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CONSULTING ENGINEERS

October 1, 2010

Veronica Kasi
Division of Technical and Financial Assistance
P.O. Box 8467
11th Floor, RCSOB, 400 Market Street
Harrisburg, PA 17105-8467

RE: Altoona Water Authority
Easterly WWTF BNR Upgrades and Expansion
PENNVEST Application Project No. 07042021008-CS
American Recovery and Reinvestment Act
Green Infrastructure Criteria Analysis and Business Case

Dear Ms. Kasi:

On behalf of the Altoona Water Authority, please find enclosed the Green Infrastructure Criteria Analysis for the above referenced project and PENNVEST Funding Application.

If you have any questions or need additional information, please contact me.

Sincerely,
GWIN, DOBSON & FOREMAN, INC.

Thomas (Tim) Boland

Thomas (Tim) Boland, P.E.
Design Operations Director/Engineering Manager

TEB/amk
08064-61.doc
cc: Altoona Water Authority
Sunil Desai, PA DEP
File

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Green Project Checklist[1]

Project Name: Easterly Wastewater Treatment Facility Biological Nutrient Removal Upgrade and Expansion

Applicant: Altoona Water Authority

County: Blair

PV Project Number:

DEP RO Reviewer:

Date:

I. DEP RO Reviewer If the project is *not* Green (See the attached EPA April 21, 2010 guidance) check here. ( ) The review is complete.

II. (RO) Is the project *categorically* Green (See the attached EPA April 21, 2010 guidance)?

Yes No

Explain (if yes, include reference to a section in the guidance) and proceed to "IV" below:

III. (RO) If the project is green, but not categorically green, it must have a Business Case to be approved.

A Business Case is a brief report which briefly describes what the project is and why it is green. All Business Cases must show that the project has identifiable and substantial benefits. Those benefits must be quantified (in terms of water, energy and dollars whenever possible). All projects must be cost-effective.

Describe the Green scope of the project:
Summarize the basis of the Green determination in the Business Case:

List documented water, energy and cost savings:

[1] Based on EPA April 21, 2010 Guidance

Is the Business Case approvable?

Yes
No

Explain:

Attach the business case.

<u>IV: (RO) Category and Dollars</u>

What is the predominant green category?

Water Efficiency	( )
Energy Efficiency	(x)
Green Infrastructure	( )
Environmentally Innovative	( )

What is your estimate of the cost of the green components? $

III. (CO) Provide an electronic copy of the Business Case to PennVest (for entry to the website).

Done	(x)
N/A	( )

IV. (CO) Priority List Followup:

If the above confirms that the project is Green, ensure that the priority list shows:

1. The project is approved as Green
2. Which Green category (Water Efficiency, Energy Efficiency, Green Infrastructure, or Environmental Innovative)
3. Whether or not the project is "Categorical" Green
4. Eligible Green dollars

American Recovery and Reinvestment Act
Green Infrastructure Criteria Analysis and Business Case

Applicant Name:	**Altoona Water Authority**
Project Title:	**Easterly WWTF BNR Upgrades and Expansion**
Total Project Cost:	**$33,910,000 (Construction Cost)**
Project Cost for "Green" Components:	**$1,577,200**

Project Abstract:

The Altoona Water Authority operates a regional wastewater collection and treatment system serving the City of Altoona and surrounding portions of Logan Township and Allegheny Township, Blair County.

The existing Easterly Altoona wastewater treatment facility (WWTF) is an extended aeration activated sludge wastewater treatment plant built in 1952, and upgraded in 1993 to provide treatment for ammonia removal.

Since its inception, the Easterly plant has complied with all water quality and effluent parameters specified in the state/federal discharge permit (i.e. National Pollutant Discharge Elimination System (NPDES) permit).

The January 31, 2008 NPDES permit issued by PADEP includes total annual nitrogen and phosphorus annual loading limits for the Easterly WWTF. The WWTF continues to meet current effluent limits, but will be unable to meet the future NPDES permit limits for total nitrogen and phosphorous.

Implementation of the proposed project will result in a treatment system capable of achieving the Chesapeake Bay Initiative and new NPDES limits for annual total nitrogen and phosphorus loading in addition to organic and suspended solids removal and more adequately handle and treat wet weather flow which has historically burdened the facility and overall treatment capabilities.

The existing WWTF will be upgraded to meet the proposed annual total nitrogen and total phosphorus limits. All the construction work will take place at the existing plant site. The major elements of the upgrade project include the following: construction of a new pretreatment/headworks building to accommodate fine bar screens and vortex grit removal, conversion of two (2) existing aeration tanks to Biological Nutrient Removal (BNR) reactors and the construction of two (2) BNR reactors, the replacement of the three (3) existing clarifier mechanisms, construction of a new clarifier, installation of two (2) new channel UV disinfection units, construction of one (1) sludge holding tank, one (1) chemical feed building, distributions boxes, flow conveyance channels and pipes and upgrade to the instrumentation and control systems.

In addition, the planning and design of this infrastructure improvements project has been diligent to utilize the most effective and efficient means and methods which are practical and cost attentive. Attention and implementation of "green infrastructure" to allow for energy efficiency and overall environmental sustainability has been incorporated in this project and will be outlined in the subsequent sections.

American Recovery and Reinvestment Act
Green Infrastructure Criteria Analysis and Business Case

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Green Project Criteria:

Energy Efficiency:
The construction of new treatment facility building allows for the implementation of energy efficient building materials exceeding the minimum R-Value required by the IEC-2006, the implementation of energy efficient lighting, efficient HVAC systems, and implementation of the most energy efficient pumps and motor controls practical for the application. Variable frequency drives (VFD) will be used to control motors allowing for optimum operation and overall conservation via the automated process. Utilization of VFD's allows a wider array of operating conditions to occur via one pump and motor control, which can be regulated to demand as opposed to a steady state operation which is inefficient and wasteful. All chemical metering pumps will be flow paced allowing for efficient and effective treatment and overall conservation of energy resources. The proper design, selection and automation of such process controls allows for superior operational efficiency over the existing treatment facility and processes.

Implementation of such innovative and conservative practices is necessary in today's environment to conserve natural resources, maintain cost effective and efficient operations and stay at the forefront of sustainability.

The design and specifications for the infrastructure components compiling the treatment facility have been specified to utilize recycled material meeting structural stability requirements, and serves as a means of reducing the dependency on natural non-renewable resources.

Proposed Facility Process

The following shall serve as an outline of the proposed facility processes coupled with detailed descriptions of specifications for "green" design and sustainability.

1. Blowers

The new blowers are sized to more accurately match the air requirements of the new process. Currently the WWTF has three (3) aeration and two (2) digester blowers, all 250 H.P. During low flows they blow off excess air and during high flows they turn on additional blowers. The new design utilizes six (6) blowers, three (3) for Reactors 1 and 2 and (3) for Reactors 3 and 4. Each set includes one (1) 50 HP; one (1) 100 H.P. and one (1) 150 H.P. blower; with VFD controls. This allows more precise air control and also significantly reduces electrical costs. At low flows, the facility will run a 50 HP blower (64 amp load) versus now they run a 250 HP (302 amp load) and blow off excess air. At average flow, the 100 H.P. blower (120 amp load) will run verses running as 250 H.P. blower (302 amp load). At peak daily flow, all three (3) blowers will run for a total of 300 H.P. (361 amp load) verses two (2) 250 H.P. blower for a comparative total of 500 H.P. (604 amp load). Note the new blowers are high efficiency turbo blowers with better turn down capacity. Refer to the attached detailed calculations prepared by HSI, the specified blower supplier for this project.

Applicant Name:	**Altoona Water Authority**
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2. Pumps

Recycle flow varies based on influent flow by about 2.5 times. VFD's on the pumps allow the pump speed to vary to match the recycle flow requirement. We evaluated the Return Activated Sludge Pumps and Waste Activated Sludge Pumps for this project. Refer to the attached calculations.

3. Energy Efficient Lighting

Energy efficient lighting will be installed. Energy saving electronic ballasts will be installed in new buildings associated with this project. Utilizing electronic energy savings ballasts instead of standard magnetic ballasts produces an average demand savings of 20 watts per ballast. On this particular project, the demand savings created by using electronic ballasts in fluorescent fixtures is roughly 36.3 kW. The demand cost savings that is tabulated by taking the demand savings x the demand charge x the number of months the equipment is operating.

The average demand cost savings for the fluorescent lighting on this project is:
36.3 kW (x) $6.65/kW x 12 months = $2,900 per year.

If magnetic ballasts had been used, the equivalent annual cost per year would have been $4,300. These figures clearly show a greater than 30% savings over conventional magnetic ballast usage.

4. VFD Drives

Variable Frequency Drives will be used on all blowers and process pumps. Variable Frequency drives provide automatic speed control via the SCADA system. While pumps and blowers are designed to handle peak loads, control of this process equipment by standard full voltage motor starters or reduced voltage motor starters leads to energy inefficiency because the load requirements vary greatly during various times of the day and season to season and the wastewater treatment system often operates at reduced load for long periods of time. The ability to adjust motor speed in direct relations to the load requirements at any particular point in time, allows immense energy savings and rapid payback of the costs associated with the purchase of the drives.

Many factors such as total head, system curves, pump or blower design points, motor efficiency and pump efficiency must all be taken into account when tabulating energy savings. Premium efficiency motors provide anywhere from 2 to 8% in energy savings while the use of VFDs to vary output based on motor speed can typically **save as much as 30%** over standard motor controls. However, because of so many variables it is not feasible to provide detailed analysis and calculations for this component. We propose that in accordance with the "Guidance for Determining Project Eligibility" Part A, CWSRF, Part 5.2 the project was designed to enable equipment to operate most efficiently which strengthens this Business Case.

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5. System Control and Data Acquisition Systems:

System Control and Data Acquisition Systems (SCADA) will be utilized to effectively monitor system operations and will improve efficiency by conservative operation of the system in conjunction with automation of process controls. The new treatment facility and appurtenances will be equipped with a state-of-the-art Supervisory Control and Data Acquisition (SCADA) system allowing for real-time analysis of process activities, control of process components and equipped with system alarms to ensure the safe treatment of wastewater and immediate cessation of process activities should an alarm set point be triggered. Utilization of such automation improves overall process efficiency and conservation of resources. However, because of so many variables it is not feasible to provide detailed analysis and calculations for this component. We propose that in accordance with the "Guidance for Determining Project Eligibility" Part A, CWSRF, Part 5.2 the project was designed to enable equipment to operate most efficiently which strengthens this Business Case.

Cost Estimates of Green Components

Blowers	$936,000
Pumps - WAS	$288,000
Pumps - RAS	$243,200
Lighting	$110,000
TOTAL	**$1,577,200**

Altoona, PA - Easterly

Process Average - Multistage Blower

Flow (SCFM)	# of Blowers	Flow Per Unit	Discharge Pressure	Temp (F)	RH (%)	TOTAL HP DRAW	TOTAL KW DRAW
1600	1	1600	10.0	105	90%	113.05	84.30
1550	1	1550	10.0	68	36%	109.80	81.88
1600	1	1600	10.0	105	90%	97.04	72.36
1550	1	1550	10.0	68	36%	83.56	62.31

Mulitstage

Blower kW		81.88
Hours Annual	Hr	8,760.00
Annual kW	kWh	717,283.96
Cost per kW	$/kWh	0.05
Annual kW Cost	**$**	**37,011.85**

Turbo

Blower kW		62.31
Hours Annual	Hr	8,760.00
Annual kW	kWh	545,850.56
Cost per kW	$/kWh	0.05
Annual kW Cost	**$**	**28,165.89**

Annual Savings:	8,845.96
20 Year Savings:	176,919.26

ALTOONA WATER AUTHORITY
EASTERLY WASTEWATER TREATMENT FACILITY
BNR UPGRADES AND EXPANSION
ELECTRICAL ENERGY SAVINGS

Return Activated Sludge Pumps

Existing Pumps are 60 hp

Proposed Pumps are 40 hp (Refer to specifications)

$$\text{kwh} = \frac{(\text{hp})\ (746)\ (\text{hrs})}{1{,}000}$$

Existing Pumps

$$\text{kwh} = \frac{(60\text{hp})\ (746)\ (24\text{hrs})}{1{,}000} = 1{,}074 \text{ kwh/day}$$

Proposed Pumps

$$\text{kwh} = \frac{(40\text{hp})\ (746)\ (24\text{hrs})}{1{,}000} = 716 \text{ kwh/day}$$

Energy Savings per pump

1,074 kwh/day - 716 kwh/day = 358 kwh/day

At least two pumps will be running all of the time.

Annual kwh savings

(2 pumps) (358 kwh/day) (365 days/yr) = 261,340 kwh/yr

Authority pays $0.0516/kwh for Electric Power

Annual savings

(261,340 kwh/yr) ($0.0516/kwh) + $13,485/yr

20 Year Payback

(20 years) ($13,485/yr) = $269,700

Waste Activated Sludge Pumps

Existing Pumps are 20 hp

Proposed Pumps are 2 at 40hp, 2 at 10hp, 2 at 5hp (Refer to specifications)

$$\text{kwh} = \frac{(\text{hp})\ (746)\ (\text{hrs})}{1{,}000}$$

Assume sludge is wasted 8 hrs/day

Existing Pumps

$$\text{kwh} = \frac{(6\text{ pumps})\ (20\text{ hp})\ (746)\ (8\text{ hrs/day})}{1{,}000} = 716\text{ kwh/day}$$

Proposed Pumps

40 hp Pumps

$$\text{kwh} = \frac{(2\text{ pumps})\ (40\text{ hp})\ (746)\ (8\text{ hrs/day})}{1{,}000} = 477\text{kwh/day}$$

10 hp Pumps

$$\text{kwh} = \frac{(2\text{ pumps})\ (10\text{ hp})\ (746)\ (8\text{ hrs/day})}{1{,}000} = 119\text{kwh/day}$$

5 hp Pumps

$$\text{kwh} = \frac{(2\text{ pumps})\ (5\text{ hp})\ (746)\ (8\text{ hrs/day})}{1{,}000} = 59\text{kwh/day}$$

TOTAL = 655 kwh/day

Energy Savings

716 kwh/day - 655 kwh/day = 61 kwh/day

Annual kwh savings

(61 kwh/day (365 days/yr) - 22,265 kwh/yr

Authority pays $0.0516/kwh for Electric Power

Annual Savings

(22,265 kwh/yr) ($0.0516/kwh) = $1,148/yr

20 year Payback

(20 years) ($1,148/yr) = 22,960

Note that the energy in kilowatthours is simply the energy in watthours divided by 1000.

To develop some sense for the kilowatthour energy level, consider that 1 kWh is the energy dissipated by a 100-W bulb in 10 h.

The *kilowatthour meter* is an instrument for measuring the energy supplied to the residential or commercial user of electricity. It is normally connected directly to the lines at a point just prior to entering the power distribution panel of the building. A typical set of dials is shown in Fig. 4.17 with a photograph of a kilowatthour meter. As indicated, each power of 10 below a dial is in kilowatthours. The more rapidly the aluminum disc rotates, the greater the energy demand. The dials are connected through a set of gears to the rotation of this disc.

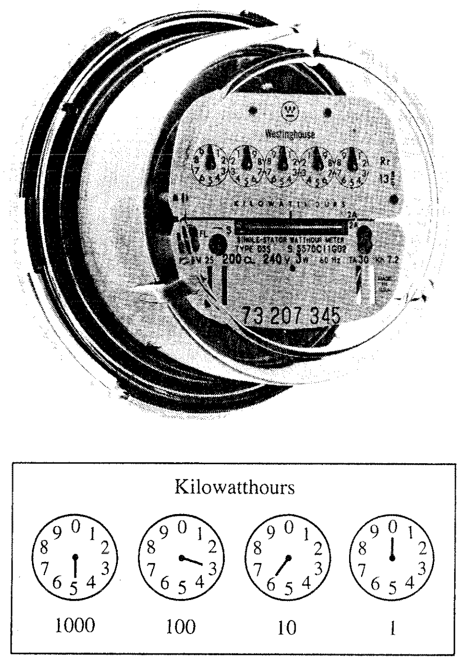

FIG. 4.17
Kilowatthour meter. (Courtesy of Westinghouse Electric Corp.)

EXAMPLE 4.15. For the dial positions of Fig. 4.17, calculate the electricity bill if the previous reading was 4650 kWh and the average cost is 7¢ per kilowatthour.
Solution:

$$5360 - 4650 = 710\,\text{kWh used}$$

$$710\,\cancel{\text{kWh}}\left(\frac{7¢}{\cancel{\text{kWh}}}\right) = \mathbf{\$49.70}$$

EXAMPLE 4.16. How much energy (in kilowatthours) is required to light a 60-W bulb continuously for 1 year (365 days)?
Solution:

$$W = \frac{P \cdot t}{1000} = \frac{(60)(24)(365)}{1000} = \frac{525{,}600}{1000} = \mathbf{525.60\,kWh}$$

EXAMPLE 4.17. How long can a 205-W television set be on before using more than 4 kWh of energy?
Solution:

$$W = \frac{P \cdot t}{1000} = \frac{(205)(t)}{1000} \Rightarrow t(\text{hours}) = \frac{(4)(1000)}{205} = \mathbf{19.51\,h}$$

EXAMPLE 4.18. What is the cost of using a 5-hp motor for 3 h if the cost is 7¢ per kilowatthour?
Solution:

$$W\ (\text{kilowatthours}) = \frac{(5)(746 \times 3)}{1000} = 11.2\,\text{kWh}$$

$$\text{Cost} = (11.2)(7) = \mathbf{78.4¢}$$

Return Activated Sludge Pumps

3. The screw centrifugal pumps specified in this section shall be furnished by and be the product of one manufacturer.

4. All screw centrifugal solids handling pumps shall be individually tested for capacity and performance in complete accordance with the applicable ANSI/HI pump test standards.

B. Performance

1. The pumps shall be designed for continuous operation and will be operated continuously under normal service. To minimize operation power costs, the hydraulic efficiencies listed for each pump are the minimum acceptable, and must be guaranteed by the manufacturer.

2. Operating Conditions

Pump Curve Operating Points	Flow GPM	TDH FT	Max. Pump RPM	Pump Efficiency %	Brake HP Required	Min. Shut-Off TDH	Max. Motor Size	Max. Motor RPM
Design Condition 1	600	15	730	62	3.8	16	40	1,800
Design Condition 2	1,042	18.6	900	73.9	6.6	30	40	1,800
Design Condition 3	1,563	23.8	1,120	78.7	11.9	47	40	1,800
Design Condition 4	1,910	28	1,280	78.9	17.1	63	40	1,800
Design Condition 5	2,300	35	1,465	78.4	25.9	81	40	1,800

3. Pump Criteria

a. Minimum suction diameter: 8-inch
b. Minimum discharge diameter: 8-inch
c. Minimum non-compressible solids passage: 4-inch
d. Minimum B-10 bearing life: 50,000 hrs.

C. Pumps

1. Design

a. The basic design shall be a single passage, clog free pump, utilizing a screw centrifugal impeller. The overall pump design shall combine high efficiency, low required NPSH, a large solid passage, and the ability to handle rags or other fibrous material without plugging.

b. The hydraulic design of the impeller shall combine the action of a positive displacement screw with the action of a single vane centrifugal impeller to provide a single, non bifurcated flowstream with only gradual changes in flow direction.

Waste Activated Sludge Pumps

1. Performance Characteristics

APPLICATION DATA

Pump Number	WSP-1	WSP-2	WSP-3	WSP-4	WSP-5	WSP-6
Description	Spare	To Digesters	To Sludge Holding Tank	To Gravity Belt Thickener	To Centrifuge and Belt Filter Press	To Centrifuge and Belt Filter Press
Pumped Medium	Sludge	Sludge	Sludge	Sludge	Sludge	Sludge
Operating Temperature, degrees F	50-86	50-86	50-86	50-86	50-86	50-86
Solid Content, approx. % DS	1 to 4	1 to 4	0.35	0.35	2 to 4	2 to 4
Suction Type	Flooded	Flooded	Flooded	Flooded	Flooded	Flooded
Capacity, GPM	50-750	50-750	60-240	60-240	25-125	25-125
Pressure (max.), PSI	18-36	18-36	13-17	13-17	13	13
Speed, RPM	30-320	30-320	70-275	70-275	50-245	50-245
Rubbing Velocity, ft/s	0.8 to 8.7	0.8 to 8.7	1.4 to 5.4	1.4 to 5.4	0.8 to 4	0.8 to 4
Required Power, HP	20-25	20-25	6.5	6.5	2.8	2.8
Motor Horsepower, HP	40	40	10	10	5	5
Installation area	inside, dry	inside, dry	inside, dry	inside, dry	inside, dry	inside, dry
Model/Type	1 (see below)	1 (see below)	2 (see below)	2 (see below)	3 (see below)	3 (see below)
Suction connection, inches, 125lb ANSI Flange	8	8	6	6	6	6
Discharge connection, inches, 125lb ANSI Flange	6	6	6	6	4	4

Model Type 1: NM105BY01L07K
Model Type 2: NM076BY01L07V
Model Type 3: NM063BY01L07V

2. Pumps shall be heavy duty, positive displacement, progressing cavity type. The pump shall be cradle mounted to permit the suction port to be rotated to any angle perpendicular to the centerline of the pump. Suction and discharge connections shall be 125 pound flat faced ANSI cast iron flanged.

3. Suction and discharge housings are to have smooth flow characteristics and be manufactured from GG25 cast iron. The housings shall be drilled and tapped NPT connections that can be used for the installation of pressure gauges/switches or for a drain.

4. The rotor shall be driven by means of a heavy duty drive train. The pump rotor shall be machined of AISI 4150 alloy steel, hardened to a Rockwell "C" value of 57 to 60 and covered with a heavy layer of hard chrome plate at least 0.010-in thick for abrasion resistance.

The rotor shall be joined to the drive shaft by a carbon steel connecting rod and oil-lubricated sealed pin type or crown gear type universal joints of chrome alloy tool steel of adequate design to transmit the required thrust and torque while

Leo J. Drass

From: briankai@earthlink.net
Sent: Thursday, November 05, 2009 3:08 PM
To: Leo J. Drass
Subject: Re: Altoona Westerly

Thanks Leo
------Original Message------
From: Leo J. Drass
To: Brian Fenstemaker
Sent: Nov 5, 2009 2:25 PM
Subject: Altoona Westerly

Brian,

Altoona pays 5.16 cents per kWh for their primary power service.

Leo

Sent from my Verizon Wireless BlackBerry