Chapter 15: Greenhouse Gases

This chapter presents an analysis of impacts on the generation of greenhouse gases (GHG) from implementation of any of the action alternatives for the Cedar Hills Regional Landfill (CHRLF) (HDR 2009e).

The GHG analysis focused on the energy consumption differences between the alternatives, including both the action alternatives and the No Action Alternative. Specifically, the GHG analysis examined the energy consumption differences for the KCSWD from continuing to operate CHRLF rather than rail exporting solid waste to an out-of-county disposal facility. The analysis did not compare GHG impacts between any of the action alternatives and other conversion technologies (i.e., waste-to-energy) due to the unknown extent and location of such technologies.

The analysis period used for the study was between the currently estimated closure date for CHRLF of 2018 and 2031 (the estimated closure date under Alternative 5, which would extend the life of the CHRLF farthest into the future). The GHG emissions analysis considered the following inputs:

- Solid waste tonnage forecasts for King County
- Additional landfill capacity (years of life) from each alternative
- Distances from King County (waste producer) to the out-of-county disposal facilities

The environmental review determined that there would be no significant unavoidable adverse impacts due to GHG emissions during construction or operation of any of the alternatives.

15.1 Affected Environment

Solid waste is currently collected from residential and non-residential customers throughout King County (except Seattle and Milton) and disposed at the CHRLF. According to current tonnage forecasts, the CHRLF is projected to reach capacity and close in approximately 2018 (under the No Action Alternative).

Waste generation in King County is projected to increase over the next 22 years as the county's population grows. However, the quantity of waste generated by each person (e.g., per capita) is expected to decrease as waste prevention and recycling programs become increasingly effective. The current projection of solid waste generation in King County is shown in (Table 1-2 in Chapter 1).

15.1.1 Methodology

For comparison purposes in this analysis, it was assumed that all of the forecasted solid waste tonnage shown in Table 1-2 would be landfilled either at the CHRLF or a disposal facility with comparable environmental protection systems and operations. Landfill space would need to be provided either at CHRLF or at another, out-of-county facility to meet King County's future disposal needs. Several alternative landfill facilities are potentially available to accept solid waste from King County. These potential landfills are listed in Table 15-1.

Table 15-1. Potential Locations for Out-of-County Landfill Disposal

Landfill Name	Location	Miles from Seattle	Total Permitted Capacity (tons)	Remaining Capacity (2009)	Estimated Closure
Active Landfills					
Columbia Ridge Landfill and Recycling Center	Gilliam County, OR	325	221,875,000	201,000,000	2135+
Roosevelt Regional Landfill	Klickitat County, WA	330	244,600,000	205,000,000	2075+
Finley Buttes Regional Landfill	Morrow County, OR	352	124,000,000[a]	117,000,000	2100+
Simco Road Regional Landfill	Elmore County, ID	628	210,000,000[b]	200,000,000+	2100+
Landfills Permitted, Not Operating					
Eagle Mountain Landfill	Riverside County, CA	1,325	708,000,000	708,000,000	2125
Mesquite Regional Landfill	Imperial County, CA	1,420	600,000,000	600,000,000	2110

[a] Finley Buttes has the potential to expand to a permitted capacity of 400 million tons.
[b] Simco Road Regional Landfill is currently expanding to a permitted capacity of 420 million tons.

Costs, both in terms of operating costs and energy consumption, of this replacement landfill space were assumed to be relatively the same for each landfill listed in Table 15-1. CHRLF currently operates a landfill gas collection system that reduces the amount of GHG that enters the atmosphere. For purposes of this analysis, it was assumed that similar systems are in place at each of the potential locations for out-of-county landfill disposal. It is not known which of the sites would ultimately be selected as an alternative to CHRLF, and comparing the efficacy of landfill gas collection and utilization systems at the various locations is beyond the scope of this analysis.

Haul distances from transfer stations to an intermodal railhead in King County, or from transfer stations to the CHRLF, were assumed to be about the same and, consequently, would not be a differentiating factor for the analysis. Three alternative landfills currently operate within 350 miles of CHRLF with sufficient capacity to accept King County solid waste. Therefore, this haul distance plus backhaul of empty containers was used for the analysis.

The analysis expects that all landfill capacity used for King County solid waste would be replaced with landfill space that meets current standards, and the financial costs of this replacement landfill space would be relatively the same for each landfill alternative.

This analysis assumed that rail would be used to transport King County solid waste to an alternative disposal site. Given the volume of solid waste generated in King County and the distance to alternative disposal sites, using rail containers to transport solid waste would consume less energy (CSX 2009) and is expected to be less expensive than transport via truck. Energy consumption estimates for rail haul are based on accepted industry factors, and GHG emissions are estimated based on energy consumption using industry-accepted factors.

15.2 Environmental Impacts

15.2.1 Direct Impacts

As described above, all of the relevant factors in this energy analysis are constant among the alternatives except the period over which solid waste would be exported from King County to an alternative landfill. Table 15-2 shows the added capacity of each alternative and number of years that solid waste would need to be transported from King County to an off-site location.

Table 15-2. Approximate Years of Waste Export Required Under Alternatives

Alternatives	Added Capacity (cubic yards)	Approximate Years of Waste Export
Alternative 1	4,700,000	10
Alternative 2	8,500,000	8
Alternative 3	12,100,000	4
Alternative 5	16,500,000	0
No Action Alternative	0	13

Table 15-3 shows the anticipated energy consumption for each alternative. As shown in Table 15-3, waste export can consume a substantial amount of energy and produce a large quantity of GHG emissions. The energy analysis concludes that extending the life of CHRLF would enable King County to dispose of solid waste closer to the source of waste and reduce energy consumption and the quantity of GHG emissions. Compared with the No Action Alternative, selecting Alternative 5 would save an estimated 12 million gallons of fuel (Table 15-3). In general, the longer the life of CHRLF could be extended, the less energy would be consumed and the less GHG emissions would be produced.

Table 15-3. Energy Consumption by Alternative

Alternative	Tons Transported	Ton Miles[1]	Fuel Consumed (gallons)[2, 3,4]	CO_2 Low Estimate[5] (Metric ton)	CO_2 High Estimate[6] (Metric ton)
Alternative 1	8,260,000	2,891,000,000	8,591,769	42,263	112,964
Alternative 2	5,600,000	1,960,000,000	5,824,928	28,653	91,530
Alternative 3	3,080,000	1,078,000,000	3,203,710	15,759	47,002
Alternative 5	0	0	0	0	0
No Action Alternative	11,550,000	4,042,500,000	12,013,914	59,096	144,243

1 Assumes transport distance of 350 miles. The Columbia Ridge Landfill and Recycling Center, Roosevelt Regional Landfill, and the Finley Buttes Regional Landfill are located within 350 miles of Cedar Hills.
2 Based on an average freight rail energy intensity of 330 British thermal units (Btus) per ton per mile. This is the current (2006) average for Class I freight railroads in the U.S.
3 Based on a conversion factor of 138,800 Btus per gallon of diesel fuel. (U.S. DOE 2009)
4 Includes adjustment for deadhead backhaul at 25 percent of loaded trains (Poulsen 2009)
5 Emission factors are based on the Center for Clean Air Policy Guidebook Emissions Calculator for freight trains.
6 Emission factor is from CSX Corporation. CSX Corporation is a rail freight company.
CO_2 = carbon dioxide

Alternatives 3 and 5 may include relocation of administrative and maintenance facilities to the southeastern part of the landfill site, requiring removal of up to 21 acres of forested land in the existing buffer. The analysis assumes that this acreage would not be available for conversion back to forest land for about 50 years because at least part of the facilities would remain in place during post-closure monitoring of the landfill. According to recent estimates (EPA 2009), an average increase in carbon dioxide (CO_2) of 4.4 metric tons per year results from a reduction of an acre of forest land. To calculate impacts at CHRLF, a somewhat higher estimate specific to Douglas fir of 5.13 metric tons of CO_2 (EPA 2009) was used. Table 15-4 presents total CO_2 increases by alternative for both energy consumption and loss of forested land. With the combination of CO_2 increases from both energy consumption and loss of forested land, the conclusion remains the same. The longer the life of CHRLF could be extended, the lower the impacts would be to GHG.

Table 15-4. Total CO_2 Increases by Alternative

Alternative	CO_2 Increase from Energy Consumption (Metric tons)		CO_2 Increase from loss of Forested Land (Metric tons)	Total CO_2 Increase (Metric tons)	
	Low Estimate	High Estimate		Low Estimate	High Estimate
Alternative 1	42,263	112,964	0	42,263	112,964
Alternative 2	28,653	91,530	0	28,653	91,530
Alternative 3	15,759	47,002	5,387	21,146	52,389
Alternative 5	0	0	5,387	5,387	5,387
No Action Alternative	59,096	144,243	0	59,096	144,243

CO_2 = carbon dioxide

Technological advances in rail engines over the last several decades have reduced the amount of energy required to move a ton of freight. These advancements have occurred as part of a greater societal trend to improve energy efficiency, largely a result of high petroleum prices and an ever-increasing demand for energy. These trends are expected to continue, impacting the emissions in the results predicted here.

As mentioned previously, the GHG analysis did not consider the differences in the landfill gas management systems (such as collection efficiency and end use of the collected landfill gas) between CHRLF and the potential out-of-county disposal landfills due to complexity in evaluating the number of variables and the availability of information on the other disposal landfills. It is likely that the landfill gas collection efficiency at the CHRLF equals, or exceeds, the collection efficiency of the out-of-county disposal facilities.

15.2.2 Indirect and Cumulative Impacts

Production of GHG associated with any of the alternatives, when combined with other global sources, could contribute to climate change.

15.3 Mitigation Measures

KCSWD has endeavored to reduce the production of GHG from CHRLF operations through various means, such as the installation and operation of state-of-the-art landfill gas management systems and installation of interim and final covers with geomembrane liner material. KCSWD would continue these measures under all of the action alternatives and also seek other ways of further achieving reductions in GHG emissions.

15.4 Significant Unavoidable Adverse Impacts

As shown in Table 15-3, exporting solid waste from King County to an out-of-county location would consume approximately 1 million gallons of fuel each year. In total, under the No Action Alternative more than 15 million gallons of fuel would be consumed versus Alternative 5 (during the additional 13 years that solid waste would be exported out of King County). Implementation of the No Action Alternative would result in greater GHG production than the GHG produced by any of the action alternatives. Conversely, fuel consumption would be less for all of the action alternatives as compared to the No Action Alternative. As shown in Table 15-4, CO_2 production would also be greatest for the No Action Alternative (which would not extend the current life of CHRLF). CO_2 production would be lowest for Alternative 5, which would extend the life of CHRLF the most.