Opportunities for and Benefits of Combined Heat and Power at Wastewater Treatment Facilities

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For more information about the EPA CHP Partnership, please visit:
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Executive Summary

As part of its broader outreach and education efforts to expand knowledge of the benefits and applications of combined heat and power (CHP), the U.S. Environmental Protection Agency's (EPA's) CHP Partnership (CHPP) has undertaken targeted efforts to increase CHP use in three specific market sectors: dry mill ethanol production, hotels/casinos, and wastewater treatment. The CHPP's work in these sectors is intended to serve two main audiences: energy users and industry Partners. Sector-specific information on the technical and economic benefits of CHP is provided so energy users can consider employing CHP at their own facilities. Market analyses help our CHP industry Partners increase their penetration into these sectors. This guide presents the opportunities for and benefits of CHP applications at municipal wastewater treatment facilities (WWTFs), also known as publicly owned treatment works (POTWs).

CHP is a reliable, cost-effective option for WWTFs that have, or are planning to install, anaerobic digesters. The biogas flow from the digester can be used as "free" fuel to generate electricity and power in a CHP system using a turbine, microturbine, fuel cell, or reciprocating engine. The thermal energy produced by the CHP system is then typically used to meet digester heat loads and for space heating. A well-designed CHP system offers many benefits for WWTFs because it:

- Produces power at a cost below retail electricity.
- Displaces purchased fuels for thermal needs.
- Qualifies as a renewable fuel for green power programs.
- Enhances power reliability for the plant.
- Offers an opportunity to reduce greenhouse gas and other air emissions.

The primary purpose of this guide is to provide basic information for assessing the potential technical fit for CHP at WWTFs that have anaerobic digesters. It is intended to be used by CHP project developers, WWTF operators, and other parties who are interested in exploring the benefits of CHP for a WWTF. The guide provides the following information:

- The size of facilities that have the greatest potential for employing cost-effective CHP.
- Rules of thumb for estimating a CHP system's potential electricity and thermal outputs based on wastewater flow rate.
- The emission reduction benefits associated with CHP at WWTFs.
- The cost-effectiveness of CHP at WWTFs.
- Strategic issues involved with employing CHP at WWTFs.

Through its market and technical analyses, the CHPP has found that:

- CHP is a strong technical fit for many WWTFs.
- CHP is commercially available and has been proven effective in application at WWTFs.
- CHP can be a compelling investment at WWTFs, depending on local electricity prices and fuel costs.
- CHP offers additional values and benefits for WWTFs, including offset equipment costs, increased reliability, and emission reductions.
- CHP has been underutilized at WWTFs to date.

Specifically, the CHPP estimates that if all 544 WWTFs in the United States that operate anaerobic digesters and have influent flow rates greater than 5 MGD were to install CHP, approximately 340 MW of clean electricity could be generated, offsetting 2.3 million metric tons of carbon dioxide emissions annually. These reductions are equivalent to planting approximately 640,000 acres of forest, or the emissions of approximately 430,000 cars.

Engineering Rules of Thumb for Considering CHP at a WWTF

- A typical WWTF processes 100 gallons per day of wastewater for every person served.[1]
- Approximately 1.0 cubic foot (ft^3) of digester gas can be produced by an anaerobic digester per person per day.[2] This volume of gas can provide approximately 2.2 Watts of power generation.[3]
- The heating value of the biogas produced by anaerobic digesters is approximately 600 British thermal units per cubic foot (Btu/ft^3).[4]
- For each 4.5 MGD processed by a WWTF with anaerobic digestion, the generated biogas can produce approximately 100 kilowatts (kW) of electricity.[5]

[1] Great Lakes-Upper Mississippi Board of State and Provincial Public Health and Environmental Managers, "Recommended Standards for Wastewater Facilities (Ten-State Standards)," 2004.
[2] Metcalf & Eddy, "Wastewater Engineering: Treatment, Disposal, Reuse," 1991.
[3] Assumes the energy content of biogas is 600 Btu/ft^3, and the power is produced using a 30 percent efficient electric generator.
[4] Metcalf & Eddy, "Wastewater Engineering: Treatment, Disposal, Reuse," 1991.
[5] See section 4.1: Electric and Thermal Generation Potential from CHP Systems.

1.0 Introduction

Today, more than 16,000 municipal wastewater treatment facilities (WWTFs) operate in the United States, ranging in capacity from several hundred million gallons per day (MGD) to less than 1 MGD. Roughly 1,000 of these facilities operate with a total influent flow rate greater than 5 MGD, but only 544 of these facilities employ anaerobic digestion to process the wastewater. Moreover, only 106 WWTFs utilize the biogas produced by their anaerobic digesters to generate electricity and/or thermal energy. In places where the spark spread[1] is favorable, great potential for combined heat and power (CHP) at WWTFs exists.

The U.S. Environmental Protection Agency's (EPA's) Combined Heat and Power Partnership (CHPP) has developed this guide to provide basic information for assessing the potential technical fit of CHP at WWTFs that have anaerobic digesters. The guide is intended to be used by CHP project developers, WWTF operators, and other parties who are interested in exploring the benefits of CHP for a WWTF.

Though outside the scope of the remainder of this guide, WWTFs that do not presently employ anaerobic digesters for biosolids management should note that the benefits of CHP deployment at a WWTF are in addition to the typical benefits of anaerobic digesters, which include:

- Production of biogas that can offset purchased fuel and be used in a CHP system.
- Enhanced power reliability at the facility if biogas is used to produce backup power.
- Reduced odors and uncontained methane emissions.
- Additional revenue streams, such as soil fertilizers that can be produced from digester effluent.

The CHPP based its analyses of the opportunities for and benefits of CHP within the wastewater treatment market sector on data obtained from the 2004 Clean Watersheds Needs Survey (CWNS), Energy and Environmental Analysis, Inc.'s (EEA's) Combined Heat and Power Installation Database, and additional independent research. The guide is organized as follows:

- Section 2 introduces the wastewater treatment data used for the CHPP's analyses, including information on data collection and limitations.
- Section 3 describes the potential market for CHP at WWTFs.
- Section 4 explains the technical fit for CHP at WWTFs, presenting the CHPP's analyses of electric and thermal energy generation potential at WWTFs, and the associated greenhouse gas emissions benefits.
- Section 5 presents cost-effectiveness information for CHP at WWTFs.
- Section 6 presents some strategic issues related to installing CHP at WWTFs, including the potential eligibility for renewable fuel credits and clean energy funding.
- Section 7 lists additional sources of relevant information.
- Appendix A includes a full list of WWTFs in the United States with flow rates greater than 5 MGD that have at least one anaerobic digester. This list includes the potential electricity capacity a CHP system could produce at each facility.
- Appendix B presents the anaerobic digester design criteria and models used in the analyses.

[1] Spark spread is the differential between the price of electricity and the price of natural gas or other fuel used to generate electricity, expressed in equivalent units.

2.0 Data Sources

To develop an overview of the wastewater treatment sector and the potential energy available for CHP, the CHPP used publicly available information contained in the 2004 Clean Watersheds Needs Survey (CWNS) Database[2], EEA's Combined Heat and Power Installation Database[3], and conducted independent research.

The CWNS is conducted as a joint effort between EPA's Office of Wastewater Management and the states in response to Section 205(a) and 516 of the Clean Water Act. The CWNS contains information on POTWs, facilities for control of sanitary sewer overflows (SSOs), combined sewer overflows (CSOs), stormwater control activities, nonpoint sources, and programs designed to protect the nation's estuaries. Wastewater facilities voluntarily report facility-specific information through a survey, and information obtained from the survey is maintained in the CWNS Database. The collected data are used to produce a Report to Congress that provides an estimate of clean water needs for the United States. The 2004 CWNS contains information on 16,676 operating wastewater treatment facilities.

Several limitations exist when using the CWNS data to analyze the potential for CHP at WWTFs. First, the data are voluntarily reported. As such, a completely accurate picture of wastewater activity cannot be obtained from the CWNS. Second, although facilities report if they have anaerobic digesters, the CWNS does not indicate how many digesters are in operation at a facility, or how facilities use the produced biogas. Third, the data contained in the 2004 CWNS are two years old, and therefore might not reflect the current state of operations for each plant.

The Combined Heat and Power Installation Database is maintained by EEA for the U.S. Department of Energy and Oak Ridge National Laboratory. The database lists all CHP systems in operation in the United States. Information is gathered in real time and originates from industry literature, manufacturer contacts, regional CHP centers, and EPA. The database is a work in progress, and EEA notes that all data might not be complete.

The CHPP also conducted independent research, which included reviewing case studies of WWTFs that employ CHP, acquiring accepted carbon dioxide emissions factors for power generation, and utilizing the extensive CHP resources and contacts available to the CHPP.

3.0 The Market

3.1 Wastewater Treatment Facilities with Anaerobic Digestion

To evaluate the market potential for CHP systems in the wastewater treatment sector, the CHPP queried the CWNS Database to determine the number of WWTFs using anaerobic digestion. The CHPP focused on facilities with anaerobic digesters because anaerobic digesters have the ability to produce "free" fuel (i.e., biogas), and they have a heat load that a CHP system can meet. The CHPP then categorized WWTFs by influent flow rate to evaluate the CHP potential for various sizes of WWTFs. The minimum flow rate for WWTFs included in the analysis is 5 MGD, which is based on previous analyses performed by the CHPP that showed that WWTFs with influent flow rates less than 5 MGD could not produce enough biogas from anaerobic digestion of

[2] The 2004 CWNS is available through EPA's Office of Wastewater Management.
[3] EEA's Combined Heat and Power Installation Database can be accessed online at: www.eea-inc.com/chpdata/index.html

biosolids to make CHP technically and economically feasible. Table 1 shows the number of WWTFs with anaerobic digestion and off-gas utilization, and Table 2 shows the flow rate to WWTFs with anaerobic digestion and off-gas utilization.

Table 1: U.S. Wastewater Treatment Facilities with Anaerobic Digestion and Off-Gas Utilization by Number

WWTFs by Wastewater Flow Rates (MGD)	Total WWTFs	WWTFs with Anaerobic Digestion	WWTFs with Anaerobic Digestion and Gas Utilization	Percentage of WWTFs with Anaerobic Digestion that Utilize Biogas
> 200	15	10	5	50
100 – 200	26	17	9	53
75 – 100	27	16	7	44
50 – 75	30	18	5	28
20 – 50	178	87	25	29
10 – 20	286	148	19	13
5 – 10	504	248	36	15
Total	**1,066**	**544**	**106**	**19**

Source: 2004 Clean Watersheds Needs Survey

Table 2: U.S. Wastewater Treatment Facilities with Anaerobic Digestion and Off-Gas Utilization by Flow Rate

WWTFs by Wastewater Flow Rates (MGD)	Total WWTFs	Total Wastewater Flow at WWTFs (MGD)	Wastewater Flow to WWTFs with Anaerobic Digestion (MGD)	Wastewater Flow to WWTFs with Anaerobic Digestion and Gas Utilization (MGD)	Wastewater Flow to WWTFs with Anaerobic Digestion and No Gas Utilization (MGD)
> 200	15	5,147	3,783	1,530	2,253
100 – 200	26	3,885	2,652	1,462	1,190
75 – 100	27	2,321	1,350	604	745
50 – 75	30	1,847	1,125	327	798
20 – 50	178	5,373	2,573	698	1,876
10 – 20	286	3,883	2,036	261	1,775
5 – 10	504	3,489	1,728	257	1,471
Total	**1,066**	**25,945**	**15,247**	**5,140**	**10,107**

Source: 2004 Clean Watersheds Needs Survey

The 2004 CWNS identified 16,676 operational WWTFs in the United States. As Tables 1 and 2 show, only 1,066 of these facilities have flow rates greater than 5 MGD. The data in Table 1 indicate that for WWTFs with total influent flow rates greater than 5 MGD, nearly 50 percent (544/1,066) operate anaerobic digesters for biosolids management. However, only about 19 percent (106/544) of the WWTFs with anaerobic digestion utilize digester gas for heating or electricity generation. The CHPP assumes that the remaining WWTFs with anaerobic digestion flare their digester gas. The data in Table 1 also indicate that larger WWTFs tend to use their digester gas, while smaller WWTFs do not. Specifically, 50 percent of WWTFs with design influent flows greater than 200 MGD utilize the biogas generated from anaerobic digesters, while only 13 percent of WWTFs with influent flows ranging between 10 and 20 MGD utilize the digester gas.

The data in Table 2 indicate that, for WWTFs with total influent flow greater than 5 MGD, roughly 58 percent (15,247 MGD/25,945 MGD) of all wastewater flow goes to facilities with anaerobic digestion. However, only 20 percent (5,140 MGD/25,945 MGD) of wastewater flow goes to facilities with anaerobic digestion and gas utilization.

3.2 Wastewater Treatment Facilities with CHP

As of December 2006, wastewater treatment CHP systems were in place at 76 sites in 24 states, representing 220 megawatts (MW) of capacity. Table 3 shows the number of sites by state, as well as the total CHP capacity in each state. California and Oregon have the largest number of facilities with CHP systems, and Massachusetts has the largest installed capacity.

Table 3: Number of Wastewater CHP Systems and Total Capacity by State

State	Sites	Capacity (MW)
AR	1	1.7
AZ	1	4.2
CA	23	38.1
CO	2	7.9
CT	1	0.2
FL	1	6.0
IA	2	3.4
ID	2	0.5
IL	2	4.3
MA	1	76.0
MN	2	5.1
MT	3	1.1
NE	3	5.4
NH	1	0.4
NJ	3	4.6
NY	5	13.3
OH	1	0.1
OR	10	5.9
PA	3	22.4
UT	2	2.6
VA	1	3.0
WA	3	13.6
WI	2	0.5
WY	1	0.03
Total	**76**	**220.1**

Source: EEA Combined Heat and Power Installation Database

4.0 Technical Fit

Anaerobic digestion is the key indicator of CHP potential at WWTFs because the process generates biogas containing approximately 60 percent methane. The biogas can be used as fuel for a number of purposes:

- To fire boilers and hot water heaters needed to maintain optimal digester temperatures and provide space heating.
- To generate electricity to operate pumps and blowers used throughout the treatment process.
- To generate electricity using equipment such as microturbines for onsite use and/or to sell back to the grid.

Anaerobic digestion produces biogas on a continuous basis, allowing for constant electricity production. Internal process heat used for the digesting process represents the most common use of wastewater treatment methane, but great potential exists for facilities to use the generated biogas for CHP applications.

4.1 Electric and Thermal Generation Potential from CHP Systems at Wastewater Treatment Facilities

To determine the electricity and thermal energy generation potential for CHP at WWTFs, the CHPP modeled the fuel produced and required by two typically sized digesters—one mesophilic digester and one thermophilic digester.[4] Each digester model was based on a total influent flow rate of 9.1 MGD.[5] This wastewater flow rate produces roughly 91,000 standard cubic feet (ft^3) of biogas per day, which has an energy content of 58.9 million British thermal units per day (MMBtu/day).[6] Both types of digesters were modeled for summer and winter operation. Appendix B contains the digester design criteria used for the analysis.

The CHPP estimated the biogas utilization of each model digester under four possible cases of biogas utilization. The first case assumes no CHP system, where only the amount of biogas needed for the digester heat load is utilized and the rest is flared. The other three cases assume that a CHP system utilizes the captured biogas to produce both electricity and thermal energy. The three modeled CHP systems include an internal combustion engine, a microturbine, and a fuel cell. In its analysis, the CHPP used a current industry average electric efficiency for each CHP technology as listed in the "Catalogue of CHP Technologies."[7] However, the possibility for employing a CHP system capable of achieving greater electric efficiencies exists. The use of any CHP technology must be determined by both the site and policy conditions of a particular location. Tables 4 and 5 present the results for each of these models. In each table, the results represent an average of winter and summer digester operation.

As Tables 4 and 5 illustrate, an influent flow rate of 9.1 MGD can produce approximately 200 kilowatts (kW) of electricity along with roughly 25 MMBtu/day of thermal energy. Using the biogas from a typically sized digester, a fuel cell CHP system can produce the most electricity (roughly 285 kW). The thermal output of a fuel cell also most closely matches the heat load of

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[4] Two conventional anaerobic digestion processes exist: mesophilic and thermophilic. Both have heat loads. The mesophilic process takes place at ambient temperatures typically between 70° F and 100° F; the thermophilic process takes place at elevated temperatures, typically up to 160° F. Due to the temperature differences between the two processes, the residence time of the sludge varies. In the case of mesophilic digestion, residence time may be between 15 and 30 days. The thermophilic process is usually faster, requiring only about two weeks to complete. However, thermophilic digestion is usually more expensive because it requires more energy and is less stable than the mesophilic process.

[5] The total influent flow rate of 9.1 MGD is based on the sludge capacity of a typically sized digester (i.e., 20 ft. deep and 40 to 60 feet in diameter). See Appendix B for the digester design parameters.

[6] Biogas generation was calculated based on 100 gallons of wastewater flow per day per capita, and approximately 1.0 cubic foot per day of digester gas per capita (See "Engineering Rules of Thumb" in Executive Summary for sources). Although the values used to calculate gas generation are empirical, they do provide a good estimate of gas volume. For example, the city of Rockford, Illinois, operates an anaerobic digester for biosolids management at its wastewater treatment plant. The wastewater plant receives on average 32 MGD of raw wastewater, and its anaerobic digester produces 320,000 ft^3 per day of biogas (i.e., 1.0 ft^3/100 gallons of raw wastewater).

[7] The "Catalogue of CHP Technologies" can be downloaded from the CHPP Web site at: www.epa.gov/chp/project_resources/catalogue.htm.

the digester (which minimizes the amount of heat that is wasted).[8] In many cases, however, the use of fuel cells is limited due to high cost. The two more common CHP systems employed at WWTFs—internal combustion engines and microturbines—can produce roughly 200 kW of electricity and 25 MMBtu/day of thermal energy with a wastewater flow rate of 9.1 MGD. This analysis indicates that roughly 100 kW of electric capacity can result from a total wastewater influent flow rate of 4.5 MGD.

Table 4: Electric and Thermal Energy Potential with CHP for Typically Sized Digester: Mesophilic

	No CHP system	**Microturbine CHP**	**Fuel Cell CHP**	**Internal Combustion Engine CHP**
Total POTW flow (MGD)	9.1	9.1	9.1	9.1
Heat requirement for sludge (Btu/day)	5,148,750	5,148,750	5,148,750	5,148,750
Wall heat transfer (Btu/day)	541,727	541,727	541,727	541,727
Floor heat transfer (Btu/day)	507,869	507,869	507,869	507,869
Roof heat transfer (Btu/day)	326,231	326,231	326,231	326,231
Total digester heat load (Btu/day)	6,524,577	6,524,577	6,524,577	6,524,577
Heat required for digester heat load* (Btu/day)	**8,155,721**			
Heat potential of gas (Btu/day)	54,370,800	54,370,800	54,370,800	54,370,800
% of gas used for digester heat load (Btu/day)	15.0%			
Amount of gas flared (Btu/day)**	**46,215,079**			
Electric Efficiency		0.28	0.43	0.30
Power to heat ratio		0.61	1.95	0.64
Electric production (Btu/day)		**15,223,824**	**23,379,444**	**16,311,240**
Electric production (kW)		**186**	**286**	**199**
Heat recovery (Btu/day)		**24,957,089**	**11,989,458**	**25,486,313**
Additional heat available* (Btu/day)**		**18,432,512**	**5,464,882**	**18,961,736**

Note: Assumes 50 percent summer and 50 percent winter.
*Assumes 80 percent efficient boiler.
**Assumes no other uses except boiler.
***Assumes digester is only heat load.

[8] Table 5 indicates that the thermal generation from a fuel cell CHP system does not meet the thermophilic digester heat load. Running less biogas through the fuel cell and using it to produce heat for the digester would rectify this, but less electricity would be produced.

Table 5: Electric and Thermal Energy Potential with CHP for Typically Sized Digester: Thermophilic

	No CHP system	Microturbine CHP	Fuel Cell CHP	Internal Combustion Engine CHP
Total POTW flow (MGD)	9.1	9.1	9.1	9.1
Heat requirement for sludge (Btu/day)	11,155,625	11,155,625	11,155,625	11,155,625
Wall heat transfer (Btu/day)	490,799	490,799	490,799	490,799
Floor heat transfer (Btu/day)	419,334	419,334	419,334	419,334
Roof heat transfer (Btu/day)	343,303	343,303	343,303	343,303
Total digester heat load (Btu/day)	12,409,061	12,409,061	12,409,061	12,409,061
Heat required for digester heat load* (Btu/day)	**15,511,327**			
Heat potential of gas (Btu/day)	54,370,800	54,370,800	54,370,800	54,370,800
% of gas used for digester heat load (Btu/day)	28.53%			
Amount of gas flared (Btu/day)**	**38,859,473**			
Electric efficiency		0.28	0.43	0.30
Power to heat ratio		0.61	1.95	0.64
Electric production (Btu/day)		**15,223,824**	**23,379,444**	**16,311,240**
Electric production (kW)		**186**	**286**	**199**
Heat recovery (Btu/day)		**24,957,089**	**11,989,458**	**25,486,313**
Additional heat available* (Btu/day)**		**12,548,027**	**-419,603**	**13,077,251**

Note: Assumes 50 percent summer and 50 percent winter.
*Assumes 80 percent efficient boiler.
**Assumes no other uses except boiler.
***Assumes digester is only heat load.

4.2 National Electric Generation Potential from CHP at Wastewater Treatment Facilities

The 2004 CWNS identified 10,107 MGD of wastewater flow at facilities greater than 5 MGD that have anaerobic digestion but no biogas utilization. If these facilities were to employ a CHP system, approximately 225 MW of electric capacity could be produced.[9] The CWNS also identified 5,140 MGD of wastewater flow at facilities greater than 5 MGD that have anaerobic digestion with biogas utilization. Anecdotal evidence suggests that very few facilities with anaerobic digestion and off-gas utilization use the biogas for electricity generation. As such, assuming these facilities only use the captured biogas for digester heat loads, an additional 115 MW of electric capacity could be produced.[10] CHP at WWTFs represents an excellent technical fit, with the ability to generate roughly 340 MW of electric capacity that could be used for onsite electricity needs or sold back to the electric grid. Appendix A lists all U.S. WWTFs greater than

[9] Assumes 100 kW of electric capacity results from a wastewater influent flow rate of 4.5 MGD.
[10] The CHPP recognizes that the total flow rate identified by the 2004 CWNS at facilities that have anaerobic digestion and use the captured biogas does not yield the CHP capacity reported in Table 3 when using 4.5 MGD = 100kW. This is most likely due to the two-year time difference between 2006 data and the 2004 dataset, and the fact that not all WWTFs report data for the CWNS.

5 MGD that have at least one anaerobic digester and notes the electric generation potential associated with CHP utilization for each facility.

4.3 Potential Carbon Dioxide Emission Benefits

The CHPP estimated the potential carbon dioxide emission offsets associated with increased use of CHP at WWTFs. To estimate these emission reductions, the CHPP assumed the following:

- Biogas from WWTFs is biogenic; therefore, utilizing it in a CHP system yields no net positive carbon dioxide emissions.
- 100 kW of electric grid capacity is offset with an influent flow rate of 4.5 MGD.
- WWTFs with anaerobic digestion and no off-gas utilization use natural gas for their digester heat loads.

Using CWNS data, a total of 2.3 million metric tons of carbon dioxide emission reductions can be achieved through increased use of CHP at WWTFs. These reductions are equivalent to planting approximately 640,000 acres of forest, or the emissions of approximately 430,000 cars. Table 6 presents these results.

Table 6: Potential Carbon Dioxide Emission Offsets with CHP at Wastewater Treatment Facilities

	All WWTFs with anaerobic digestion, but no gas utilization (>5MGD)	**All WWTFs with anaerobic digestion and gas utilization, assuming all gas used for digester heat load only (>5 MGD)**
Total flow (MGD)	10,107	5,140
(kW/MGD)	22	22
Total electric offset (kW)	224,598	114,221
(MMBtu/day)	18,392	9,353
Electrical Emission Offset (tons CO2/year)	1,527,229	776,685
(metric tons CO2/year)	1,388,390	706,078
Number of 9.1 MGD digesters	1,111	
Heat load per digester* (MMBtu/day)	12	
Total heat offset (MMBtu/day)	13,139	
Heat Emission Offset (tons CO2/year)	280,553	
(metric tons CO2/year)	255,048	
Potential Offsets (metric tons CO2/year)	1,643,438	706,078
Acres of forest	448,330	192,618
Cars	298,887	128,412
Total Potential Offsets (metric tons CO2/year)	**2,349,516**	
Acres of forest	**640,948**	
Cars	**427,299**	

5.0 Cost-Effectiveness

A well designed CHP system can be an attractive investment for a WWTF. A CHP system allows a WWTF to generate both electric and thermal energy on site, offsetting the costs of grid power and purchased fuel. To highlight the cost savings of generating energy with a CHP system at a WWTF, the CHPP estimated the cost-effectiveness of three representative CHP systems[11] that would be appropriate for different size WWTFs:

- 130 kW microturbine
- 300 kW carbonate fuel cell
- 1,060 kW reciprocating engine

Each WWTF considering CHP will need to perform its own site-specific feasibility analysis to determine potential biogas generation rates; methods to compress, clean, and dry the biogas before combustion; and the specific costs and benefits of generating onsite heat and electricity for their WWTF. In states where electricity prices are low, using biogas directly in boilers might be the best investment for a WWTF.

Based on influent flow rates and typical digester heat loads (as presented in Section 4.1, Tables 4 and 5), the microturbine would be appropriate for a small WWTF with a minimum influent flow rate of 6.8 MGD. The fuel cell could serve a medium-size WWTF with a minimum influent flow rate of 10.7 MGD. The reciprocating engine would be appropriate for a large WWTF with at least a 41.4 MGD influent flow rate.

Table 7 presents the system performance characteristics for the three sample CHP systems on which the economic analyses are based. The electric output that can be generated from the digester gas input and the amount of heat that can be recovered drive the project economics.

[11] Data used for performing these analyses were based on actual prices and performance characteristics of commercially available equipment (as stated by the manufacturers). To avoid implicitly endorsing any manufacturers or products, the CHPP has removed the brand names from the discussion of these systems.

Table 7: CHP System Performance Characteristics for Cost-Effectiveness Analysis

Performance Characteristic	CHP System Type		
	Microturbine	Fuel Cell	ReciprocatingEngine
Minimum WWTF Size (MGD)	*6.8*	*10.7***	*41.4*
Digester Biogas Produced/day (MMBtu)	*40.7*	*58.0*	*247.4*
Nameplate Capacity (kW)	130	300	1,060
Compressor/Aux. (kW)	(4)	—	—
Net Output* (kW)	126	300	1,060
Electrical Efficiency	26.1%	42.3%	35.1%
Electricity Production/day (kWh)	**3,024**	**7,200**	**35,440**
Electric/Thermal Output Ratio	0.86	2.84	0.82
Heat Rate (Btu/kWh HHV)	13,050	8,060	9,724
Thermal Output (Btu/kWh)	3,984	1,200	4,173
Heat Production/day (MMBtu)	**12.0**	**8.6**	**106.2**

* The net power output of the microturbine system is adjusted because the fuel must be compressed to about 75 to 100 psig using an electrically driven fuel compressor.
** The fuel cell does not produce enough waste heat to meet the digester heat load. About 10 percent of the available digester gas must go directly to a supplemental boiler. The 10.7 MGD size is 10 percent more than the 9.7 MGD needed to fuel a 300 kW fuel cell.

Table 8 presents the capital costs for the three sample CHP systems. The largest cost component for each system is the gen-set package which contains the prime mover and the generator. The next major cost component is the fuel treatment system to ensure that the biogas is of operational quality. Fuel treatment can consist of chillers, moisture separators, hydrogen sulfide removal vessels, siloxane removal vessels, heat exchangers, blowers, and connections. Switchgear and controls are required for system operation and paralleling with the utility grid. Additional switchgear (transfer switches, wiring, and electrical panels) would also be needed if the WWTF decides to configure back-up capabilities into the system (i.e., to allow the system to serve critical loads during a utility outage). The heat recovery equipment in each of these sample systems produces hot water for the digesters and other facility needs.

For the three CHP systems, the major equipment costs range from 58 to 65 percent of the total installed costs. Remaining costs include those for design, engineering, consulting, installation, and obtaining necessary permits. Typically, municipal facilities use a design-bid-build approach in which the facility is first designed and then the system components are competitively bid. In order to have a better integrated package, some facility managers suggest employing a design-build approach. However, using this contracting avenue might necessitate a special municipal directive.[12]

The capital costs shown in Table 8 do not include any credits for federal or state incentive programs that might be available either to stimulate renewable energy, reduce greenhouse gas emissions, promote high efficiency, or to support particular technologies, such as fuel cells. These credits can significantly enhance the economic value of CHP to WWTFs.

[12] *Gresham Waste Water Treatment Plant: Case Study*, Energy Trust of Oregon (prepared by Energy and Environmental Analysis, Inc.) September 2006.

Table 8: Estimated Capital Costs for Three CHP Systems at Wastewater Treatment Facilities

Capital Cost	CHP System Type					
	126 kW (net) Microturbine		300 kW Fuel Cell		1,060 kW Internal Combustion Engine	
	Cost ($)	Cost per kW ($/kW)	Cost ($)	Cost per kW ($/kW)	Cost ($)	Cost per kW ($/kW)
Gen-Set	$143,000	$1,135	$1,200,000	$4,000	$685,000	$646
Fuel Gas Compressor	$15,600	$124	—	—	—	—
Fuel Treatment	$89,000	$706	$147,000	$490	$313,000	$295
Switchgear & Controls	$19,500	$155	$97,600	$325	$125,000	$118
Heat Recovery	$26,000	$206	$23,200	$77	$100,000	$94
Total Equipment Costs	**$293,100**	**$2,326**	**$1,467,800**	**$4,893**	**$1,223,000**	**$1,154**
Consulting and Design	$114,400	$908	$125,000	$417	$150,000	$142
Installation	$23,400	$186	$433,500	$1,445	$576,500	$544
Permits & Inspection	$9,750	$77	$25,000	$83	$25,000	$24
Contingency 5%	$22,033	$175	$102,565	$342	$98,725	$93
Total Project Costs	**$462,683**	**$3,672**	**$2,153,865**	**$7,180**	**$2,073,225**	**$1,956**

The CHPP estimated net power costs for each of the three sample CHP systems based on three separate cases:

- **Case 1** assumes that the WWTF previously used digester gas for all thermal requirements, and that there was no purchased fuel used at the site. In this case, the CHP system replaces the thermal load with recovered heat from the prime mover. As previously mentioned, the fuel cell does not produce enough waste heat after generation of electricity, so this unit must be sized appropriately to allow some of the digester gas to fuel a supplemental boiler to provide the necessary make-up heat.
- **Case 2** assumes that the WWTF previously used digester gas in a boiler for digester heat loads and purchased natural gas for other facility needs. In this case, the excess thermal energy produced by the CHP system (beyond what's required for the digester heat load) displaces natural gas purchased for other facility needs such as space heating.
- **Case 3** assumes that the WWTF previously did not use digester gas and purchased natural gas for both digester heat loads and other facility needs. In this case, the thermal energy produced by the CHP system displaces natural gas purchased for all of the facility's thermal needs including the digester heat load.

Table 9 presents the net power cost estimates for each CHP system. The capital recovery costs are estimated for municipal facilities. Municipal facilities are assumed to have a cost of capital (municipal bonds) of 5 percent and a capital repayment horizon of 20 years. In cases where it is assumed that natural gas is being replaced, the CHPP assumes a natural gas price of $7.00/MMBtu. In these cases, a thermal credit is incorporated into the net power costs to account for the avoided fuel costs. The fuel savings and the digester heat requirements assume that the necessary thermal energy would have been produced from an 80 percent efficient boiler.

Table 9: Net Power Cost Estimates for Three CHP Systems at Wastewater Treatment Facilities

Cost Element	CHP System Type		
	126 kW (net) Microturbine	300 kW Fuel Cell	1,060 kW Internal Combustion Engine
Maintenance ($/kWh)	$0.022	$0.030	$0.018
Case 1: CHP thermal replaces biogas-fueled boiler for digester heating and other local use*			
Capital Recovery ($/kWh)	$0.035	$0.069	$0.019
Unit Power Cost ($/kWh)	**$0.057**	**$0.099**	**$0.037**
Case 2: Excess thermal energy (above digester needs) replaces natural gas elsewhere on site**			
Digester Heat Needed (Btu/kWh)	2,979	1,840	2,219
Natural Gas Displaced (Btu/kWh)	1,006	(640)	1,953
Thermal Credit ($/kWh)	$0.009	No Excess	$0.017
Net Unit Power Cost ($/kWh)	**$0.049**	**$0.099**	**$0.020**
Case 3: 100 percent natural gas replacement with CHP thermal energy***			
Natural Gas Displaced (Btu/kWh)	4,980	1,500	5,216
Thermal Credit ($/kWh)	$0.035	$0.011	$0.037
Net Unit Power Cost ($/kWh)	**$0.023**	**$0.089**	**$0.000**

*Assumes: Municipal Capital Recovery Factor of 8.0 percent (5 percent interest rate, 20 years); 95 percent capacity factor.
**Assumes: Digester fuel requirement as a percent of total gas produced = 28.5 percent (consistent with thermophilic average in Table 5); avoided boiler efficiency of 80 percent; avoided boiler fuel cost of $7.00/MMBtu.
***Assumes: Avoided boiler efficiency of 80 percent; avoided boiler fuel cost of $7.00/MMBtu.

A facility manager can easily compare the net costs presented in Table 9 to the WWTF's current cost of purchased power to get a quick estimate of whether a CHP system might be cost-effective. If a WWTF purchases power for less than the net power cost, a CHP system may not be cost-effective. However, each WWTF needs to perform its own cost-effectiveness analysis to determine the economic feasibility of investing in a CHP system at their particular facility with site-specific digester, heating, and electric loads. A system-specific level 1 feasibility analysis will uncover additional costs and value streams that are not captured in this basic cost-effectiveness analysis.

6.0 Wastewater Treatment Biogas as Renewable Energy

The use of biogas from anaerobic digestion at WWTFs is often eligible for renewable fuel credits and clean energy funding. For example, biogas-fueled electricity generation qualifies as a renewable energy source in each state with a renewable portfolio standard (i.e., 22 states and the District of Columbia as of October 2006). National voluntary renewable energy credit (REC) programs also consider new electricity generation fueled by biogas from WWTFs as eligible sources for RECs.

In addition, some states offer financial incentives (e.g., grants, rebates) for the production of clean onsite generation (such as biogas-fueled CHP) that reduces peak period electricity demand. For an up-to-date list of states that provide such incentives, see the Partner Resources section of the CHPP Web site at: *www.epa.gov/chp/funding_opps.htm*.

7.0 Additional Resources

EPA Combined Heat and Power Partnership (CHPP) – The CHPP is a voluntary program that seeks to reduce the environmental impact of power generation by promoting the use of CHP. The CHPP works closely with energy users, the CHP industry, state and local governments, and other stakeholders to support the development of new projects and promote their energy, environmental, and economic benefits. Web site: *www.epa.gov/chp/*

The CHPP offers a number of tools and resources that can help a WWTF implement a CHP system. These include:

- Description of the CHP project development process, including information on key questions for each stage of the process along with specific tools and resources: *www.epa.gov/chp/project_resources/proj_dev_process.htm*
- The CHP and biomass/biogas funding database with bi-weekly updates of new state and federal incentive opportunities : *www.epa.gov/chp/funding_opps.htm*
- The CHP Catalogue of Technologies, which describes performance and cost characteristics of CHP technologies: *www.epa.gov/chp/project_resources/catalogue.htm*

7.1 Organizations

The following organizations work closely with the wastewater treatment industry and offer a wealth of knowledge concerning wastewater treatment and the use of anaerobic digestion.

EPA Office of Wastewater Management (OWM) – The OWM oversees a range of programs contributing to the well-being of the nation's waters and watersheds.
Web site: *www.epa.gov/owm/*

National Association of Clean Water Agencies (NACWA) – NACWA represents the interests of more than 300 public agencies and organizations. NACWA members serve the majority of the sewered population in the United States and collectively treat and reclaim more than 18 billion gallons of wastewater daily.
Web site: *www.nacwa.org/*

Water Environment Federation (WEF) – Founded in 1928, the WEF is a not-for-profit technical and educational organization with members from varied disciplines who work toward the organization's vision of preservation and enhancement of the global water environment.
Web site: *www.wef.org/Home*

Water Environment Research Foundation (WERF) – WERF helps improve the water environment and protect human health by providing sound, reliable science and innovative, effective, cost-saving technologies for improved management of water resources.
Web site: *www.werf.us/*

Air and Waste Management Association (A&WMA) – A&WMA is a nonprofit, nonpartisan professional organization that provides training, information, and networking opportunities to thousands of environmental professionals in 65 countries.
Web site: *www.awma.org/*

7.2 Articles

The following journal article and conference presentation highlight the technologies available for digester gas utilization.

Hinrichs, Doug; Jimison, John; Lemar, Paul. (November/December 2005). Using Biogas to Fuel DG and CHP plants. *Platts Power: Business and Technology for the Global Generation Industry*, Vol 49, No. 9, 67-70.

Mosteller, Kevin L. (2002). Energy Crisis Impact on Anaerobic Digester Gas Utilization Technology: Fuel Cells, Co-Generation, and Other Options. *South Carolina Environmental Conference*. Retrieved June 20, 2006, from *http://sc-ec.org/PDFs/2002SCEC/20-Digester%20Gas.pdf*.

7.3 Case Studies

Following are selected case studies that demonstrate the benefits and operational characteristics of installing CHP systems at a variety of WWTFs. These case studies highlight a variety of technologies and biogas utilization options.

- **"Waukesha Engine Energizes New Hampshire Water Utility Digesting Sludge for Fuel" –** New Hampshire's Water Utility uses its 12 to 18 MGD of wastewater to produce electricity and hot water for the facility with a 365 kW internal combustion engine. The anaerobic digesters at the facility handle approximately 60,000 gallons of sludge per day, and what is left after the digestion process is sold as compost.
  Web site: *https://dresser.com/internet/businessunits/waukesha/pages/documents/publications/casehistory/nh_water_utility.pdf*

- **"Maintenance Helps *Million Hour* Engines Thrive at Tucson, Arizona Wastewater Cogeneration Plant" –** The Ina Road WWTF treats approximately 35 MGD of wastewater. The facility uses six internal combustion engines to generate approximately 2.5 MW of electricity and thermal energy that is used for hot water; chilled water; heating, ventilation, and cooling (HVAC); and to run the anaerobic digesters. By utilizing biogas, the facility pays no more than $0.05/kWh, which compares very favorably with the local average of $0.08 to $0.11/kWh.
  Web site: *www.grove.it/internet/businessunits/waukesha/pages/documents/publications/casehistory/tucsonwater_utility.pdf*

- **"King County (Washington) Fuel Cell Demonstration Project" –** In 2003, King County's South WWTF installed a 1 MW molten carbonate fuel cell (MCFC) demonstration project that generates electricity and thermal energy for onsite needs.
  Web site: *www.fce.com/downloads/king_county_brochure_03.pdf*

- **"Essex Junction WWTF (Vermont): 60 kW CHP Application" –** The Essex Junction WWTF uses two 30 kW microturbines to generate electricity and thermal energy. The CHP system's operational efficiency is 80 percent and produces annual energy savings of 412,000 kWh (36 percent of the facility's electricity demand). The project was installed in 2003 and has an estimated payback of seven years.

Web site:
http://www.northeastchp.org/uploads/Essex%20Junction%20Project%20Profile.pdf

- **"Albert Lea WWTF (Minnesota): 120 kW CHP Application" –** The Albert Lea WWTF uses four 30 kW microturbines to generate 120 kW of electricity and 28 MMBtus of thermal energy per year, which is used for space heating and to heat the facility's anaerobic digesters. The CHP system was installed in 2003 and has an estimated payback of four to six years.
  Web site:
  www.chpcentermw.org/pdfs/Project_Profile_Albert_Lea_Wastewater_Treatment_Center.pdf

- **"Columbia Boulevard Wastewater Treatment Plant (Portland, Oregon): 320 kW Fuel Cell and Microturbine Power Plants" –** The Columbia Boulevard WWTF uses a 200 kW CHP system to produce electricity and thermal energy for the facility. A primary motivation for the CHP system was to provide back-up power for the facility after it experienced several extended power outages during the mid-1990s. The CHP system was financed by tax dollars, as well as multiple national, state, and utility grants.
  Web site: *www.chpcenternw.org/NwChpDocs/ColumbiaBlvdWastewaterCaseStudyFinal.pdf*

Appendix A: Full List of U.S. Wastewater Treatment Facilities (> 5 MGD) with at Least One Anaerobic Digester

Notes:

The potential electric capacity calculation assumes that 100 kW of capacity is produced for every 4.5 MGD of influent flow. The plant data comes from the 2004 CWNS. Several limitations exist when using the CWNS data. First, the data are voluntarily reported. As such, the following tables might not include all WWTFs in the United States with influent flow rates greater than 5 MGD. Second, although facilities report if they have anaerobic digesters, the CWNS does not indicate how many digesters are in operation at a facility, or how facilities use the produced biogas. Third, the data contained in the 2004 CWNS are two years old, and therefore might not reflect the current state of operations for each plant.

The following tables present an estimate of the potential electric capacity from CHP utilization at each facility based off the CHPP analysis. Each WWTF considering CHP will need to perform its own site-specific feasibility analysis to determine the true potential biogas generation rates; methods to compress, clean, and dry the biogas before combustion; and the costs and benefits of generating onsite heat and electricity.

A1: Facilities with no off-gas utilization

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
ALABAMA	ANNISTON CHOCCOLOCCO WWTP	CALHOUN	CITY OF ANNISTON WW & SB	9.11	202
ALABAMA	DECATUR DRY CREEK WWTP	MORGAN	CITY OF DECATUR WW DEPT	18.08	402
ALABAMA	GADSDEN WEST WWTP	ETOWAH	GADSDEN WATERWORKS AND SEWER BOARD	9.71	216
ALABAMA	MOBILE WILLIAMS WWTP	MOBILE	MOBILE, BOARD OF WATER AND SEWER COMMISSIONERS	20.471	455
ALABAMA	MONTGOMERY CATOMA CREEK WWTP	MONTGOMERY	MONTGOMERY WW & SAN SWR BD	20.005	445
ALABAMA	MONTGOMERY ENCONCHATE WWTP	MONTGOMERY	MONTGOMERY WW&SAN SWR BD	10.591	235
ALABAMA	TUSCALOOSA WWTP	TUSCALOOSA	TUSCALOOSA WW & SWR BD	16.5	367
ALABAMA	ALBERTVILLE EASTSIDE WWTP	MARSHALL	ALBERTVILLE, CITY OF	6.04	134
ARIZONA	PHOENIX 91ST AVE WWTP	MARICOPA	CITY OF PHOENIX	124	2756

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
ARIZONA	ROGER RD TRTMNT PLNT	PIMA	PIMA COUNTY WWMD	29.6	658
ARIZONA	YUMA FIGUEROA WPCF	YUMA	CITY OF YUMA PUBLIC WORKS DEPT	8.5	189
ARKANSAS	LITTLE ROCK FOURCHE CREEK STP	PULASKI	LITTLE ROCK	13.1	291
ARKANSAS	SPRINGDALE STP	WASHINGTON	SPRINGDALE	12.2	271
CALIFORNIA	LAGUNA WASTEWATER TREATMENT PLANT	SONOMA	SANTA ROSA, CITY OF	17.5	389
CALIFORNIA	DUBLIN-SAN RAMON WWTF	ALAMEDA	DUBLIN SAN RAMON SERVICES DISTRICT	9.9	220
CALIFORNIA	SUNNYVALE WWTF	SANTA CLARA	SUNNYVALE, CITY OF	16.22	360
CALIFORNIA	CENTRAL CONTRA COSTA WWTF	CONTRA COSTA	CENTRAL CONTRA COSTA SANITARY DISTRICT	49.39	1098
CALIFORNIA	HAYWARD WPCF	ALAMEDA	HAYWARD, CITY OF	13.7	304
CALIFORNIA	DALY CITY WWTP	SAN MATEO	DALY CITY, CITY OF	6.27	139
CALIFORNIA	SAN JOSE/SANTA CLARA WPCP	SANTA CLARA	SAN JOSE, CITY OF, ENVIRONMENTAL SERVICES DEPART.	143.3	3184
CALIFORNIA	SAN MATEO WWTF	SAN MATEO	SAN MATEO, CITY OF	12.7	282
CALIFORNIA	SANTA CRUZ WWTF	SANTA CRUZ	SANTA CRUZ, CITY OF	15.32	340
CALIFORNIA	SANTA BARBARA WWTF	SANTA BARBARA	SANTA BARBARA, CITY OF	8.8	196
CALIFORNIA	WATSONVILLE WWTF	SANTA CRUZ	WATSONVILLE, CITY OF	7.4	164
CALIFORNIA	VENTURA WATER RECLAMATION FACILITY	VENTURA	VENTURA, CITY OF	10	222
CALIFORNIA	HILL CANYON WWTP	VENTURA	THOUSAND OAKS, CITY OF	10.3	229
CALIFORNIA	VALENCIA WRP	LOS ANGELES	COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY	14	311
CALIFORNIA	TERMINAL ISLAND WWTP	LOS ANGELES	CITY OF LOS ANGELES, BUREAU OF SANITATION	16	356

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
CALIFORNIA	SACRAMENTO REGIONAL WWTF	SACRAMENTO	SACRAMENTO COUNTY REGIONAL SANITATION DISTRICT	165	3667
CALIFORNIA	BAKERSFIELD WWTP #2	KERN	BAKERSFIELD, CITY OF	17.3	384
CALIFORNIA	BAKERSFIELD WWTP #3	KERN	BAKERSFIELD, CITY OF	11.3	251
CALIFORNIA	CHICO WPCP	BUTTE	CHICO, CITY OF	7.5	167
CALIFORNIA	LODI WPCF	SAN JOAQUIN	LODI, CITY OF	6.2	138
CALIFORNIA	MODESTO WWTF	STANISLAUS	MODESTO, CITY OF	27.4	609
CALIFORNIA	VISALIA WWTP	TULARE	VISALIA, CITY OF	12	267
CALIFORNIA	YUBA CITY WRP	SUTTER	YUBA CITY, CITY OF	5.5	122
CALIFORNIA	CLEAR CREEK WWTF	SHASTA	REDDING, CITY OF	7.93	176
CALIFORNIA	TRACY WWTP	SAN JOAQUIN	TRACY, CITY OF	7.1	158
CALIFORNIA	MADERA STP	MADERA	MADERA, CITY OF	5.85	130
CALIFORNIA	DAVIS WWTF	YOLO	DAVIS, CITY OF	6.5	144
CALIFORNIA	SOUTH TAHOE WWTF	EL DORADO	SOUTH TAHOE PUD	5	111
CALIFORNIA	PALM SPRINGS WWRF	RIVERSIDE	PALM SPRINGS, CITY OF	8.29	184
CALIFORNIA	PALM DESERT WWRF	RIVERSIDE	COACHELLA VLY CO WTR DIST	5.38	120
CALIFORNIA	SAN JACINTO REGIONAL WRF	RIVERSIDE	EASTERN MUNICIPAL WATER DISTRICT	8.72	194
CALIFORNIA	IEUA REGIONAL PLANT NO.1	SAN BERNARDINO	INLAND EMPIRE UTILITIES AGENCY	38.8	862
CALIFORNIA	CORONA WWTF #1	RIVERSIDE	CORONA, CITY OF	9.007	200
CALIFORNIA	RIALTO WWTP	SAN BERNARDINO	RIALTO, CITY OF	7.4	164
CALIFORNIA	SAN CLEMENTE WRP	ORANGE	SAN CLEMENTE, CITY OF	5	111
COLORADO	PUEBLO WWTP	PUEBLO	PUEBLO, CITY OF	16.8	373
COLORADO	BOULDER 75TH STREET WWTP	BOULDER	BOULDER, CITY OF	5.86	130
COLORADO	FORT COLLINS DRAKE WW RECLAMAT FAC	LARIMER	FORT COLLINS, CITY OF	13	289
COLORADO	GREELEY WWTP	WELD	GREELEY W & S DEPT	8.42	187
COLORADO	LONGMONT WWTP	BOULDER	LONGMONT, CITY OF	7.39	164

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
COLORADO	LITTLETON/ENGLEWOOD WWTP	ARAPAHOE	LITTLETON/ENGLEWOOD	32.67	726
COLORADO	BOULDER CREEK	BOULDER	BOULDER, CITY OF	16	356
CONNECTICUT	DANBURY WPCF	FAIRFIELD	DANBURY CITY OF	6.37	142
CONNECTICUT	EAST HARTFORD WPCF	HARTFORD	METROPOLITAN DISTRICT	5.963	133
CONNECTICUT	TORRINGTON MAIN WPCF	LITCHFIELD	TORRINGTON, CITY OF	5.28	117
DELAWARE	WILMINGTON STP	NEW CASTLE	WILMINGTON CITY COUNCIL	71.23	1583
FLORIDA	BUCKMAN STREET STP	DUVAL	JEA	37.96	844
FLORIDA	SOUTH WWTF	ORANGE	ORANGE CO FL SEW & W DEPT	14.98	333
FLORIDA	ALTAMONTE SPGS MAIN STP	SEMINOLE	ALTAMONTE SPRINGS, CITY	5.46	121
FLORIDA	MAIN STREET PLANT	ESCAMBIA	ECUA	14.63	325
FLORIDA	THOMAS P. SMITH WTP	LEON	TALLAHASSEE, CITY OF	13.39	298
FLORIDA	HOWARD F CURREN AWTP	HILLSBOROUGH	TAMPA	50.5	1122
FLORIDA	PLANT CITY STP	HILLSBOROUGH	PLANT CITY, CITY OF	5.3	118
FLORIDA	LARGO STP	PINELLAS	LARGO, TOWN OF	13	289
FLORIDA	MARSHALL STREET AWTTP	PINELLAS	CLEARWATER, CITY OF	6.34	141
FLORIDA	ST PETERSBURG SOUTHWEST WWTP	PINELLAS	ST PETERSBURG, CITY OF	10.1	224
FLORIDA	ST PETERSBURG NORTHEAST WWTP	PINELLAS	ST PETERSBURG, CITY OF	11.5	256
FLORIDA	ST PETERSBURG NORTHWEST WWTP	PINELLAS	ST PETERSBURG, CITY OF	11.04	245
FLORIDA	ALBERT WHITTED WWTP	PINELLAS	ST PETERSBURG, CITY OF	7.9	176
FLORIDA	LOXAHATCHEE R. REG STP	PALM BEACH	LOXAHATCHEE RIVER ENVIRONMENTAL CONTROL DISTRICT	7.5	167
FLORIDA	DAYTONA BEACH REG. STP	VOLUSIA	DAYTONA BEACH, CITY OF	6.05	134
FLORIDA	BETHUNE POINT WWTP	VOLUSIA	DAYTONA BEACH, CITY OF	8.46	188

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
GEORGIA	MACON POPLAR STREET WPCP	BIBB	MACON-BIBB CO. WSA	16.75	372
GEORGIA	INTRENCHMENT CREEK WWTP	DEKALB	ATLANTA PUBLIC WORKS DEPT	14.57	324
GEORGIA	SOUTH RIVER WWTP	FULTON	ATLANTA PUBLIC WORKS DEPT	32.26	717
GEORGIA	R M CLAYTON WPCP	FULTON	ATLANTA PUBLIC WORKS DEPT	87.52	1945
GEORGIA	JOHNS CREEK WPCP	FULTON	FULTON CO BD OF COMMISSIONERS	7.05	157
GEORGIA	FULTON CO-CAMP CREEK WPCP	FULTON	FULTON CO BD OF COMMISSIONERS	10.07	224
GEORGIA	COBB COUNTY SUTTON WPCP	COBB	COBB COUNTY WATER & SEWER	31.84	708
GEORGIA	COBB NOONDAY CREEK WPCP	COBB	COBB COUNTY WATER AND SEWER	8.75	194
GEORGIA	GWINNETT CROOKED CREEK STP	GWINNETT	GWINNETT COUNTY WATER POL	14.13	314
GEORGIA	SOUTH COLUMBUS WPCP	MUSCOGEE	COLUMBUS BD OF WAT COMM.	30	667
GEORGIA	ALBANY JOSHUA ROAD WPCP	DOUGHERTY	ALBANY, CITY OF	19.09	424
GEORGIA	AUGUSTA WWTP	RICHMOND	AUGUSTA, CITY COUNCIL OF	30.64	681
GEORGIA	ATHENS NORTH OCONEE WPCP	CLARKE	ATHENS, CITY OF	7.9	176
GEORGIA	GAINESVILLE FLAT CREEK WPCP	HALL	GAINESVILLE, CITY OF	5.68	126
GEORGIA	MILLEDGEVILLE WPCP	BALDWIN	MILLEDGEVILLE, CITY OF	5.9	131
GEORGIA	ROME WPCP	FLOYD	ROME WATER AND SEWER DEPT	9.68	215
GEORGIA	THOMASVILLE WPCP	THOMAS	THOMASVILLE, CITY OF	5.29	118
HAWAII	SAND ISLAND WWTF	HONOLULU	HONOLULU, CITY AND CO	77.6	1724
HAWAII	KAILUA WWTF	HONOLULU	HONOLULU, CITY & CO	6.93	154
HAWAII	HONOULIULI WWTF	HONOLULU	HONOLULU, CITY & CO	24.6	547
IDAHO	POCATELLO STP	BANNOCK	POCATELLO, CITY OF	6.34	141

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
IDAHO	TWIN FALLS STP	TWIN FALLS	TWIN FALLS, CITY OF	7.95	177
IDAHO	BOISE, CITY OF- LANDER STREET	ADA	BOISE, CITY OF	14.6	324
IDAHO	BOISE, CITY OF--WEST BOISE	ADA	BOISE, CITY OF	11.5	256
IDAHO	IDAHO FALLS STP	BONNEVILLE	IDAHO FALLS, CITY OF	10.5	233
IDAHO	NAMPA STP	CANYON	NAMPA, CITY OF	9.89	220
IDAHO	CALDWELL SEWAGE TRT FACIL	CANYON	CALDWELL, CITY OF	7.31	162
ILLINOIS	QUINCY STP	ADAMS	QUINCY, CITY OF	7	156
ILLINOIS	KANKAKEE RIVER METROPOLIT AN AGENCY	KANKAKEE	KANKAKEE RIVER METROPOLITAN AGENCY (KRMA)	14.68	326
ILLINOIS	FREEPORT STP	STEPHENSON	FREEPORT WATER & SEWER CO	5.1	113
ILLINOIS	UCSD-NORTHEAST STP	CHAMPAIGN	URBANA & CHAMPAIGN S.D.	10	222
ILLINOIS	FOX LAKE NW REGIONAL WRF	LAKE	FOX LAKE, VILLAGE OF	6.4	142
ILLINOIS	JOLIET - EASTSIDE STP	WILL	JOLIET, CITY OF	16	356
ILLINOIS	JOLIET-WESTSIDE STP	WILL	JOLIET, CITY OF	5.9	131
ILLINOIS	ELMHURST SEWAGE TREATMENT	DUPAGE	ELMHURST, CITY OF	10.4	231
ILLINOIS	WHEATON SD SEWAGE TR PLNT	DUPAGE	WHEATON SANITARY DISTRICT	7	156
ILLINOIS	DEKALB MAIN PLANT	DEKALB	DEKALB SANITARY DISTRICT	6	133
ILLINOIS	BELLEVILLE STP #1	ST. CLAIR	BELLEVILLE, CITY OF	5.95	132
ILLINOIS	ALTON S T P	MADISON	ALTON, CITY OF	8.42	187
ILLINOIS	ROCK ISLAND MAIN STP	ROCK ISLAND	ROCK ISLAND, CITY OF	8	178
ILLINOIS	SPRINGFIELD SD E SUG CRK	SANGAMON	SPRINGFIELD SANITARY DIST	9.27	206
ILLINOIS	DECATUR SD STP	MACON	DECATUR SAN. DIST.	38.4	853
ILLINOIS	PEORIA STP	PEORIA	GREATER PEORIA SANITARY D	27	600

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
ILLINOIS	BLOOMINGTON-NORMAL STP	MCLEAN	BLOOMINGTON-NORMAL SD	16	356
ILLINOIS	THORN CREEK BASIN. S.D. STP	COOK	THORN CREEK BASIN S.D.	13	289
ILLINOIS	JACKSONVILLE STP	MORGAN	JACKSONVILLE, CITY OF	5.95	132
ILLINOIS	GALESBURG STP	KNOX	GALESBURG SANITARY DIST	10	222
ILLINOIS	MCELWAIN REG STP	COOK	HINSDALE SANITARY DIST	10.48	233
ILLINOIS	GLENBARD WW AUTH	DUPAGE	GLEN ELLYN, VILLAGE OF	10	222
ILLINOIS	DOWNERS GROVE STP	DUPAGE	DOWNERS GROVE SAN DIST	8	178
ILLINOIS	STICKNEY WRD	COOK	CHICAGO MWRDGC	812	18044
ILLINOIS	HANOVER PARK WRP	COOK	CHICAGO MWRDGC	9	200
ILLINOIS	JOHN E EGAN WRP	COOK	CHICAGO MWRDGC	27	600
ILLINOIS	CALUMET WRP	COOK	CHICAGO MWRDGC	232.58	5168
INDIANA	SOUTHPORT WWTP	MARION	INDIANAPOLIS SAN. DIST.	125	2778
INDIANA	SPEEDWAY, TOWN OF	MARION	SPEEDWAY, TOWN OF	7.5	167
INDIANA	EAST CHICAGO STP	LAKE	EAST CHICAGO, CITY OF	15	333
INDIANA	GARY SANITARY DISTRICT	LAKE	GARY SANITARY DISTRICT	41.32	918
INDIANA	HAMMOND WWTP	LAKE	HAMMOND SD	48	1067
INDIANA	VALPARAISO STP	PORTER	VALPARAISO, CITY OF	6	133
INDIANA	TERRE HAUTE WWTP	VIGO	TERRE HAUTE S.D.	13.34	296
INDIANA	SOUTH BEND WWTP	ST. JOSEPH	SOUTH BEND BOARD OF PUBLIC	37.7	838
INDIANA	W LAFAYETTE SEWAGE WRKS	TIPPECANOE	WEST LAFAYETTE, CITY OF	9	200
INDIANA	MOSS ISLAND ROAD PLANT	MADISON	ANDERSON, CITY OF	20.53	456
INDIANA	EASTSIDE WWTP	VANDERBURGH	EVANSVILLE, CITY OF	18	400
INDIANA	EVANSVILLE WESTSIDE WWTP	VANDERBURGH	EVANSVILLE, CITY OF	20.6	458
INDIANA	JEFFERSONVILLE STP	CLARK	JEFFERSONVILLE, CITY OF	5.2	116
INDIANA	COLUMBUS WWTP	BARTHOLOMEW	COLUMBUS, CITY OF	7.94	176
INDIANA	CONNERSVILLE WWTP	FAYETTE	CONNERSVILLE, CITY OF	6.58	146

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
INDIANA	ELKHART WWTP	ELKHART	ELKHART, CITY OF	16.31	362
INDIANA	GOSHEN WWTP	ELKHART	GOSHEN, CITY OF	12.5	278
INDIANA	KOKOMO MUN WWTP	HOWARD	KOKOMO, CITY OF	19.5	433
INDIANA	LAPORTE WWTP	LA PORTE	LAPORTE, CITY OF	5.06	112
INDIANA	LOGANSPORT WWTP	CASS	LOGANSPORT, CITY OF	6.76	150
INDIANA	MICHIGAN CITY STP	LA PORTE	MICHIGAN CITY	12	267
INDIANA	NEW CASTLE STP	HENRY	NEW CASTLE, CITY OF	8	178
IOWA	AMES WWTP	STORY	AMES, CITY OF	5.89	131
IOWA	COUNCIL BLUFFS WWTP	POTTAWATTAMI E	COUNCIL BLUFFS, CITY OF	6.71	149
IOWA	DAVENPORT WWTP	SCOTT	DAVENPORT, CITY OF	19.02	423
IOWA	DES MOINES MAIN WWTP	POLK	DES MOINES WASTEWATER RECLAMATION FACILITY	33.35	741
IOWA	IOWA CITY NORTH WWTP	JOHNSON	IOWA CITY, CITY OF	5.91	131
IOWA	OTTUMWA WWTP	WAPELLO	OTTUMWA, CITY OF	5.36	119
IOWA	SIOUX CITY WWTP	WOODBURY	SIOUX CITY, CITY OF	18.29	406
IOWA	WATERLOO WWTP	BLACK HAWK	WATERLOO, CITY OF	16.91	376
KANSAS	HUTCHINSON WWTP	RENO	HUTCHINSON, CITY OF	5.506	122
KANSAS	WICHITA WWTP #1 + #2	SEDGWICK	WICHITA, CITY OF	40.617	903
KANSAS	KCK WWTP #1-KP WWTP	WYANDOTTE	KANSAS CITY, CITY OF	23.1	513
KANSAS	LAWRENCE WWTP	DOUGLAS	LAWRENCE, CITY OF	7.77	173
KANSAS	PITTSBURG WWTP	CRAWFORD	PITTSBURG, CITY OF	5.423	121
KANSAS	TOPEKA OAKLAND WWTP	SHAWNEE	TOPEKA, CITY OF	10.23	227
KANSAS	JO CO MISSION TOWNSHIP MSD #1 WWTP	JOHNSON	JOHNSON CO UNIFIED SD	7.1	158
KANSAS	JO CO TOM CRK WWTP	JOHNSON	JOHNSON CO. UNIFIED SD	5	111
KANSAS	JO CO TURKEY CREEK MSD #1 WWTP	JOHNSON	JOHNSON CO UNIFIED SD	6.86	152
KENTUCKY	LFUCG TOWN BRANCH STP	FAYETTE	LEXINGTON-FAYETTE URBAN COUNTY GOVERNMENT	19.85	441

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
KENTUCKY	LFUCG W HICKMAN STP	JESSAMINE	LEX-FAYETTE UCG	17.56	390
KENTUCKY	RWRA OWENSBORO WEST & CS	DAVIESS	REG WATER RESOURCE AGENCY	8.146	181
KENTUCKY	MSD - MORRIS FORMAN STP & CSO	JEFFERSON	LOU-JEFF CO MSD	60.36	1341
KENTUCKY	ELIZABETHTOWN	HARDIN	ELIZABETHTOWN, CITY OF	5.21	116
LOUISIANA	HOUMA S REG TRTMT PLT	TERREBONNE	TERREBONNE PARISH CONSOLIDATAED GOVERNMENT	8	178
LOUISIANA	KENNER TF STP #1	JEFFERSON	KENNER, CITY OF	5.3	118
LOUISIANA	LAKE CHARLES PLANT A	CALCASIEU	LAKE CHARLES, CITY OF	5	111
LOUISIANA	MONROE WATER POLL CONTROL CENTER	OUACHITA	MONROE, CITY OF	17	378
LOUISIANA	HARVEY PLANT	JEFFERSON	JEFF PARISH DD & S	7.5	167
LOUISIANA	BRIDGE CITY OLD PLANT	JEFFERSON	JEFF PARISH DD & S	6	133
LOUISIANA	MARRERO PLANT	JEFFERSON	JEFF PARISH DD & S	6.4	142
LOUISIANA	MUNSTER BLVD PLANT	ST. BERNARD	ST BERNARD PARISH GOVERNMENT	6.5	144
MARYLAND	COX CREEK WWTP	ANNE ARUNDEL	ANNE ARUNDEL COUNTY DPW	11.11	247
MARYLAND	ANNAPOLIS CITY WWTP	ANNE ARUNDEL	ANNE ARUNDEL COUNTY DPW	6.609	147
MARYLAND	SOD RUN WWTP	HARFORD	HARFORD COUNTY DPW	11.476	255
MARYLAND	WESTERN BRANCH WWTP	PRINCE GEORGE'S	WASHINGTON SUBURBAN SANITARY COMMISSION	17.679	393
MARYLAND	CUMBERLAND WWTP	ALLEGANY	CUMBERLAND, MAYOR OF	10.886	242
MARYLAND	MATTAWOMAN WWTP	CHARLES	CHARLES CO. PLANNING DEPT	7.675	171
MARYLAND	FREDERICK CITY WWTP	FREDERICK	FREDERICK, CITY OF	6.5	144
MARYLAND	HAGERSTOWN WPCF	WASHINGTON	HAGERSTOWN, CITY OF	8.149	181
MARYLAND	OCEAN CITY WWTP	WORCESTER	OCEAN CITY WASTEWATER DEP	10.783	240
MARYLAND	SENECA CREEK WWTP	MONTGOMERY	WASH SUB SAN COM	6.392	142
MASSACHUSETTS	LYNN REGIONAL WPCF	ESSEX	LYNN, CITY OF	25.8	573

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
MASSACHUSETTS	PITTSFIELD WWTF	BERKSHIRE	PITTSFIELD, CITY OF	10.57	235
MASSACHUSETTS	LEOMINSTER WWTP	WORCESTER	LEOMINSTER DPW	6.03	134
MASSACHUSETTS	MWRA DEER ISLAND WWTP	SUFFOLK	MWRA	348	7733
MICHIGAN	GRAND RAPIDS WWTP	KENT	GRAND RAPIDS, CITY OF	54.6	1213
MICHIGAN	WYOMING WWTP	KENT	WYOMING WWTP	14	311
MICHIGAN	FLINT WPCF	GENESEE	FLINT, CITY OF	43.3	962
MICHIGAN	MARYSVILLE STP	ST. CLAIR	MARYSVILLE, CITY OF	6.14	136
MICHIGAN	WARREN WWTP	MACOMB	WARREN, CITY OF	30	667
MICHIGAN	PONTIAC STP	OAKLAND	PONTIAC DEPT OF PUB WKS	8	178
MICHIGAN	DETROIT STP	WAYNE	DETROIT BOARD OF WATER CO	660.5	14678
MICHIGAN	ANN ARBOR WWTP	WASHTENAW	ANN ARBOR DEPT OF PUB WKS	15.14	336
MICHIGAN	YCUA WWTP	WASHTENAW	WASHTENAW COUNTY DPW	8.27	184
MICHIGAN	MONROE METRO WWTP	MONROE	MONROE METROPOLITAN WASTE	15.794	351
MICHIGAN	SAGINAW STP	SAGINAW	SAGINAW DPW PU	8.3	184
MICHIGAN	JACKSON WWTP	JACKSON	JACKSON, CITY OF	13.43	298
MICHIGAN	BENTON HARBOR-ST JOSEPH	BERRIEN	BENTON HARBOR ST JOSEPH J	7.21	160
MICHIGAN	MIDLAND WWTP	MIDLAND	MIDLAND , CITY OF	8.5	189
MICHIGAN	HURON VALLEY WWTP-SOUTH	WAYNE	HURON VALLEY	14	311
MINNESOTA	AUSTIN WWT FACILITY	MOWER	AUSTIN, CITY OF	7.875	175
MINNESOTA	GRAND RAPIDS STP	ITASCA	GRAND RAPIDS, CITY OF	10.31	229
MISSISSIPPI	HCW&SWMA - WEST BILOXI POTW	HARRISON	HARR. CO. WWMD	8.83	196
MISSISSIPPI	HCW&SWMA, GULFPORT POTW	HARRISON	HARR. CO. WWMD	10.22	227
MISSISSIPPI	NATCHEZ POTW	ADAMS	NATCHEZ,CITY OF, WORKS, C	5	111
MISSOURI	CAPE GIRARDEAU WWTP	CAPE GIRARDEAU	CAPE GIRARDEAU, CITY OF	6.4	142
MISSOURI	HINKSON-PERCHE PLANT	BOONE	COLUMBIA, CITY OF	14.5	322

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
MISSOURI	ROCK CREEK WWTP	JACKSON	INDEPENDENCE, CITY OF	8.2	182
MISSOURI	TURKEY CREEK WWTP	JASPER	JOPLIN, CITY OF	8.2	182
MISSOURI	K.C. BLUE RIVER STP	JACKSON	KANSAS CITY, CITY OF	75	1667
MISSOURI	K. C. WEST SIDE WWTP	JACKSON	KANSAS CITY, CITY OF	19.31	429
MISSOURI	ST JOSEPH WWTP	BUCHANAN	ST JOSEPH, CITY OF	19	422
MISSOURI	COLDWATER CREEK WWTP	ST. LOUIS	ST LOUIS MSD	27.59	613
MISSOURI	MISSOURI RIVER WWTP	ST. LOUIS	ST LOUIS MSD	24	533
MISSOURI	SPRINGFIELD SW WWTP	GREENE	SPRINGFIELD, CITY OF	35	778
MISSOURI	SPRINGFIELD NW WWTP	GREENE	SPRINGFIELD, CITY OF	5.35	119
MONTANA	MISSOULA STP	MISSOULA	MISSOULA, CITY OF	7.52	167
MONTANA	BOZEMAN WWTP	GALLATIN	BOZEMAN, CITY OF	5	111
MONTANA	GREAT FALLS STP	CASCADE	GREAT FALLS, CITY OF	9.9	220
MONTANA	BILLINGS WWTP	YELLOWSTONE	BILLINGS, CITY OF	15.8	351
NEBRASKA	THERESA STREET STP	LANCASTER	LINCOLN, CITY OF	20.2	449
NEBRASKA	NORTHEAST STP	LANCASTER	LINCOLN, CITY OF	6.5	144
NEVADA	LAS VEGAS WWTF	CLARK	LAS VEGAS, CITY OF	62	1378
NEW JERSEY	BERGEN CNTY UTILITIES AUTHORITY	BERGEN	BERGEN COUNTY UTILITIES AUTHORITY	75.19	1671
NEW JERSEY	JOINT MEETING OF ESSEX & UNION	UNION	J M OF ESSEX & UNION	85	1889
NEW JERSEY	LINDEN ROSELLE SA STP	UNION	LINDEN ROSELLE SA	12	267
NEW JERSEY	MOLITOR WATER POLLUTION CONTROL FAC	MORRIS	MADISON CHATHAM JT MTG	7.58	168
NEW JERSEY	RAHWAY VALLEY SEW. AUTHORITY-STP	MIDDLESEX	RAHWAY VALLEY SA	31.85	708
NEW JERSEY	NORTH HUDSON S.A. - ADAM ST. WTP	HUDSON	NORTH HUDSON SA	13.053	290

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
NEW JERSEY	NORTH BERGEN MUA - CENTRAL STP	HUDSON	NORTH BERGEN, TWP. OF	7.68	171
NEW JERSEY	PARSIPPANY-TROY HILLS STP	MORRIS	PAR-TROY HILLS TOWNSHIP	12.66	281
NEW JERSEY	MOUNTAIN VIEW STP	PASSAIC	WAYNE TOWNSHIP	6.9	153
NEW JERSEY	MIDDLESEX CNTY UA	MIDDLESEX	MIDDLESEX COUNTY UA	177.633	3947
NEW JERSEY	MIDDLETOWN SA (TOMSA)	MONMOUTH	MIDDLETOWN TOWNSHIP S.A.	8.04	179
NEW JERSEY	SOUTHERN WPC FAC - OCUA	OCEAN	OCEAN COUNTY UA	7	156
NEW JERSEY	OCEAN TWP. SEWERAGE AUTHORITY	MONMOUTH	TOWNSHIP OF OCEAN SEWERAGE AUTHORITY	5.23	116
NEW JERSEY	SOUTH MONMOUTH REG STP	MONMOUTH	SOUTH MONMOUTH RSA	7.198	160
NEW JERSEY	NEPTUNE TWP REG STP	MONMOUTH	TWP OF NEPTUNE SA	5.978	133
NEW JERSEY	ATLANTIC COUNTY UTILITIES AUTH WWTF	ATLANTIC	ATLANTIC CO UA (CSTL)	31.333	696
NEW JERSEY	GLOUCESTER CNTY UTIL AUTH	GLOUCESTER	GLOUCESTER COUNTY UTILITIES AUTHORITY	19	422
NEW JERSEY	ELSA STP - EWING-LAWRENCE S.A.	MERCER	EWING-LAWRENCE SEWERAGE AUTHORITY	11.306	251
NEW JERSEY	TRENTON SEWER UTILITY	MERCER	TRENTON, CITY OF	20	444
NEW MEXICO	ALBUQUERQUE #2 PLANT	BERNALILLO	ALBUQUERQUE, CITY OF	47.9	1064
NEW MEXICO	LAS CRUCES STP	DONA ANA	LAS CRUCES, CITY OF	5.5	122
NEW YORK	LONG BEACH WPC PLANT	NASSAU	LONG BEACH (CITY) DPW	5.217	116
NEW YORK	BAY PARK (NASSAU C) STP & SD#2	NASSAU	NASSAU COUNTY DPW	53.017	1178
NEW YORK	CEDAR CREEK (NASSAU C) STP/SD#3	NASSAU	NASSAU COUNTY DPW	57.067	1268
NEW YORK	ROCKLAND COUNTY (CO) SD#1	ROCKLAND	ROCKLAND COUNTY SEWER DISTRICT NO.1	21.335	474

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
NEW YORK	WESTCHESTER (CO) PEEKSKILL SD STP	WESTCHESTER	WESTCHESTER CO DEF	6.4	142
NEW YORK	WESTCHESTER (CO)PORT CHESTER SD STP	WESTCHESTER	WESTCHESTER CO DEF	5.25	117
NEW YORK	WESTCHESTER (CO) YONKERS JOINT STP	WESTCHESTER	WESTCHESTER COUNTY DEF	79.428	1765
NEW YORK	SCHENECTADY (C) SEWERS & STP	SCHENECTADY	SCHENECTADY, CITY OF	13.325	296
NEW YORK	GLOVERSVILLE-JOHNSTOWN (C) WWTP	FULTON	GLOVERSVILLE-JOHNSTOWN JOINT WATER BOARD	7.29	162
NEW YORK	WATERTOWN (C) WWTP	JEFFERSON	WATERTOWN, CITY OF	9.105	202
NEW YORK	ROME (C) STP	ONEIDA	ROME, CITY OF	6.683	149
NEW YORK	BINGHAMTON-JOHNSON CITY JT.S BD.STP	BROOME	BINGHAMTON - JOHNSON CITY JOINT SEWAGE BOARD	19.079	424
NEW YORK	ENDICOTT (V) STP	BROOME	ENDICOTT, VILLAGE OF	6.387	142
NEW YORK	CORTLAND (C) WWTP	CORTLAND	CORTLAND, CITY OF	6.167	137
NEW YORK	ONONDAGA (CO) METRO SYRACUSE STP	ONONDAGA	ONONDAGA COUNTY DEPT. OF DRAINAGE & SANITATION	64.395	1431
NEW YORK	ONONDAGA (CO) OAK ORCHARD WWTP	ONONDAGA	ONONDAGA COUNTY DEPT. OF DRAINANGE & SANITATION	5.583	124
NEW YORK	ITHACA (C) ITHACA AREA STP	TOMPKINS	ITHACA, CITY OF	6.1	136
NEW YORK	CHEMUNG (CO) ELMIRA SD STP	CHEMUNG	ELMIRA, CITY OF (CHEMUNG CO. SD OWNER)	6.081	135
NEW YORK	WEBSTER (T) WWTP & ONSITES	MONROE	WEBSTER, TOWN OF	6.171	137
NEW YORK	JAMESTOWN (C) WWTP	CHAUTAUQUA	JAMESTOWN DPW	5.891	131
NEW YORK	BUFFALO(SEWER AUTH.)BIRD ISLAND STP	ERIE	BUFFALO SEWER AUTHORITY	149	3311
NEW YORK	TONAWANDA (T) WWTP	ERIE	TONAWANDA, TOWN OF	19.625	436
NEW YORK	LOCKPORT (C) WWTP	NIAGARA	LOCKPORT DPW	8.8	196
NEW YORK	NORTH TONAWANDA (C) WWTP	NIAGARA	NORTH TONAWANDA, CITY OF	5.746	128

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
NORTH CAROLINA	SOUTH BURLINGTON WWTP	ALAMANCE	BURLINGTON, CITY OF	7.4	164
NORTH CAROLINA	EAST BURLINGTON WWTP	ALAMANCE	BURLINGTON, CITY OF	7.9	176
NORTH CAROLINA	BUNCOMBE COUNTY MSD WWTP	BUNCOMBE	MET SEW DIST OF BUNCOMBE	20.08	446
NORTH CAROLINA	NORTH DURHAM WATER REC. FAC.	DURHAM	DURHAM, CITY OF	8.3	184
NORTH CAROLINA	SOUTH DURHAM WATER REC. FAC.	DURHAM	DURHAM, CITY OF	8.4	187
NORTH CAROLINA	ROCKY MOUNT WWTP	EDGECOMBE	ROCKY MOUNT, CITY OF	13	289
NORTH CAROLINA	ARCHIE ELLEDGE WWTP	FORSYTH	CITY/COUNTY UTILITIES COM	23.55	523
NORTH CAROLINA	HIGH POINT EASTSIDE WWTP	GUILFORD	HIGH POINT, CITY OF	8.23	183
NORTH CAROLINA	NORTH BUFFALO WWTP	GUILFORD	GREENSBORO, CITY OF	14.3	318
NORTH CAROLINA	MCALPINE CREEK WWTP	MECKLENBURG	CHARLOTTE-MECKLENBURG UTI	28.68	637
NORTH CAROLINA	IRWIN CREEK WWTP	MECKLENBURG	CHARLOTTE-MECKLENBURG UTI	11.48	255
NORTH CAROLINA	SUGAR CREEK WWTP	MECKLENBURG	CHARLOTTE-MECKLENBURG UTI	13.3	296
NORTH CAROLINA	J A LOUGHLIN WWTP	NEW HANOVER	WILMINGTON DEPT OF PUB W	9.69	215
NORTH CAROLINA	MKEAN MAFFITT WWTP (S)	NEW HANOVER	WILMINGTON, DEPT OF PUB W	8.48	188
NORTH CAROLINA	MASON FARM WWTP	ORANGE	ORANGE WAT AND SEW AUTH	5.8	129
NORTH CAROLINA	MT. AIRY WWTP	SURRY	MT AIRY, TOWN OF	5.448	121
NORTH CAROLINA	HOMINY CREEK WWTP	WILSON	WILSON, CITY OF	8.93	198
NORTH DAKOTA	FARGO WWTP	CASS	FARGO MUNICIPAL WWTP	12.58	280
OHIO	ALLIANCE WWTP & SEWERS	STARK	CITY OF ALLIANCE	6.2	138
OHIO	ASHTABULA WWTP & SEWER SYSTEM	ASHTABULA	CITY OF ASHTABULA	7	156

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OHIO	UPPER MILL CREEK WWTP & SEWERS	BUTLER	BUTLER COUNTY DEPARTMENT OF ENVIRONMENTAL SERVICES	9.11	202
OHIO	NORTH REGIONAL WWTP	MONTGOMERY	TRI CITIES NORTH REGIONAL WASTEWATER AUTHORITY	7.937	176
OHIO	SOUTHERLY WWTP	CUYAHOGA	NORTHEAST OHIO REGIONAL SEWER DISTRICT	200	4444
OHIO	COLUMBUS JACKSON PIKE WWTP & SEWERS	FRANKLIN	COLUMBUS DIVISION OF SEWERAGE AND DRAINAGE	68	1511
OHIO	COLUMBUS SOUTHERLY WWTP & SEWERS	FRANKLIN	COLUMBUS DIVISION OF SEWERAGE AND DRAINAGE	92	2044
OHIO	ELYRIA WWTP & SEWER SYSTEM	LORAIN	CITY OF ELYRIA	7.89	175
OHIO	EUCLID WWTP & SEWER SYSTEM	CUYAHOGA	CITY OF EUCLID	20.64	459
OHIO	FAIRFIELD WWTP & SEWER SYSTEM	BUTLER	CITY OF FAIRFIELD	6.7	149
OHIO	FINDLAY WWTP & SEWER SYSTEM	HANCOCK	CITY OF FINDLAY	9.07	202
OHIO	FOSTORIA WWTP & SEWER SYSTEM	WOOD	CITY OF FOSTORIA	5.7	127
OHIO	FREMONT WPCC & SEWER SYSTEM	SANDUSKY	CITY OF FREMONT	5	111
OHIO	LITTLE MIAMI DRAINAGE BASIN/WWTP	HAMILTON	MSD OF GREATER CINCINNATI	34.3	762
OHIO	SYCAMORE CREEK DRAINAGE BASIN/WWTP	HAMILTON	MSD OF GREATER CINCINNATI	6.7	149
OHIO	GREATER MENTOR WWTP & SEWER SYSTEM	LAKE	LAKE COUNTY DEPARTMENT OF UTILITIES	11.26	250

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
OHIO	LAKEWOOD WWTP & SEWER SYSTEM	CUYAHOGA	CITY OF LAKEWOOD	7	156
OHIO	LIMA WWTP & SEWER SYSTEM	ALLEN	CITY OF LIMA	12	267
OHIO	LORAIN BLACK RIVER WWTP	LORAIN	CITY OF LORAIN	13.1	291
OHIO	MANSFIELD WWTP & SEWER SYSTEM	RICHLAND	CITY OF MANSFIELD	12	267
OHIO	MASSILLON WWTP & SEWER SYSTEM	STARK	CITY OF MASSILLON	11	244
OHIO	MIDDLETOWN WWTP & SEWER SYSTEM	BUTLER	CITY OF MIDDLETOWN	16	356
OHIO	NEWARK WWTP & SEWER SYSTEM	LICKING	CITY OF NEWARK	10	222
OHIO	NILES WWTP & SEWER SYSTEM	TRUMBULL	CITY OF NILES	5.31	118
OHIO	NORTH OLMSTED WWTP & SEWER SYSTEM	CUYAHOGA	CITY OF NORTH OLMSTED	7	156
OHIO	ROCKY RIVER WWTP & SEWER SYSTEM	CUYAHOGA	CITY OF ROCKY RIVER	16.063	357
OHIO	SANDUSKY WWTP & SEWER SYSTEM	ERIE	CITY OF SANDUSKY	12.5	278
OHIO	SPRINGFIELD WWTP & SEWER SYSTEM	CLARK	CITY OF SPRINGFIELD	14	311
OHIO	WASHINGTON CH WWTP & SEWERS	FAYETTE	CITY OF WASHINGTON COURT HOUSE	5.36	119
OHIO	WOOSTER WWTP & SEWER SYSTEM	WAYNE	CITY OF WOOSTER	6	133
OKLAHOMA	ENID WWT	GARFIELD	ENID, CITY OF, S-20931	8.5	189
OKLAHOMA	STILLWATER WWT	PAYNE	STILLWATER, CITY OF, S-20947	6.8	151
OKLAHOMA	NORMAN (MAIN) WWT	CLEVELAND	NORMAN, CITY OF S-20616	12	267

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
OKLAHOMA	TULSA NORTHSIDE WWT	TULSA	TULSA METROPOLITAN UTILITY AUTHORITY, S-21309	36.1	802
OREGON	MEDFORD STP	JACKSON	MEDFORD, CITY OF	20.05	446
OREGON	MCMINNVILLE WWTP	YAMHILL	MCMINNVILLE, CITY OF	5.5	122
PENNSYLVANIA	VALLEY FORGE SEWER AUTH	CHESTER	VALLEY FORGE SEWER AUTH	9.3	207
PENNSYLVANIA	WEST GOSHEN STP	CHESTER	WEST GOSHEN SEWER AUTH	5.57	124
PENNSYLVANIA	AMBLER BORO STP	MONTGOMERY	AMBLER, BOROUGH OF	5.79	129
PENNSYLVANIA	WARMINSTER STP	BUCKS	WARMINSTER TWNSHP MUN AUT	6	133
PENNSYLVANIA	PHILADELPHIA WATER DEPT (SE)	PHILADELPHIA	PHILADELPHIA WATER DEPT - WPC DIVISION	94.8	2107
PENNSYLVANIA	DOWNINGTOWN AREA STP	CHESTER	DOWNINGTOWN AREA REGIONAL AUTH	6.41	142
PENNSYLVANIA	NORRISTOWN MUN WASTE AUTH	MONTGOMERY	NORRISTOWN MUN WASTE AUTH	6.08	135
PENNSYLVANIA	HARRISBURG AUTHORITY STP	DAUPHIN	HARRISBURG AUTHORITY	13.2	293
PENNSYLVANIA	ALLENTOWN CITY STP	LEHIGH	ALLENTOWN AUTHORITY	34	756
PENNSYLVANIA	LEBANON CITY STP	LEBANON	LEBANON AUTHORITY, CITY OF	6	133
PENNSYLVANIA	BETHLEHEM CITY STP	NORTHAMPTON	BETHLEHEM AUTHORITY, CITY OF	12.6	280
PENNSYLVANIA	READING AREA FRITZ ISLAND STP	BERKS	READING, CITY OF	15.66	348
PENNSYLVANIA	EASTON AREA STP	NORTHAMPTON	EASTON AREA JOINT SEW AUTH	6.7	149
PENNSYLVANIA	SCRANTON SEWER AUTHORITY	LACKAWANNA	SCRANTON SEW AUTH	15.9	353
PENNSYLVANIA	WYOMING VALLEY SAN AUTH	LUZERNE	WYOMING VALLEY SAN AUTH	22.3	496
PENNSYLVANIA	YORK CITY SEW AUTH	YORK	YORK CITY SEWER AUTHORITY	11.74	261
PENNSYLVANIA	JOHNSTOWN CITY STP	CAMBRIA	JOHNSTOWN, CITY OF	9	200
PENNSYLVANIA	ALTOONA EASTERLY STP	BLAIR	ALTOONA CITY AUTHORITY	5.858	130

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
PENNSYLVANIA	ALTOONA WESTERLY STP	BLAIR	ALTOONA CITY AUTHORITY	6.2	138
PENNSYLVANIA	SHAMOKIN-COAL TWP STP	NORTHUMBERLAND	SHAMOKIN-COAL TWP JT AUTH	6	133
PENNSYLVANIA	INDIANA BORO STP	INDIANA	INDIANA, BOROUGH OF	7.25	161
PENNSYLVANIA	KISKI VALLEY WPCA	WESTMORELAND	KISKI VALLEY WPCA	6	133
PENNSYLVANIA	ERIE CITY STP	ERIE	ERIE SEWER AUTHORITY	68.59	1524
PENNSYLVANIA	NEW CASTLE STP	LAWRENCE	NEW CASTLE SAN AUTH	6.02	134
RHODE ISLAND	VEOLIA WATER - CRANSTON WPCF	PROVIDENCE	CRANSTON, DPW	13.4	298
RHODE ISLAND	WOONSOCKET REGIONAL WWTF	PROVIDENCE	WOONSOCKET DPW SEWAGE DIV	7.85	174
RHODE ISLAND	BUCKLIN PT STP	PROVIDENCE	NARRAGANSETT BAY COMM.	23.6	524
SOUTH CAROLINA	METRO WWTP	RICHLAND	COLUMBIA, CITY OF	44.575	991
SOUTH CAROLINA	MANCHESTER CREEK WWTP	YORK	ROCK HILL, CITY OF	15	333
SOUTH CAROLINA	FLORENCE/MAIN PLANT	FLORENCE	FLORENCE UTILITIES DIVISI	9.9	220
SOUTH DAKOTA	RAPID CITY WWT FACILITY	PENNINGTON	RAPID CITY, CITY OF	10.3	229
SOUTH DAKOTA	SIOUX FALLS WWT FACILITY	MINNEHAHA	SIOUX FALLS, CITY OF	11.79	262
TENNESSEE	OOSTANAULA WWTP	MCMINN	ATHENS UTILITY BOARD	6.318	140
TENNESSEE	MOCCASIN BEND WWTP	HAMILTON	CHATTANOOGA, CITY OF	70.227	1561
TENNESSEE	CLEVELAND UTILITIES STP	BRADLEY	CLEVELAND UTILITIES	8.21	182
TENNESSEE	COOKEVILLE STP	PUTNAM	COOKEVILLE, CITY OF	6.83	152
TENNESSEE	JACKSON UD WWTP - MILLER AVENUE	MADISON	JACKSON ENERGY AUTHORITY	11.5	256
TENNESSEE	BRUSH CREEK STP	WASHINGTON	JOHNSON CITY, CITY OF	7.471	166
TENNESSEE	KINGSPORT STP	SULLIVAN	KINGSPORT, TOWN OF	7.74	172
TENNESSEE	KUWAHEE WWTP	KNOX	KNOXVILLE UTILITIES BOARD	35.3	784
TENNESSEE	FOURTH CREEK WWTP	KNOX	KNOXVILLE UTILITIES BOARD	9.09	202

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
TENNESSEE	NASHVILLE - DRY CREEK WWTP	DAVIDSON	METRO. NASHVILLE DEPT. OF WATER & SEWER SVCS.	17.6	391
TENNESSEE	NASHVILLE - WHITE'S CREEK WWTP	DAVIDSON	METRO. NASHVILLE DEPT. OF WATER & SEWER SVCS.	34.935	776
TEXAS	WACO REGIONAL WWTP	MCLENNAN	BRAZOS RIVER AUTHORITY	21.23	472
TEXAS	RIVER ROAD WWTP	POTTER	AMARILLO	12.01	267
TEXAS	HOLLYWOOD ROAD WWTP	RANDALL	AMARILLO	5.33	118
TEXAS	MIDLAND PLANT #1 WWTP	MIDLAND	MIDLAND	13.21	294
TEXAS	HASKELL ST WWTP	EL PASO	EL PASO	16.792	373
TEXAS	LAREDO STP	WEBB	LAREDO	10.2	227
TEXAS	CARTER'S CREEK WWTP	BRAZOS	COLLEGE STATION	6.5	144
TEXAS	CENTRAL WWTP - DALLAS	DALLAS	DALLAS	166.704	3705
TEXAS	SOUTHSIDE WWTP - DALLAS	DALLAS	DALLAS	78.81	1751
TEXAS	ROWLETT CREEK WWTP	DALLAS	GARLAND	17.066	379
TEXAS	POST OAK CREEK WWTP	GRAYSON	SHERMAN	11.69	260
TEXAS	VILLAGE CREEK STP	TARRANT	FORT WORTH	138.9	3087
TEXAS	WILSON CREEK WWTP	COLLIN	NORTH TEXAS MWD	31.327	696
TEXAS	WESTSIDE STP #2	SMITH	TYLER	9.56	212
TEXAS	SOUTHSIDE STP #2	SMITH	TYLER	5.12	114
TEXAS	LONGVIEW MAIN WWTP	GREGG	LONGVIEW	14.41	320
TEXAS	HILLEBRANDT WWTP	JEFFERSON	BEAUMONT	24	533
TEXAS	VINCE BAYOU WWTP	HARRIS	PASADENA	6.82	152
TEXAS	DOS RIOS WWTP	BEXAR	SAN ANTONIO	58	1289
VIRGINIA	NORTHSIDE/SOUTHSIDE STP	DANVILLE	DANVILLE, CITY OF	16.05	357
VIRGINIA	MARTINSVILLE STP	MARTINSVILLE	MARTINSVILLE, CITY OF	5.35	119
VIRGINIA	HARRISONBURG-ROCKINGHAM	ROCKINGHAM	HARRISONBURG-ROCKINGHAM	7.5	167

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
VIRGINIA	RICHMOND STP	RICHMOND CITY	RICHMOND, CITY OF	59.53	1323
VIRGINIA	FALLING CREEK STP	CHESTERFIELD	CHESTERFIELD COUNTY	7.5	167
VIRGINIA	SOUTH CENTRAL REGIONAL WWTP	PETERSBURG	SOUTH CENTRAL WASTEWATER AUTHORITY	20	444
VIRGINIA	MOORES CREEK STP	CHARLOTTESVILLE	RIVANNA WATER AND SEWER	10.37	230
VIRGINIA	HOPEWELL STP	HOPEWELL	HOPEWELL, CITY OF	33.69	749
VIRGINIA	JAMES RIVER W P C F	NEWPORT NEWS	HAMPTON ROADS SAN DIST	13.99	311
VIRGINIA	YORK RIVER W P C F	YORK	HAMPTON ROADS SAN DIST	6.66	148
VIRGINIA	ARMY BASE W P C F	NORFOLK	HAMPTON ROADS SAN DIST	14.18	315
VIRGINIA	VIRGINIA INITIATIVE PLANT	NORFOLK	HAMPTON ROAD SAN DIST	28.05	623
VIRGINIA	NANSEMOND W P C F	SUFFOLK	HAMPTON ROADS SAN. DIST	17	378
VIRGINIA	ALEXANDRIA STP	ALEXANDRIA	ALEXANDRIA SANITATION	36.8	818
VIRGINIA	ARLINGTON CO WPCP	ARLINGTON	ARLINGTON COUNTY	22.43	498
WASHINGTON	W. BREMERTON/ CHARLESTON STP	KITSAP	BREMERTON, CITY OF	7.6	169
WASHINGTON	CENT. KITSAP REG. STP	KITSAP	KITSAP CO. COMMISSIONERS	8	178
WASHINGTON	RICHLAND STP	BENTON	RICHLAND UTILITY SERVICES	6	133
WASHINGTON	SPOKANE STP	SPOKANE	SPOKANE, CITY OF	44	978
WASHINGTON	TACOMA CENTRAL STP #1	PIERCE	TACOMA, CITY OF	26	578
WASHINGTON	WALLA WALLA STP	WALLA WALLA	WALLA WALLA, CITY OF	6.18	137
WASHINGTON	YAKIMA REGIONAL WWTP	YAKIMA	YAKIMA, CITY OF	11.308	251
WEST VIRGINIA	FAIRMONT STP	MARION	FAIRMONT, TOWN OF	6.06	135
WEST VIRGINIA	MORGANTOWN WPC FAC	MONONGALIA	MORGANTOWN UTILITY BOARD	8.3	184
WEST VIRGINIA	WHEELING WPC FAC	OHIO	WHEELING SANITARY BOARD	10	222

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
WEST VIRGINIA	PINEY CREEK STP	RALEIGH	BECKLEY, CITY OF	8	178
WISCONSIN	APPLETON WWTP	OUTAGAMIE	APPLETON, CITY OF	14.564	324
WISCONSIN	BELOIT WWTP	ROCK	BELOIT, CITY OF	5.67	126
WISCONSIN	BROOKFIELD - FOX RIVER WPCC	WAUKESHA	BROOKFIELD FOX WATER POLLUTION CONTROL	6.74	150
WISCONSIN	EAU CLAIRE WWTP	EAU CLAIRE	EAU CLAIRE, CITY OF	6.4	142
WISCONSIN	HEART OF THE VALLEY MSD	OUTAGAMIE	HEART OF THE VALLEY METROPOLITAN SEWERAGE DIST.	5.84	130
WISCONSIN	JANESVILLE WWTP	ROCK	JANESVILLE, CITY OF	12.23	272
WISCONSIN	KENOSHA, CITY OF - WWTP	KENOSHA	KENOSHA, CITY OF	21.8	484
WISCONSIN	LA CROSSE WWTP	LA CROSSE	LA CROSSE, CITY OF	10.18	226
WISCONSIN	MADISON MSD STP	DANE	MADISON MSD	41	911
WISCONSIN	MANITOWOC WWTP	MANITOWOC	MANITOWOC, CITY OF	8.72	194
WISCONSIN	RACINE STP	RACINE	RACINE, CITY OF	25.71	571
WISCONSIN	SHEBOYGAN REGIONAL WWTP	SHEBOYGAN	SHEBOYGAN, CITY OF	12	267
WISCONSIN	SUN PRAIRIE STP	DANE	SUN PRAIRIE, CITY OF	6.321	140
WISCONSIN	WAUKESHA STP	WAUKESHA	WAUKESHA CITY OF	11.56	257
WISCONSIN	WAUSAU WWTP	MARATHON	WAUSAU, CITY OF	5.31	118
WISCONSIN	SALEM UTILITY DISTRICT STP	KENOSHA	SALEM, TOWN OF	6.96	155
WYOMING	METRO CHEYENNE WWTP	LARAMIE	CHEYENNE BOARD OF PUB UTILITIES	5.491	122
PUERTO RICO	BARCELONETA REGIONAL SYSTEM	BARCELONETA	PRASA	6.15	137

A2: Facilities with off-gas utilization

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
ARIZONA	WILDCAT HILL WWTF	COCONINO	CITY OF FLAGSTAFF, UTILITIES DEPT.	7.8	173
ARIZONA	TOLLESON WWTF	MARICOPA	TOLLESON, CITY OF	13	289
ARIZONA	INA ROAD STP	PIMA	PIMA CO WW MGMT DEPT	31	689
ARKANSAS	LITTLE ROCK ADAMS FIELD STP	PULASKI	LITTLE ROCK	30	667
CALIFORNIA	ELK RIVER WWTF	HUMBOLDT	EUREKA, CITY OF	5	111
CALIFORNIA	RICHMOND WWTF	CONTRA COSTA	RICHMOND, CITY OF	6.6	147
CALIFORNIA	EAST BAY MUD MAIN WWTP	ALAMEDA	EAST BAY MUD	80	1778
CALIFORNIA	SAN LEANDRO WPCP	ALAMEDA	SAN LEANDRO, CITY OF	6	133
CALIFORNIA	SO SF-SAN BRUNO WWTF	SAN MATEO	CITY OF SOUTH SAN FRANCISCO	10.97	244
CALIFORNIA	ORO LOMA WWTF	ALAMEDA	ORO LOMA SANITARY DISTRICT	17.3	384
CALIFORNIA	SAN PABLO WWTF	CONTRA COSTA	WEST COUNTY WASTEWATER DISTRICT	7.8	173
CALIFORNIA	INDUSTRIAL SHORE SUB FAC	CONTRA COSTA	DELTA DIABLO SAN DIST	7.45	166
CALIFORNIA	ALVARADO WWTF	ALAMEDA	UNION SANITARY DISTRICT	30	667
CALIFORNIA	LIVERMORE WRP	ALAMEDA	LIVERMORE, CITY OF	6.4	142
CALIFORNIA	MRWCPA WWTF	MONTEREY	MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY	21.5	478
CALIFORNIA	SIMI VALLEY WWTP	VENTURA	SIMI VALLEY, CITY OF	9	200
CALIFORNIA	JOINT WPCP	LOS ANGELES	LACSD	322	7156
CALIFORNIA	LANCASTER WRP	LOS ANGELES	COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY	13.2	293
CALIFORNIA	PALMDALE WRP	LOS ANGELES	COUNTY SANITATION DISTRICTS OF LOS ANGELES COUNTY	9.2	204
CALIFORNIA	HYPERION WWTP	LOS ANGELES	CITY OF LOS ANGELES, BUREAU OF SANITATION	362	8044

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
CALIFORNIA	OXNARD WWTP	VENTURA	OXNARD, CITY OF	22.4	498
CALIFORNIA	FRESNO-CLOVIS REGIONAL WRF	FRESNO	FRESNO, CITY OF	75	1667
CALIFORNIA	MERCED STP	MERCED	MERCED, CITY OF	7.7	171
CALIFORNIA	EASTERLY WWTP	SOLANO	VACAVILLE, CITY OF	8.4	187
CALIFORNIA	VICTOR VALLEY REGIONAL WWRP	SAN BERNARDINO	VIICTOR VALLEY WASTEWATER RECLAMATION AUTHORITY	10.7	238
CALIFORNIA	SAN BERNARDINO WRP	SAN BERNARDINO	SAN BERNARDINO MUNICIPAL WATER DEPARTMENT	26.5	589
CALIFORNIA	OCSD WRP NO. 1	ORANGE	ORANGE COUNTY SANITATION DISTRICT	88	1956
CALIFORNIA	OCSD WWTP NO. 2	ORANGE	ORANGE COUNTY SANITATION DISTRICT	151	3356
CALIFORNIA	ENCINA WPCF	SAN DIEGO	ENCINA WASTEWATER AUTHORITY	26.2	582
CALIFORNIA	LATHAM WWTP	ORANGE	SOUTH ORANGE COUNTY WASTEWATER AUTHORITY	10.9	242
CALIFORNIA	POINT LOMA WWTF	SAN DIEGO	CITY OF SAN DIEGO METROPOLITAN WASTEWATER DEPART.	184	4089
CALIFORNIA	HALE AVENUE RRF	SAN DIEGO	ESCONDIDO, CITY OF	15.625	347
COLORADO	C SPRINGS WWTP	EL PASO	COLORADO SPRINGS, CITY OF	32	711
COLORADO	METRO RECLAMAT DIST CENTRAL PLANT	ADAMS	METRO WW RECLAM DISTRICT	160	3556
CONNECTICUT	BRISTOL STP	HARTFORD	BRISTOL, CITY OF	9.569	213
CONNECTICUT	FAIRFIELD WPCF	FAIRFIELD	FAIRFIELD, TOWN OF	9.078	202
CONNECTICUT	GREENWICH WPCF	FAIRFIELD	GREENWICH CHIEF EXECUTIVE	9.413	209
CONNECTICUT	ROCKY HILL WPCF	HARTFORD	METROPOLITAN DISTRICT	7.09	158
CONNECTICUT	MANCHESTER WPCF	HARTFORD	MANCHESTER, TOWN OF	6.449	143
CONNECTICUT	MERIDEN WPCF	NEW HAVEN	MERIDEN, CITY OF	9.672	215
CONNECTICUT	MILFORD - HOUSATONIC WPCF	NEW HAVEN	MILFORD, TOWN OF	6.827	152
CONNECTICUT	WALLINGFORD WPCF	NEW HAVEN	WALLINGFORD, TOWN OF	5.364	119
FLORIDA	BROWARD CNTY N. DIST REG	BROWARD	BROWARD COUNTY UTILITIES	70	1556
FLORIDA	PLANTATION STP	BROWARD	BROWARD CO. UTILITIES	11	244

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
GEORGIA	UTOY CREEK WWTP	FULTON	ATLANTA PUBLIC WORKS DEPA	32.314	718
ILLINOIS	DANVILLE STW	VERMILION	DANVILLE S D	10.1	224
ILLINOIS	FOX METRO WRD STP	KENDALL	FOX METRO WRD	24.5	544
INDIANA	FORT WAYNE WPCP	ALLEN	FORT WAYNE BOARD OF PUBLI	85	1889
INDIANA	MUNCIE WWTP	DELAWARE	MUNCIE SANITARY DISTRICT	24	533
INDIANA	LAFAYETTE WWTP	TIPPECANOE	LAFAYETTE, CITY OF	16	356
INDIANA	MARION WWTP	GRANT	MARION, CITY OF	12	267
INDIANA	RICHMOND SD	WAYNE	RICHMOND SANITARY DISTRIC	18	400
IOWA	FT. DODGE WWTP	WEBSTER	FT DODGE, CITY OF	6.5	144
KENTUCKY	ASHLAND WPCP	BOYD	ASHLAND, CITY OF	6.01	134
KENTUCKY	MCCRACKEN CO JSA-PADUCAH	MCCRACKEN	PADUCAH, CITY OF	6.65	148
MASSACHUSETTS	BROCKTON WPCF	BRISTOL	BROCKTON, CITY OF	15.73	350
MISSISSIPPI	HCW&SWMA, EAST BILOXI POTW	HARRISON	HARR. CO. WWMD	8.5	189
NEVADA	CARSON CITY WWTF	CARSON CITY	CARSON CITY PUBLIC WORKS	5	111
NEVADA	RENO-SPARKS WWTF	WASHOE	CITY OF SPARKS PUBLIC WORKS DEPT.	30	667
NEW JERSEY	NORTHERN WPC FAC -OCUA	OCEAN	OCEAN COUNTY UA	23	511
NEW JERSEY	CENTRAL WPC FAC - OCUA	OCEAN	OCEAN COUNTY UA	23	511
NEW JERSEY	HAMILTON TWP WPCF	MERCER	HAMILTON TOWNSHIP WPC OFFICE	17	378
NEW YORK	NEW YORK (C) - WARDS ISLAND WPCP	NEW YORK	NYCDEP	250	5556
NEW YORK	NEW YORK (C) - HUNTS POINT WPCP	BRONX	NYCDEP	122.12	2714
NEW YORK	NEW YORK (C) - BOWERY BAY WPCP	QUEENS	NYCDEP	129.11	2869
NEW YORK	NEW YORK (C) - TALLMAN ISLAND WPCP	QUEENS	NYCDEP	61.06	1357
NEW YORK	NEW YORK (C) - JAMAICA WPCP	QUEENS	NYCDEP	96.09	2135
NEW YORK	NEW YORK (C) - 26TH. WARD WPCP	KINGS	NYCDEP	64.06	1424
NEW YORK	NEW YORK (C) - RED HOOK WPCP	KINGS	NYCDEP	60	1333

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
NEW YORK	NEW YORK (C) - PORT RICHMOND WPCP	RICHMOND	NYCDEP	34.03	756
NEW YORK	NEW YORK (C) - CONEY ISLAND WPCP	KINGS	NYCDEP	93.09	2069
NEW YORK	NEW YORK (C) - OWLS HEAD WPCP	KINGS	NYCDEP	87.09	1935
NEW YORK	NEW YORK (C) - NEWTON CREEK WPCP	KINGS	NYCDEP	271.26	6028
NEW YORK	NEW YORK (C) - NORTH RIVER WPCP	NEW YORK	NYCDEP	170	3778
NEW YORK	NEW YORK (C) - OAKWOOD BEACH WPCP	RICHMOND	NYCDEP	24.02	534
NEW YORK	NEW YORK (C) - ROCKAWAY WPCP	QUEENS	NYCDEP	21.02	467
OHIO	DAYTON WWTP & SEWER SYSTEM	MONTGOMERY	CITY OF DAYTON	72	1600
OHIO	MILL CREEK DRAINAGE BASIN/WWTP	HAMILTON	MSD OF GREATER CINCINNATI	151	3356
OHIO	LANCASTER WWTP & SEWER SYSTEM	FAIRFIELD	CITY OF LANCASTER	5.52	123
OHIO	PORTSMOUTH LAWSON RUN WWTP & SEWERS	SCIOTO	CITY OF PORTSMOUTH	5	111
OHIO	ZANESVILLE WWTP & SEWER SYSTEM	MUSKINGUM	CITY OF ZANESVILLE	7.75	172
OREGON	KELLOGG CREEK STP	CLACKAMAS	CLACKAMAS CO SERV DIST 1	7.9	176
OREGON	TRI CITY WPCP	CLACKAMAS	WATER ENVIRONMENT SERVICES	7	156
OREGON	GRESHAM STP	MULTNOMAH	GRESHAM, CITY OF	10.531	234
OREGON	TRYON CREEK STP	CLACKAMAS	PORTLAND, CITY OF	6.98	155
OREGON	ROCK CREEK STP	WASHINGTON	CLEAN WATER SERVICES, INC	32.02	712
OREGON	SALEM WILLOW LAKE STP	MARION	SALEM, CITY OF	29.7	660
OREGON	MWMC - EUGENE/SPRINGFIELD STP	LANE	METROPOLITAN WASTEWATER MANAGEMENT COMMISSION	24.7	549
OREGON	CORVALLIS STP	BENTON	CORVALLIS, CITY OF	7.75	172
OREGON	GRANTS PASS STP	JOSEPHINE	GRANTS PASS, CITYOF	5.2	116
OREGON	ALBANY STP	LINN	ALBANY, CITY OF	5.7	127
OREGON	ST HELENS STP	COLUMBIA	ST HELENS, CITY OF	30.7	682

State	Facility Name	County	Authority Name	Total Influent (MGD)	Potential Electric Capacity (kW)
PENNSYLVANIA	PHILADELPHIA WATER DEPT (NE)	PHILADELPHIA	PHILADELPHIA WATER DEPT - WPC DIVISION	196.7	4371
PENNSYLVANIA	PHILADELPHIA WATER DEPT (SW)	PHILADELPHIA	PHILADELPHIA WATER DEPT	198.5	4411
PENNSYLVANIA	E NORR PLYM WHIT STP	MONTGOMERY	E. NOR./PLY/WHIT JSA	6.26	139
SOUTH CAROLINA	MAULDIN RD PLANT	GREENVILLE	WCRSA	29	644
TEXAS	SOUTHEAST PLANTS 1 2 .3	LUBBOCK	LUBBOCK, CITY OF	20.78	462
TEXAS	PECAN CREEK WWTP	DENTON	DENTON	13.324	296
TEXAS	TEXARKANA SOUTH REGIONAL WWTP	BOWIE	TEXARKANA	13.63	303
VERMONT	RUTLAND WPCF	RUTLAND	RUTLAND, CITY OF	5.7	127
VIRGINIA	WESTERN VIRGINIA WATER AUTH. WWTP	ROANOKE CITY	WESTERN VIRGINIA WATER AUTHORITY	40.5	900
VIRGINIA	ATLANTIC W P C F	VIRGINIA BEACH	HAMPTON ROADS SAN DIST	34.65	770
WASHINGTON	WEST POINT WWTP	KING	MUN OF METRO SEATTLE	325	7222
WASHINGTON	BUDD INLET STP	THURSTON	OLYMPIA, CITY OF	17.9	398
WEST VIRGINIA	CHARLESTON WWTF	KANAWHA	CHARLESTON, CITY OF	14	311
WEST VIRGINIA	PARKERSBURG WWTF	WOOD	PARKERSBURG SAN BD	8.812	196

Appendix B: Anaerobic Digester Design Criteria

The following anaerobic digester design criteria were used to estimate the total wastewater influent flow rate that a typically sized digester can treat, as well as the biogas generation rate and the heat load of a typically sized digester. Design parameters were obtained from the sources listed below.

Mesophilic

System Design Requirements	Value	Units	Source
Reactor Type	Complete Mix		2
Reactor Shape	Circular		2
Organic Load	13730	lbs/day VS	1
Percent Solids in Flow	8	% (w/w)	1
Sludge Density	8.5	lbs/gal	1
Flow to Reactor	171625	lbs/day	
Flow to Reactor	20191	gal/day	
Flow to Reactor	2699	ft3/day	
Reactor Depth	20	ft	3
Design Load	0.25	lbs VS/ft3/day	2
Total Reactor Volume	54920	ft3	
Reactor Area	2746	ft	
Reactor Diameter	60	ft	2
Retention Time	20	days	
Influent Temp (Winter)	50	oF	2
Air Temp (Winter)	50	oF	2
Earth around wall Temp (Winter)	40	oF	2
Earth below floor Temp (Winter)	40	oF	2
Reactor Temp	95	oF	2
Influent Temp (Summer)	80	oF	2
Air Temp (Summer)	80	oF	2
Earth around wall Temp (Summer)	50	oF	2
Earth below floor Temp (Summer)	50	oF	2
Sp. Heat sludge	1.0	Btu/(lb*deg F)	2
Area walls	3769.9	ft2	
Area roof	2827.4	ft2	
Area floor	2827.4	ft2	
U walls (concrete)	0.119748	Btu/(hr*ft2*deg. F)	2
U roof (concrete)	0.160251	Btu/(hr*ft2*deg. F)	2
U floor (concrete)	0.149685	Btu/(hr*ft2*deg. F)	2
Gas Generation	12	cu ft/lb VS removed	2
Gas Heat Content	600	Btu/cu ft	2
VS Removal Percent @ 20 days	55	%	1
VS Removed	7,552	lbs/day	
Gas Generation	90,618	cu ft/day	
Heat Potential of Gas	54,370,800	Btu/day	
Gas Generation per Capita	1	cu ft/day/person	2
Population Served by POTW	90,618	persons	2
Flow per Capita	100	gal/day/person	3
Total POTW Flow	9.1	MGD	

Thermophilic

System Design Requirements	Value	Units	Source
Reactor Type	Complete Mix		2
Reactor Shape	Circular		2
Organic Load	13730	lbs/day VS	1
Percent Solids in Flow	8	% (w/w)	1
Sludge Density	8.5	lbs/gal	1
Flow to Reactor	171625	lbs/day	
Flow to Reactor	20191	gal/day	
Flow to Reactor	2699	ft3/day	
Reactor Depth	20	ft	3
Design Load	0.5	lbs VS/ft3/day	2
Total Reactor Volume	27460	ft3	
Reactor Area	1373	ft	
Reactor Diameter	42	ft	2
Retention Time	10	days	
Influent Temp (Winter)	50	oF	2
Air Temp (Winter)	50	oF	2
Earth below floor Temp (Winter)	40	oF	2
Reactor Temp	130	oF	2
Influent Temp (Summer)	80	oF	2
Air Temp (Summer)	80	oF	2
Earth below floor Temp (Summer)	50	oF	2
Sp. Heat sludge	1.0	Btu/(lb*deg F)	2
Area walls	2627.3	ft2	
Area roof	1373.3	ft2	
Area floor	1373.3	ft2	
U walls (concrete)	0.119748	Btu/(hr*ft2*deg. F)	2
U roof (concrete)	0.160251	Btu/(hr*ft2*deg. F)	2
U floor (concrete)	0.149685	Btu/(hr*ft2*deg. F)	2
Gas Generation	12	cu ft/lb VS removed	2
Gas Heat Content	600	Btu/cu ft	2
VS Removal Percent @ 20 days	55	%	1
VS Removed	7,552	lbs/day	
Gas Generation	90,618	cu ft/day	
Heat Potential of Gas	54,370,800	Btu/day	
Gas Generation per Capita	1	cu ft/day/person	2
Population Served by POTW	90,618	persons	2
Flow per Capita	100	gal/day/person	3
Total POTW Flow	9.1	MGD	

Sources:

1. Eckenfelder, Principals of Water Quality Management, 1980.
2. Metcalf and Eddy, Wastewater Engineering and Design, 1991.
3. Recommended Standards for Wastewater Facilities (10-State Standards), 2004.

Notes

** Mesophilic digester is below grade (wall heat transfer with ground).
** Thermophilic digester is completely above ground (wall heat transfer with air).
** With no CHP, only the amount of energy needed for digester heat load is used from gas. The rest is flared.
** With CHP applications, all of the gas energy is run thorugh electric generator. The heat needed for the digester heat load is used from the heat recovered, and the rest is dumped.