DAVIS BOWEN & FRIEDEL, INC.
ARCHITECTS • ENGINEERS • SURVEYORS

SNOW HILL 300 years on the River 1686 - 1986

TOWN OF SNOW HILL, MARYLAND

WASTEWATER TREATMENT PLANT UPGRADE

GREEN ENERGY CONSERVATION ELEMENTS BUSINESS CASE

Prepared by:

DAVIS, BOWEN & FRIEDEL

One Plaza East, Suite 200

P.O. Box 93

Salisbury, MD 21803

(410) 543-9091

July 2011

TOWN OF SNOW HILL
WASTEWATER TREATMENT PLANT UPGRADE
GREEN ENERGY CONSERVATION ELEMENTS BUSINESS CASE

1. SUMMARY

The Town of Snow Hill's Wastewater Treatment Plant Upgrade project has incorporated many green energy elements into the design of the new treatment plant. The elements will provide for substantial cost savings in operational expenses, as well as decreased negative environmental impacts. This report will provide quantitative and qualitative data to show the benefits of providing the green energy elements as defined below:

1. Upgrade three existing influent and four sludge pumps to high efficiency pumps with improved power factor ($163,300).
2. Install variable frequency drives on 21 pumps to reduce energy consumption ($147,738).
3. Install variable frequency drives on 11 air blowers and 10 dissolved oxygen sensors with controllers to limit air blower operation to the extent necessary in order to minimize energy consumption ($123,450).
4. Utility water recycle system to avoid use of potable water use at the wastewater treatment plant; which uses effluent water for yard hydrants, pump bearing lubrication, spray nozzles, wash down water, and chemical dilution water ($71,390).
5. Replace five existing PTAC units, 22 electric heaters and a water heater with energy efficient units ($37,000).
6. Replace existing indoor lighting fixtures to energy efficient lighting fixtures with electronic ballast fluorescent fixtures ($51,072).
7. Replace existing outdoor lighting fixtures to energy efficient LED lighting fixtures with photocell control ($56,050).

The total estimated cost of these green energy related elements is $650,000.00.

2. REPLACING EXISTING PUMPS

a. Introduction

The existing pumps at the wastewater treatment plant are over 20 years old. The age of these pumps has lead to decreased reliability and decreased efficiency. The decreased efficiency of these pumps has increased energy costs.

b. Energy Savings

Comparing the energy requirements of the existing system with the energy requirements of the proposed upgrades yields an increase in energy efficiency.

Proposed pumping systems were designed to operate in their most efficient zone. Pumps should be selected to operate close to the Best Efficiency Point (BEP) on a pump curve defined as the point with maximum efficiency of the pump.

c. Energy Saving Justification

The pump replacements demonstrate significant energy savings because, given the age of the existing pumps, there is a large difference between the existing pumps and the new pumps efficiencies. This difference can be attributed to the wear and corrosion found on the existing pumps. Timing of pump replacement is important for process reliability. As pumps age their reliability becomes an increasing concern to businesses reliant on the pump's continued performance.

Often a more efficient pump can replace an aging pump and the energy savings offsets the capital cost of the new pump. Although not ideal, the typical replacement time for a pump is after pump failure. The deferral of the replacement decision until failure can result in unnecessary stress (at failure) and excessive energy costs in the interim.

Timing the replacement of the pumps prior to failure is important. Identifying when the time is right requires an understanding of the pump's condition. Presently the existing influent pump station and sludge pumps are decades old and at low efficiencies, as well as problematic and have high maintenance costs. The efficiency percentages presented are "wire to water" which includes the motor and pump.

d. Daily Energy Savings

The table on the following page shows the daily energy and maintenance savings by replacing the existing pumps.

MDE SRF GREEN FUNDING BUSINESS CASE
ESTIMATED DAILY ENERGY SAVINGS BY REPLACING EXISTING PUMPS
SNOW HILL WWTP UPGRADE PROJECT

PUMPS

PUMP	NUMBER OF PUMPS	HP	EXISTING PUMPS			PROPOSED PUMPS			ENERGY SAVINGS
			HOURS/DAY	% EFFICIENCY	ENERGY LOST	HOURS/DAY	% EFFICIENCY	ENERGY LOST	
Influent	3	37	8	45%	$34.47	8	69%	$19.43	$15.04
Sludge	2	7.5	4	40%	$2.54	4	57%	$1.82	$0.72
Sludge Press Booster	2	10	4	42%	$3.27	4	67%	$1.86	$1.41
TOTAL					**$40.28**			**$23.11**	**$17.17**

ENERGY LOST EQUATION:

$$Cost\ (\$)_{pump\ energy} = HP * \left(0.746\ {}^{kW}/_{HP}\right) * Hours * \left({}^{\$0.0946}/_{kWH}\right) * (1 - \%_{Eff.})$$

SUMMARY OF SAVINGS

DAILY SAVINGS WITH REPLACEMENT PUMPS	$17.17
PERCENT OF ENERGY SAVINGS	42.63%

CAPITAL COST VERSES ENERGY SAVINGS

CAPITAL COST OF PROPOSED PUMPS	$163,300
ANNUAL SAVINGS IN MAINTENANCE COSTS	$9,750
ANNUAL ENERGY SAVINGS	$6,268
TOTAL ANNUAL SAVINGS	$16,018

Note: Calculations exclude Variable Frequency Drives (VFD) for relative comparision. The VFD evaluation is presented in Section 3 of this report.

e. Pump Replacement Savings Summary

The daily savings from replacing the pumps is estimated to be $17.17 per day, with the percent of energy savings being 42.63%. The total annual savings including savings in maintenance costs is $16,018.

3. VARIABLE FREQUENCY DRIVE ON PUMPS

a. Introduction

The Town of Snow Hill has selected pumps utilizing variable frequency drives (VFD) to provide energy efficiency in their wastewater treatment plant operations. The pumps are expected to receive variable flows throughout the diurnal cycle and are therefore well suited for VFDs.

b. Advantages of Using VFDs

1. Provide precise speed control of an AC motor
2. Can generate full torque from motor at very low speed
3. Allow simple set-point control throughout the speed range
4. Protects the motor and wiring from overload current
5. Provide very efficient built in Power factor correction
6. Limit inrush current to provide a soft start and a soft stop; thus preventing spikes in power consumption
7. Allow a simple connection to a communication network
8. Provide substantial energy savings on pump & fan applications

c. VFD's Energy Savings in Centrifugal Pump Application

Variable Frequency Drives can increase system energy efficiency by providing a means to reduce the motor speed of variable torque loads. The centrifugal loads operate along the laws of affinity and provide the opportunity for significant energy savings.

d. Affinity Laws of Centrifugal Loads on Pumps

- Flow is proportion to load
- Pressure is proportional to the motor speed squared
- Power is proportional to the motor speed cubed
- A motor running at 50% of full capacity has a motor torque of 25% of the full speed.
- The electricity required to operate the motor at 80% of full speed is 55% of the amount of the electricity required if the motor was running at full speed capacity
- Thus the motor speed can significantly reduce the electrical energy consumption

e. Relationship of Speed and Capacity on Blowers

- Flow is proportional to load
- A delivery rate has approximately a linear relationship to motor speed
- Reducing the motor speed (and air delivery rate) based on dissolved oxygen sensors will optimize the level of treatment and minimize energy use.

f. Daily Energy Savings

See the "Estimated Daily Energy Saving Using Variable Frequency Drives" on the following page.

MDE SRF GREEN FUNDING BUSINESS CASE
ESTIMATED DAILY ENERGY SAVINGS USING VARIABLE FREQUENCY DRIVES
SNOW HILL WWTP UPGRADE PROJECT

PUMPS

PUMP	NUMBER OF PUMPS	HP	FULL SPEED HOURS/DAY 100%	FULL SPEED HOURS/DAY ENERGY COST	VFD SPEED HOURS/DAY 100%	VFD SPEED HOURS/DAY 80%	VFD SPEED HOURS/DAY 60%	VFD SPEED HOURS/DAY ENERGY COST	ENERGY COST SAVINGS
Influent	3	37	8	$62.67	2	4	2	$35.09	$27.57
EQ and DET Tank	4	9.1	12	$30.83	3	6	3	$17.26	$13.56
RAS/WAS	4	2.85	12	$9.65	3	6	3	$5.41	$4.25
Nitrate Recycle	4	9.1	12	$30.83	3	6	3	$17.26	$13.56
Utility Water	2	15	12	$25.41	4	4	4	$14.65	$10.76
Sludge	2	7.5	4	$4.23	1	2	1	$2.37	$1.86
Sludge Press Booster	2	10	4	$5.65	1	2	1	$3.16	$2.48
TOTAL				$169.26				$95.21	$74.05

ENERGY COST EQUATION:

$$Cost\ (\$)_{pump\ energy} = HP * (\%)^3 * \left(0.746\ {}^{kW}/_{HP}\right) * Hours * \left({}^{\$0.0946}/_{kWH}\right)$$

BLOWERS WITH DISSOLVED OXYGEN SENSOR CONTROLS

BLOWER	NUMBER OF BLOWERS	HP	FULL SPEED HOURS/DAY 100%	FULL SPEED HOURS/DAY ENERGY COST	VFD SPEED HOURS/DAY 90%	VFD SPEED HOURS/DAY 60%	VFD SPEED HOURS/DAY 30%	VFD SPEED HOURS/DAY ENERGY COST	ENERGY COST SAVINGS
EQ and DET Tank	4	20	12	$67.75	2	6	4	$37.26	$30.49
WAS Tanks	3	10	16	$33.87	3	10	3	$20.32	$13.55
Reactor Tanks	2	40	12	$67.75	2	6	4	$37.26	$30.49
Re-Aeration Zones	2	5	12	$8.47	2	6	4	$4.66	$3.81
TOTAL				$177.84				$99.51	$78.33

ENERGY COST EQUATION:

$$Cost\ (\$)_{blower\ energy} = HP * (\%) * \left(0.746\ {}^{kW}/_{HP}\right) * Hours * \left({}^{\$0.0946}/_{kWH}\right)$$

SUMMARY OF SAVINGS

DAILY SAVINGS WITH VFD	$152.38
DAILY COST WITHOUT VFD	$347.10
PERCENT OF ENERGY SAVINGS	43.90%

CAPITAL COST VERSES ENERGY SAVINGS

CAPITAL COST OF VFD ON PUMPS	$147,738
CAPITAL COST OF VFD ON BLOWERS AND SENSOR CONTROLS	$123,450
ANNUAL ASSOCIATED ENERGY SAVINGS	$55,621

g. VFD Savings Summary

As shown in the table, the daily cost without VFDs is $347.10. The daily savings of using VFDs on the pumps and blowers are $152.38. The percentage of energy savings is 43.90%. These pumps will operate 365 days per year.

4. UTILITY WATER RECYCLE SYSTEM

a. Introduction

The potable water would typically be delivered to the plant via a Town owned water main. The average daily usage of 44,290 gallons per day (GPD) is expected. A utility (grey or reuse) water system is included in the Snow Hill Wastewater Treatment Plant ENR upgrade to avoid using potable water. The utility water provides a substantial energy and cost savings, as well as reduces the flow of the water in both the water and wastewater systems.

The treatment plant upgrade includes a utility water booster pump and conveyance system to supply treated effluent to the belt filter press and to other locations typically supplied with potable water. The utility water will be drawn from the treatment plant effluent just prior to the UV disinfection tanks.

A number of locations were identified as users of utility water including those in the table on page 10.

Water usage is based upon equipment and process requirements and scheduled cleaning routines by the treatment plant operators. The estimated potable water usage of 44,290 GPD could equate to an annual water savings of 16.2 million gallons from the groundwater, if utility water is utilized instead of potable water.

Potable water will be supplied to the WWTP for use in the laboratory, rest rooms, sinks, eye wash stations, break room, and laundry facilities.

b. Piping Diagram and Flow Schematic

A flow diagram for piping and pump systems is included in the project design and construction contract documents. The proposed piping plan minimizes the construction costs by converting as much of the existing potable water supply for the utility water distribution as possible.

All exposed piping carrying utility (reuse) water should be painted with purple paint and labeled "Reuse Water" with proper signage according to the U.S. Environmental Protection Agency's "Guidelines for Water Reuse" dated September 2004.

c. Water Usage and Energy Savings

The table below shows the utility water use, costs and savings.

MDE SRF GREEN FUNDING BUSINESS CASE
DAILY ENERGY SAVINGS USING UTILITY WATER
SNOW HILL WWTP UPGRADE PROJECT

WATER USAGE CALCULATIONS

NO.	LOCATION	USE	AVG. FLOW (gal./min.)	AVG. USAGE (min./day)	TOTAL FLOW (GPD)
1	Headworks	Grit Removal	50	120	6,000
2	Headworks	Headworks Compactor	10	1,440	14,400
3	Chemical Building	Chemical Carry & Make-up Water	4	1,440	5,760
4	Yard Hydrants (12)	Wash Water	45	45	2,025
5	Clarifier	Spray Nozzles	28	20	560
6	Reactor	Spray Nozzles	76	20	1,520
7	Septage Receiving Station	Process wash water	30	60	1,800
8	Sludge Filter Press Bldg.	Belt Filter Press	40	300	12,000
9	Buildings	Floor Rinse Down Water	5	45	225
		Total Max. Flow	288		44,290

ENERGY SAVINGS CALCULATIONS

COST (PER GALLON) OF POTABLE WATER TREATMENT AND SUPPLY TO WWTP	$0.00335
DAILY SAVINGS IN WATER USAGE	$148.37
ADDED ENERGY USAGE TO PUMP UTILITY WATER	$14.65
COST (PER GALLON) OF WASTEWATER TREATMENT AT WWTP	$0.00240
DAILY SAVINGS TREATMENT OF POTABLE WATER AT WWTP	$106.30
OVERALL DAILY SAVINGS	$240.02
CAPITAL COST OF UTILITY WATER SYSTEM	$71,390.00
DAILY (AND CORRESPONDING ANNUAL) SAVINGS IN ENERGY AND WATER RESOURCES	94%

d. Estimated Annual Savings

The estimated annual savings for the proposed utility water system in energy and water resources is 94%. This is based on a daily energy cost of $14.65 for pumping utility water with a daily savings of $240.02 associated with reducing the quantity of potable water conveyance, potable treatment and corresponding wastewater treatment.

5. AIR CONDITIONING, HEATERS AND WATER HEATER REPLACEMENT

a. Efficiency Data

The table below provides a comparison between the existing systems and the new systems at the wastewater treatment plant. The type of equipment included in this comparison is HVAC and domestic water heating equipment. The efficiency values below are for an energy efficiency comparison between existing equipment energy efficiency and the energy efficiency of the new equipment.

HEATING/COOLING							
EQUIPMENT TYPE	QTY	EXISTING EQUIPMENT HEATING EFFICIENCY	NEW EQUIPMENT HEATING EFFICIENCY	EFFICIENCY GAIN	CAPACITY IN THOUSAND BTU HOURS (MBH)	% OF TOTAL HEATING CAPACITY	TOTAL WEIGHTED GAIN IN EFFICIENCY
WATER HEATER	1	100%	100%	0%	103	11%	16.4%
PACKAGED TERMINAL AIR CONDITIONERS (PTAC)	5	98%	98%	0%	72	7%	
HEATERS	22	78%	98%	20%	762	82%	

b. Overall Annual Savings

Annual maintenance on existing LP gas is approximately $1,800. This maintenance will not be required on the electric heaters which provide an additional savings of 3.4% on the expected annual energy cost. Therefore the overall annual savings is approximately 19.8%.

6. REPLACE EXISTING INDOOR LIGHTING FIXTURES

a. Introduction

To cut energy costs, the treatment plant upgrade will incorporate fluorescent lamps and ballasts. As a result the treatment plant will get a higher quality of light at similar light levels and reduce power consumption up to 40%. Savings in energy costs produce a typical payback of two to three years.

b. Features

- Energy savings (up to 40% less energy)
- Better color rendering
- Cooler operation
- Quieter operation
- Lightweight design
- No flicker during start-up or operation

For years, commercial lighting has been dominated by the common 1.5-inch diameter (T12) cool-white fluorescent lamps and transformer-type magnetic ballasts. This older technology is fast becoming obsolete. High-efficiency 1-inch (T8) lamps—teamed up with electronic ballasts—are setting new standards for low power consumption, low life-cycle cost and illumination that more closely resembles natural light.

1. Energy efficient

The 32-watt T8 lamps produce similar levels of light as the older 40-watt T12 bulbs. The slim profile of the T8 lamps enables its gases and rare-earth phosphors to function more efficiently. T8 lamps are available in 4-foot and 8-foot lengths.

2. Superior color

The light from T8 lamps has a higher "color rendering index," or CRI, than standard T12s. The higher CRI makes objects and surfaces in a room appear more like they would under natural light.

3. Efficient electronic ballasts

All fluorescent lamps require ballasts to provide the right voltage and current. Electronic ballasts use high-frequency, solid-state circuitry instead of heavy copper windings to perform this task. As a result, electronic ballasts produce more light for each watt, run cooler and last longer. Electronic ballasts that feature high power factor ratings and low-harmonic distortion are available.

4. No flicker or hum

Some people are sensitive to the rapid flicker and the soft hum or buzz of common fluorescent lights. Electronic ballasts nearly eliminate both the flicker and the hum and are less than half the weight of magnetic ballasts. A retrofit of electronic ballasts could eliminate nearly six pounds from a typical four-lamp fixture.

5. How to save the most

Traditional cool-white T12 lamps, standard electromagnetic ballasts and rooms requiring continuous lighting will save the most. Under these conditions, instant-start electronic ballasts with T8 lamps produce the greatest savings in energy consumption. For intermittent lighting, a rapid-start ballast, which consumes slightly more power, may be used to maintain lamp life.

c. Annual Energy Savings

In the table below, the energy savings equations and calculations are shown.

Annual Energy Saving Comparison F40 (40-watt, 4-foot) T12 and magnetic ballast fixture versus F32 (32-watt, 4-foot) T8 and Electronic ballast fixture			
Lamp/Ballast Combination	KW/Fixture	Number of Fixtures	**Annual Energy Cost**
F40-T12 Fixture (3 lamps, 2 ballast)	**0.144**	**149**	**$7,409**
F32-T8 Fixture (3 lamps, 1 ballast)	**0.084**	**149**	**$4,322**

$$\text{Annual Energy Cost (\$)} = \#_{fixtures} * {}^{kW}/_{fixture} * 10\,{}^{hr}/_{day} * 365\,{}^{days}/_{year} * {}^{\$0.0946}/_{kW \cdot hr}$$

d. Annual Energy Savings Summary

The annual savings of installing the F32-T8 Fixtures is approximately $3,087, **which is 41.7% of energy costs.** The proposed fixtures are less costly to maintain for an annual savings of about $2,150 per year, coupled with the annual energy savings of $3,087, for a total annual savings of $5,237.

7. REPLACE EXISTING OUTDOOR LIGHTING FIXTURES

a. Introduction

The operational life of current white LED street lamps is 60,000 hours, which in normal operation can last for over 16 years. The long operational life of a led lamp is a stark contrast to the average life of a sodium bulb, which is approximately 15,000 hours. Many of the lighting fixtures are in a difficult location for maintenance and using LEDs would virtually eliminate the need for routine bulb replacement.

It is difficult to compare between the costs of LED lights vs. traditional sodium options. With sodium bulbs, the true cost of the bulb is the cost of replacement bulbs and the labor expense and time needed to replace them. These are significant factors, especially where there are a large number of installed bulbs.

The key strength of LED lighting is reduced power consumption. When designed properly, an LED circuit will approach 80% efficiency, which means 80% of the electrical energy is converted to light energy. The remaining 20% is lost as heat energy. Compare that with sodium bulbs which operate at around 30% efficiency (70% of the electrical energy is lost as heat).

b. Advantages of LED Lights

- **Long-lasting** - LED bulbs last up to 4 times as long as sodium bulbs.
- **Durable** - since LEDs do not have a filament, they are not damaged under circumstances when a regular sodium bulb would be broken. Because they are solid, LED bulbs hold up well to jarring and bumping.
- **Cool** - these bulbs do not cause heat build-up; LEDs produce only 3.4 btu's/hour.
- **Mercury-free** - no mercury is used in the manufacturing of LEDs.
- **More efficient** - LED light bulbs have efficiencies up to 80%. Also, because these bulbs last for years, energy is saved in maintenance and replacement costs.
- **Cost-effective** - although LEDs are expensive, the cost is recouped over time and in battery savings. For the AC bulbs and large cluster arrays, the best value comes from commercial use where maintenance and replacement costs are expensive.

c. Estimated Energy Savings

The estimated energy savings is shown in the table on the next page.

MDE SRF GREEN FUNDING BUSINESS CASE
ESTIMATED ENERGY SAVINGS FOR LED STREET LIGHT
SNOW HILL WWTP UPGRADE PROJECT

Number of Lights Installed	19
Price per kWh for the application	0.0946
Average number of hours in operation per day	10

	Sodium Bulbs	LED Lights
Watts per lamp (nominal)	250	120
Watts per fixture (lamp plus ballast)	313	120
Price per fixture (includes house, lamp and ballast)	$ 250.00	$ 872.78
Maintenance cost per light per year per application	$ 125.00	$ 35.00
Number of visits for maintenance per light, per year	2	1
Average liftime (in hours)	15,000	60,000
Total electricity cost per light per year	$ 108.08	$ 41.43
Total maintenance cost per light per year	$ 250.00	$ 35.00
Total operating cost per year	$ 358.08	$ 76.43
Average lifetime for each light (in years)	4.11	16.44
Total operating cost during the LED lifetime	$ 5,886.77	$ 1,256.59
CO2 emissions (lbs per year)	1874	718

Sodium and LED Comparisons

Energy Saved in kWh per year	704
Savings per year	$ 281.64
Savings During LED Lifetime	$ 4,630.18
Percentage Saving	**78.65%**
Reduced CO2 Emissions (lbs per year)	1156
Percentage Annual Reduction in CO2 Emissions	62%

Return on Investment

Incremental Investment (single unit)	$ 622.78
Total Investment in LED for Above Number of Lamps	$ 11,832.82
Total Savings per year	$ 5,351.18
Total Savings over LED Lifetime	$ 87,973.37

MDE SRF GREEN FUNDING BUSINESS CASE
ESTIMATED ENERGY SAVINGS FOR LED POLE LIGHTS
SNOW HILL WWTP UPGRADE PROJECT

Number of Lights Installed	71
Price per kWh for the application	0.0946
Average number of hours in operation per day	10

	Sodium Bulbs	LED Lights
Watts per fixture	100	35
Price per fixture (includes house, lamp and ballast)	$ 232.00	$ 435.00
Average liftime (in hours)	4,000	44,000
Total electricity cost per light per year	$ 34.53	$ 12.09
Total maintenance cost per light per year	$ 70.57	$ -
Total operating cost per year	$ 104.20	$ 12.08
Average lifetime for each light (in years)	1	12
Total operating cost during the LED lifetime	$ 1,482.00	$ 580.00

Sodium and LED Comparisons

Energy Saved in kWh per year	237
Savings per year	$ 75.17
Savings During LED Lifetime	$ 902.00
Percentage Saving	**72.14%**

Return on Investment

Incremental Investment (single unit)	$ 203.00
Total Investment in LED for Above Number of Lamps	$ 14,413.00
Total Savings per year	$ 5,337.07
Total Savings over LED Lifetime	$ 64,042.00

d. Annual Savings Summary

The annual savings of installing LED outdoor street lighting is $4,630 which is 78.65% of the annual cost of standard sodium lighting. There are also other environmental benefits, such as a 62% reduction in CO_2 emissions and LED bulbs are mercury free. The annual savings of installing LED outdoor wall and pole lighting is $5,337 which is 72.14% of the annual cost of standard sodium lighting. The weighted average of savings for all 90 outdoor LED lights is 75.26%.

8. CONCLUSIONS

The green elements of the Snow Hill Wastewater Treatment Plant ENR Upgrade Project provide a significant annul energy and maintenance cost savings which are about 50% for the weighted average of the projects combined green elements as shown in the table below.

MDE SRF GREEN FUNDING BUSINESS CASE
WEIGHTED AVERAGE ANNUAL SAVINGS
SNOW HILL WWTP UPGRADE PROJECT

ELEMENT	ELEMENT CAPITAL COST	ELEMENT % TOTAL COST	ELEMENT % ANNUAL SAVINGS	% TOTAL ANNUAL SAVINGS
HIGH EFFICIENCY PUMP INSTALLATION	$ 163,300.00	25.12%	42.63%	10.71%
VARIABLE FREQUENCY DRIVE - PUMPS/BLOWERS	$ 271,188.00	41.72%	43.90%	18.32%
UTILITY WATER RECYCLE SYSTEM	$ 71,390.00	10.98%	94.00%	10.32%
A/C, HEAT AND WATER HEATER	$ 37,000.00	5.69%	19.80%	1.13%
HIGH EFFICIENCY INDOOR LIGHTING	$ 51,072.00	7.86%	41.70%	3.28%
HIGH EFFICIENCY OUTDOOR LIGHTING	$ 56,050.00	8.62%	75.26%	6.49%
BUSINESS CASE TOTALS	$ 650,000.00	100.00%	COMBINED SAVINGS:	50.24%

All of the green elements are included in the present treatment plant design except for the outdoor LED lighting which will require a minor change order of approximately $26,250. There is adequate construction contingency to cover this cost. The project is bid and an award has been made to Howard Robson, Inc. for the construction. The construction activity is to begin in August of this year.

All of these green elements are crucial to the Town of Snow Hill because it will reduce the operation and maintenance costs. As wastewater treatment plants upgrade to ENR Treatment levels, the cost of operation and maintenance also increases, which in this case will be somewhat offset by the proposed green elements in the project.

EXHIBIT 1

1

Snow Hill WWTP Plant

Existing Influent Pumps

Actual Field Data:

Power In – 208 volts times 40 amps (meter reading) is 8,320 watts power consumed

Hydraulic Power out – 498 gpm (meter reading)
62.4 lb/cf density
32.17 ft/sec squared gravity
40 ft of differential head (measured)
for 3,760 watts power delivered

Efficiency equals 3,760 divided by 8,320 equals 45% efficiency

Existing Sludge Pumps

The sludge pumps are even less efficient because of the high solids concentration, typically 5% to 10% less, estimated number of 5% to be conservative. There is no amp or flow meter to get exact energy usage.

Existing Sludge Press Booster pumps

The booster pump is a conventional pump with many years of wear, thus an efficiency of 42% was estimated to be conservative. There is no amp or flow meter to get exact energy usage.

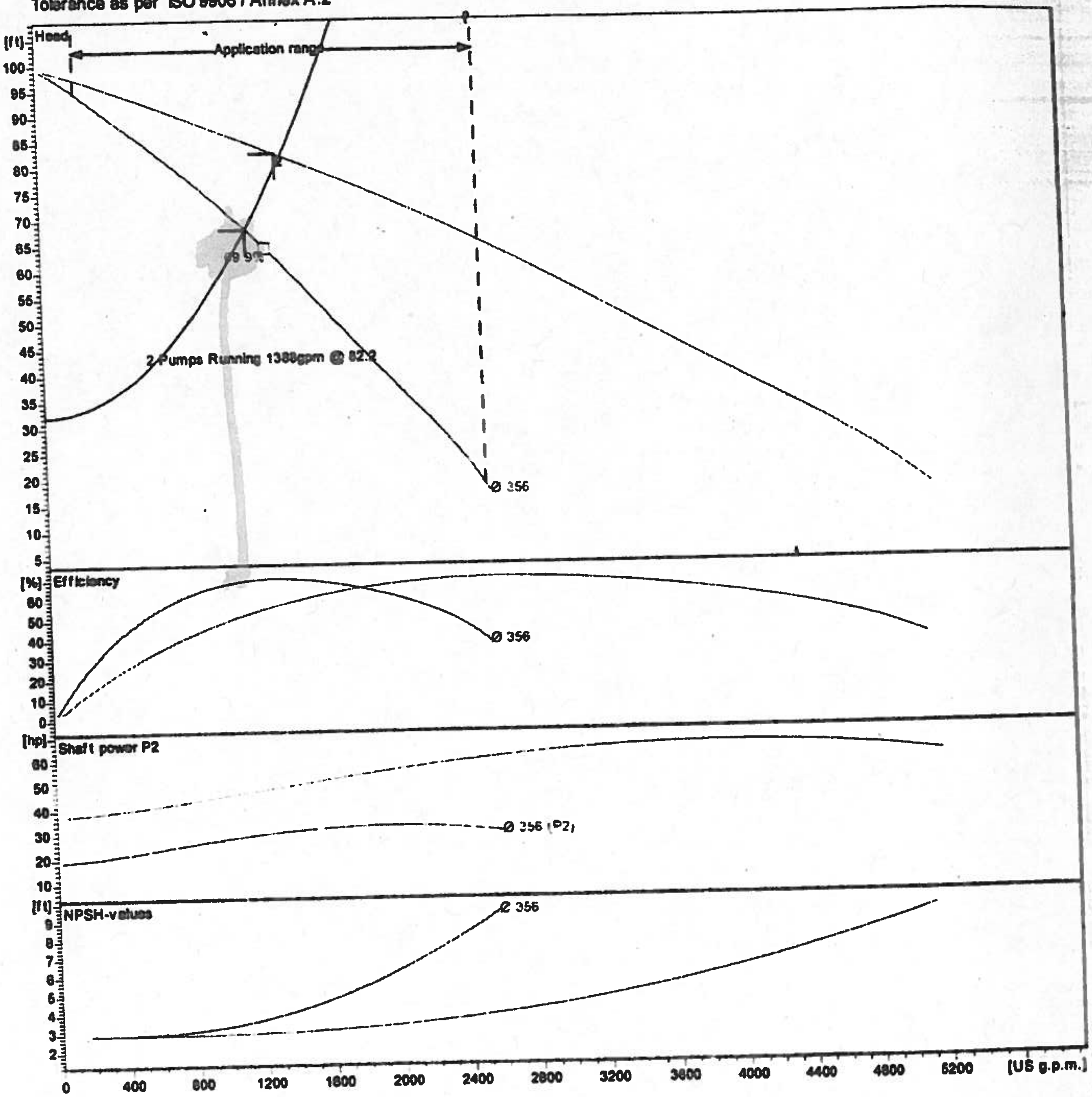
ject	2 Pumps Running for 1388GPM	Created on:	2010-09-16		WILO
roject number:	Snow Hill	Created by:	Chris Perkins		2

Performance curves
Submersible sewage pump FA 15.77Z

with motor FK 27.1-6/32

Pow er data referred to: Water, pure [100%] ; 293K; 998.19kg/m³; 1.0004mm²/s

Tolerance as per ISO 9906 / Annex A.2



Pump				Duty point data			
Impeller Ø	designed	356	mm	Volume flow		1200	US g.p.m.
Nominal speed		1140	1/min	Head		68.1	ft
Frequency		60	Hz	Shaft pow er	P_2	30	hp
Impeller type		Tw o-channel		Pump efficiency		69.8	%
Motor				Pow er input	P_1	35	hp
Rated pow er		37	hp	Required pump NPSH		3.7	ft
Sel. explosion protection		CSA		Speed		1157	1/min

Sludge Pumps

2

Bill Remington

From: Trevor Lawson [TLawson@pennvalleypump.com]
Sent: Friday, August 12, 2011 10:29 AM
To: wlr@dbfinc.com
Cc: Pat Foley
Subject: Snow Hill, MD

Bill,

The Volumetric efficiency of the Penn Valley in this case is about 80% because there is very little slippage with the operation of the two discs.
The mechanical efficiency is more like 90% because there is very little torque/power required to turn the pump over.

Is even higher That presented in Green Business Case.

Most PD pumps are going to be more efficient then centrifugal pumps. The biggest consideration in this case is the double disc pumps ability to run dry and produce vacuum up to 25"HG. There is a relatively long suction line with a possible suction lift. No other pump can run dry while trying to prime the suction line. If the pump does run dry there is no resulting wear. Other close tolerance pumps will wear into the application and the volumetric efficiency is reduced until there are no clearances and repairs need to be made.

We will be using a 7.5HP motor with 91% efficiency. This is less than the existing pumps required HP if I remember correctly and can lead to energy savings.

I hope this information was helpful. Please feel free to contact either Pat or me should you have any questions.

Regards,

Trevor Lawson

Penn Valley Pump Co. Inc.

Ph: 215-343-8750
Fax: 215-343-8753
Mobile: 215-582-3343
www.pennvalleypump.com

3

Bill Remington

From: daniels@snowhillmd.com
Sent: Friday, August 12, 2011 9:37 AM
To: bill remmington
Subject: snow hill 2010 water and wastewater total treated

Bill

The town of snow hill provided the following water and wastewater treatment gallons for 2010.

Wastewater: 129 million gallons, Budget $305,000.00, $0.0024 /gallon
Water: 90 million gallons, Budget $387,500.00, $0.0043/gallon ← even higher than presented in Business Case

As you can see rain and some houses with wells contributed 39 million gallons last year.

Frank
Supt. W/WW
Town of Snow Hill

Actual 2010 Budgets provided by Town, budget spent in 2010.

4

Dept. of Energy

Inputs

	Your Current System	New System
Heater Type	Propane - Forced Air Furnace	Electric - Forced Air Furnace
Fuel Cost $	2.86 / Gallon	0.10 / kWh
Heater Efficiency %	78	100
Dist Efficiency %	98	98

Results

	Your Current System	New System
BTU*/Unit of Fuel	91,600	3,413
Space Heating Cost ($ Per Million Btu)	40.85	29.90
Operating Cost/year ($)	2,785.97	2,039.18

By choosing the new system over the current system, you will save (on average) $747 /year in fuel costs.**

Please note that space heating operating cost and savings numbers are provided for comparison purposes only. Your costs will vary, according to such factors as home insulation, climate, and size of your home.

* British Thermal Unit, a measurement of energy; one BTU is approximately the amount of heat released by burning a wooden kitchen match.
** Based on the annual energy consumption for space-heating in a single-family household: 68.2 Million Btus/Year in 2005. (www.eia.doe.gov)

Return

4

Fuel Efficiency Comparison

Review of some common properties of different types of fuel used in heating appliances (stoves, burners, fireplaces, and furnaces)

by MKerogazov

Hello world. I'm a software developer and an apprentice affiliate marketeer.

12 featured lenses
Winner of 4 trophies!
Top lens » Austrian Gold Coins

CONTENTS AT A GLANCE

Fuel Efficiency

Fuel Efficiency can be viewed as a multi-part aspect.

Actual fuel efficiency: how much fuel you have to spend to get some amount of heat

Cost efficiency: how dear it is comparing to other fuel types

Easiness: how easy it is to use, maintain, operate, and clean

Environment Impact: how much pollution it will produce.

Electricity

Actual fuel efficiency: about 100% - there is no heat loss as for other fuel types

Cost efficiency: electricity is the dearest type, unless you of course are using solar energy

Easiness: most of the time, the easiest. No starting fires, no cleaning ashes, no need for chimneys of vent pipes.

Environment Impact: varies depending on the source of electricity, if it's a nuclear plant, than potentially huge impact; but if it's a solar power facility, than it's perfect

Click here to have a look at electric heating appliances that are selling now (a new window will open)

4

Squidoo tips

Search Squidoo

Gas (Natural and Propane)

Actual fuel efficiency: about 80%, some heat loss

Cost efficiency: high to medium. Natural gas is less expensive and even propane is burning hotter, it is dearer to use.

Easiness: moderate. You don't need to clean your fireplace from ashes, but most of the models require ventilation systems and installation as not as easy as for electric appliances.

Environment impact: moderate. As any fossil fuel, burning gas produces carbon dioxide, which is a pollutant, but not as much of it as coal or wood.

Click here to have a look at gas heating appliances that are selling now (a new window will open)

Wood

Actual fuel efficiency: low, about 60%.

Cost efficiency: medium to low. It is about twice as cheap as electricity, but still not as cheap as coal.

Easiness: low. Takes more efforts to start, operate, clean, and supply fuel stock.

Environment impact: high. As a fossil fuel, wood combustion produces more pollution than other fuel types (but not as much as any automobile).

Click here to have a look at wood heating appliances that a selling now

Wood Pellets

Actual fuel efficiency: medium to high, it's about 80%.

Cost efficiency: medium to high. Can be a bit cheaper than using natural gas.

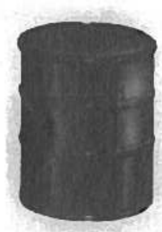
Easiness: medium. Not as easy as electricity and gas, but still easier than regular wood.

Environment impact: medium. Still produces pollution through combustion, but less than regular wood.

Click here to have a look at pellet heating appliances that a selling now

Fuel Oil

Actual fuel efficiency: medium to high, about 80%.



Cost efficiency: medium to low. Can be as cheap as using wood or natural gas.

Easiness: medium. Easier than wood or coal, but not as easy as electric ones.

4

Search Squidoo

Environment Impact: medium. Oil fuel is another type of fossil fuel, so it will produce pollutants while burning.

Coal

Actual fuel efficiency: medium to low, about 75%

Cost efficiency: highest. Even with the low efficiency, it can be as trice as cheap as using electricity

Easiness: low. Requires the most efforts to operate and maintain. It's not even easy to start a coal fire (read here).

Environment impact: highest. Produces most pollutants while burning comparing to all other fuel types listed above.

Click here to have a look at coal heating appliances that a selling now

About this Lens

Hopefully this lens answered some of your questions. You can have a look at the Fuel Comparison Table here if you want more information.

More "heated" lenses

- How to Make Wood Pellets
- Propane vs. Natural Gas

New Guestbook

add your comment

Share this Guestbook

2 RSS

Print

Indoor

mge.com > My Business > Saving Energy > **T8 Fluorescent Lamps and Electronic Ballasts**

T8 Fluorescent Lamps and Electronic Ballasts

To cut energy costs, upgrade your fluorescent lamps and ballasts. You'll get a higher quality of light at similar light levels and reduce power consumption up to 40%. Savings in energy costs produce a typical payback of two to three years.

Features

- Energy savings (up to 40% less energy)
- Better color rendering
- Cooler operation
- Quieter operation
- Lightweight design
- No flicker during start-up or operation

For years, commercial lighting has been dominated by the common 1.5-inch diameter (T12) cool-white fluorescent lamps and transformer-type magnetic ballasts. This older technology is fast becoming obsolete. High-efficiency 1-inch (T8) lamps—teamed up with electronic ballasts—are setting new standards for low power consumption, low life-cycle cost and illumination that more closely resembles natural light.

Energy efficient

The 32-watt T8 lamps produce similar levels of light as the older 40-watt T12 bulbs. The slim profile of the T8 lamps enables its gases and rare-earth phosphors to function more efficiently. T8 lamps are available in 4-foot and 8-foot lengths.

Superior color

The light from T8 lamps has a higher "color rendering index," or CRI, than standard T12s. The higher CRI makes objects and surfaces in a room appear more like they would under natural light.

Efficient electronic ballasts

All fluorescent lamps require ballasts to provide the right voltage and current. Electronic ballasts use high-frequency, solid-state circuitry instead of heavy copper windings to perform this task. As a result, electronic ballasts produce more light for each watt, run cooler and last longer. Electronic ballasts that feature high power factor ratings and low-harmonic distortion are available.

No flicker or hum

Some people are sensitive to the rapid flicker and the soft hum or buzz of common fluorescent lights. Electronic ballasts nearly eliminate both the flicker and the hum and are less than half the weight of magnetic ballasts. A retrofit of electronic ballasts could eliminate nearly six pounds from a typical four-lamp fixture.

Who saves the most?

If you have traditional cool-white T12 lamps, standard electromagnetic ballasts and rooms requiring continuous lighting, you will save the most. Under these conditions, instant-start electronic ballasts with T8 lamps produce the greatest savings in energy consumption. For intermittent lighting, a rapid-start ballast, which consumes slightly more power, may be used to maintain lamp life.

Annual energy savings comparison
F40 (40-watt, 4-foot) T12 and magnetic ballast fixture versus
F32 (32-watt, 4-foot) T8 and electronic ballast fixture

Lamp/Ballast combination	Watts/Fixture	Annual energy cost	Annual savings
F40-T12 fixture (4 lamps, 2 ballasts)	192W × 0.75 = 144W/fi 144 for 3 Lamps	$29.20	-
F32-T8 fixture, (4 lamps, 1 ballast)	112W × 0.75 84 for 3 Lamps	$17.03	$12.17

For more information

Outdoor Lighting
Security Lighting

Outdoor

LED Lighting Energy Savings

IMBUTEC
Phone 412.372.8832 Fax 412.322.1130
920 North Lincoln Avenue Pittsburgh PA 15233
Contact us at: sales@imbutec.com
Or visit us at: www.imbutec.com

Application	Replaces Current Fixture	LED Wattage	% Savings
Parking Lot Light	250 Watt HID Fixtures (+45W ballast)=295 400 Watt HID Fixtures (+65W ballast)=465	35 70	88 85
Canopy/Parking Garage Light	70 Watt HID Fixtures (+20W ballast)=90 100 Watt HID Fixtures (+29W ballast)=129 150 Watt HID Fixtures (+38W ballast)=188	24 24 24	73 81 87
Decorative Acorn Post Top	70 Watt HID Fixtures (+20W ballast)=90 100 Watt HID Fixtures (+29W ballast)=129 150 Watt HID Fixtures (+38W ballast)=188	32 32 32	64 75 83
Street Light ††	250 Watt HID Fixtures (+45W ballast)=295	94	68
Warehouse Light	250 Watt HID Fixtures (+45W ballast)=295 400 Watt HID Fixtures (+65W ballast)=465	91 91	70 79
LED Wall Pack	70 Watt HID Fixtures (+20W ballast)=90 100 Watt HID Fixtures (+29W ballast)=129 150 Watt HID Fixtures (+38W ballast)=188	24 24 24	73 81 87
LED Vertical Wall Pack	50 Watt HID Fixtures (+19W ballast)=69 70 Watt HID Fixtures (+20W ballast)=90	9 9	87 90

Current

New

†† Additional energy savings can be achieved by utilizing the power down chip to lower light output during off-peak periods, e.g. 2 am–dawn.

*** Life expectancy of our LED fixtures is 20+ years and they are maintenance FREE. ***

The actual return on investment is significantly higher when operational savings are taken into account.

7/15/2009

EXHIBIT 2

Snow Hill WWTP
Green Energy Calculation on Pumps Based on Field Data

1) Existing Booster Pump (Gould Booster Pump Model 18GB20)

Field Data: 460 volt. amps measured 3.5/3.2/3.1 (3 phase). 22 gpm. 50-120 psi boost.

HP in = 460 volts x 3.3 amps / 746 = 2.03 HP

Rating is 2 HP. Okay

120-50 psi x 2.31 = 162 ft

HP out = 162 ft x 22 gpm / 3960 = 0.9 HP

Eff. = 0.9 HP out / 2.0 HP in = 0.44. **Result is 44% efficient**

2) Existing Sludge Pump (Seepex Model 05-24 BN)

Field Data: 460 volt. amps measured 5.8/5.7/5.7 (3 phase). 2 gpm. 0 psi. VFD Set at 70%.

Refer to Seepex Pump Curve. This is a positive displacement pump with a linear RPM vs. Pump Rate Curve. Standard centrifugal pump performance calculations (for HP out) do not apply to this pump: therefore the calculation is based on actual pumping performance which does apply because of the linear relationship of RPM & Flow Rate

Note that existing pump is in very poor condition and has performance issues. which is better understood after running calculations. Clearly the pump is worn significantly. Also. that there is up to 15 feet (7 psi) of suction head on the pumps and 0 psi at outlet.

HP in = 460 volts x 5.7 amps / 746 = 3.5 HP

VFD is set at 70%. 1500 x 0.7 = 1050 RPM Speed. per pump curve the pump rate should be 8.8 gpm.

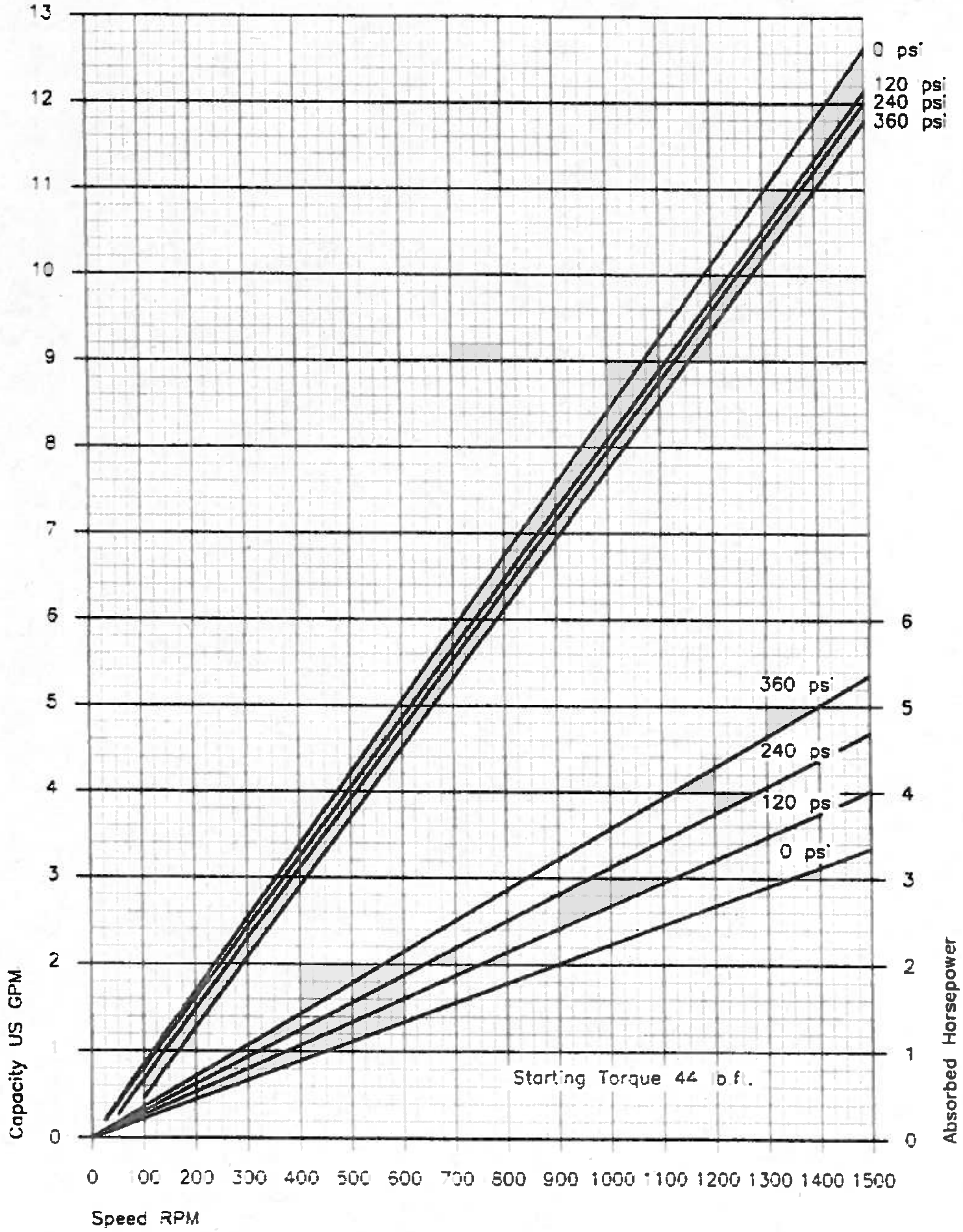
Actual pump rate is 2.0 gpm which would be at 240 RPM if pump was at 100% Eff.. per pump curve.

Eff. = 2.0 gpm / 8.6 gpm = 0.24. **Result is 24% efficient (motor, VFD and Pump)**

Likewise the 7.5 HP motor on the VFD at 70% should be at 5.25 HP and is only 3.5 HP based on amperage measurements: which would indicate that the standard operational pump torque of 26.3 LB-FT is significantly decreased and causing the less work for the motor. (Torque in LB FT x RPM / 5252 = HP).

This is understandable because the motor eff. is typically 85%. VFD eff. is typically 97%. which would put the pump at about 30%. It could be assumed that the pump vanes are worn significantly and now having difficulty pulling the required suction head.

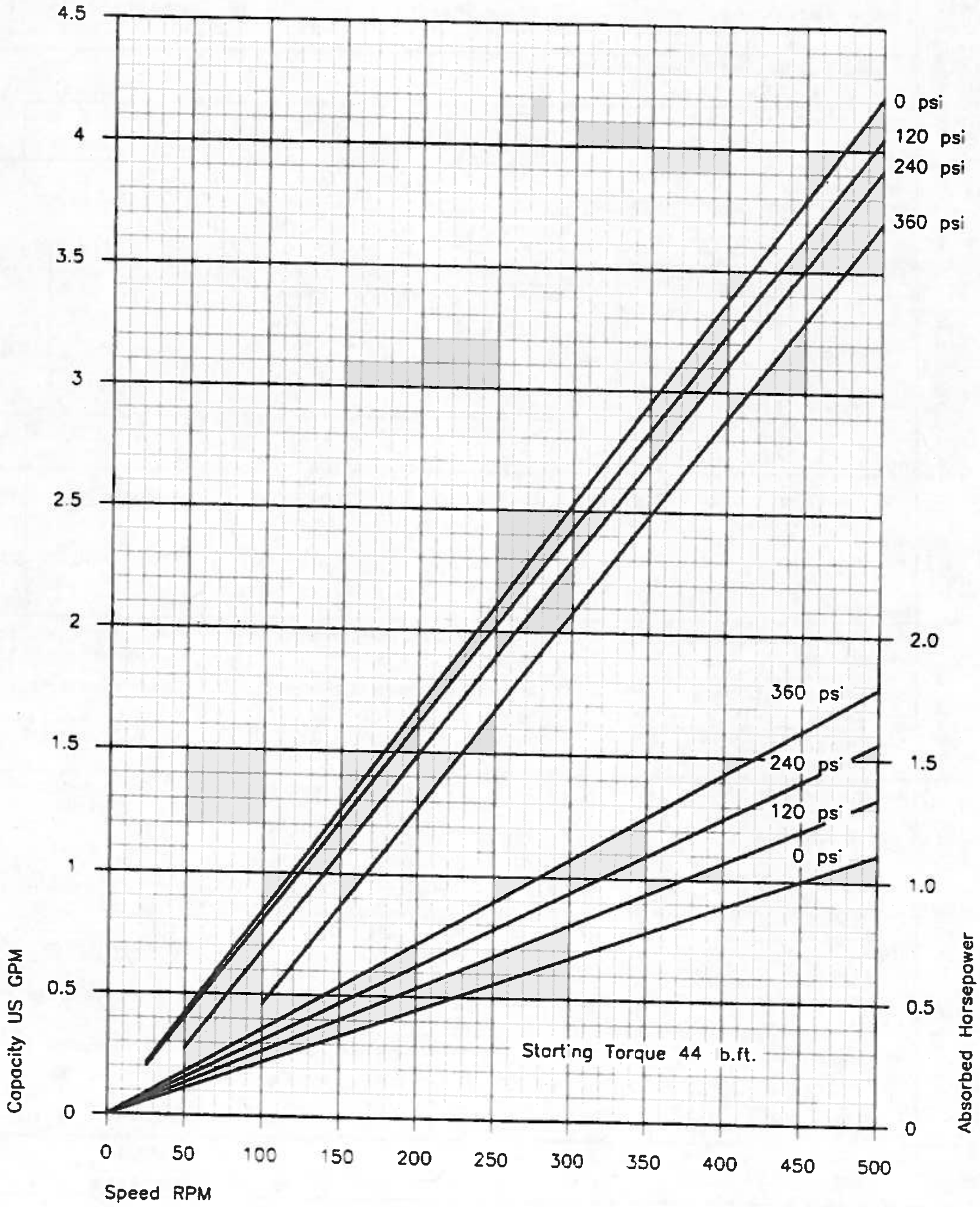
Characteristic Curves
Size
05-24



Values based upon water 68°F ; For notes on drive selection refer to PER

CHA.05-24 B 12.02us

Characteristic Curves
Size
05–24



Values based upon water 68°F ; For notes on drive selection refer to PER

CHA.05–24.s B 12.02us

Auftragslaufkarte

Auftrag Nr. 3-08407-00-OSP

Original

Ak-Nr. / Komm.-Nr.	26538-26541/83-27
Liefertermin	41./42. Woche 1983

Datenblatt Nr. 1 zu ~~Angebot~~ Auftragsbestätigung vom 21. Sept. 1983

an Firma Peacock, Canada

Typ	Exzenterschnecken-Pumpe: 4	Bezeichnung: SEEPEX	Baugröße: 5	Druckstufe: 24	Baureihe: BN	Kennzahl: 110-1521-3.0.3-11.1

Förder-Medium

Bezeichnung: zur Förderung eines Öl-/Wasser-Gemischs mit geringem Sandanteil					Temp. C: normal / angenommen, max. °C
Konzentration oder Zusammensetzung: ohne Angabe					
Feststoffanteil: gering	Korngröße: o.A.	Feststoff-Art hart/weich – rund/kantig	spez. Gewicht: o.A. kp/cm³	pH-Wert: o.A.	Viskosität: fließfähig

Betriebs-Daten

Fördermenge gegen Prüfdruck	Q_1 = 2,92 ³	Drehzahl	n_1 = 265 U/min
	Q_2 =		n_2 = U/min

Förderleitung	Geod. Höhe	Ges.-Länge	Formstücke	Armaturen	NW	Prüfdruck
saugseitig	Zulauf ANGENOMMEN					Hs = – kp/cm²
druckseitig	21,09 bar					Ho = kp/cm²

Leistungsbedarf Pumpe	Max. Anfahrmoment	Gew.-Antr.-Leistung	Drehrichtung
N_{Erf} = 3,4 kW	Md_A = kpm	N_{Mot} kW	links

Bauform Anschlüsse

Aufstellung		Saug-Stutzenstllg.	Sauganschluß	Druckanschluß	Doppelmantel	Wellenabdichtg.	Ausf.
horizontal	x	1	ANSI B 16,5 NW 80 ND. 150 lbs DIN	ANSI B 16,5 NW 65 ND. 300 lbs DIN	NW ... ND ... DIN ...	Stopfbuchsp.	1
vertikal						Gleitringdichtg.	– –

Werkstoffe

Gehäuseteile (flüssigkeitsberührt) Werkstoff-Nr.: GG 25	Kraftübertragungsteile (flüssigkeitsber.) Werkstoff-Nr.: 1.4021	Rotor hartverchromt Werkstoff-Nr.: 1.4301
Gehäuseeinsatz (Stator): Perbunan	Gelenkabdichtungen (Manschetten): Perbunan	Stopfbuchspackung: K 41
Gleitringdichtung	Doppelmantel	Sicherheitsventil / Umgehungsleitg.

Zubehör-Pumpe

Antriebs-Aggregat	Typ	Bauform	Drehzahl-Motor	Drehzahl-Abtrieb U/min	Regelbereich U/min
Bockwoldt-Getriebe	CB3-NFF-132-VL Flansch 250 mm	B 5			

Motor-Leistung	Spannung	Frequenz	Schutzart	Ex-Schutz	Einschaltung
kW	V	Hz	IP		direkt / Y Δ

Drehzahl-Untersetzung	Drehzahl-Regulierung	Drehzahl-Anzeige
i = 6,2		

B.C.F.-Motore, Baugrösse 132S, 1750 UpM, 3x440 Volt, 60 Hz, explosionsgeschützt, Bauform B5, CSA-Ausführung, werden kundenseits angebaut.

Grundplatte	Kupplung	Umgehungsleitung	Sicherheitsventil
Grundplatte n 4, Norm 3, 62-50/5-24-7/4-4x		NW ... ND ... DIN ...	NW ... ND ... DIN ... Einstellung ... kp/cm²

Lack. Gew.

RAL	Brutto	Netto	Verpackung
5017 x1)	kp	kp	seemässig kp

Sonder-Ausf.: Steckwelle – Bohrung 40 x 70.

Versandvorschrift: per Seefracht an Ihre Anschrift

Verteiler

Ausgestellt	Gesch.-Ltg.	Verkauf	TB	Mat.-Disp./AV	Werkstatt Abnahme
Mu/S.-					