CEDAR HILLS REGIONAL LANDFILL
2023 ANNUAL REPORT

King County
Department of
Natural Resources and Parks
Solid Waste Division

Waste **Prevention** | *Resource* **Recovery** | *Waste* **Disposal**

www.kingcounty.gov/solidwaste

April 2024

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SECTION 1 - OVERVIEW

The King County Solid Waste Division (SWD) owns and operates the Cedar Hills Regional Landfill (CHRLF) in eastern King County for the disposal of municipal solid waste (MSW) generated in the county, exclusive of the cities of Seattle and Milton. It is a 920-acre site located at 16645 228th Avenue Southeast, off Cedar Grove Road, approximately three miles north of Maple Valley, six miles east of the City of Renton, and four miles south of the City of Issaquah. In addition to the landfill, the site contains Passage Point, a transitional housing facility; a landfill gas-to energy facility owned and operated by Bio Energy Washington, LLC (BEW); and rights-of-way for a natural gas pipeline and numerous power transmission lines.

In 2023, waste disposal continued in refuse Area 8 after having commenced in 2019. Authorization to begin accepting waste in Area 8 was granted on July 5, 2019, by Public Health of Seattle and King County (PHSKC); a copy of their authorization letter is included in Attachment A. In addition, an Order of Approval was issued by the Puget Sound Clean Air Agency (PSCAA), dated July 2, 2019, under Notice of Construction Number 11307 authorizing SWD to begin operating Area 8.

This report includes a compilation of activity summaries and system evaluations associated with the following:

- Landfill capacity;
- Financial assurance cost estimates for closure and post-closure maintenance;
- Changes to landfill operations; and
- An environmental management program, including results from our work with groundwater, stormwater, leachate, landfill gas, and odor management.

This annual report is submitted pursuant to the provisions of the Washington State Criteria for Municipal Solid Waste Landfills, Operating Criteria - Annual Reports - Washington Administrative Code (WAC) 173-351-200(11), and the Cedar Hills Regional Landfill Operating Permit, Section XII - Reporting Requirements, Part B - Annual Report and Permit Renewal Application. Municipal Solid Waste Permit PR0015736 was reissued to SWD for operation of CHRLF by PHSKC on May 7, 2019, and authorizes activity through May 7, 2029. The permit was renewed via an addendum to the original permit, per WAC 173-351-750(3), on June 2, 2023, and authorized landfill operation (retroactively) from January 1, 2023, to December 31, 2023. Copies of the permit and addendum are included in Attachment A.

SECTION 2 – CHRLF 2023 INFORMATION

A summary of CHRLF 2023 waste disposal and recycling activities is included in Appendix B: *Annual Report Municipal Solid Waste Landfill*. This form is required by Washington Department of Ecology (WDOE) for submittal of this report.

2.1 CHRLF Operational Activities

Significant operations activities that occurred at CHRLF in 2023 include the following:

- Continuation of waste disposal in Area 8 after having begun in the summer of 2019.
- Pilot study of Cedar Grove Overs as Alternative Daily Cover process started in 2023.Continued regular use of Byers Scientific Odor Control System This system releases a vapor that neutralizes odors emitted from Area 8. For reference, the 2023 Analysis of Odor Complaints is included in Attachment G. Based on the success of the pilot, operation of the system will continue in 2024.
- In conjunction with the Byers Vapor Phase Machine, delivery and set up of 24 air monitors / E-noses were deployed. KC staff is learning the Enviro-Suite System to utilize this technology.
- Regrading of the south slope of Area 8 to conform to design.
- Began prepping for Cedar Hills Facility Relocation.
- Pilot study of Loci Controls for automated controls of landfill gas well heads and continuous monitoring. Pilot study found the automated system to be effective on vertical wells only.

2.2 CHRLF Construction and Regulatory Activities

Significant construction and regulatory activities that occurred at CHRLF in 2023 include the following:

- Repair and maintenance of the North Flare Station (NFS) flares.
- Issuance of conditional approval from PHSKC to fill the NE setback of A8, lifts 5 & 6.
- Additional 18 Dual Phase Well installed in Areas 4, 5, 6 and 7.A6 south slope
- Alternative Emissions Analysis completed Central Header laterals excavated, and pipe replaced.
- Area 7 west sub-header tee connection replaced connection boot to the low BTU flare at NFS removed and serviced 2 NFS blowers removed and Serviced Low BTU flare motor
- NFS new Master Control Center building construction completed, including switch over of all electrical and mechanical systems associated with the NFS and installation of new ultra violet (UV) flame sensors on all 5 ground flares
- Replaced all 5-ground flare actuator motors with Class 1 Division 1 motors emissions testing for hydrogen sulfide (H2S) for Area 8 Puget Sound Clean Air Agency (PSCAA)
- Order of Approval requirements Fixed low spot on the 4 interior headers to increase gas flow extended the sub-header to haul road 7BEW Condensate Diversion Infrastructure installed.

SECTION 3 - LANDFILL CAPACITY AND DEVELOPMENT STATUS

CHRLF has capacity remaining in three Refuse Areas: 3,030,000 cubic yards in the combined Areas 5 and 6, and 3,815,609 cubic yards in Area 8, as of the October 27, 2023, aerial flyover. Area 8 has a permitted capacity of 7,840,000 cubic yards. Capacities are calculated by comparing the difference between existing landfill contours and a design surface at completion. Attachment D contains documentation for calculating capacity.

Efforts are underway to optimize the use of this remaining built capacity. This includes decreasing the amount of airspace consumed by disposal, recovering returned airspace due to settlement, and recycling efforts. The capacity available for disposal is also impacted by airspace consumed by daily soil cover over refuse and road construction in the active areas. Airspace available for disposal is increased through the use of tarps for alternative daily cover, recovery of rock used for roads, and mechanical compaction.

As the landfill ages, it settles, creating airspace that can be recovered for disposal. Settlement occurs due to consolidation and loss of mass from leachate and landfill gas (LFG) collection. As leachate and LFG is collected and removed from the landfill, additional airspace is gained. Soil surcharge (i.e., stockpiling clean soils on top of covered waste) is used to accelerate settlement. Areas 5 and 6 both currently have soils partially stockpiled over existing waste. This soil is intended for uses such as daily cover, road construction, or other on-site earthwork projects.

The table below presents current and planned capacity in cubic yards and tons by Refuse Area, as of October 27, 2023. These figures are based upon an airspace utilization of 1,600 pounds (lbs.) of refuse disposed per cubic yard (CY) of air space consumed, actual monthly tonnage disposed in 2023, and the average yearly tonnage forecasted through 2029. A conservative airspace utilization factor of 1,600 lbs./CY is based on historical densities achieved in previous areas at CHRLF. This density is also expected to be reached in Area 8 using current operational practices (compaction, daily cover usage, and rock recovery). See Attachment D for details.

Area	Remaining Capacity (cubic yards)	Remaining Capacity (tons)	Remaining Capacity (years)
8	3,815,609	3,052,487	~3.5
5 & 6	3,030,000	2,424,000	~2.5
Total	***6,845,609***	***5,476,487***	***~6.0***

Note: Remaining capacity based on the most recent aerial flyover of CHRLF on October 27, 2023.

The development status of the landfill is summarized in the table below. Closed Areas are Refuse Areas that have been closed in accordance with pertinent regulatory requirements and not currently scheduled to receive additional waste. The Area 5 and Area 6 Top Deck surfaces have interim covers that will be maintained until the completion of the last remaining lifts.

STATUS OF LANDFILL AREAS

Landfill Area	Area Specific Information	
Main Hill	Status	Closed
	Exposed Surface Area	84.4 acres
South Solid Waste Area	Waste was removed from this area and relocated to Area 7.	
Southeast Pit	Status	Closed
	Exposed Surface Area	9.6 acres
Central Pit	Status	Closed
	Exposed Surface Area	9.6 acres
Area 2/3	Status	Closed
	Exposed Surface Area	22.2 acres
Area 4	Status	Closed
	Exposed Surface Area	22.2 acres
Area 5	Status	Interim closure
	Final Cover Surface Area	9.2 acres
	Top Deck Interim Cover Area	31.4 acres
Area 6	Status	Interim closure
	Final Cover Surface Area	25.2 acres
	Top Deck Interim Cover Area	30.1 acres
	Volume in Place	6,800,000 cubic yards
Area 7	Status	Final Closure (Pending)
	Final Cover Surface Area	9.1 acres
	Top Deck Area	17.4 acres
	Volume in Place	8,070,000 cubic yards
Area 8	Status	Active
	Liner Footprint Area	31.4 acres
	Volume in Place (as of Oct 27, 2023)	3,815,609 cubic yards

Note: Areas are net final cover plan view surfaces or as otherwise noted.

SECTION 4 - FINANCIAL ASSURANCE ANALYSIS

SWD maintains a Landfill Reserve Fund (LRF) account for new area development, closure, post-closure, and corrective action in accordance with WAC 173-351-600. The LRF receives monthly transfers from the SWD operating fund, which obtains about 94 percent of its revenue each year from customers paying the waste disposal fee for MSW brought into the SWD solid waste system. The transfer amount is set during the disposal rate approval process and adjusted annually. The 2023 LRF contribution was $15.35 per ton versus the 2022 contribution of $14.42 per ton. In addition to WAC 173-351-600 requiring the LRF to provide financial assurance for closure and post-closure care, King County Code (4A.200.390) requires the LRF to include funding for new area development costs.

The current LRF rate is based on a projected expenditures forecast, which is based on the current rate. Each year SWD reassesses the following items and calculates a new LRF contribution, based on the following items:

[a] Updated tonnage forecast;

[b] The current interest rate set by the King County Office of Economic and Financial Analysis (OEFA);

[c] Updated projected costs in each future year for closure, new area development, and facility improvements;

[d] Updated assumptions for future capacity development of the site and updated post-closure maintenance estimates; and

[e] Updated post-closure maintenance estimate.

The post-closure maintenance estimate is updated annually. The updated estimate is based on current costs for maintenance of the systems and considers whether there have been changes to the environmental control systems that would lead to changes in maintenance costs, as well as any changes to current costs of maintenance.

Based on a recommendation from the King County Auditor's Office, SWD uses the OEFA forecast for both the inflationary assumptions and likely future investment return interest rates. The current and forecasted return interest rates are included in Attachment E. The 2023 estimate is that $4,356,594 (2023 dollars) per year will be required to maintain the landfill for 42 years. The background for this year's estimate is included in Attachment E.

Note: 42 years is currently estimated for the landfill to reach functional stability, a status attained after closure whereby there is little, or no settlement, leachate production, or landfill gas production and only custodial care is required, vs. the 30 years required by WAC 173-351 as a minimum for PCM.

SECTION 5 - WASTE DISPOSAL QUANTITIES

The CHRLF received 839,235.39 tons of municipal solid waste in 2023. Detailed information can be found in Attachment B.

SECTION 6 - SUMMARY OF 2023 GROUNDWATER, STORMWATER, LEACHATE AND LANDFILL GAS MONITORING PROGRAM AND 2023 PROPOSED ENVIRONMENTAL MONITORING PROGRAM

6.1 Summary of Groundwater Monitoring Program

Groundwater monitoring is conducted in accordance with WAC 173-351-410 and reported here in compliance with WAC 173-351-415(1). A summary of groundwater data collected during the reporting year is presented in Part 7 of Attachment F.

The Groundwater Monitoring Program is described in detail in the *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill (2013)* (SAP), and in Attachment F of this annual report. Thirty-one groundwater monitoring wells are monitored for groundwater elevations and geochemical sampling in the regional aquifer, and eleven for the perched saturated zones. Three additional wells in the regional aquifer and three additional wells in the perched zones are monitored only for groundwater elevations. Detection monitoring wells are located downgradient of, or lateral to, waste placement areas. Background characterization wells are located up-gradient of waste placement areas.

In 2023, Aspect Consulting, LLC (Aspect) assessed seven groundwater monitoring well identified by KCSWD for potential corrective actions. Four wells were identified based on recent changes in purge water turbidity and/or recent trends in total metals (MW-68, MW-75, MW-87, MW-93). There was no damage to casings or screens, however significant to minor plugging and biofouling were observed on well screens which becames more severe with depth. Redevelopment at a regular intervals was recommended for all. Additionally, monitoring wells MW-69 and MW-79 were recently struck and damaged by heavy equipment and the extent of damage to the wells at depth was unknown. It is to be noted that MW-79 is not part of the current compliance monitoring program. Aspect subcontracted with Holt Services, Inc. (Holt) to evaluate these two damaged wells. The recommendation for both of these wells was to decommission and drill new wells within 15 to 100 feet of existing wells to maintain monitoring of the aquifer. The seventh well was an older undocumented well with dual completions with unknown purpose (gas or groundwater monitoring) and construction. SWD is going to incorporate these recommendations in the project that is updating the Cedar Hills Sitewide Hydrogeologic Report.

6.2 Summary of Stormwater Monitoring Program

The Stormwater Monitoring Program is described in the SAP. The goals of this program include these elements:

- Monitor the effectiveness of Best Management Practices (BMPs) per the Stormwater Pollution Prevention Plan (SWPPP) for CHRLF;
- Evaluate compliance with the Industrial Stormwater General Permit (ISGP); and

- Evaluate compliance with the Construction Stormwater General Permit (CSWGP).

Stormwater discharges associated with industrial activities at CHRLF are covered by the ISGP, which establishes monitoring requirements and benchmark values for several parameters. Three discharge locations are monitored quarterly for compliance with the ISGP. Routine inspections also are conducted monthly and more frequently following certain storm events. Permit compliance monitoring locations are at N4 (north end of the landfill); GS1 (south end of the landfill); and SL3 (discharges to a conveyance/infiltration system along 228th Avenue Southeast near the entrance to the landfill).

Besides routine monitoring conducted in accordance with the ISGP, SWD maintains several contingency surface water monitoring stations. The purpose of the contingency monitoring stations is to allow additional surface water monitoring if ISGP monitoring results exceed applicable benchmarks and broader surface water monitoring is warranted.

Copies of required stormwater reports submitted to WDOE are included in Attachment H.

6.3 Summary of Leachate Monitoring Program

SWD primarily collects two types of leachate samples at CHRLF: characterization and compliance. Leachate characterization is a critical component of the on-going groundwater contamination detection monitoring performed at the landfill. Leachate characterization also serves to assess pretreatment needs prior to discharge, and to evaluate the effectiveness of pretreatment. Characterization includes all analytes for which groundwater is analyzed, plus several analytes specifically related to wastewater characterization and treatment. Monthly characterization samples are collected at four monitoring locations: Leachate Effluent Pumping Station (LEPS), Vault 1A (which replaced the Leachate Aeration Pond Influent that was decommissioned and removed in 2018 with Area 8 construction), Pump Station 2A, and MH46N.

Compliance samples refer to those collected to support compliance with Wastewater Discharge Permit No. 7842-03 (for the period January 1, 2023 through October 25, 2023) or Permit No. 7842-04 (for the period October 26, 2023 through December 31, 2023), issued by King County Industrial Waste (KCIW). Permit No. 7842-03 required weekly compliance samples collected from LEPS, which are analyzed for all permit-specified parameters. Pursuant to Permit No. 7842-04, the self-monitoring frequency for arsenic increased from weekly to twice a week. Monthly inorganic nitrogen (nitrate/nitrite as N and ammonia as N) monitoring was also added under Permit No. 7842-04. Sample analyte concentrations and leachate discharge flow data are used to calculate permit analyte loadings. Compliance is determined by comparing results to allowable limits specified in the permit.

SWD is required to report inorganic nitrogen concentrations, as well as calculate and report metals mass loading values alongside their respective concentration and flow values on the KCIW Self-Monitoring Report (SMR) form. SMRs are generated monthly and submitted to KCIW. SMRs for

2023 can be found in Attachment I. SWD also submits an *Annual Facility and Sampling and Monitoring Report* to KCIW detailing sampling and analytical results for all non-permit-required sampling and analysis, such as the characterization sampling described above.

In addition to compliance sampling and reporting, SWD has been conducting an on-going investigation of characterization locations within the landfill leachate conveyance system since 2018, including historical leachate flows from Pump Station 1A, Pump Station 4, Area 5-6-7, and the seasonal flow from the contaminated stormwater (CSW) lagoon. In 2019, additional sampling locations and analytes were added to the investigation, including flows from Area 8 and BEW. Continuing investigation efforts in 2023 also included additional BEW wastewater effluent sampling. Collaboration with the University of Washington Civil and Environmental Engineering Department that began in 2018 also continues to support these investigative efforts.

Field and analytical leachate data are included in Part 7 of Attachment F.

6.4 Summary of Landfill Gas Monitoring Program

Landfill gas (LFG) monitoring is performed in accordance with provisions of WAC 173-351-200(4). A network of LFG monitoring probes has been installed at strategic locations and elevation intervals below the ground surface to monitor the potential presence of LFG in the subsurface vadose zone outside of the footprint of the landfill refuse (see Attachment G).

According to WAC 173-351-200 (4)(a), the concentration of methane gas generated by the facility shall meet the following limits:

- The concentration of methane gas generated by the facility does not exceed 25 percent of the lower explosive limit (LEL) for methane in facility structures (excluding gas control or recovery system components).
- The concentration of methane gas does not exceed the LEL for methane (50,000 parts per million [ppm]) at the facility property boundary or beyond.
- The concentration of methane gases does not exceed one hundred ppm by volume of methane in offsite structures.

There are two categories (defined by function) of LFG probes at the CHRLF:

- Migration Monitoring Compliance Probes (Property Line)
- Interior Monitoring Probes

Migration Monitoring Compliance Probes are primarily intended to verify that methane concentrations at the property boundary do not exceed 50,000 ppm in the subsurface vadose zone. There are 36 Migration Monitoring (Compliance) Probes at CHRLF. The installation history of the

LFG monitoring probes at CHRLF was described in the 2005 CHRLF Annual Report. These probes are either single or multiple completion probes installed at different depths depending on subsurface geological formation. A figure showing the location of each migration monitoring compliance probe is included in Attachment G.

Interior Monitoring Probes are used to evaluate and manage the performance of the LFG collection system with respect to LFG composition (methane, oxygen, and carbon dioxide) and vacuum radius of influence. This information is used to adjust the LFG collection and conveyance system to minimize the potential for LFG migration outside of the refuse footprint. There are 30 interior monitoring probes at CHRLF. The installation history of the LFG interior monitoring probes at CHRLF was described in the 2005 CHRLF Annual Report. The probes are either single or multiple completion probes installed at different depths depending on subsurface geological formation. A figure showing the location of each interior monitoring probe is included in Attachment G.

Migration and interior probe monitoring are performed both quarterly (in compliance with WAC 173-351), and monthly for operational indicators. Monitoring results are included in Attachment G. Results from LFG migration monitoring for 2023 are discussed in Section 8.4 of this report.

6.5 Environmental Monitoring Program for 2023

Effective January 1, 2016, SWD implemented the SAP, as approved by PHSKC and WDOE in 2015. The SAP outlines current monitoring programs designed to comply with the requirements of Chapter 173-351 WAC and other applicable environmental regulations and permits, including wastewater discharge permits and stormwater permits. Modifications to the SAP will occur only with prior approval of PHSKC and WDOE.

SECTION 7 - SUMMARY OF LANDFILL PERSONNEL TRAINING PROGRAM

The SWD implements a landfill training program ensuring that landfill personnel comply with the certification requirements of WAC 173-300-060. Employees with valid Solid Waste Association of North America Landfill Certification as Manager of Landfill Operations (MOLO) are listed below in the table below.

MOLO Certifications

NAME	TITLE	DATE OF EXPIRATION
Cynthia Adams	Operations Supervisor	Certified through 05/12/2024
Dean Bell	Operations Supervisor	Certified through 06/22/2025
Diane Leedle	Transfer Station Manager	Certified through 12/04/2025
Henry Dotson	Operations Supervisor	Certified through 05/12/2024
James Gentili	Operations Supervisor	Certified through 05/12/2024
Jason Gonzales	Equipment Operators Lead	Certified through 07/15/2024
Jeff Dye	Landfill Gas Lead	Certified through 07/22/2025
Joseph Newton	Operations Supervisor	Certified through 06/22/2025
Mark Monteiro	Operations Manager	Certified through 06/08/2024
Nigel White	Special Projects Manager	Certified through 06/28/2025
Rusty Bogart	Landfill Gas Operator	Certified through 01/11/2025
Sam Medina	Equipment Operators Lead	Certified through 07/15/2024
Scott Barden	Assistant Operations Manager	Certified through 01/02/2024
Sergio Barbosa	Transfer Station Manager	Certified through 12/04/2025
Shawn Carter	Operations Supervisor	Certified through 01/02/2024
Tyler Fogelberg	Operations Supervisor	Certified through 05/12/2024

SECTION 8 - EVALUATION REPORTS

8.1 Summary of Emergency or Corrective Actions Taken in 2023

The following is a listing of emergency situations and/or corrective actions taken by SWD in 2023 to maintain compliant operation of the landfill.

8.1.1 Stormwater Corrective Action

In 2023, CHRLF did not exceed any ISGP established stormwater monitoring benchmark limits or effluent limitations. Thus, no corrective actions were necessary.

8.1.2 Wastewater Discharge Permit Corrective Action

In 2023, SWD continued to investigate and develop a remedy for the Notice of Violation (NOV) received from KCIW in July 2018 for arsenic and chromium loading exceedances in wastewater discharged from CHRLF. Actions taken followed the outline provided in the Assessment of Penalty and Compliance Order issued by KCIW on December 21, 2018. KCIW issued a Revised Compliance Order (RCO) dated October 29, 2019, which superseded and replaced the December 2018 Compliance Order. The Revised Compliance Order primarily modified the due-dates and reporting requirements. SWD's continuing response includes research and development of realistic engineered alternatives to reduce metals loading below permit limits using source control and/or treatment technologies.

Sampling results indicate that 2023 wastewater discharges frequently exceeded the permit limit for arsenic loading. In accordance with permit requirements, these exceedances were reported to KCIW using its 14-day report protocol, which explained the cause(s) of the exceedances, corrective actions taken to respond to the exceedances, and ensure ongoing compliance and resampling, as applicable. KCIW sent one warning letter to SWD in 2023, dated January 23, 2023. The warning letter described arsenic loading exceedances measured during the previous quarter (fourth quarter of 2022.) The warning letter required no further action from SWD.

SWD received four NOVs and one compliance order from KCIW in 2023. The four NOVs, dated January 12, 2023, May 8, 2023, August 16, 2023, and November 6, 2023 regarded arsenic mass loading violations detected in samples collected by KCIW's monitoring team. These samples were collected on December 1, 2022, April 10, 2023, July 19, 2023, and October 12, 2023, respectively. Because SWD is complying with the elements of the Revised Compliance Order mentioned above, each NOV required no further action. The compliance order, dated March 6, 2023, required SWD to submit an interim management solution to address arsenic-laden BEW plant condensate until a long-term approved wastewater treatment system is installed or other appropriate long-term management options are approved in accordance with the RCO referenced above. A comprehensive written response was sent to KCIW on April 5, 2023. SWD installed a system to collect and divert the BEW plant condensate to an appropriate facility but generator determination is required to start operating the system.

No other corrective actions occurred in 2023 regarding the wastewater discharge permit.

8.1.3 PHSKC Inspection Reports and Corrective Actions

In 2023, PHSKC inspected CHRLF twelve times. The only violations noted in the inspection reports were to control litter and to control access (public/animal/vehicle) by maintaining barriers. PHSKC also made some overall recommendations, primarily for improving litter control; ponding at Area 5 & pump station 3, fence repair, odor at the leachate lagoons, repainting protective bumpers at extraction wells, and bird control measures in Area 8. Corrective actions were taken in response to each of the violations and observations made by PHSKC, including routine and enhanced efforts for maintenance activities, such as litter collection, fence maintenance, odor control, and stormwater BMP maintenance.

8.1.4 Title V Air Operating Permit Deviation Reports

Failures to comply with requirements of Title V Air Operating Permit #10138 must be self-reported to PSCAA in the form of deviation reports. Title V deviation reports in 2023 included the following:

March 26, 2023: Two methane surface emission measurements over 500 parts per million (ppm) were recorded. Welding around the boot of A6IS007E came loose and caused exceedance. The boot at A6IS007E was exposed and leaks were repaired. An anchor trench was not installed as per design, causing the detections at area 6 near LFG line A6IS0006. An anchor trench alternative design has been developed. Construction will be addressed in 2024.

July 19, 2023: Methane surface emission exceedance was recorded, measuring 550 parts per million (ppm) at Area 6 slope in an interceptor well collector (A6IS0006). The exceedances was observed during PSCAA's annual inspection of CHRL and was also SWD's only detection on July 19, 2023. This is the same point where SWD recorded methane exceedance in March 2023 and also in September 2022 and notified PSCAA. The anchor trench was not installed as per the design, resulted the exceedances. An anchor trench alternative design has been developed. Construction will be addressed in 2024.

September 16, 2023; September 22, 2023: Three distinct methane surface emissions greater than 500 parts per million (ppm) on the south slope of Area 7 – near active area east of the energy dissipater vault, south of A7IS0005 and A7VW0004 - were measured on September 16, 2023. These readings were sporadic in Area 7 south slope and small tears were identified as the primary reasons of those detections. Repairs were completed at October and the tears were patched by county utility crews as part of the monthly maintenance.

On September 22, 2023, 1,000 parts per million (ppm) was recorded at Area 6 slope in an interceptor well collector (A6IS0005). This is the same location where SWD recorded methane exceedances in September 2022 and March 2023. Note that this location does not currently have a

geomembrane top liner, which means that there is no boot to repair. SWD placed compost and bark materials in the Area 6 locations as a temporary solution.

December 20, 2023; December 23, 2023, and December 30, 2023: Seven surface emission exceedances in the southeast side of the Main Hill area, southeast pit, center of Area 6 stockpile and on the south of central pit. Broken T-connections, broken flex hose, incomplete construction of dual phased well caused all these exceedances. Investigation and excavation was followed by complete repair for five landfill gas lines. A contractor has been scheduled to repair the remaining 2 landfill gas line stations (A7IS007E and A7L0510E).

8.1.5 Independent Remedial Action

SWD is proceeding with an Independent Remedial Action in the East Perched Zone (EPZ) under the Model Toxics Control Act (MTCA) in accordance with WAC 173-340-510 and 173-340-515. SWD issued a Remedial Investigation/Feasibility Study (RI/FS) in December 2016. EPZ Phase 1 Interim Actions were completed in June 2020. Work completed included on-going monitoring of the six new groundwater monitoring wells, as well as the additional landfill gas wells that were installed in 2018 in the EPZ. Multiple recommended EPZ Phase 2 Interim Actions have also taken place, including optimization of extraction wells and enhanced monitoring in the EPZ area. A consultant for support with the additional recommended Phase 2 Interim Actions of the EPZ RI/FS project has been selected and the contract has been executed and an amendment will be developed to add the specific work for the EPZ Phase 2 Interim Actions.

8.1.6 Leachate Pipeline Releases and Remedial Actions

In 2023, SWD initiated evaluation and remediation work to respond to a release from the leachate conveyance pipeline that occurred near mile post 20 on the shoulder of northbound Maple Valley Highway/SR-169 on April 1, 2022. The draft report from the investigation is under review by SWD. SWD also initiated evaluation and remediation work to respond to a release that occurred on the north shoulder of Cedar Grove Road SE east of the intersection with SE Lake Francis Road on December 29, 2023. The draft report from this investigation is under review by SWD. SWD will proceed with any necessary remedial actions after the report is accepted.

8.2 Evaluation of Stormwater Monitoring Data

Under the ISGP, quarterly sampling is required for the following 12 parameters: biological oxygen demand, total suspended solids, ammonia (total as N), alpha terpineol, benzoic acid, p-Cresol (4-methylphenol), phenol, zinc (total), pH, turbidity, copper (total), and oil sheen. Field and analytical stormwater data are included in Part 7 of Attachment F.

Monitoring station N4 monitors discharges to an unnamed tributary to McDonald Creek, which ultimately flows into Issaquah Creek. Monitoring station SL3 monitors discharges to a series of roadside ditches along 228th Avenue SE and Cedar Grove Road SE. While the ditches ultimately connect to the Cedar River, the underlying geology is highly porous, resulting in the infiltration of stormwater discharging from CHRLF long before it reaches the Cedar River. Monitoring station GS1 measures discharges to a designated King County wetland with palustrine forested, palustrine open water, and palustrine emergent wetland classes. The wetland does not contain key aquatic life uses.

8.3 Evaluation of Groundwater Monitoring Data

Groundwater at the CHRLF occurs both in a regional aquifer and in perched zones. The regional aquifer flows through advance outwash and deeper deposits and is separated from the base of waste placement areas by approximately 200 feet of unsaturated sands and gravels. Perched groundwater occurs in onsite till, ice-contact deposits, and recessional outwash. No laterally or vertically extensive perched zones have been identified, leaving the regional aquifer beneath the landfill as the earliest target hydraulic pathway for groundwater contaminant detection.

Attachment F contains a detailed analysis of groundwater monitoring results. Sections 8.3.1 and 8.3.2 give a summary of the conclusions of the Annual Groundwater Monitoring Report certified in Attachment F.

8.3.1 Regional Aquifer

The regional aquifer beneath CHRLF is recharged entirely by precipitation. A local recharge area is located immediately south of the landfill within the Queen City Farms (QCF) property and is centered north of the Main Gravel Pit Lake. In general, groundwater flow in the regional aquifer is radial from the recharge area. Beneath the landfill, regional flow is to the north in the south and central portions of the landfill site. Flow direction in the northern part of the site turns northeasterly as recharge from the McDonald Creek drainage affects flow patterns. Regional aquifer flow is physically separated from the Cedar River and likely discharges to Issaquah Creek. There is no significant seasonal variation in horizontal groundwater flow paths. Horizontal gradients are influenced by infiltrating precipitation in the recharge area. Vertical hydraulic gradients are demonstrated by head differences in adjacent wells screened at different depths and related to hydraulic conductivity of the aquifer materials. A flow-path analysis has been previously completed for the site and indicates a complex flow regime in the landfill vicinity. Site hydrogeological reports and supporting documentation show that the regional aquifer is the first continuously saturated zone beneath the landfill and serves as the earliest path for detection monitoring.

A monitoring network is in place consisting of 31 regional monitoring wells located to characterize groundwater flow and to obtain representative samples for water quality characterization. Downgradient flow converges into a high-transmissivity zone, which provides critical monitoring coverage for all flow paths delineated within the potential source area.

Each year, an extensive list of chemical analytes and field parameters are sampled and analyzed at CHRLF. The results are reviewed and evaluated by a variety of graphical and statistical methods. The groundwater data analyses presented in this report describe onsite groundwater elevations, flow direction, and velocity, and summarizes the evaluation of groundwater quality to determine if chemical concentrations have changed over time or differ between well locations. This report determines whether these findings are indicative of impacts to groundwater quality by surface activities.

Upgradient groundwater quality, especially in wells nearest the southern recharge zone, is significantly affected by conditions and activities that have occurred on the adjoining QCF property. Groundwater quality results are variable and likely subject to surface activities occurring near or within the recharge zone. A significant increase in trends for multiple water quality indicator parameters began in 2011 and have continued to increase through 2023. These increases are coincident with major clearing, grading, and stockpiling activities on the QCF property that have continued over time.

As flow continues into areas beneath the landfill footprint, changes are discernible as groundwater encounters and equilibrates to different oxidation-reduction conditions, soil gas/groundwater interface conditions, and solvent/solute interactions. Flow paths under the landfill footprint and immediately downgradient of waste cells are potentially influenced by the presence of LFG and/or leachate in the unsaturated strata. Flow paths in the north landfill area are also notably higher in chloride concentrations, along with several other ionic species. The data suggest a historical input from the onsite, overlying infrastructure located north of the closed landfill area. Chloride concentrations have declined and stabilized since maximum levels were reached in 2008-2010. Dispersion along the flow path is apparent in other downgradient wells. However, trends in alkalinity and other water-quality indicator parameters suggest groundwater that has been influenced by LFG may be migrating towards the northeast outflow channel from the site. This includes increases in key total metals concentrations, including arsenic, barium, and vanadium.

Downgradient groundwater quality is also highly variable and displays temporal trends. Much as recharge effects are dampened with distance from the source, the concentrations of many analytes are attenuated by processes such as dispersion, dilution, sorption, and degradation as groundwater flows beneath the landfill. The highest concentrations of numerous water quality analytes occur in upgradient wells, including the only detections/exceedances of chlorinated volatile organic compounds (CVOCs) in the regional aquifer. Groundwater in the regional aquifer leaving the site has no exceedances of primary drinking water standards.

MW-67, a downgradient well located in the northeast portion of CHRLF, was investigated in December 2020 by SWD and a licensed hydrogeologist consultant, with the intention of redeveloping the well. During investigation, MW-67 was determined to be inadequate for groundwater monitoring due to damage to the well screen (as evidenced by filter pack sand present in the borehole), and inappropriate sizing of the well casing (diameter of the well is too small to allow redevelopment). This well is planned to be decommissioned, and a replacement well drilled adjacent to the existing wellhead. This work will be incorporated into the project to update the Cedar Hills Sitewide Hydrogeologic Report. In the interim, MW-67 continues to be sampled semi-annually until a replacement well design and location is approved and can be installed.

When comparing upgradient and downgradient groundwater data at CHRLF, it is evident that the regional aquifer beneath the landfill acts as an attenuation zone for upgradient impacts, allowing a reduction in the concentration of CVOCs to occur as groundwater flows from the south property line to the north-northeast. The most recent water quality evaluation of the QCF groundwater monitoring program is available in *Fifth Five-Year Review Report for Queen City Farms* (2018).

8.3.2 Perched Zones

Perched groundwater occurs in onsite till, ice-contact deposits, and recessional outwash. No laterally or vertically extensive perched zones have been identified. Recharge is by precipitation with possible hydraulic continuity to surface streams.

Impacts from past landfilling practices have previously been recognized in several perched zones. Site improvements and engineered facilities have been effective in reducing contaminant concentrations attributable to past practices. Declining or stable long-term trends for many contaminants are apparent in these wells.

The East Main Hill perched zone is undergoing an independent clean-up action led by SWD. Recent investigation findings for this zone are presented in the *East Perched Zones Remedial Investigation and Feasibility Study* (December 2016). A discussion of conditions in the perched zone near the former South Solid Waste Area are available in the Technical Memoranda *Results of Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment* (April 2010).

8.3.3 Prediction Limit Exceedances

During 2023, KCSWD reported a 3-of-3 prediction limit exceedance for total barium in downgradient well MW-75. MW-75 is located on the north side of the CHRLF property and is monitored quarterly. Groundwater at MW-75 continues downgradient to MW-85 and then offsite. Despite the 3-of-3 prediction limit exceedances occurring for total barium in MW- 75, concentrations remain well below the Federal primary drinking water standard of 2000 ug/L and the Washington State Groundwater criteria of 1000 ug/L.

MW-93, a cross-gradient well, reported a 3-of-3 prediction limit exceedance for total arsenic in 2022 and these exceedances continued in each quarter of 2023. All PL exceedances were below the Primary Federal Drinking Water Maximum Contaminant Levels and the background Puget Sound Basin Groundwater level of 0.008 mg/L (*Natural Background Groundwater Arsenic Concentrations in Washington State,* Ecology Publication No. 14-09-044). SWD submitted a report on the background threshold value (BTV) calculation for the Cedar Hills local regional area, as required by the Municipal Solid Waste Handling Permit. The report was agreed to with PHSKC and Ecology in response to the

previous 3-of-3 prediction limit exceedance for MW-67 in 2020. The new BTV calculated a more representative background value to compare total arsenic, dissolved iron, and dissolved manganese concentrations within the Cedar Hills region. During 2023, the well assessment study (see section 6.1 for details) suggested redevelopment at a regular interval for MW-93. KCSWD plans to accomplish the redevelopment under the Cedar Hills Sitewide Hydrogeologic Report.

8.4 Evaluation of Landfill Gas Monitoring Data

During 2023, no exceedance of the methane regulatory limit occurred in any of the compliance migration monitoring probes.

Methane was detected in multiple interior monitoring probes, ranging from 1 to 6 interior probes in each month of 2022 by more than 5 percent volume. Adjustments were made on an on-going basis in more than 300 LFG wells inside the footprint of the landfill refuse to optimize collection of LFG. These extraction wells are upgradient from the above-referenced interior monitoring probes. Adjustments were made twice a month to ensure the containment of LFG within the footprint of landfill refuse. These adjustments were successful in preventing potential migration of LFG outside of the landfill refuse footprint, as demonstrated by the methane readings in the migration monitoring probes.

Additionally, no methane was detected inside any of the CHRLF facilities or in offsite facilities (Passage Point) at concentrations above 100 ppm (4^{th} quarter 2023 monitoring data indicated a calibration issue with the sensor).

All LFG monitoring data for 2023 for the perimeter compliance probes, interior probes, migration probes, and building monitoring are included in Attachment G.

8.5 Evaluation of Wastewater Monitoring Data and Volumes Generated

Leachate collected throughout the landfill is routed to the onsite leachate lagoons, where it mixes with other sources of wastewater at CHRLF (e.g., contaminated stormwater, grey water, sewage, and BEW process/condensate wastewater). Following aeration, the combined wastewater discharges to the King County sewerage system pursuant to Waste Discharge Permit No. 7842-03 and Waste Discharge Permit No. 7842-04 issued to SWD by KCIW.

8.5.1 Wastewater Volumes

The volume of wastewater discharged from the leachate aeration basins by way of the LEPS are recorded daily by SWD Operations staff. The actual leachate volume generated within the landfill is not measured directly.

The maximum allowed daily discharge volume for wastewater from CHRLF per permit 7842-03 and 7842-04 is 2.7 million gallons per day. There were no exceedances of this permitted discharge volume in 2023.

8.5.2 Wastewater Monitoring Analytical Data

Waste Discharge Permit No. 7842-03 and 7842-04 lists several effluent limitations and self-monitoring requirements. In 2023, wastewater monitoring analytical data indicated 20 exceedances

of the total loading limit for Arsenic, which is 0.27 pounds per day. An exceedance of the soluble sulfide screening limit, which is 0.1 ppm, was detected on May 17, 2023. The observed soluble sulfide screening level on May 17, 2023 was 0.2 ppm. Subsequent monitoring on May 26, 2023 showed a return to compliance.

All other results met permit-specified limits.

All wastewater and leachate monitoring analytical data is included in Attachment F. SMRs submitted to KCIW in 2023 are included in Attachment I.

8.6 Landfill Settlement

Settlement monitoring at CHRLF began in 1992, and by 2005 seven monitoring locations had been established. More stations were added in 2007, while others have been abandoned because of operational impacts, including one station that was covered with Area 8 excavation soils in the summer of 2017. There are currently eight total settlement monitoring stations. Annual settlement, which is in part dependent on refuse thickness as well as time, has historically varied in a range of 0 percent to nearly 4 percent of total refuse thickness for different settlement monitoring locations over time. Settlement at all stations monitored in 2023 was minimal. It is anticipated that landfill settlement will continue, with older landfill areas settling at a comparatively lower rate to newer areas of disposed refuse.

SECTION 9 - ATTACHMENTS

Attachment A – Municipal Solid Waste Permit

Attachment B – Tonnage Report

Attachment C – Disposal Fees

Attachment D – Landfill Capacity Documentation

Attachment E – Financial Assurance Documentation

Attachment F – Annual Summary of Groundwater Monitoring Results

Attachment G – Landfill Gas Probe Monitoring Results

Attachment H – Stormwater Discharge Monitoring Reports

Attachment I – Wastewater Discharge Self-Monitoring Reports