



MISSOURI DEPARTMENT OF NATURAL RESOURCES

**City of Joplin
Wastewater Treatment Plants Improvements**

**Clean Water State Revolving Fund
Green Project Reserve
Business Case**

**State Fiscal Year 2010 Intended Use Plan
Project Number C295548-02**

**Loan Closing Date: January 26, 2011
Loan Amount: \$26,000,000
Green Amount: \$5,001,000**

I. TURKEY CREEK WWTP – TURBO BLOWERS W/VFDS

Summary

- Three 175 horsepower (HP) high-speed turbo blowers with direct motor drive and variable frequency drive.
- Anticipated Total Loan amount = \$26,000,000
- Estimated Categorical energy efficient (green) portion of loan for this component = 1.4% (\$371,000)
- Estimated annual energy savings \$58,900 per year.

Background

The turbo blowers are being installed for the new aerobic digester which will help increase efficiency and lower energy costs compared to conventional blowers.

Energy Efficiency Justification

Units are of high efficiency design with precise control of output based on oxygen demand and mixing requirements. Units are anticipated to result in a 25% reduction in energy consumption compared to conventional positive displacement or centrifugal, gear-driven blowers.

Power savings is estimated at approximately 90 HP for full-time operation, which equals \$58,900 per year at \$0.10/kilowatt-hour (kWh). The blowers are estimated to cost about \$100,000 more than conventional blowers, therefore the payback on the turbo blowers is approximately 1.7 years ($\$100,000 \div \$58,900 = 1.7$ years) for a piece of equipment with a 15-year useful life.

Conclusion

- By using these high-speed turbo blowers, the city will reduce the power demand by approximately 25%.
- The savings is approximately \$58,900 per year in energy costs with a payback period of 1.7 years.
- Categorically GPR-eligible per Section 3.2-2, “*Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR*”.

2. TURKEY CREEK WWTP – PUMP VARIABLE FREQUENCY DRIVES

Summary

- Variable frequency drives to be installed on two 60 HP and one 125 HP peak flow pumps, two 70 HP raw sewage pumps, and six 30 HP sludge pumps.
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy efficient (green) portion of loan for this component = 0.7% (\$190,000)
- Estimated annual energy savings \$13,100 per year.

Background

The variable frequency drives provide a uniform flow through the process, with a minimum of starts and stops, reducing starting amperage, and optimizing pumping efficiency.

Energy Efficiency Justification

It is estimated that the use of VFDs for the eleven pumps will reduce overall power consumption by about ten percent when compared with full voltage operation of the pumps. This power savings result primarily, from a reduction in the inrush current associated with multiple pump starts, as well as an ability to control pump operating speed and capacity within an efficient operating range

Of the previously listed pumps, approximately 200 HP will be in continuous operation. The savings in power associated with the VFDs is therefore estimated at about 20 HP. At \$0.10/kWh, this 20 continuous horsepower costs \$13,100 per year. The payback on the variable frequency drives is approximately 14.5 years ($\$190,000 \div \$13,100 = 14.5$ year), which is less than the 20 year useful life of the variable frequency drives, and is therefore cost effective.

Conclusion

- The savings is approximately \$13,100 per year in energy costs with a payback period of 14.5 years.
- Per Section 3.5-9, “*Variable Frequency Drive can be justified based upon substantial energy savings*”.

3. TURKEY CREEK WWTP – OXIDATION DITCH MIXERS

Summary

- Four slow speed propeller mixer to be installed in the oxidation ditches.
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy efficient (green) portion of loan for this component = 0.4% (\$114,000)
- Estimated annual energy savings \$35,300 per year.

Background

The slow speed propeller mixers will allow for proper mixing of activated sludge without the over aeration by the brush rotor aerators.

Energy Efficiency Justification

The use of the four 6.5 HP mixer is expected to reduce brush rotor power consumption by an average of 80 HP, resulting in a net reduction in power consumption of 54 HP. At a cost of \$0.10/kWh, the addition of the mixers is estimated to save \$35,300 per year in electrical costs.

The payback on the oxidation ditch mixers is approximately 3.2 years ($\$114,000 \div \$35,300 = 3.2$), while the mixers have a useful life of nearer 15 years. Installation of the mixer is clearly cost-effective.

Conclusion

- The savings is approximately \$35,300 per year in energy costs with a payback period of 3.2 years.
- Per Section 3.4-1, *“Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset”*.

4. TURKEY CREEK WWTP – SLUDGE DEWATERING EQUIPMENT

Summary

- Two belt filter presses with gravity thickening capabilities.
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy innovative (green) portion of loan for this component = 9% (\$2,327,000)
- Estimated annual sludge hauling savings \$190,165 per year.

Background

The belt filter presses will significantly reduce the volume of sludge to be hauled to and applied at land application sites.

Environmentally Innovative Justification

The hauling of liquid waste sludge costs the City of Joplin approximately \$180 per tanker load. At design conditions an estimated 59,000 gallons per day of waste sludge would need to be hauled and land applied from the Turkey Creek WWTP. This equates to an average of 9.8 tanker loads per day. With the belt filter presses at design conditions the waste sludge volume will be reduced to approximately 8,685 gallons per day, which equated to an average of 1.7 trucks loads per day.

The hauling of the dewatered sludge saves the City approximately \$1,458 per day in hauling costs at design conditions. Operation of the belt filter presses is estimated to cost \$937 per day at design conditions, thereby saving the City \$521 per day, or \$190,165 per year when compared with liquid sludge hauling. Given a useful life of 20 years for sludge dewatering equipment, the \$190,165 per year savings is determined to be cost-effective ($\$2,327,000 \div \$190,165 = 12.2$ year payback).

Conclusion

- The savings is approximately \$190,165 per year in sludge hauling costs with a payback period of 12.2 years.
- Per Section 4.5-5b, “*Treatment technologies or approaches that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals*”.

5. SHOAL CREEK WWTP – TURBO BLOWERS W/VFDS

Summary

- Four 175 HP high-speed turbo blowers with direct motor drive and variable frequency drive control.
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy efficient (green) portion of loan for this component = 2% (\$510,000)
- Estimated annual energy savings \$78,400 per year.

Background

The high-speed turbo blowers are being installed for the new aerobic digester which will help increase efficiency and lower energy costs compared to conventional blowers.

Energy Efficiency Justification

Units are of high efficiency design with precise control of output based on oxygen demand and mixing requirements. Units are anticipated to result in a 25% reduction in energy consumption compared to conventional positive displacement or centrifugal, gear-driven blowers.

Power savings is estimated at approximately 120 HP for full-time operation, which equals \$78,400 per year at \$0.10/kWh. The blowers are estimated to cost about \$135,000 more than conventional blowers, therefore the payback on the turbo blowers is approximately 1.7 years ($\$135,000 \div \$78,400 = 1.7$ years) for a piece of equipment with a 15-year useful life.

Conclusion

- By using these high-speed turbo blowers, the city will reduce the power demand by approximately 25%.
- The savings is approximately \$78,400 per year in energy costs with a payback period of 1.7 years.
- Categorically GPR-eligible per Section 3.2-2, “*Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR*”.

6. SHOAL CREEK WWTP – OXIDATION DITCH MIXERS

Summary

- Four slow speed propeller mixer to be installed in the oxidation ditches.
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy efficient (green) portion of loan for this component = 0.4% (\$114,000)
- Estimated annual energy savings \$35,300 per year.

Background

The slow speed propeller mixers will allow for proper mixing of activated sludge without the over aeration by the brush rotor aerators.

Energy Efficiency Justification

The use of the four 6.5 HP mixer is expected to reduce brush rotor power consumption by an average of 80 HP, resulting in a net reduction in power consumption of 54 HP. At a cost of \$0.10/kWh, the addition of the mixers is estimated to save \$35,300 per year in electrical costs.

The payback on the oxidation ditch mixers is approximately 3.2 years ($\$114,000 \div \$35,300 = 3.2$), while the mixers have a useful life of nearer 15 years. Installation of the mixer is clearly cost-effective.

Conclusion

- The savings is approximately \$35,300 per year in energy costs with a payback period of 3.2 years.
- Per Section 3.4-1, “*Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset*”.

7. SHOAL CREEK WWTP – DIGESTER COVERS

Summary

- Remove, repair, and replace digester covers
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy efficient (green) portion of loan for this component = 0.4% (\$100,000)
- Estimated annual energy savings \$28,470 per year

Background

The existing digester covers have developed leaks that allow methane to escape, thereby increasing the consumption of natural gas for sludge heating.

Energy Efficiency Justification

It is estimated that an average of 10,000 cubic feet (c.f.) of digester gas is lost daily, representing 6.5 million British thermal units (BTU) per day. An equivalent volume of natural gas is 6,500 cubic feet which, at \$12/1,000 c.f. equals \$78 per day, or \$28,470 per year. The calculated payback of the repair is 3.5 years ($\$100,000 \div \$28,470 = 3.5$ years), while the useful life of the repaired cover is approximately 20 years.

Conclusion

- The savings is approximately \$28,470 per year in energy costs with a payback period of 3.5 years.
- Per Section 3.4-1, *“Project must be cost effective. An evaluation must identify energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset”*.

8. SHOAL CREEK WWTP – SLUDGE THICKENING EQUIPMENT

Summary

- One gravity belt thickener.
- Anticipated Total Loan amount = \$26,000,000
- Estimated energy innovative (green) portion of loan for this component = 4.5% (\$1,175,000)
- Estimated annual sludge hauling savings \$328,000 per year.

Background

The gravity belt thickener will significantly reduce the volume of sludge to be hauled to and applied at land application sites.

Environmentally Innovative Justification

The gravity belt thickener is provided to allow for thickening of the waste activated sludge from approximately 1.5% solids to 6% solids, thereby reducing the volume of sludge to be hauled to land application sites. At design conditions, the gravity belt thickener will reduce the waste sludge volume from 59,000 gallons per day (gpd) at 1.5% solids to 15,000 gpd at 6% solids. This 44,000 gpd reduction in waste sludge hauling represents a savings of approximately \$1,320 per day at a current disposal cost of \$0.03 per gallon. The corresponding cost to operate the gravity belt thickening equipment equals about \$420 per day, resulting in a net savings of \$900 per day, or \$328,000 per year, when using the gravity belt thickener.

The \$900 per day net savings in sludge hauling costs equates to a payback of 3.6 years ($\$1,175,000 \div \$328,000 = 3.6$ years). Given a 20-year useful life for equipment, the use of a gravity belt thickener to reduce sludge hauling cost is cost-effective.

Conclusion

- The savings is approximately \$190,165 per year in sludge hauling costs with a payback period of 12.2 years.
- Per Section 4.5-5b, “*Treatment technologies or approaches that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals*”.

9. SHOAL CREEK WWTP – NON-POTABLE WATER SYSTEM

Summary

- Existing water system will be converted to a non-potable water system
- Anticipated Total Loan amount = \$26,000,000
- Estimated Categorical water efficient (green) portion of loan for this component = 0.4% (\$100,000)

Background

Changing of the potable water system to a non-potable system where possible, to allow the use of plant effluent for cleanup, sludge dewatering, etc. will significantly reduce the potable water consumption at the Shoal Creek WWTP.

Water Efficiency Justification

The non-potable water system will significantly reduce the potable water consumption at the WWTP.

Conclusion

- Categorically GPR-eligible per Section 2.2-6, “*Recycling and water reuse projects that replace potable sources with non-potable sources*”.

References

- Attachment 2. 2010 Clean Water and Drinking Water State Revolving Fund 20% Green Project Reserve: Guidance for Determining Project Eligibility.
- Proposed Green Project Reserve Components - WWTP Improvements – SRF C295548-02 - Joplin, Missouri
- Allgeier, Martin and Associates, Inc. facility plan, “Turkey Creek and Shoal Creek Wastewater Treatment Plant Upgrades” on behalf of the city of Joplin approved on October 29, 2009.