2022

City of Washburn Wastewater Utility Energy Assessment

WISCONSIN RURAL WATER ASSOCIATION

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March,2022

Energy Efficiency Program Overview:

The Wisconsin Rural Water Association has implemented a program to assist water and wastewater utility systems to evaluate and lower their energy consumption and costs. This energy efficiency assessment considers current and past energy use, identifies the primary energy consuming components, and identifies methods to lower energy use and costs.

The Energy Efficiency program will include a visit at the treatment plant site and a thorough audit of existing systems at the plant. Then an analysis of the gathered data is examined and recommendations for energy savings can be made. WRWA will then provide any funding information that may be available. These data can provide decision makers with information to make an informed decision on future energy conservation projects.

UTILITY INFORMATION

Utility Name:	Washburn Wastewater Treatment Plant
Address:	948 W. Bigelow St.
	Washburn, WI 54891
Plant Contact:	Joel Weber
Phone #:	715-373-6055
Email:	city114@centurytel.net
Assessor:	Dan Wundrow
Phone #:	(715)563-0188
Email:	dwundrow@wrwa.org
Assessment Date:	3/28/2022


Executive Summary of Potential Energy/Money Savings

The Washburn WWTP was originally built in 1996 and uses an activated sludge process for treating approximately 93 million gallons of wastewater per year. Plans have been completed with the installation of a solar system along with some other upgrades. The plant still has process problems with the aeration zone (having areas that will not mix or dead zones) excessive aeration needed to complete day to day operations and lack of containment around an outdoor aerobic digester. The City of Washburn is interested in the return on investment of the solar field. An energy follow up was done on March 28, 2022. Mr. Dan Wundrow, WRWA Energy Efficiency Technician audited the plant by having the lead operator, Mr. Joel Weber, take him through the plant to look over all electrical equipment, pumps, HVAC, and lighting. An analysis was performed by Mr. Wundrow using the EPA Energy Use Assessment tool and an Energy Saving tool provided by a private vendor. Following are the results of the audit:

The City of Washburn is in Bayfield County in northern Wisconsin and has a population of 2,051. During the Energy Assessment it was discovered that Washburn wastewater used 6,387kWh/MGAL in 2018 an in 2021 used 4,137kWh/MGAL that is a total reduction of 64%. In the operating year of 2018 Washburn wastewater used 592,498kWh annually and cost $39,156. Once the solar system was installed and operational Washburn wastewater used 311,840kWh annually and cost $15,936. Washburn wastewater saves annually $23,219 and the simple payback will be 7-years. It should be noted the Levelized Cost of Energy (LCOE) of the solar array is currently on track 6-8 years. Washburn should be budgeting for the replacement of the inverters. Typically, inverters are built into the project but if not replacement of the inverters are done around 10 to 15 years of the life cycle.

During a follow-up visit Mr. Weber had some areas of concerns that need to be looked at. During a small inspecting some more energy savings could be found along with some optimizing some treatment. After reviewing the equipment and operations an estimated 92,382kWh reduction could be achieved by implementing the following recommendations. Along with the reduction of kWh Washburn wastewater could see and estimated $3,698 annual cost savings.

- Install VFD on Blower 1
- Install VFD on Blower 4

The estimated cost for a VFD for a 20h.p. blower is $1,531 plus installation with a simple payback of .8 months. This recommendation would provide a monetary savings of $1,849 for each VFD installed and a combined savings of $3,698. Along with the monetary savings Washburn wastewater could see a reduction of 46,191kWh for each VFD and a combined reduction of 92,382kWh. Both savings are on annual basis.

Mr. Weber and the Energy Technician also found other areas that could optimize treatment that should be noted. Listed are the areas that need to be addressed.

- Poor aeration/mixing within the aeration basin
- No cover on the outdoor aerobic digester
- Replace return airlift pump with submersible pump

Poor aeration/mixing within the aeration basin. Washburn aeration basin currently uses fine bubble aeration which is currently the most efficient aeration to use. Currently the aeration basin is lacing some mixing within the corners of the basin thus the reason for having a higher D.O. to try and mix the corners better. Either more fine bubbles need to be added in dead zones or adding coarse bubble diffuser in strategic locations. Mr. Weber stated that the corners near the building and the Northeast side of the aeration zone are poorly mixed. In the image to the left the aeration does not appear to reach close to the northeast side of the pond and at the corners of the building of the aeration basin. Fixing these problems would allow the operator to reduce the amount of D.O. for mixing and could achieve more kWh reduction in the future.

No cover on the outdoor aerobic digester. Mr. Weber stated during the winter months it is required to run the blower 24/7 to prevent freeze ups of the digester. If this was covered Washburn could run the digester blower on 15-minute cycle. (15-minutes on and 15-minutes off) This is the same as the 4hours on and 4 hours off that Washburn currently operates in the summer months.

Replace return airlift pump with submersible pump. During the follow-up visit it was noted that an airlift pump was being operated for the RAS and WAS. Additional kWh savings could be achieved by installing a submersible pump with a flow meter. It should be noted that the calculated saving was low. Without knowing the requirements of the airlift, the Energy Technician could not give an accurate annual savings thus the reason it is listed as a recommendation for optimizing treatment.

During the follow-up visit the Energy Technician and Mr. Weber also discussed the importance of what to look at when replacing or fixing electric motors. It should be noted that Washburn replaced Sewage pump 3 and had Sewage pump 4 motor rebuilt. When Sewage pump 3 was replaced, it was replaced with a high-efficient motor at 92.4% and current amps was recorded at 12.4 amps. While Sewage pump 4 was rebuilt and the recorded amps was 22 amps. A discussion was had that when motors need repair and/or replacement to identify what the energy efficiency rating. Any Motor below 90% efficiency should be replaced with high-efficient motor when possible.

The Energy Technician also recommended other low cost/no cost improvements for Washburn wastewater system which included maintenance of equipment, turning off unnecessary lighting and installing occupancy sensors, installing programable thermostats, and idle any unnecessary equipment.

Table 1: UTILITY USE, COST AND WASTEWATER TREATMENT FLOW SUMMARY FOR WASHBURN YEAR 2018 AND 2021

Account	Flow	Energy Consumption (kWh)	Energy Cost ($)
WWTP 2021(bills)	75.368	311,840	$ 15,936.95
WWTP 2018 (bills)	92.754	592,498	$ 39,156.77
Savings after Solar upgrade			$ 23,219.82
2021 kWh/MGAL			4,137.57
2018 kWh/MGAL			6,387.84
2021 Cost/MGAL			$ 211.46
2018 Cost/MGAL			$ 422.16

Table 1 represents the City of Washburn flow, electrical consumption, and cost for the years of 2018 and 2021. This table also shows the savings from 2018 and 2021 of the kWh/MGAL and Cost/MGAL. After the solar system was up and running the saving in electrical consumption was 280,658kWh and cost savings of $23,219 annually.

Chart 1: UTILITY kWh/MGAL FROM 2018 AND 2021

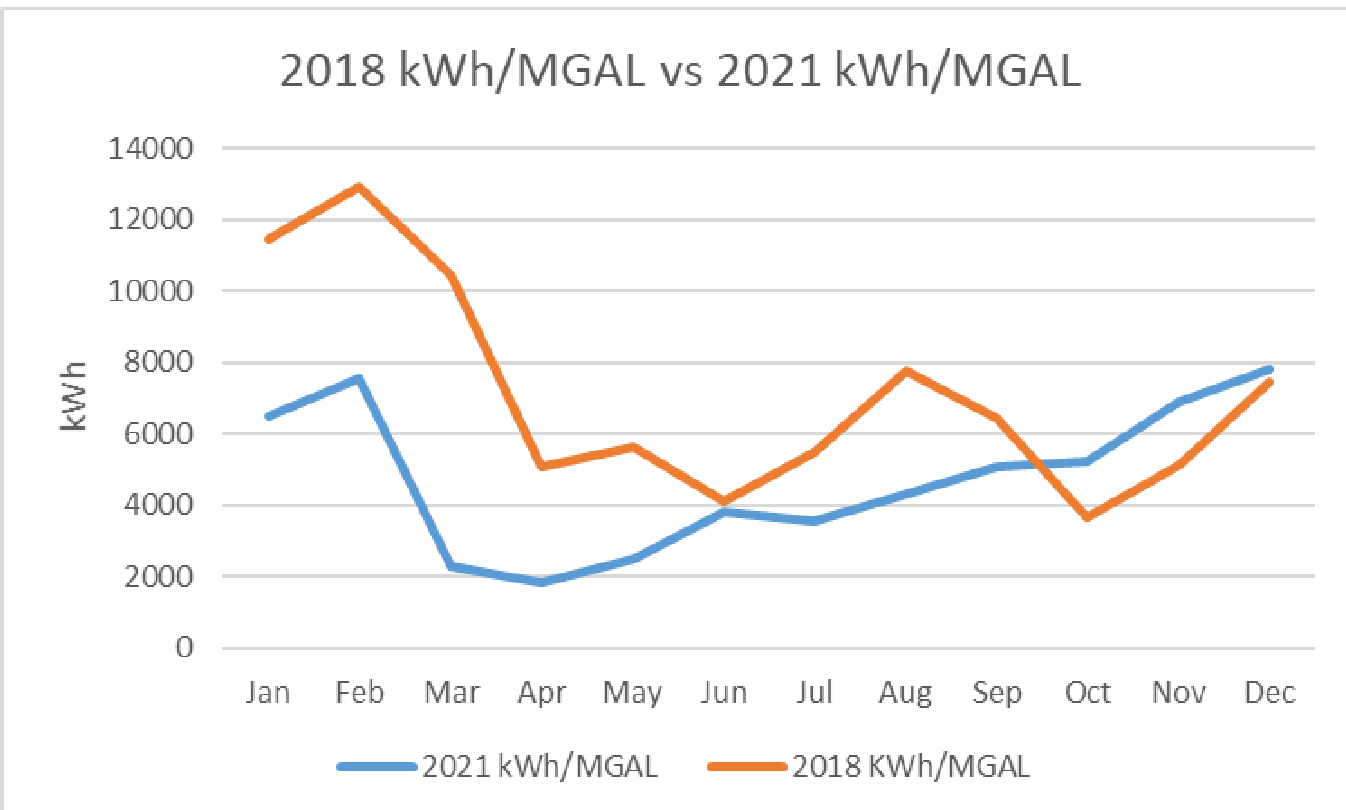

Chart 1 represents the City of Washburn kWh/MGAL from 2018 and 2021. This chart is showing how the kWh/MGAL has reduced by half. It should be noted that in October of 2021 you can see that the kWh/MGAL goes over the kWh/MGAL from 2018. This is accounted for that in after research the operator noticed the problems with aerobic digester freezing up and would have to run heat tap and the blower 24 hours a day until the freezing months are over. It should also be noted that the operator has also needed to run all 4 aeration to keep the aeration zone more mixed.

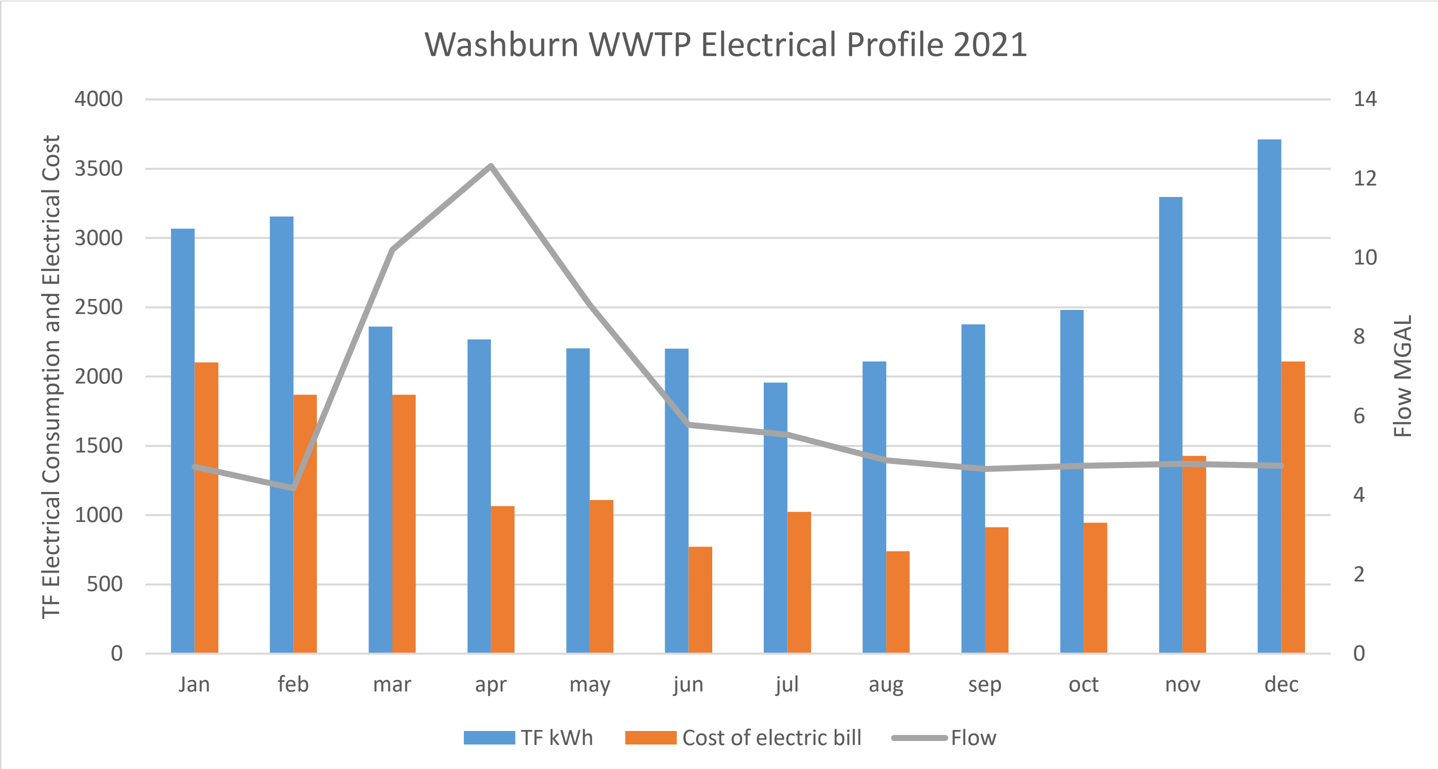

Figure 1: WASTEWATER POND SYSTEM ELECTRICAL PROFILE

Figure 1 shows the monthly electrical cost and consumption for the City of Washburn wastewater system 2021. The transformed consumption presented in Figure 1 represents 10 percent of actual electrical consumption. The greatest electrical cost and consumption occurred in December 2021 while the greatest flow occurred in April 2021.

Project Overview:

The Washburn Wastewater Treatment Facility (originally built in 1996) process is an Activated Sludge System in an Oxidation Basin configuration with secondary clarification, reed bed/sludge storage. Influent enters the plant via gravity main that enters a large wet well. From there influent is pumped to a splitter box that will direct the wastewater into the aeration ditch. In the event of heavy rains, water will automatically be pumped to and EQ basin and wait for later treatment. Once the wastewater enters the aeration ditch the wastewater will get treated with fine bubble aeration, once the wastewater exits via gravity to the clarifier solid will settle out to the bottom where some will become RAS, and Some will become WAS. RAS is returned to the head of the aeration and the WAS is sent to the aerobic digester. Water from the clarifier then moves to UV disinfection then discharged to the Lake Superior. After the aerobic digester waste is then pumped to the reed beds.

Energy Efficiency Observations/Opportunities:

After a detailed inspection of the wastewater treatment system, a list of major energy consuming components was observed:

Table 2: EQUIPMENT INVENTORY: BREAKDOWN OF ESTIMATED ELECTRICAL ENERGY USE FOR MAJOR/ENERGY INTENSIVE EQUIPMENT

Major Process/Top Energy Use Systems	Motor Efficiency (%)	Efficiency Rating	Electric Energy Use (%)	Electric Energy Use (kWh)	Electric Energy Cost ($)
Aerobic Digestion					
Blower - Blower 1	91	High	27.53%	85,851	$4,387.49
Blower - Blower 2	91	High	31.41%	97,952	$5,005.97
Blower - Blower 3	91	High	31.80%	99,151	$5,067.23
Anaerobic Digestion					
Blower - Blower 4	91	High	34.29%	106,943	$5,465.45
Flow Equalization Basin					
Pump - Pump 3	92.4	High	2.69%	8,391	$428.85
Headworks					
Pump - Pump 5	91.7	High	0.00%	1	$0.05
Pump - Pump4	91.7	High	3.78%	11,772	$601.63
Pump - Pumps 6	91.7	High	0.00%	6	$0.33
Internal Plant Pumping					
Pump - Reed Bed Pump 1	90	Medium	0.00%	7	$0.36
Pump - Reed Bed Pump 2	90	Medium	0.00%	7	$0.34
Ultraviolet Disinfection					
Other kW Load -	N/A	N/A	5.62%	17,520	$895.38

Estimated Annual Electric Use & Cost	427,602	$21,853
Actual Annual Electric Use & Cost	311,840	$15,937
Difference Between Billed and Identified	115,762	$5,916
Percent of Site Electrical Energy Identified		137.12%

Table 2 gives an inventory break down of the Washburn wastewater system. The software program used to create this table accounted for over 137 percent of the electrical energy used by the system. It should be noted that the percent of energy account for is higher is because of the offset of solar power. Blowers account for the largest electrical consumption within the wastewater system.

Electricity is provided to the Washburn wastewater pond system through Xcel Energy. Cost of electricity to the pond system is $0.0511 per kWh, and the total electrical cost is $15,937 per year. The other remaining electricity is provided via solar power.

Additional Energy Efficiency Recommendations:

The following recommendations for energy reduction and cost savings were explored for the City of Washburn wastewater system:

- Install VFD on Blower 1
- Install VFD on Blower 4 for aerobic digester

Table 3: ENERGY SAVING RECOMMENDATIONS

Recommendations	Investment	Estimated Annual Cost Savings	Simple Payback
Install VFD on Blower 1	[F]$1,531 plus installation	$1,849 annually	.8 months
Install VFD on Blower 4	[F]$1,531 plus installation	$1,849 annually	.8 months

Note: Columns with [F] are eligible for a prescriptive rebate through Focus on Energy (FOE). Values shown in these columns reflect after-rebate prices. Savings are based on motor operation at 48 hertz. All values within Table 3 are intended as estimated guidelines only and as such do not represent exact savings. FOE also offers custom rebate incentives for qualifying projects – contact FOE for more information.

Capital Improvement Recommendations

Capital Improvement 1: Install VFD on Blower 1 for aeration
Existing State: Current blower is not operating on VFD and runs at 100% speed in the year of 2021 Washburn wastewater used 85,851 kWh to operate blower 1.
Proposed State: It is possible to lower the energy if a VFD is installed to current blower motor to achieve both required aeration and energy savings.
Savings and Investment: A VFD for a 20 hp costs approximately $1,531 plus installation. If a VFD controlled motor operated at 48 hertz (80% control output) would achieve an estimated reduction of 46,191 kWhs per year, would save approximately $1,849 per year, and have a simple payback of .8 months.
Measurement & Verification: Note usage of kWhs reduced on energy bills.

Capital Improvement 2: Install VFD on Blower 4 for aeration of aerobic digester.
Existing State: Current blower is not operating on VFD and runs at 100% speed in the year of 2021 Washburn wastewater used 85,851 kWh to operate blower 4.
Proposed State: It is possible to lower the energy if a VFD is installed to current blower motor to achieve both required aeration and energy savings.
Savings and Investment: A VFD for a 20 hp costs approximately $1,531 plus installation. If a VFD controlled motor operated at 48 hertz (80% control output) would achieve an estimated reduction of 46,191 kWhs per year, would save approximately $1,849 per year, and have a simple payback of .8 months.
Measurement & Verification: Note usage of kWhs reduced on energy bills.

Low Cost/No Cost Recommendations

The following is a standard list of Low Cost/No Cost Recommendations for wastewater treatment:

- Evaluate your current rate schedule and identify the most efficient rate for your facilities.

Operational energy saving examples include:

- Maintain pumps; inspect, lubricate, and replace seals and bearings; check belt tension and alignment and adjust for optimal operation per manufacturers recommendations.
- Turn off unnecessary lighting and install occupancy sensors.
- Adjust system operations when there is a change in water load.
- Shift nightly low flow periods or seasonal low flow periods to lower VFD energy levels, if applicable.
- Install programmable thermostats and utilize night set back / set up settings.
- Review your operations to identify if any pumps are being throttled. If throttled pumps are identified, review to determine if they can be unthrottled to operate more efficiently.
- Idle any unnecessary equipment.
- Review Focus on Energy's Water and Wastewater Energy Efficiency Best Practices Guide. This updated guide outlines the basic steps in building an energy management program, as well as providing detailed information on water, wastewater, building efficiency, and general best practices.

Sources of Funding:

The City of Washburn is currently eligible for USDA RUS/RD loan/grant funds. It is suggested that any energy efficiency improvements be funded with a loan/grant that comes from either of these sources when an upgrade is done. In addition, the Wisconsin Focus on Energy program can award grants for energy efficient equipment upgrades.