PROGRAM BUDGET SUMMARY

Biosolids Management - Business Unit 5423

Description	2020	2021	2022	2023	2024	2020-2024 Average
Actual - Total Program Costs	$704,765	$630,752	$765,590	$743,922	$728,029	$714,612
- Land Application Contractor Related Costs	$388,553	$419,348	$526,669	$496,147	$474,816	$461,107
-Composting	$86,042	$72,629	$95,697	$97,378	$90,729	$88,495
% Composting Costs to Total Actual Program Costs	12%	12%	12%	13%	12%	12%
Biosolids Produced	24,415	24,831	25,268	23,250	26,197	24,792
Total Biosolids Land Applied (WT)	23,003	23,130	23,446	20,837	22,451	22,574
Total Land App Contractor Beneficial Use ($/WT)	$16.89	$18.13	$22.46	$23.81	$21.15	**$17.87**
% of Overall Production	94%	93%	93%	90%	86%	91%
Total Biosolids Composted (WT)	1,261	1,236	1,364	1,373	1,377	1,322
Compost Cost ($/WT)	$68.2	$58.8	$70.16	$70.92	$65.89	**$66.79**
% of Overall Production	5%	5%	5%	6%	5%	5%

	2020	2021	2022	2023	2024
Beneficial Use <40 miles(WT)	12,013.0	13,154.0	11,571.0	3,450.0	10,788.5
Beneficial Use > 40(WT)	10,990.0	9,976.0	11,875.0	17,387.2	11,663.0
TOTAL	**23,003.0**	**23,130.0**	**23,446.0**	**20,837.2**	**22,451.5**

	2020	2021	2022	2023	2024
Beneficial Use <40 miles(WT)	52.2%	56.9%	49.4%	16.6%	48.1%
Beneficial Use > 40(WT)	47.8%	43.1%	50.6%	83.4%	51.9%

Greenhouse Gas (GHG) Emissions

Greenhouse gas (GHG) emissions estimates were calculated using the Canadian Biosolids Emissions Assessment Model (BEAM)[5] for two scenarios based on estimated sludge production of 26,265 wtpy: all biosolids produced by the AWWTP going to composting or all biosolids continuing to be land applied. The model consists of 12-unit process calculator modules and an aggregating spreadsheet that calculates net GHG emissions based on the values determined within each applicable module. Of the 12 possible GHG-generating unit processes, five were modeled: storage, anaerobic digestion, composting, land application, and transportation. A summary of model output is in Table 5 and calculations are in Appendix E.

Table 5. GHG Emissions Summary (metric tons of $CO_{2\text{-equivalent}}$ per year)

Unit Process	Composting	Land Application
Storage	- -	2,902
Anaerobic Digestion[1]	50,591	50,591
Composting	(3,352)	- -
Land Application	- -	(1,357)
Transportation	27	118
Totals	**47,226**	**52,255**
Equivalent number of cars[2]	10,266	11,360
Equivalent head of dairy[3]	11,806	13,064

[1]Including 48,935 MT CO_{2eq} per year due to flaring biogas from the anaerobic digesters

[2]Assuming 22 miles per gallon fuel efficiency and GHG emissions of 4.6 metric tons of CO2 per year per car (EPA, 2019)[6]

[3]Assuming 4 MT CO2eq per dairy cow (Rotz, 2018)[7]

[5] Canadian Council of Ministers of the Environment, Biosolids Emissions Assessment Model, July 2009

[6] U.S. EPA, "Greenhouse Gas Emissions from a Typical Passenger Vehicle", https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle

[7] Rotz, C., "Modeling Greenhouse Gas Emissions from Dairy Farms", *Journal of Dairy Science*, 101:6675-6690, 2018

Based on the model inputs (see Appendix E) estimated GHG emissions from composting are a net emission of 47,226 MT/year compared to land application which has a projected GHG generation rate of 52,255 MT/year. This is primarily due to soil carbon sequestration of compost-amended soils plus lesser transportation impacts plus discontinuance of on-site biosolids storage.

Economic Evaluation

Capital Costs

Capital costs were estimated for each alternative and included site development, infrastructure, and equipment. For the composting technologies, costs were calculated for all four approaches; the Reversing ASP approach was the most cost-effective of the four considered, and is the approach presented here for Alternative 3. Capital costs are summarized in Table 6 and detailed calculations are in Appendix F.

Table 5. Capital Costs for Alternatives

Alt. No.	Name	Capital Costs
1	Expand BSB by 11,055 wet tons	$7,372,000
2a	Expand BSB by 6,056 wet tons and build 10,000 wtpy composting facility - RASP	$13,492,000
2b	Expand BSB by 6,056 wet tons and build 10,000 wtpy composting facility - Tunnel ASP	$16,884,000
2c	Expand BSB by 6,056 wet tons and build 10,000 wtpy composting facility - Fabric-covered ASP	$16,738,000
2d	Expand BSB by 6,056 wet tons and build 10,000 wtpy composting facility - Agitated bed ASP	$15,302,000
3a	Build 20,000 wtpy composting facility - RASP	$16,880,450
3b	Build 20,000 wtpy expansion in 2028 - RASP	$20,248,100

Alt No. 1 Actual total costs for engineering and construction = $6,148,228 (2021-2024)