERIAL PHOTOGRAPH LICENSED FROM GOOGLE EARTH PRO.

2.) MONITORING WELL LOCATIONS SURVEYED BY JAMES M. STEWART, INC. OF PHILADELPHIA, PA, MAY, 2004.

3.) MONITORING WELL MW-5AR TAKEN FROM ELECTRONIC FILE Final Development Plan - UPDATED 130108.pdf, ENTITLED "FINAL DEVELOPMENT PLAN - SHEET 4 OF 4," PREPARED BY LAYOUT INC., DATED NOVEMBER 29, 2012.

250 0 250 500
APPROXIMATE SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

GLOBAL LANDFILL
2018 GROUNDWATER AND ECOLOGICAL MONITORING REPORT
TOWNSHIP OF OLD BRIDGE, MIDDLESEX COUNTY, NJ

TITLE

CLASSIFICATION EXCEPTION AREA LIMITS

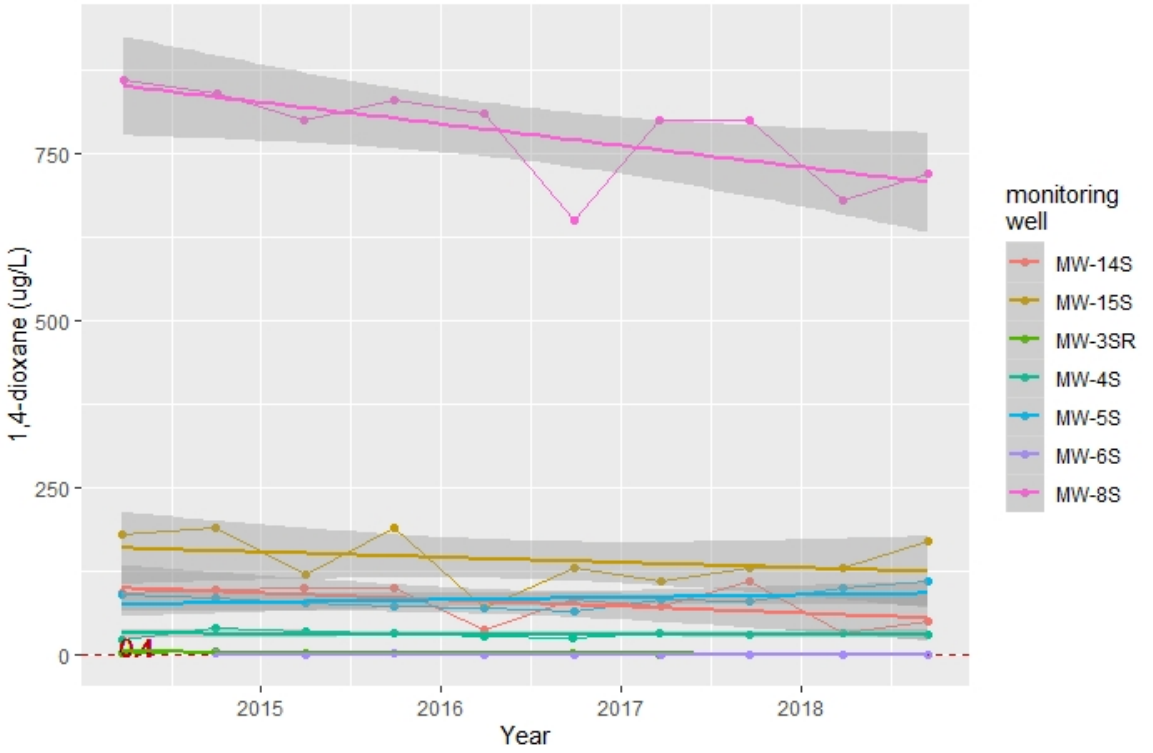
NJ Authorization #24GA28029100

GOLDER

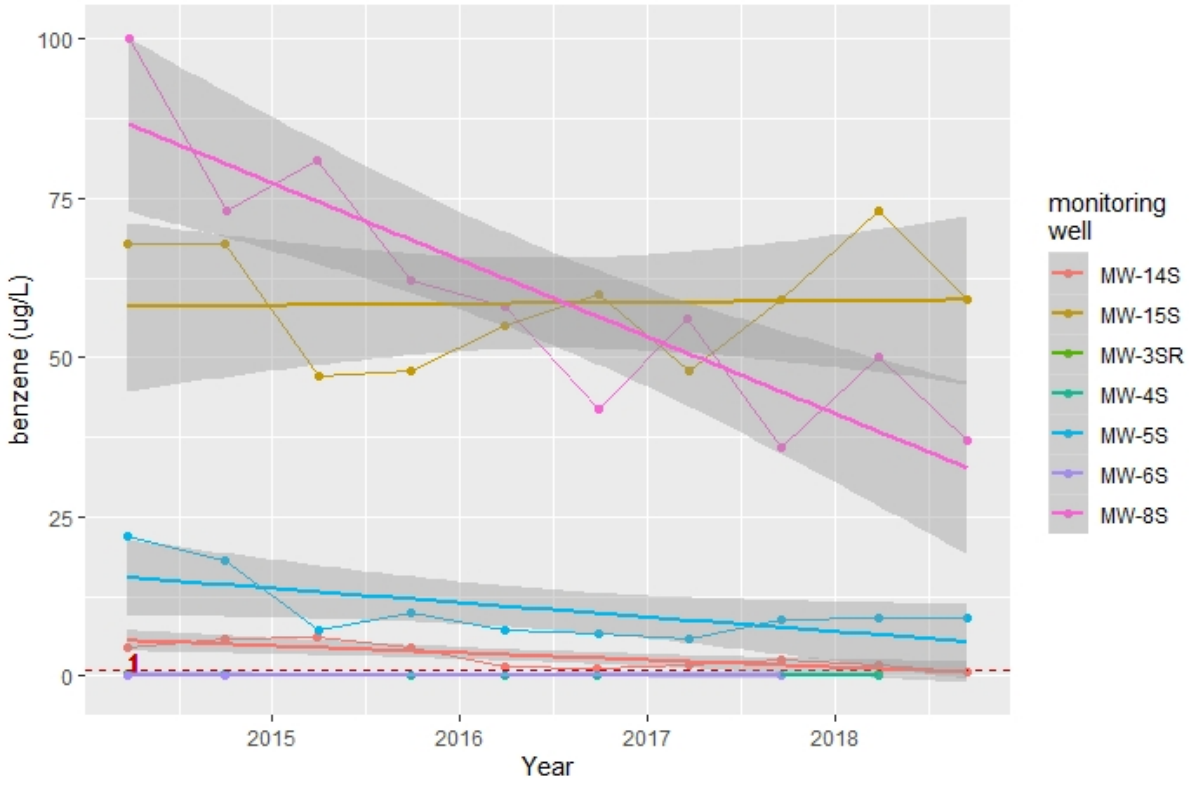
PROJECT No.		943-6183	FILE No.		9436183ZQ22
DESIGN	FGM	04/02/19	SCALE	AS SHOWN	REV. 0
CADD	RG	04/02/19			
CHECK	FGM	04/02/19			
REVIEW	CDH	04/02/19			

FIGURE 2

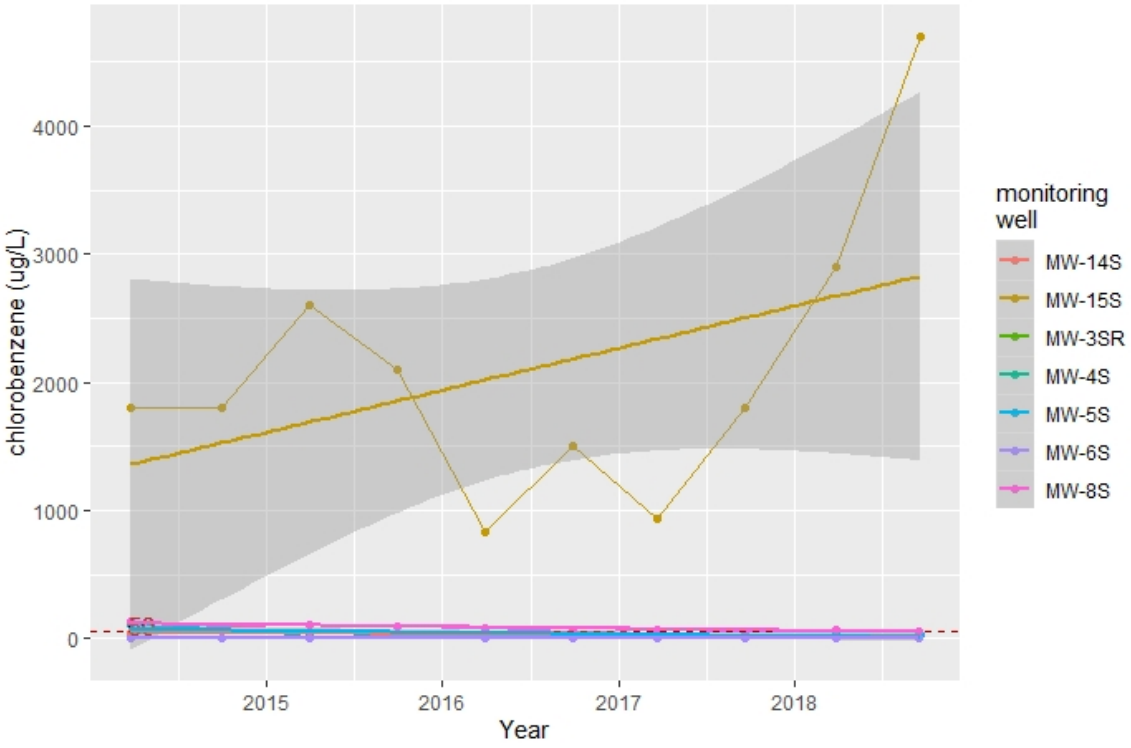
Plot 1. Concentration of 1,4-dioxane over time, UWZ



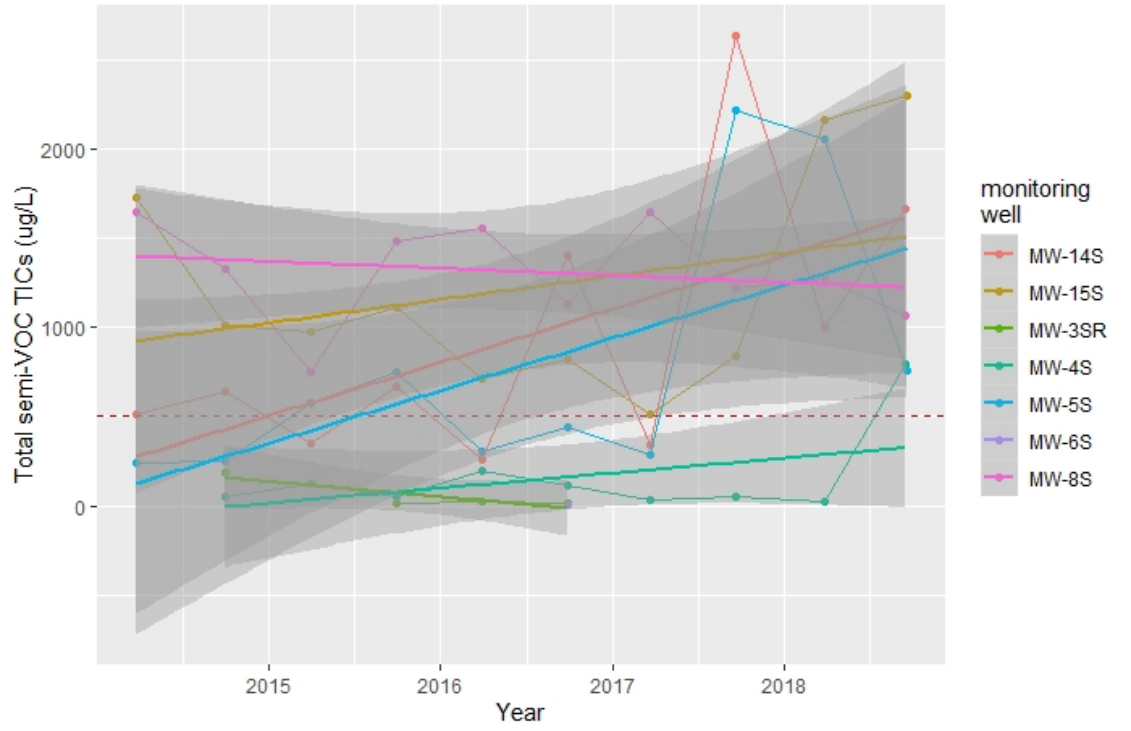
Plot 2. Concentration of benzene over time, UWZ



Plot 3. Concentration of chlorobenzene over time, UWZ



Plot 4. Concentration of Total semi-VOC TICs over time, UWZ



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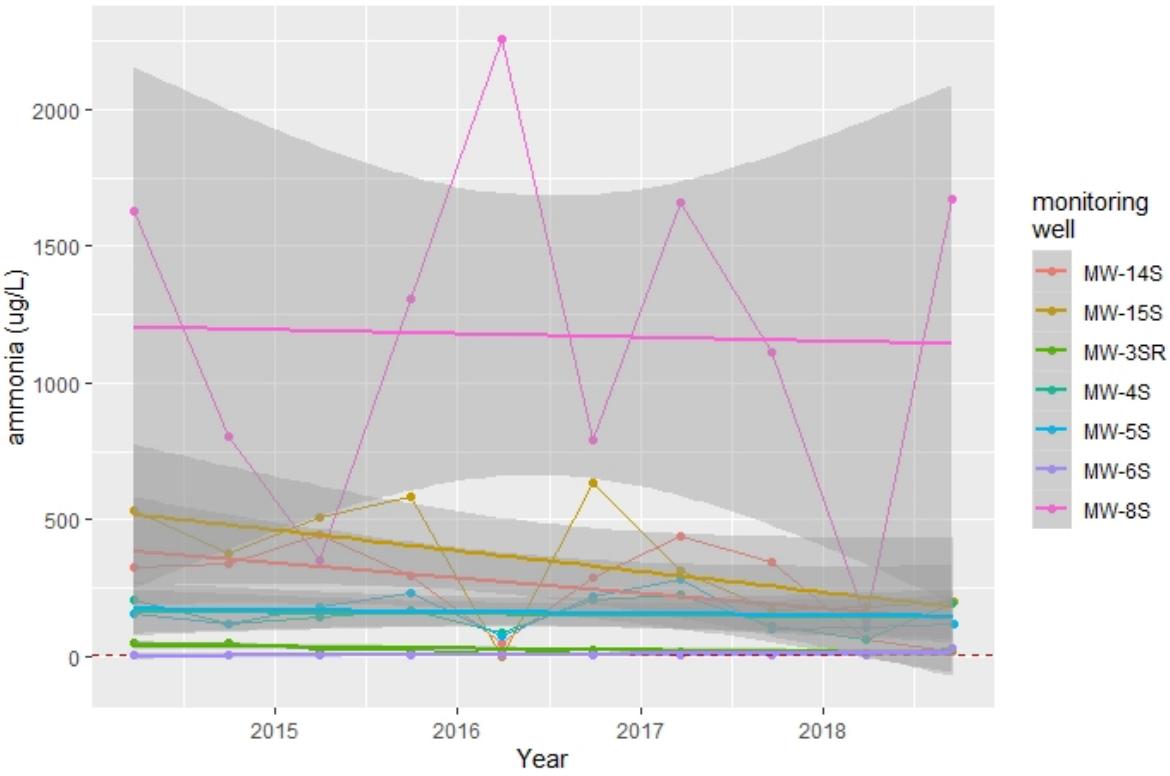
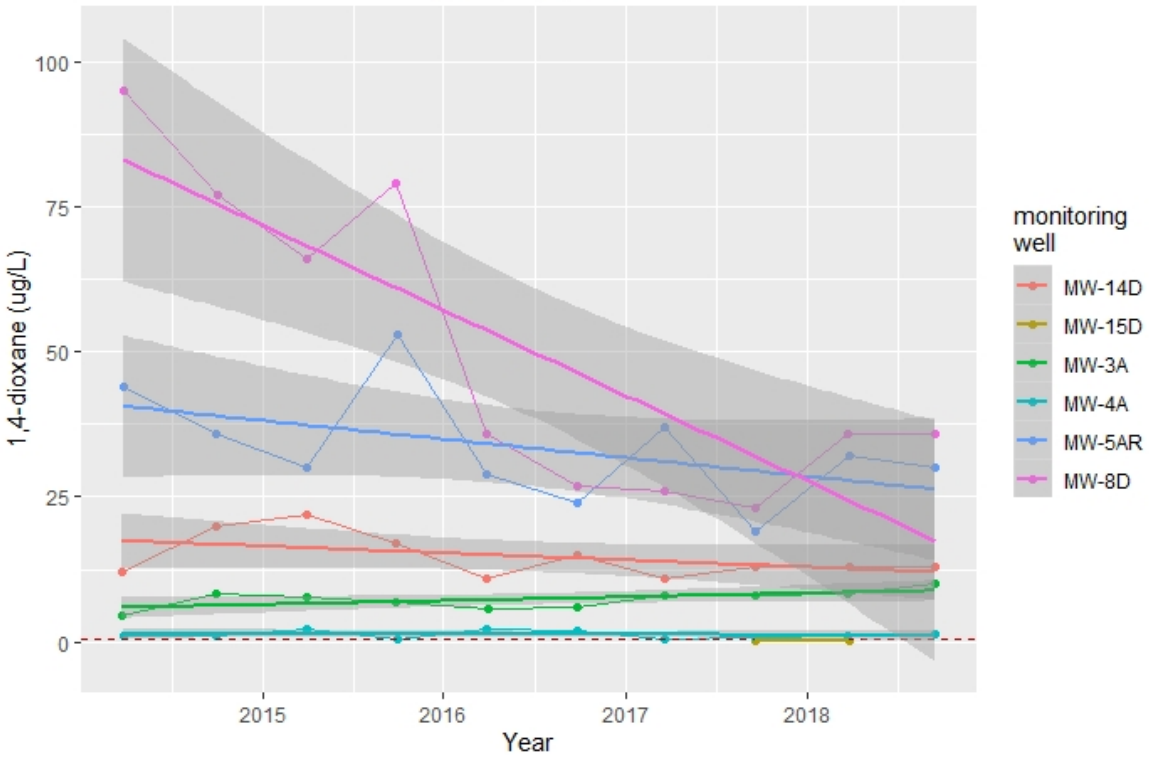
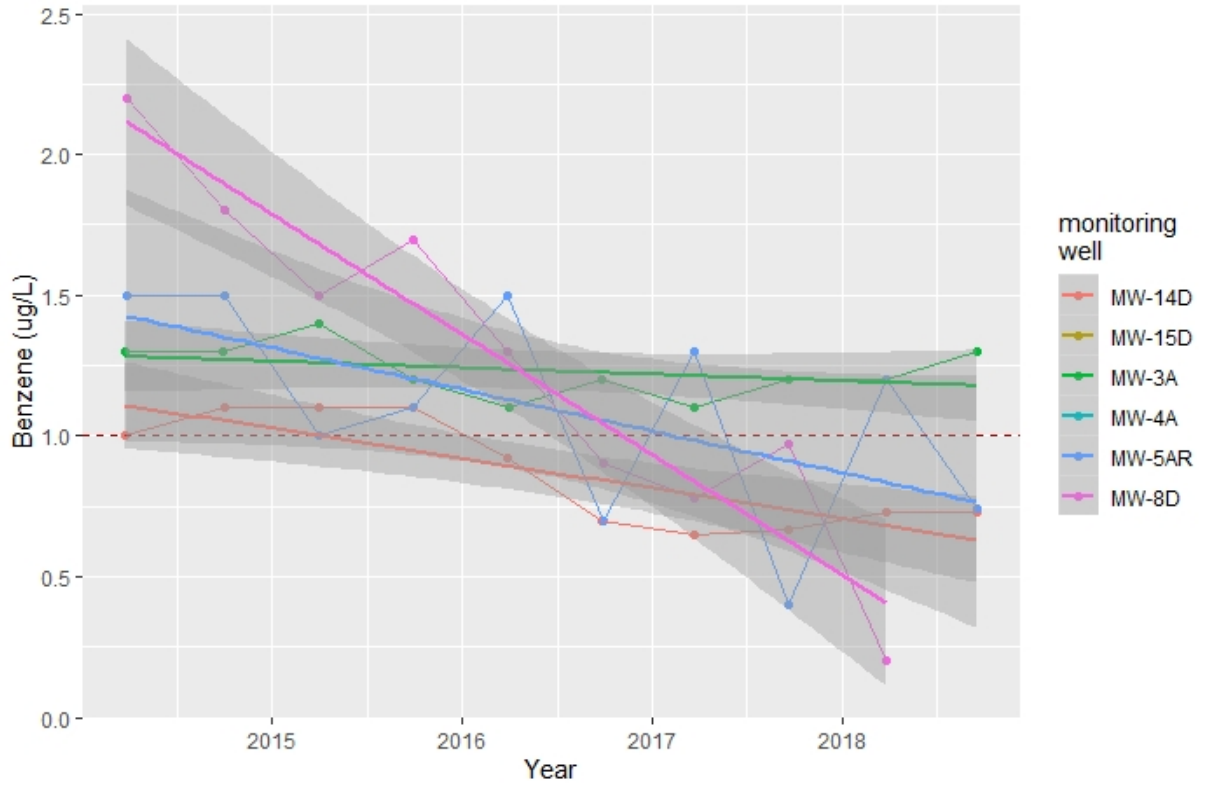
Plot 5. Concentration of ammonia over time, UWZ



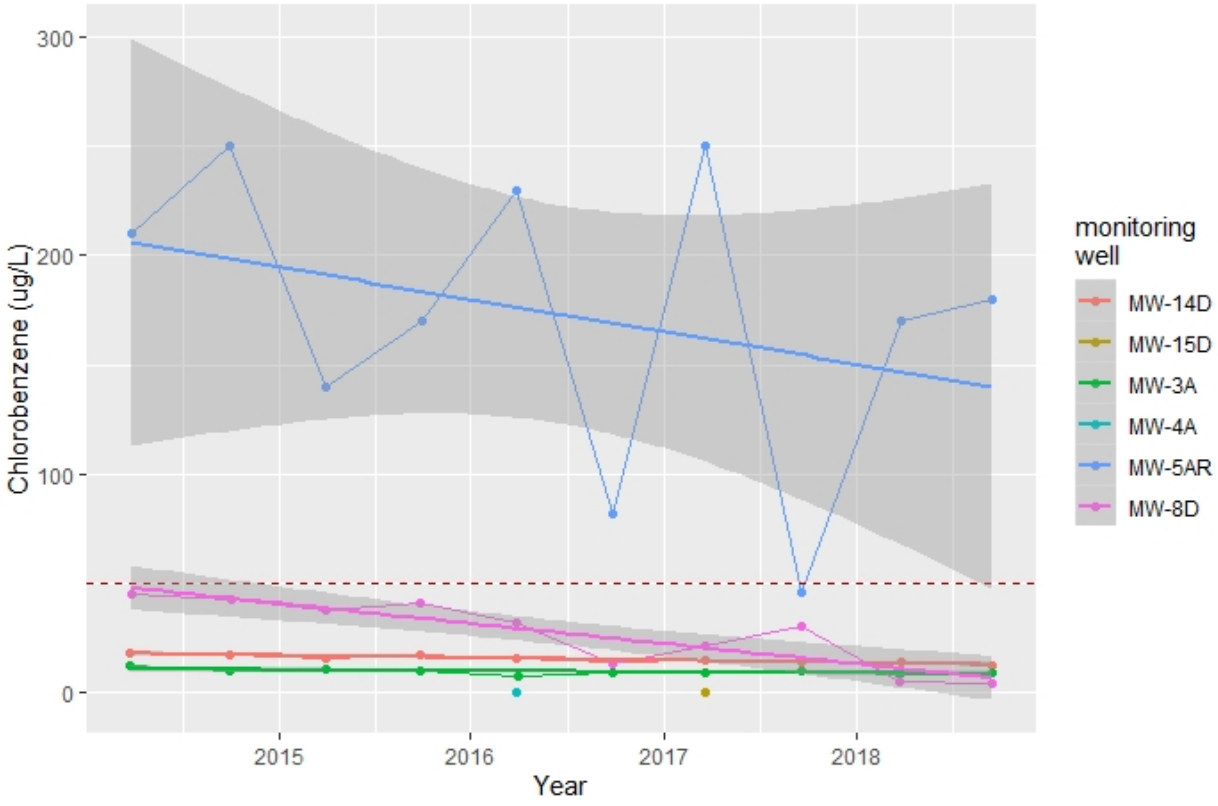
Plot 6. Concentration of 1,4-dioxane over time, LWZ



Plot 7. Concentration of Benzene over time, LWZ



Plot 8. Concentration of Chlorobenzene over time, LWZ



Plot 9. . Concentration of Tetrachloroethene over time, LWZ