Should anyone have a question regarding content in the appendices, please contact Betsy Varghese at bvarghese@dillon.ca to discuss.

Appendix A

Waste Quantity Projections

SF TONNES

Status Quo - SF Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	13,606	6,683	20,289	33%
2021	13,934	6,845	20,779	33%
2022	14,271	7,010	21,281	33%
2023	14,615	7,179	21,795	33%
2024	14,968	7,353	22,321	33%
2025	15,330	7,530	22,860	33%
2026	15,700	7,712	23,412	33%
2027	16,079	7,898	23,977	33%
2028	16,467	8,089	24,556	33%
2029	16,865	8,284	25,149	33%
2030	17,272	8,484	25,756	33%
2031	17,689	8,689	26,378	33%
2032	18,116	8,899	27,015	33%
2033	18,553	9,114	27,667	33%
2034	19,001	9,334	28,335	33%
2035	19,460	9,559	29,019	33%
2036	19,930	9,790	29,720	33%
2037	20,411	10,026	30,437	33%
2038	20,904	10,268	31,172	33%
2039	21,409	10,516	31,925	33%
2040	21,925	10,770	32,695	33%
2041	22,455	11,030	33,485	33%
2042	22,997	11,296	34,293	33%
2043	23,552	11,569	35,121	33%
2044	24,121	11,848	35,969	33%
2045	24,703	12,134	36,838	33%
2046	25,300	12,427	37,727	33%
2047	25,911	12,727	38,638	33%
2048	26,536	13,035	39,571	33%

35% Diversion - SF Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	13,606	6,683	20,289	33%
2021	13,919	6,860	20,779	33%
2022	14,240	7,041	21,281	33%
2023	14,567	7,227	21,795	33%
2024	14,903	7,418	22,321	33%
2025	15,246	7,614	22,860	33%
2026	15,596	7,815	23,412	33%
2027	15,955	8,022	23,977	33%
2028	16,323	8,233	24,556	34%
2029	16,698	8,451	25,149	34%
2030	17,082	8,674	25,756	34%
2031	17,475	8,902	26,378	34%
2032	17,877	9,137	27,015	34%
2033	18,289	9,378	27,667	34%
2034	18,709	9,625	28,335	34%
2035	19,140	9,879	29,019	34%
2036	19,580	10,140	29,720	34%
2037	20,030	10,407	30,437	34%
2038	20,491	10,681	31,172	34%
2039	20,962	10,962	31,925	34%
2040	21,444	11,251	32,695	34%
2041	21,938	11,547	33,485	34%
2042	22,442	11,851	34,293	35%
2043	22,958	12,163	35,121	35%
2044	23,486	12,483	35,969	35%
2045	24,026	12,812	36,838	35%
2046	24,578	13,149	37,727	35%
2047	25,143	13,495	38,638	35%
2048	25,721	13,850	39,571	35%

52.5% Diversion - SF Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	13,606	6,683	20,289	33%
2021	13,789	6,990	20,779	34%
2022	13,974	7,307	21,281	34%
2023	14,159	7,636	21,795	35%
2024	14,345	7,976	22,321	36%
2025	14,531	8,329	22,860	36%
2026	14,719	8,693	23,412	37%
2027	14,906	9,071	23,977	38%
2028	15,095	9,461	24,556	39%
2029	15,284	9,865	25,149	39%
2030	15,473	10,283	25,756	40%
2031	15,662	10,716	26,378	41%
2032	15,851	11,163	27,015	41%
2033	16,041	11,626	27,667	42%
2034	16,230	12,105	28,335	43%
2035	16,419	12,600	29,019	43%
2036	16,608	13,111	29,720	44%
2037	16,796	13,641	30,437	45%
2038	16,984	14,188	31,172	46%
2039	17,171	14,753	31,925	46%
2040	17,358	15,338	32,695	47%
2041	17,543	15,942	33,485	48%
2042	17,727	16,567	34,293	48%
2043	17,909	17,212	35,121	49%
2044	18,090	17,879	35,969	50%
2045	18,270	18,568	36,838	50%
2046	18,447	19,280	37,727	51%
2047	18,623	20,015	38,638	52%
2048	18,796	20,775	39,571	53%

70% Diversion - SF Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	13,606	6,683	20,289	33%
2021	13,659	7,120	20,779	34%
2022	13,708	7,573	21,281	36%
2023	13,750	8,045	21,795	37%
2024	13,787	8,534	22,321	38%
2025	13,817	9,043	22,860	40%
2026	13,841	9,571	23,412	41%
2027	13,857	10,120	23,977	42%
2028	13,867	10,689	24,556	44%
2029	13,869	11,280	25,149	45%
2030	13,863	11,893	25,756	46%
2031	13,848	12,529	26,378	47%
2032	13,825	13,189	27,015	49%
2033	13,793	13,874	27,667	50%
2034	13,751	14,584	28,335	51%
2035	13,699	15,320	29,019	53%
2036	13,636	16,083	29,720	54%
2037	13,563	16,875	30,437	55%
2038	13,477	17,695	31,172	57%
2039	13,380	18,544	31,925	58%
2040	13,271	19,425	32,695	59%
2041	13,148	20,337	33,485	61%
2042	13,011	21,282	34,293	62%
2043	12,861	22,261	35,121	63%
2044	12,695	23,274	35,969	65%
2045	12,514	24,324	36,838	66%
2046	12,317	25,410	37,727	67%
2047	12,103	26,535	38,638	69%
2048	11,871	27,700	39,571	70%

ICI TONNES

Status Quo - SF Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	21,113	-	21,113	0%
2021	21,622	-	21,622	0%
2022	22,144	-	22,144	0%
2023	22,679	-	22,679	0%
2024	23,227	-	23,227	0%
2025	23,787	-	23,787	0%
2026	24,362	-	24,362	0%
2027	24,950	-	24,950	0%
2028	25,552	-	25,552	0%
2029	26,169	-	26,169	0%
2030	26,801	-	26,801	0%
2031	27,448	-	27,448	0%
2032	28,111	-	28,111	0%
2033	28,790	-	28,790	0%
2034	29,485	-	29,485	0%
2035	30,197	-	30,197	0%
2036	30,926	-	30,926	0%
2037	31,672	-	31,672	0%
2038	32,437	-	32,437	0%
2039	33,220	-	33,220	0%
2040	34,022	-	34,022	0%
2041	34,844	-	34,844	0%
2042	35,685	-	35,685	0%
2043	36,547	-	36,547	0%
2044	37,429	-	37,429	0%
2045	38,333	-	38,333	0%
2046	39,258	-	39,258	0%
2047	40,206	-	40,206	0%
2048	41,177	-	41,177	0%

35% Diversion - IC&I Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	21,113	-	21,113	0%
2021	21,352	270	21,622	1%
2022	21,591	554	22,144	3%
2023	21,829	850	22,679	4%
2024	22,065	1,161	23,227	5%
2025	22,301	1,487	23,787	6%
2026	22,535	1,827	24,362	8%
2027	22,767	2,183	24,950	9%
2028	22,997	2,555	25,552	10%
2029	23,225	2,944	26,169	11%
2030	23,451	3,350	26,801	13%
2031	23,674	3,774	27,448	14%
2032	23,894	4,217	28,111	15%
2033	24,111	4,678	28,790	16%
2034	24,325	5,160	29,485	18%
2035	24,535	5,662	30,197	19%
2036	24,741	6,185	30,926	20%
2037	24,942	6,730	31,672	21%
2038	25,139	7,298	32,437	23%
2039	25,330	7,890	33,220	24%
2040	25,517	8,506	34,022	25%
2041	25,697	9,146	34,844	26%
2042	25,872	9,813	35,685	28%
2043	26,039	10,507	36,547	29%
2044	26,200	11,229	37,429	30%
2045	26,354	11,979	38,333	31%
2046	26,499	12,759	39,258	33%
2047	26,636	13,570	40,206	34%
2048	26,765	14,412	41,177	35%

52.5% Diversion - IC&I Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	21,113	-	21,113	0%
2021	21,217	405	21,622	2%
2022	21,314	830	22,144	4%
2023	21,403	1,276	22,679	6%
2024	21,485	1,742	23,227	8%
2025	21,557	2,230	23,787	9%
2026	21,621	2,741	24,362	11%
2027	21,675	3,275	24,950	13%
2028	21,720	3,833	25,552	15%
2029	21,753	4,416	26,169	17%
2030	21,776	5,025	26,801	19%
2031	21,787	5,661	27,448	21%
2032	21,786	6,325	28,111	23%
2033	21,772	7,017	28,790	24%
2034	21,745	7,740	29,485	26%
2035	21,704	8,493	30,197	28%
2036	21,648	9,278	30,926	30%
2037	21,577	10,096	31,672	32%
2038	21,490	10,948	32,437	34%
2039	21,386	11,835	33,220	36%
2040	21,264	12,758	34,022	38%
2041	21,124	13,720	34,844	39%
2042	20,965	14,720	35,685	41%
2043	20,786	15,761	36,547	43%
2044	20,586	16,843	37,429	45%
2045	20,364	17,968	38,333	47%
2046	20,120	19,138	39,258	49%
2047	19,852	20,354	40,206	51%
2048	19,559	21,618	41,177	53%

70% Diversion - IC&I Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	21,113	-	21,113	0%
2021	21,082	541	21,622	3%
2022	21,037	1,107	22,144	5%
2023	20,978	1,701	22,679	8%
2024	20,904	2,323	23,227	10%
2025	20,814	2,973	23,787	13%
2026	20,708	3,654	24,362	15%
2027	20,584	4,366	24,950	18%
2028	20,442	5,110	25,552	20%
2029	20,281	5,888	26,169	23%
2030	20,101	6,700	26,801	25%
2031	19,900	7,548	27,448	28%
2032	19,678	8,433	28,111	30%
2033	19,433	9,357	28,790	33%
2034	19,165	10,320	29,485	35%
2035	18,873	11,324	30,197	38%
2036	18,555	12,370	30,926	40%
2037	18,212	13,461	31,672	43%
2038	17,840	14,597	32,437	45%
2039	17,441	15,780	33,220	48%
2040	17,011	17,011	34,022	50%
2041	16,551	18,293	34,844	53%
2042	16,058	19,627	35,685	55%
2043	15,532	21,014	36,547	58%
2044	14,972	22,457	37,429	60%
2045	14,375	23,958	38,333	63%
2046	13,740	25,518	39,258	65%
2047	13,067	27,139	40,206	68%
2048	12,353	28,824	41,177	70%

DEPOT TONNES

Status Quo - Depot Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	12,198	5,782	17,981	32%
2021	12,493	5,922	18,415	32%
2022	12,795	6,065	18,860	32%
2023	13,103	6,211	19,315	32%
2024	13,420	6,361	19,781	32%
2025	13,744	6,515	20,259	32%
2026	14,076	6,672	20,748	32%
2027	14,416	6,833	21,249	32%
2028	14,764	6,998	21,762	32%
2029	15,120	7,167	22,287	32%
2030	15,485	7,340	22,826	32%
2031	15,859	7,518	23,377	32%
2032	16,242	7,699	23,941	32%
2033	16,634	7,885	24,519	32%
2034	17,036	8,075	25,111	32%
2035	17,447	8,270	25,717	32%
2036	17,868	8,470	26,338	32%
2037	18,300	8,675	26,974	32%
2038	18,741	8,884	27,625	32%
2039	19,194	9,099	28,292	32%
2040	19,657	9,318	28,976	32%
2041	20,132	9,543	29,675	32%
2042	20,618	9,774	30,392	32%
2043	21,116	10,010	31,125	32%
2044	21,626	10,251	31,877	32%
2045	22,148	10,499	32,646	32%
2046	22,682	10,752	33,435	32%
2047	23,230	11,012	34,242	32%
2048	23,791	11,278	35,069	32%

35% Diversion - Depot Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	12,198	5,782	17,981	32%
2021	12,474	5,941	18,415	32%
2022	12,756	6,103	18,860	32%
2023	13,045	6,270	19,315	32%
2024	13,340	6,442	19,781	33%
2025	13,641	6,618	20,259	33%
2026	13,949	6,799	20,748	33%
2027	14,265	6,984	21,249	33%
2028	14,587	7,175	21,762	33%
2029	14,917	7,371	22,287	33%
2030	15,253	7,572	22,826	33%
2031	15,598	7,779	23,377	33%
2032	15,950	7,991	23,941	33%
2033	16,311	8,208	24,519	33%
2034	16,679	8,432	25,111	34%
2035	17,056	8,662	25,717	34%
2036	17,441	8,898	26,338	34%
2037	17,834	9,140	26,974	34%
2038	18,237	9,389	27,625	34%
2039	18,648	9,644	28,292	34%
2040	19,069	9,906	28,976	34%
2041	19,500	10,176	29,675	34%
2042	19,940	10,452	30,392	34%
2043	20,389	10,736	31,125	34%
2044	20,849	11,028	31,877	35%
2045	21,320	11,327	32,646	35%
2046	21,800	11,634	33,435	35%
2047	22,292	11,950	34,242	35%
2048	22,795	12,274	35,069	35%

52.5% Diversion - Depot Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	12,198	5,782	17,981	32%
2021	12,359	6,056	18,415	33%
2022	12,521	6,339	18,860	34%
2023	12,683	6,632	19,315	34%
2024	12,845	6,936	19,781	35%
2025	13,008	7,251	20,259	36%
2026	13,171	7,577	20,748	37%
2027	13,335	7,914	21,249	37%
2028	13,499	8,263	21,762	38%
2029	13,663	8,625	22,287	39%
2030	13,827	8,999	22,826	39%
2031	13,991	9,386	23,377	40%
2032	14,155	9,786	23,941	41%
2033	14,318	10,201	24,519	42%
2034	14,482	10,629	25,111	42%
2035	14,645	11,073	25,717	43%
2036	14,807	11,532	26,338	44%
2037	14,968	12,006	26,974	45%
2038	15,129	12,496	27,625	45%
2039	15,289	13,004	28,292	46%
2040	15,447	13,528	28,976	47%
2041	15,605	14,070	29,675	47%
2042	15,761	14,631	30,392	48%
2043	15,915	15,210	31,125	49%
2044	16,068	15,809	31,877	50%
2045	16,219	16,428	32,646	50%
2046	16,367	17,067	33,435	51%
2047	16,514	17,728	34,242	52%
2048	16,658	18,411	35,069	53%

70% Diversion - Depot Tonnes

Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	12,198	5,782	17,981	32%
2021	12,244	6,171	18,415	34%
2022	12,285	6,575	18,860	35%
2023	12,320	6,995	19,315	36%
2024	12,351	7,431	19,781	38%
2025	12,375	7,884	20,259	39%
2026	12,393	8,355	20,748	40%
2027	12,405	8,844	21,249	42%
2028	12,411	9,351	21,762	43%
2029	12,409	9,878	22,287	44%
2030	12,400	10,425	22,826	46%
2031	12,384	10,993	23,377	47%
2032	12,359	11,582	23,941	48%
2033	12,326	12,193	24,519	50%
2034	12,284	12,827	25,111	51%
2035	12,234	13,484	25,717	52%
2036	12,173	14,165	26,338	54%
2037	12,102	14,872	26,974	55%
2038	12,021	15,604	27,625	56%
2039	11,929	16,363	28,292	58%
2040	11,825	17,150	28,976	59%
2041	11,710	17,965	29,675	61%
2042	11,582	18,810	30,392	62%
2043	11,441	19,685	31,125	63%
2044	11,286	20,591	31,877	65%
2045	11,118	21,529	32,646	66%
2046	10,934	22,501	33,435	67%
2047	10,735	23,507	34,242	69%
2048	10,521	24,548	35,069	70%

TOTAL TONNES

Status Quo - Total Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	46,917	12,466	59,383	21%
2021	48,050	12,767	60,817	21%
2022	49,210	13,075	62,285	21%
2023	50,398	13,391	63,789	21%
2024	51,615	13,714	65,329	21%
2025	52,861	14,045	66,906	21%
2026	54,137	14,384	68,522	21%
2027	55,444	14,732	70,176	21%
2028	56,783	15,087	71,870	21%
2029	58,154	15,451	73,605	21%
2030	59,558	15,825	75,383	21%
2031	60,996	16,207	77,203	21%
2032	62,469	16,598	79,067	21%
2033	63,977	16,999	80,976	21%
2034	65,522	17,409	82,931	21%
2035	67,104	17,829	84,933	21%
2036	68,724	18,260	86,984	21%
2037	70,383	18,701	89,084	21%
2038	72,082	19,152	91,235	21%
2039	73,823	19,615	93,437	21%
2040	75,605	20,088	95,693	21%
2041	77,430	20,573	98,004	21%
2042	79,300	21,070	100,370	21%
2043	81,215	21,579	102,793	21%
2044	83,175	22,100	105,275	21%
2045	85,184	22,633	107,817	21%
2046	87,240	23,180	110,420	21%
2047	89,347	23,739	113,086	21%
2048	91,504	24,312	115,816	21%

35% Diversion - Total Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	46,917	12,466	59,383	21%
2021	47,746	13,071	60,817	21%
2022	48,587	13,698	62,285	22%
2023	49,441	14,348	63,789	22%
2024	50,308	15,021	65,329	23%
2025	51,187	15,719	66,906	23%
2026	52,081	16,441	68,522	24%
2027	52,987	17,189	70,176	24%
2028	53,907	17,964	71,870	25%
2029	54,840	18,766	73,605	25%
2030	55,787	19,596	75,383	26%
2031	56,748	20,455	77,203	26%
2032	57,722	21,344	79,067	27%
2033	58,711	22,265	80,976	27%
2034	59,713	23,217	82,931	28%
2035	60,730	24,203	84,933	28%
2036	61,761	25,222	86,984	29%
2037	62,807	26,277	89,084	29%
2038	63,867	27,368	91,235	30%
2039	64,941	28,496	93,437	30%
2040	66,030	29,663	95,693	31%
2041	67,134	30,869	98,004	31%
2042	68,253	32,117	100,370	32%
2043	69,387	33,406	102,793	32%
2044	70,535	34,740	105,275	33%
2045	71,699	36,118	107,817	33%
2046	72,878	37,542	110,420	34%
2047	74,072	39,014	113,086	34%
2048	75,281	40,536	115,816	35%

52.5% Diversion - Total Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	46,917	12,466	59,383	21%
2021	47,365	13,451	60,817	22%
2022	47,808	14,477	62,285	23%
2023	48,245	15,544	63,789	24%
2024	48,674	16,655	65,329	25%
2025	49,097	17,810	66,906	27%
2026	49,511	19,011	68,522	28%
2027	49,917	20,259	70,176	29%
2028	50,313	21,557	71,870	30%
2029	50,700	22,906	73,605	31%
2030	51,075	24,307	75,383	32%
2031	51,440	25,763	77,203	33%
2032	51,792	27,274	79,067	34%
2033	52,131	28,844	80,976	36%
2034	52,457	30,474	82,931	37%
2035	52,768	32,165	84,933	38%
2036	53,063	33,921	86,984	39%
2037	53,342	35,742	89,084	40%
2038	53,603	37,632	91,235	41%
2039	53,846	39,592	93,437	42%
2040	54,069	41,624	95,693	43%
2041	54,271	43,732	98,004	45%
2042	54,452	45,918	100,370	46%
2043	54,610	48,183	102,793	47%
2044	54,744	50,531	105,275	48%
2045	54,853	52,964	107,817	49%
2046	54,935	55,485	110,420	50%
2047	54,988	58,098	113,086	51%
2048	55,013	60,804	115,816	53%

70% Diversion - Total Tonnes				
Year	Garbage	Divertables	Total Waste Generated	% Diversion
2020	46,917	12,466	59,383	21%
2021	46,985	13,831	60,817	23%
2022	47,030	15,255	62,285	24%
2023	47,049	16,740	63,789	26%
2024	47,041	18,288	65,329	28%
2025	47,006	19,900	66,906	30%
2026	46,941	21,580	68,522	31%
2027	46,846	23,329	70,176	33%
2028	46,720	25,151	71,870	35%
2029	46,559	27,046	73,605	37%
2030	46,364	29,019	75,383	38%
2031	46,132	31,070	77,203	40%
2032	45,862	33,204	79,067	42%
2033	45,552	35,423	80,976	44%
2034	45,200	37,730	82,931	45%
2035	44,805	40,128	84,933	47%
2036	44,364	42,619	86,984	49%
2037	43,876	45,207	89,084	51%
2038	43,339	47,896	91,235	52%
2039	42,750	50,687	93,437	54%
2040	42,107	53,586	95,693	56%
2041	41,408	56,595	98,004	58%
2042	40,651	59,718	100,370	59%
2043	39,834	62,959	102,793	61%
2044	38,953	66,322	105,275	63%
2045	38,006	69,810	107,817	65%
2046	36,991	73,429	110,420	66%
2047	35,905	77,181	113,086	68%
2048	34,745	81,071	115,816	70%

Should anyone have a question regarding content in the appendices, please contact Betsy Varghese at bvarghese@dillon.ca to discuss.

Appendix B

Evaluation Assessment Tool and Task 6 Memo

Memo

To: Tauhid Khan, City of Kawartha Lakes

From: Betsy Varghese, P.Eng., Dillon Consulting Limited

Date: April 8, 2021

Subject: Confirmation of Potential Options and Evaluation Criteria

Our File: 20-3756

Dillon Consulting Limited (Dillon) was retained by the City of Kawartha Lakes (City) to complete a Future Waste Disposal Options Study. As part of this study, an evaluation of potential options to fulfill the City's future disposal options will be undertaken.

The purpose of this memo is to present the Alternative Technologies **(Task 4)** and Landfill Related Options **(Task 5)** that will be assessed. The identification of the draft criteria and indicators to be used to evaluate the proposed list of options is also presented through this memo for City approval. The draft evaluation criteria was developed through review of background documentation provided by the City, including the City's Integrated Waste Management Study (2015) update in 2019 and the City of Kawartha Lakes' Healthy Environmental Plan.

Review of Alternative Technologies and Operational Experiences

Task 4 involved the review of alternative technologies that process residual waste. Operational experiences, target material/feedstock and outputs, capital and operating cost range, advantages and disadvantages, and applicability to the City will be reviewed for each of the alternative technologies covered under **Task 4** of the project. The selected draft alternative technologies to be reviewed as part of this study are outlined in **Table 1**.

Table 1: Alternative Technologies

Technology	Description
Mixed Waste Processing	Mixed waste processing is a process to recover materials such as recyclables, organics and/or reusable materials, which leave the residual waste for landfilling or another waste processing application. Mixed waste processing facilities are also known as "dirty" material recovery facilities (MRFs) depending on the streams processed.
Mass Burn Incineration	Mass burn incineration involves the use of traditional combustion to manage residual waste. The resulting bottom ash can be landfilled at a non-hazardous site and the fly ash requires disposal at a hazardous

Technology	Description
	waste landfill. The process generates heat that can be converted into electricity and/or steam.
Gasification	Gasification involves converting solid or liquid carbon-based wastes into gas form at high temperature without combustion. There are different types of gasification technologies.
Pyrolysis	Pyrolysis involves heating municipal solid waste in an oxygen-free environment to produce a combustible gaseous or liquid product and a carbon char residue.

Review of Landfill-Related Options and Operational Experiences

Task 5 involves the review of landfill related options. Operational experiences, target material/feedstock and outputs, capital and operating cost range, advantages and disadvantages and applicability to the City will be reviewed for each of the landfill related options covered under **Task 5** of the project. The selected draft landfill-related options to be reviewed as part of this study are outlined in **Table 2**.

Table 2: Landfill Related Options

Option	Description
Landfill Expansion	Expanding an existing landfill is the most common way to add new disposal capacity in Ontario. Expanding a landfill generally involves regulatory approvals such as an Environmental Assessment (EA), multimedia Environmental Compliance Approval (ECA) amendments (air/noise, sewage works and waste disposal), engineering and design of new cells (including landfill gas and leachate collection systems), planning approvals (e.g., site plan) and construction.
Development of a New City Owned Landfill	Disposal capacity in Ontario is quickly diminishing and the process involved in securing additional disposal capacity via a new landfill is typically lengthy and thus expensive. In addition to the approvals noted above, the development of a new landfill would also require the completion of a siting study and preparation of new ECA applications for the multi-media.
Landfill Mining	Landfill mining refers to the process of excavating previously landfilled waste to recover valuable recyclable materials and/or

Option	Description
	space. This can be a complicated process and its economic feasibility is based on the expected content of the landfill and/or reducing long-term liabilities and recovered airspace. Reducing long-term liabilities can be related to re-disposal of previously improperly landfilled waste or re-engineering of the landfill base with a more robust base liner system.
Export Waste out of the City	Exporting of waste consists of hauling waste to a facility outside of the jurisdiction's boundary. Typically, waste from curbside collection trucks is consolidated into large transfer trailers at a transfer station to minimize transportation costs and GHG emissions. Exporting waste is typically performed as a result of limited landfilling capacity within a jurisdiction's property boundary, as a way to preserve capacity or due to a lack of available space to site a new landfill.
Privatization of City Facilities	Local governments face increasing regulatory costs in owning and operating landfills, as well as finding politically acceptable locations for new facilities to replace sites that have reached capacity or accommodate new landfill capacity. A way to respond to these regulatory and siting challenges is to privatize their landfills.

Evaluation Criteria Applicability to the City

To develop the evaluation criteria and indicators for this project, Dillon reviewed background documents provided by the City. These documents included the Making Waste Matter: Integrated Waste Management Strategy (2015), update to the Strategy in 2019, the Kawartha Lakes Strategic Plan 2020 – 2023, and the City of Kawartha Lakes' Healthy Environmental Plan. The draft evaluation criteria was developed based on their alignment to the principles, goals and strategies within these documents.

1.1.1 Making Waste Matter: Integrated Waste Management Strategy

In 2015, the City prepared an Integrated Waste Management Strategy, which aimed to outline where waste management in the City was at that time and provided short-term and long-term strategies for waste management services into the future (until 2048). The waste management initiatives proposed under the 2015 strategy were evaluated using the following criteria:

- Flexibility of programming (e.g. easy to implement and adapt);
- Successful examples of similar municipal programs;
- Impact on the strategy's diversion goal;

- Implementation and scheduling requirements;
- Financial implications to the City; and
- Regulatory requirements.

A comprehensive ranking exercise was conducted using the key criteria to create a short list of potential waste program initiatives for the City. In the 2015 Strategy, the main principles were also defined, which are summarized in **Table 3** below.

Table 3: Integrated Waste Management Strategy (2015) Principles

Principles	Description
Adaptable and accountable format	Designed to grow and change with future waste management needs and opportunities due to a built-in regular review process.
'Waste less living' framework	A lens through which to assess incoming initiatives, guide decision-making and generate educational materials.
Emphasis on dialogue and partnership	Consulting and collaborating with residents, businesses, schools, sector and industry partners, non-profit organizations, researchers and others to address gaps and challenges.
Comprehensive and evolving promotion and education program	One that meets the needs of a diverse and expansive community.

The 2015 Strategy noted that it would be critical to regularly review, update, and expand the document due to frequent and significant changes in waste management practices, legislation, and waste quantities in the municipality. Based on the frequency of these changes it has been determined that an update of the Strategy will occur every five years.

This first update was completed in 2019 which included initiatives to be implemented from 2020 to 2024. It is noted that the primary goal of the Strategy is to guide the City towards diverting 70% of its annual generated waste away from their landfills by 2048. The draft evaluation criteria for this project were developed based on the strategy's established 2015 criteria and principles.

1.1.2 City of Kawartha Lakes Healthy Environment Plan

The City of Kawartha Lakes' Healthy Environment Plan was developed over a two-year period under the guidance of a Steering Committee and multi-stakeholder Working Group. The Healthy Environment Plan aims to reduce community risks and increase safety as a result of progressive climate action, and provides an opportunity to contribute to reducing greenhouse gas emissions. In collaboration with the Steering Committee, Working Group and consulting team, a set of goals were developed within the

Healthy Environment Plan. As such, the goals applicable to this project that were used to develop the draft evaluation criteria for this project are below:

- **Cross-cutting:** Incorporate climate change mitigation and adaptation considerations into existing and future plans and policies.
- **People, Safety & Health:** Ensure the health, safety and resilience of the community by preparing for an increase in climate change related health impacts.
- **Natural Environment:** Ensure the resiliency of Kawartha Lakes' natural environment such as forests, bodies of water, open spaces and natural heritage features.
- **Energy Systems:** Foster a culture of energy conservation that is resilient to climatic threats.
- **Waste:** Increase waste diversion from the landfill.

1.1.3 Kawartha Lakes Strategic Plan 2020 - 2023

The Kawartha Lakes Strategic Plan used a collaborative approach to determine direction and goals for a four year period between 2020 and 2023. Its mission to deliver the highest standards of municipal services while creating a healthy and sustainable future for all residents and businesses is supported by four guiding principles: fiscal responsibility, openness and transparency, partnership and collaboration, and service excellence. Its vision to create a thriving and growing community within a healthy and natural environment focuses on four strategies priority areas:

- **A Healthy Environment** – The goals in this strategic priority area align with the project in the following ways: increase waste reduction and diversion, reduce corporate carbon footprints, and manage waste at municipal facilities. Key indicators to measure progress include: waste diversion rate and greenhouse gas emissions
- **An Exceptional Quality of Life**
- **A Vibrant and Growing Economy** – The goals in this strategic priority area align with the project in the following way: creates an environment that attracts business to Kawartha Lakes. The key indicator of progress is the number of jobs in the community compared to the provincial forecast.
- **Good Government**

Evaluation Methodology

As part of **Task 6** of the project, to develop the criteria evaluation to assess the alternative technology and landfill options, Dillon has proposed the following evaluation criteria and indicators shown in **Table 4**. The criteria is based on a triple bottom line, covering off the impacts to people, profit/revenue and environment. The criteria indicators were also developed based on their applicability to the 2015 strategy criteria and principles and the City of Kawartha Lakes' Healthy Environmental Plan. As part of the assessment, the criteria will be evaluated based on a ranking system for each individual option.

Table 4: Assessment Criteria

Criteria	Criteria Indicator
Economic Feasibility	Annual operating costs
	Capital costs
	Level of risk - liability or environmental (e.g., low risk, expected results, may vary, City has little control)
Social Impacts	Public acceptance
	Collaboration with others (i.e. partner with other municipalities)
	Proven or unproven (e.g., unproven, proven at smaller scale, proven at larger scale)
	Level of effort to develop, implement, operate and maintain the option (e.g., low to high level of effort)
Environmental Impacts	Climate change impacts (e.g., estimated GHG reductions)
	Energy (e.g., produced, consumed)
	Air quality impact
	Land requirements
	Impact to groundwater and surface water
	Nuisance impacts (odour, noise, traffic, litter)
	Potential for diversion from landfill disposal

An evaluation tool will be set up to evaluate each alternative technology and landfill-related option by applying the three criteria categories economic feasibility, social impacts and environmental impacts. The following provides an explanation on the evaluation components:

- **Rank:** Each criteria indicator has either three or four choices for ranking the option. A ranking of 1 is most favourable and a ranking of 3 or 4 (depending on the criteria) is least favourable.
- **Relative Weightings**: Based on background information, the proposed weightings per criteria were developed and presented in **Table 5**.
- **Key Performance Indicators (KPIs):** The KPIs establish how the indicators are evaluated. KPIs are provided for each criterion. KPIs are either quantitative or qualitative. For example, "Capital Cost" criterion is quantitative since it is measured as a cost, whereas rationale for "Public Acceptance" requires a qualitative response.

- **Score and Rationale:** The evaluation will assign a score based on the rankings and explanation for the selection.

Table 5 shown on the next two pages provides a summary of the evaluation tool, including the ranking system, relative weightings and KPI's in addition to the alignment with the Strategy and Healthy Environment Plan.

Next Steps

In February 2021, Dillon met with the City to provide an update on the background review (Task 2) and seek confirmation on proposed options to review. The next step will involve a meeting with the City team to review the findings from Tasks 3 through 6. Dillon will also discuss next steps of the project with the City, including the preferred approach for Task 7 and 8.

Table 5: Evaluation Assessment Tool

Evaluation Criteria	Indicator	KPI	Rank	Rank Details	Relative Weightings (%)	
Economic Feasibility	Annual Operational Costs	$	1	$5,000,000 or greater	30	Financial implications to the City
			2	$1,000,000 to $5,000,000		
			3	< $1,000,000		
	Capital Cost	$	1	$50,000,000 or greater	30	Financial implications to the City
			2	$10,000,000 to $50,000,000		
			3	< $10,000,000		
	Level of risk - liability or environmental (e.g., low risk, expected results, may vary, City has little control)	Qualitative	1	Very high risk (e.g. results, liability, environmental impacts, control by City)	40	Financial implications to the City
			2	Moderate risk (e.g. some risks but they can be mitigated)		
			3	Very low risk (e.g. good results, good for the environment, limited liability)		
Social Impact	Public Acceptance	Qualitative	1	Potential for opposition to the option	15	
			2	No public perception of the option		
			3	Option anticipated to be accepted/encouraged by the community		
	Collaboration with others (i.e. partner with other municipalities)	Qualitative	1	Anticipated decrease, or hindrance to collaboration	35	
			2	No change anticipated		
			3	Option will lead to increase collaboration with others (i.e. municipalities)		
	Proven or unproven (e.g., unproven, proven at smaller scale, proven at larger scale)	Qualitative	1	Unproven (e.g. currently at a pilot or small scale, no full scale implementation)	20	Flexibility of programming (e.g. easy to implement and adapt) Successful examples of similar municipal programs
			2	Proven in jurisdictions smaller than the City		
			3	Proven in jurisdictions like the City or larger		
	Level of effort to develop, implement, operate and maintain the option (e.g., low to high level of effort)	Qualitative	1	High level of effort to develop and implement (e.g. more than 5 years)	30	Flexibility of programming (e.g. easy to implement and adapt) Implementation and scheduling requirements
			2	Moderate effort to implement (e.g. some additional resources are needed, can be implemented in 3-5 years)		
			3	Easy to implement (e.g. can be done with existing staff resources)		
Environmental Impacts	Climate change impacts (e.g., estimated GHG reductions)	Qualitative	1	Results in little to no reduction in GHG emissions	20	Regulatory requirements.
			2	Results in a moderate reduction in GHG emissions		
			3	Significant reduction in GHG emissions		
	Energy (produced, consumed)	Qualitative	1	Will lead to a net increase in energy consumption	15	Regulatory requirements.
			2	Minimal to no energy required		
			3	Will lead to a net gain of energy production		
	Air Quality Impact	Qualitative	1	Significant release of emissions to atmosphere	10	Regulatory requirements.
			2	Some release of emissions to atmosphere		
			3	Minimal to no release of emissions to atmosphere		
	Land Requirements	Qualitative	1	Additional land required.	20	Regulatory requirements.
			2	Minimal to no additional land required.		
			3	Optimize existing asset, use existing site/building and/or potential to make land available		
	Impact to Groundwater and Surface Water	Qualitative	1	High potential to contaminate groundwater and/or surface water	10	Regulatory requirements.
			2	Some potential to contaminate groundwater and/or surface water		
			3	Minimal to no potential release of contaminants to groundwater and/or surface water		
	Nuisance Impacts (odour, noise, traffic, litter)	Qualitative	1	Will increase nuisance impacts	10	Regulatory requirements.
			2	Minimal to no change to nuisances		
			3	Will reduce nuisance impacts		
	Potential for diversion from landfill disposal	Qualitative	1	2% diversion or less or is difficult to measure	15	Impact on the strategy's diversion goal
			2	2 to 5% waste diversion/reduction		
			3	>5% waste diversion/reduction		

Should anyone have a question regarding content in the appendices, please contact Betsy Varghese at bvarghese@dillon.ca to discuss.

Appendix C

Alternative Technologies and Landfill Related Data

Base assumptions:

- Process an annualized average of between 40,000 and 60,000 tonnes of residual waste based on diversion rate scenario.
- Waste diversion scenarios included achieving 21%, 35%, 53% and 70% by 2048.
- Waste is generated from Kawartha Lakes only from the residential and IC&I sectors
- In 2020, the City sent 47,000 tonnes of residual waste to landfill.
- Site would be located within the City of Kawartha Lakes boundaries however, exact site is not known. Impacts associated with collection and hauling are not considered at this time unless otherwise stated
- Ownership model is unknown.
- Facility would require multi-media ECA approval at a minimum and would be subject to conditions of approval.
- Alternative technologies will require involvement of multiple parties such as equipment vendors, suppliers, etc.
- Alternative technologies will require less land than a landfill.

Option	1 - Mixed Waste Processing	2 - Mass Burn Incineration	3 - Gasification	4 - Pyrolysis
Description	A mixed waste processing (MWP) facility typically processes residual waste to recover materials such as recyclables and/or organic materials, which leaves the residual waste for landfilling or another waste processing application. Mixed waste processing facilities are also known as "dirty" material recovery facilities (MRFs) depending on the streams processed.	The use of traditional combustion to manage residual waste, resulting bottom ash can be landfilled at a non-hazardous site and the fly ash requires disposal at a hazardous waste facility. Heat is recovered from gases produced and converted to electricity, steam or both.	Gasification involves converting solid or liquid carbon-based wastes into gas form at high temperature without combustion. Gasification is a process that converts solid organic material under controlled conditions of partial oxidation into fuel gases and other by-products.	Pyrolysis involves heating municipal solid waste in an oxygen-free environment to produce a combustible gaseous or liquid product and a carbon char residue. Pyrolysis is a chemical process in which organic materials are decomposed by high temperatures in the absence of oxygen. The decomposed materials are converted to gas, liquid, and solid fuels.
Major Assumptions	- City would construct a MWP facility to remove high value recyclables and organics remaining in the residual waste stream - Blue Box materials would continue to be source separated and processed separately. - City meets diversion targets over time through a source separation Green Bin program for organic materials - Landfilling or another final disposal facility will be required to manage the residual waste stream coming out of the MWP facility.	- City would develop a waste-to-energy facility to process residual waste and recover some metals and energy - Bottom ash will be generated and will be beneficially reused. - Fly ash will require disposal in a hazardous landfill.	- The facility would process residual waste to recover material and/or energy.	- The facility would process residual waste to recover material and/or energy.

Evaluation Criteria	Indicator	KPI	Rank	Rank Details	Score	Rationale	Score	Rationale	Score	Rationale	Score	Rationale
Economic Feasibility	Annual Operational Costs	$	1	$5,000,000 or greater	1	Annual operating and maintenance costs are anticipated to be high based on existing facilities Additional costs are required for planning, siting and approvals.	1	The annual operating costs are anticipated to be more than $5 million and would depend on the size and throughput of the facility.	1	The annual operating costs are anticipated to be more than $5 million and would depend on the size and throughput of the facility.	1	The annual operating costs are anticipated to be more than $5 million and would depend on the size and throughput of the facility.
			2	$1,000,000 to $5,000,000								
			3	< $1,000,000								
	Capital Cost	$	1	$50,000,000 or greater	2	A facility processing the amount of waste requiring management is anticipated to cost between $10 and $50M.	1	A facility managing between 40,000 - 60,000 tonnes of residual waste is anticipated to require more than $50 million in capital costs. Land acquisition costs would be additional costs.	1	A facility managing X0,000 tonnes of residual waste is anticipated to require more than $50 million in capital costs. Land acquisition costs would be additional costs.	1	A facility managing X0,000 tonnes of residual waste is anticipated to require more than $50 million in capital costs. Land acquisition costs would be additional costs.
			2	$10,000,000 to $50,000,000								
			3	< $10,000,000								
	Level of risk - liability or environmental (e.g., low risk, expected results, may vary, City has little control)	Qualitative	1	Very high risk (e.g. results, liability, environmental impacts, control by City)	2	Potential risks associated with limited application in Canada (e.g., Nova Scotia), however, widely used in Europe. Reduces amount of residual waste requiring landfilling and organic content. The quality of end products is anticipated to be low resulting in potential challenge with finding end markets. Technology and process would be new to the City.	2	Moderate risk is anticipated. Facilities are operating in Ontario and results are as expected. Potential risks associated with the complexity of the facility and securing a power purchasing agreement for the sale of energy.	1	High level of risk associated with the limited data on processing municipal solid waste and lack of operating facilities in Canada.	1	High level of risk associated with the limited data on processing municipal solid waste and lack of operating facilities in Canada.
			2	Moderate risk (e.g. some risks but they can be mitigated)								
			3	Very low risk (e.g. good results, good for the environment, limited liability)								
Social Impact	Public Acceptance	Qualitative	1	Potential for opposition to the option	1	Option aims to extract recyclable and organic materials prior to final disposal which may be perceived positively by the public however the siting process and additional costs may garner opposition.	1	Siting a waste disposal facility garners opposition and additional opposition is anticipated for a thermal treatment facility. There may be perceived benefits associated with extending the landfill life and some acceptance given examples of successful facilities operating in Ontario.	1	Siting a waste disposal facility garners opposition and additional opposition is anticipated for a gasification facility which is less proven in Canada. There may be perceived benefits associated with extending the landfill life.	1	Siting a waste disposal facility garners opposition and additional opposition is anticipated for a pyrolysis facility which is not proven at full scale. There may be perceived benefits associated with extending the landfill life.
			2	No public perception of the option								
			3	Option anticipated to be accepted/encouraged by the community								
	Collaboration with others (i.e. partner with other municipalities)	Qualitative	1	Anticipated decrease, or hindrance to collaboration	2	At this time, there is no firm potential to collaborate with others (e.g., neighbouring municipalities sending residual waste to CKL or CKL sending waste outside of the City). Durham and Peel Regions are contemplating building MWP facilities, with Peel Region open to collaborating with other municipalities.	2	Some interest has been expressed regarding partnering opportunities for a mass burn incineration facility however, these plans are in the initial planning stages.	2	No change in collaboration is anticipated given the limited current opportunities for this technology type.	2	No change in collaboration is anticipated given the limited current opportunities for this technology type.
			2	No change anticipated								
			3	Option will lead to increase collaboration with others (i.e. municipalities)								
	Proven or unproven (e.g., unproven, proven at smaller scale, proven at larger scale)	Qualitative	1	Unproven (e.g. currently at a pilot or small scale, no full scale implementation)	3	In Canada, Halifax has been operating a mixed waste processing facility for over 20 years to preprocess and stabilize waste prior to landfilling. Nova Scotia is constructing a MWP facility with bio-oil productions from plastics separated at the MWP and Durham Region is in the process of developing a mixed waste pre-sort facility to recover materials from garbage. Facilities are operating in the US and Europe.	3	Mass burn incineration is a proven technology and is currently used in Canada and worldwide for municipal solid waste in jurisdictions such as Region of Durham and Metro Vancouver.	1	Gasification is an emerging technology for municipal solid waste and pilot studies have not been successful to date.	1	Pyrolysis is currently at a pilot project, research state for MSW. There are some facilities in North America processing MSW on a pilot-scale level, however there are no commercial facilities.
			2	Proven in jurisdictions smaller than the City								
			3	Proven in jurisdictions like the City or larger								
	Level of effort to develop, implement, operate and maintain the option (e.g., low to high level of effort)	Qualitative	1	High level of effort to develop and implement (e.g. more than 5 years)	1	The siting, approval, design and construction processes are anticipated to require more than five years to implement. This type of facility will be new for CKL to own and/or operate and thus additional staff will be required and trained	1	In order to implement this option, planning, siting and procurement processes will be required. An Environmental Screening Process may be sufficient but it is likely that an EA would be required based on the Durham York Energy Centre approval process. This facility would be new for the City.	1	This alternative technology has lengthy and uncertain approval processes. This type of facility would be new to the City. Siting, planning and procurement processes will be required. Pre-processing will also be required to create a uniform feedstock. Stringent operational and maintenance requirements are anticipated.	1	This alternative technology has lengthy and uncertain approval processes. This type of facility would be new to the City. Siting, planning and procurement processes will be required. Stringent operational and maintenance requirements are anticipated.
			2	Moderate effort to implement (e.g. some additional resources are needed, can be implemented in 3-5 years)								
			3	Easy to implement (e.g. can be done with existing staff resources)								
Environmental Impacts	Climate change impacts (e.g., estimated GHG reductions)	Qualitative	1	Results in little to no reduction in GHG emissions	2	Facility is anticipated to result in a moderate reduction in GHG emissions given the separation and diversion of organics compared to current approach.	3	Potential for GHG emissions reductions due to avoided GHG emissions associated with the generation of renewable electricity and steam which offsets (avoids) emissions from electricity generation sources. Potential for GHG emissions associated with transportation of bottom and/or fly ashes to final disposal facility.	3	Electricity, heat, ethanol and/or biofuels are outputs of gasification and can be used to displace the need of fossil fuels and recover energy.	3	Electricity, heat, ethanol and/or biofuels are outputs of pyrolysis and can be used to displace the need of fossil fuels and recover energy.
			2	Results in a moderate reduction in GHG emissions								
			3	Significant reduction in GHG emissions								
	Energy (produced, consumed)	Qualitative	1	Will lead to a net increase in energy consumption	1	MWP facilities alone do not typically produce energy and may produce a refuse derived fuel product. Energy consumption would be similar to a materials recycling facility or composting facility.	3	High potential to generate energy to offset fuel/energy used and potential to sell excess energy.	3	Option will result in a gain of energy production however potential markets for the energy generated are unknown.	3	Option will result in a gain of energy production however potential markets for the energy generated are unknown.
			2	Minimal to no energy required								
			3	Will lead to a net gain of energy production								
	Air Quality Impact	Qualitative	1	Significant release of emissions to atmosphere	3	It is assumed that the facility is designed and operated to meet environmental regulations.	2	Some potential for a release of emissions to the atmosphere.	2	There is limited data available but it is anticipated that there will be some release of air emissions.	2	There is limited data available but it is anticipated that there will be some release of air emissions.
			2	Some release of emissions to atmosphere								
			3	Minimal to no release of emissions to atmosphere								
	Land Requirements	Qualitative	1	Additional land required.	1	A new facility would require additional lands with site servicing. Based on typical area needs for a MWP (minimum capacity of 70,000 tpy) site requirements are 1.5 ha (based on known space requirements for MWP proposed in BC).	1	A siting process will be required and it anticipated a location that is suitable to connect to an energy market will be required.	1	Additional land would be required for this new facility. A siting study would be required to determine the location.	1	Additional land would be required for this new facility. A siting study would be required to determine the location.
			2	Minimal to no additional land required.								
			3	Optimize existing asset, use existing site/building and/or potential to make land available								
	Impact to Groundwater and Surface Water	Qualitative	1	High potential to contaminate groundwater and/or surface water	3	No impact on groundwater or surface water assuming the process is well-contained and contact with stormwater is minimized.	3	No impact on groundwater or surface water assuming the process is well-contained and contact with stormwater is minimized.	3	No impact on groundwater or surface water assuming the process is well-contained and contact with stormwater is minimized.	3	No impact on groundwater or surface water assuming the process is well-contained and contact with stormwater is minimized.
			2	Some potential to contaminate groundwater and/or surface water								
			3	Minimal to no potential release of contaminants to groundwater and/or surface water								
	Nuisance Impacts (odour, noise, traffic, litter)	Qualitative	1	Will increase nuisance impacts	1	The construction and operation of a new MWP facility has the potential to increase nuisance impacts assuming it is located at a new site creating impacts to new neighbours around the property and along the haul route.	1	The construction and operation of a new incineration facility has the potential to increase nuisance impacts assuming it is located at a new waste site.	1	The establishment of a new gasification facility will increase nuisance impacts assuming it is located at a new waste site.	1	The establishment of a new pyrolysis facility will increase nuisance impacts assuming it is located at a new waste site.
			2	Minimal to no change to nuisances								
			3	Will reduce nuisance impacts								
	Potential for diversion from landfill disposal	Qualitative	1	2% diversion or less or is difficult to measure	3	The City's residual waste stream currently consists of approximately 10% recyclable materials and 48% of organic materials based on residential waste audit data. It is anticipated that a MWP facility will divert more than 5% from landfill initially and with increased diversion at-source, this may be reduced over time. It is anticipated that marketing the recovered materials may be challenging given the feedstock quality.	3	There is a high potential to recover and divert reusable, recyclable, organic and other marketable materials and a significant decrease of waste volumes such as bottom ash and fly ash entering landfills.	3	A gasification facility will significantly reduce the quantity of waste requiring landfill disposal.	3	Although pyrolysis is not proven at the commercial scale, it is assumed it would significantly reduce the quantity of waste requiring landfill disposal.
			2	2 to 5% waste diversion/reduction								
			3	>5% waste diversion/reduction								

Base assumptions:

- Waste diversion scenarios included achieving 21%, 35%, 53% and 70% by 2048 and waste projections were completed to estimate a range of residual waste quantities to be managed.
- Process an annualized average of between 40,000 and 60,000 tonnes of residual waste based on diversion rate scenario.
- Based on the existing remaining capacity and achieving a density of 700 kg/m3, between 1.2 mil and 350,000 m3 of air space could be required depending on the waste diversion rate achieved.
- Waste is generated from Kawartha Lakes only from the residential and IC&I sectors
- In 2020, the City sent 47,000 tonnes of residual waste to landfill.

Option	5 - Landfill Expansion	6 - Development of a New Landfill	7 - Landfill Mining/Reclamation	8 - Exporting waste out of the City	9 - Privatization of City facilities
Description	Municipalities throughout Ontario have increased disposal capacity by extending the fill area at existing landfills sites. Expanding a landfill generally involves regulatory approvals such as Environmental Assessments (EA), multimedia ECA amendments (air/noise, sewage, etc.), engineering and design of new cells, and construction.	Development of a new landfill site would require availability of suitable land and environmental approvals. Disposal capacity in Ontario is quickly diminishing and the process involved in securing additional disposal capacity (e.g., new landfills or energy from waste facilities) is lengthy and very expensive.	Landfill mining refers to the process of excavating previously landfilled waste to recover valuable recyclable materials and/or space. This is a complicated process involving the excavation, screening and sorting of waste.	Exporting of waste consists of shipping waste to a disposal facility (e.g., landfill or energy from waste facility) outside the jurisdiction's boundary. Exporting waste is typically done when there is limited or no disposal capacity within a jurisdiction's boundary.	Privatization of landfills is becoming a growing trend in the United States due the increasing regulatory costs in owning and operating landfill that local governments face. Privatization options range from cooperative agreements with private firms for support services to management contracts, asset sales, and even complete reliance on the landfill market for services.
Major Assumptions	- An EA will be required for the expansion which can take up to 10 years considering the necessary environmental studies, stakeholder and public consultations. - Once the EA is approved, the site ECA requires amending and potentially other approvals will be required/amending. Staff time will be required to oversee this process. - A vertical expansion would be within property boundaries, but further investigation would be required for a horizontal expansion. -While vertical expansion of existing landfills could provide some of the additional volume required, it is assumed it would not meet the entire volume needed and some amount of horizontal expansion would be required.	- The City undergoes a siting study to develop a new greenfield landfill within Kawartha Lakes. - The new landfill will manage residual waste currently handled by the City (residential, ICI). - An Individual EA will be undertaken and subsequent approvals and permits will be sought following EA approval (e.g., EPA, Planning Act, Conservation Authority). Significant consultation would be required as part of the EA process.	- City would undertake landfill mining at an active City landfill site in order to add air space for landfilling of the City's residual waste. (Noted the City explored mining at closed site but concluded there was not a strong business case) - It is anticipated that less than 100,000 m3 would be excavated thus not requiring an EA for the mining activities. - The specific site is not known but some equipment needed for mining would be available from landfill operations. - Additional equipment is assumed to be rented and not purchased by the City. - Some recyclable materials and soil will be screened and sent for recycling and reuse, respectively. The exact quantities and proportion are unknown. - Landfill mining would occur over a short term (i.e., 1-2 years).	- The City's transfer station would require upgrading/expansion to receive and transfer garbage to the disposal facility. - The disposal facility is a landfill or an energy from waste facility that is located outside of the City's property boundary but within Ontario. There will be capacity available to manage the City's waste. - Tipping fees will be higher than current fees at the City landfill sites given the additional transportation costs but savings will occur to not managing a landfill. - Export would be employed once the City's major landfill exhausted its capacity but it is noted that it could be used to delay closure.	- The City sells a landfill site to the private sector who will own and operate the facility. - The City will send its residual waste to the privately operated facility located in Kawartha Lakes. - The buyer will be responsible for all capital and development costs. - External legal counsel will be required.

Evaluation Criteria	Indicator	KPI	Rank	Rank Details	Score	Rationale	Score	Rationale	Score	Rationale	Score	Rationale	Score	Rationale
Economic Feasibility	Annual Operational Costs	$	1	$5,000,000 or greater	3	This option would see the extension of the current operational costs incurred to manage the City's landfill sites and as such, the incremental costs from current are anticipated to be small. However, it is anticipated that there will be a reduction given the consolidation of landfill sites to one site to accommodate future residual waste quantities. Additional staffing resources are not anticipated to be required.	3	Once approved, the additional costs to operate the new landfill site may not be that different from current costs and could potentially be lower with a consolidated site(s). Design, commissioning and staffing of a new landfill will require significant operating expenses over several years (>10 years estimated).	1	Rental of equipment for mining activities (e.g., trommel screens). Additional staffing or a contractor would be required for mining operations. Hauling of recovered materials for recycling or reuse will be required.	2	It currently costs the City approximately $2.7 million to operate the five landfill sites. It is anticipated that the costs to export will be higher than current costs.	3	City will need to pay tipping fees to the private sector for the landfilling of City waste which could be higher than present costs. However the City will experience cost savings as a result of not managing an active landfill site(s).
			2	$1,000,000 to $5,000,000										
			3	< $1,000,000										
	Capital Cost	$	1	$50,000,000 or greater	2	Depending on the site(s), extent of the expansion, etc. the cost to design and construct additional cells are anticipated to be between $10 - $50 mil.	1	A siting study, land acquisition, approvals and permitting and construction costs will be high.	3	It would cost less than $10 million to rent equipment needed for mining activities.	2	Upgrades to the City's transfer station or a new transfer station may be required to accommodate the receipt and transfer of residual waste.	3	The private company will assume the capital expenses. External legal counsel for contract negotiations will be required.
			2	$10,000,000 to $50,000,000										
			3	< $10,000,000										
	Level of risk - liability or environmental (e.g., low risk, expected results, may vary, City has little control)	Qualitative	1	Very high risk (e.g. results, liability, environmental impacts, control by City)	3	Low risk since this option would continue current operations which the City is very familiar with.	1	Significant studies are required to confirm the suitability of the proposed landfill site which will be done throughout the EA. The process from start to operation is very lengthy. An additional landfill site will require ongoing environmental monitoring after closure.	2	Some risks associated with uncertainty with what materials will be uncovered during reclamation (including quality of materials) and resulting impact on additional diversion and air space.	2	Liabilities would be assumed by the disposal facility owner. There is risk with the City relying on a non-City owned facility and availability of private sector disposal capacity in Ontario.	2	As the City no longer owns the site, the level of risk for operating the site decreases. Potential risk with lack of flexibility, limited control on tipping fees and loss of capital asset.
			2	Moderate risk (e.g. some risks but they can be mitigated)										
			3	Very low risk (e.g. good results, good for the environment, limited liability)										
Social Impact	Public Acceptance	Qualitative	1	Potential for opposition to the option	1	Any expansion of the landfill may introduce concerns from the public regarding continued use of the site. Public concerns could be addressed through appropriate public consultation defining mitigation measures and social benefits.	1	Siting a new landfill could see significant public resistance. Significant consultation with the public, Indigenous communities and stakeholders will be required.	1	Depending on which site the mining occurs, there is a potential for opposition due to noise and odour concerns. Public may favour additional diversion and increase in airspace.	2	Potential for local opposition as a result of transfer trailers along a haul route to the disposal site. The host community may be opposed to receiving waste from outside sources. Compared to landfill expansion and a new landfill, minimal opposition is anticipated.	1	Potential for opposition due to private sector assuming responsibility of a City-owned site.
			2	No public perception of the option										
			3	Option anticipated to be accepted/encouraged by the community										
	Collaboration with others (i.e. partner with other municipalities)	Qualitative	1	Anticipated decrease, or hindrance to collaboration	2	No change in collaboration are anticipated as a result of this option.	2	No change in collaboration opportunities are anticipated.	2	Minimal change to collaboration anticipated given this would occur at an existing City site.	3	This option requires collaboration with other municipalities and/or private sector disposal facilities.	1	Assuming private sector company owns and operates the facility, there will be limited collaboration other than the City being a customer to the private company.
			2	No change anticipated										
			3	Option will lead to increase collaboration with others (i.e. municipalities)										
	Proven or unproven (e.g., unproven, proven at smaller scale, proven at larger scale)	Qualitative	1	Unproven (e.g. currently at a pilot or small scale, no full scale implementation)	3	Landfill expansion is a proven approach and has been implemented in many existing landfills in Ontario.	2	Landfilling of waste is a proven method for waste disposal in Ontario and for the City. It is noted that the development of new landfill sites in Ontario is limited due to the regulatory environment and public opposition. Although landfill capacity in Ontario is diminishing, the development of a new municipal landfill has not occurred in decades and there are few private sector landfill sites that have been approved. Expansion of existing landfills is far more common in Ontario.	2	It is a proven approach in Canada and has occurred in Ontario at Durham Region in 2018 and the City of Barrie from 2009 to 2016. Mining the volume needed to meet the City's future residual waste quantities is not as common.	3	Exporting waste outside of municipal boundaries is a proven approach in Ontario (e.g., Regions of Peel and York, City of Guelph, and York Region).	2	Common approach in the United States and limited in Canada with one recent example in Cumberland County, Nova Scotia. Unproven in Ontario due to limited disposal capacity. The City of Toronto purchased a private landfill to ensure municipal access.
			2	Proven in jurisdictions smaller than the City										
			3	Proven in jurisdictions like the City or larger										
	Level of effort to develop, implement, operate and maintain the option (e.g., low to high level of effort)	Qualitative	1	High level of effort to develop and implement (e.g. more than 5 years)	2	Landfill expansions requires a lengthy EA process with significant consultation which can take several years to conduct, however, will be less complex than siting a new landfill and can use existing staff.	1	The process to develop a new landfill site will be difficult due to the contentious siting process, public opposition, and lengthy approval requirements.	2	The excavation, screening and sorting of waste is new to the City and additional resources will be required. An amendment to the ECA and an EA screening would be required if less than 100,000 m3 is excavated for the mining activities.	3	Modifications to the City's transfer station are anticipated including an ECA amendment. However, City staff are familiar with transfer station operations.	3	Legal and waste management staff will be required during the procurement process initially.
			2	Moderate effort to implement (e.g. some additional resources are needed, can be implemented in 3-5 years)										
			3	Easy to implement (e.g. can be done with existing staff resources)										
Environmental Impacts	Climate change impacts (e.g., estimated GHG reductions)	Qualitative	1	Results in little to no reduction in GHG emissions	2	Landfill gas will continue to be captured and managed. The short-term construction of the expansion will also generate higher amounts of GHG emissions.	2	A new landfill would contribute additional GHGs but collection and management of landfill gas would be required and could be converted to energy.	1	Given the requirement to expose and handle previously buried waste, a short-term increase in release of GHG at the landfill mining area is likely as well as increased traffic/vehicles hauling material longer distances will increase methane emissions from landfill disposal	1	GHG emissions would increase as a result of longer driving distance to haul residual waste to the disposal facility.	1	Option is anticipated to result in little to no reduction in GHG emissions.
			2	Results in a moderate reduction in GHG emissions										
			3	Significant reduction in GHG emissions										
	Energy (produced, consumed)	Qualitative	1	Will lead to a net increase in energy consumption	3	Landfilling more waste will generate more landfill gas which will allow more energy to be produced, however the short-term construction of the expansion will increase energy consumed.	3	Energy will be consumed during the construction of the new landfill site (short-term impact). However, landfill gas will be captured and converted to energy.	2	Minimal additional energy will be required to power equipment and for hauling of materials to end markets.	1	A higher amount of energy will be consumed by transporting waste further distances.	2	Minimal to no change in energy requirements are anticipated.
			2	Minimal to no energy required										
			3	Will lead to a net gain of energy production										
	Air Quality Impact	Qualitative	1	Significant release of emissions to atmosphere	2	Construction and operation involved in expanding a landfill will have some impact on air quality. Anticipate current management practices will be employed.	2	Developing a new landfill provides potential to increase release of emissions to the atmosphere however, best management practices and compliance with approvals and permits are assumed to be employed.	1	Potential for impact to air quality (e.g., odours, dust) during mining activities.	2	Increased air emissions due to hauling of waste to the disposal facility.	3	Minimal to no change in emissions to atmosphere.
			2	Some release of emissions to atmosphere										
			3	Minimal to no release of emissions to atmosphere										
	Land Requirements	Qualitative	1	Additional land required.	2	Land requirements will depend on whether the chosen approach is horizontal or vertical expansion as vertical expansion does not require additional land while horizontal expansion will. Land requirements will also depend on if the selected site(s) require purchase of additional land.	1	Developing a new landfill within the City would require additional land to be purchased.	3	Mining uses an existing landfill site and will make additional airspace available.	2	Space will be required for a new or expanded transfer station which is assumed to be located at an existing City landfill site.	3	Option looks to optimize existing asset through the sale of an existing landfill site to the private sector.
			2	Minimal to no additional land required.										
			3	Optimize existing asset, use existing site/building and/or potential to make land available										
	Impact to Groundwater and Surface Water	Qualitative	1	High potential to contaminate groundwater and/or surface water	2	Potential for some impact to groundwater and surface water however, current management and monitoring practise will be employed.	2	Potential for some impact to groundwater and surface water however, current management and monitoring practices will be employed.	3	It is anticipated that best management practices will be followed along with conditions in an amended ECA. Minimal potential release of contaminants to groundwater and surface water.	3	Minimal to no potential release of contaminants to groundwater and/or surface water at the transfer station assuming operations are well-contained and contact with stormwater is minimized.	2	Potential for some impact to groundwater and surface water however, the private operator is assumed to maintain management and monitoring practices as per the ECA requirements.
			2	Some potential to contaminate groundwater and/or surface water										
			3	Minimal to no potential release of contaminants to groundwater and/or surface water										
	Nuisance Impacts (odour, noise, traffic, litter)	Qualitative	1	Will increase nuisance impacts	2	As this option extends the current landfilling operations, minimal change to nuisances are anticipated.	1	A new landfill will increase traffic and visual impacts and potentially produce odour, noise, litter and dust which are anticipated to be mitigated.	1	Potential for increased nuisances such as odour, traffic, litter and dust for site neighbours during the mining process.	2	Minimal change to nuisances anticipated aside from increased traffic as a result of transfer trailers accessing the transfer station.	2	As this option extends the current landfilling operations, minimal change to nuisances are anticipated.
			2	Minimal to no change to nuisances										
			3	Will reduce nuisance impacts										
	Potential for diversion from landfill disposal	Qualitative	1	2% diversion or less or is difficult to measure	1	This option looks to manage residual waste only thus, no potential for additional diversion to occur.	1	This option looks to manage residual waste only thus, no potential for additional diversion to occur.	1	It is currently difficult to estimate the diversion impact however it is anticipated that some waste will be diverted for recycling and reuse (e.g., excavated soil used as daily cover).	1	Option does not increase diversion.	1	This option looks to manage residual waste only thus, no potential for additional diversion to occur.
			2	2 to 5% waste diversion/reduction										
			3	>5% waste diversion/reduction										