MISSOULA WWTP BIOSOLIDS EVALUATION

ALTERNATIVE ANALYSIS

City of Missoula

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DATE: Draft – November 22, 2010
Final – December 8, 2010

1.0 EXECUTIVE SUMMARY

The Missoula Wastewater Treatment Plant (WWTP) has relied upon EKO Compost (EKO) for many years to handle the biosolids or sludge which is a by-product of the activated sludge treatment process. The sludge is transported from the WWTP to EKO by conveyor belt, which is simple and inexpensive for the City of Missoula, valuable for EKO, and environmentally friendly with respect to carbon footprint of the facility.

Recently questions have arisen regarding the dependency on EKO for sludge disposal. Should EKO decide to close its doors or move its location, sludge disposal would become more difficult and expensive. To date, alternatives to disposing of sludge at EKO had not been evaluated. This study explores disposal options available to the City of Missoula with the intent of identifying disposal alternatives that are inexpensive and beneficial to the community with specific consideration of greenhouse gas emissions and carbon footprint.

1.1 Regulatory Requirements for Sludge Disposal & Topics of Concern

40 CFR Part 503 covers disposal of sludge by land application for agricultural purposes. Montana has a General Permit for Disposal of Sewage Sludge by Land Application which follows the EPA Region 8 General Permit and interprets the 503 regulations. The regulations specify requirements for sewage sludge classification, metals content, and vector attraction reduction requirements (VAR's). The regulations also define pathogen limits, management practices, and operational standards, as well as monitoring, record keeping and reporting requirements.

40 CFR Part 258 regulates disposal of sewage sludge in landfills. The regulations define acceptable metal limits, moisture content, and vector attraction requirements.

Historically, Missoula sludge has not exceeded the metals limits. Sludge must pass a "paint filter test" to ensure that it does not contain free liquid and must be covered within a specified period of time to reduce vector attraction. An exception is Class A sludge, which is unrestricted and may be used as daily cover.

1.2 Green House Gas Emissions

The "Missoula Greenhouse Gas Emission Inventory and Analysis (MGGEIA) 2003-2008" assessed the energy use, cost, and emissions from several major municipal sources of greenhouse gas producers in the community. The assessment identifies the WWTP to be the largest of the City-owned greenhouse gas producers. At 38% of the total municipal greenhouse gas production, it is an excellent opportunity for significant point source reduction. The MGGEIA study will be used as a reference for carbon footprint analysis throughout this report. Emissions are reported in metric tons of carbon dioxide equivalents, defined in the MGGEIA report as the metric tons of greenhouse gas multiplied by the Global Warming Potential.

According to the Intergovernmental Panel on Climate Change (IPCC), the leading international body for the assessment of climate change, greenhouse gas emission accounting and inventories are based on the following guidelines:

1. Include CO_2 emissions from burning of fossil fuel used to heat wastewater treatment plant buildings and processes, as well as to generate electricity used in the plant.
2. Include emissions of methane (this does not include methane that is flared, because burning converts the methane to CO_2). Methane is 23 times more likely to contribute to global warming than CO_2 and is reported as a CO_2 equivalent.
3. Include emissions of nitrous oxide. Nitrous oxide is 296 times more likely to contribute to global warming than CO_2 and is reported as a CO_2 equivalent.
4. Include credits for non-fossil carbon sequestration to offset fossil fuel CO_2 emissions.

1.3 Current Sludge Treatment at the Missoula WWTP

Missoula produces two different sludge products, both of which are directly conveyed to EKO. The sludge treatment process is shown in Figure 1-1.

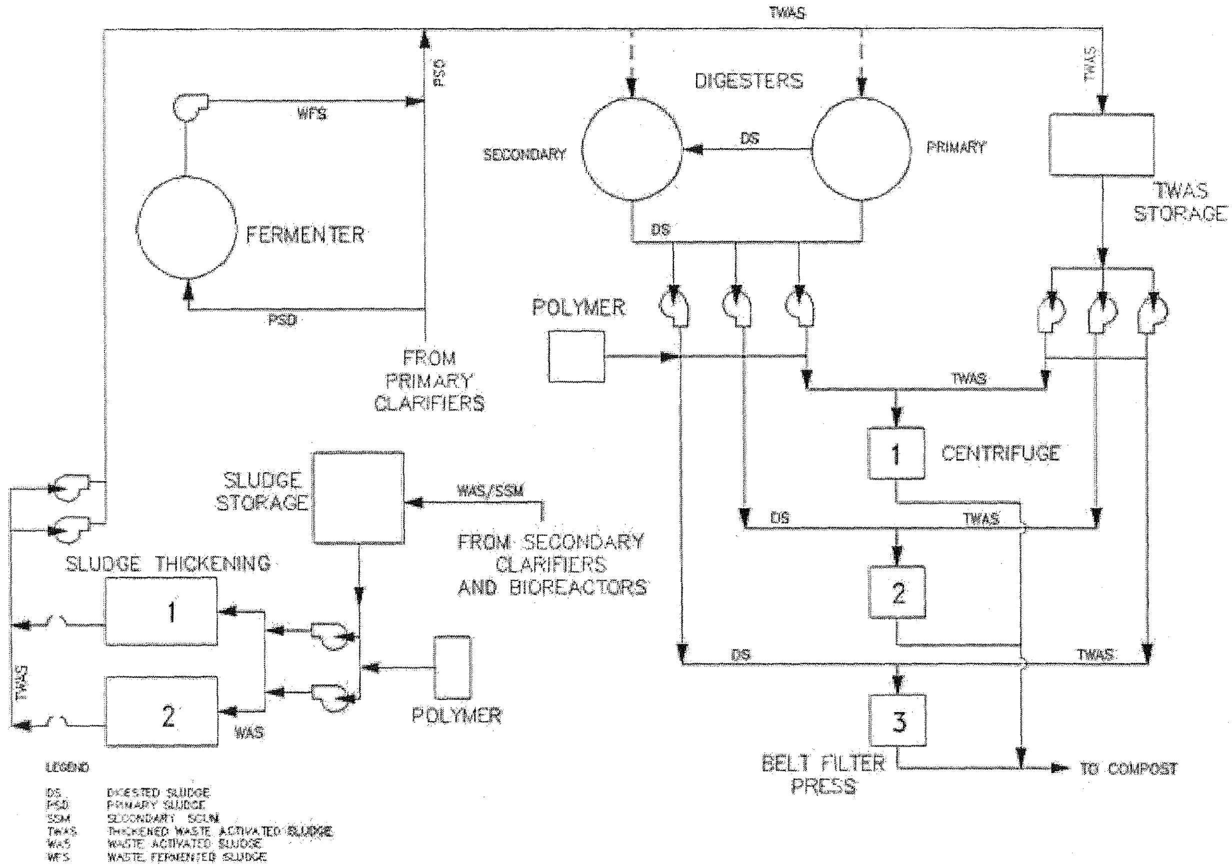

Figure 1-1. Solids Handling Process Diagram

1.4 Sludge Volume

The 2007 and 2008 sludge production, presented in Table 1-1 below for both digested primary sludge and TWAS were used to reflect the most recent operation of the facility. These numbers are averages over the period 2007-2008. 2026 sludge and bio-gas production was calculated based on a 1.33 projection factor.

TABLE 1-1
CURRENT AND FUTURE SLUDGE PRODUCTION

Parameter	Current Production[1]	Projected 2026 Production[2]	Unit
Primary Sludge	14,600	19,500	Gal/day
Secondary Sludge (TWAS)	41,300	55,100	Gal/day
Production Rate	39	52	gpm
Wet Tons	11,500	15,300	Tons/Year
% Solids at Outlet of Centrifuge	17	17	%
Dry Tons	1,960	2,600	Tons/Year

1. Based on 2007 and 2008 data.
2. Future volumes based on a projection factor of 1.33 .

1.5 Process Energy

WWTP amounts of biogas production and use, as well as demand for natural gas and electricity were estimated based on the current sludge handling process. Also included was energy use for composting operations, even though at this time these are not part of the WWTP. Table 1-2 summarizes energy production and use in the sludge process.

TABLE 1-2
WWTP ENERGY SUMMARY

Parameter	Current[1]	2026 (projected)[2]
Total Biogas Produced, ft^3/yr (MMBtu/yr)	29,117,200	38,725,900 (19,220)
Biogas Burned in Boiler, ft^3/yr (MMBtu/yr)	17,785,300	23,361,000 (11,680)
Biogas Flared, ft^3/yr (MMBtu/yr)	11,331,900	15,071,400 (7,540)
Natural Gas Purchased For Fixed Services (Primarily Building Heat) , ft^3/yr (MMBtu/yr)	2,600	2,560
Plant Electricity, kWh/yr	5,014,200	6,668,900
Energy used for Composting Operations, MMBtu/yr	2,670	3,550

1. Data based on 2007 and 2008.
2. Volumes projected to 2026 are based on a projection factor of 1.33 and building heating independent of influent flow rates.

1.6 Carbon Footprint of the Existing Biosolids Processes

The carbon footprint for 2026 conditions utilizing the existing biosolids process was calculated to include the processes shown on Figure 1-1. Carbon dioxide (CO_2) equivalents were determined based on conversions given in the MGGEAI report for the parameters listed in Table 1-2. Energy demand at EKO was estimated in kWh and converted to a CO_2 equivalent. Table 1-3 summarizes energy and CO_2 equivalents for the current process as projected to 2026.

TABLE 1-3
CARBON FOOTPRINT OF CURRENT SLUDGE PROCESSES[1]

Parameter	2026 (MMBtu/year)	2026 (Mt CO_2e)
Bio-gas Flared	7,540	580
Bio-gas Burned in Boiler	11,680	900
Natural Gas Purchased For Fixed Services (Primarily Building Heat)[2]	2,600	150
Electricity	2,960	400
Composting	3,550	480
Total Estimate Future	**28,330**	**2,510**

1. As projected to 2026.
2.Split of natural gas is further explained in Appendix A.

1.7 Alternative Analysis Screening

Each of the alternatives for achieving Class A or Class B sludge as well as details for landfilling and land application are discussed in detail. A brief summary of each process is outlined in Table 1-4. Capital, operating cost, and present worth estimates are presented where known. All cost estimates are located in Appendix B. Where analysis was possible, carbon footprint analysis is presented in metric tons of carbon dioxide equivalent released. Not all information obtained by vendors was of equal detail, and assumptions were applied where needed in order to make quantitative comparisons.

TABLE 1-4
BIOSOLIDS MANAGEMENT ALTERNATIVES

Alternative	Description
BS-1 EKO Compost , No Action Alternative	No changes are made to the current WWTP Operations and EKO to treat and process sludge to a Class A biosolids.
BS-2 EKO Compost under City of Missoula Management	EKO is acquired by the City of Missoula and no changes are made to the WWTP operations.
BS-3 Land Application of Existing Solids	Land application of the existing biosolids is used assuming all biosolids are treated in the digester to produce Class B biosolids.
BS-4 Allied Landfill Disposal	No changes are made to the current WWTP Operations and sludge is disposed of at Allied Landfill.
BS-5 Incineration/Combustion/ Heat Recovery	Combustion is added to the existing operation. The remaining inerts and ash (BS-4a and BS-4c) could be sold as a product to industrial users or landfilled. BS-4b looks at flare gas recovery for cogeneration. Several options are available: **BS-5a**: On-site incineration **BS-5b**: Stirling Engine with energy recovery **BS-5c:** Teaming with the University of Montana on their biomass boiler.
BS-6 [OTHER SLUDGE PRODUCTION PROCESS] Innovative Technologies – CleanB ™	An innovative treatment process is implemented for sludge treatment to achieve Class A or B biosolids. Alternative provided by BCR Environmental.
BS-7 Alkaline Stabilization	An alkaline addition pasteurization process is implemented to achieve Class A or Class B sludge.
BS-8 Belt Drying	A belt dryer is implemented to achieve Class A or B biosolids. Several options are available: **BS-8a**: BioCon™ with EES (energy exchange system) **BS-8b**: BioCon™ with ERS (energy recovery system) **BS-8c:** Andritz Belt Dryer
BS-9 Autothermal Thermophilic Aerobic Digestion System (ATAD)	Digestion to Class A sludge using two new aerobic digestion concrete tanks and conversions of an existing tank. Dewatering would occur in the existing centrifuge.

1.8 Summary

A summary of capital cost, O&M cost and present worth for the alternatives that were carried forward for further analysis is shown in Table 1-5. Alternatives BS-1, BS-2, and

BS-5b continue to use EKO as the final choice for solids disposal. All other alternatives assume landfill disposal costs which results in higher present worth values.

1.9 Carbon Footprint

Estimated metric tons of carbon dioxide equivalents are shown in Table 1-5 for each alternative brought forward for further analysis. Alternative BS-5b which uses methane created during anaerobic digestion to produce electricity and heat is the lowest greenhouse gas emitter when credits for reducing natural gas and electricity demands are added into the carbon footprint analysis.

TABLE 1-5
COST SUMMARY FOR BIOSOLIDS ALTERNATIVES

Alternative	Capital Cost	Annual O&M	Present Worth	2026 (Mt CO2e)
BS-1 EKO Compost, No Action Alternative	$0	$323,400	$4,030,000	1,030
BS-2 EKO Compost under City Management	$2,000,000	$323,400	$6,030,000	1,030
BS-3 Land Application of Existing Solids	$201,000	$318,000	$4,160,000	840
BS-4 Allied Landfill Disposal	$201,000	$338,000	$4,411,000	3,290
BS-5b Excess Biogas Directed to Stirling Engine	$645,000	$9,500	$763,000	690
BS-6 Innovative Technologies – CleanB ™	$4,580,000	$385,000	$9,374,000	790
BS-7 Alkaline Stabilization	$2,632,000	$507,000	$8,952,000	790
BS-8a Biocon BEES	$4,989,000	$307,000	$8,817,000	2,510
BS-8b Biocon ERS	$8,907,000	$303,600	$12,691,000	3,130
BS-8c Andritz Belt Dryer	$6,690,000	$367,800	$11,274,000	2,870
BS-9 ATAD	$4,298,000	$348,000	$8,632,000	1,640

1.10 Conclusion

Land application and Stirling engines for use of biogas are low-cost, low carbon footprint alternatives. However, due to issues with land procurement and unreliable performance of this new process these alternatives are not recommended at this time. Other low-cost alternatives include the no-action alternative (current sludge process/composting) and landfilling sludge produced with existing processes. The no-action alternative leaves the WWTP dependent on EKO and is not sustainable if EKO discontinues operations. Landfilling is not recommended because if its large carbon footprint due to methane emissions. At this time, alternative BS-2, current sludge processing with disposal at a City-owned EKO facility, is the most attractive option. Keeping the composting facility in operation will provide a simple sludge disposal option and a benefit to the entire community with the potential to reduce the overall carbon footprint for Missoula.