ORANGE WATER AND SEWER AUTHORITY

A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community.

MEMORANDUM

TO: **Natural Resources and Technical Services (NRTS) Committee**
John Young (Chair)
John Morris
Heather Payne
Ruchir Vora
Bob Morgan (*ex officio*)

THROUGH: Ed Kerwin

FROM: Ruth Rouse

DATE: November 30, 2017

SUBJECT: December 5, 2017 NRTS Committee Meeting

The NRTS Committee will meet on Tuesday, December 5 at 4:30 pm in the OWASA Boardroom. The meeting will include the following topics:

1. Potential Biogas-to-Energy Project Opportunities (Attachment #1) – Mary Tiger, Sustainability Manager
2. Drought Planning (Attachment #2) – Ruth Rouse, Planning and Development Manager

The enclosed documents provide additional background information on biogas-to-energy and drought planning resources.

We welcome the Board members' questions and feedback on both topics.

We look forward to seeing you on December 5, 2017.

Ruth C. Rouse

Ruth Rouse, AICP
Planning and Development Manager

c: OWASA Board of Directors
Robert Epting, OWASA General Counsel

Attachments
Attachment 1: Considerations and Options for Moving Forward with a Biogas-to-Energy Project at the Mason Farm Wastewater Treatment Plant
Attachment 2: Drought Planning Resources and Documents

ATTACHMENT 1: Considerations and options for moving forward with a biogas-to-energy project at the Mason Farm Wastewater Treatment Plant

Purpose

This memorandum provides the Natural Resources and Technical Systems (NRTS) Committee with an update of considerations and options for moving forward with a biogas-to-energy project at the Mason Farm Wastewater Treatment Plant (WWTP). The Committee will discuss this update at its December 5, 2017 meeting.

The following document provides an overview of the options presented to the OWASA Board of Directors in April 2017 and has been updated with case study information, an assessment of partnership potential, and staff commentary.

Background

The Mason Farm WWTP produces about 110,000 cubic feet of biogas each day as a by-product of the anaerobic digestion process. The biogas is comprised of methane, carbon dioxide (CO_2), water vapor, and other trace gases, and is a renewable energy source with an estimated energy content of about 560 BTUs per cubic foot.

Currently, OWASA uses a portion of the biogas as fuel for two boilers that provide heat for the WWTP digestion process. Throughout the year, the WWTP produces more biogas than needed for the boilers. According to the U.S. Environmental Protection Agency, the global warming potential of methane is 28 to 36 times greater than CO_2. Therefore, the unused biogas at the WWTP is flared off by a waste gas burner to oxidize the methane to CO_2 and water, thereby minimizing fugitive methane emissions. It is estimated that in CY 2016, we used an average of about 33.3 million BTUs/day to meet our digester heating requirements. That is about 54% of the estimated BTU value of the biogas produced each day at the WWTP.

Many wastewater utilities have implemented other technologies to maximize the beneficial use of their biogas. The primary strategies include treating and conditioning the biogas for use as: (a) fuel for running a combined heat and power (CHP) system that includes an engine that produces electrical or mechanical energy, and a system for recovering and using the waste heat from the engine (of which a portion can be used to heat the digesters); (b) a renewable compressed natural gas (*r*CNG) that can be used as vehicle fuel; and (c) a renewable fuel supply that is injected into the natural gas pipeline grid for subsequent use by other parties. Other utilities also use it as a fuel for drying biosolids or for powering blowers required for the aeration process.

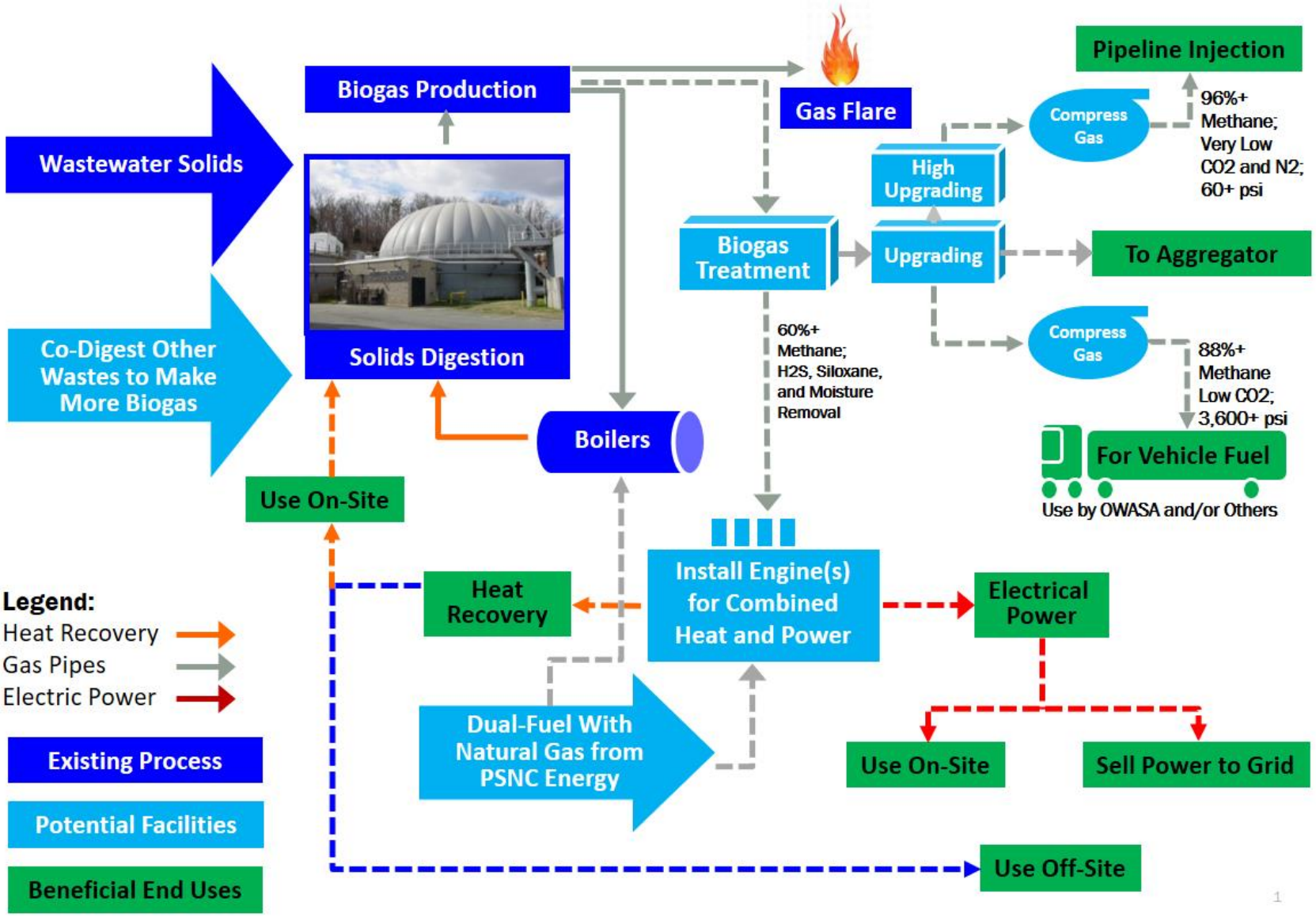
Several utilities have also successfully implemented strategies for increasing the amount of biogas produced at their WWTPs, such as accepting fats, oils, and grease, food waste, and other high-strength organic waste (HSOW) for co-digestion with wastewater solids and using advanced digestion processes to achieve greater volatile solids destruction.

By maximizing the beneficial use of biogas through the above strategies, wastewater utilities can reduce their carbon footprint, lessen the impact of future increases in the cost of grid-supplied electricity and natural gas, and meet some or all their on-site power/fuel requirements with a locally-produced and controlled supply of renewable energy, thereby increasing reliability and redundancy, and resiliency. Unlike renewable wind and solar energy production (excluding systems that have integrated energy storage capacity), digester biogas can provide a reliable baseload power and heat supply, and/or vehicle fuel supply, as it is produced 24 hours a day, 7 days a week, regardless of weather or daytime factors.

But it comes at a cost. Biogas treatment, conditioning, and compression systems are costly from both a capital and operating and maintenance standpoint, and the costs will vary depending on quality of the raw biogas and the ultimate use of the biogas. In converting biogas to energy, key parameters of concern are hydrogen sulfide, carbon dioxide, siloxanes, and moisture. If biogas is to be used as vehicle fuel or delivered to the natural gas pipeline grid, additional treatment and high-level compression will be required. The energy required for gas treatment, conditioning, and compression equipment will offset some of the energy production and carbon reduction benefits from the biogas to energy system.

The figure on the following page illustrates the potential for application of these strategies at the WWTP and introduces the options discussed later in this memo.

Schematic of Biogas-to-Energy Options at the Mason Farm Wastewater Treatment Plant



Option 7

Option 6

Option 5

Options 2, 3 and 4

In recognition of the potential benefits mentioned above, the OWASA Board of Directors established an objective of maximizing the beneficial use of the biogas produced at the WWTP by the end of Calendar Year 2022, provided the preferred strategy is projected to have a positive payback within the expected useful life of the required equipment. In April 2017, staff presented a screening-level analysis for several options for maximizing the beneficial use of OWASA's biogas in the 2017 Energy Management Plan.

In response, the OWASA Board of Directors requested that staff explore partnership opportunities in the region and work with Natural Resources and Technical Service (NRTS) Committee in the Fall of 2017 to evaluate biogas-to-energy options with additional information on the readiness and willingness of regional agencies to partner in further exploration of options. On September 26, 2017, staff presented the NRTS Committee with a summary of partnership potential. Subsequently, staff attended a day-long workshop entitled "The Universe of Digester Gas Utilization and How to Select the Best Alternative for your Water Resource Recovery Facility." The NRTS Committee requested that our information be updated with relevant information learned at this workshop. The following summary of biogas-to-energy options has been updated with relevant information.

Summary of Biogas to Energy Options

Option 1 – Continue to use the biogas as fuel for the boilers, and flare off any unused gas (Status Quo)

This option involves the continuation of OWASA's current practice of using a substantial portion of the biogas as fuel for the two boilers at the WWTP, and flaring off the biogas that is not needed for digester heating. This is the simplest, lowest cost, and most commonly used approach for beneficially using WWTP biogas.

Use of the biogas for digester heating enables OWASA to offset the need use of fossil fuel-based natural gas. However, as noted above, natural gas must be purchased and used to meet digester heating requirements during periods when the supply of biogas is interrupted. And other times, we generate more biogas than we can use, and the biogas must be flared.

At this point, maintaining this system requires a modest, marginal investment. Currently, the biogas is not able to be used in the boilers due to recurrent condensation in the biogas line, and we are pursuing a project that we hope will fix this. Very minimal treatment of the biogas is provided for use in boilers; therefore, this option has the highest operating and maintenance costs for maintenance, repair and periodic re-tubing of the boilers. (In FY17, we spent about $7,000 on boiler maintenance.)

Summary Commentary: Staff is currently undertaking efforts to ensure that this system is working as well as can be expected. However, even in the best situations, we must flare about half of the biogas we generate.

Option 2 – Install a biogas-fueled 330 kW CHP system to offset electrical power use and meet much of the digester heating requirements

This option includes the installation of a reciprocating internal combustion engine and waste heat recovery system that is designed to operate continuously, and closely matched to the current biogas production. The electricity produced by the engine would either be sold to Duke Energy under a power purchase agreement (PPA), or used to offset electrical use and billing charges through a net metering arrangement.

To ensure proper operation and extend the useful life of the engine, the biogas must be treated to remove H_2S, moisture, siloxanes, and particulates which can damage the engine. The minimum required methane content of the biogas is 60%.

The engine would be enclosed to provide for sound attenuation. Given the special expertise required to ensure proper operation and maintenance of the CHP and gas treatment systems, it is assumed that OWASA would enter extended maintenance contracts with the engine and gas treatment system manufacturers.

This option does not include supplemental High Strength Organic Waste (HSOW) receiving and co-digestion, nor a direct third-party recipient of the output (aside from negotiations with Duke Energy).

Several wastewater utilities have successfully implemented biogas CHP systems at this scale, primarily in higher energy cost markets and/or with funding assistance from others.

Locally, two utilities have proceeded with the implementation of larger baseload CHP systems at their wastewater facilities: Charlotte Water's McAlpine Creek Wastewater Management Facility and Winston-Salem's Muddy Creek Wastewater Treatment Plant. A brief summary of each of these cases is provided below.

> ***Case Study:*** Charlotte Water began evaluating the viability of a biogas-fueled CHP system in 2008 because they wanted to beneficially use the biogas generated at their wastewater treatment facilities. For years, the economics proved difficult to make work. In mid-2017, they finally brought a ~1 MW biogas-fueled engine online made possible by sourcing a discounted engine, a 0% interest loan from the State, and a power purchase agreement with Duke Energy. The electricity generated goes directly to the electrical grid, and Charlotte Water does not have the capability to run the plant from the system.
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> ***Case Study:*** Winston-Salem/Forsyth County Utilities Division is currently constructing a 1.1 MW CHP System at its Muddy Creek Wastewater Treatment Plant. The investment was motivated by a need to increase their back-up generator system and the replacement of their digester gas-fired blowers due to their condition. Once running, the utility will deliver electricity directly to the grid with a power purchase agreement with Duke Energy (although they do not yet have a contract). The system will also be able to power the plant if the grid goes down to extend the life of the back-up generator.

Partnership Assessment: Duke Energy would be the major partner on this option. Under current regulations, a CHP system that is smaller than 1 MW can be net-metered at retail rates, rather than through a power purchase agreement at largely wholesale rates. However, due to high fixed monthly charges and the relatively low cost of energy at the Mason Farm WWTP, more analysis would need to be done on the most desirable contract with Duke Energy. Unfortunately, neither option is likely to create favorable economics for a system this size.

This summer, Duke University expressed preliminary interest in purchasing natural gas offsets, although OWASA's biogas-to-energy CHP system would likely account small fraction of those that they hope to purchase on-the-whole. Additional revenue from natural gas offsets and renewable energy credits were not incorporated into the financial analysis, at this point, but would likely be relatively small.

Summary Commentary: Assuming cooperation from Duke Energy, this option is relatively straightforward to implement, in terms of precedent and partnerships. Unfortunately, due to the low cost of electricity at this point in time and the scale of the system that OWASA could fuel on wastewater biogas alone, the economics are not favorable even in the best circumstances. A CHP system does have the added potential benefit of providing back-up power. Some utilities have opted to design their system to provide this redundancy (e.g. Winston-Salem/Forsyth County) and other have not (e.g. Charlotte Water). We currently have two diesel generators at the WWTP with rated capacities that exceed the maximum power demand of the plant (which was about 1,400 kW in FY17).

Option 3 – Install a biogas-fueled 950 kW CHP system, and optimize the operation of the system around peak time of day rate periods for electricity

This option includes the installation of a reciprocating internal combustion engine and waste heat recovery system that is designed and operated to primarily offset electricity demands at the WWTP during Duke Energy's peak time of day rate period. Under this approach, the engine would typically operate about 8 hours a day for five days a week, and the waste heat would be recovered and used for digester heating during that period. The engine would be designed to run primarily off biogas, but have the capability to also be fueled by natural gas. Natural gas use would be required to meet digester heating needs during the time of the day when the engine was not being run.

Gas treatment and conditioning requirements and operation and maintenance service arrangements would be the same as for Option 2.

In 2016, OWASA staff requested assistance from the Department of Energy's Combined Heat and Power Technical Assistance Program (CHP TAP) to conduct screening-level analysis of this option at no cost to OWASA. DOE CHP TAP concluded that if an additional 135,000 cubic feet of gas storage capacity was installed at the WWTP to store biogas during the off-peak hours for use during the on-peak hours, the current gas production rate would enable a 1,350-kW engine to offset the WWTP's monthly peak power requirements, assuming Calendar Year 2016 demand conditions. For the purposes of this analysis, we have adjusted the economics to account for a 950-kW system to take advantage of the net metering option in our assumptions and better align the engine's waste heat with digester needs.

Like Option 2, the engine would be enclosed to provide for sound attenuation, and it is assumed that OWASA would enter extended maintenance contracts with the engine and gas treatment system manufacturers.

***Case Study*:** We have not identified a case where this this type of system is being used.

Partnership Assessment: As with Option 2, this option would require cooperation and partnership with Duke Energy. Given the atypical nature of the project, this could significantly delay the project and hinder the economics.

Summary Commentary: This option is intriguing because of the back-up power potential offered by a dual-fueled (biogas and natural gas) reciprocating engine, and its capacity to adapt to supplemental high strength organic waste in the future and run around the clock. However, the economics of this project alone (without supplemental high strength organic waste) are quite unfavorable, and the likelihood of Duke Energy's willingness to accommodate a peaking-only CHP system are questionable.

Option 4 – Install a biogas-fueled 700 kW CHP system and High Strength Organic Waste (HSOW) receiving and processing facilities to enhance biogas production and renewable energy generation[1]

This option includes installation of a 700 kW CHP system, and facilities for receiving and processing HSOW for co-digestion to enhance gas production and support greater power production levels. Due to higher percent solids and converted volatile solids, food waste and, even more so fats, oils, and grease, can generate more energy in digestion.

Like Option 2, the engine would be operated on a continuous basis, and closely matched to the much higher projected biogas production rate associated with co-digestion of HSOW.

Electricity produced could either be sold to Duke Energy under a PPA, or used to offset electrical use and billing charges through a net metering arrangement. Gas treatment and conditioning requirements and operation and maintenance service arrangements would be the same as for Options 2 and 3.

This option potentially offers significant additional revenue streams from the receipt of tip fees for accepting HSOW, and the sale of greater amounts of electricity made possible by enhanced gas production. However, when compared to Options 2 and 3, this option would have much higher capital and operating and maintenance costs, be more challenging to operate and maintain, and present greater operating and financial risks due to the inclusion of facilities for HSOW receiving, processing and co-digestion. The operation of HSOW receiving and processing facilities would result in more truck traffic, increased risk of objectionable off-site odors, and would require a significant amount of space.

If the anticipated supply of HSOW and/or the tip fees for accepting and processing those wastes are lower than projected, revenues would be less favorable. Lower volumes of HSOW will mean less biogas production, less power generation, and lower revenues from the sale of electricity than projected for this option. Implementation of HSOW receiving and co-digestion will require careful management to ensure proper performance of the digesters and quality of the biosolids. For this analysis, the costs of increased production of biosolids that is likely to accompany the acceptance of supplement HSOW was not incorporated.

> ***Case Study:*** The Sheboygan Regional Water Resource Recovery Facility on the Western shore of Lake Michigan co-digests organic waste from nearby dairies, food additive companies, and grease to power about 700 kW of microturbines. They received over $1 million in grants and sell electricity back to the grid at retail rates. Recently, when faced with a significant capital improvement need for the system, declining tipping fees, and the fact that 90% of the organic waste was coming from one supplier, the City decided to stop the co-digestion program.
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> **Case Study:** The Santa Rosa Laguna Treatment Plant in California co-digests HSOW from a nearby dairy, poultry farm, brewery, food processor, and local restaurants to fuel four 1.1 MW engines. They received a $2.4 million self-generation incentive from Pacific Gas and Electric. About ¾ of their system is powered by the gas generated from digesting HSOW; the other fourth from wastewater biogas.

[1] Option 4 below includes the installation of HSOW receiving facilities and co-digestion of supplemental waste streams to increase gas production. It would also be possible to include HSOW processing for each of the other options; however, that was not done for the purpose of this screening analysis.

Partnership Assessment: There is preliminary general interest from Orange County Solid Waste, the Chapel Hill-Carrboro City School District, and potentially the University of North Carolina in evaluating a local organics management strategy. The likely and primary source for high strength organic waste in our area would be post-consumer waste (both food and fats, oils, and grease) as opposed to agricultural or commercial waste, which increases quality concerns.

Summary Commentary: Co-digesting high strength organic waste has the potential to significantly improve the economics of any biogas-to-energy option (CHP, vehicle fuel, or pipeline injection). Assuring a consistent, high-quality source or sources of the organic waste is paramount to this equation. It's also important to keep in mind that co-digestion would reduce digester capacity available for wastewater biosolids, increase biosolid production, increase traffic at the Mason Farm plant, and impact other plant operations. Concurrent to securing a high-quality source of high strength organic waste, a significant engineering analysis would be required to fully understand the near and long -term impacts on the Mason Farm Wastewater Treatment Plant of co-digestion.

Because of the integrated nature of this option (both with regional partners and internally at the plant), it is not likely to be fully implemented by 2022. Rather, staff would recommend that if we move forward in evaluating one or more options that we design such an option so that it does not rule out the acceptance of HSOW at a later date.

Option 5 – Install a system that enables biogas to be used as rCNG in vehicles and certain equipment

This option includes installation of a gas treatment and conditioning system, gas compression and storage facilities, and an *r*CNG fueling station to fill OWASA vehicles at the WWTP. To be used as vehicle fuel, the *r*CNG must have a higher methane content (>88%) and lower CO_2 content than is needed to fuel a CHP as proposed for Option 2 - 4. The biogas must also be compressed to a much higher pressure – about 3,600 pounds per square inch (psi). Thus, this option involves higher costs for gas treatment, conditioning and compression than the CHP options.

At current biogas production rates, it is estimated that an rCNG system could generate around 130,000 diesel gallon equivalents (or about 164,000 gasoline gallon equivalents) of vehicle fuel each year, which substantially exceeds OWASA's total annual vehicle fuel requirements. For this option, it is assumed that the excess *r*CNG vehicle fuel produced would be sold for use by others. Since it is very unlikely that OWASA could provide an rCNG fill station at the WWTP for use by others, it is assumed that an *r*CNG tube truck will be used to transport the fuel for off-site use and delivered to an off-site CNG fueling station constructed by the benefitting party.

This option assumes that a slow-fill rCNG fueling station is installed at the WWTP to enable refueling of the biosolids tanker trucks, roll-off container truck, and other trucks parked overnight at the facility.

To fully use the fuel produced under this option, OWASA and other fleet owners would need to convert a number of existing vehicles to run on *r*CNG, and/or replace existing vehicles with new *r*CNG-ready vehicles. Vehicle conversion costs or incremental costs for new rCNG-ready vehicles can cost from around $10,000 to more than $30,000.

The environmental attributes of this option are substantial, as use of *r*CNG instead of diesel fuel or gasoline substantially reduces emissions of nitrous oxide, carbon monoxide, particulate matter, and volatile organic compounds and ozone-forming emissions.

In addition to the revenue received from the sale of *r*CNG fuel (or the vehicle fuel purchase costs offset by this option), additional revenues are projected for the sale of renewable energy credits associated with the sale and use of the *r*CNG. A Renewable Identification Number (RIN) is assigned to biofuel for tracking its production, use, and trading under the U.S. Environmental Protection Agency's Renewable Fuel Standard (RFS) established in accord with the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007. Gross revenues for sale of the RINs are assumed to be $2.50 per Ethanol Gallon Equivalent (for D3 cellulosic RINS); costs for RIN certification and marketing is assumed to be 25% of the gross revenues.

This option has the potential to be a strong investment for OWASA, if certain assumptions prove favorable, such as RIN market value and longevity and end-market acceptance for excess *r*CNG.

> ***Case Study:*** The City of Grand Junction (CO) pipes biogas from its Persigo WWWTP via a 5.7 mile pipeline to a natural gas refueling station where it is used to fuel 46 city-owned vehicles. The $2.8 million investment does not include the vehicle conversion or fueling station. With a long-term agreement with the City and County to purchase CNG at fixed rate of $1.50 per gallon of gasoline equivalent, a $500,000 grant, and the sale of RINs, the utility projects a 9-year payback on the gas treatment and delivery system.
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> ***Case Study:*** The City of South Bend, Indiana is currently phasing in a biogas-to-vehicle fuel strategy to fuel six City-owned trash trucks and one roll-off truck that hauls biosolids. A study conducted found that the most cost-effective use of South Bend's already conditioned digester gas was in two existing natural gas engines and the existing vehicle fueling station.

Partnership Assessment: This summer, the Town of Carrboro staff expressed interest in evaluating alternative fleet fueling strategies, including rCNG for their entire fleet. However, due to recent and pending staff turnover, this evaluation will likely be delayed and potentially reconsidered.

In addition to the sale of RINs, this option has the potential to attract outside funding. The State of North Carolina is currently accepting feedback on how to distribute $92 million in Volkswagen settlement funds to reduce pollution from mobile sources. While the funds are not likely to be able to be used for a CNG fueling station, they might be able to be used for vehicle conversion costs.

Summary Commentary: This option has greatest potential in terms of economic viability, however, the finances are dependent on a third-party's interest and purchase of rCNG for their fleet, as well as the existence of a market for RINs. Because we have not identified a ready partner, bringing this strategy online will likely take longer than 2022 (if at all), at which point the RIN market could be different. However, if the option could be mobilized quickly, it has the potential to take advantage of outside funding, although attracting this funding will likely be out of OWASA's direct control.

Option 6 – Install a system that enables biogas to be converted to *r*CNG for off-site transport to an end user or a biomethane aggregator that upgrades the biogas for wholesale delivery to a natural gas pipeline and/or other end users ("Mobile Pipeline" option)

This option includes a gas treatment and conditioning system and compression facilities for uploading biogas into tube trucks for transport to an off-site location for use by another party, such as an industry, *r*CNG fueling operation, or aggregator that upgrades the biogas and injects it into a natural gas pipeline and/or delivers it to other end users.

*r*CNG production levels would be the same as for Option 5. The level of gas treatment that OWASA would need to provide will depend on the recipient's needs; however, for this screening analysis, it is assumed that biogas would be treated and compressed to the same level as for Option 5, but the required tube transport truck would be owned and operated by another party.

It is assumed that any additional equipment needed for upgrade of the biogas would be paid for and operated and maintained by the end user or aggregator.

> ***Case Study:*** The Optima KV Pipeline RNG Project in Eastern NC will combine, or aggregate, the biogas created from the anaerobic digestion of swine waste from five adjacent farms. The Optima-KV project includes the construction of an in-ground anaerobic digester at each farm. The resulting biogas is captured from each farm, and routed to an adjacent, centralized biogas upgrading facility where the biogas undergoes purification and cleaning to pipeline specification. The renewable natural gas produced from this system will be sold to an electric utility subject to the requirements of the North Carolina Renewable Energy Portfolio Standards. (Biogas generated by hog farms in North Carolina meets requirements in the state's Renewable Energy Portfolio Standard. Wastewater biogas does not.)

Summary Commentary**:** There are no existing biomethane aggregator systems in our area; therefore, there is great uncertainty in the terms and conditions, and associated costs and benefits that would apply to OWASA under this option. Currently, there is no path forward for OWASA to pursue this option.

Option 7 – Install a system for upgrading the biogas for direct injection into the natural gas pipeline system, where it can be used by natural gas customers

This option includes the treatment and compression of the biogas to gas pipeline standards, and the establishment of an interconnection to inject *r*CNG into the natural gas pipeline system. The *r*CNG would be blended in the pipeline and be available for heating, industrial process, CNG fueling, and other purposes.

This option assumes that we can take advantage of the existing natural gas pipeline infrastructure and enables 100% of the biogas to be used. PSNC has provided information that the nearest pipeline into which we could inject is about 1.5 miles away.

This option would have substantial capital costs for gas treatment and conditioning, as the biogas would likely be required to meet very strict gas quality standards. Extensive gas testing and monitoring would be required on an ongoing basis.

As with Option 5, this option also would allow OWASA to participate in the RIN market, so long as the market is active.

North Carolina does yet not have statewide standards for the injection of biogas into the natural gas pipeline. OWASA's natural gas provider, PSNC, is currently participating in a collaborative working group convened by the North Carolina Utilities Commission to develop a gas quality standard for pipeline injection

(along with Piedmont Natural Gas). We have received notification from our account representative that PSNC Energy intends to accept biogas injected into its system, assuming certain issues can be resolved.

These issues include, but are not limited to, the quality of the gas produced/received, the location of PSNC's and the producer's facilities, the respective ownership of certain facilities, and an agreement on the cost recovery of interconnection, operations and maintenance that PSNC will incur in conjunction with accepting the gas. In the interim, we can only make assumptions on these conditions, most of which have significant impact on the economics.

> ***Case Study:*** The King County South Treatment Plant (WA) biogas-to-pipeline project in Renton, Washington has been in operation since 1987. They attribute their successful system to close proximity to major gas pipeline, 24-hour operations and maintenance, favorable commodity prices, low levels of H2S in raw biogas, and relatively low siloxane levels. Their system involves close coordination with and online monitoring and right-of-refusal by the gas utility.
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> ***Case Study:*** The City of Raleigh evaluated various biogas utilization strategies in conjunction with the installation of a high-heat anaerobic digestion system at their Neuse River Resource Recovery Facility. In their evaluation, they found a biogas-to-City bus strategy to be their most viable option. This option was deemed favorable with rCNG being trucked to the vehicle fueling station, but was made even more favorable when PSNC requested to build a new large natural gas main through the land owned by the City adjacent to the Facility. This presented an opportunity to the City to achieve more value for the gas during the early phases of the project (pending conversion of the City's bus fleet to CNG) and to provide a more straightforward means of transferring gas in the future. The interconnection standards have not been developed yet, and the project is not expected to come online until 2021 or 2022.

Partnership Assessment**:** As previously discussed, this option will require a Memorandum of Understanding between OWASA and PSNC Energy regarding gas quality and monitoring requires, infrastructure ownership, and other details. This will have to be approved by the North Carolina Utilities Commission. As mentioned before, Duke University may be interested in purchasing natural gas offsets, an option that would need to be considered along with the sale of RINs.

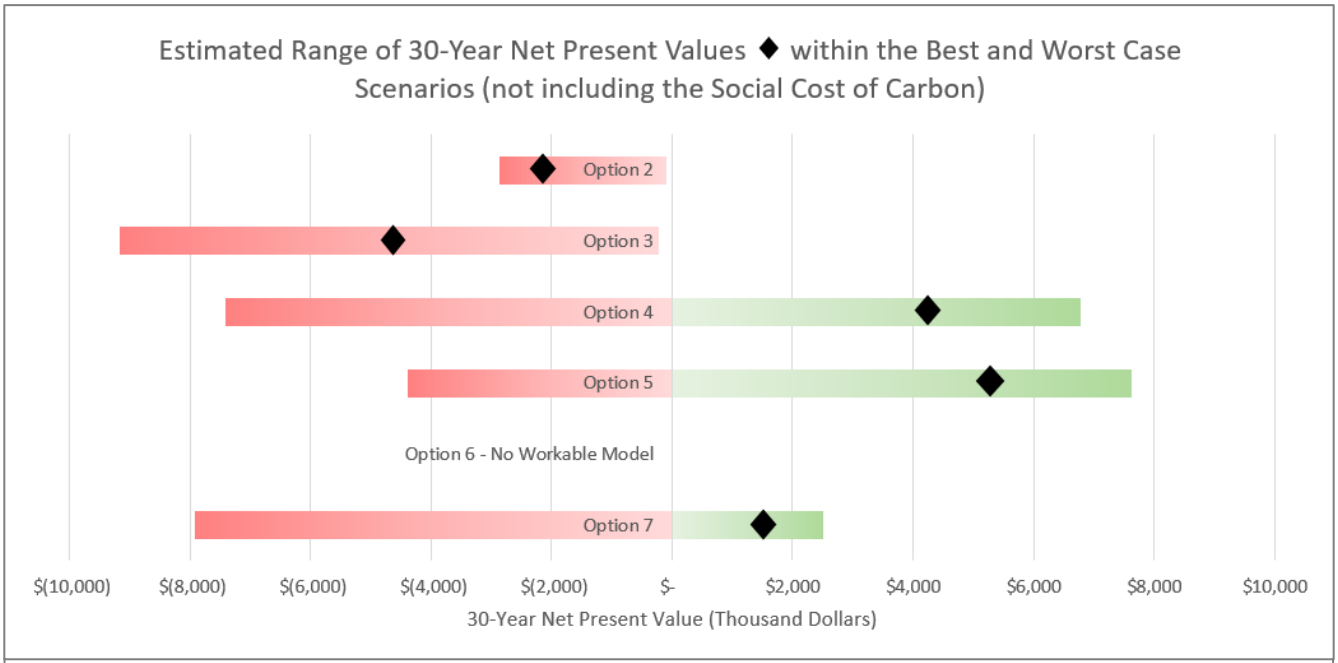
Summary Commentary: This option is the most "actionable", economically viable option. More analysis is needed to develop specifications for gas treatment and conditioning, plant integration, RIN marketing, and, of course, pipeline interconnection requirements.

Considerations for Next Steps

At the end of this memo, there is a table that provides a relative comparison of biogas-to-energy options against a series of individual criteria. The following narrative summarizes the key takeaways of this table.

Financially Responsible: The identification of a successful biogas-to-energy option does not lie in the economics alone, but it is a critical threshold to a sustainable project and defined in the goal itself. Through participation in the workshop and case study evaluation, staff has refined cost estimates from those provided in April.

Staff's screening level analysis shows that using the biogas as a renewable compressed natural gas for vehicle fuel (Option 5) and injecting the biogas into the natural gas pipeline (Option 7) have potential to have a positive net present value within the life of the asset even without co-digestion. Co-digestion of high strength organic waste has the potential to increase the economic viability of any of the options (as shown in Option 4), but also introduces financial risk and operational and capacity costs at the Mason Farm WWTP.



Option 2: *Biogas Combined Heat and Power (CHP) system operating continuously (330 kW)*
Option 3: *Biogas CHP system operating during on-peak times (950 kW)*
Option 4: *Biogas CHP with high-strength organic waste receiving (700 kW)*
Option 5: *Biogas used as a Renewable Compressed Natural Gas (rCNG) for vehicle fuel*
~~***Option 6:*** *Biogas delivered to other parties or aggregator via "Mobile Pipeline" strategy*~~
Option 7: *Biogas injected to PSNC Natural Gas Pipeline*

At this point, the range between most best and worst-case scenarios is broad. Even those that are projected to be economically viable have scenarios well "in-the-red". A peer review by a third-party consulting firm with recent experience in similar projects could narrow the ranges. A more thorough design and implementation plan would narrow the range further.

Realistic/Implementable: In establishment of the energy management goals and objectives, the OWASA Board of Directors set a goal to beneficially use all biogas by 2022. In order to comfortably meet this deadline, we need to move forward with a more detailed design and refined financial and implementation plan in Fiscal Year 2019, due the complexity of the system, its potential impact on our operations, and the contractual requirements to sell the output. However, 2022 is not a regulatory requirement, and the Board has discretionary authority to revise the target date as it deems appropriate.

Given that there is no regional partner ready to move forward with project design, options that involve lockstep coordination with one or more regional partners are likely on a longer timeline. These options include co-digestion of food waste (a version of Option 4) or selling rCNG as vehicle fuel (Option 5).

Project coordination with utilities alone will be significant, but is likely more actionable in the near term. As noted above, moving forward with Option 7 will require up-front work with PSNC to define gas quality standards and contractual agreements. Some of this work has begun, but much more is required. (There is the potential to partner with the City of Raleigh on this work.)

Other Factors: The decision framework for the Energy Management Program identifies other factors for consideration in prioritizing projects, including operational impacts, energy/carbon reduction potential, coordination with other projects, and the community impacts.

Choosing any option other than the status quo increases the beneficial use of our biogas and reduces greenhouse gas emissions. Additionally, any option other than the status quo increases staff maintenance responsibility and the complexity of operations, even if operations and maintenance of the system itself is contracted out (the costs of which we have incorporated into each of the options). Furthermore, without the context of a long-term resource recovery plan for the Plant, it is difficult to forecast how any option will integrate with future plans at the WWTP.

There are some distinguishing considerations between the options.

A combined heat and power system (Options 2-3) have the potential to increase the resiliency and reliability of the plant, but they do so at a cost (see financial responsibility).

Options that involve regional collaboration (Options 4-5) could provide a direct benefit to our community, but would require us to operate on a longer timeframe that is less in our control.

At this point, Option 7 has potential to be financially responsible, implementable, and makes beneficial use of our biogas, but it will complicate operations and maintenance at the plant without any direct benefit to our plant or the community.

Options for Next Steps

With these considerations in mind, staff has provided some options for next steps for our efforts to meet our biogas to energy goal:

1. **Proceed with preliminary engineering evaluation, detailed financial analysis, and implementation plan of one option**

Given the potential economic and implementation viability, the most prime candidate for this option would be Option 7 (with consideration for future co-digestion of HSOW). This option gives us the highest likelihood of achieving the goal of having a project online by 2022. When presented with the outcome of this evaluation, the OWASA Board of Directors would be presented with information to decide whether or not to invest in the multimillion-dollar project. If conditions are not right for moving forward, we would have a basis of design and implementation plan that would need some level of "freshening up" depending on how much conditions have changed.

Estimated cost of next step: $75,000 - $125,000[2] and staff time

[2] Estimated costs are provided to give general waypoints. These costs could be further defined with the benefit of the NRTS Committee's direction on scope.

2. **Refine financial analysis of multiple options with the assistance of a third-party expert with recent similar experience**

This option would provide an expert review of staff assumptions, refine cost estimates, and could perhaps introduce game-changing scenarios or options (although no presentation or conversation at the workshop provided such a game changing scenario). This step would keep us moving toward our goal while allowing potential partners to conduct complementary analyses. We would have a very slim chance of meeting our 2022 deadline if this step is taken, but could conceivably have a project under design or potentially construction by then. The results of this step would either be a recommendation to proceed with preliminary design and implementation plan on a given option or to wait for conditions to change.

Estimated cost of next step: $50,000 - 60,000 and staff time

3. **Improve the status quo; engage and assist with complementary analyses by the Town of Carrboro, Orange County Solid Waste, Chapel Hill-Carrboro City Schools, and/or University of North Carolina; and continue to consider opportunities to make beneficial use of all of the biogas generated at the WWTP**

Staff recommends this step regardless of whether either of the previous steps are taken. If this step alone is taken, we will not meet our 2022 goal.

Estimated cost of next step: Modest investment in biogas-to-boiler upgrades, boiler maintenance, and staff time

Conclusion

There is no outside regulatory driver to proceed with this project right now. But embedded in our mission is that we are responsible and creative stewards of the resources we manage. Biogas, a potent greenhouse gas with an inherent energy value, is as much of a resource generated by the wastewater services we provide, as a waste product. If we can find a way to make beneficial use of that energy at no additional cost to our customers, we are acting in-line with our values of environmental responsibility, affordability and value, and sustainability.

Staff's analysis, presented in this document, suggests that there is potential in a few different options and trade-offs among them: actionable versus economically viable, operationally distinct versus operationally integrated, etc. To get a more conclusive answer, staff requests priorities from the Board on where to focus and technical assistance from consultants who have recent experience in designing and implementing similar projects. We appreciate the Board of Director's guidance and support in this initiative.

Relative Comparison of Biogas-to-Energy Options Against Evaluation Criteria

Relative comparison of performance to each other (only applicable to the objective for that row)

Key to Cell Shading: UNACCEPTABLE | SIGNIFICANT CONCERN | ACCEPTABLE | BETTER | BEST

		OPTION 1 BASELINE (EXISTING PROGRAM) BIOGAS TO BOILERS WITH EXCESS FLARED OFF	OPTION 2 BIOGAS CHP SYSTEM OPERATING CONTINUOUSLY - 330 kW NET METERING TO DUKE ENERGY	OPTION 3 BIOGAS CHP SYSTEM DUAL-FUELED WITH NATURAL GAS FOR FULL PEAK POWER GENERATION - 950 kW	OPTION 4 BIOGAS CHP SYSTEM WITH HIGH-STRENGTH ORGANIC WASTE (HSOW) RECEIVING - 700 kW	OPTION 5 BIOGAS USED AS RENEWABLE COMPRESSED NATURAL GAS (rCNG) FOR VEHICLE FUEL	OPTION 7 BIOGAS WHOLESALED TO PSNC NATURAL GAS PIPELINE
FINANCIALLY RESPONSIBLE	ESTIMATED 30-YEAR NET PRESENT VALUE (w/out the Social Cost of Carbon) (Best Case/Worst Case)		($2,000,000) ($89,000) / ($2,781,000)	($4,303,000) ($227,000) / ($8,931,000)	$3,390,000 $6,788,000 / ($7,412,000)	$4,733,000 $7,624,000 / ($4,483,000)	$882,000 $2,512,000 / ($7,913,000)
	ESTIMATED 30-YEAR NET PRESENT VALUE (w/ SCC) (Best Case/Worst Case)		($246,000) $1,700,000 / ($991,000)	($3,519,000) $557,000 / ($8,146,000)	$6,129,000 $9,527,000 / ($4,673,000)	$6,330,000 $9,221,000 / ($2,786,000)	$2,244,000 $4,074,000 / ($6,350,000)
	INITIAL CAPITAL COSTS	$0 No new equipment needed	$2.2 million - $2.8 million Small engine and heat recovery system; gas treatment and conditioning; electrical systems integration ~60% methane concentration	$2.5 million - $3.5 million Large engine and heat recovery system; additional biogas storage tank; gas treatment and conditioning; electrical systems integration ~60% methane concentration	$4.6 million - $6.5 million Moderate-sized engine and heat recovery system; HSOW receiving and processing facilities; larger gas treatment and conditioning system; electrical systems integration ~60% methane concentration	$3.0 million- $4.2 million Gas treatment, conditioning and upgrade system; gas compression; gas storage and vehicle fueling station; vehicle conversions; tube truck for off-site transport of gas ~88% - 90% methane concentration	$2.6 million- $4.3 million Gas treatment, conditioning, and upgrade system; gas compression; pipeline interconnection ~98% methane concentration
	OPERATING AND MAINTENANCE (O&M) COSTS	Boiler maintenance (higher because there is no gas treatment and conditioning); supplemental purchase of natural gas	~$135,000 - $200,000/year Moderate O&M costs for engine and gas treatment systems	~$120,000 - $175,000/year Moderate O&M costs for engine and gas treatment systems	~$260,000 - $445,000/year High O&M costs for engine, gas treatment, and HSOW receiving and processing systems (more run-time requires more O&M)	~$200,000 - $280,000/year Potentially high O&M costs for gas treatment and compression system and vehicle fueling arrangements as well as mobile gas transport operations	~$210,000 - $300,000/year Potentially high O&M costs for gas treatment and compression system and ongoing monitoring

		OPTION 1 BASELINE (EXISTING PROGRAM) BIOGAS TO BOILERS WITH EXCESS FLARED OFF	OPTION 2 BIOGAS CHP SYSTEM OPERATING CONTINUOUSLY - 330 kW NET METERING TO DUKE ENERGY	OPTION 3 BIOGAS CHP SYSTEM DUAL-FUELED WITH NATURAL GAS FOR FULL PEAK POWER GENERATION - 950 kW	OPTION 4 BIOGAS CHP SYSTEM WITH HIGH-STRENGTH ORGANIC WASTE (HSOW) RECEIVING - 700 kW	OPTION 5 BIOGAS USED AS RENEWABLE COMPRESSED NATURAL GAS (rCNG) FOR VEHICLE FUEL	OPTION 7 BIOGAS WHOLESALED TO PSNC NATURAL GAS PIPELINE
	ANNUAL NET SAVINGS (COSTS) POTENTIAL - EXCLUDING SCC	Use of biogas in boilers instead of natural gas offsets cost of natural gas	~$115,000 -$235,000/year Reduction in electricity purchases and of natural gas needed for heating digesters	~$0 - $250,000/year Reduction in electricity purchases and of natural gas needed for heating digesters	~$225,000 - $940,000/year Revenue from tipping fees and reduction in electricity purchases and of natural gas needed for heating digesters	~$380,000 - $670,000/year Revenue from sale of *r*CNG and any associated RINs; offset purchase of vehicle fuel	~$200,000 - $435,000/year Revenue from sale of biogas and any associated RINs
	FINANCIAL RISK FACTORS	Requires no up-front capital costs to recover; Vulnerable to large increases in Duke Energy rates	Biogas storage rehabilitation can impact biogas availability; air permitting requirements for engine; Duke Energy's willingness to partner and future changes in net metering rates	Start-stop operation of engine on daily basis could potentially adversely affect useful life of engine; Duke Energy's willingness to partner and future changes in net metering rates; biogas storage rehabilitation can impact biogas availability; air permitting requirements	High risk Potential for stranded capital if supply of HSOW fails to materialize; decline in tip fees charged would reduce financial viability; processing of HSOW could increase biosolids production and associated costs, nutrient loads, etc. and reduce available digester capacity	Moderate risk RIN market price subject to volatility, and federal RFS requirements could be rescinded; rCNG system outage could affect availability of essential vehicles and equipment unless adequate alternative supply of CNG fuel was available	Moderate risk RIN market price subject to volatility, and federal RFS requirements could be rescinded; rCNG system outage could affect availability of essential vehicles and equipment unless adequate alternative supply of CNG fuel was available
REALISTIC/ IMPLEMENTABLE	DEMONSTRATED SUCCESS	Successfully used at many WWTPs in U.S.; has been used successfully by OWASA since 1977	Successfully used at several WWTPs in U.S., including at scale of OWASA	Successfully used at some private facilities and a few larger WWTPs	Successfully used at several WWTPs; however, most are at scale larger than OWASA and received grant funding to improve financial feasibility	Extensively used in Europe; a few WWTPs in U.S. are using biogas rCNG as vehicle fuel	Several large WWTPs in U.S. have pipeline injection systems, and others (including Raleigh) are planned; very little experience at scale of OWASA WWTP
REALISTIC/ IMPLEMENTABLE	IMPLEMENTATION RISK FACTORS	None	Duke Energy's willingness to partner; electrical configuration at WWTP presents challenges for integration	Duke Energy's willingness to partner; electrical configuration at WWTP presents challenges for integration	Duke Energy's willingness to partner; electrical configuration at WWTP presents challenges for integration; Securing a steady supply of HSOW; Complexity associated with partnership coordination	Complexity associated with partnership coordination	No biomethane pipeline injection standards established in NC
OPERATIONAL IMPACTS	EMPLOYEE HEALTH AND SAFETY	Minimal risk	Slightly greater risk for operation and maintenance of on-site power generation (similar to standby power generation)	Slightly greater risk for operation and maintenance of on-site power generation (similar to standby power generation); gas storage (especially if pressured) presents safety concerns	Greater risk for operation and maintenance of on-site power generation (similar to standby power generation); greater risk for operation and maintenance of HSOW receiving and processing; increased traffic at Mason Farm WWTP	Greater risk for operation and maintenance of gas treatment, conditioning and compression system and vehicle fueling system; increased traffic at Mason Farm WWTP	Greater risk for operation and maintenance of gas treatment, conditioning and compression system

		OPTION 1 BASELINE (EXISTING PROGRAM) BIOGAS TO BOILERS WITH EXCESS FLARED OFF	OPTION 2 BIOGAS CHP SYSTEM OPERATING CONTINUOUSLY - 330 kW NET METERING TO DUKE ENERGY	OPTION 3 BIOGAS CHP SYSTEM DUAL-FUELED WITH NATURAL GAS FOR FULL PEAK POWER GENERATION - 950 kW	OPTION 4 BIOGAS CHP SYSTEM WITH HIGH-STRENGTH ORGANIC WASTE (HSOW) RECEIVING - 700 kW	OPTION 5 BIOGAS USED AS RENEWABLE COMPRESSED NATURAL GAS (rCNG) FOR VEHICLE FUEL	OPTION 7 BIOGAS WHOLESALED TO PSNC NATURAL GAS PIPELINE
	WORK EFFECT ON EMPLOYEES (PROGRAM STAFF AND MANAGEMENT)	Minimal effect	CHP and biogas treatment and conditioning systems will increase staff maintenance responsibilities and complexity of operations (Bulk of O&M estimated to be handled by 3rd party)	CHP and biogas treatment and conditioning systems will increase staff maintenance responsibilities and complexity of operations (Bulk of O&M estimated to be handled by 3rd party)	CHP, biogas treatment and conditioning, and HSOW receiving systems will increase staff maintenance responsibilities and complexity of operations (Bulk of O&M estimated to be handled by 3rd party)	Much greater level of maintenance and complexity of operations for biogas treatment and conditioning system and rCNG storage and fueling system. Vehicle conversions to rCNG will increase complexity for vehicle maintenance staff	Biogas treatment and conditioning system, as well as monitoring equipment, will increase staff maintenance responsibilities and complexity of operations
	OPERATIONAL RESILIENCY AND RELIABLITY	Provides basic level of operational resiliency and reliability	Potentially greater level of operation resiliency and reliability	Greater level of operation resiliency and reliability	Greater level of operation resiliency and reliability	Greater level of operation resiliency and reliability (i.e. control over vehicle fuel)	Potential for on-site use of natural gas if pipeline goes down
	OTHER OPERATIONAL RISK FACTORS	None	Space requirements of gas treatment and storage facilities and CHP system eliminates availability for future needs of WWTP	Space requirements of gas treatment and storage facilities and CHP system eliminates availability for future needs of WWTP	Space requirements of gas treatment and storage facilities, CHP system, and HSOW receiving and processing station eliminates availability for future needs of WWTP; variability in composition and quality of HSOW could affect digestion process stability	Space requirements of gas treatment, compression, and storage facilities, *r*CNG vehicle fueling equipment, and vehicle access eliminates availability for future needs of WWTP;	Space requirements of gas treatment and compression facilities eliminates availability for future needs of WWTP
ENERGY/CARBON REDUCTION	RENEWABLE ENERGY GENERATION (NET) AND REDUCTION IN GREENHOUSE GAS EMISSIONS	Use of biogas in boilers instead of natural gas provides moderate reduction in GHGs	~ 2.2 million kWh/year ~1,100 Metric Tons/Year in GHG reduction	~1.2 million kWh/year ~496 Metric Tons/Year in GHG reduction	~ 4.6 million kWh/year ~1,700 Metric Tons/Year in GHG reduction	Off-set approximately 130,000 gallons of diesel fuel ~1,000 Metric Tons/Year in GHG reduction	Off-set approximately 120,000 gallons of diesel fuel ~990 Metric Tons/Year in GHG reduction
COORDINATION WITH OTHER PROJECTS	INTERDEPENDENCE WITH OTHER (OWASA) PROJECTS / POTENTIAL TO TAKE ADVANTAGE OF ECONOMIES OF SCALE	None	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan	Unknown without long-term WWTP site development plan

		OPTION 1 BASELINE (EXISTING PROGRAM) BIOGAS TO BOILERS WITH EXCESS FLARED OFF	OPTION 2 BIOGAS CHP SYSTEM OPERATING CONTINUOUSLY - 330 kW NET METERING TO DUKE ENERGY	OPTION 3 BIOGAS CHP SYSTEM DUAL-FUELED WITH NATURAL GAS FOR FULL PEAK POWER GENERATION - 950 kW	OPTION 4 BIOGAS CHP SYSTEM WITH HIGH-STRENGTH ORGANIC WASTE (HSOW) RECEIVING - 700 kW	OPTION 5 BIOGAS USED AS RENEWABLE COMPRESSED NATURAL GAS (rCNG) FOR VEHICLE FUEL	OPTION 7 BIOGAS WHOLESALED TO PSNC NATURAL GAS PIPELINE
COMMUNITY IMPACTS	NOISE, ODOR, AND TRAFFIC CONCERNS	Minimal concerns	Increased noise risk due to CHP system operation; increased odor risk if gas treatment system malfunctions	Increased noise risk due to CHP system operation with large engine; increased odor risk if gas treatment system malfunctions	Increased noise from CHP system operation; increased odor risk from transport, receipt, and processing of HSOW; increased truck traffic for hauling HSOW and more biosolids	Increased noise risk due to system operation; tube truck transport; increased odor risk if gas treatment system malfunctions	Increased noise risk due to system operation; increased odor risk of gas treatment system malfunctions
	SERVICE TO COMMUNITY	Provides limited direct benefit to the community	Provides limited direct benefit to the community	Provides limited direct benefit to the community	Provides convenient local option for disposal of HSOW from the community	Provides locally-derived renewable vehicle fuel for potential use locally	Provides limited direct benefit to the community

Attachment 2: Drought Planning Resources and Documents

Purpose

This document briefly summarizes OWASA's current water supply status and provides an overview of drought planning and response resources and policies which impact the conditions under which OWASA may obtain water from neighboring utilities.

OWASA staff recommends that we revise the Drought Response Operating Protocol (DROP) described later in this document soon to provide greater flexibility in managing our water supply portfolio and thereby increasing regional reliability and resilience.

OWASA's Current Water Supply

OWASA's reservoirs were 68 percent full on November 30, 2017; the average storage available on November 30 since 1995 is 82 percent full. Our area is currently classified as being in a moderate drought.

OWASA's Water Watch Webpage

OWASA's Water Watch webpage provides information on the amount of supply remaining in our reservoirs, rainfall, demands, and the estimated days of supply remaining. The days of supply remaining is conservative in that is assumes that no rainfall occurs and that demand will remain at the level it has been for the last thirty days. The web page also includes links to water conservation tips, OWASA's water conservation standards, USGS stream flow monitoring data on Cane Creek and Morgan Creek upstream of our reservoirs, and the NC Drought Monitor (see next section).

NC Drought Monitor

The North Carolina Drought Monitor currently classifies all of Orange County as being in moderate drought. Moderate drought is characterized by having some damage to crops and water shortages may be developing or imminent. Voluntary water restrictions are requested in areas classified as being in moderate drought (note: the OWASA service area has year-round water restrictions regardless of the drought status).

The drought classification is established by the Drought Management Advisory Council, which is led by the North Carolina Division of Water Resources (DWR) and includes members of several other state and federal agencies including the State Climate Office, National Weather Service, US Geological Survey, and the US Army Corps of Engineers. The Drought Management Advisory Council convenes by phone each week with the National Weather Service to discuss the most recent data and conditions and makes recommendations on North Carolina to the US Drought Monitor. The official US Drought Map is posted each Thursday.

The State Climate Office's winter outlook is drier than normal conditions with average to above average temperatures. Drought is likely to remain and may intensify over the winter.

OWASA's Water Shortage Response Plan

Session Law 2008-143 (2008 Drought Bill) and DWR's regulations at 15A NCAC 02E .0607 require public water supplies to develop a Water Shortage Response Plan (WSRP) and update that WSRP at five-year intervals. OWASA's WSRP was approved by DWR in September 2010. The WSRP was updated in January 2015, and approved by the Board.

OWASA's WSRP includes tiered levels of water conservation based on the severity of the water shortage as required by the DWR regulations. The more severe the drought, the more stringent the conservation measures. OWASA's water conservation measures are found here.

OWASA's drought management decisions are guided primarily by the estimated level of risk that usable reservoir storage will decline to 20 percent (approximately 700 million gallons [MG]) or less during the next 12 months. At OWASA's current annual average raw water demand of 7 million gallons per day (mgd), 700 MG of raw water supply on-hand would meet customer needs for approximately 100 days during an extreme drought, thus providing time to implement emergency water supply augmentation and conservation measures.

Figure 1 (included in the section on DROP) shows the mandatory drought triggers for each month for an annual average daily demand of 7 mgd. Figure 1 shows that OWASA does not need to declare a water shortage condition until reservoir levels drop to 35 percent of available storage volume in December while they only need to be at 60 percent during the summer to declare a water shortage.

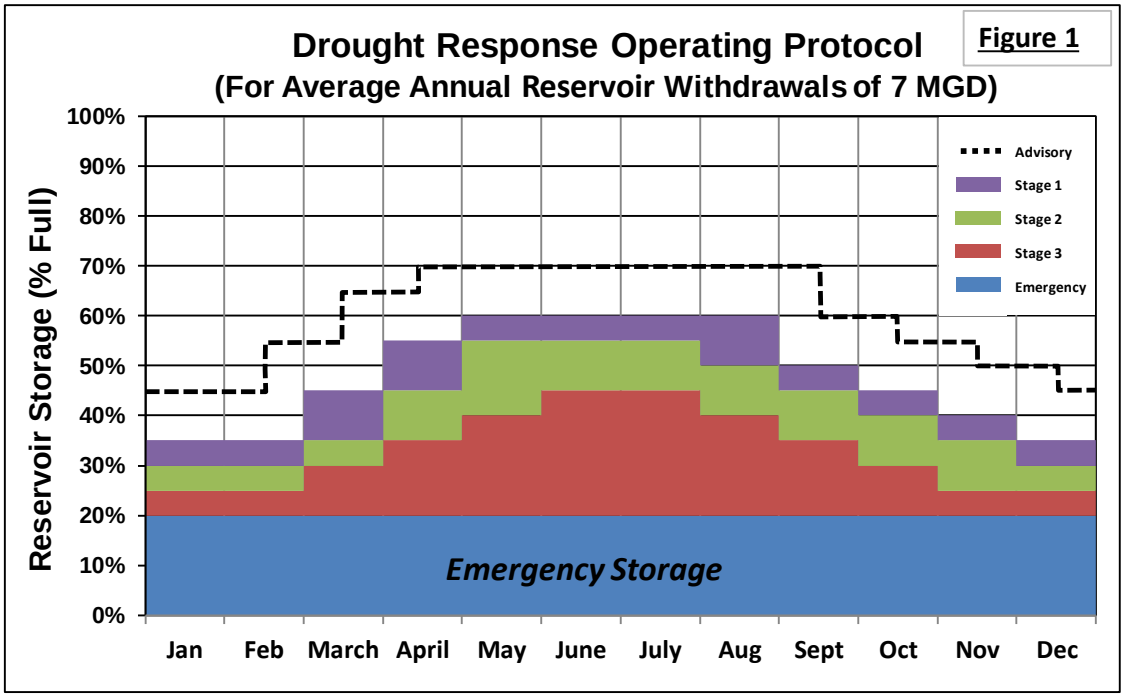
The WSRP also states that the Executive Director must declare the appropriate water shortage stage within five working days of reaching the trigger, but OWASA may declare a water shortage sooner with approval by the Board of Directors, and could choose not to implement stages sequentially if water supply and/or demand conditions changed rapidly. Other factors that are considered when determining whether to declare a water shortage before a specific trigger is reached include:

- regional water supply and demand forecasts
- demand and supply conditions at other utilities
- information provided by the North Carolina Drought Management Advisory Council
- long-term weather forecasts
- planned maintenance which reduces production

The WSRP also states that for a water shortage stage to be rescinded, the water storage volume must be at least 10 percent above the specified water shortage initiation trigger.

OWASA's Drought Response Operating Protocol

OWASA's Board of Directors adopted a DROP in January 2013, which is included in the WSRP. The DROP states that OWASA shall declare a water shortage advisory no later than when the total water storage in the reservoirs drops to within 10 percent of the mandatory Stage 1 triggers. Figure 1 illustrates this on the trigger table for an annual average water demand of 7 mgd.



These responses are based on the risk of depleting OWASA's existing Cane Creek/ University Lake/Quarry Reservoir system to the Emergency Storage level and are consistent with the Response Triggers of OWASA's State-approved Water Shortage Response Plan. Those risks do not consider Jordan Lake to be part of OWASA's existing or primary water supply (University Lake, Cane Creek, and Quarry Reservoirs), but only as an "insurance policy" for use during extended drought or emergency conditions.

Water Shortage Advisory: Aggressive public awareness/education effort, including direct communication with the Carrboro, Chapel Hill, and Orange County elected boards and the University of North Carolina at Chapel Hill. A Water Shortage Advisory may be initiated earlier at OWASA's discretion.

Stage 1 Shortage: Mandatory use restrictions -- with or without rate surcharges -- may be initiated earlier at OWASA's discretion, but not later. The OWASA Board may authorize purchases of water from other utilities and/or obtain water through its Jordan Lake allocation only when total water storage in University Lake, Cane Creek Reservoir, and the Quarry Reservoir is below this Mandatory Stage 1 trigger, but not sooner. Board approval for such a declaration or purchase decision shall not be required, however, during an operational emergency as determined by the Executive Director per OWASA's *Water Shortage Response Plan.*

Stage 2 Shortage: May be initiated earlier at OWASA's discretion, but not later.

Stage 3 Shortage: May be initiated earlier at OWASA's discretion, but not later.

Water Supply Emergency: Emergency actions will be taken to obtain supplemental water to ensure the protection of public health, safety and welfare. If Cane Creek/University Lake/Quarry Reservoir storage declines to this level, such actions would likely include the installation of temporary facilities to pump water from the Haw River to the Cane Creek Reservoir.

The DROP provides our customers and the community with timely notice of potential water shortages and provides an opportunity to reduce demands on a voluntary basis before mandatory conservation measures are initiated (beyond year-round requirements) and drought surcharges are imposed. However, the DROP approved by the OWASA Board of Directors in January 2013, prohibits the use of our Jordan Lake allocation prior to reaching a Stage 1 water shortage. Obtaining water from Jordan Lake early may prevent us from having to declare a mandatory water shortage stage, impose drought surcharges on our customers, or reaching a Stage 2 water shortage status which has impacts on certain commercial customers such as those in the power washing industry.

Following approval of the DROP, Dr. Greg Characklis at UNC Chapel Hill has been working with OWASA, the Cities of Raleigh and Durham and the Town of Cary on regional water supply reliability modeling and analysis. Dr. Characklis made a presentation to the NRTS Committee in May 2014; he noted that the highest reliability of our water supply systems is when there is a combination of transfers of water, conservation measures, and financial reserves in place.

Based on the information provided by Dr. Characklis, staff recommend that the Natural Resources and Technical Services Committee (NRTS) continue to work with staff to revise the DROP. The language in the DROP should be modified to allow the flexibility to access our Jordan Lake allocation prior to reaching a Stage 1 water shortage should that be determined advantageous based on specific circumstances at the time. Staff welcome Committee suggestions on any recommendations they would like incorporated into a revised DROP. Staff envision accessing our Jordan Lake allocation during a drought with Board of Director input and after an advisory is issued to the community.

Water and Sewer Management, Planning and Boundary Agreement

The Water and Sewer Management, Planning and Boundary Agreement (WSMPBA) was signed in 2001 by the Town of Carrboro, Town of Chapel Hill, Town of Hillsborough, Orange County and OWASA to identify those areas in the County which would be served by water and sewer and which utility would provide those services. The WSMPBA provides a comprehensive county-wide system of utility service areas upon which the signatory entities can rely when making decisions concerning land use, annexation, zoning, and growth management. OWASA staff rely on the WSMPBA to determine whether we can provide water and sewer service to a given parcel when asked by the community. In addition to providing clarity about utility service, the WSMPBA results in more dense growth in the County's urban centers and preserves the rural character of the County which helps protect our local water supply reservoirs.

However, Section VII of the WSMPBA limits OWASA's flexibility to purchase water for greater than 60 days. Under emergency conditions, we can transfer water, but must notify the Towns of Chapel Hill, Carrboro, and Orange County at 30, and 60 days. Between 60 and 90 days of transfer, each elected Board must approve or not approve continuing the transfer past 90 days. Emergency water transfers must cease after 365 days. This section of the WSMPBA would not allow us to obtain non-emergency water from our Jordan Lake allocation (or provide non-emergency water to a neighboring utility) without the approval of the elected Boards of the

Towns of Chapel Hill and Carrboro and Orange County. Based on Dr. Characklis' work briefly described above, the highest reliability of our water supplies occurs when a combination of water transfers, conservation measures, and financial reserves are in place. Thus the WSMPBA as currently written may be counter to regional reliability and resilience of our water supply. Changes to the WSMPBA requires the approval of each of the five parties to the Agreement.

Staff Recommendations and Next Steps

Staff recommend that the NRTS Committee continue to work with staff to develop a specific recommendation for the Board to revise the DROP to provide the flexibility to allow access to our Jordan Lake allocation prior to reaching a Stage 1 water shortage. This will provide OWASA with greater assurance to manage its water supplies and provide us with higher reliability of the region's water supplies. Such flexibility will allow the OWASA Board of Directors and staff to exercise their professional judgment in each situation to ensure needs are reliably and cost-effectively met. Staff welcome Committee suggestions on any recommendations they would like incorporated into a revised DROP.