

CEDAR HILLS REGIONAL LANDFILL 2021 ANNUAL REPORT



King County

Department of
Natural Resources and Parks
Solid Waste Division

Waste
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2021 ANNUAL REPORT CEDAR HILLS REGIONAL LANDFILL

APRIL 2022

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SECTION 1 - OVERVIEW

The King County Solid Waste Division (KCSWD) 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 2021, 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 – 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 KCSWD 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
- Environmental monitoring program, including a summary of groundwater, stormwater, leachate, and landfill gas monitoring results and exceedances.

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 KCSWD 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 January 15, 2021 and authorized landfill operation from January 1, 2021 to December 31, 2021. Copies of the permit and addendum are included in Attachment A.

SECTION 2 - FACILITY INFORMATION

The Washington Department of Ecology (WDOE) form, titled “Annual Report Municipal Solid Waste Landfill” that is required for submittal of this report is included in Attachment B.

Significant facility activities that occurred in 2021 include the following:

- Waste disposal continued in Area 8 after having begun in the summer of 2019.
- Construction of the Area 7/Area 8 cover tie-in was completed. This included a reconfiguration of the existing nearby landfill gas (LFG) header system and drilling of eight (8) new dual phase extraction wells, seven (7) of which are awaiting commissioning in 2022.
- Completion of aerator electrical system repair.
- Aerator repair/replacement for the leachate lagoons.
- Preparation for installation of a new electric vehicle (EV) charging station in the parking lot north of BEW, to be completed in 2022.
- Repair and maintenance of the North Flare Station (NFS) flares.
- Preparation to issue the CH Site Development Plan Final Environmental Impact Statement (FEIS), estimated to be submitted in the first half of 2022. This preparation included numerous studies on and surrounding the landfill to account for a variety of potential environmental impacts to noise, vibration, air quality, traffic, etc. Results of these studies will be published as technical appendices to the FEIS.

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 5,526,640 cubic yards in Area 8 (as of the October 19, 2021 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, and airspace from settlement 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 them. This soil is intended for later 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 19, 2021. It is based upon an airspace utilization of 1,600 pounds (lbs.) of refuse disposed per cubic yard (CY) of air space consumed, actual tonnage disposed in 2021 per month, and the average yearly tonnage forecasted through 2029. 1,600 lbs./CY is a conservative airspace utilization factor that is based on historical, conservative densities achieved in previous areas at CHRLF. This density is expected to also 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	5,526,640	4,421,312	~4.5
5 & 6	3,030,000	2,424,000	~2.5
Total	8,556,640	6,845,312	~7.0

Note: Remaining capacity based on the most recent aerial flyover of CHRLF on October 19, 2021.

The development status of the landfill is summarized in the table below. Closed Areas are Refuse Areas 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. 19, 2021)	2,313,360 cubic yards

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

SECTION 4 - FINANCIAL ASSURANCE ANALYSIS

KCSWD 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 KCSWD operating fund, which obtains about 94 percent of its revenue each year from customers paying the waste disposal fee for MSW brought into the KCSWD solid waste system. The transfer amount is set during the disposal rate approval process and adjusted annually. New rates were adopted in 2018. The 2021 LRF contribution was \$19.55 per ton versus the 2020 contribution of \$19.02. 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 projected expenditures forecast when the current rate was adopted in 2018. Each year KCSWD 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;
- [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, KCSWD 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. ¹ The 2021 estimate is that \$4,134,562 (2021 dollars) per year will be required to maintain the landfill for 42 years.² The background for this year's estimate is included in Attachment E.

¹ 2021 forecast

² It is anticipated that in 42 years the landfill will 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.

SECTION 5 - WASTE DISPOSAL QUANTITIES

The CHRLF received 876,868 tons of municipal solid waste in 2021. Detailed information can be found in Attachment B.

SECTION 6 - SUMMARY OF 2021 GROUNDWATER, STORMWATER, LEACHATE AND LANDFILL GAS MONITORING PROGRAM AND 2022 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-two (32) groundwater monitoring wells are monitored for groundwater elevations and geochemical sampling in the regional aquifer, and sixteen (16) for monitoring the perched saturated zones. Twelve (12) additional wells in the regional aquifer and thirteen (13) 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.

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 (CSGP).

Stormwater discharges associated with industrial activities at CHRLF are covered by the ISGP, which establishes monitoring requirements and benchmark values for several parameters. Three (3) discharge locations are monitored quarterly for compliance with the ISGP. Routine inspections also are conducted monthly and more frequently during 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, KCSWD 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.

In 2021, KCSWD also had continued coverage under the CSGP - permit number WAR305034 with WDOE for the remaining Areas 7/8 tie-in construction activities. A separate SWPPP was created for this CSGP permit. Permit coverage took effect in 2017 and remained active for the duration of 2021

construction. Construction site BMPs and four (4) CSGP monitoring locations are monitored weekly during construction activities (or within 24 hours of construction stormwater flows), or monthly during inactive periods, as allowed by the permit. The four monitoring locations are designated as follows: C-1 (northwest end of the site downstream of the northwest siltation pond); C-2 (northeast end of the site, downstream of the north stormwater pond); C-3 (southeast part of the site, downstream of the south stormwater lagoon and upstream of the bioswale); and, C-4 (southwest part of the site, downstream from the southwest siltation pond).

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

6.3 Summary of Leachate Monitoring Program

KCSWD 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 (V1A), which replaced Leachate Aeration Pond Influent (LAPI - decommissioned and removed in 2018 with Area 8 construction), Pump Station 2A, and MH-46N.

Compliance samples refer to those collected to support compliance with Wastewater Discharge Permit No. 7842-03, issued by King County Industrial Waste (KCIW). Weekly compliance samples collected from LEPS are analyzed for all permit-specified parameters. 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.

KCSWD calculates and reports 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 2021 can be found in Attachment I. KCSWD 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, KCSWD 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 2021 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 twenty-five 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 at the facility property boundary or beyond;
- The concentration of methane gases does not exceed one hundred parts per million (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
- Interior Monitoring Probes

Migration Monitoring 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 thirty-six (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 twenty-seven (27) 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 2021 are discussed in Section 8.4 of this report.

6.5 Environmental Monitoring Program for 2022

Effective January 1, 2016, KCSWD 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 KCSWD implements a landfill training program that ensures 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
Anthony Slaughter	Operations Supervisor	Certified through May 2022
Cynthia Adams	Operations Supervisor	Certified through 2024
Dean Bell	Operations Supervisor	Certified through March 2022
Henry Dotson	Operations Supervisor	Certified through 2024
James Gentili	Operations Supervisor	Certified through 2024
Jason Gonzales	Equipment Operators Lead	Certified through 2024
Jeff Dye	Landfill Gas Lead	Certified through 2024
Joseph Newton	Operations Supervisor	Certified through 2024
Kris Burgin	Operations Supervisor (SD)	Certified through 2024
Mark Hammer	Assistant Operations Manager	Certified through 2024
Mark Monteiro	Operations Manager	Certified through 2024
Mike Follmar	Operations Shop	Certified through 2024
Nigel White	Special Projects Manager	Certified through 2024
Rusty Bogart	Landfill Gas Operator	Certified through 2024
Sam Medina	Equipment Operators Lead	Certified through 2024
Scott Barden	Assistant Operations Manager	Certified through 2024
Shawn Carter	Operations Supervisor	Certified through 2024
Tyler Fogelberg	Operations Supervisor	Certified through 2024

SECTION 8 - EVALUATION REPORTS

8.1 Summary of Emergency or Corrective Actions Taken in 2021

The following is a listing of emergency situations and/or corrective actions taken by KCSWD in 2021 to maintain compliant operation of the landfill.

8.1.1 Stormwater Corrective Action

In 2021, CHRLF did not exceed any ISGP established stormwater monitoring benchmark limits or effluent limitations. Thus, no corrective actions were necessary.

During 2021, monitoring pursuant to the Area 8 CSGP identified exceedances of the turbidity benchmark level in January at monitoring stations C-3 and C-4, in February at C-3, in October at C-3 and C-4. In response to turbid stormwater discharges associated with the Area 8 construction project, KCSWD implemented and/or directed the Area 8 contractor to implement additional temporary erosion and sediment control improvements and repairs to maintain the water quality of construction discharges and meet discharge limits. It should be noted that CSGP coverage was transferred in its entirety to the Area 8 contractor (Goodfellow Brothers, Inc. (GBI)), in April 2021. Additional details regarding exceedances are contained in the Discharge Monitoring Reports (DMRs) included in Attachment H. Reports for January through end of March 2021 represent the portion of the year when KCSWD maintained CSGP coverage. The remaining reports represent the portion of the year when GBI maintained CSGP coverage and had sole responsibility for compliance. GBI's Discharge Monitoring Reports are also included in Attachment H as a courtesy and for information purposes.

8.1.2 Wastewater Discharge Permit Corrective Action

In 2021, KCSWD continued to investigate and develop a remedy for the Notice of Violation (NOV) received from KCIW in July of 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 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. KCSWD'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 2021 wastewater discharges frequently exceeded the permit limit for arsenic loading and occasionally exceeded the screening level for soluble sulfide. In accordance with permit requirements, these exceedances were reported to KCIW using their 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. KCSWD received three (3) NOVs from KCIW for arsenic loading exceedances in 2021. The first NOV, dated January 12, 2021, was for exceedances that occurred on October 21, 2020 and November 12, 2020. The second

NOV, dated April 20, 2021, was for exceedances that occurred January thru March 2021. The third NOV, dated November 10, 2021, was for an exceedance that occurred on October 7, 2021. Due to the aforementioned efforts made by KCSWD under the Revised Compliance Order, no further action was required by KCSWD for these NOVs.

On November 23, 2021, KCIW sent a warning letter to KCSWD regarding two (2) additional permit limit exceedances which occurred in October 2021 and were self-reported by KCSWD: one exceedance of the atmospheric hydrogen sulfide (H₂S) short-term limit at Maintenance Hole R10-52, and one exceedance of the soluble sulfide screening limit at Cedar Hills Regional Landfill. Although not required, KCSWD sent a response to KCIW on December 22, 2021. The memorandum included information regarding corrective actions taken related to the exceedances cited in the warning letter, including long-term and short-term solutions.

No other corrective actions occurred in 2021 with regard to the wastewater discharge permit.

8.1.3 PHSKC Inspection Reports and Corrective Actions

In 2021, PHSKC inspected CHRLF five (5) times. No violations were noted in the inspection reports; however, corrective actions taken in response to observations made by PHSKC included routine maintenance activities such as litter collection, fence maintenance, 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 2021 included the following:

- June 15, 2021: Three (3) methane surface emission exceedances: 1) a cover penetration point emission exceedance of 1,300 ppm in the north-east side of the Main Hill Area; 2) a cover penetration point emission exceedance of 800 ppm in the north-west side of the Main Hill Area; and, 3) an area emissions exceedance of 1,000 ppm in the south side of Area 6 stockpile. CHRLF Title V Operating Permit 10138 requires that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were:

- 1) excavating a shallow trench to investigate the source of the 1,300 ppm exceedance. That source proved to be a loose connection on LFG line C-39, which KCSWD immediately reattached on June 15, 2021. KCSWD repaired the landfill gas line C-39 and conducted the subsequent 10-day and 30-day surface emission check on June 25, 2021 and July 15, 2021 and detected low methane of 1.8 ppm and ~100 ppm at the same cover penetration location.
- 2) The second cover penetration point emissions exceedance of 800 ppm was identified as an old stainless-steel assembly at LFG line C-30. KCSWD therefore rebuilt the well head connection in the assembly with a better fitting flexible fernco coupling. The subsequent 10-day and 30-day surface emission checks were conducted on June 25, 2021 and July 15,

2021 and detected low methane of 1.8 ppm and 3.0 ppm at the same cover penetration location.

3) The third area emissions of 1,000 ppm in the south side of Area 6 stockpile began with an excavation check for leaks. A prior surface emission check on the geomembrane showed some elevated methane readings and initial investigations showed potential defects in the cover system due to differential settling. KCSWD detected a methane concentration of 65 ppm during our 10-day surface emission check on June 25, 2021 and less than 100 ppm during our 30-day surface emission check on July 15, 2021.

- June 17, 2021: a single methane area emission exceedance of 800 ppm on the west slope of Area 7 near the top lift. CHRLF Title V Operating Permit 10138 requires that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were:

1) The potential source of the 800 ppm methane emission at Area 7 West was linked to the drilling activities of the dual phase wells in the same week when the emission reading had been taken. Methane from refuse exposed during drilling migrated via a south-east wind direction to the location where the methane emission source was detected. KCSWD took action to have the contractor placed a 60 mil HDPE ring covering the gravel pack in the well annulus and placed hydrated bentonite chips approximately three feet thick to seal the annulus. Eventually the final cover was installed and booted to the well. The 2-day operation also limited the exposure time and the subsequent 10-day, and 30-day surface emission checks were conducted on June 26, 2021 and July 17, 2021 that detected low methane of 200 ppm and 135 ppm at the area emission location.

- June 22, 2021: a cover penetration point emission exceedance of 6,500 ppm in the Main Hill Area. CHRLF Title V Operating Permit 10138 required that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were: 1) An initial investigation to find the source of 6500 ppm methane near LFG line C-16 was conducted, including excavating and exposing the boot to the cover. No visible damage could be detected when examined on June 22, 2021. The 10-day follow up check on July 3, 2021 detected methane at <200 ppm and further investigation around the general area was conducted; however, KCSWD was unable to recreate the original exceedance. On July 22, 2021 another methane cover penetration point emission exceedance of 2,000 ppm was detected around the well casing and after further investigation a few small gaps were observed where the boot is clamped around the pipe, temporary repairs were made onsite by LFG personnel. The 30-day surface emission checks detected (low) methane of <300 ppm. KCSWD is currently working to organize and contract with a specialist to investigate further the boot connection and make any additional repairs to the liner.

- August 24, 2021: Routine monitoring identified two (2) interior wellheads (A7L0503E and A7L0602E) with landfill gas temperatures greater than the operating criterion specified in Air

Operating Permit 10138 (131°F). Temperature, along with nitrogen and/or oxygen, are monitored as indicators of potential excess air infiltration into the landfill. Neither nitrogen nor oxygen concentrations measured at the time of elevated temperature readings indicated excess air infiltration. Subsequent monitoring showed that landfill gas temperatures in A7L0602E dropped below the operating criterion. Temperatures in A7L0503E continued to hover in the mid-130's °F.

The corrective actions taken were: 1) KCSWD began monitoring daily wells A7L0503E and A7L0602E that showed elevated measurements of landfill gas temperatures greater than the operating criterion specified in Air Operating Permit 10138 (131°F). KCSWD also monitored carbon monoxide and all data showed no indication of air intrusion or combustion. The supplemental monitoring showed that temperatures in A7L0602E had fallen below 131 °F, and thus no further action was warranted in this location. Supplemental monitoring continued at A7L0503E and except for temperature, all gas composition remained within normal ranges, so no immediate action or changes were made to the system operations. This wellhead was already in the process of being connected to a new header system in October 2021 and was monitored closely to determine how gas temperatures responded. A7L0503E remained elevated in temperature but all gas composition operated in normal conditions until the well was attached to a new header. Once this work was performed the well no longer had elevated temperatures (consistently below 131 °F), and thus no further action was warranted in this location.

- September 17, 2021: A power outage on September 17, 201 resulted in an inability to measure temperature on a continuous basis during low-BTU flare operation. CHRLF Title V Operating Permit 10138 requires that the South Solid Waste Area passive gas flare landfill gas shall not be allowed to vent from the open flare without combustion and the control system shall shut the supply valve to the open flare whenever the temperature sensed by the thermocouple falls below 200 °F or corrective action is required.

The corrective actions taken were: 1) KCSWD operated the low-BTU flare intermittently for troubleshooting purposes over the next several days. When the low-BTU flare was not in operation, all landfill gas was routed to the North Flare Station for burning or was directed to the gas-to-energy facility co-located with the landfill. Thus, the low-BTU flare malfunction resulted in no excess emissions that KCSWD is aware of. KCSWD monitored flare temperature on a periodic basis. The operating temperature of the low-BTU flare remained in compliance with the requirements of AOP No. 10138 during the periodic temperature sampling. The programming issue was resolved on September 27, 2021, enabling a return to normal operations of the low-BTU flare, thus no further action was warranted in this location. Additionally, on Monday October 25, 2021, SWD installed a new Universal Power Supply (UPS) to mitigate loss of programming during power supply interruptions.

Additionally, on August 5, 2021, KCSWD submitted a Notice of Construction Application to PSCAA for installation of a new low-BTU flare at the Cedar Hills Regional Landfill. If

approved, the new low-BTU flare will provide a dependable primary system and the existing low-BTU flare system will become secondary, for use if/when the primary system should go offline.

- September 20, 2021: A cover penetration point emission exceedance of 500 ppm was detected in the north-east side of the Main Hill Area on September 20, 2021. CHRLF Title V Operating Permit 10138 requires that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were: 1) The source of elevated methane at E-31 was identified as a damaged polyvinyl chloride (PVC) T-connection. The damaged section of pipe was replaced with a new PVC T-connection and secured with PVC cement. Additionally, KCSWD replaced a length of flexible hose at this location as a preventive action from future damage. Subsequent 10-day and 30-day surface emission checks were conducted at the same cover penetration location on September 30, 2021 and October 20, 2021. Monitoring results of methane concentrations of 48 ppm (September 30, 2021) and 2.5 ppm (October 20, 2021) indicated a return to compliance. Thus, no further action was warranted in this location.

- September 21, 2021: A cover penetration point emission exceedance of 600 ppm was detected in the north-west side of Area 5 near gas extraction well A5IW03 on top of the edge slope on September 20, 2021. CHRLF Title V Operating Permit 10138 requires that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were: 1) KCSWD began an initial investigation to find the source of 600 ppm methane at A5IW03 landfill gas line, which was the exposed at the boot. An immediate field investigation found gaps between linear and the LFG line where the boot is clamped around the LFG line in the linear. This is a common phenomenon due to the regular landfill settlement which resulted in loose sealing between the boot and the linear. Utility crews excavated the ground and the LFG crew cut out the damaged linear section and replaced with a new linear section and re-fused with sealant between the HDPE well pipe and boot. Subsequent 10-day and 30-day surface emission checks were conducted at the same cover penetration location on October 1, 2021 and October 21, 2021. Monitoring results of methane concentrations of 2.3 ppm (October 1, 2021) and 3 ppm (October 21, 2021) indicated a return to compliance. Thus, no further action was warranted in this location.

- December 18, 2021: Five (5) discrete cover penetration exceedances occurred in Area 4 on December 18, 2021 with values greater than 500 ppm. The following cover penetration points where detections exceeding 500ppm were: 4ILSC016, WWCL0002, 4WCHDRMH, 4WFC2206, and 4WFC1343. CHRLF Title V Operating Permit 10138 requires that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were: On December 18, 2021, the LFG crew performed source investigation by visual inspection in the vicinity of each exceedance location. The visual investigation did not reveal sources that could reasonably explain the exceedances that were

detected. Additional informative samples were collected on December 21, 2021, three days after the initial exceedances in LFG line 4WFC2206. The reading was less than 100 ppm. Subsequent 10-day and 30-day surface emission checks were conducted at all five cover penetration locations on January 3, 2022 and January 17, 2022, respectively. All methane concentrations measured during the 10-day check and the 30-day check were 0 ppm at all locations. Low barometric pressure may have contributed to some extent toward the methane exceedances that occurred in Area 4 on December 18, 2021 and KCSWD was able to show through the 10-day and 30-day checks that no further detection occurred. Thus, no further action was warranted at these locations at this time.

- December 23, 2021: One surface methane emission exceedance detected at 7,000 ppm occurred in Area 7 near a gas extraction well A7L0205E on December 23, 2021. CHRLF Title V Operating Permit 10138 requires that methane surface emission limit should be less than 500 ppm or corrective action is required.

The corrective actions taken were: 1) On December 23, 2021, a visual check and visual investigation of the LFG well head and area near the landfill gas well A7L0205E. No visual damage was observed during the initial investigation. A subsequent 10-day surface emission check on January 7, 2022, showed a methane concentration of 10 ppm. A subsequent 30-day surface emission check on January 22, 2022, showed a methane concentration of 3,000 ppm. Further field investigation, resulting in some excavation work on January 22, 2022, revealed a failed boot around the riser for A7L0205E. Repairs were conducted on the boot around the well and completed on January 24, 2022. Post-repair monitoring on January 24, 2022 indicated a surface methane emission concentration of 0 ppm. Thus, no further action was warranted in this location at this time.

Formal enforcement documents received in 2021 from PSCAA included:

- Notice and Order of Civil Penalty No. 21-0017CP
 - PSCAA issued this enforcement document subsequent to Notice of Violation (NOV) 3-A000090 (issued in November 2020). The Notice and Order identified two separate days in January 2019 when KCSWD operated enclosed combustion flares below permissible temperatures. Both low-temperature events were self-reported to PSCAA in the form of deviation reports, as required.

8.1.5 Independent Remedial Action

KCSWD 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. KCSWD issued a Remedial Investigation/Feasibility Study (RI/FS) in December of 2016. EPZ Phase 1 Interim Actions were completed in June of 2020. Work completed included on-going monitoring of the six (6) new groundwater monitoring wells, as well as the additional landfill gas wells that were installed in 2018 in the EPZ. Preparation for Phase 2 of the EPZ RI/FS project is currently in the planning stages.

8.1.6 2021 Leachate Forcemain/Pipeline Repair

In September of 2020, CHRLF personnel identified a flow restriction in the forcemain/gravity pipeline that conveys leachate effluent from CHRLF to the King County Wastewater Treatment Division South Treatment Plant in Renton, WA. The flow restriction impaired CHRLF's ability to discharge leachate normally. KCSWD investigated the cause and location of the flow restriction over a 3-week period and completed repairs in mid-October 2020. During the course of repair, three (3) separate leachate releases occurred from the pipeline outside the property boundary of the landfill. Immediate action was taken by KCSWD to halt and remedy these releases. Further evaluation and restoration work was completed by KCSWD in 2021 under the guidance of WDOE (WAC 173-303-145). The leachate forcemain/gravity pipeline returned to full operational status when the blockage was removed and has functioned as designed since repairs were completed.

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. While the ditches ultimately connect to the Cedar River, the underlying geology is highly infiltrative, resulting in the infiltration of stormwater discharging from CHRLF long before it reaches the Cedar River. Monitoring station GS1 monitors 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.

The CHRLF also has a CSGP for the Area 8 construction activities. Four discharge points are monitored in compliance with the CSGP. The four monitoring locations are: C-1 at the northwest end of the site downstream of the northwest siltation pond; C-2 at the northeast end of the site, downstream of the north stormwater pond; C-3 at the southeast part of the site, downstream of the south stormwater lagoon and upstream of the bioswale; and C-4 at the southwest part of the site, downstream from the southwest siltation pond. All CSGP monitoring points discharge into the ISGP monitoring locations.

Under the CSGP, inspections are performed of any areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site, during active construction. In accordance with the permit, monitoring and sampling was reduced to a monthly schedule due to construction inactivity in the winter of 2021. Construction activity resumed April 25, 2021 and continued through the end of 2021, with weekly and/or daily monitoring occurring as per the permit. Monitoring is required for turbidity and for pH if more than 1,000 cubic yards of concrete is poured (no monitoring for pH occurred in 2021). Additionally, as referenced earlier in this report, CSGP coverage was transferred in its entirety to GBI, the Area 8 contractor, in April 2021.

Exceedances for the turbidity monitoring benchmark value per the CSGP for 2021 are summarized in the table below.

**SUMMARY OF 2021 STORMWATER MONITORING DATA
THAT EXCEEDED CSGP CRITERIA (Turbidity)**

Date	Turbidity Measurement by Monitoring Location (NTUs)			
	C1	C2	C3	C4
1/15	<25 or NS	<25 or NS	36.9	26.1
2/16	<25 or NS	<25 or NS	26.5	<25 or NS
2/17	<25 or NS	<25 or NS	31.5	<25 or NS

NTU = Nephelometric turbidity unit
 NS = Not Sampled

 = criteria exceeded

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

When turbidity exceedances occurred, the effectiveness of the existing stormwater BMPs were evaluated, and modifications were made to improve erosion and sediment controls.

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 thirty-two (32) 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 excellent monitoring coverage for all flow paths within the potential source area.

An extensive list of chemical analytes and field parameters are analyzed, and the results are 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 profoundly affected by conditions and activities that have occurred on the adjoining QCF property. Upgradient groundwater quality is variable and subject to surface activities occurring near the recharge zone. Coincidental with major clearing and grading activities on the QCF property, increasing trends for several key water quality indicator parameters began in 2011 and have continued through 2021.

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 influenced by the presence of LFG 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 are consistent with an input from onsite, overlying infrastructure in the north end. Concentrations have declined and stabilized since maximum levels were reached in 2008-2010. Dispersion along the flow path is apparent in other wells.

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 certain analytes occur in upgradient wells. Groundwater in the regional aquifer leaving the site has no exceedances of primary drinking water standards, with the exception of MW-68 and MW-87 for total arsenic in the first and fourth quarters of 2021, respectively. MW-68 and MW-87 are both located in the northeast portion of the site and are downgradient of the landfill. These wells (and all wells at CHRLF) will be assessed for suitability and representativeness of regional groundwater conditions in an upcoming sitewide project to update the existing sitewide hydrogeologic report and model and will be rehabilitated and/or replaced as necessary per the findings of the project.

MW-67, also located in the northeast portion of CHRLF, was investigated in December of 2020 by KCSWD and a licensed consultant hydrogeologist, with the intention of redeveloping the well. During the course of 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 will be decommissioned, and a replacement well drilled adjacent to the existing wellhead in a future project. In the interim, MW-67 continues to be sampled until a replacement well is approved and 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 chlorinated volatile organic compounds to occur as groundwater flows from the south property line to the north-northeast. Recent water quality evaluations of QCF groundwater are 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 KCSWD. 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 2021, MW-93 was the only monitoring well at CHRLF that experienced a 3-of-3 prediction limit exceedance (total arsenic). All PL exceedances were below the Primary Federal Drinking Water Maximum Contaminant Levels (MCLs) 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). KCSWD is in the process of updating the permit for Background Threshold Value (BTV) calculation for the Cedar Hills and vicinity areas. The program 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 will set a more representative background value to compare arsenic, iron, and manganese concentrations in the Cedar Hills region.

At this time, no additional actions are underway to address the 3-of-3 prediction limit exceedances for total arsenic at MW-93. Further information can be referenced in Attachment F of this annual report.

8.4 Evaluation of Landfill Gas Monitoring Data

During 2021, no exceedance of the methane regulatory limit occurred in any of the compliance migration monitoring probe

Methane was detected in multiple interior monitoring probes, ranging from 1 to 6 interior probes in each month of 2021 by more than five 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.

All LFG monitoring data for 2021 for the perimeter compliance probes, interior 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, gray water, sewage, and BEW process wastewater). Following aeration, the combined wastewater discharges to the King County sewerage system pursuant to a Waste Discharge Permit No. 7842-03 issued to KCSWD 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 KCSWD 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 in 2021 was 2.7 million gallons per day. There were no exceedances of this permitted discharge volume in 2021.

8.5.2 Wastewater Monitoring Analytical Data

Waste Discharge Permit No. 7842-03 lists several effluent limitations and self-monitoring requirements. In 2021, wastewater monitoring analytical data indicated exceedances of the following limits:

- Total loading limit for Arsenic: 0.27 pounds per day
- Soluble Sulfide Screening Level: 0.1 parts per million (ppm)

- Atmospheric Hydrogen Sulfide (H₂S): Short-Term Limit of 15 ppm as a 15-minute average

There were multiple exceedances of the arsenic loading limit throughout the year. There were four (4) soluble sulfide screening level exceedances. One exceedance of the short-term H₂S limit was measured at Maintenance Hole R10-52 on October 3, 2021. All other results met permit-specified limits.

All wastewater and leachate monitoring analytical data is included in Attachment F. SMRs submitted to KCIW in 2021 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 as a result of operational impacts, including one (1) station that was covered with Area 8 excavation soils in the summer of 2017. There are currently eight (8) 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 zero (0) percent to nearly four (4) percent of total refuse thickness for different settlement monitoring locations over time. Settlement at all stations monitored in 2021 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 Reports

Attachment I – Wastewater Discharge Self-Monitoring Reports