CEDAR HILLS REGIONAL LANDFILL
2015 ANNUAL REPORT

King County
Department of
Natural Resources and Parks
Solid Waste Division

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

www.kingcounty.gov/solidwaste

March 2016

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MARCH 2016

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2016 ANNUAL REPORT
CEDAR HILLS REGIONAL LANDFILL

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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 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, three miles north of Maple Valley, six miles east of the City of Renton and about 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); a right-of-way for a natural gas pipeline and numerous power transmission line rights-of-way.

Filling operations are continuing in Area 7. Area 7 is anticipated to have capacity through early 2019. Design of Area 8 is in the design phase.

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;
- Changes to landfill operations; and,
- Environmental monitoring program, including a summary of groundwater, surface water, 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 (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. The Washington Department of Ecology (WDOE) form required for submittal of this report is included in this section.

The 2016 Permit Renewal Application is included as Attachment A.

SECTION 2 - FACILITY INFORMATION

Required Facility information on forms provided by Ecology is contained in Attachment B.

Significant Facility Activities which occurred in 2015 are the relocation of waste from the South Solid Waste Area to Area 7, and the placement of interim and final cover over exterior slopes of Area 7.

Significant Facility Activities planned for 2016 are: the relocation of stormwater and contaminated stormwater facilities from the future Area 8 footprint to a location to the south; construction of a new landfill gas delivery pipeline along a new alignment from the North Flare Station to the Bio Energy Washington Facility; and design activities for Area 8. Also, in 2016, KCSWD will continue to review Site Development Plan Alternatives for extending the life of CHRLF.

SECTION 3 - LANDFILL CAPACITY AND LANDFILL DEVELOPMENT STATUS

Currently, Cedar Hills has built capacity remaining in three areas (Area 5 – 936,344 cubic yards, Area 6 – 973,358 cubic yards, and Area 7 – 3,426,325 cubic yards) totaling 5,336,027 cubic yards. These capacities are based upon the difference between existing landfill contours (February 23, 2016 Aerial Survey) and a planned final surface of these areas at a maximum elevation of 788 feet above mean sea level. Attachment D provides the backup information for calculating capacity.

Efforts are underway to optimize the use of this remaining built capacity. These include decreasing the amount of airspace consumed by disposal and recovering airspace gained due to settlement.

The amount of airspace available for disposal is impacted by airspace consumed by daily cover and road construction. The use of tarps for alternative daily cover, and the recovery of rock used for roads increases the airspace available for disposal. Additionally, mechanical compaction increases the airspace available for disposal.

As the landfill ages, it settles. Airspace from settlement can be recovered for disposal. Settlement occurs due to consolidation and to loss of mass from leachate and more importantly gas production. As gas is collected, it is removed from the landfill. The airspace gas once occupied consolidates and the landfill settles. Soil surcharge can be used to accelerate settlement. Areas 5 and 6 both have areas of soil stockpiled over them to accelerate settlement. This soil will be recovered later for other uses.

Cedar Hills has a planned capacity addition of 7,480,000 cubic yards for Area 8. Area 8 is currently in the design phase. Permitting and construction are planned to occur in 2017 and 2018.

The table below presents current and planned capacity in cubic yards and tons by area, as of February 23, 2016. It is based upon an airspace utilization of 1,600 pounds of refuse disposed per cubic yard of air space consumed, and an average yearly tonnage of 988,000 tons. 1,600 pounds per cubic yard is the airspace utilization achieved in Area 7 using current operational practices (compaction, daily cover usage, and rock recovery). See Attachment D for details.

Area	Capacity (cubic yards)	Capacity (tons)	Capacity (years)
5	936,344	749,075	0.8
6	973,358	778,686	0.8
7	3,426,325	2,741,060	2.8
Total 5, 6, and 7	5,336,027	4,268,822	4.3
8	7,480,000	5,984,000	6.1
Totals 5, 6, 7 and 8	12,816,027	10,252,822	10.4

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 surfaces have interim covers that will be maintained until the completion of the last remaining lifts.

STATUS OF LANDFILL AREAS[1]

Landfill Area	Closed Area Size (acres)	Open Area Size (acres)
Main Hill	84.4	0.0
Southeast Pit	9.6	0.0
South Solid Waste Area	30.6	0.0
Central Pit	5.5	0.0
Area 2/3	22.2	0.0
Area 4	60.4	0.0
Area 5	9.2 [2] 37.1 [3]	31.4
Area 6	25.18 [2] 37.4 [3]	30.1
Area 7	2.9 [2] 9.2 [3]	50.1
Area 8	Not Developed	Not Developed

1. Areas are net final cover plan view surfaces or as otherwise noted.
2. Final cover surface area.
3. Interim final cover surface area.

SECTION 4 - FINANCIAL ASSURANCE ANALYSIS

The 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% 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. In 2015, the LRF contribution was $12.35 per ton from January 1, 2015 to November 30, 2015 and increased to $16.76 per ton effective December 1, 2015. In addition to the requirements of Washington Administrative Code 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 the revised new area development cost estimates.

The LRF includes all currently identified projects and funds for unidentified projects further in the future. The post-closure maintenance estimate is based on current costs for maintenance of the systems and is reviewed annually. The review considers whether there have been changes to the environmental control systems that would lead to changes in maintenance costs and any changes to current costs of maintenance. The review for this report did not identify any maintenance cost changes from the previous year's reports. The total project cost of post closure maintenance is then inflated to current year dollars and is used to forecast the future costs as described below. The detailed estimate from previous years is included in Attachment E.

Based on recommendation of King County Auditor's Office, the KCSWD uses the King County Office of Economic and Financial Analysis (OEFA) forecast for the both inflationary assumptions, and likely future investment return interest rates.
The current LRF rate is based on current status at the time the rate was adopted, including:

[a] The current tonnage forecast;

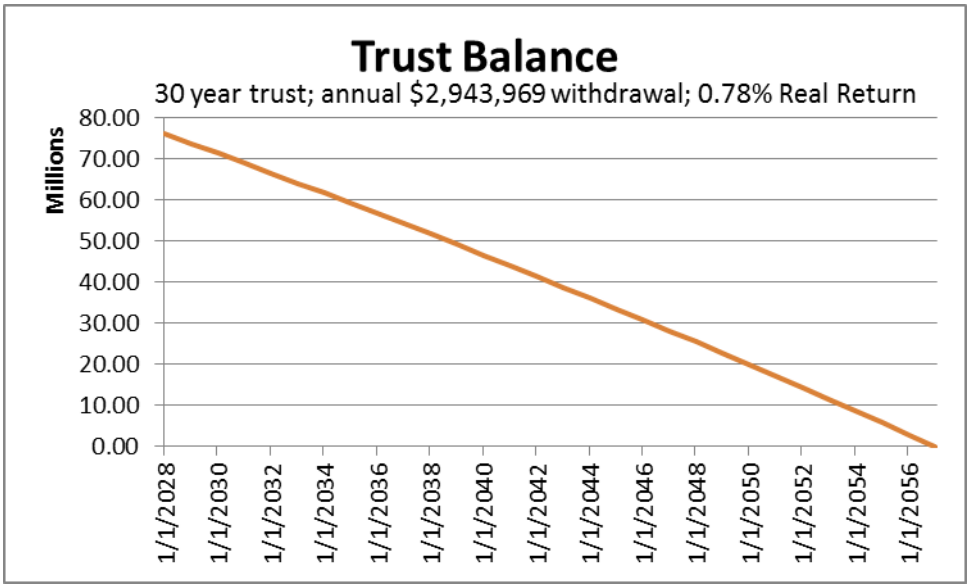
[b] The current interest rate set by OEFA, which is updated throughout the year;

[c] The projected costs in each future year, for Closure, New Area Development, and Facility Improvements;

[d] The assumption that waste receipt will stop in June of 2027, and final closure completed in 2029;

[e] The prediction from the previous year that the requirement, at the completion of final closure will be $2, 943,969 (2015 dollars) per year to maintain the landfill for 30 years For a total of $87.5 million ($2,917,319 per year times 30 years) in expenses over the closure period. Refer to Attachment E to this report for detailed itemizations of cost and inflationary assumptions; and,

[f] This $87.5 million in total spending can be sustained over a 30-year period with a trust fund of about $78 million invested in government-backed securities paying a real (after inflation) rate of return of 0.78%, as of December 2027.



The closure costs are forecast based on historical per acre costs. The schedule of activities for area closures is provided in Attachment E. The forecast cost for corrective action includes in the near years the forecasted costs for currently planned activities. The forecast cost of unplanned future activities is included at a flat rate of $200,000 annually. The Post Closure Maintenance estimate used in the 2012 Rate Request was reviewed for 2015 and is included for this report. This estimate is reviewed annually for any significant changes.

SECTION 5 - WASTE DISPOSAL QUANTITIES

The CHRLF received an average of 2,383 tons of municipal solid waste a day in 2015. Detailed information can be found in Attachment B.

SECTION 6 - SUMMARY OF 2015 GROUNDWATER, SURFACE WATER, LEACHATE AND LANDFILL GAS MONITORING PROGRAM AND 2016 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 the *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill* and in Attachment F of this annual report. Thirty six (36) groundwater monitoring wells are used for monitoring groundwater elevations and geochemical sampling in the regional aquifer, and nine (9) for monitoring the perched saturated zones. Five (5) 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 down-gradient of, or lateral to, waste placement areas. Background characterization wells are located up-gradient of waste placement areas.

6.2 Summary of Surface Water Monitoring Program

The surface water monitoring program is also described in the *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill.* The goals of this program include the following elements:

- Monitor changes in water quality;
- Verify the effectiveness of leachate management facilities in controlling leachate discharges to surface water;
- Monitor the effectiveness of Best Management Practices (BMPs) per the Stormwater Pollution Prevention Plan (SWPPP); and
- Evaluate compliance with the Industrial Stormwater General Permit.

Surface water quality is monitored at twelve (12) strategic locations around the landfill. Surface water samples are collected monthly for characterization. CHRLF is covered by the State Industrial Stormwater General Permit (ISGP), which establishes monitoring requirements and benchmark values for several parameters. Three (3) discharge locations are monitored quarterly for compliance with the ISGP. Permit compliance monitoring locations are at N4 at the north end of the landfill, GS1 at the south end and SL3 at the discharge of the bioswale along 228th Avenue Southeast. Field and analytical surface water data are included in Part 7 of Attachment F.

6.3 Summary of Leachate Monitoring Program

Leachate is analyzed for characterization and compliance with Wastewater Discharge Permit No. 7842-02. Leachate is sampled monthly at four stations for characterization and monthly at the Leachate Effluent Pump Station wet well for compliance with permit conditions. Leachate characterization is a critical component of detection monitoring, enabling the detection of any potential for groundwater contamination by leachate. Leachate characterization also serves to assess pretreatment needs prior to discharge and to evaluate the effectiveness of pretreatment. Characterization includes all analytes that groundwater is analyzed for plus several analytes specifically related to wastewater characterization and treatment. Permit compliance samples are analyzed for metals concentrations to monitor compliance with discharge permit requirements and to calculate loadings.

Self-monitoring discharge permit reports are generated monthly and submitted to the King County Wastewater Treatment Division. 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 measure LFG composition and pressure (see Attachment E). In general, there are two categories (defined by function) of probes at the CHRLF. Migration Monitoring Probes are primarily intended to verify that methane concentrations at the property boundary are not exceeding the lower explosive limit (LEL) for methane (typically 5 percent, by volume) and whether subsurface LFG is migrating into surrounding native soils. Interior LFG Monitoring Probes are used to evaluate and manage the performance of the LFG collection system and will indicate if any operational adjustments to the system are required.

Monitoring Probe Network: The installation history of the LFG monitoring probes at the CHRLF was described in the 2005 CHRLF Annual Report. The probes are either single or multiple completion probes. Information on the location, elevation, and installation date, and a description of each probe is provided in the Monitoring Plan figure included in Attachment G. Parameters typically measured at the LFG monitoring probes include methane, oxygen and carbon dioxide concentrations and static pressure. Monitoring is performed quarterly for compliance with WAC 173-351, and monthly for operational indicators. Monitoring data results are included in Attachment G. Results from LFG migration monitoring for 2015 are discussed in Sections 8.1 and 8.3 of this report.

Cedar Hills Buildings as well as Passage Point Buildings are also monitored for methane. There were no detections in 2015 of methane above 3 parts per million (ppm). The regulatory limit is 100 ppm.

6.5 Environmental Monitoring Program for 2016

Effective January 1, 2016, KCSWD is implementing the *Environmental Monitoring Sampling and Analysis Plan for Cedar Hills Regional Landfill* (SAP) (December 31, 2013), as approved by Public Health – Seattle and King County (PHSKC) and the Washington State Department of Ecology (WSDOE in 2015. The updated SAP outlines current monitoring programs designed to comply with the requirements of Chapter 173-351 WAC as well as other applicable environmental regulations and permits, including wastewater discharge permits and stormwater permits.

Changes to the environmental monitoring program include:

- Decommissioning of five (5) monitoring wells in conjunction with the removal of the South Solid Waste Area and in anticipation of the development of Area 8;
- Reclassification of redundant monitoring wells;
- Modified sampling frequency for select groundwater monitoring wells;
- Enhanced statistical evaluation for the protection of groundwater quality; and
- Modifications to the stormwater monitoring program to better align with requirements in the Industrial Stormwater General Permit (ISGP).

If and when further changes to the SAP are deemed appropriate, KCSWD will seek approval of such changes from PHSKC and WSDOE.

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 earned SWANA Landfill Certification as Manager of Landfill Operations (MOLO) are listed below in the table below.

MOLO Certifications

NAME	TITLE	DATE OF CERTIFICATION
John Hills	Lead Equipment Operator	Certified through April 2018
Lenny Kuzaro	Lead Equipment Operator	Certified through April 2018
Rusty Bogart	Landfill Gas Operator	Certified through February 2017
Nigel White	Special Projects Manager	Certified through June 2016
Wally Grant	Landfill Gas Supervisor	Certified through 2016
Shawn Carter	Transportation Supervisor	Certified through October 2017
Scott Barden	Landfill Operations Manager	Certified through October 2017
Bill Berni	Operations Manager	Certified through July 2018

SECTION 8 - EVALUATION REPORTS

8.1 Summary of Emergency or Corrective Actions Taken in 2015

8.1.1 Surface Water Corrective Action

Select stormwater monitoring results in 2015 exceeded benchmarks established in the ISGP issued to the CHRLF. The benchmark for turbidity was exceeded in the first and third quarters of 2015 and the benchmark for copper was exceeded in the first quarter for 2015. KCSWD's response to these benchmark exceedances focused on enhanced maintenance of existing stormwater BMPs and preparation for the construction of a new stormwater treatment and flow control pond (construction planned for summer 2016). For more information, refer to Section 8.2

8.1.2 Wastewater Discharge Permit Corrective Action

As discussed in Section 8.5, KCSWD initiated corrective actions in response to recurring arsenic loading exceedances in wastewater discharged from CHRLF in 2015. This is further discussed in Section 8.5.2.

No other emergency or corrective actions were taken with respect to the Wastewater Discharge Permit issued to the CHRLF in 2015.

8.1.3 Inspection Reports and Corrective Actions

In 2015, PHSKC inspected CHRLF five times; all inspections were deemed satisfactory. No emergency or corrective actions were taken in response to inspection reports.

KCSWD identified and repaired a small leachate seep that occurred on the north side of the haul road between Areas 5 and 7 in December 2015. PHSKC was notified of the seep and its repair.

8.1.4 Title V Air Operating Permit Deviation Reports

KCSWD reports deviations from the Title V Air Operating Permit by submitting Deviation Reports to the Puget Sound Clean Air Agency (PSCAA) if they occur. The Title V Air Operating Permit establishes a standard for air intrusion for the landfill gas collection system. The standard for air intrusion is that oxygen concentration should be less than 5 percent. There were two deviations from oxygen standards in 2015: one at A5UC001W in January 2015, and the other at A61W4005 in March 2015. These deviations were short term and corrected by adjusting valve positions.

An additional deviation occurred on December 23, 2015 for flare operating temperature. Flare No. 5 at the North Flare Station operated around 1,100 degrees Fahrenheit for 12 hours which is lower than the permitted (1,418 degrees Fahrenheit) established in an August 2015 Stack Test. The root cause of the failure to reach permitted operating temperature was insufficient gas to Flare No. 5 caused by seizure of one of three operating blowers at the North Flare Station, and temporary seizures of the two standby blowers. Repairs on one standby blower were completed on the same day. The seized operating blower has been since rebuilt. The second standby blower is planned to be replaced by a new blower.

8.1.5 Independent Remedial Action

KCSWD is proceeding with and Independent Remedial Action with respect to the East Perched Zone under the Model Toxics Control Act (MTCA) in accordance with WAC 173-340-510 and 173-340-515. KCSWD is preparing a Remedial Investigation/Feasibility Study (RI/FS) with consultation from WSDOE. Data collected during this effort in not presented in this annual report.

8.2 Evaluation of Surface Water Monitoring Data

The CHRLF operates under a National Pollutant Discharge Elimination System (NPDES) ISGP, number WAR000756. Three (3) discharge points are monitored in compliance with the ISGP. These points are N4 to the north, GS1 in the south, and SL3 along 228th Avenue SE.

Under the ISGP, quarterly sampling is required for the following twelve (12) parameters: BOD, 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. Actual monitoring includes quarterly monitoring for these analytes at these three locations, as well as monthly monitoring for additional analytes at all locations. Field and analytical surface water data is 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.

Exceedances of the ISGP for 2015 are summarized in the table below.

SUMMARY OF 2015 STORMWATER MONITORING DATA
THAT EXCEEDED ISGP CRITERIA

	Sample Period	Sample Result	Unit	Criteria Exceeded		
				Benchmark	Effluent Limit	
				Quarterly Average	Monthly Average	Daily Maximum
	Sample Location: N4					
2015	Q1	Cu = 14.39	ug/L	14	--	--
2015	Q2	No exceedances*				
2015	Q3	No exceedances				
2015	Q4	No exceedances				
	Sample Location: GS1					
2015	Q1	TSS = 44.5	mg/L	--	27	88
2015	Q1	Turb = 81	NTU	25	--	--
2015	Q2	No exceedances*				
2015	Q3	Turb = 127	NTU	25	--	--
2015	Q4	No exceedances				
	Sample Location: SL3					
2015	Q1	No exceedances				
2015	Q2	No exceedances				
2015	Q3	No exceedances				
2015	Q4	No exceedances				

Notes:

= exceedance

TSS = total suspended solids

Turb = turbidity

Cu = copper

ug/L = micrograms per liter

mg/L = milligrams per liter

NTU = Nephelometric turbidity unit

-- = not defined

* = inadvertently omitted alpha-terpineol, benzoic acid, p-cresol, & phenol analyses

8.3 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 more than 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 entirely recharged 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 completed for the site and indicates a complex flow regime in the landfill vicinity

A monitoring network is in place consisting of forty-one (41) monitoring and production wells. Monitoring network wells are 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 if 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 manifests a high degree of spatial variation and temporal trends, which are expected given recharge area site history which has included a variety of land uses, investigations and remediation.

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 footprint and immediately downgradient of waste cells are influenced by LFG in the unsaturated strata. Flow paths in the north landfill area (aligned along MW-66, MW-74, MW-75 and MW-85) are notably higher in chloride concentrations. The data are consistent with an input from onsite, overlying infrastructure in the north end. Concentrations have declined since maximum levels were reached in 2008-2010 in MW-74. Dispersion along the flowpath is apparent in other wells.

Downgradient groundwater quality also manifests a high degree of spatial variation and 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 quality in the regional aquifer leaving the site remains consistent with historical data.

These data indicate that CHRLF acts as an attenuation zone for upgradient impacts, allowing a reduction in the concentration of chlorinated volatile organic compounds (CVOCs).

Site hydrogeological reports and supporting documentation identify the regional aquifer is the first continuously saturated zone beneath the landfill and serves as the earliest path for detection monitoring. Recent water quality evaluations of QCF groundwater are available in the *2010 Expanded Hydrogeology Assessment Queen City Farms King County, Washington*, (December 2010) and *Report Evaluation of Remedial Action 10-Year Review Queen City Farms King County, Washington* (2008).

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 zone wells. 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. Additional investigations are underway to evaluate residual impacts and make recommendations. Recent findings are available in the Technical Memoranda *Results of Groundwater Sampling and Fate and Transport Analysis South Solid Waste Area Perched Zone Assessment,* April 2010, and the *East Main Hill Perched Zones*, October 2010.

8.4 Evaluation of Gas Monitoring Data

See Attachment G for LFG probe monitoring data. According to WAC 173-351-200 (4) (a), the concentration of methane gas generated by the facility shall not exceed 25 percent of the lower explosive limit (LEL) for methane in facility structures (excluding gas control or recovery system components), exceed the LEL for methane at the facility property boundary or beyond, or exceed 100 ppm by volume of methane in off-site structures.

The LFG compliance monitoring probes (LFG migration monitoring probes) are located along the perimeter of the landfill as shown in Attachment G. The rest of the probes are used to monitor LFG levels in the interior of the landfill and for transitional evaluation of LFG collection and extraction-specific facilities.

KCSWD has historically monitored landfill gas on a monthly or quarterly basis for compliance with WAC 173-351. In addition to this compliance monitoring, additional monitoring has occurred at the perimeter and interior probes to provide information to the LFG extraction system operators. All the monitoring data for the year for the perimeter compliance probes is included in Attachment G.

Cedar Hills Buildings as well as Passage Point Buildings are also monitored for methane. There were no detections in 2015 of methane above 3 ppm. The regulatory limit is 100 ppm.

8.5 Evaluation of Wastewater Monitoring Data and Volumes Generated

Leachate collected throughout the landfill is routed to the Leachate Effluent Pump Station (LEPS) where it mixes with other, smaller sources of wastewater at CHRLF (e.g., contaminated stormwater, gray water, and BEW process water). Following aeration, the combined wastewater discharges to the King County sewerage system pursuant to a Waste Discharge Permit issued to KCSWD by the King County Industrial Waste Program (KCIW) (permit no. 7842-02).

8.5.1 Wastewater Volumes

The recorded volumes of wastewater discharged from the leachate aeration basins by way of the LEPS are indicated in the table below. The actual leachate volume generated within the landfill is not measured directly.

LEACHATE DISCHARGE DATA AND EXCEEDANCES FOR 2015

Month	**Flow** (million gallons)	**Daily Max Discharge Volume Exceedances** (limit = 2.7 million gallons per day)
January	19.5996	None
February	19.4755	None
March	16.5016	None
April	9.5569	None
May	6.1239	None
June	2.8986	None
July	1.7796	None
August	6.0775	None
September	6.3237	None
October	12.6941	None
November	32.2479	None
December	42.9810	None
Total	**176.2599**	**None**
Average/Month	**14.6883**	**0**

8.5.2 Wastewater Monitoring Data

A compilation of leachate monitoring data is included in Part 7 of Attachment F. All wastewater discharges from the LEPS in 2015 were in compliance with permit-specified effluent limits (volume, concentration, and loading) with the exception of arsenic exceedances described below. Waste Discharge Permit No. 7842-02 specifies effluent limits for total arsenic, but the permit does not require KCSWD to analyze for arsenic in our monthly samples. Periodically, KCIW will collect its own compliance samples and those samples are analyzed for arsenic. In June 2015, KCIW informed KCSWD that a sample they collected exceeded the loading limit for arsenic. In response, KCSWD investigated possible causes and initiated a series of operational changes with the goal of lowering the amount of arsenic discharged from LEPS.

Arsenic in leachate is not believed to be a product of the waste disposed of, but rather (like in groundwater) related to oxidation/reduction reactions of native soils containing arsenic. These native soils are used for daily cover and arsenic may by be released from them into leachate.

The initial and three (3) subsequent exceedances were attributed to elevated arsenic concentrations in leachate that resulted from exceptionally dry weather conditions (precipitation tends to dilute leachate). To combat rising arsenic concentrations in leachate (and therefore, in the combined wastewater loading), KCSWD limited the volume of wastewater discharged in a given day to the maximum extent feasible by limiting the duration of wastewater pumping from LEPS. By summer's end, the concentration of arsenic was sufficiently elevated that wastewater pumping was restricted to approximately an hour per day. KCSWD is continuing to investigate methods of reducing arsenic loading.

The LEPS has a finite capacity for holding and treating wastewater at CHRLF and discharge can only be restricted to a point before significant environmental and property damages occur. In 2015, when the need to pump wastewater from CHRLF exceeded the restricted pumping limits established for compliance with arsenic loading limits, KCSWD discharged as needed and documented the reason for doing so (e.g., lowering leachate ponds in advance of predicted rain event).

8.6 Landfill Settlement

Settlement Monitoring at CHRLF began in 1992, and by 2005 seven (7) monitoring locations had been established. More stations were added in 2007, while others were abandoned as a result of operational impacts. The total number of stations is currently nine (9). Annual Settlement, which is in part dependent on refuse thickness as well as time, has varied from 0.18% to 3.79% of refuse thickness. Total settlement at all stations in 2015 was variable, with settlement rates varying from 0.3% to 0.6%. It is anticipated that landfill settlement will continue, with older landfill areas settling at a comparatively lower rate.

SECTION 9 - ATTACHMENTS

Attachment A – Permit Renewal Application

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