July through December 2025 Semi-Annual Corrective Measures Progress Report

for

Paint Street Landfill
Chillicothe, Ohio

Prepared for:

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December 18, 2025
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Statement of Certification

Corrective Measures Progress Report
July through December 2025
Paint Street Landfill ID 71-00-03

I, Melisa Phan Darrow, a qualified groundwater scientist, as a representative of Smurfit WestRock, Inc do certify that, to the best of my knowledge, the information contained in this report is true and accurate.

Signature ______________________________ Date 12/18/2025

I, Jeffrey Manuszak, a qualified groundwater scientist, as a representative of Smurfit WestRock, Inc do certify that, to the best of my knowledge, the information contained in this report is true and accurate.

Signature ______________________________ Date 12/18/2025

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1.0 INTRODUCTION

The Paint Street Landfill is owned and operated by Smurfit Westrock (SW), formerly WestRock CP, LLC (WestRock) and MeadWestvaco Corporation (MWV) located in Chillicothe, Ohio (Site). The Paint Street Landfill is closed and currently under corrective action monitoring. The following Corrective Measures Progress Report presents the results of semi-annual groundwater monitoring conducted between July and December 2025 as required by Ohio Administrative Code (OAC) 3745-27- 10(E)(4)(C) and as specified in the Paint Street Landfill Corrective Measures Plan ([CMP], (Mead Paper Division January 2002). The report has been prepared by Langan Engineering and Environmental Services, LLC (Langan).

1.1 Report Organization

This Report is organized into the following sections.

- Section 1.0 (Introduction) discusses the purpose of this evaluation along with a summary of the site's background and hydrogeologic setting as it pertains to groundwater monitoring.
- Section 2.0 (Data Management) presents the new data pertinent to this report and discusses its content and arrangement.
- Section 3.0 (Statistical Procedures) outlines data management and statistical approaches applied to the data.
- Section 4.0 (Results) presents the results of the statistical evaluation and their meaning in respect to the site and current status.
- Section 5.0 (Determination of Rate, Extent, and Concentration) reviews the hydrological and statistical data to determine the status and potential movement of impacted groundwater and the effectiveness of the Diversion Well Field recovery well system (RWS).
- Section 6.0 (Conclusions and Recommendations) summarizes the pertinent findings of the evaluation and presents recommendations for future activities and direction.
- Section 7.0 (References) lists the pertinent reports and documents used in preparing this report.

1.2 Site History and Background

The Site is located along the northern edge of the Paint Creek Valley, approximately 4-miles upstream of Paint Creek's confluence with the Scioto River. The hydrogeological setting of this area is characterized by a sequence of unconsolidated materials of clay, silt, sands, and gravels (up to

100 feet in thickness) overlying Devonian-aged bedrock (Ohio and Olentangy Shales).

Prior to commencement of the Paint Street Landfill operations, the Site was used as a soil-borrow source. After commencement of landfill operations, waste material, consisting of ash from the former Mead Paper mill's coal fired power plant; general mill trash; rejected lime; demolition and construction debris; and waste lumber and pallets were disposed of in the landfill.

The landfill stopped receiving waste and closure was initiated on May 1, 1989. The final cover system consists of a two-foot thick, low permeability, compacted clay layer and 18 inches of native cover soils. At the base of the slope, a perimeter toe drain was installed to collect leachate and subsurface drainage. The toe drain is connected to extraction manholes where the leachate is collected and removed from the Site for disposal. Outside of the toe drain, a compacted clay key was installed to terminate the low permeability compacted clay layer and improve collection efficiency of the perimeter toe drain. At the completion of construction, the final cover and all disturbed areas were seeded and mulched. Construction of the final cover system and closure of the landfill were completed in September 1990. Closure certification was received in May 1995.

In February 1995, the Paint Street Landfill Corrective Measures Study (CMS), dated February 2, 1995, was submitted to the Ohio Environmental Protection Agency (OEPA) in accordance with OAC 3745-27- 10(F). Copies of the CMS were submitted to the Ross County Public Library for public review and an announcement for a public meeting was placed in the Chillicothe Gazette in December 1995. The public meeting was held on January 8, 1996. There was no public attendance, and no comments were received regarding the CMS. At the request of OEPA, revisions to the CMS were incorporated into the Paint Street Landfill CMP. The revised CMP was submitted to OEPA in January 2002 and subsequently approved by the Director of OEPA on June 4, 2002.

2025 marks the end of the 30-year Post-Closure Care period for the Paint Street Landfill. The Post-Closure Care PCC Proposal, dated June 21, 2021, outlines the status of the landfill monitoring and corrective measures and recommends changes to the operation and monitoring plans that are currently in effect for the facility (WestRock 2021). Accordingly, a PCC Certification and Termination Request will be submitted on behalf of SW in the first quarter of 2026. The PCC Certification and Termination Request was developed to confirm that the landfill has fulfilled regulatory requirements as specified in OAC 3745-27-10(E)(4)(C), OAC 3745-27-10(F)(15-16), and the approved CMP (Mead Paper Division 2002), and provides recommendations for focused landfill monitoring and maintenance in the future.

1.3 Constituent Source

The landfill was previously operated as an unlined disposal facility, and during the course of normal operations, precipitation generated leachate. Chemical analyses and statistical evaluation of groundwater samples taken from assessment and detection assessment monitoring wells historically showed elevated concentrations of arsenic, chloride, chemical oxygen demand (COD), and sodium. Additionally, limited volatile organic compounds (VOCs) were detected in the groundwater, but are no longer detected.

1.4 Recovery Well System and Groundwater Flow

As a corrective measure to the detected constituents in the late 1980's, a Diversion Well Field Recovery Well System (RWS) was installed and consists of groundwater recovery wells located to the south and east of the landfill (Figure 1). Twelve wells were placed into operation as a corrective measure in 1989. In March 1997, P-34, was installed between Wells P-30 and P-31 to enhance capture of the groundwater east of the landfill. A production well, designated P-34R, was installed and placed into operation in June 2010.

The RWS was originally designed to extract a maximum of 7,000 gallons per minute (gpm). From 1990 through 1996, total pumping rates were 2,000 to 4,000 gpm and gradually decreased due to reduced well efficiency and physical and mechanical problems with the production wells. By 2006, the total RWS pumping rate was approximately 1,000 gpm. The water was diverted to the adjacent paper mill where it was used in the manufacturing process and then sent to the onsite wastewater treatment plant.

Prior to the startup of the Diversion Well Field RWS in mid-1989, groundwater flow was in an easterly direction (Figure 2). After the startup of the RWS, groundwater flow was in a southerly and easterly direction with respect to the landfill. Figure 3 depicts the potentiometric surface map for August 18, 1994, which shows conditions that were typical for the RWS operation from 1990 through 1996.

In August 2006, STS Consultants, Ltd. (STS) submitted a report to OEPA on behalf of MWV evaluating groundwater conditions and remediation activities at the Site. The report recommended ceasing operation of groundwater recovery pumping and reliance on natural attenuation and additional groundwater monitoring (STS 2006). Subsequently, a two-phase deactivation of the RWS wells in conjunction with the installation and sampling of additional wells was submitted to OEPA (STS 2007). Phase 1 of the deactivation plan included wells P-39, P-40, P-41, and P-43 and was implemented in November 2007. Following the implementation of Phase 1, groundwater conditions were evaluated and a recommendation for the implementation Phase 2 was made

(AECOM 2009). OEPA authorized the implementation of Phase 2 in August 2009, which included installation of wells P-37 and P-38. Operation of recovery wells P-30, P-31 and P-34 continued until November 2009 when P-31 was taken off- line due to pump and well integrity problems. Installation of the new production well, designated P-34R, was initiated on March 2010 and was completed in June 2010, located 50 feet north of P-34 (Figure 1).

On October 13, 2013, MWV presented OEPA with a review of the groundwater quality data, the operation of the RWS, and a proposal to reduce pumping from the RWS. OEPA provided comments to the proposal and agreed to a trial period of reduced RWS pumping (OEPA 2014), Revisions to the reduced RWS pumping plan was submitted on March 18, 2014 (Layne 2014). MWV implemented the reduced RWS pumping on April 1, 2014. Under this plan, the operation for the RWS focused on continuous pumping of only well P-30 with well P-34 as a backup. Wells P-30 and P-34 were redeveloped in April and May 2014 to facilitate implementation of the reduced RWS pumping. In accordance with the March 12, 2014, plan, the reduced RWS pumping was conducted for a trial period of two years.

The reduced pumping plan called for a preliminary review of the water quality data, focused on potential impacts from the reduced pumping, and a full review of the groundwater quality being submitted following two years of operation. The preliminary review was included in the semi-annual corrective measures progress report for the period from January through June 2015 (Layne July 20, 2015), and the full review was presented in the progress report for January through June 2016 (Layne August 23, 2016(a)). From this review, it was concluded that there have been no adverse groundwater quality impacts associated with the reduced RWS pumping. Based on this result, it was recommended that the next phase of the reduced pumping plan be implemented. The March 12, 2014, proposal recommended that this phase consist of an intermittent pumping schedule, and it was proposed that the intermittent pumping schedule be on a quarterly basis with a cycle of pumping from one well (P-30, P-31 or P-34R) for one quarter and no pumping during the next quarter. The well with the highest capacity would be used for the quarterly pumping. It was further recommended that the intermittent pumping be evaluated on an annual basis for a period of two years.

In a letter dated September 21, 2016, the OEPA gave approval to conduct the intermittent pumping as a pilot program. Following receipt of OEPA's approval, WestRock implemented the quarterly pumping schedule by discontinuing pumping at the beginning of October 2016. With the discontinuation of pumping in the 4th quarter of 2016, the schedule consisted of pumping conducted during the 1st and 3rd quarters of each year, and no pumping during the 2^{nd} and 4^{th} quarters. Groundwater sampling was conducted near the end of the 2^{nd} and 4^{th} quarters. The preliminary 1-year evaluation of the intermittent pumping was included in the semiannual corrective measures progress report for the period from July to December 2017 (Layne February 19, 2018).

In July 2016, Layne attempted to redevelop well P-30. However, during the redevelopment, a sudden breach occurred in the well casing just above the well screen. This type of failure has been observed in other pumping wells at the Paint Street facility. These failures typically have occurred in the low carbon steel casing just above the stainless-steel screen. The cause of these failures is likely the dissimilar metals used in the casing and screen. The breach resulted in the surge tool becoming locked within the well screen. The surge tool was removed utilizing a pump rig hoist and an airline to loosen the material holding the tool in place. During a subsequent video survey of the well it was determined that the well screen had been raised approximately 10 feet up into the casing when the surge tool was removed. This prevented the well from being placed back into service. Given the structural problems and proposed further reductions in pumping from the RWS, a request was made to deactivate P-30 from the RWS (Layne September 21, 2016). The intermittent pumping was being conducted utilizing wells P-34 and P- 34R.

During the OEPA's review of the Corrective Measures Progress Report for the Paint Street Landfill for the period from July through December 2016, the OEPA noticed that manganese concentrations in some of the monitoring wells at the Site exceed the manganese drinking water health advisory level (HAL) of 300 micrograms per liter (µg/L). During a March 14, 2017, conference call between OEPA, WestRock and WestRock's consultant Layne Christensen Company (Layne), OEPA indicated that they believe that the Paint Street Landfill is the cause of the elevated manganese levels in some of the downgradient wells. WestRock and Layne disagreed with this interpretation, but WestRock agreed to evaluate the historical manganese data for the Site and determine whether the manganese levels can be attributed to natural groundwater chemistry or to landfill related impact.

On March 24, 2017, the OEPA conducted sampling of seven private wells located to the east and south of the Paint Street landfill (potentially downgradient). The results of water analyses from these all these wells were below the HAL of 300 µg/L for manganese.

A report on the evaluation of the manganese data from the Site was submitted to the OEPA on April 6, 2017 (Layne April 6, 2017). The primary conclusion of the manganese evaluation report was that there is no evidence linking groundwater manganese concentrations above the HAL to impact from the Paint Street Landfill. In a letter dated June 27, 2017, OEPA disagreed with this conclusion and requested that WestRock provide an evaluation to determine if the well field pumping rate should be increased in order to capture the plume more effectively. Subsequent to this, a Capture Zone Evaluation report (Layne December 28, 2017) was prepared and submitted to the OEPA. The capture zone evaluation indicated that pumping from wells at the P-30 location and well P-34/P-34R location shows the most effective capture of the impacted groundwater with the least amount of pumping. It was recommended that if it was determined additional pumping is necessary to capture groundwater to the east of the Paint Street Landfill, well P-30 should be repaired or replaced, and that well P-34 or P-34R be pumped in addition to P-30 to obtain the optimum capture of groundwater at the east end of the landfill.

In an interoffice memorandum dated March 13, 2018, the OEPA reiterated that it believes that the Paint Street Landfill is either directly or indirectly responsible for the elevated levels of manganese in groundwater at the site in addition to the constituents already attributed to the landfill. Also, the OEPA believes that an effective pumping configuration will need to include wells P-30, P-31, and P34/P-34R. In a conference call subsequent to this memorandum, WestRock agreed to discontinue the trial of the intermittent pumping schedule for the RWS and repair or replace P-30.

In May 2018, Layne utilized a cable-tool drill rig to pull the existing screen from P-30. A new 10-inch diameter well screen and 10-inch diameter casing were lowered into the well and bailed into place with the bottom of the screen at a depth of 50 feet. The top of the new 10-inch casing was welded to the top of the existing 14-inch casing. A quick setting, high-strength cement plug was poured into the bottom of the well and allowed to cure. Then the well was developed by surging and bailing. Following the well development, a new pump and motor was installed. Once the repairs were completed, P-30 was put back into service on May 21, 2018.

Wells P-30 and P-34R were redeveloped in June and July of 2019. The pump motor in P-34R was replaced in November 2019. In 2020, power to the pumping wells at the site was offline due to multiple lightning strikes, therefore pumping operations were discontinued from July 2020 to August 2023. Pumping was re-initiated at P-30 and P-34R in September 2023.

In a letter to WestRock dated 08 August 2023, OEPA indicated that pumping at wells P-30 and P-34R should be continued to stabilize downgradient impacts of the landfill, specifically for manganese. It further requested that a discussion of downtime be included in the semi-annual reports.

In accordance with OEPA's request, groundwater pumping resumed at the extraction wells subsequent to the collection of groundwater samples during the June 2023 event. Based on input provided by SW, P-30 and P-34R was operated at a combined pumping rate of 30 gpm until February 7, 2024. The pumps were taken out of service on February 8, 2024, due to electrical issues. In August 2024, a replacement pump was installed in P-34R and was returned to service with a pumping rate of 20 gpm. Well P-30 was in a state of disrepair and was evaluated for return to service. Initial repair work on P-30 began on September 11, 2024, and the well returned to service on October 31, 2024, with a pumping rate of 22 gpm.

In response to EPA's letter dated July 22, 2024, well P-31 was returned to service. Well P-31 was equipped with a new pump and is being pumped at a rate of 32 gpm. At the time of this monitoring event, Langan performed an inspection of the wells an found that wells P-31 and P-34R were pumping; however, P-30 was inactive due pump failure. WR informed Langan that they are in the process of bringing this well back on-line and will return it to service.

The potentiometric surface map for the monitoring round conducted in September 2025 during pumping conditions is depicted in Figure 4As mentioned previously, P-30 was down due to electrical failure. Collectively, the pumping rate of P-31 and P-34R was 35.6 gpm at the time of the monitoring event.

1.5 Groundwater Monitoring

Currently, groundwater quality at the Paint Street Landfill is monitored in accordance with the approved CMP. The original plan included eight groundwater monitoring wells:

- Background well: P8-37.
- Detection assessment wells located at the edge of waste placement: P13-42, P14-40, and P15-35 (installed in 1994).
- Assessment wells: P9-45, P10-50, P11-52, and P12-40 (installed in 1983-1984).

The locations of the wells at the Site with respect to the landfill are shown on Figure 1. The background, detection assessment and assessment wells are sampled on a semi-annual basis.

A replacement well, designated P12-30R, was installed adjacent to P12-40 in April 2006. In July 2007, MWV installed an additional eight monitoring wells to assess groundwater quality during and following the implementation of the recovery well deactivation plan. These wells are designated P16-50, P17-50, P18-50, P19-50, P20-50, P21-47, P22-45, and P23-40 (Figure 1). Of these, wells P18-50 and P19-50 were installed as replacements for wells OW-10 and OW-11. Additionally, monitoring well P9-45R was installed as an eventual replacement well for P9-45. The additional wells were initially sampled in December 2007 and are currently sampled on a semi-annual basis. In a letter dated August 19, 2011, OEPA approved the use of P9-45R as a replacement for P9-45, and consequently P9-45 has not been sampled since the 1st half of 2011. Monitoring well P10-50 and observation well P10-73 were abandoned in December 2016.

Currently, 16 wells constitute the groundwater quality monitoring program as approved by OEPA, and are as follows:

- Background well (upgradient of the Site) P8-37.
- P13-42, P14-40, P15-50, P19-50, P21-47, P22-45 and P23-40 located adjacent to and downgradient of the Site.
- P9-45R, P11-52, P12-40 and P12-30R located off SW property on the east side of Paint Creek and downgradient of the Site.
- P16-50, P17-50, P18-50 and P20-50 located on the west side of Paint Creek to the south of the landfill in locations that are side-gradient to the Site under the current groundwater flow patterns.

The locations of the wells at the Site with respect to the landfill are shown on Figure 1. In addition to the groundwater quality monitoring wells, there are a number of observation wells and piezometers installed around the Paint Street landfill that are no longer utilized for groundwater monitoring.

1.6 Recovered Groundwater

Groundwater recovered from the RWS is pumped to the Pixelle Specialty Solutions LLC (formerly Glatfelter, NewPage Corporation, MeadWestvaco and Mead) mill's Water Treatment Plant (WTP). The WTP treats the water using a lime softening method in order to meet process water specifications for use in the pulp and paper manufacturing process. All process water is utilized and then treated and discharged through the mill's Wastewater Treatment Plant (WWTP). On September 11, 2025, SW resumed pumping at the RWS. Well P-31 is pumping at 17.6 gpm and P-34R is pumping at 18 gpm. The collective RWS pump rate was 35.6 gpm at the time of this report. As noted previously, P-30 is currently undergoing repairs and will be brought back on-line.

1.7 Gas Monitoring

Landfill gas measurements were collected on September 11, 2025, from dedicated wells and various punch probe locations on the landfill cap that were between five to six feet in depth. Sampling was performed with the use of an MSA Altair 5x gas instrument and pressure readings were taken with a Magnehelic. Both instruments were calibrated in accordance with manufacturer recommendations and OAC 3745-27-12 requirements. The explosive gas monitoring and waste mass readings provide Lower Explosive Limit (LEL) readings for methane, oxygen, gas pressure, and water level information. Figure 1 depicts gas monitoring locations.

2.0 DATA COLLECTION

2.1 Groundwater Data Collection

The monitoring wells at the Site were sampled in September of 2025. Sample collection, preservation, handling, shipping, and analytical procedures followed the Groundwater Monitoring Plan. Sample collection, preservation, handling, and shipping was conducted by Langan personnel and sample analysis was conducted by the Australian Laboratory Services (ALS Laboratory).

The laboratory analytical results for the current semi-annual period are included as Appendix A. The historical water quality data are presented in Appendix B.

2.2 Groundwater Analytical Parameters

The Paint Street Landfill CMP (Mead Paper Division 2002), as approved by the OEPA (OEPA June 4, 2002), calls for groundwater monitoring for the following seven parameters semi-annually:

- Arsenic, iron, magnesium, sodium, in accordance with United States Environmental Protection Agency (USEPA) Method SW846: 6020A
- Chloride in accordance with USEPA Method 300.0
- COD in accordance with USEPA Method 410.4
- Total Dissolved Solids (TDS) in accordance with Method SM 2540C

Parameters listed in OAC 3745-27-10 Appendix I plus butyl benzyl phthalate are analyzed every three years.

For several years, in addition to the required parameters, MWV had analyzed groundwater samples from the Site background well, and detection assessment and assessment monitoring wells for the constituents listed in OAC 3745-27-10 Appendix I and the semi-volatile compound butyl benzyl phthalate on a semi-annual basis and analyzed samples from these wells on a semiannual basis for the constituents listed in OAC 3745-27-10 Appendix II. The constituents analyzed for the samples from the additional monitoring wells P16-50 through P23-40 varied by well based on the STS sampling plan for these wells (STS 2007).

On behalf of MWV, Layne submitted an email to the OEPA to determine if the semi-annual analysis for the Appendix I parameters and the annual analysis for the Appendix II parameters are requirements for the current Site groundwater monitoring program (Layne October 7, 2013). The response from the OEPA was that the required parameters are those listed in the 2002 CMP. Analysis for the Appendix II parameters is not required, and analysis for the complete Appendix

I list is required only every three years (OEPA October 17, 2013).

Based on this determination from the OEPA, MWV changed the parameters that are being analyzed for the groundwater monitoring for the Paint Street Landfill in 2014. The samples from the Paint Street Landfill are now analyzed for the parameters as required by the CMP plus additional parameters to help characterize the geochemical conditions at the Site. The background detection assessment, assessment monitoring wells and the additional monitoring wells installed to monitor groundwater are sampled semi-annually and the samples from all of the wells have been analyzed for the same parameters. The parameter list that has been used for this semi-annual sampling are as follows:

- Alkalinity in accordance with Method SM 2320B
- Ammonia in accordance with USEPA Method 350.1
- Chloride, nitrate, nitrite, and sulfate in accordance with USEPA Method 300.0
- Total and dissolved metals (arsenic, barium, calcium, iron, magnesium, manganese, potassium, and sodium) in accordance with Method SW846: 6020A
- COD in accordance with USEPA Method 410.4
- TDS in accordance with Method SM 2540C
- Field analysis for pH, temperature, specific conductance, and turbidity.

The background, detection assessment, and assessment monitoring wells are to be sampled every three years for all OAC 3745-27-10 Appendix I parameters. Based on the three-year sampling requirements, analysis for OAC 3745 27 10 Appendix I parameters was conducted for samples from monitoring rounds in 2013, 2016, 2019, 2022, and September 2025. During the December 2022 sampling event, Appendix I parameters were collected. As stated in Section 6.0 of the CMP, any VOC with detection during the triennial sampling event will be resampled at the next semi-annual sampling event. Toluene was detected in well P16-50 (0.6 µg/L) during the December 2022 sampling event. Toluene was not detected in well P16-50 during the September 2025 semi-annual sampling event.

2.3 Groundwater Data Management

Groundwater quality data were entered into an Excel spreadsheet for analyses using the Sanitas software package as wells as PHREEQC for generation of piper and stiff diagrams.

In addition to groundwater quality data, groundwater level data are collected from the recovery wells and piezometers in the landfill area on a semi-annual basis and converted to elevations for development of a potentiometric surface map. Groundwater level data collected from wells in September 2025 are included in Appendix C.

2.4 Groundwater Data Validation

Analytical data were evaluated to identify results that might be questionable or compromised. This evaluation considered field sampling and analysis, sample blanks, outlier testing, laboratory quality control data and completeness. The water quality data from the 2nd half 2025 groundwater quality monitoring are considered valid for their intended purpose based on a review from the contract laboratory with the exception of nitrate as N and nitrite as N (USEPA Method 300). Samples collected exhibited an exceedance of the recommended holding time (> 96 hours). The associated results were qualified as R because the holding time was exceeded more than 2 times. Langan requested ALS to rerun samples in accordance with USEPA Method 353.2. Associated results were considered useable.

Total alkalinity was reported as the sum of Alkalinity as Bicarbonate and Alkalinity as $CaCO_3$. Associated results were considered useable.

Data for the 2nd half 2025 monitoring event were submitted to OEPA on October 1, 2025, within 75 days of the sampling event in accordance with the 2002 CMP.

2.5 Gas Monitoring Data Collection

Gas monitoring is performed semi-annually with the last round of samples collected in September 2025. Historically, the landfill gas readings have been collected and reported separately from this semi-annual report. SW has requested that the data be included within the semi-annual report for OEPAs consideration.

Eighteen landfill gas and waste mass Explosive Gas (EG) measurements were collected from dedicated wells and various punch probe locations on the landfill cap that were between 5 to 6 feet in depth. Langan personnel performed EG sampling for the second semi-annual event of 2025. Gas monitoring is conducted in the field and was collected with the use of an MSA Altair 5x gas instrument and pressure readings were taken with a Magnehelic. Both instruments were calibrated in accordance with manufacturer recommendations and OAC 3745-27-12 requirements.

2.6 Gas Monitoring Analytical Parameters

The following parameters were sampled in accordance with SW's Gas Monitoring Plan and OAC

3745-27-12.

- Ambient barometric pressure, ambient air temperature, and observed weather conditions.
- EG LEL, oxygen levels, depth to water from the top of casing, and gas pressure.

The results for the current semi-annual period are provided in Appendix G and summarized in Section 4.8.

2.7 Leachate Derived Constituents Data Collection

Leachate-derived constituent data collection is sampled semi-annually. Leachate samples were collected September 11, 2025, from six manholes (Figure 1). The six samples were composited into one sample. Sample collection, preservation, handling, and shipping were conducted by the Langan personnel. Sample analysis was performed by ALS Laboratory. The laboratory report is provided in Appendix H. The most recent laboratory results for the constituents are summarized in Table 5.

2.8 Leachate Derived Constituents Analytical Parameters

Key parameters reviewed in the sample collection include:

- Heavy metals such as lead, cadmium, and arsenic, which can pose health risks if they contaminate groundwater or surface water.

- Organic compounds, including VOCs like benzene and toluene, and semi-volatile organic compounds (SVOCs) such as polycyclic aromatic hydrocarbons (PAHs), are also essential to monitor due to their potential toxicity and persistence in the environment.

- Additionally, nutrient levels, including nitrogen and phosphorus, are tracked to prevent eutrophication in nearby water bodies.

- Parameters like pH, biochemical oxygen demand (BOD), COD, and TDS are measured to assess the overall chemical and biological activity in the leachate.

It should be noted that 1,4-dioxane, mercury, and dichlorobromomethane were inadvertently omitted from the analysis for VOCs. However, historically, these constituents have been stable and below respective laboratory detection limits.

3.0 STATISTICAL PROCEDURES

The statistical evaluation was conducted utilizing groundwater quality data from the following groundwater wells at the Site:

Detection Assessment	Assessment Wells
P13-42	P9-45R
P14-40	P11-52
P15-35	P12-40
	P12-30R

The detection assessment wells are located downgradient of the Site but upgradient of the RWS. The assessment wells are located downgradient of the RWS.

A replacement well, P12-30R, was installed adjacent to P12-40 in April 2006 as discussed in the introductory section. Both wells have been sampled since May 2006. Samples from P12-40 have frequently had high turbidity levels. One historic sample from P12-40 had a turbidity level of 375 NTU. The average of the turbidity values for P12-40 excluding this extreme value is 15 NTU, and more than 30% of the turbidity values for P12-40 exceed 20 NTU. Because samples from P12-40 could be unrepresentative of the groundwater quality due to high turbidity values, and because there are now a sufficient number of semi-annual sample sets from P12- 30R, it is SW's opinion that sampling of P12-40 should be discontinued, and the well be properly abandoned. However, in an August 19, 2011, letter, the OEPA disapproved replacement of P12-40 with P12-30R. P12-40 has continued to be sampled and the sampling results have been included in the statistical analysis for this semi-annual period.

A replacement for P9-45 (P9-45R) was installed in July 2007. Also, in July 2007, additional monitoring wells were installed to evaluate the phased RWS deactivation. These wells are designated P16-50, P17-50, P18-50, P19 50, P20-50, P21-47, P22-45, and P23-40. Of these, wells P18-50 and P19-50 were installed as replacements for wells OW-10 and OW-11. In the August 19, 2011, letter, the OEPA approved the use of P9- 45R as a replacement for P9-45, P18-50 as a replacement for OW-10 and P19-50 as a replacement for OW-11. Wells OW-10, OW-11 and P9-45 have not been sampled since 2011.

As discussed in Section 1.5, well P10-50 was removed from the monitoring program and was properly abandoned in December 2016. Past analytical results for P10-50 are included in Appendix B.

Statistical analysis was not performed for the gas monitoring and leachate derived constituent data.

3.1 Statistical Methods

3.1.1 Statistical Evaluation

Statistical analyses were performed using the software package Sanitas version 9.5, by Sanitas Technologies (Formerly NIC and Intelligent Decision Technologies, Ltd. [Sanitas Technologies 2014]).

Prior to analysis, the data were screened to determine the applicable statistical procedures for evaluating groundwater quality of the assessment and detection assessment wells. This pre-qualification process considered: the number of samples per well per constituent; the proportion of the non-detect data for each constituent; and whether the data for each constituent are normally or could be transformed-normally distributed.

A statistical testing program has been developed to best meet the requirements of a sound groundwater monitoring program. The groundwater corrective action-monitoring program has incorporated a testing program that removes spatial variability and is sensitive to changes in groundwater chemistry due to a contaminant release. This goal was accomplished by utilizing intrawell statistical evaluations such as intrawell Tolerance Intervals. A Tolerance Interval is a concentration range that is constructed to contain a specified proportion of the population of observations with a specified confidence level. Tolerance Intervals are acceptable statistical methods for reviewing groundwater data as per OAC 3745-27-10 (C)(6)(c).

MCL-based Tolerance Intervals have been developed for those constituents with health-risk based concerns, and concentration-based. Tolerance Intervals have been developed for those constituents without health-risk based data. Tolerance Intervals were developed using data from the eight (8) most recent sampling events. Parametric Tolerance Intervals were calculated for data sets that were normally or transform-normally distributed and had a low number of non-detect values. If less than fifteen (15) percent of a data set were non-detect values, the non-detect values were replaced with the value of one half (1/2) of the reported detection limit prior to testing for normality and calculating the Tolerance Interval. If more than fifteen (15) percent but less than fifty (50) percent of a data set were non-detect values, the data set's sample mean and standard deviation were adjusted according to the method of Aitchison prior to calculating the Tolerance Interval. If more than fifty (50) percent of a data set were non-detect values, the non-detect values were replaced with a value of one half (1/2) of the reported detection limit, and a non-parametric Tolerance Interval was calculated. A non-parametric Tolerance Interval was also calculated if the data were not normally distributed and transforming the data did not produce a normal distribution (Sanitas Technologies 2014).

The upper limit of the parametric tolerance interval is computed as follows:

$$ULTI = X + (K \times S)$$

Where:

ULTI = upper limit of the tolerance interval;
X = the mean of the observed concentrations;
K = a factor based on the sample size, n (for n=8, K=3.188 (USEPA, 1989); and
S = the standard deviation of the concentrations.

For the non-parametric tolerance interval, the highest observed concentration from the data set (the 8 most recent samples) is set as the ULTI. For both the parametric and non-parametric tolerance intervals, the ULTI is compared to the concentration action limit. If the ULTI exceeds that limit, this is considered statistically significant evidence that the constituent concentration exceeds the concentration action limit.

In addition to the intra-well Tolerance Interval evaluation of the groundwater quality data, MWV and the OEPA agreed that trend analysis on all constituents will be conducted once per year. Trend analysis can be used to determine the significance of an apparent trend and to estimate the magnitude of the trend. The trend analysis allows evaluation of the progress of the corrective measures. Because of concerns expressed by the OEPA about the number of statistically significant increasing trends shown by the analysis of the groundwater quality data through October 2004 (OEPA June 9, 2005), additional trend analyses have been conducted on a semi-annual basis since July 2006. The annual trend analyses for this sampling event are included in this report.

In addition to the trend analyses, time series plots were prepared and examined for each well for selected constituents with the sampling data currently in the database. Time series plots were also prepared that plot the chloride data from each well together with the chloride data from the upgradient well P8-37. The time-series plots are included as Appendix D.

The trend analyses are performed by applying the Sen's Slope Estimator and the Mann-Kendal test for temporal trend. The Sen's Slope Estimator is a non-parametric method for estimating a linear trend (Sanitas Technologies 2014). When applied to groundwater quality data it produces results in terms of change in concentration units per year. The Mann-Kendal test was applied to determine if trend values from the Sen's Slope Estimator were statistically significant. The Mann-Kendal evaluation is a non- parametric analysis of increase or decrease of data with respect to time that uses the relative magnitude of the data (Sanitas Technologies 2014).

As part of the RWS well deactivation plan (STS 2007), Sen's Slope trend analyses were conducted on the dissolved iron results. All other statistical analyses of metals data are conducted on the total metal results.

3.1.2 Concentration Action Levels

OAC 3745-27-10 (F)(7) requires the establishment of concentration action levels for those constituents of concern identified in the CMP. Arsenic, chloride, COD, and sodium are the constituents identified in the CMP that require concentration action levels. The concentration action level is set at the MCL for constituents for which an MCL has been promulgated under the Federal Safe Drinking Water Act (arsenic). Concentration action levels have been developed for the remaining constituents of concern based on toxicity assessment and well data. Well specific standards are not proposed because the Tolerance Interval statistic will trigger a constituent as statistically significant at concentrations below the MCL or concentration action level.

The MCL and concentration action level for constituents of concern are listed below:

Arsenic	10 µg/L (0.010 mg/L)	MCL
Chloride	60,000 µg/L (60 mg/L)	ACL
COD	60,000 µg/L (60 mg/L)	ACL
Sodium	222,000 µg/L (222 mg/L)	ACL

Notes:
micrograms per liter (µg/L)
milligrams per liter (mg/L)

Additionally, OAC 3745-32-12 requires concentration action levels for gas monitoring of closed landfills to fall within concentrations not exceeding 25% of the LEL within the landfill structure. The LEL for methane is 5% by volume in air, hence 25% of the LEL is 1.25% by volume. Moreover, at the landfill boundary, methane concentrations should not exceed the LEL of 5% by volume in air. Acceptable oxygen levels fall between 19.5%-23.5%. Where oxygen level <19.5% are considered oxygen deficient and levels >23.5% are considered oxygen rich. In which are hazardous environments.

Lastly, leachate concentration action levels are in accordance with laboratory analysis method references of the USEPA Methods EPA 200.8 for metals, and SW846: 8260 for VOCs.

4.0 DISCUSSION OF RESULTS

The results of the statistical analyses for the last eight sampling events are included in Appendix E of this report. Table 2 summarizes the results for each well utilizing the last eight sampling events, including whether the apparent concentration trends are statistically significant.

4.1 Individual Well Results

A tabulated summary of the statistical analyses of groundwater is provided below. Wells with data that do not exceed a ULTI are indicated in blue.

Well	Constituents Exceeding ULTI (1)	ULTI (2)	Concentration Action Level	Statistically Significant Trends for 8 Most Recent Samples (3)	Discussion
Up-Gradient Well					
P8-37	None				None of the last 8 chloride concentrations exceeded the ULTI or concentration action level of 60 mg/L and 69.64 mg/L, respectively. The last 8 chloride concentrations varied from 34 to 56.7 mg/L.
Down-Gradient Wells					
P9-45R	None			Decreasing: TDS	
P11-52	None			Increasing: Iron - Dissolved Decreasing: Manganese Manganese - Dissolved	
P12-40	None			Increasing: Barium Potassium	The arsenic concentrations in the last 8 samples varied from 4 to 14 µg/L and the arsenic concentration exceeded the action limit in 2 of the last 8 samples (on 6/8/21 and 5/23/23). The ULTI value for the last 8 samples was 20.17 µg/L.
P12-30R	None				The arsenic concentrations in the last 8 samples varied from 0.19 to 7 µg/L and the arsenic concentration action limit has not been exceeded in the last 8 samples. The ULTI value for the last 8 samples was 7 µg/L.

Well	Constituents Exceeding ULTI (1)	ULTI (2)	Concentration Action Level	Statistically Significant Trends for 8 Most Recent Samples (3)	Discussion
P13-42	None				The arsenic concentrations in the last 8 samples varied from 20 to 27 µg/L and

					all the last 8 arsenic concentrations exceeded the action level. The ULTI value for arsenic for the last 8 samples was 31.55 µg/L. The chloride concentrations in the last 8 samples varied from 38 to 59 mg/L and none of the last 8 chloride concentrations exceeded the action level. The chloride ULTI for the last 8 samples is 71.2 mg/L.
P14-40	None			Decreasing: Arsenic - Dissolved	The arsenic concentrations in the last 8 samples varied from less than 0.19 to 13 µg/L and 1 of the last 8 arsenic concentrations exceeded the action level (12/5/23). The ULTI for the last 8 samples was 18.5 µg/L.
P15-35	None			Increasing: Alkalinity Magnesium Calcium	
P19-50	None				The chloride concentrations in the last 8 samples varied from 37 to 63 mg/L and 1 of the last 8 chloride concentrations (10/16/2024) exceeded the action level. The ULTI for chloride for the last 8 samples is 91.42 mg/L.
P21-47	None			Increasing: Chloride Manganese - Dissolved Decreasing: Arsenic Iron	The chloride concentrations in the last 8 samples varied from 41 to 55 mg/L and none of the last 8 arsenic concentrations exceeded the action level. The ULTI for chloride for the last 8 samples was 61.45 mg/L.
P22-45	None			Increasing: Chloride	The chloride concentrations in the last 8 samples varied from 38 to 48 mg/L. None of the last 8 samples were above the concentration action limit.
P23-40	None			Decreasing: Sodium Potassium	The arsenic concentrations in the last 8 samples varied from 25 to 38 µg/L and all the last 8 arsenic concentrations exceeded the action level. The ULTI for the last 8 samples was 48.88 µg/L.
Side-Gradient Wells					
P16-50	None				
P17-50	None			Decreasing: Manganese Manganese - Dissolved Sodium	
P18-50	None			Increasing: Sulfate Decreasing: Manganese - Dissolved	
P20-50	None			Decreasing: Magnesium Manganese - Dissolved Sodium	

Notes:
1) TI - tolerance interval; Tolerance intervals calculated for arsenic, COD, chloride and sodium.
2) ULTI - upper limit of tolerance interval calculated for the 8 most recent analytical results for the well and constituent indicated.
3) The trend analyses were conducted for the 8 most recent analytical results for the well and constituent indicated.

The calculated ULTI for arsenic exceeds the concentration action level in well P12-40 and is based on the last 8 monitoring events. As noted previously, P12-40 has historically generated turbid samples with an average turbidity of 20.27 NTUs over the last 8 monitoring events. The well was redeveloped prior to sampling in October 2024, and now has a turbidity of 1.4 NTU as of the last monitoring event, with a corresponding arsenic concentration of less than 0.19 µg/L. In the adjacent well, P12-30R, the ULTI for arsenic is below the concentration action level. A total of 37 samples were collected in 18 years at P12-30R, and the maximum arsenic concentration is 7 µg/L.

For the 2nd half 2025 data set, dissolved iron samples show a statistically significant increasing trend while total and dissolved manganese decreased in P11-52. Historically, statistically significant increasing trends for alkalinity, barium, COD, total iron, potassium, sodium, and TDS were observed in P11-52. In the last five sampling events, the concentrations of these constituents have either stabilized or decreased.

4.2 Geochemical Characterization

4.2.1 Stiff and Piper Diagrams

As indicated in Section 2.1, in the selection of the revised list of analytical parameters for the Paint Street Landfill monitoring program, parameters were included to help characterize the geochemical conditions at the Site. The parameter list includes the major anions and cations likely to be present in groundwater.

Graphical methods were utilized to characterize the geochemical characteristics of the groundwater at the Paint Street Landfill. The graphical methods utilized included Stiff diagrams and Piper diagrams. Stiff diagrams can be constructed to facilitate rapid graphical comparison of the distribution of major anions and cations among water samples (Freeze and Cherry 1979). The diagrams are constructed by converting the major ion concentrations from mg/L to milliequivalents per liter (meq/L), which is done by dividing the concentration in mg/L by the molecular weight and multiplying by the valence. The Stiff diagrams are created by plotting the concentrations of the major anions: chloride, bicarbonate, and sulfate with the distance from the central axis increasing to the right proportional to the concentrations; and concentrations of the major cations: sodium plus potassium, calcium and magnesium with the distance from the central axis increasing to the left proportional to the concentrations. A line is then drawn connecting the endpoints of the results for the different ions.

Individual Stiff diagrams were prepared for the analytical results for each well in the monitoring program for the samples collected in the 2nd half of 2025. To show the spatial distribution of the water quality, the individual Stiff diagrams have been arranged on the map presented as Figure 6. The stiff diagrams for the individual wells are also presented in Appendix F along with the Piper diagrams.

Piper diagrams graphically display the proportions of the major cations and anions in water samples on trilinear diagrams (Freeze and Cherry 1979). The percentages of the major cations (calcium, magnesium, and sodium + potassium) are displayed on a trilinear diagram on the lower left. The percentages of the major anions (chloride, sulfate, and bicarbonate + carbonate) are displayed on a trilinear diagram on the lower right, and a central diamond-shaped field displays proportions of sums of the major cations and anions projected from the lower trilinear plots. Piper diagrams were prepared for the analytical results for each well in the monitoring program for the samples collected in 2nd half 2025. Figure 7 depicts the Piper diagram for the 2nd half 2025 samples, and Piper diagrams for each well are included in Appendix F. No adjustments to contract reported laboratory alkalinity values were utilized in the reporting period.

Estimated Alkalinity Values Used for Stiff and Piper Diagrams						
Well	Laboratory Reported Result For 2nd Half 2025		Average of Previous 8 Results	Estimated Value Used for Piper and Stiff Diagrams		
	Alkalinity (mg/L)	Charge Balance Error (percent)	Alkalinity (mg/L)	Alkalinity (mg/L)	Charge Balance Error (percent)	Source of Estimated Alkalinity Value
P8-37	588	-28.1	376	588	-28.1219	Laboratory result
P9-45R	1024	-29.5	594	1024	-29.5372	Laboratory result
P11-52	688	-28.4	502	688	-28.3808	Laboratory result
P12-40	1240	-34.2	714	1240	-34.1551	Laboratory result
P12-30R	1164	80.9	663	1164	80.8622	Laboratory result
P13-42	1148	-36.0	620	1148	-35.9739	Laboratory result
P14-40	1640	-39.5	925	1640	-39.477	Laboratory result
P15-35	628	-28.1	356	628	-28.0721	Laboratory result
P16-50	656	-32.0	416	656	-31.985	Laboratory result
P17-50	0.84	73.6	311	0.84	73.6461	Laboratory result
P18-50	792	-33.4	467	792	-33.3801	Laboratory result
P19-50	656	51.6	384	656	51.555	Laboratory result
P20-50	760	-29.7	475	760	-29.7427	Laboratory result
P21-47	1084	-33.7	609	1084	-33.694	Laboratory result
P22-45	1080	-35.1	633	1080	-35.116	Laboratory result
P23-40	1996	-37.7	1106	1996	-37.7255	Laboratory result

4.2.2 Geochemical Characterization Results

The wells P13-42 and P23-40 have arsenic concentrations at levels above the concentration action level (10 µg/L). P13-42 and P23-40 have markedly higher arsenic concentrations than the other wells at the Site. The average arsenic concentrations for the last eight samples were 23.7 µg/L, and 32.7 µg/L for wells P13-42 and P23-40, respectively, with averages for P13-42, and P14-40 being above the arsenic concentration action level of 10 µg/L. Although well P14-40 has had higher arsenic concentrations than other wells on the site, only two of the last eight arsenic results for P14-40 have been above the concentration action level. Similarly, to well P14-40, P12-40 has only had two of the last eight arsenic results above the concentration action level.

The general water quality in P14-40 is similar to the general water quality in P23-40. In general, wells P14-40 and P23-40 have higher levels of alkalinity, ammonia, COD, magnesium, potassium, sodium and TDS than the other wells at the Site. The elevated levels of sodium in P14-40 and P23-40 are apparent with the maximum sodium concentration from all the other wells for the last eight samples being 140 and 150 mg/L respectively, whereas the minimum sodium concentrations from both wells P14-40 and P23-40 from the last eight samples was 110 and 130 mg/L (none of the sodium concentrations from the last eight samples exceed the concentration action level of 222 mg/L). The average COD concentrations for the last eight samples were 38.9 and 36.6 mg/L for P14-40 and P23-40, respectively, with both averages below the concentration action level of 60 mg/L. Wells P14-40 and P23-40 have noticeably lower concentrations of sulfate and manganese with respect to the other wells on-site. Wells P14-40 and P23-40 do not have chloride concentrations that are elevated compared to other wells at the Site. The average chloride concentrations in P14-40 and P23-40 from the eight most recent samples (36.6 and 42.2 mg/L, respectively) are about the same as the average chloride concentration in the upgradient well P8-37 (41 mg/L).

Although P13-42 has the second highest average arsenic concentrations of the wells at the Site (23.7 µg/L for the last eight samples and above the concentration action level of 10 µg/L), it does not have particularly high levels of alkalinity, magnesium, manganese, potassium, sodium, COD or TDS. The average sodium concentration for the last eight samples was 46.7 mg/L (below the concentration action level of 222 mg/L). The average COD concentration for the last eight samples was 18.04 mg/L (below the concentration action level 60 mg/L). P13-42 does have among the higher barium and iron concentrations as do P12-40 and P23-40. However, other wells including P11-52 have iron concentrations higher than those in P13-42.

The Stiff diagrams show the distinct difference of the water quality of the two wells on the east side of the landfill, P14-40 and P23-40, with respect to the water quality in the wells at the rest of the Site. The Stiff diagrams show the water from these wells is noticeably higher in alkalinity, sodium and magnesium and lower sulfate relative to the other wells. As shown on Figure 5, the wells to the east and southeast of the landfill tend to have higher alkalinity.

The Piper diagrams show that calcium is the major cation for most of the wells and bicarbonate is the major anion. As shown on Figure 6, the wells that appear as atypical on the Piper diagram are P14-40 and P23-40, which have a lower proportion of calcium than the other wells and have little or no sulfate. The other wells have relatively similar proportions of major cations. The proportions of major anions are also relatively similar among the other wells, although there is more variation in the proportions of the anions than there is in the proportions of the cations.

The geochemical evaluation shows that the groundwater quality at wells P14-40 and P23-40 is distinctly different from the groundwater quality at the other wells at the Site. The groundwater quality in downgradient wells P12-30R and P12-40, are more similar to that of the other wells on Site. Although there are elevated arsenic concentrations in P13-42, the general water quality in P13-42 is more similar to the surrounding wells that have much lower arsenic concentrations than it is to the water quality in P14-40 and P23-40. The geochemical evaluation indicates that the current extent of landfill influenced groundwater is generally limited to the zone between the landfill and Paint Creek. As noted by OEPA in its letter dated 8 August 2023, some influence on the groundwater chemistry may be seen at well P11-52 based on the general chemistry signature. Well P11-52 also shows markedly different values in manganese and iron when compared to other nearby wells (P12-30R, P12-40, and P14-40). OEPA previously sampled the domestic wells downgradient of the landfill and none exceeded the HAL of 300 µg/L. As discussed previously, during an inspection in October 2025, wells P-31 and P-34R were online and pumping; however, P-30 was inactive due to pump failure. P-30 is currently undergoing repairs.

4.3 Dissolved Iron Trend Analysis

As part of the previous plan for the phased deactivation of RWS wells, a trend analysis of the dissolved iron concentrations was performed. STS recommended using statistically increasing iron concentrations in the new monitoring wells as an indicator that the deactivation of RWS wells might be resulting in adverse changes in groundwater quality. Statistically significant increases in dissolved iron concentrations in specified monitoring wells is the criteria for the potential reactivation of RWS wells (STS 2007). The results of the trend analysis for dissolved iron are summarized in Table 3. Figure 8 provides an isoconcentration map for dissolved iron for the 2nd half of 2025.

Dissolved iron trend analysis was previously performed to help evaluate the phased deactivation of the RWS wells. As the RWS was reactivated in the second half of 2024, dissolved iron analyses were not performed as part of this report. Analysis will not be performed in future reports unless the RWS is deactivated.

4.4 Arsenic Distribution

The most recent data indicated that the arsenic exceeded the concentration action level in wells P13-42 (20.9 µg/L), and P23-40 (28.3 µg/L). All other wells were below the concentration action level. A summary of the total arsenic trend analysis results is presented in Table 4. Wells P14-40 and P21-47 have decreasing arsenic concentration trends.

An isoconcentration map depicting the total arsenic values at the Paint Street landfill from the samples collected during the 2nd semi-annual 2025 event is presented in Figure 9. The arsenic isoconcentration map is similar to the isoconcentration map for the samples collected during the 1st and 2nd semi-annual 2024 events (Langan, August 2024 and January 2025).

Arsenic is a naturally occurring element, and the results of the OEPA ambient groundwater monitoring program have shown that groundwater in the lower portions of sand and gravel aquifers in Ohio might have elevated concentrations of naturally occurring arsenic (OEPA 2005). The US Geological Survey has also documented the occurrence of arsenic in the groundwater in sand and gravel aquifers in Ohio (Thomas 2003). US Geological Survey researchers have noted elevated concentrations of arsenic in Devonian-aged black shale (Tuttle and Breit 2004), and these deposits outcrop and subcrop in the Paint Creek Valley.

In May 2012, MWV obtained samples from the shale outcrop to the north and east of the Paint Street Landfill (Layne September 7, 2012). The shale samples were collected at three (3) locations to the north and east of the landfill. At each location two (2) shale samples were collected, with the first sample being from the exposed outcrop surface and the second sample was collected from a few inches below the exposed outcrop surface. An additional shale sample was collected from the scree slope just below an outcrop. The samples were analyzed by the MWV Laboratory for arsenic and iron content and pH. The total arsenic concentrations in the exposed shale samples varied from a minimum of 18 to a maximum of 150 milligrams per kilogram (mg/kg equivalent to parts per million), while the total arsenic concentrations in the shale samples from below the surface varied from 32 to 40 mg/kg. The total iron concentrations in the exposed shale samples varied from 12,300 to 54,500 mg/kg, while the total iron concentrations in the shale samples from below the surface varied from 20,000 to 30,800 mg/kg. The sample results indicate the potential for the shale bedrock to act as a source of arsenic and iron in the groundwater.

It is SW's opinion that the elevated arsenic concentrations in the area immediately downgradient of the landfill are attributed to the reducing conditions in the groundwater in this area mobilizing the naturally occurring arsenic (STS 2006, STS, 2008 and MWV, September 7, 2010). As presented in the 2006 Paint Street Landfill Evaluation conducted by STS Consultants, Ltd. (now AECOM), there are three distinct reduction-oxidation (redox) zones around the landfill. There is an area of oxidizing conditions upgradient of the landfill; there is an area of reducing conditions immediately downgradient of the landfill; and there is an area of oxidizing conditions side-gradient and downgradient of the landfill. The highest arsenic concentrations are observed in the zone of reducing conditions immediately downgradient of the landfill.

Because of the location of the detection assessment well P13-42 near the edge the landfill, it is not surprising that this well exhibits elevated concentrations of constituents that are associated with the landfill and the resultant metals mobilization caused by landfill generated reducing conditions. This well is located downgradient of the Paint Street Landfill but upgradient of the RWS wells P-30 and P-34R.

Well P23-40 is located close to the bedrock valley wall that is present to the north of the landfill. The sand and gravel aquifer becomes thinner and finer from observation wells P14-40 to P23-40 and is not present at P-1R. The median of the arsenic concentrations in P23-40 from the last eight samples is about five times the median arsenic concentration in P14-40 and nearly double the median arsenic concentration in P13-42, and both P13-42 and P14-40 are closer to the landfill than P23-40.

Additionally, the median of the ammonia concentrations in P23-40 in the last eight samples is about two times the median ammonia concentration in P14-40. Elevated ammonia concentrations are characteristic of the reducing conditions that can mobilize arsenic in groundwater (USGS 2007). The observation of the highest arsenic concentrations in P23-40 is likely due to its being the closest to the bedrock wall of the wells that are currently being sampled. The location of P23-40 at the northern boundary of the aquifer in an area where the permeability is likely low could be conducive to reducing groundwater conditions that mobilize naturally occurring arsenic and iron, and therefore not directly associated with the landfill.

4.5 Manganese Distribution

An isoconcentration map depicting the distribution of the total manganese in the groundwater at the Site based on the 2nd half 2025 sample results is presented in Figure 10. The manganese distribution for the most recent samples is similar to that for the 1st half 2025 samples (Langan, August 2025) and the 2nd half of 2024 samples (Langan, March 2024). Well P12-30R has the highest manganese concentration with the most recent sample result being 636 µg/L. The manganese concentrations in P12-30R have been relatively stable over the last ten sampling events.

The primary conclusion of the manganese evaluation report (Layne April 6, 2017) was that there is no evidence linking groundwater manganese concentrations above the HAL (300 µg/L) to impact from the Paint Street Landfill. This conclusion was also reached in a subsequent semi-annual progress report (Layne February 19, 2018). However, in response to the OEPA's concerns about the elevated manganese levels, SW discontinued the trial of intermittent pumping of the RWS. Wells P-30, P-31, and P-34R were back online subsequent to the October 2024 sampling event. As of October 2025, P-31 and P-34R are online and P-30 is offline for pump repairs. A conceptual site model for manganese will be presented in the forthcoming Post Closure Care Certification Report that address manganese in groundwater surrounding the landfill.

4.6 Chloride Distribution

For the 2nd half of 2025 dataset, no wells exceeded the ULTI for chloride. The chloride concentration action level of 60 mg/L was exceeded only once in well P19-50, which recorded a maximum concentration of 63 mg/L during the last eight sampling events. Chloride concentrations in the other wells ranged from 34 to 59 mg/L, with most values below the action level. The upgradient well P8-37 had chloride concentrations between 34 to 51 mg/L, which are comparable to or slightly lower than those observed in downgradient wells. The highest chloride concentrations tend to occur in a band between wells P8-37 and P19-50 to the south of the Paint Street Landfill, while wells downgradient and side gradient to the landfill generally have chloride concentrations similar to or lower than those in the upgradient well.

Given that only one well (P19-50) exceeded the action level and that chloride concentrations in other wells are not substantially higher than those in the upgradient well, the occurrence of chloride concentrations exceeding the action level does not appear to be associated with landfill impacts. Instead, these concentrations likely reflect general groundwater chloride trends in the area surrounding the landfill.

4.7 Summary of Results

The results of the 2nd half of 2025 groundwater monitoring at the Paint Street Landfill are consistent with previous sampling events. Wells P9-45R, P11-52, P12-30R, P15-35, P16-50, P17-50, P18-50, P20-50, and P22-45 do not have any constituents that exceed the established concentration action limits. No wells exceeded the ULTI for arsenic, COD, chloride or sodium during this monitoring period.

Wells P13-42 and its duplicate sample, P19-50, and P21-47 exhibited chloride concentrations approaching the action level, but only P19-50 exceeded the chloride concentration action limit of 60 mg/L (63 mg/L on 10/16/2024). Chloride concentrations in other wells were similar to or slightly higher than those in the upgradient well P8-37 (34 to 51 mg/L), indicating that the occurrence of elevated chloride is likely related to regional groundwater conditions rather than landfill impacts.

For arsenic, wells P15-35 and P21-47 show statistically significant decreasing trends, while all other wells exhibit no significant trends. No wells exceeded the arsenic concentration action level during this monitoring period.

Manganese concentrations remain elevated in several wells, with the highest concentrations observed at P12-30R (636 µg/L), P15-35 (498 µg/L), P16-50 (422 µg/L), P11-52 (414 µg/L), and P20-50 (417 µg/L), all exceeding the USEPA HAL of 300 µg/L. Wells immediately downgradient of the landfill, such as P13-42 (70.2 µg/L) and P23-40 (71.3 µg/L), remain well below the HAL. Geochemical evaluations indicate that elevated manganese concentrations are attributable to naturally occurring conditions in the Paint Creek floodplain rather than landfill-related impacts.

Appendix I constituents required by OEPA Rule 3745-27-10 were non detect with the exception of barium and potassium for all wells. The highest observation of barium and potassium was 0.544 mg/L and 15 mg/L, respectively for well P23-40 and laboratory results are provided in Appendix A.

Overall, groundwater quality trends and spatial distribution patterns remain stable compared to previous monitoring events. The current extent of landfill-influenced groundwater appears limited to the zone between the landfill and Paint Creek, with some influence possible at well P11-52. Pumping at adjacent extraction wells has been reimplemented to monitor trends at this location. Groundwater monitoring at the landfill has now extended beyond the 30-year post-closure care period, and historical data indicate no significant differences between semi-annual monitoring events.

4.8 Summary of Gas Monitoring Results

Ten landfill gas and waste mass EG measurements were collected from dedicated wells and various punch probe locations on the landfill cap that were between five to six feet in depth. All landfill gas and ambient air samples were collected on September 10, 2025, with an average temperature of 68° F, 85% humidity and an average Barometric Pressure of 30.23.

A summary of the landfill gas and ambient air measurements are included in the table below and the SW report are presented in Appendix G.

Paint Street Landfill Gas Monitoring Results					
Location	**Location Description**	**% LEL**	**% O_2**	**Gas Pressure**	**Well Water Level (ft TOC)**
Background Point	Background Point	0	20.9	0	-
Temp GW-10	Entrance gate	0	20.9	0	-
EG-7	Railroad tracks	0	20.9	0	18.29

EG-9	MCEE building	0	20.9	0	17.52
EG-10	Cement block before beaver pond entrance	0	20.9	0	16.95
EG-11	In woods by beaver pond	0	20.9	0	18.45
Temp GW-4	1st on hill	0	20.9	0	-
Temp GW-10	2nd on hill	0	20.9	0	-
Temp GW-12	3rd on hill	0	20.9	0	-
EG-1	Landfill corner in woods	0	20.9	0	35.18

Notes:

- \- Not applicable
- % - percent
- ft TOC – feet top of casing
- LEL – lower explosive limit
- O_2 – oxygen

All locations returned a LEL of 0%, oxygen levels of 20.9%, and a gas pressure of 0. Well water levels were provided for samples that corresponded to wells. Based on historic reports submitted by SW to OEPA, gas levels have not exceeded the LEL in the past 5 years. As previously reported to OEPA, during the April 2024 sampling event an anomalous reading was noted at EG-10. The reading was observed after repairs were made to the surface casing. OEPA was notified of the anomalous reading, and subsequent verification sampling completed one week later documented non-detect levels for explosive gas. Historic gas readings are provided in Appendix I.

4.9 Summary of Leachate Derived Constituents Results

A composite leachate sample was collected and analyzed by the ALS laboratory on September 17, 2025. VOC and metal analytes were detected below laboratory detection limits with the exception of cis-1,3-Dichloropropene (0.57 µg/L), Iodomethane (2.02 µg/L) and barium (0.19 mg/L). A summary of the leachate sample analytical data is included in Table 5 and presented below.

Analyte	Location	Chillicothe	
	Sample ID	**Paint St. Leachate**	
	Lab ID	Paint St. Leachate	
	Sample Date	9/17/2025	
	Unit	Result	
Volatile Organic Compounds (VOCs)			
1,1,1,2-Tetrachloroethane	g/L	<	0.5
1,1,1-Trichloroethane	g/L	<	0.5
1,1,2,2-Tetrachloroethane	g/L	<	0.5
1,1,2-Trichloroethane	g/L	<	0.5
1,1-Dichloroethane	g/L	<	0.5
1,1-Dicloroethene	g/L	<	1.0
1,2,3-Trichloropropane	g/L	<	2.0
1,2-Dibromo-3-Chloropropane	g/L	<	5.0
1,2-Dibromoethane	g/L	<	0.5
1,2-Dichlorobenzene	g/L	<	0.5

1,2-Dichloroethane	g/L	<	1.0
1,2-Dichloropropane	g/L	<	1.0
1,3-Dichlorobenzene	g/L	<	0.5
1,4-Dichlorobenzene	g/L	<	0.5
2-Hexanone	g/L	<	4.0
4-Methyl-2-pentanone	g/L	<	3.0
Acetone	g/L	<	20
Acrylonitrile	g/L	<	15
Benzene	g/L	<	0.5
Bromochloromethane	g/L	<	1.0
Bromoform	g/L	<	1.0
Bromomethane	g/L	<	2.0
Carbon Disulfide	g/L	<	1.0
Carbon Tetrachloride	g/L	<	0.5
Chlorobenzene	g/L	<	0.5
Chloroethane	g/L	<	1.0
Chloroform	g/L	<	0.5
Chloromethane	g/L	<	1.0
cis-1,2-Dichloroethene	g/L	<	0.5
cis-1,3-Dichloropropene	g/L		0.57
Dibromochloromethane	g/L	<	0.5
Dibromomethane	g/L	<	1.0
Ethylbenzene	g/L	<	0.5
Iodomethane	g/L		2.02
Methyl Ethyl Ketone	g/L	<	10
Methylene Chloride	g/L	<	2.0
Styrene	g/L	<	0.5
Tetrachloroethene	g/L	<	0.5
Toluene	g/L	<	0.5
trans-1,2-Dichloroethene	g/L	<	0.5
trans-1,3-Dichloropropene	g/L	<	0.5
trans-1,4-Dichloro-2-butene	g/L	<	5.0
Trichloroethene	g/L	<	0.5
Trichlorofluoromethane	g/L	<	1.0
Vinyl Acetate	g/L	<	3.0
Vinyl Chloride	g/L	<	1.0
Xylene	g/L	<	0.5
RCRA Metals			
Arsenic	mg/L		0.00019
Barium	mg/L		0.179
Cadmium	mg/L	<	0.001
Chromium	mg/L	<	0.002
Lead	mg/L	<	0.002
Selenium	mg/L	<	0.002
Silver	mg/L	<	0.002
WET CHEM			
Alkalinity	mg/L		1116
Chloride	mg/L		20.7

COD	mg/L		13.3
Conductivity	mg/L		822
Nitrogen, Ammonia	mg/L		0.962
Nitrogen, Nitrate	mg/L		1.14
Nitrogen, Nitrite	mg/L		0.408
pH, Field	mg/L		6.96
Solids, Dissolved	mg/L		570
Sulfate	mg/L		18.1
Temperature	C		20.5
Turbidity	NTU		–

Notes
RCRA Resource Conservation and Recovery Act
MDL Minimum Detection Limit
NS No Standard
mg/L Milligrams per liter
g/L Micrograms per liter
Sample exceeds Screening Level
< Value is less than the MDL

5.0 DETERMINATION OF RATE, EXTENT, AND CONCENTRATION

5.1 Diversion Well Field RWS

Because of the OEPA's concern of manganese in the groundwater near the Site, SW agreed to restart pumping of the RWS. Pumping for the recovery of groundwater on the east side of landfill was reinstated in after the June 2023 sampling event at recovery wells P-30 and P-34R. In February 2024, P-30 and P-34R were removed from service due to pump failure. After the installation of a new pumps, P-34R was returned to service in August 2024. The October 2025 inspection indicate wells P-31 and P-34R were pumping; however, P-30 was inactive due to pump failure. P-30 is currently undergoing repairs and will be returned to service. Average pumping rate for the wells is provided on Figure 4.

Synoptic rounds of water levels were collected on September 9, 2025. This includes depth to water level measurements at the pumping wells.

Extraction Well ID	Depth to Water at Well Head
P-30	29.3
P-31	32.11
P-34R	32.55

A potentiometric surface map based on the groundwater levels in September 2025 is provided on Figure 4.

5.2 Average Groundwater Flow Velocity

Average groundwater flow velocities between the landfill and adjacent recovery wells for pumping conditions of wells were computed using the following equation:

$$v = (K\ dh/dl) / ne \qquad [1]$$

where:

v = average groundwater velocity (L/T)
K = hydraulic conductivity of the aquifer (L/T)
dh/dl = hydraulic gradient (dimensionless)
ne = effective porosity (dimensionless)

Average aquifer hydraulic conductivity values (K) for the Paint Street Landfill vary from 335 feet per day (ft/day) south of the landfill to 134 ft/day east of the landfill.

Based on the potentiometric surface map for well pumping conditions shown in Figure 4, the average hydraulic gradient on the south side of the landfill in September 2025 is estimated to be 0.0017 ft/ft. Assuming an effective porosity of 0.3 and using the above equation, the average groundwater flow velocity to the south of the landfill is 1.93 ft/day. This compares with an average estimated velocity of 2.2 ft/day in December 2024 (RWS on) and 2.0 ft/day in June 2024 (RWS off).

Based on the potentiometric surface map shown for well pumping conditions in Figure 4, the average hydraulic gradient on the east side of the landfill in the vicinity of P-30 and P34-R for September 2025 is estimated to be 0.0028 ft/ft. Again, assuming an effective porosity of 0.3, the average groundwater flow velocity between the landfill and recovery wells P-30 and P34-R is 3.1 ft/day. This compares with an average velocity of 9.36 ft/day estimated for December 2024 and 2.4 ft/day estimated for June 2024.

As equation [1] indicates, the calculated flow velocity is proportional to the hydraulic gradient of the groundwater surface and the hydraulic conductivity of the aquifer materials. Consequently, estimated average groundwater flow velocities will vary correspondingly in response to the spatial variability of these parameters.

5.3 Distribution of Leachate Derived Constituents

As previously noted in this report, leachate samples were collected September 17, 2025, by ALS. The most recent laboratory report is presented in Appendix H and results for the constituents for which statistical analyses are performed are summarized in Table 5.

Based on the groundwater flow patterns shown in Figure 4, and the generally consistent concentrations in the assessment monitoring wells, it follows that the extent of landfill impacted groundwater is generally limited to the zone between the landfill and Paint Creek. As stated previously, pumping at P-34R has been reinstated and the conditions will continue to be monitored. Wells P-30 and P-31 returned to service in October 2024. P-30 is currently off-line for pump repairs.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

Statistical analyses of groundwater quality data from the Paint Street Landfill using intrawell procedures indicate that none of the wells exceeded the ULTI for arsenic, COD, chloride, or sodium during the 2nd half of 2025 monitoring period. Chloride concentrations did not exceed the concentration action limit in any of the wells during the 2nd semi-annual 2025 monitoring event. 60 mg/L in P19-50 (63 mg/L on 10/16/2024). Arsenic concentrations exceeded the respective action level in wells P13-42 (20.9 µg/L) and P23-40 (28.3 µg/L), with statistically significant decreasing trends observed at P15-35 and P21-47.

Manganese concentrations continue to exceed the USEPA HAL (300 µg/L) in multiple wells, including P9-45R (357 µg/L), P12-30R (636 µg/L), P15-35 (498 µg/L), P16-50 (422 µg/L), P11-52 (414 µg/L), and P20-50 (417 µg/L). Wells immediately downgradient of the landfill, such as P13-42 and P23-40, remain below the HAL. Geochemical evaluations confirm that elevated manganese concentrations are attributable to naturally occurring conditions within the Paint Creek floodplain rather than landfill-related impacts.

Leachate sampling conducted on September 17, 2025, detected only trace VOCs (cis-1,3-Dichloropropene at 0.57 µg/L and Iodomethane at 2.02 µg/L) and low levels of barium (0.179 mg/L). No VOCs or metals were detected at levels of concern. These results indicate that leachate chemistry remains stable and consistent with historical data.

Groundwater quality trends and spatial distribution patterns remain stable compared to previous monitoring events. The current extent of landfill-influenced groundwater appears limited to the zone between the landfill and Paint Creek, with some influence possible at P11-52. Pumping at adjacent extraction wells P-30, P-31, and P-34R has been reimplemented although P-30 was not online at the time of the 2nd semi-annual sampling event and is currently undergoing repairs.

Landfill gas monitoring results indicate safe conditions, with all locations reporting 0% LEL, oxygen levels of 20.9%, and zero gas pressure, consistent with OSHA standards.

SW will be submitting a Post-Closure Care Plan Certification and Termination Request to OEPA, as groundwater monitoring has extended beyond the 30-year post-closure care period and data indicate no significant changes in groundwater quality or landfill gas conditions.

6.2 Recommendations

SW has previously submitted a post closure care proposal to the OEPA in 2021. The Post-Closure Continued Care Program Proposal, dated June 21, 2021, outlined the current status of the landfill monitoring and corrective measures and recommends changes to the operation and monitoring plans that are currently in effect for the facility (WestRock 2021). Furthermore, WR is in the process of preparing the Post Closure Care Certification report and will be submitting that report in Quarter 1 of 2026. Until OEPA has reviewed these documents, monitoring of the landfill and operation of RWS will continue per the approved work plan and recent correspondence with OEPA.

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